Hanover Center Traffic Study
Hanover, Massachusetts

Development and Evaluation of Alternative Safety Improvements

Prepared For:
Hanover Board of Public Works
40 Pond Street
Hanover, MA 02339

Prepared by:
Fay, Spofford & Thorndike, Inc.
Engineers • Planners • Scientists
20 Park Plaza, Suite 920
Boston, MA
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May 1, 1998

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Project Summary

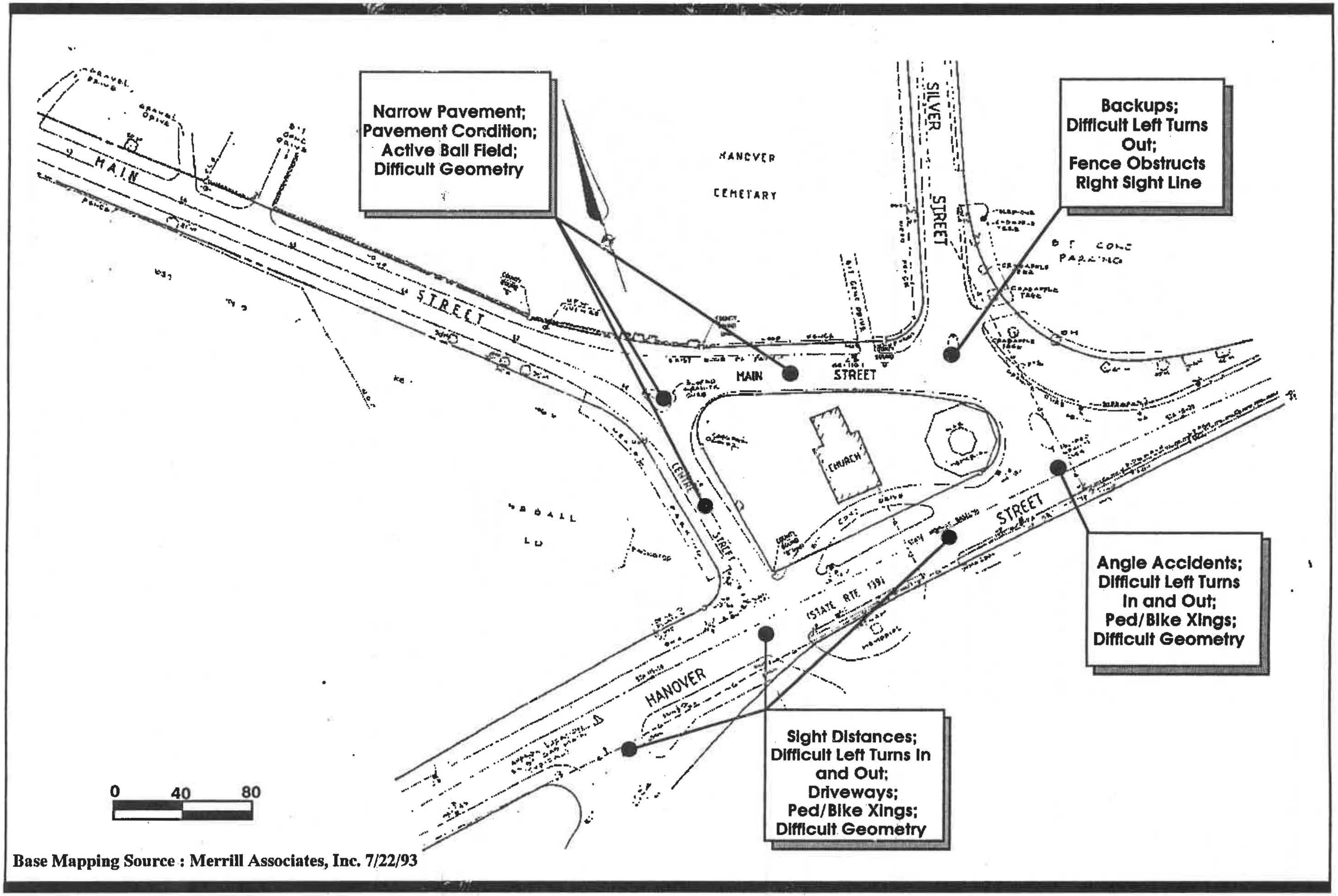
In November, 1997, the Hanover Board of Public Works retained Fay, Spofford & Thorndike, Inc. (FST) to develop and evaluate potential traffic safety and operational improvements at the convergence of Hanover Street (State Route 139), Main Street, Silver Street, and Center Street in Hanover Center, Massachusetts. The emphasis of this study is clearly on safety.

Concurrently, the Massachusetts Highway Department (MHD) is upgrading Hanover Street through the project study area by constructing pavement, drainage, and sidewalk improvements. MHD is not proposing pavement widening as part of the Hanover Street upgrade project. As part of this project, a flashing beacon at the intersection of Hanover and Grove Streets is to be replaced with a new flashing beacon.

This study considers the impacts that Hanover Center alternatives will have on these MHD improvements, which are to be completed later this year.

During the four year period between January 1993 and December 1996, Hanover Center streets experienced a total of 34 reported accidents, 7 of which involved personal injuries. Motorists who travel through Hanover Center are very familiar with the difficulty and frustration of negotiating left turns from either Main, Silver, or Center Streets onto Hanover Street -- particularly during the afternoon peak hours. Pedestrians and bicyclists are also faced with difficulties in crossing Hanover Center streets during the busiest traffic hours.

Figure E-1 illustrates existing study area roadways and study area traffic and safety issues.



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Existing Traffic Issues Hanover Town Center Traffic Study
Hanover, Massachusetts

FIGURE E-1

Hanover Center is an historic district that represents the institutional heart of the Town of Hanover. South of Hanover Street, the study setting includes the Hanover Town Hall and the police department (soon to be relocated), the Hanover public library, the Town fire station, and a Veteran's Memorial. These institutional and cultural resources are located opposite the historic First Congregational Church and parsonage and civil war monument to the north of Hanover Street. Also north of Hanover Street and west of Center Street, town land has been used for many years as a 'T'-ball baseball field. Historic Hanover Cemetery is located adjacent to Main Street behind the First Congregational Church. Two schools are located in the study area, one on Hanover Street east of the study area and the other on Silver Street northeast of the study area.

Within the context of such a setting, the pros and cons of traffic circulation changes must be carefully evaluated from a wide array of perspectives. This traffic study builds upon previous studies of the area by considering circulation impacts on all roadway users including motorists, pedestrians, and bicyclists, as well as the impacts on aesthetics, open space, and emergency vehicles.

To help build consensus for potential improvements, this study included three public meetings. Public meetings were held on November 17, 1997, January 21, 1998, and April 1, 1998.

At the public meeting held on November 17, 1997, results of traffic counts conducted in the vicinity of Hanover Center during late October were presented along with accident history information and observations of Hanover Center during peak hours and issues. Public input was obtained to assist in defining alternatives to be considered during the study.

Following receipt of public comments at the November 17th meeting, written correspondence subsequent to the meeting, and a subsequent discussion with the Hanover Board of Public Works, a total of four build alternatives were developed for comparison to the Base Condition alternative (i.e., Hanover Center as it exists today). Among the Hanover Center alternatives considered were realigning Main, Center, and Silver Streets, closure of the segment of Main Street behind the First Congregational Church, and various circulation pattern changes.

Projections were made of year 2007 weekday PM peak hour traffic volumes and operations with each circulation alternative.

Results of analysis of the four alternatives were presented at a second public meeting held on January 21, 1998.

At that meeting, alternatives under consideration were evaluated for a wide array of issues including:

- Traffic operations
- Emergency vehicle access
- Traffic, pedestrian, and bicycle safety
- Visual impact on existing historical land uses
- Impact on the existing ballfield
- Impact on total available green space
- Impacts on existing trees
- Consistency with future Town plans and MHD Route 139 improvements

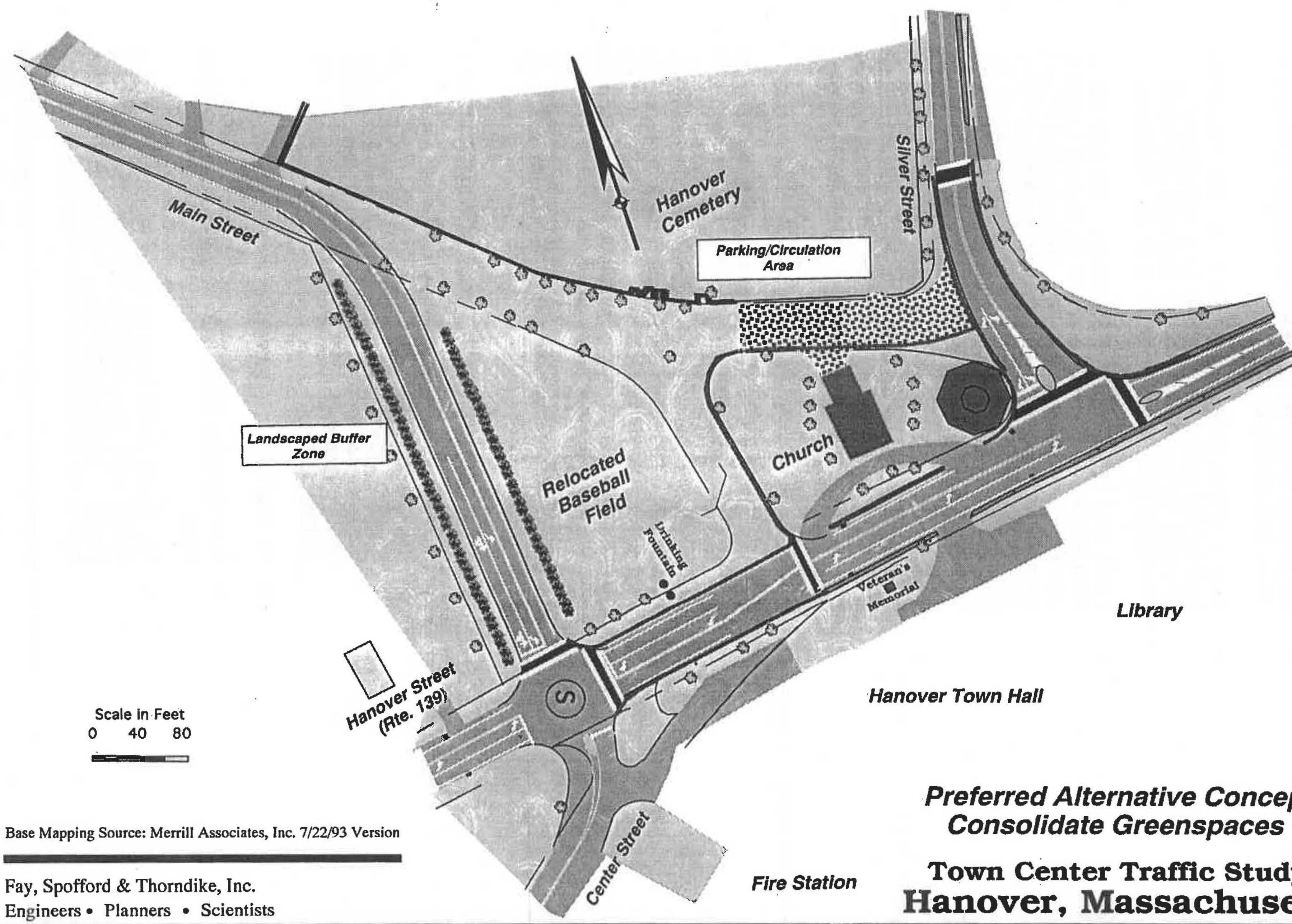
During the January 21 meeting, evaluation forms with each of the above criteria were distributed so those in attendance could express their opinions about each of the alternatives. An analysis of the informal request for public input from the meeting indicated that most attendees did not view Alternatives 3, or 4 favorably. According to information received by FST, attendees generally liked the idea of closing Main Street behind the Church and realigning Silver Street; evaluation forms were generally split between Alternatives 1 and 2.

After reviewing the pros and cons of various alternatives, FST concluded that Alternative 2 concept, or some variation thereof, would be the most effective alternative for Hanover Center from traffic safety and operational standpoints. At a Board of Public Works meeting on February 18, 1998, the Board agreed with FST that the Alternative 2 concept was the best of the alternatives under consideration. However, some refinements were suggested to be included in the Preferred Alternative – i.e., a buffer zone between the realigned Main Street corridor, and retention of vehicle access to the rear of the church and Hanover Cemetery.

Implementation of Preferred Alternative minimizes the paved area in Hanover Town Center. Five unsignalized intersections (three of which are congested during the PM and Saturday peak hours) would be replaced with two intersections, one of which would be signalized. The spacing of the intersection of Relocated Silver Street at Hanover Street would be far enough away from that of the Relocated Main Street/Center Streets intersection, that it could be signalized in the future. Safety is expected to be improved through the reduction of conflict points and the ability of Main Street and Center Street traffic to enter Route 139 while traffic on Route 139 is stopped. Channelization of traffic streams and the creation of additional gaps in Route 139 traffic is expected to produce safety benefits as well.

Illustrated on Figure E-2, the Preferred Alternative has the following features:

- Main Street and Center Street would be realigned to form a four-way signalized intersection at Route 139. The traffic signal would be of an ornamental variety consistent with the Town Center's historic character.



Base Mapping Source: Merrill Associates, Inc. 7/22/93 Version

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Preferred Alternative Concept
Consolidate Greenspaces

Town Center Traffic Study
Hanover, Massachusetts

Figure E-2

- Silver Street would be realigned and extended to form a 'T' intersection with Route 139.

- Large segments of Main Street and Center Street would be removed and replaced with a large consolidated green space that could become the site of a relocated ballfield or whatever greenspace use is chosen by the Town for implementation.

- Landscaped buffer would be developed on the west side of the relocated Main Street. Access to the Hanover Cemetery and the rear entrance to the First Congregational Church would be retained, as recommended by the Board of Public Works. Off-street parking would be possible behind the Church to serve both the Church and the relocated ballfield, Special pervious pavement might be considered.

- Route 139 would be restriped to provide a left turn lane in each direction on its approaches to the re-aligned Center Street and Main Street intersection and a left turn lane in the eastbound direction on its approach to Silver Street. A flush or raised channelization island would be added to the westbound approach of Route 139 to Silver Street.

The third public meeting on April 1, 1998 was held to discuss the Preferred Alternative. Those in attendance were generally inclined to favor primarily Alternative 0 (Base Condition), although some limited interest was indicated for testing closure of Main Street behind the First Congregational church (similar to Alternative 1). Some of the attendees called for simply adding police control during peak hours. Others called for expanding the study's scope along the Route 139 corridor to Spring and Grove Streets on Route 139. Some thought was that by controlling these two intersections with traffic signals, the Town Center would operate better.

Concerns expressed with the Preferred Alternative included:

- Representatives of the Brigg's family indicated it would adversely affect their residence, including bringing traffic closer to the residence, scaring their horses, creating increased noise impacts and causing flooding on their property.

- It would cause the elimination of 3-4 mature trees.

- It would cause flooding in a resident's yard on Main Street.

- The signal would cause more safety problems than it would solve (i.e., residents did not view the Town Center as having a particularly high accident rate; and believe that a signal would make things worse).

Within the context of the April 1 meeting, FST would like to offer the following comments:

1) None of the alternatives should be implemented without the general support of Hanover residents.

2) Alternative 0 with some minor modifications, appears to be the Preferred Alternative of the Hanover residents in attendance at the April 1, 1998 meeting. Given this situation, implementable modifications might include improving lighting along Main and Center Streets, possible pavement and drainage upgrades of Center Street between Main and Hanover Streets without widening. The Town should consider requesting MHD on its current project to install additional caution signs on both approaches of Route 139 to the Town Center (e.g., 'SLOW' 'TRAFFIC ENTERING').

3) Due to the geometrics of the intersections in Hanover Center, and the absence of a safe area where police can control on-coming traffic entering Hanover Center, regular peak period police control does not appear to a viable option.

4) We concur with the Board of Public Works Chairman that the segment of Main Street behind the Church should not be closed in an operational test due to safety concerns. Geometric improvements, similar to those proposed with Alternative 1, coupled with sight line improvements at the Hanover Street/Center Street (north) intersection would be needed to conduct a representative test of the modified traffic pattern with Main Street closed behind the Church.

Existing and Projected Traffic Operations

Table E-1 compares overall levels of service between 1997 existing conditions, projected future year 2007 Base Case conditions, and projected future conditions with Hanover Center traffic circulation alternatives, including the Preferred Alternative, Alternative 2.

Table E-1
Hanover Center, Massachusetts
Traffic Operations
Comparison of 1997 and Year 2007 Base Case (Alternative 0) To Alternatives 1-4

	1997	2007 Alt. 0 Future ase Case	2007 Alt. 1 Realign Streets	2007 Alt. 2 Combine Green Spaces	2007 Alt. 3 Silver St. Diversion	2007 Alt. 4 One Way Pattern
Intersection Location	PM Peak Hour LOS[1]	PM Peak Hour LOS	PM Peak Hour LOS	PM Peak Hour LOS	PM Peak Hour LOS	PM Peak Hour LOS
Route 139 @ Main Street	F	F	N/A	N/A	A	B
Main Street @ Silver Street	F	F	N/A	N/A	B	A
Route 139 @ Center Street (North)	F	F	N/A	N/A	B	B
Route 139 @ Center Street (South)	A	A	A (F)	N/A	F	A
Main Street @ Center Street	A	A	N/A	N/A	A	B
Route 139 @ Relocated Main Street	N/A	N/A	F (B)[2]	N/A	N/A	N/A
Route 139 @ Relocated Silver Street	N/A	N/A	C /F[3]	C	N/A	N/A
Route 139 @ Relocated Main Street and Center Street Intersection	N/A	N/A	N/A	C	N/A	N/A

1 Overall LOS - Level of Service from A-F.

LOS 'A' represents less than 5 seconds of delay for all vehicles entering the intersection during the peak 15 minute period. LOS 'F' represents greater than 45 seconds of delay at an unsignalized intersection or greater than 60 seconds of delay at a traffic signal location. An overall LOS 'F' means one or more traffic movements are experiencing excessive delays, not necessarily an intersection 'failure'. An intersection 'failure' occurs when an intersection becomes blocked and is unable to process traffic demands.

2 X(X) - LOS without a traffic signal (LOS with a traffic signal)

3 Expected to be LOS 'F' due to average backups if a signal is installed at Center Street (north) intersection at Route 139.

N/A Not Applicable

Shaded area represents Preferred Alternative.

At Hanover Center, projected year 2007 PM peak hour traffic volumes in the area are expected to be approximately 10% higher than existing traffic volumes. Because the PM peak hour represents normal 'worst case' traffic operations, future traffic operations were all compared assuming Year 2007 PM peak hour traffic conditions. All alternatives are being compared under similar conditions.

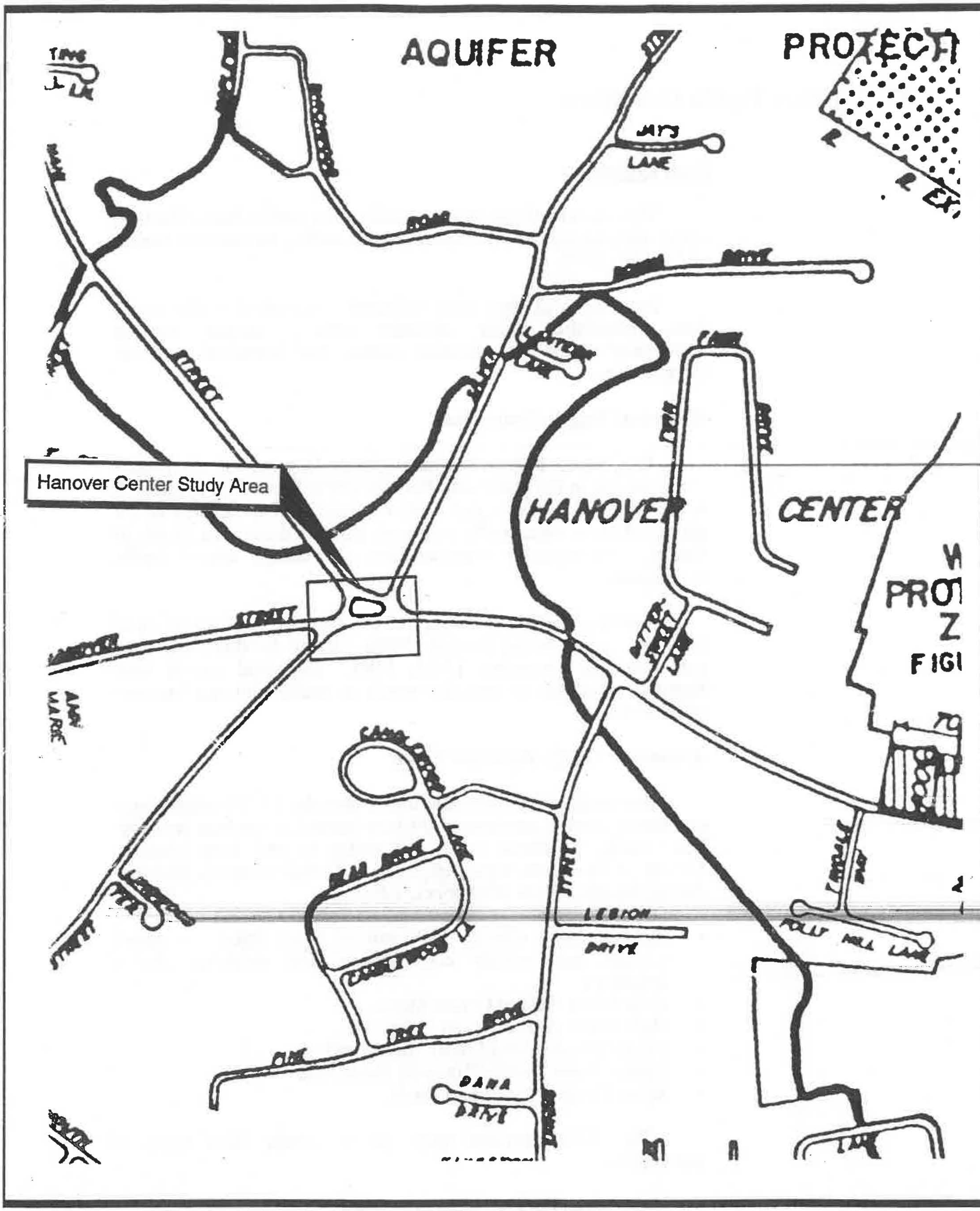
From Table E-1, only Alternatives 4 and 2 provide acceptable overall levels of service. However, public review indicated a concern that Alternative 4 would, overall, be less safe than Alternative 2. Additionally, the diversion of substantial traffic on Route 139, the retention of 5 intersections, and the increase in traffic on Main Street behind the Church were viewed as substantial drawbacks with Alternative 4. Consequently, Alternative 2 was viewed as most favorable, overall.

I. Introduction

Fay, Spofford & Thorndike, Inc. (FST) was retained by the Hanover Board of Public Works to conduct a traffic safety and operational study of Hanover Center. The community of Hanover has an estimated 1998 population of approximately 13,400 residents. The Hanover Center study area includes:

- Hanover Street (State Route 139) west of Center Street to approximately 150 feet east of Main Street. Hanover Street is functionally classified as a rural arterial;
- Main Street west of Center Street to its easterly terminus at Hanover Street. Main Street is functionally classified as a collector street.
- Center Street between its northerly terminus at Main Street and approximately 150 feet south of Hanover Street. Center Street is also classified as a collector street.
- Silver Street approximately 150 feet north of Main Street to Main Street. Silver Street is also functionally classified as a collector street.

The above streets intersect one another to form Hanover Center. Figure 1 shows the regional project vicinity.



Base Mapping Source: Town of Hanover Zoning Map

Scale 1" = Approximately 1,000 feet

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Regional Project Vicinity
Hanover Town Center Traffic Study
Hanover, Massachusetts

Figure 1

II. Existing Traffic Conditions

Data Collection

This section of the report describes the traffic data collection effort undertaken and observations made during the last two weeks of October 1997.

Four types of data were collected -- historical traffic count data, automatic traffic recorder counts, manual turning movement/vehicle classification counts, and historical accident information.

Historical Traffic Count Data

The closest Massachusetts Highway Department continuous count station in the study area (Station 29) is located on Route 139 in the Town of Hanover, just west of Route 53. On the basis of the historical count data, traffic counts on Route 3 during the month of October are typically representative of average annual traffic conditions.

Vanasse Hangen Brustlin, Inc. conducted a previous study of Hanover Center during the mid-1980's. Counts for that study were performed on December 15-16, 1986. Historical counts were therefore available to compare trends in traffic volumes between 1986-1997.

Automatic Traffic Recorder Count

Pneumatic tube automatic traffic recorder (ATR) counts were conducted over a continuous 24-hour period to analyze hour-by-hour traffic variations on access routes to and from Hanover Center. ATR counts were performed at the following six locations during the third week of October, 1997:

- Hanover Street (Route 139) east of Main Street -- speed, volume, and vehicle classification (full weekday plus a Saturday);
- Main Street west of Center Street;
- Main Street east of Center Street;
- Center Street south of Main Street; and
- Center Street south of Hanover Street; and
- Silver Street east of Main Street.

The ATR counters were set to obtain three types of information:

- Hourly directional volume count data;

- Hourly vehicle travel speed data

- Hourly 'gap' data, which establishes the duration and amount of gaps measured in seconds between vehicles in the Hanover Street traffic stream. This data is used to evaluate the ease of future turning movements into and out of Hanover Street.

Figure 2 shows existing 24-hour average weekday traffic volumes on roadways in the study area. Refer to the technical appendix for detailed summaries of the ATR data. Hanover Street was the highest volume facility with more than 15,300 vehicles per day in both directions. Both Main Street and Silver Street carry approximately 5,700 vehicles per day in and out of the study area, while Center Street carries nearly 4,500 vehicles per day in and out of the study area.

Manual Turning Movement Counts

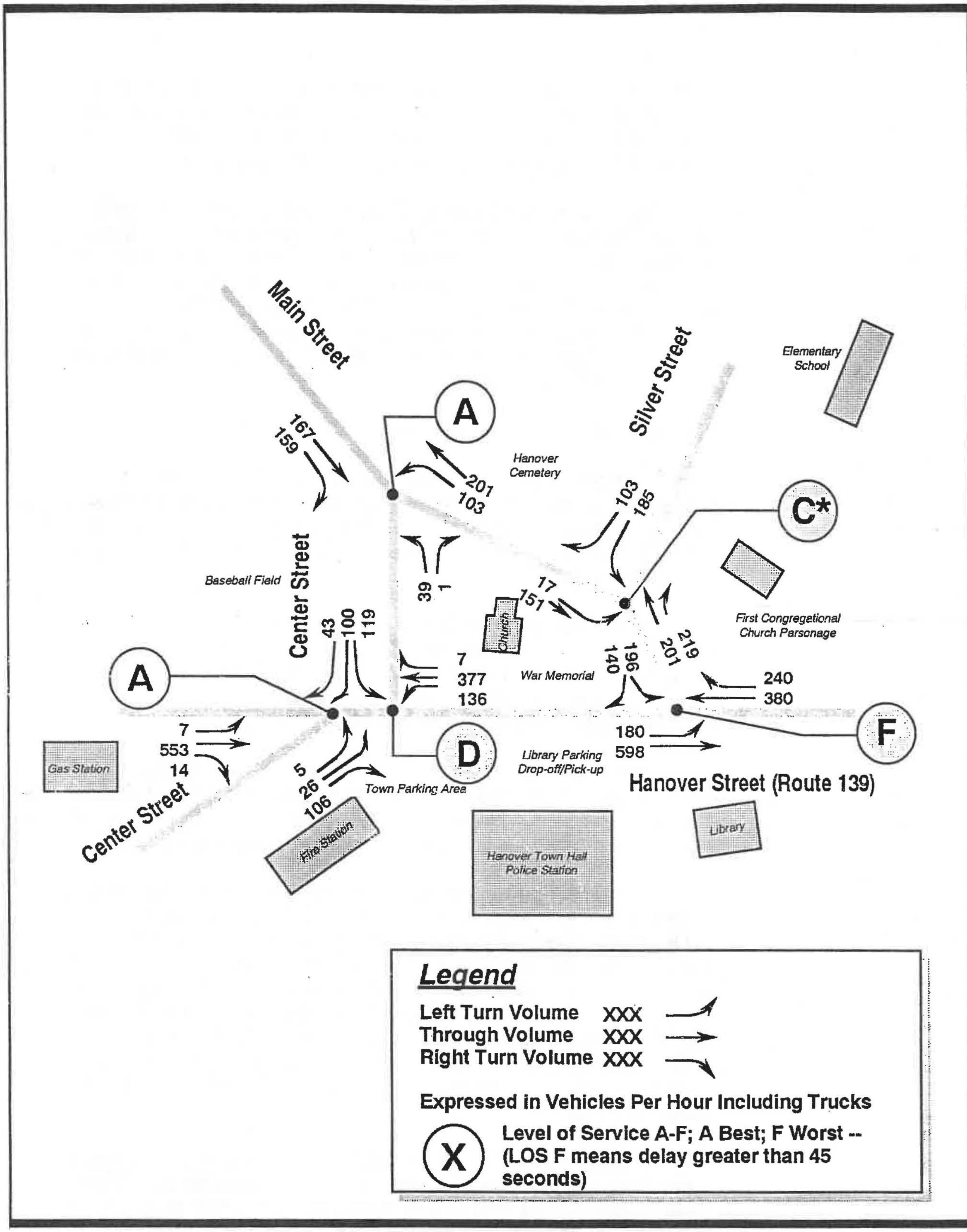
Weekday manual vehicle classification/turning movement counts and queue observations were conducted at the following locations during 7-9 AM and 4-6 PM peak periods on Thursday October 25, 1997 and Saturday October 27, 1997 at the intersections of:

- Center Street and Main Street (3-way unsignalized)
- Main Street and Silver Street (3-way unsignalized)
- Center Street and Hanover Street (two separate 3-way unsignalized intersections); and
- Main Street at Hanover Street (3-way unsignalized).

These time periods were selected as being representative of time periods when street traffic conditions related to Hanover Center are busiest. During the count period, a small amount of pedestrian and bicycle activity was observed in the study area.

To ensure that the manual counts were performed during the busiest periods, manual counts were performed subsequent to the ATR counts during the two highest two-hour AM and PM peak period intervals between 7 AM and 6 PM on a weekday or Saturday. The intent was to evaluate the two worst peak hour conditions during a typical weekday or Saturday. Concurrent with the 'worst case' manual count program during the PM peak hours, FST videotaped peak period traffic conditions from different vantage points to evaluate the movements of vehicles through Hanover Center.

Concurrent with the manual count program, videotape recordings were made of peak hour traffic conditions. These observations found that delays during the PM peak period were excessive at the intersection of Main and Silver Streets, Center Street (southbound) and Hanover Street, and Main and Hanover Streets. Figures 3 and 4 illustrate the results of the weekday PM peak hour and Saturday peak hour count program. Refer to the technical appendix for detailed summaries of the manual turning movement count data collected in the study area.



Schematic Illustration

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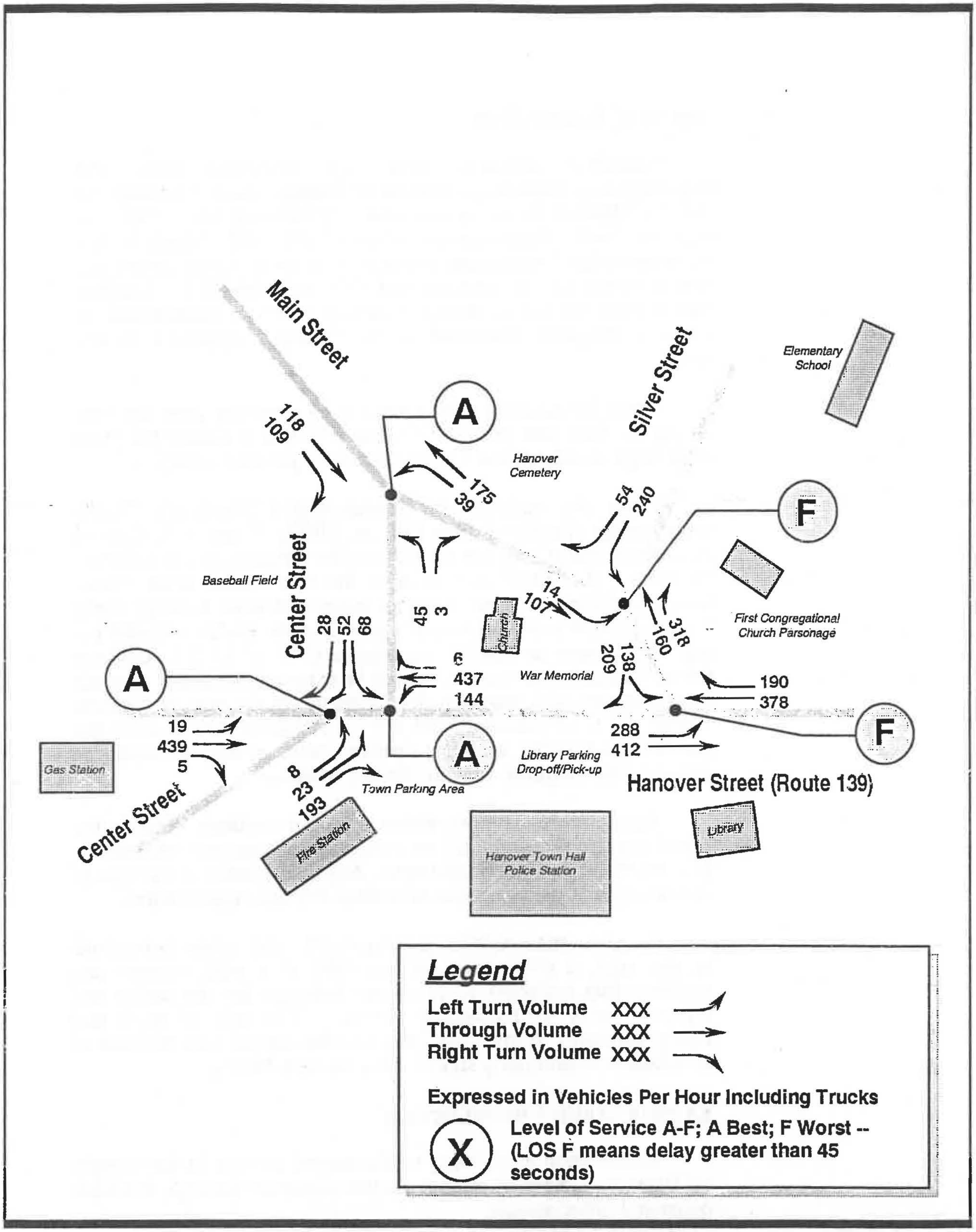
October 1997 Weekday PM Peak Hour Volumes And Overall Levels of Service

Hanover Town Center Traffic Study

Hanover, MA

Figure 3



Schematic Illustration

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October 1997 Saturday Peak Hour Volumes And Levels of Service

Hanover Town Center Traffic Study

Hanover, MA

Historical Accident Data

Historical accident data was requested from the MassHighway Department Bureau of Transportation Planning and Development for the entire community of Hanover, MA. Data was available for the three-year period from 1993-1995. Similarly, the Hanover Police Department provided data on accidents during the twelve-month period between mid-1996 and mid-1997. Accident data at Hanover Center during these four years are summarized on collision diagrams contained in the Technical Appendix to this report.

From the accident data, a total of 34 accidents were reported during the four-year period. Of these, 67% (5.5 accidents per year) were angle accidents and 7 (21%) involved personal injuries.

From the Institute of Transportation Engineer's *Traffic Engineering Handbook* (4th Edition, 1992), Figure 4-5, Critical Accident Rates (CAR) are established for various types of roadway facilities. If viewed as a system, the five intersections, which comprise Hanover Center, have an entering Annual Average Daily Traffic (AADT) volume sum of approximately 20,750 vehicles per day. With such an AADT, an average CAR of 1.7-2.2 accidents per million entering vehicles would be expected for minor arterials and collectors with scattered development. In the case of Hanover Center, the CAR between 1993-1997 is estimated at 4.35 accidents per million entering vehicles, or about twice as high as would be expected for facilities carrying similar volumes.

Furthermore, The proportion of angle accidents exceeds the signal warrant threshold of 5 or more accidents per year susceptible to correction through signalization. Angle accidents are the type of accidents most susceptible to correction through signalization.

To give some context to future traffic and safety projections in the area, a comparison of the 1997 data with volume and accident data collected 10 years ago indicates that the safety and volume trends are reasonably similar. The ratio of angle and injury accidents to total accidents and the annual total number of accidents has held fairly steady since the mid-1980's.

Existing Traffic Control Devices

Information on existing traffic control devices in the vicinity of Hanover Center development was obtained through available plans and observations.

Hanover Street (State Route 139)

Hanover Street is a heavily traveled two-way rural arterial street with one lane in each direction and no on-street parking. It is the primary east-west roadway in the Town of Hanover. It has shoulders, which vary in width from 4 to 8 feet. The posted speed limit on Hanover Street is 40 miles per hour. The automatic traffic recorder count taken on November 18-19, 1997 indicated that the 50th percentile travel speed on Hanover Street in front of the site is 36 miles per hour. The 85th percentile speed (i.e., the speed at which 85 percent of the traffic on is traveling at or below) is 42 miles per hour.

Hanover Street's pavement varies in width from 32 feet east of Main Street to 40 feet west of Main Street within a right-of-way layout that also varies in width, but is typically 64-66 feet wide through the study area. Its pavement, in good to fair condition, is being improved by the MHD during 1998.

Bituminous concrete sidewalks are provided on both sides of Hanover Street east of Main Street, but only on the south side between Hanover Town Hall and Main Street. These are soon to be replaced with brick sidewalks by the MHD. Sidewalks are not provided in the vicinity of Center Street.

Approximately 96.2% of the vehicles on Hanover Street are automobiles or 2 axle trucks, while approximately 3.4% are heavy trucks and 0.4% are buses. Observations indicate most of the buses are school buses.

Main Street

Main Street, functionally classified as a collector, is generally a north-south two-lane street with one lane in each direction. An access route between Mann's Corner and Hanover Center, Main Street's pavement varies in width from 27' - 38' in the study area.

Main Street has a variable width layout, typically 48' wide. West of Center Street, Main Street's paved width is typically 27' wide with 1.5' offsets to the curb. Between Center and Silver Street its pavement is typically 30' wide with 3' offsets to the curb. Though Main Street has the right-of-way through its intersections with Center and Silver Streets, it is controlled by a stop sign and divided by a channelization island at its intersection with Hanover Street.

Except for a small segment, which is the continuation of a sidewalk on the east side of Silver Street to Hanover Street, Main Street has no sidewalks through the study area. Its pavement is generally good west of Center Street, fair between Center and Silver Streets, and good between Silver and Hanover Streets.

Silver Street

Also functionally classified as a collector street, Silver Street, like Main Street is a two-way street with one lane in each direction. Silver Street serves as a shortcut route between Route 53 and Hanover Street. Its pavement varies from 25'-30' in width through the study area within a typical 42' wide layout. At its intersection with Main Street, Silver Street is controlled by a stop sign and divided by a channelization island.

Silver Street has a sidewalk on its east side to its intersection with Main Street continuing to the Main Street intersection with Hanover Street. Its pavement surface is very good to excellent.

Center Street

Also functionally classified as a collector street, Center Street, like Main and Silver Streets, is a two-way street with one lane in each direction. Center Street is generally a north-south route providing access between Grove and Hanover Streets. In the study area, Center Street's pavement varies from 24'-25' in width within a typical 40'-46' wide layout. At its north and south offset intersections with Hanover Street, Center Street is controlled by stop signs.

Center Street has no sidewalks, but has a gravel parking surface on its west side adjacent to the 'T'-ball baseball field north of Hanover Street. Center Street provides direct access to the Hanover Fire Station. The pavement surface of Center Street is in poor condition between Main and Hanover Streets. The pavement of Center Street south of Hanover Street is in good condition.

<u>Existing Traffic Operations</u>

Peak hour volumes represent the highest four consecutive 15-minute periods recorded during the peak period counts. Traffic analyses were carried out for the weekday PM and Saturday peak hours illustrated previously on Figures 3 and 4.

Level of Service

Level of Service (LOS) is a commonly accepted measure of effectiveness of peak hour traffic operating conditions. LOS accounts for such factors as automobile and truck volumes, roadway capacity, speeds, grades, traffic control devices, the progression of vehicular traffic flow along an arterial roadway, roadway types, roadway widths and geometric layouts, as well as anticipated delays. Levels of service range from A, which is the optimal condition, to F, which indicates demands beyond capacity or excessive delay conditions. Levels of service A through D are generally considered desirable for the peak traffic hours. LOS E and LOS F roadway or intersection operations are typically regarded as 'undesirable' peak hour levels of service. Thus, LOS D has become a nationally accepted threshold between desirable and undesirable peak hour traffic operations.

Level of Service Criteria – Unsignalized Intersections

Traffic operations at unsignalized intersections are given LOS rankings based on conflicting traffic flows and anticipated delays related to those conflicting traffic flows. These conflicting flows are the vehicular turning movements at an intersection, which potentially must yield the right-of-way to other traffic movements at an intersection. Examples of these conflicting movements would be left turns from a major street to a minor side street (across the opposing flow of traffic), or left and right turns from a minor street or side street to the major street.

LOS ranking at an unsignalized intersection is determined by calculating the average total delay in seconds per vehicle. Total delay is the total elapsed time from when a vehicle stops at the end of a queue until the vehicle departs from the stop line and enters the traffic stream. This includes the time required for the vehicle to travel from the last-in-queue position to the first-in-queue position. The average total delay for any particular minor movement is a function of the traffic demand flow rate and the capacity of the approach.

An average total delay of less than 5 seconds per vehicle is defined as LOS A. A total delay of 45 seconds per vehicle is assumed as the break point between LOS E and F. Table 1 summarizes the relationship between LOS and average total delay at unsignalized intersections

Table 1
Level Of Service Criteria
Unsignalized Intersections*

Level Of Service	**Average Total Delay (seconds/vehicle)**
A	≤ 5
B	>5 and ≤ 10
C	>10 and ≤ 20
D	>20 and ≤ 30
E	>30 and ≤ 45
F	>45

* Source: Highway Capacity Manual, Special Report #209 (1994 Edition)

Level of Service Criteria - Signalized Intersections

Though not applicable to existing conditions in the Hanover Town Center, LOS for signalized intersections, is also defined in terms of delay, which is a measure of driver discomfort and frustration, fuel consumption, and lost travel time. Specifically, LOS criteria are stated in terms of the average stopped delay per vehicle for a 15-minute analysis period. Table 2 summarizes the relationship between LOS and average stopped delay at signalized intersections.

Note that the criteria for LOS F at signalized intersections involves average vehicle delay of 60 or more seconds, as opposed to unsignalized intersections where the LOS F involves 45 or more seconds of average vehicle delay.

Existing traffic operations were calculated for the unsignalized intersections where traffic counts were performed and are presented on Table 3.

From Table 3, the intersections of Main Street at Hanover Street, Main Street at Silver Street, and Center Street at Hanover Street are experiencing operational problems during the 1997 PM and Saturday peak hours. Field observations confirmed these operational problems.

On the basis of the operational calculations, it was found that two of the five unsignalized intersections operate overall at LOS F during the PM and Saturday peak hours. The intersection of Silver Street at Main Street in isolation would be operating overall at a LOS C. However, due to traffic backups from the nearby intersection of Main and Hanover Streets, the intersection operates at LOS F for left turns out during the PM peak hour.

Table 2
Level Of Service Criteria
Signalized Intersections*

Level Of Service	**Average Total Delay (seconds/vehicle)**
A	$\leq$5.0
B	>5 and $\leq$15
C	>15 and $\leq$25
D	>25 and $\leq$40
E	>40 and $\leq$60
F	>60.0

* Source: Highway Capacity Manual, Special Report #209 (1994 Edition)

Table 3
Hanover Center, Massachusetts
Existing PM and Saturday Peak Hour Traffic Operations

Intersection Location	1997 PM Peak Hour LOS[1]	1997 Saturday Peak Hour LOS
Route 139 @ Main Street	F	F
Main Street @ Silver Street	F	F
Route 139 @ Center Street (North)	D	A
Route 139 @ Center Street (South)	A	A
Main Street @ Center Street	A	A

1 Overall LOS - Level of Service from A-F.

LOS 'A' represents less than 5 seconds of delay for all vehicles entering the intersection during the peak 15 minute period. LOS 'F' represents greater than 45 seconds of delay at an unsignalized intersection.

III. Development of Hanover Center Circulation Alternatives

Alternatives Considered

At issue is the potential need for improvements at Hanover Center compared to the Base Case -- the 'Do-Nothing' alternative. For analysis purposes, the Base Case alternative is being referred to as Alternative 0 and is illustrated on Figure 5.

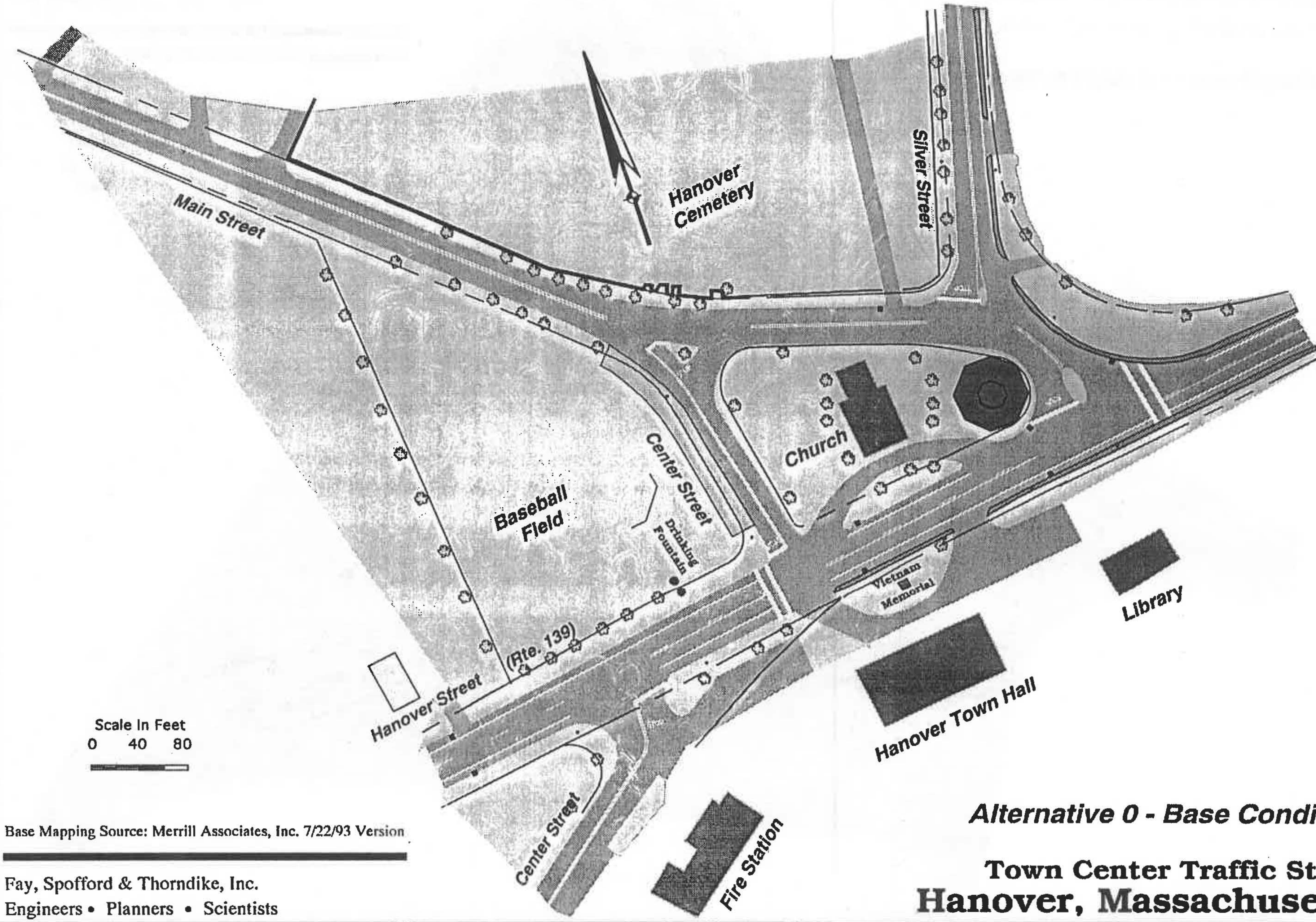
A total of four build alternatives were developed for comparison against Alternative 0. Illustrated on Figures 6-9, they are:

- Alternative 1 - Realignments
- Alternative 2 - Consolidate Greenspaces
- Alternative 3 - Silver Street Diversion
- Alternative 4 - One-way Pattern

Further on, each of the above alternatives is described in detail.

Conversations with the Town of Hanover planning department indicate that a small amount of growth is expected in 'background' traffic in the area over the next several years. Locally, an additional single family residential development (65 more units) is programmed which may directly affect traffic in Hanover Center. To account for this development and modest regional growth in background traffic, the analysis contained in this report assumes that background traffic will grow slowly at approximately 1% per year between 1997 and 2007, a total of 10.5% traffic growth over the next ten years.

Because the PM and Saturday peak hour volumes are relatively similar, but the PM peak hour has slightly higher traffic volumes, future analysis comparisons focus on Projected year 2007 PM peak hour traffic volumes. Projected year 2007 PM peak hour traffic volumes and levels of service for Alternatives 0-4 are presented on Figures 10-14.



Base Mapping Source: Merrill Associates, Inc. 7/22/93 Version

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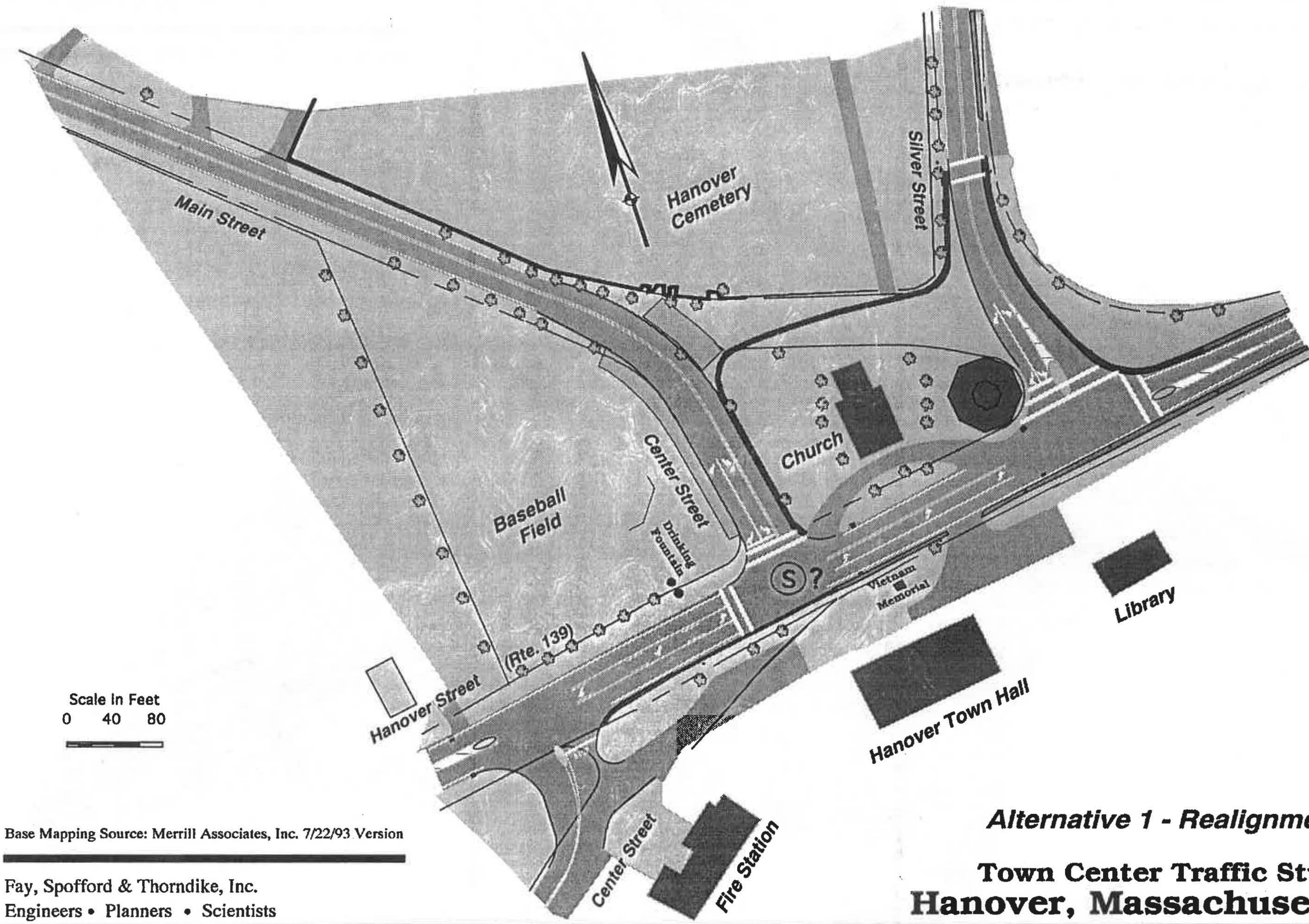
Alternative 0 - Base Condition

Town Center Traffic Study
Hanover, Massachusetts

Figure 5



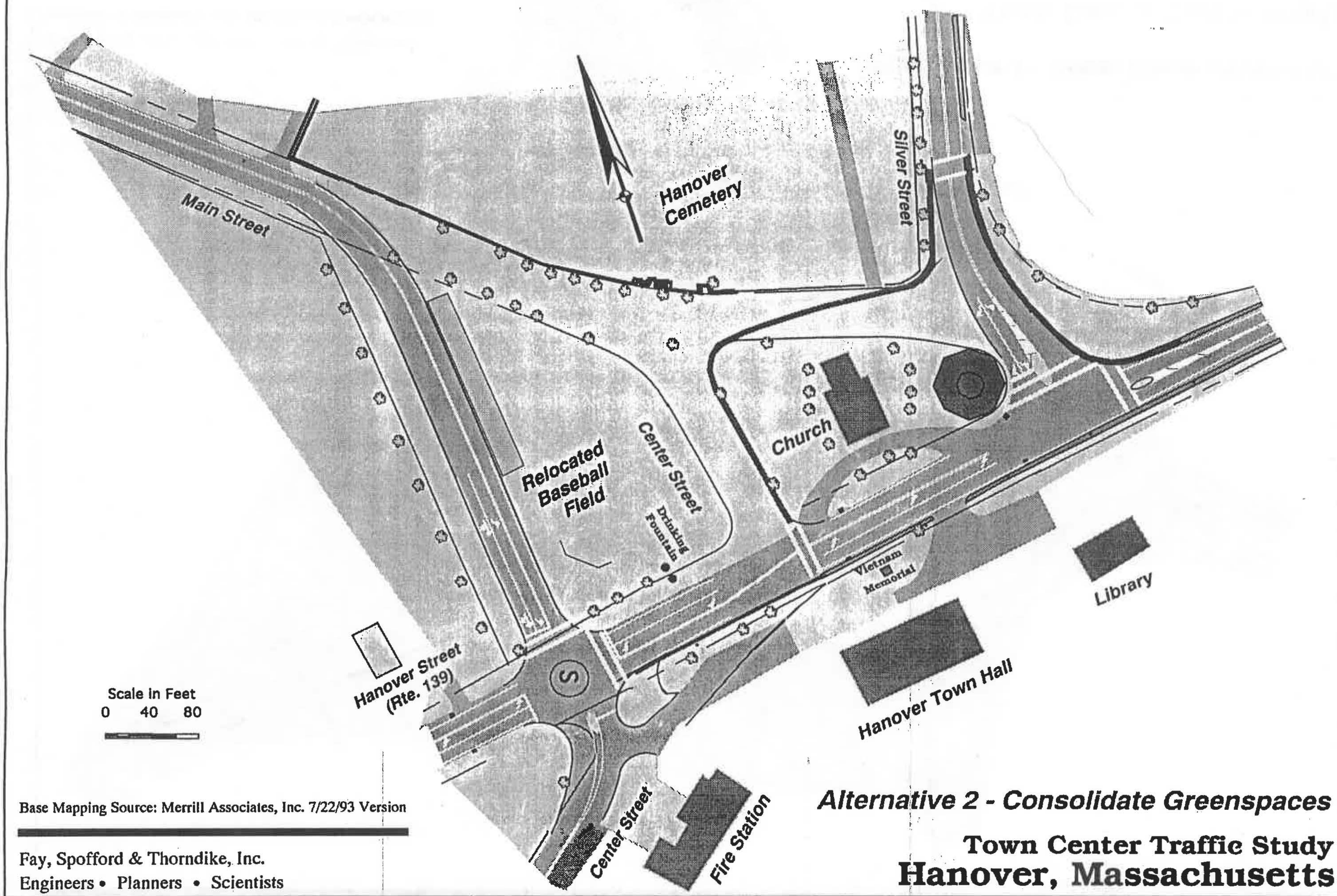
Base Mapping Source: Merrill Associates, Inc. 7/22/93 Version

Fay, Spofford & Thorndike, Inc.
Engineers • Planners • Scientists

Alternative 1 - Realignments

Town Center Traffic Study
Hanover, Massachusetts

Figure 6



Base Mapping Source: Merrill Associates, Inc. 7/22/93 Version

Fay, Spofford & Thorndike, Inc.
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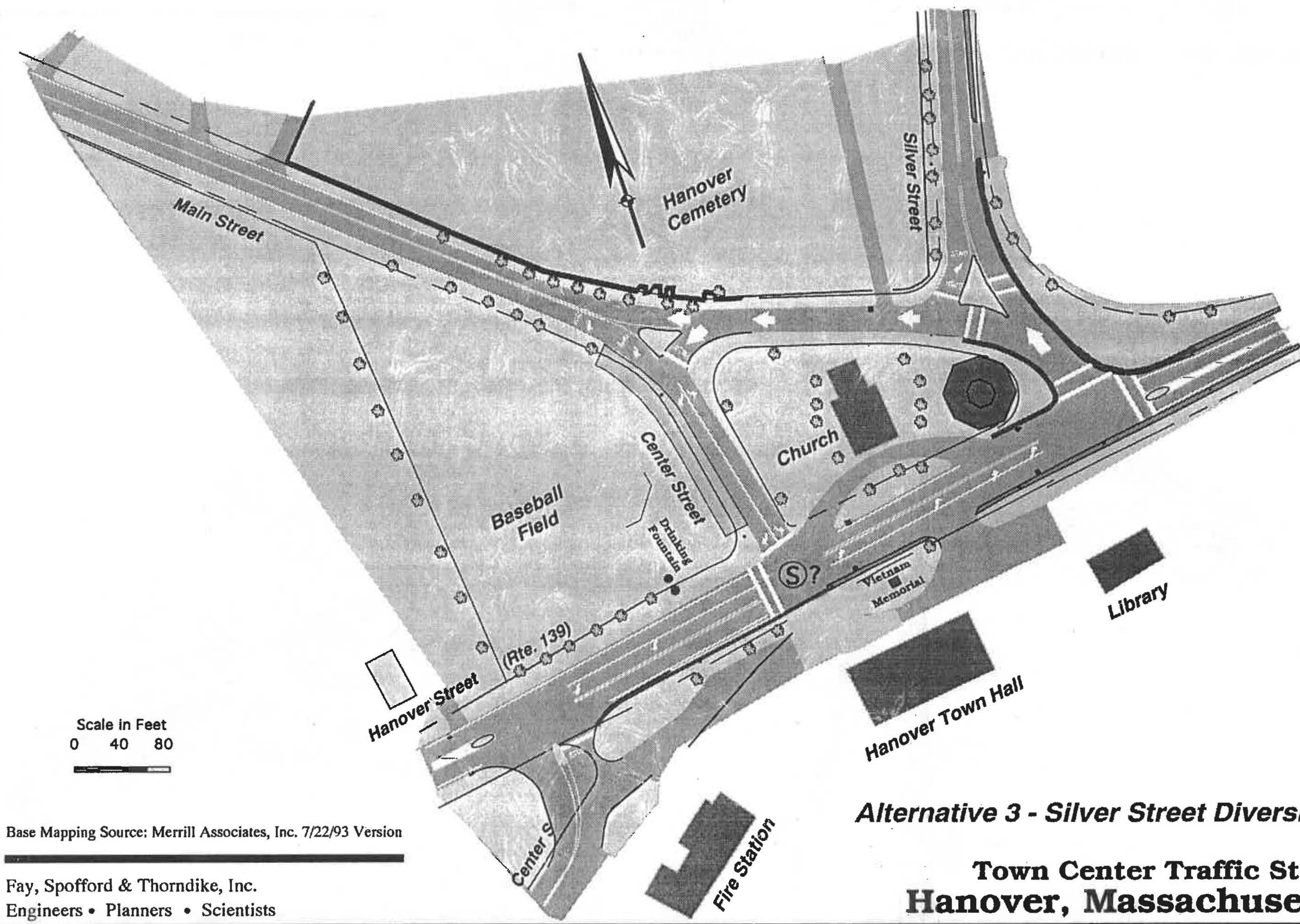
Alternative 2 - Consolidate Greenspaces

Town Center Traffic Study
Hanover, Massachusetts

Figure 7



Alternative 3 - Silver Street Diversion

Base Mapping Source: Merrill Associates, Inc. 7/22/93 Version

Fay, Spofford & Thorndike, Inc.
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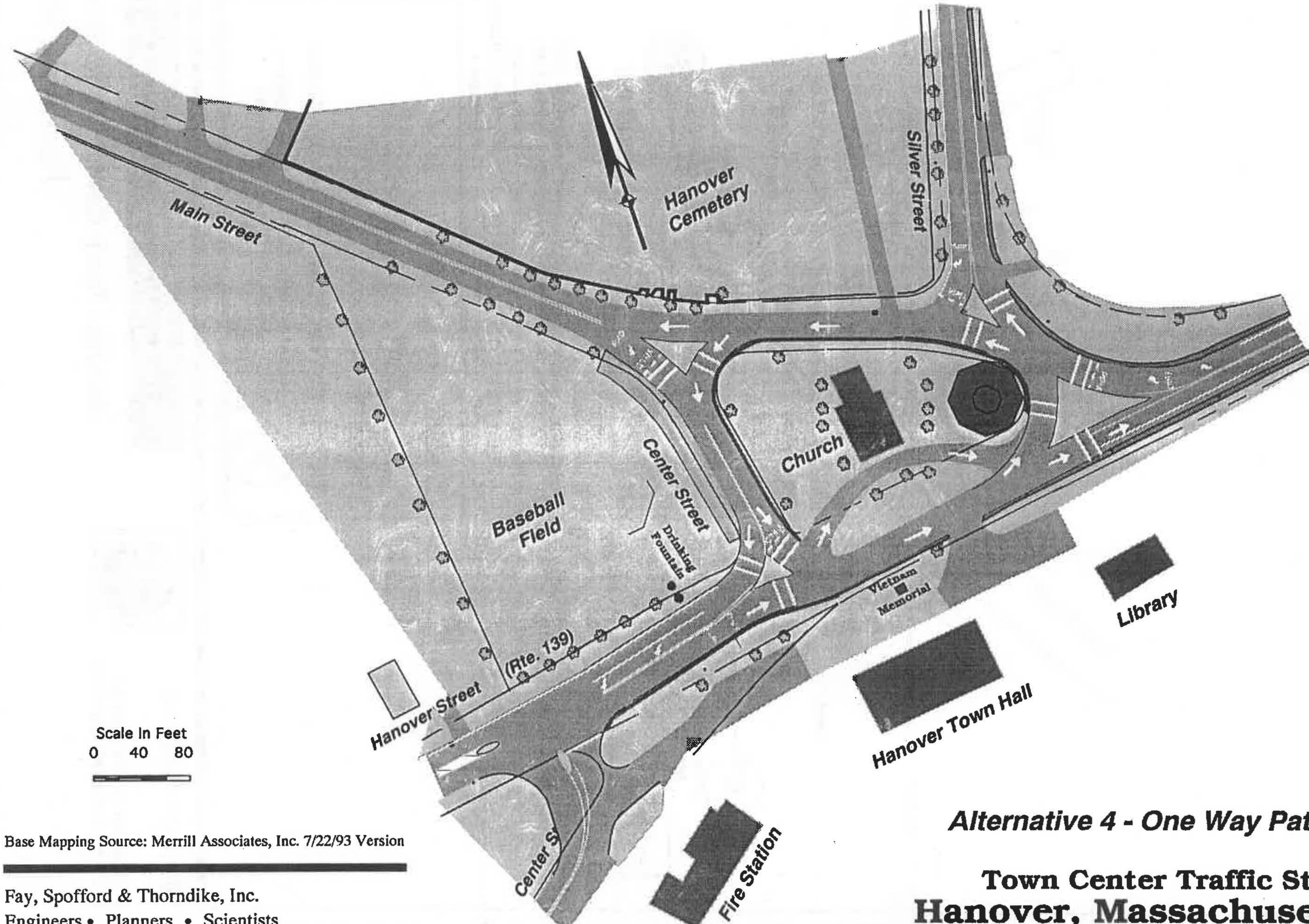
Town Center Traffic Study
Hanover, Massachusetts

Figure 8



Base Mapping Source: Merrill Associates, Inc. 7/22/93 Version

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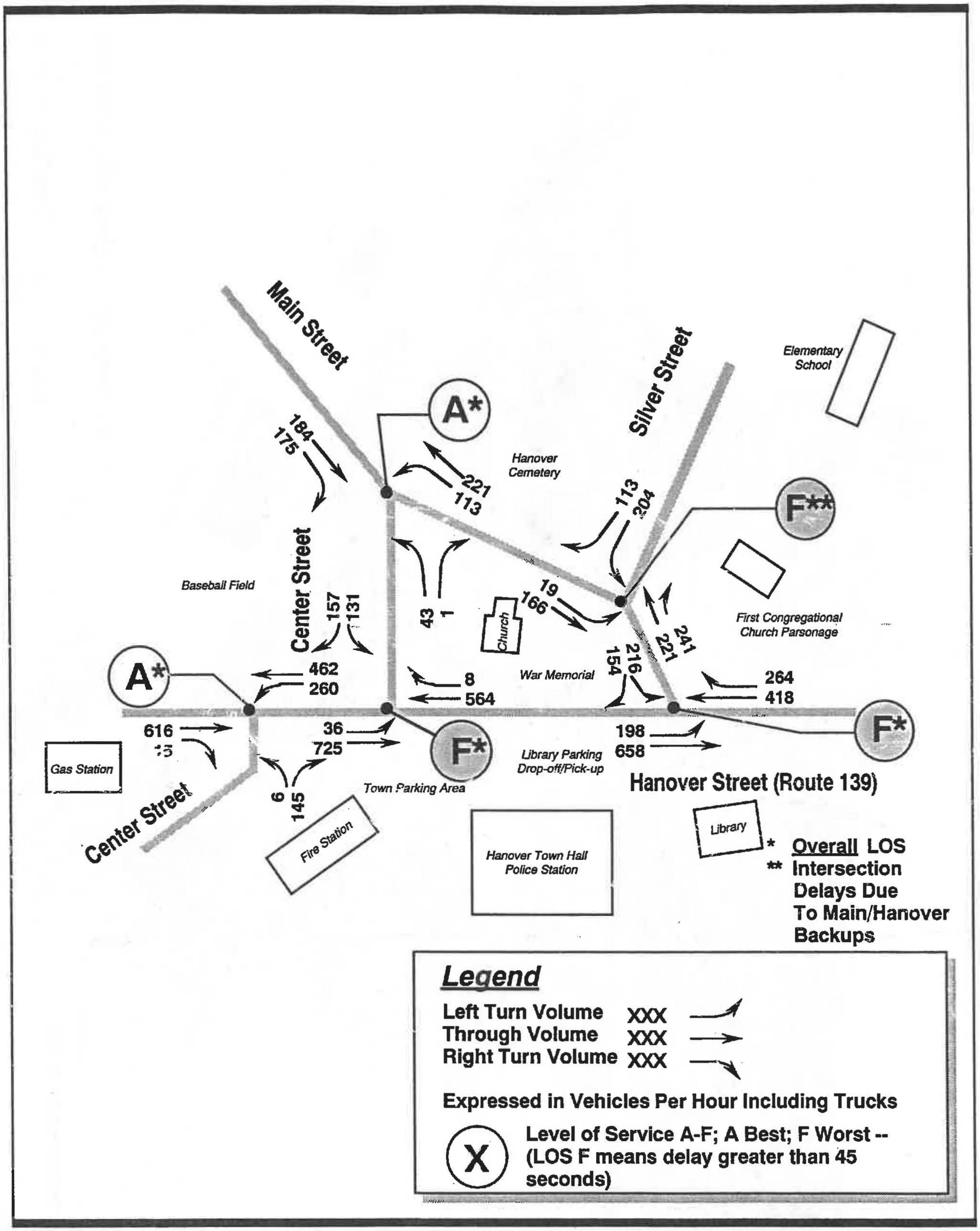
Alternative 4 - One Way Pattern

Town Center Traffic Study
Hanover, Massachusetts

Figure 9



Schematic Illustration

Fay, Spofford & Thorndike, Inc.
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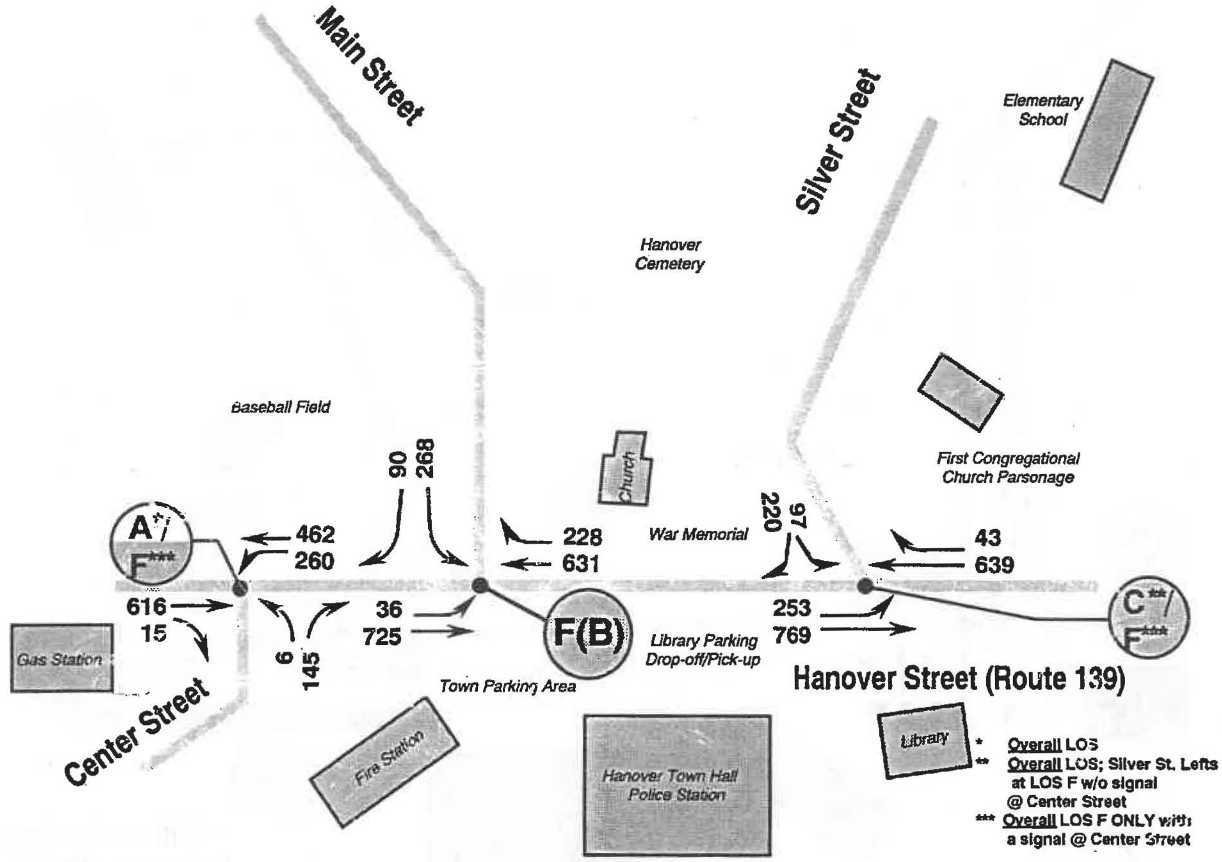
2007 Weekday PM Peak Hour Volumes
Alternative 0 - Base Condition

Hanover Town Center Traffic Study

Hanover, MA

Figure 10



Legend

X(X) - LOS without signal (LOS with signal)

Left Turn Volume XXX

Through Volume XXX

Right Turn Volume XXX

Expressed in Vehicles Per Hour Including Trucks

X Level of Service A-F; A Best; F Worst -- (LOS F means delay greater than 45 seconds w/o a signal; greater than 60 seconds with a signal)

Schematic Illustration

Fay, Spofford & Thorndike, Inc.
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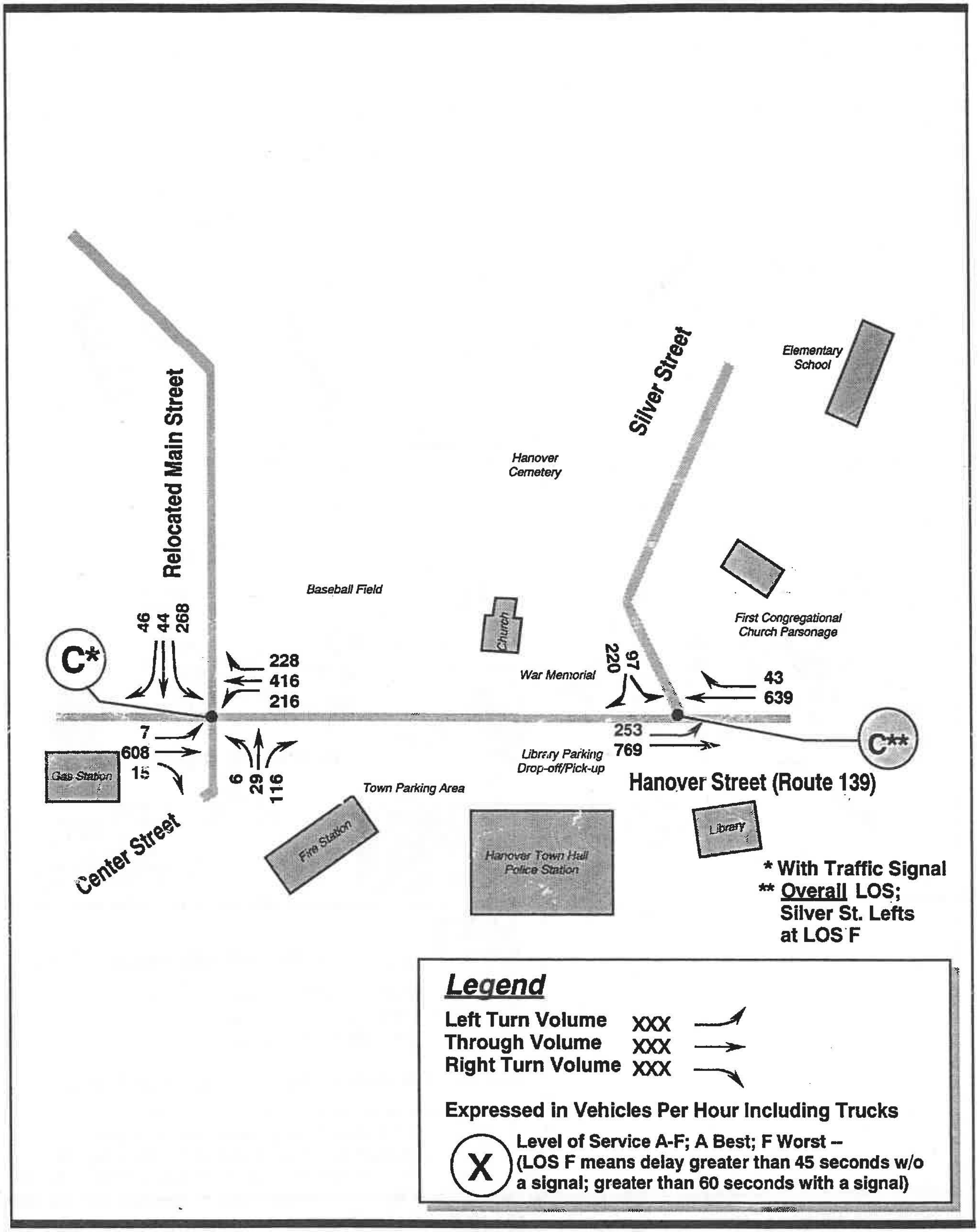
N

2007 Weekday PM Peak Hour Volumes
Alternative 1- Realignments

Hanover Town Center Traffic Study

Hanover, MA

Figure 11



Schematic Illustration

Fay, Spofford & Thorndike, Inc.
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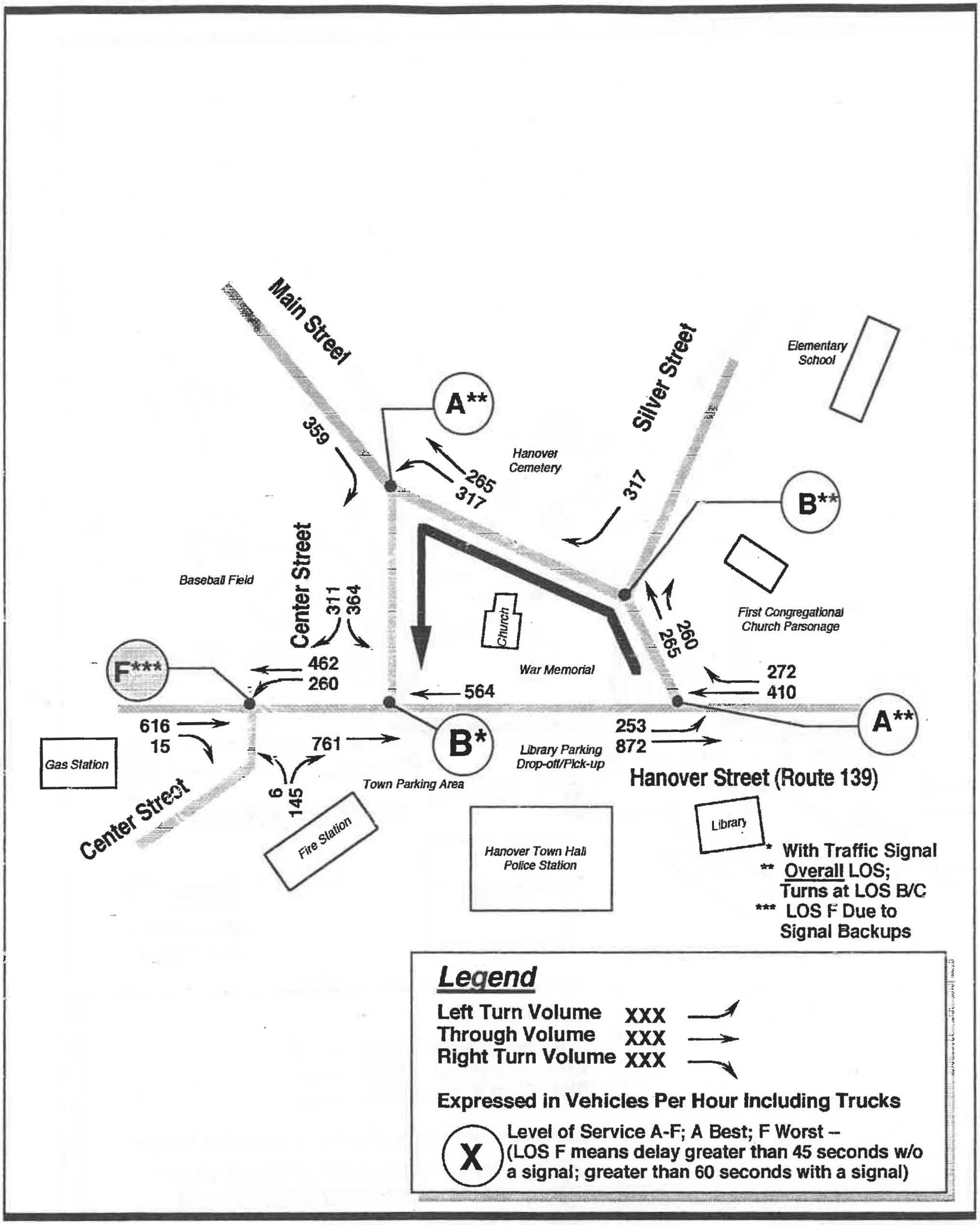
2007 Weekday PM Peak Hour Volumes
Alternative 2 - Consolidate Green Spaces

Hanover Town Center Traffic Study

Hanover, MA

Figure 12



Schematic Illustration

Fay, Spofford & Thorndike, Inc.
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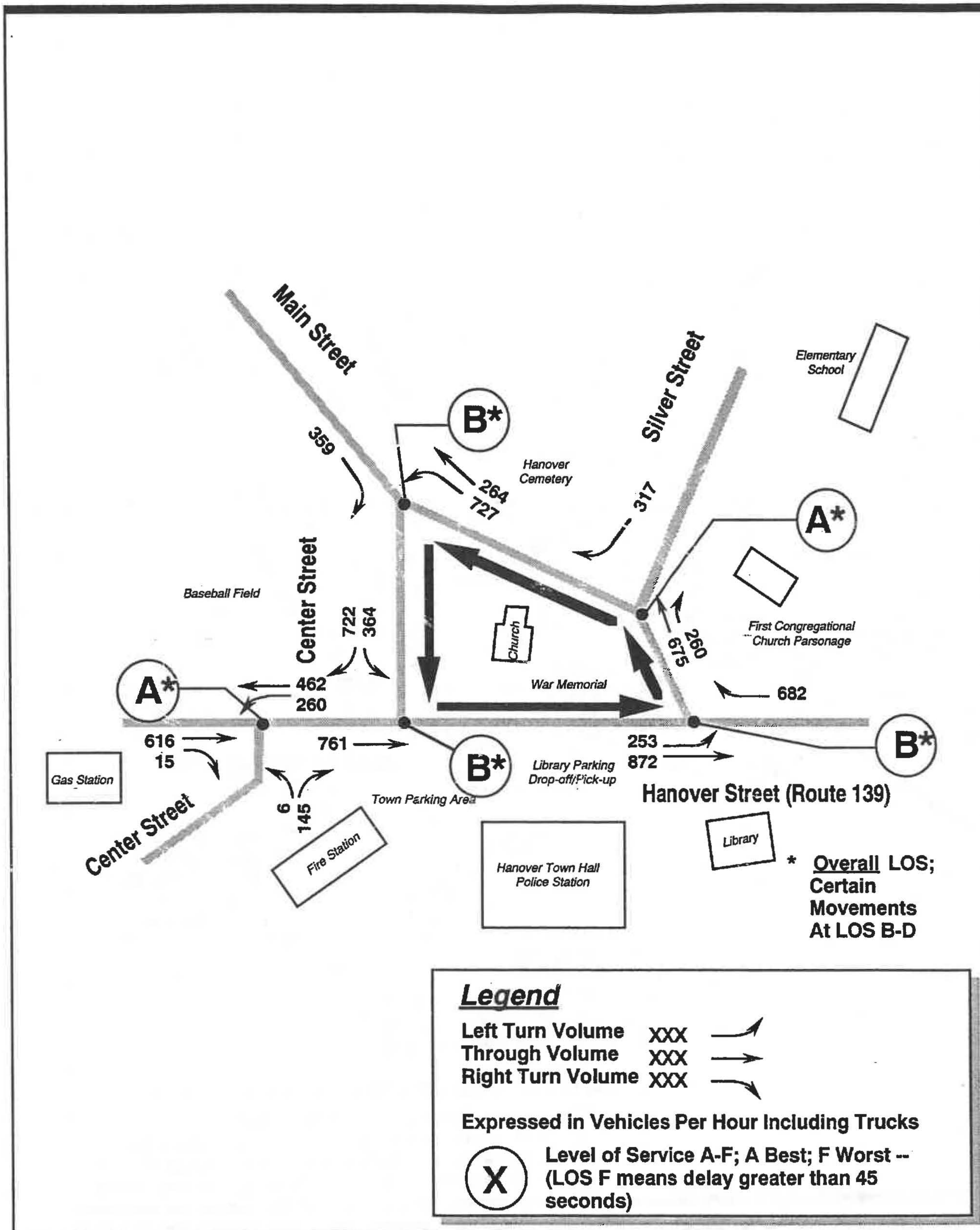
2007 Weekday PM Peak Hour Volumes
Alternative 3 - Silver Street Diversion

Hanover Town Center Traffic Study

Hanover, MA

Figure 13



Schematic Illustration

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2007 Weekday PM Peak Hour Volumes
Alternative 4 - One Way Pattern

Hanover Town Center Traffic Study

Hanover, MA

Figure 14

Alternative 1 - Realignments

Alternative 1 was considered as one of two alternatives that did not include signalization. However, a sub-analysis was performed with a traffic signal in place to examine the impacts that a signal would have with Alternative 1.

The initial basis for Alternative 1 was suggested at the first November 17, 1997 meeting, when an attendee noted that simple realigning of Center and Silver Streets and closing Main Street behind the Church was all that was needed to solve existing traffic problems in the area. Alternative 1 contains the following elements:

- Closure of Main Street between Center and Silver Streets and replacement of five unsignalized intersections with three unsignalized intersections. Closure of one of the access roads into Hanover Cemetery is required.

- Realignment of Silver Street to an angle closer to 90° at Hanover Street. The Relocated Silver Street approach to Hanover Street would have a separate left and right turn lane. The radius of curvature to Silver Street would be reduced to that required for fire truck access to slow the speed of turning traffic, thereby improving pedestrian safety.

- Realignment of Center Street from the south to an angle closer to 90° at Hanover Street. The Relocated Center Street approach to Hanover Street would be a single lane wide enough at the intersection to accommodate a waiting left turn vehicle with room to bypass right turning vehicles. A channelization island (flush or raised) would be provided on the Center Street approach to Hanover Street.

- Provision of new channelization islands (flush or raised) on the Route 139 approaches to Relocated Silver Street and Relocated Center Street. These new islands would channel eastbound and westbound Route 139 traffic to the right opposite new exclusive left turn lanes from Route 139 to Relocated Silver Street and Relocated Center Street.

- Provision of a new sidewalk on Silver Street in the abandoned Main Street layout and the east side of Relocated Main Street, which would be in the same right-of-way as the existing Center Street alignment.

- Retention of existing crosswalks on Route 139. A new crosswalk would be provided on Silver Street opposite the proposed new sidewalk behind the Church.

- Closure of the access to Town Hall opposite Center Street.

Alternative 2 - Consolidate Greenspaces

Alternative 2, a signalized variation of Alternative 1, also involves closure of Main Street behind the Church. Essentially, Alternative 2 maximizes the provision of green space in Hanover Center compared to any of the alternatives considered, including Alternative 0. The elements of Alternative 2 include:

- Removal of a ±540-foot segment of Main Street and a ±190-foot segment of Center Street and construction of a ±470-foot segment of Relocated Main Street opposite a realigned Center Street segment. Replacement of five unsignalized intersections with one unsignalized and one signalized intersection. Alternative 2, as illustrated, retains all access roads into Hanover Cemetery.

- Realignment of Silver Street to an angle closer to 90° at Hanover Street. The Relocated Silver Street approach to Hanover Street would have a separate left and right turn lane.

- Provision of a channelization island (flush or raised) on the Relocated Center Street approach to Hanover Street. The Relocated Center Street approach to Hanover Street would be a single lane wide enough at the intersection to accommodate a waiting left turn vehicle with room to bypass right turning motorists, the vast majority of all motorists who approach Center Street from this direction. Access to the nearest parking area on Center Street would be retained, but relocated as far away from the intersection as possible (at least 50 feet).

- Provision of a new channelization island (flush or raised) on the Route 139 approach to Relocated Silver Street. This new island would channel westbound Route 139 traffic to the right opposite new exclusive left turn lanes from Route 139 to Relocated Silver Street and Center Street.

- Provision of new sidewalks on Silver Street in the abandoned Main Street and Center Street layouts (similar to Alternative 1) and on the north side of Route 139.

- Addition of one crosswalk to Route 139 at the proposed signal location. Like Alternative 1, a new crosswalk would be provided on Silver Street opposite the proposed new sidewalk behind the Church. Optionally, the unsignalized crosswalk on Hanover Street at the Church could be eliminated and replaced by a sidewalk on the north side of Hanover Street connecting to the new crosswalk at the traffic signal, thereby keeping the number of crosswalks on Hanover Street to two, as existing. The intersection of Silver Street and Route 139 could be considered for potential signalization by providing a signal conduit between the new signal at Route 139/Center/Relocated Main Street.

- Disposition of the new consolidated green space is a Town of Hanover issue to be resolved. The existing baseball field could be relocated in the same area (the area created is roughly equivalent to that of the existing ballfield), or some other greenspace use (e.g., a Town Common 'special event' open space) could be considered.

- Closure of the access to Town Hall opposite Center Street.

Alternative 3 - Silver Street Diversion

Alternative 3 would not close Main Street behind the Church, but includes a traffic signal at the southbound Center Street intersection with Hanover Street. Alternative 3 changes the directionality of Main Street between Hanover Street and Center Street to one-way westbound. Elements of Alternative 3 include:

- Reconstruction of the Silver Street and Main Street intersection to accommodate the change of Main Street from two-way to one-way westbound between Hanover and Center Streets. A new triangular island would be created to channelize all Silver Street traffic to a right-turn-only and to divide Main Street westbound and Silver Street northbound traffic flow volumes.

- Conversion of Center Street from two-way operation to one-way southbound operation between Main and Hanover Streets. Signalization would be required at the intersection of southbound Center Street with Hanover Street.

- Diversion of Main Street and Silver Street to approach Hanover Street via southbound Center Street. The Center Street approach to Hanover Street would have separate left and right turn lanes.

- Narrowing of the one-way westbound segment of Main Street between Silver and Center Streets by approximately 6 feet. A new channelization island would be constructed at the intersection between Main and Center Streets.

- Provision of new channelization islands (flush or raised) on the Route 139 approaches to Relocated Silver Street and Relocated Center Street. These new islands would channel eastbound and westbound Route 139 traffic to the right opposite new exclusive left turn lanes from Route 139 to Relocated Silver Street and Relocated Center Street.

- Provision of a new sidewalk on the south side of Hanover Street between Town Hall and the Center Street leg south of Hanover Street.

- Closure of the access to Town Hall opposite Center Street.

Alternative 4- One Way Pattern

Like Alternative 3, Alternative 4 would not close Main Street behind the Church, but does not require the installation of a traffic signal. Alternative 4, however, not only involves changing the directionality of Main Street between Hanover Street and Center Street to one-way westbound, but also requires changing Hanover Street to one-way eastbound between Main and Center Streets. Elements of Alternative 4 include:

- Conversion of the two-way segments of Main Street, Center Street, and Hanover Streets to one-way operation, similar to a 'round-about' circulation pattern. New channelization islands would be constructed at the intersections of Main and Hanover Streets, Silver and Main Streets, Main at Center Streets, as well as Hanover at Center Street.

- Crosswalks would be provided at one-way merge and diverge points.

- Narrowing of the one-way segments of Hanover and Main Streets compared to existing conditions to a typical cross-section of 24-28 feet.

- Provision of a new channelization island (flush or raised) and some deflection curvature on the Route 139 eastbound approach to Relocated Center Street. This new island would channel eastbound Route 139 traffic to the right opposite new westbound exclusive left turn lane from Route 139 to Relocated Center Street. The deflection would slow the eastbound Route 139 traffic as it enters the area where the one-way pattern occurs.

- Provision of a new sidewalk behind the Church connecting the area near the Civil War monument to the east side of Center Street near the Church, as well as a new sidewalk on the south side of Hanover Street between Town Hall and the Center Street leg south of Hanover Street.

- Closure of the access to Town Hall opposite Center Street.

IV. Evaluation of Alternatives

Prior to a public meeting held on January 21, 1998, a matrix was developed to compare various features of Alternatives 1-4 versus Alternative 0, the Base Condition. The matrix, illustrated on Figure 15, addresses such issues as:

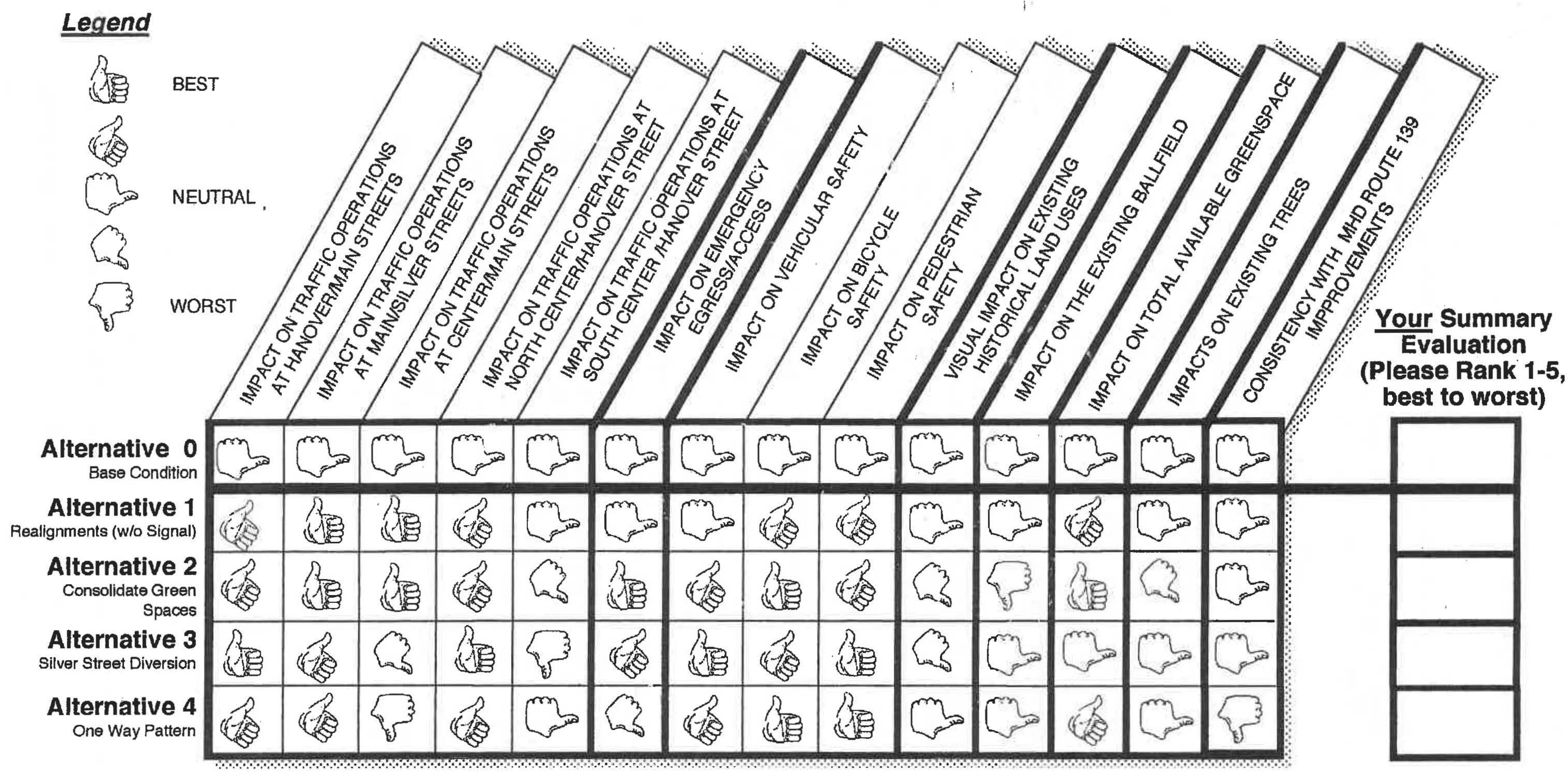
- Traffic operations
- Emergency vehicle access
- Traffic, pedestrian, and bicycle safety
- Visual impact on existing historical land uses
- Impact on the existing ballfield
- Impact on total available green space
- Impacts on existing trees
- Consistency with future Town plans and MHD Route 139 improvements

Overall Safety Evaluation

Continuation of Alternative 0 invites a continuation of existing safety deficiencies in Hanover Center. If current trends continue, FST estimates that approximately 90 accidents will occur within the Hanover Center study area over the next 10 years with Alternative 0. Of these, approximately 20 accidents are likely to involve personal injuries.

With an unsignalized Alternative 1, Realignments, only a marginal improvement is expected in safety. A marginal improvement is expected because the existing five unsignalized intersections would be reduced to three unsignalized intersections.

While PM peak hour traffic volumes with Alternative 1 are expected to be processed better than with Alternative 0, an LOS F is still expected at the intersection of Relocated Main Street (within the existing Center Street alignment) at Hanover Street. Sight lines at the Relocated Main Street intersection are impaired somewhat due to the rise in the elevation of the land in front of the Church. While Alternative 1 does not assume a signal at the intersections of Relocated Main Street at Hanover Street, a signal at that location would improve its operations to LOS B. Traffic backups from the traffic signal would impair traffic operations at the Center Street/Hanover Street and Relocated Silver Street/Hanover Street signals.



Note: **Alternative 0** is the base against which impacts of Alternatives 1-4 are compared. Comparisons represent the opinion of the Consultant compared to **Alternative 0**. FST assumes all factors are **not** weighted equally. Selection of a preferred alternative involves assignng weight to each evaluation factor (e.g. some people may consider safety more important than operations; others may consider historical impacts to be more important than traffic operations).

Hanover, MA — Hanover Center

Summary Traffic Circulation Alternatives Evaluation Form

Figure 15

Fay, Spofford & Thorndike, Inc.
Engineers • Planners • Scientists

Safety Evaluation (Cont.)

With Alternative 2, the proposed traffic signal at the four-way intersection of Hanover Street at Relocated Main Street/Relocated Center Street is projected to operate at an overall LOS of C during the year 2007 PM peak hour. Traffic backups, or queues, from the traffic signal will not be long enough to adversely affect the operations of the Relocated Silver Street at Hanover Street intersection. Because most of the turning movements from Relocated Silver Street will be right turns, its overall operations will be LOS C, even though left turns out of the intersection will be at LOS F. It is important to understand that left turn volumes (refer back to Figures 10 and 14) from Relocated Silver Street will be reduced by substantially compared to Alternative 0. Additionally, the signal at the Relocated Main Street/Relocated Center Street intersection will create gaps in traffic flow that will help reduce left turn movement delays out of relocated Silver Street. Overall, the features of Alternative 2 are expected to reduce the predominate angle accidents compared to Alternative 0.

With Alternative 3, Silver Street Diversion, the proposed traffic signal at the intersection of Center Street at Hanover Street is expected to queue traffic back far enough to block the intersection of Center Street at Hanover Street, but not the intersection of Relocated Silver Street at Hanover Street.

Because Alternative 3 is expected to provide pedestrians to and from the Church with a more convenient crossing point of Hanover Street than with Alternative 2, it is anticipated that its overall safety impacts will be comparable to or slightly better than with Alternative 2. Alternative 3 retains five intersections, which is considered to be a safety drawback compared to Alternative 2. The LOS F at the offset Center Street is another potential safety drawback of Alternative 3.

Alternative 4, Silver Street Diversion, would retain the existing number of intersections in the area. While projected levels of service would be somewhat improved over existing conditions, the public perception of Alternative 4 is that it would degrade safety. While this perception may not match reality, the forced diversion of heavy traffic volumes on Hanover Street to Main Street behind the Church is considered to be a substantial drawback to Alternative 4.

Signal Warrant Analysis

Public input indicates the issue of placing signals in Hanover Center is very controversial. Most residents would like to avoid the addition of a signal due to aesthetic concerns. Furthermore, studies show traffic signals can increase rear-end accidents. This is why it is necessary to consider carefully the need for a traffic signal.

A signal warrant analysis can be used to determine whether a signal can be installed -- meeting signal warrants does not mean that a signal must be installed. At the present time, the signal warrant analysis provided in the Manual on Uniform Traffic Control Devices (MUTCD) and published by the Federal Highway Administration contains a total of 11 signal warrants. The intersections of Hanover Street with Main Street and Center Street meet signal warrants today. The intersection of Hanover Street/Main Street meets Warrants 1, 2, 6, 7, 8, 9, 10 and 11, while both the offset Hanover Street/Center Street intersections meets Warrants 2, 7, 8, 9 and 11.

Traffic signalization is proposed only with Alternatives 2 and 3 and, in both cases, only at one intersection -- the one with the most serious operational deficiencies. Because existing measured traffic volumes meet signal warrants, by definition, the intersections proposed for future signalization with Alternatives 2 and 3 would meet signal warrants. With Alternative 2, the intersection of Relocated Main Street and Relocated Center Street at Hanover Street is proposed for signalization. With Alternative 3, the intersection of Center Street (with diverted Main and Silver Street approach volumes) at Hanover Street is proposed for signalization. In both instances, the proposed signalized locations will meet Warrants 1, 2 and 6-11.

It is noted that with Alternative 1, the intersection of Relocated Main Street at Hanover Street would meet Signal Warrants 1, 2 and 6-11, but public input requested examining Alternative 1 without signalization, so analyses were completed with and without signalization.

Signal Aesthetics

Many types of ornamental traffic signal fixtures are available for possible application to Hanover Center. For example, available black curved fixtures with Victorian detail would clearly fit better in the community than standard aluminum pole fixtures. Such specialty fixtures should be considered within an historic district.

Projected Costs

Table 4 was prepared to provide preliminary construction and design costs for further information in the evaluation of the four circulation alternatives at Hanover Center.

These preliminary cost estimates should be considered as an 'opinion of probable cost' for budgeting purposes only. To be conservative, a contingency of 37.5% has been assumed in each construction cost estimate. Costs do not include costs involved with closing the access to Town Hall opposite Center Street north and reconfiguring the parking lot/Town Hall access accordingly.

This action is an option at the Town's discretion, which would improve safety, particularly with Alternatives 1, 3, and 4, but is not as critical with Alternative 2. However, potential closure of the Center Street south access to the Town parking lot has not been assumed with Alternative 2, but is clearly desirable due to queuing on the northbound Center Street approach. It is assumed a suitable substitute access to the parking area can be developed if it becomes necessary to close the Center Street access.

Table 4
Hanover Center, Massachusetts
Projected Construction/Engineering Costs By Alternative

Alternative	**Preliminary Construction Cost Estimate**	**Engineering @ 10-15% of Construction Cost**
Alternative 1 - Realignments		
Without a traffic signal at Relocated Main Street	$270,000	$27,000-$40,500
With a traffic signal at Relocated Main Street	$350,000	$35,000-$52,500
Alternative 2 Consolidated Green Space With a traffic signal at Relocated Main Street/Center	$350,000	$35,000 - $52,500
Alternative 3 Silver Street Diversion With a traffic signal at Center Street North	$390,000	$39,000 - $58,500
Alternative 4 One Way Pattern Without traffic signals	$180,000	$21,600 - $27,000

V. Findings and Conclusions

FST concludes from the analysis that without signalization, traffic operations and safety characteristics of Alternative 1 will only be marginally better than with Alternative 0. With Alternative 3, PM peak hour traffic backups, or queues, on Hanover Street will extend into the intersection of Center Street (northbound) at Hanover Street. Alternative 2 traffic operations during the year 2007 are expected to be better than with Alternatives 0 or 3. While Alternative 4 results in acceptable traffic operations, the required diversion of Hanover Street traffic would put the Church in the middle of an 'roundabout' -- a condition many residents found objectionable. The perception of the public was that the geometrics of the Alternative 4 one-way pattern would create confusion and potentially more safety problems than existing conditions. Alternative 4 is also the most inconsistent with ongoing MHD improvements to Hanover Street.

Attendees at a public meeting on January 21, 1998 indicated support for Alternatives 0, 1 and 2. Virtually no support was indicated for Alternatives 3 and 4. At the final public meeting on April 1, 1998, virtually none of the attendees expressed support for Alternative 2 – most tended to support Alternative 0, though some requested testing closure of Main Street behind the church without any other changes.

FST concluded that from a traffic perspective the most beneficial alternative, overall, would be Alternative 2, or some variation thereof. Implementation of Alternative 2 would minimize the paved area in Hanover Town Center compared to any of the alternatives considered, including Alternative 0. Five unsignalized intersections (three of which are congested during the PM and Saturday peak hours) would be replaced with two intersections, one of which would be signalized. Safety is expected to be improved through the reduction of conflicting volumes and conflict points and the channelization of traffic streams. Accessibility of Main Street, Silver Street, and Center Street traffic to Route 139 would be improved. Pedestrian crossings of Route 139 would be improved.

However, due to lack of support for such an alternative, the following measures are offered:

Within the context of the April 1 meeting input received, FST would like to offer the following comments:

1) None of the alternatives should be implemented without the general support of Hanover residents.

2) Alternative 0 with some minor modifications, appears to be the Preferred Alternative of the Hanover residents in attendance at the April 1, 1998 meeting. Given this situation, implementable modifications might include

improving lighting along Main and Center Streets, possible pavement and drainage upgrades of Center Street between Main and Hanover Streets without widening. The Town should consider requesting MHD on its current project to install additional caution signs on both approaches of Route 139 to the Town Center (e.g., 'SLOW' 'TRAFFIC ENTERING').

3) Due to the geometrics of the intersections in Hanover Center, and the absence of a safe area where police can control on-coming traffic entering Hanover Center, regular peak period police control does not appear to a viable option.

4) We concur with the Board of Public Works Chairman that the segment of Main Street behind the Church should not be closed in an operational test due to safety concerns. Geometric improvements, similar to those proposed with Alternative 1, coupled with sight line improvements at the Hanover Street/Center Street (north) intersection would be needed to conduct a representative test of the modified traffic pattern with Main Street closed behind the Church.

APPENDICES

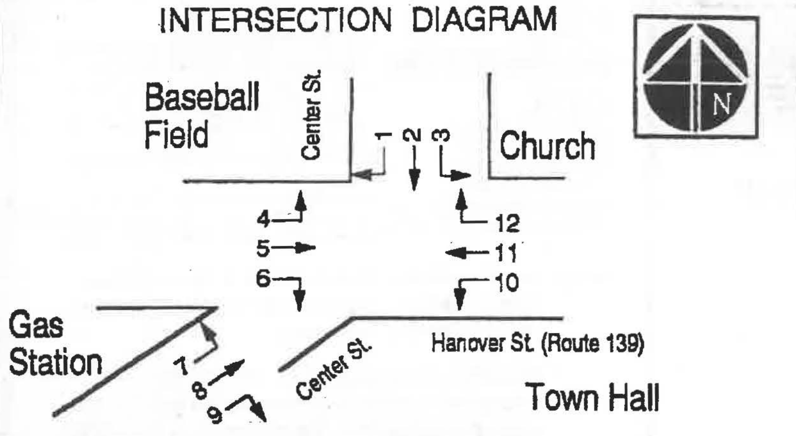
Fay, Spofford & Thorndike, Inc.
Engineers & Planners

COUNT SUMMARY

PEAK PERIOD: ☐ AM ☑ MIDDAY ☐ PM

FST JOB NO. PH-002

INTERSECTION DIAGRAM



TOWN: Hanover, MA
INTERSECTION: Center @ Rte. 139
DATE: October 25, 1997
WEATHER: Rain
REMARKS:
RECORDER: Joe Bertolin Jr

Notes: Vehicles with 3 or More Axles are to be counted as Heavy Vehicles. Use tick marks in upper right corner (by movement by time period).

Pedestrian crossings are to be noted by tick marks in lower left corner of thru movement on the approach crossed by pedestrians. (by movement by time period).

	1	2	3	4	5	6	7	8	9	10	11	12	TOTALS	
11 :00-:15														
:15-:30														
:30-:45	3	16	21	5	140	1	3	2	27	85	104	2	343	
:45-:00	5	8	14	4	107	1	1	7	69	[illegible]	[illegible]		365	
12 :00-:15	6	12	20	5	120	1	3	8	42	39	104	1	361	1'
:15-:30	7	11	17	6	115	1	3	3	[illegible]	51	97	4	340	
:30-:45	6	14	17	4	127	2	1	5	54	42	107		386	4'
:45-:00	2	5	12	6	124		1	4	39	29	131	1	350	2
1 :00-:15	4	13	14	5	119	2	2	2	39	[illegible]	104	2	361	2 Peds 3
:15-:30	3	16	11	2	104	1	1	3	28	36	91	2	292	1
:30-:45														11
:45-:00														
:00-:15														2 Peds
:15-:30														
:30-:45														
:45-:00														
PEAK HR.	24	45	68	19	466	5	8	23	205	144	433	6	1446	
HVY VEH %	0 %			0 %			1 %							

PEAK HOUR TIME: 11:45 to 12:45 PEAK HOUR FACTOR: 0.95

Center SB Center NB 139 EB 139 WB = 1%

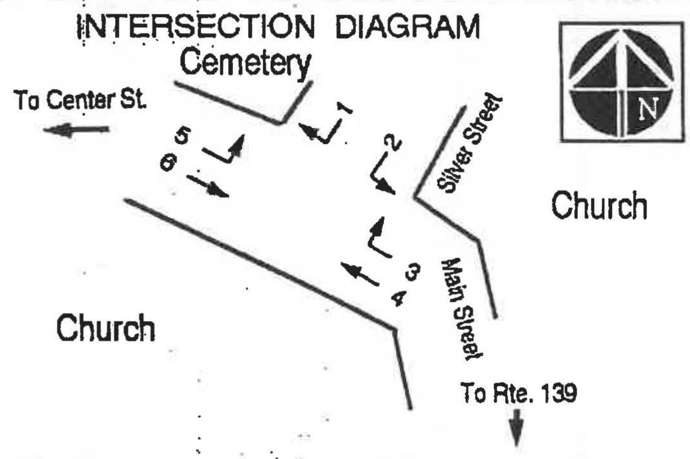
Fay, Spofford & Thorndike, Inc.
Engineers & Planners

COUNT SUMMARY

PEAK PERIOD: ☐ AM ☑ MIDDAY ☐ PM

FST JOB NO. PH-002

INTERSECTION DIAGRAM



TOWN: Hanover, MA
INTERSECTION: Silver St. at Main St.
DATE: October 25, 1997
WEATHER: HEAVY RAIN
REMARKS:
RECORDER: CALOGERA BERTOLINO

Notes: Vehicles with 3 or More Axles are to be counted as Heavy Vehicles. Use tick marks in upper right corner (by movement by time period).

Pedestrian crossings are to be noted by tick marks in lower left corner of thru movement on the approach crossed by pedestrians. (by movement by time period).

	1	2	3	4	5	6	7	8	9	10	11	12	TOTALS
11 :00-:15													
:15-:30													
:30-:45	9	61	68	42	1	30							211
:45-:00	9	45	96	52	5	33							240
12 :00-:15	13	56	57	41	6	26							199
:15-:30	9	56	62	44	2	28							201
:30-:45	16	58	83	37	6	28							228
:45-:00	11	56	81	47	1	24							220
1 :00-:15	9	63	71	39	5	17							204
:15-:30	10	63	83	37	1	32							226
:30-:45													
:45-:00													
:00-:15													
:15-:30													
:30-:45													
:45-:00													
PEAK HR.	46	240	318	160	13	101							878

HVY VEH %: 0 % | 0 % | 0 %

PEAK HOUR TIME: 12:30 to 1:30

PEAK HOUR FACTOR: 0.96

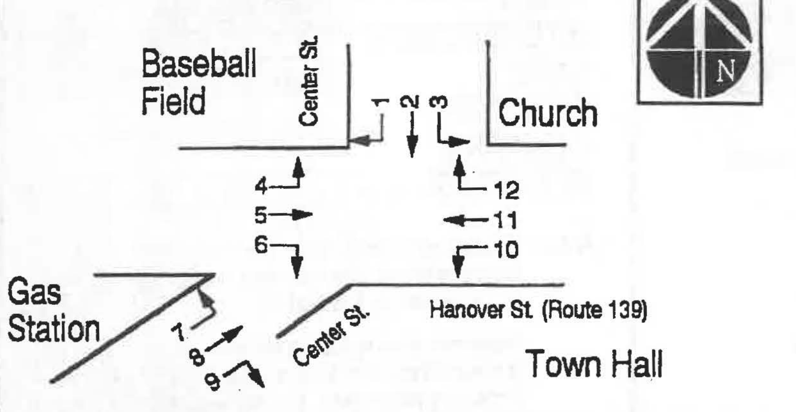
Fay, Spofford & Thorndike, Inc.
Engineers & Planners

COUNT SUMMARY

PEAK PERIOD: ☐ AM ☐ MIDDAY ☑ PM

FST JOB NO. PH-002

INTERSECTION DIAGRAM



TOWN: Hanover, MA
INTERSECTION: Center @ Rte. 139
DATE: October 23, 1997
WEATHER: Ptly cloudy + cool
REMARKS:
RECORDER: Joe Bertolino Jr.

Notes: Vehicles with 3 or More Axles are to be counted as Heavy Vehicles. Use tick marks in upper right corner (by movement by time period).

Pedestrian crossings are to be noted by tick marks in lower left corner of thru movement on the approach crossed by pedestrians. (by movement by time period).

		1	2	3	4	5	6	7	8	9	10	11	12	TOTALS
4	:00-:15													
	:15-:30													
	:30-:45	8	13	26	2	105	03	1	8	31	33	90	2	320
	:45-:00	5	17	17	2	126	4		8	26	39	99	2	343
5	:00-:15	11	25	37	1	159	2	2	8	21	36	122	1	424
	:15-:30	15	21	33	3	155		1	2	35	34	31	3	311
	:30-:45	9	17	25		133	4	2	5	24	46	106	2	371
	:45-:00	8	10	31	2	159	5	4	5	46	47	8	1	325
6	:00-:15	8	16	17	2	102		1	6	26	31	79		288
	:15-:30	6	11	20	2	94	3	1	8	21	36	80		282
	:30-:45													
	:45-:00													
	:00-:15													
	:15-:30													
	:30-:45													
	:45-:00													
PEAK HR.		40	80	112	10	553	11	5	23	106	155	358		1449

350

11

1495

HVY VEH %	0 %	1 %	1 %	PEAK HOUR TIME: to	PEAK HOUR FACTOR: 0.85

.85

Center SB Center NB 139 EB 139 WB = 1%

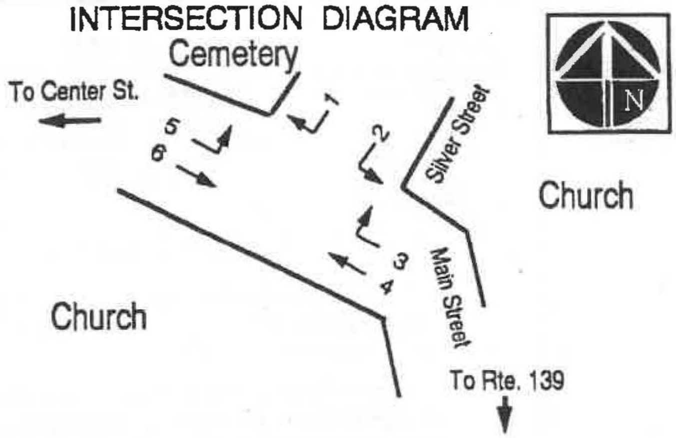
Fay, Spofford & Thorndike, Inc.
Engineers & Planners

COUNT SUMMARY

PEAK PERIOD: ☐ AM ☐ MIDDAY ☑ PM

FST JOB NO. PH-002

INTERSECTION DIAGRAM



TOWN: Hanover, MA
INTERSECTION: Silver St. at Main St.
DATE: October 23, 1997
WEATHER: CLEAR
REMARKS:
RECORDER: CALOGERA BERTOLINI

Notes: Vehicles with 3 or More Axles are to be counted as Heavy Vehicles. Use tick marks in upper right corner (by movement by time period).

Pedestrian crossings are to be noted by tick marks in lower left corner of thru movement on the approach crossed by pedestrians. (by movement by time period).

		1	2	3	4	5	6	7	8	9	10	11	12	TOTALS
4	:00-:15													
	:15-:30													
	:30-:45	10	53	58	48	5	41					215		
	:45-:00	14	47	44	36	5	36					182		
5	:00-:15	32	54	43	39	4	47				5Ped.	219		
	:15-:30	28	41	67	65	5	31				1	237		
	:30-:45	22	39	44	40	3	42					190		
	:45-:00	14	51	65	42	5	31				1	208		
6	:00-:15	15	60	58	31	0	38					202		
	:15-:30	11	54	43	30	1	39					178		
	:30-:45													
	:45-:00													
	:00-:15													
	:15-:30													
	:30-:45													
	:45-:00													
PEAK HR.		96	185	219	186	17	151				PHF = 0.90	854		

HVY VEH %	1 %	1 %	0 %	PEAK HOUR TIME: 5:00 to 6:00	PEAK HOUR FACTOR

Location : Route 139 East of Main St
City/State: Hanover, MA
Counter : N4
JANUS File: PH002001

Accurate Counts
508-664-2565
860-282-0223

Site Code : PH002001
Start Date: 10/17/97
File I.D. : 002CLSEB
Page : 1

Eastbound

Begin Time	Bikes	Cars & Tlrs	2 Axle Long	Buses	2 Axle 6 Tire	3 Axle Single	4 Axle Single	<5 Axl Double	5 Axle Double	>6 Axl Double	<6 Axl Multi	6 Axle Multi	>6 Axl Multi	Totl
12:00 10/17	0	36	1	0	0	0	0	0	0	0	0	0	0	37
01:00	0	25	3	0	0	0	0	0	0	0	0	0	0	28
02:00	0	7	0	0	0	0	0	0	0	0	0	0	0	7
03:00	0	11	6	0	0	0	0	0	0	0	0	0	0	17
04:00	0	17	6	0	2	0	0	0	1	0	0	0	0	26
05:00	0	39	23	0	4	2	0	0	0	0	0	0	0	68
06:00	0	104	43	5	7	1	0	2	2	0	0	0	0	164
07:00	5	216	102	4	13	3	0	3	0	2	0	0	0	348
08:00	2	337	82	5	8	3	0	1	2	1	0	1	0	442
09:00	0	300	72	1	16	2	0	3	0	0	0	0	0	394
10:00	0	287	81	6	12	1	0	4	0	0	0	0	0	391
11:00	0	353	91	7	13	2	0	1	1	0	1	0	0	469
12:00 pm	1	353	81	1	9	0	0	2	1	0	0	2	0	450
01:00	3	326	99	5	13	5	0	4	0	0	0	0	1	456
02:00	6	446	115	11	8	5	1	0	2	2	0	0	0	596
03:00	2	509	117	1	7	2	0	2	2	0	0	1	0	643
04:00	5	505	142	1	20	1	0	3	1	0	0	0	0	678
05:00	7	630	129	1	13	5	0	1	1	0	0	0	0	787
06:00	4	474	112	0	10	1	0	0	1	0	0	0	0	602
07:00	2	299	65	0	3	1	0	1	0	0	0	0	0	371
08:00	0	191	44	0	0	0	1	0	0	0	0	0	0	236
09:00	1	167	30	0	2	0	0	0	2	1	0	0	0	203
10:00	0	129	29	0	1	0	0	0	0	0	0	0	0	159
11:00	0	100	16	1	2	0	0	0	0	0	0	0	0	119
Day Totals	38	5861	1489	49	163	34	2	27	16	6	1	4	1	7691
12:00 10/18	0	94	7	0	3	0	0	1	1	0	0	0	0	106
01:00	0	26	8	0	3	0	0	1	0	0	0	0	0	38
02:00	0	26	2	0	0	0	0	0	0	0	0	0	0	28
03:00	0	14	7	0	0	0	0	0	0	0	0	0	0	21
04:00	0	15	4	0	1	0	0	0	0	0	0	0	0	20
05:00	0	34	5	0	3	0	0	0	0	0	0	0	0	42
06:00	0	78	18	1	4	0	0	0	1	0	0	0	0	102
07:00	0	213	57	2	11	1	0	3	0	0	0	0	0	287
08:00	2	275	108	2	7	2	1	0	0	3	0	0	0	400
09:00	1	403	126	1	8	4	1	2	0	0	1	0	1	548
10:00	4	506	117	1	9	3	0	3	1	3	0	0	0	647
11:00	6	470	118	4	12	5	0	3	0	4	1	0	2	625
12:00 pm	3	495	131	1	6	3	1	0	0	0	0	0	0	640
01:00	3	512	105	0	7	2	0	3	0	0	0	0	0	632
02:00	2	403	115	0	8	3	0	0	0	0	0	0	0	531
03:00	3	516	100	0	13	2	0	1	0	0	0	0	0	635
04:00	4	431	119	0	10	0	0	0	0	0	0	0	0	564
05:00	4	401	83	1	3	0	0	2	1	0	0	0	0	495
06:00	1	279	58	0	2	0	0	0	0	0	0	0	0	340
07:00	0	227	52	0	0	0	0	0	1	0	0	0	0	280
08:00	2	187	36	0	1	0	0	0	1	0	0	0	0	227
09:00	0	119	22	0	2	0	0	0	0	0	0	0	0	143
10:00	0	111	22	0	1	0	0	0	0	0	0	0	0	134
11:00	0	104	12	0	0	0	0	0	0	0	0	0	0	116
Day Totals	35	5939	1432	13	114	25	3	19	6	10	2	*	3	7601
Totals	73	11800	2921	62	277	59	5	46	22	16	3	4	4	15292
Percent	.4%	77.1%	19.1%	.4%	1.8%	.3%	.0%	.3%	.1%	.1%	.0%	.0%	.0%	

Location : Center South of Main
City/State: Hanover, MA
Counter : 8

Accurate Counts
508-664-2565
860-282-0223

Site Code : PH002004
Start Date: 10/13/97
File I.D. : PH002004
Page : 1

Begin	Mon.	10/13	Tues.		Wed.		Thur.		Fri.		Sat.		Sun.		Week	Avg.
Time	NB	SB	NB	SB	NB	SB	NB	SB	NB	SB	NB	SB	NB	SB	NB	SB
12:00 am	*	*	*	*	*	*	0	6	*	*	*	*	*	*	0	6
01:00	*	*	*	*	*	*	0	0	*	*	*	*	*	*	0	0
02:00	*	*	*	*	*	*	3	2	*	*	*	*	*	*	3	2
03:00	*	*	*	*	*	*	1	2	*	*	*	*	*	*	1	2
04:00	*	*	*	*	*	*	3	1	*	*	*	*	*	*	3	1
05:00	*	*	*	*	*	*	8	5	*	*	*	*	*	*	8	5
06:00	*	*	*	*	*	*	26	11	*	*	*	*	*	*	26	11
07:00	*	*	*	*	*	*	61	67	*	*	*	*	*	*	61	67
08:00	*	*	*	*	*	*	57	43	*	*	*	*	*	*	57	43
09:00	*	*	*	*	*	*	41	51	*	*	*	*	*	*	41	51
10:00	*	*	*	*	*	*	30	59	*	*	*	*	*	*	30	59
11:00	*	*	*	*	*	*	34	75	*	*	*	*	*	*	34	75
12:00 pm	*	*	*	*	*	*	31	77	*	*	*	*	*	*	31	77
01:00	*	*	*	*	*	*	24	58	*	*	*	*	*	*	24	58
02:00	*	*	*	*	*	*	27	121	*	*	*	*	*	*	27	121
03:00	*	*	*	*	*	*	48	174	*	*	*	*	*	*	48	174
04:00	*	*	*	*	*	*	42	194	*	*	*	*	*	*	42	194
05:00	*	*	*	*	*	*	44	252	*	*	*	*	*	*	44	252
06:00	*	*	*	*	*	*	20	127	*	*	*	*	*	*	20	127
07:00	*	*	*	*	*	*	25	51	*	*	*	*	*	*	25	51
08:00	*	*	*	*	*	*	11	34	*	*	*	*	*	*	11	34
09:00	*	*	*	*	*	*	13	31	*	*	*	*	*	*	13	31
10:00	*	*	*	*	*	*	6	7	*	*	*	*	*	*	6	7
11:00	*	*	*	*	*	*	2	7	*	*	*	*	*	*	2	7
Totals	0	0	0	0	0	0	557	1455	0	0	0	0	0	0	557	1455
	0		0		0		2012		0		0		0		2012	
Avg. Day	.0%	.0%	.0%	.0%	.0%	.0%	100.0%	100.0%	.0%	.0%	.0%	.0%	.0%	.0%		
AM Peaks							07:00	11:00							07:00	11:00
Volume							61	75							61	75
PM Peaks							03:00	05:00							03:00	05:00
Volume							48	252							48	252
ADTs																

Location : Route 139 East of Main St
City/State: Hanover, MA
Counter : N4
JANUS File: PH002001

Accurate Counts
508-664-2565
860-282-0223

Site Code : PH002001
Start Date: 10/17/97
File I.D. : 002SPEB
Page : 1

Eastbound

Begin Time	1-14	15-19	20-24	25-29	30-34	35-39	40-44	45-49	50-54	55-59	60-64	65-69	70-999	Totl	50th Pct.	85th Pct.
12:00 10/17	0	0	1	2	7	8	11	7	1	0	0	0	0	37	38	45
01:00	0	0	0	2	5	11	4	5	1	0	0	0	0	28	37	46
02:00	0	0	0	0	0	0	3	2	2	0	0	0	0	7	46	51
03:00	0	0	0	1	1	5	6	3	1	0	0	0	0	17	40	45
04:00	0	0	0	0	0	6	10	5	3	2	0	0	0	26	42	50
05:00	2	0	0	2	6	9	21	22	5	0	1	0	0	68	42	47
06:00	0	0	1	8	19	40	70	22	2	1	0	0	1	164	40	44
07:00	1	2	8	33	72	112	101	12	4	0	1	0	2	348	36	42
08:00	3	6	12	45	137	115	107	14	0	0	0	0	3	442	35	41
09:00	0	1	2	10	77	153	127	16	5	1	0	0	2	394	37	42
10:00	0	1	4	7	74	136	146	21	0	0	1	0	1	391	37	42
11:00	0	1	2	14	99	191	137	20	1	2	0	0	2	469	36	42
12:00 pm	0	1	2	7	90	174	157	15	1	0	0	0	3	450	37	42
01:00	6	1	2	13	106	163	126	33	3	0	0	0	3	456	36	42
02:00	8	16	42	87	214	124	95	4	0	0	1	1	4	596	32	40
03:00	2	1	10	31	198	242	139	13	0	1	1	0	5	643	35	41
04:00	0	6	10	21	166	265	184	16	3	3	2	1	1	678	36	41
05:00	3	1	6	8	223	328	200	10	0	1	1	1	5	787	36	41
06:00	1	0	2	12	148	254	172	7	2	1	0	0	3	602	36	41
07:00	0	0	3	4	93	155	103	12	0	0	0	0	1	371	36	41
08:00	0	0	0	2	54	79	77	21	2	0	0	0	1	236	37	42
09:00	0	0	0	3	22	59	87	30	1	1	0	0	0	203	40	44
10:00	0	1	1	3	26	43	68	17	0	0	0	0	0	159	39	43
11:00	0	0	0	1	18	27	49	21	3	0	0	0	0	119	40	45
Day Totals	26	38	108	316	1855	2699	2200	348	40	13	8	3	37	7691	36	

Location : Silver East of Main
City/State: Hanover, MA
Counter : 14

Accurate Counts
508-664-2565
860-282-0223

Site Code : PH002006
Start Date: 10/13/97
File I.D. : PH002006
Page : 1

Begin Time	Mon. 10/13 NB	SB	Tues. NB	SB	Wed. NB	SB	Thur. NB	SB	Fri. NB	SB	Sat. NB	SB	Sun. NB	SB	Week Avg. NB	SB
12:00 am	*	*	*	*	*	*	4	28	*	*	*	*	*	*	4	28
01:00	*	*	*	*	*	*	6	11	*	*	*	*	*	*	6	11
02:00	*	*	*	*	*	*	1	1	*	*	*	*	*	*	1	1
03:00	*	*	*	*	*	*	1	1	*	*	*	*	*	*	1	1
04:00	*	*	*	*	*	*	22	7	*	*	*	*	*	*	22	7
05:00	*	*	*	*	*	*	100	7	*	*	*	*	*	*	100	7
06:00	*	*	*	*	*	*	116	37	*	*	*	*	*	*	116	37
07:00	*	*	*	*	*	*	195	101	*	*	*	*	*	*	195	101
08:00	*	*	*	*	*	*	224	111	*	*	*	*	*	*	224	111
09:00	*	*	*	*	*	*	184	84	*	*	*	*	*	*	184	84
10:00	*	*	*	*	*	*	163	117	*	*	*	*	*	*	163	117
11:00	*	*	*	*	*	*	148	119	*	*	*	*	*	*	148	119
12:00 pm	*	*	*	*	*	*	174	151	*	*	*	*	*	*	174	151
01:00	*	*	*	*	*	*	180	185	*	*	*	*	*	*	180	185
02:00	*	*	*	*	*	*	247	227	*	*	*	*	*	*	247	227
03:00	*	*	*	*	*	*	206	236	*	*	*	*	*	*	206	236
04:00	*	*	*	*	*	*	238	280	*	*	*	*	*	*	238	280
05:00	*	*	*	*	*	*	255	267	*	*	*	*	*	*	255	267
06:00	*	*	*	*	*	*	182	210	*	*	*	*	*	*	182	210
07:00	*	*	*	*	*	*	132	209	*	*	*	*	*	*	132	209
08:00	*	*	*	*	*	*	73	163	*	*	*	*	*	*	73	163
09:00	*	*	*	*	*	*	46	120	*	*	*	*	*	*	46	120
10:00	*	*	*	*	*	*	29	51	*	*	*	*	*	*	29	51
11:00	*	*	*	*	*	*	16	42	*	*	*	*	*	*	16	42
Totals	0	0	0	0	0	0	2942	2765	0	0	0	0	0	0	2942	2765
	0		0		0		5707		0		0		0		5707	
Avg. Day	.0%	.0%	.0%	.0%	.0%	.0%	100.0%	100.0%	.0%	.0%	.0%	.0%	.0%	.0%		
AM Peaks							08:00	11:00							08:00	11:00
Volume							224	119							224	119
PM Peaks							05:00	04:00							05:00	04:00
Volume							255	280							255	280

ADTs

Location : Route 139 East of Main St
City/State: Hanover, MA
Counter : N4
JANUS File: PH002001

Accurate Counts
508-664-2565
860-282-0223

Site Code : PH002001
Start Date: 10/17/97
File I.D. : 002SPWB
Page : 1

Westbound

Begin Time	1-14	15-19	20-24	25-29	30-34	35-39	40-44	45-49	50-54	55-59	60-64	65-69	70-999	Totl	50th Pct.	85th Pct.
12:00 10/17	0	0	0	0	0	2	2	1	2	0	0	0	0	7	43	51
01:00	0	0	0	0	0	1	2	3	1	0	0	0	0	7	45	48
02:00	0	0	0	0	0	0	0	3	1	0	0	0	0	4	47	48
03:00	0	0	0	0	0	0	3	0	2	0	0	0	0	5	42	51
04:00	0	0	0	0	0	2	5	0	2	0	0	0	0	9	41	51
05:00	0	0	3	0	9	14	30	9	3	1	0	0	0	69	40	45
06:00	0	0	0	2	44	103	135	46	6	0	0	2	0	338	40	44
07:00	2	5	7	15	87	241	173	36	5	1	1	0	4	577	37	42
08:00	0	2	16	39	101	150	150	30	5	3	1	0	1	498	36	42
09:00	0	2	1	6	56	139	163	30	6	1	0	1	2	407	38	42
10:00	2	1	2	6	46	183	165	26	3	1	0	1	0	436	38	42
11:00	0	4	1	5	52	169	164	19	3	0	2	0	1	420	38	42
12:00 pm	1	0	2	3	54	214	210	30	1	1	0	1	3	520	38	42
01:00	0	2	12	21	68	176	164	19	3	1	1	0	2	469	37	42
02:00	2	5	73	100	155	92	41	4	1	1	1	0	1	476	30	37
03:00	4	4	18	21	127	202	132	26	1	3	3	1	3	545	36	42
04:00	0	9	1	18	93	252	193	17	6	3	6	2	3	603	37	42
05:00	2	10	2	53	200	242	92	5	4	2	1	0	4	617	35	40
06:00	0	2	0	10	130	205	126	10	3	3	2	0	3	494	36	41
07:00	0	1	0	12	95	172	78	14	2	0	2	0	1	377	36	41
08:00	0	0	0	3	28	96	109	25	5	1	1	0	0	268	39	43
09:00	0	0	1	2	17	76	104	24	0	3	0	0	2	229	40	43
10:00	0	0	1	2	22	48	51	23	4	0	0	0	0	151	39	45
11:00	0	1	0	0	4	25	60	26	3	0	1	0	0	120	41	46
Day Totals	13	48	140	318	1388	2804	2352	426	72	25	22	8	30	7646	37	

Location : Route 139 East of Main St
City/State: Hanover, MA
Counter : N4
JANUS File: PH002001

Accurate Counts
508-664-2565
860-282-0223

Site Code : PH002001
Start Date: 10/17/97
File I.D. : 002SPEB

Eastbound

Begin Time	1-14	15-19	20-24	25-29	30-34	35-39	40-44	45-49	50-54	55-59	60-64	65-69	70-999	Totl	50th Pct.	85th Pct.
12:00 10/18	0	0	0	0	13	25	44	21	3	0	0	0	0	106	40	46
01:00	0	0	1	0	8	8	15	5	1	0	0	0	0	38	40	43
02:00	0	0	0	2	1	5	11	7	2	0	0	0	0	28	41	47
03:00	0	0	0	0	2	2	6	6	3	1	1	0	0	21	43	52
04:00	0	0	0	1	2	3	4	6	1	3	0	0	0	20	43	53
05:00	0	0	0	2	1	7	18	9	3	2	0	0	0	42	41	48
06:00	0	0	1	5	6	20	57	7	3	2	0	1	0	102	40	43
07:00	6	7	10	24	65	88	68	18	0	1	0	0	0	287	35	42
08:00	8	19	21	52	105	88	89	14	2	0	0	0	2	400	33	41
09:00	25	36	80	158	166	56	18	2	2	0	1	0	4	548	27	34
10:00	17	38	86	161	228	85	23	3	1	0	0	1	4	647	29	35
11:00	35	55	76	124	195	104	22	2	2	0	2	0	8	625	29	36
12:00 pm	8	6	25	86	278	165	59	5	2	1	2	1	2	640	32	37
01:00	7	7	18	56	237	220	77	4	1	0	3	1	1	632	33	38
02:00	3	1	5	37	160	217	100	6	1	0	0	0	1	531	35	40
03:00	1	1	1	15	135	284	164	23	3	2	0	1	5	635	36	42
04:00	0	0	2	14	134	178	204	25	4	1	0	0	2	564	37	42
05:00	0	1	3	1	95	182	182	29	1	1	0	0	0	495	37	42
06:00	0	0	0	3	73	129	113	20	1	1	0	0	0	340	37	42
07:00	0	0	0	1	52	97	112	12	4	0	0	0	2	280	38	42
08:00	0	0	1	5	38	90	71	18	2	1	1	0	0	227	37	42
09:00	0	0	0	3	33	45	47	13	1	1	0	0	0	143	37	42
10:00	0	0	0	4	22	33	52	19	4	0	0	0	0	134	40	45
11:00	0	1	0	1	18	31	48	15	2	0	0	0	0	116	40	43
Day Totals	110	172	330	755	2067	2162	1604	289	49	17	10	5	31	7601	35	
Totals	136	210	438	1071	3922	4861	3804	637	89	30	18	8	68	15292		

Speed Statistics.

15th Percentile Speed : 29 MPH
Median Speed (50th percentile): 36 MPH
Average Speed - All Vehicles : 37 MPH
85th Percentile Speed : 41 MPH
95th Percentile Speed : 45 MPH
10 MPH Pace Speed : 30-39 MPH
Number of Vehicles in Pace : 8783
Percent of Vehicles in Pace : 57.97%
Number of Vehicles > 30 MPH : 12653
Percent of Vehicles > 30 MPH: 83.51%

Westbound

Begin Time	Bikes	Cars & Tlrs	2 Axle Long	Buses	2 Axle 6 Tire	3 Axle Single	4 Axle Single	<5 Axl Double	5 Axle Double	>6 Axl Double	<6 Axl Multi	6 Axle Multi	>6 Axl Multi	Totl
12:00 10/17	0	1	6	0	0	0	0	0	0	0	0	0	0	7
01:00	0	3	4	0	0	0	0	0	0	0	0	0	0	7
02:00	0	2	2	0	0	0	0	0	0	0	0	0	0	4
03:00	0	0	4	0	1	0	0	0	0	0	0	0	0	5
04:00	0	5	3	0	0	0	0	1	0	0	0	0	0	9
05:00	1	43	19	0	5	1	0	0	0	0	0	0	0	69
06:00	0	253	79	1	2	0	0	1	0	2	0	0	0	338
07:00	2	414	123	3	20	4	0	5	4	0	0	1	1	577
08:00	4	358	116	8	5	3	0	1	1	2	0	0	0	498
09:00	0	281	97	2	19	2	1	2	3	0	0	0	0	407
10:00	1	307	103	6	16	3	0	0	0	0	0	0	0	436
11:00	4	303	87	6	13	2	0	2	2	1	0	0	0	420
12:00 pm	6	384	89	7	22	2	0	3	4	3	0	0	0	520
01:00	6	345	103	0	10	0	1	4	0	0	0	0	0	469
02:00	4	352	91	9	11	2	0	1	4	1	1	0	0	476
03:00	8	406	92	6	20	6	0	4	2	0	1	0	0	545
04:00	10	438	123	1	17	7	0	4	3	0	0	0	0	603
05:00	7	466	119	1	17	1	0	2	2	1	0	0	1	617
06:00	2	377	99	2	14	0	0	0	0	0	0	0	0	494
07:00	2	289	76	2	6	0	0	2	0	0	0	0	0	377
08:00	1	228	36	0	3	0	0	0	0	0	0	0	0	268
09:00	1	196	30	0	2	0	0	0	0	0	0	0	0	229
10:00	0	125	25	0	1	0	0	0	0	0	0	0	0	151
11:00	0	101	19	0	0	0	0	0	0	0	0	0	0	120
Day Totals	59	5677	1545	54	204	33	2	32	25	10	2	1	2	7646
12:00 10/18	0	47	7	0	1	0	0	0	0	0	0	0	0	55
01:00	0	36	3	0	1	0	0	0	0	0	0	0	0	40
02:00	0	16	2	0	0	0	0	0	0	0	0	0	0	18
03:00	0	16	5	0	2	0	0	0	0	0	0	0	0	23
04:00	0	8	5	0	3	0	0	1	0	0	0	0	0	17
05:00	0	40	14	0	1	0	0	0	0	0	0	0	0	55
06:00	0	76	33	0	1	0	0	2	1	0	0	0	0	113
07:00	0	157	58	0	2	0	0	0	0	0	0	0	0	217
08:00	0	238	69	2	7	3	0	1	0	1	0	0	0	321
09:00	3	313	101	0	7	4	0	1	0	0	0	0	0	429
10:00	2	440	133	0	11	9	1	1	1	0	1	0	0	599
11:00	7	450	119	4	8	0	0	4	2	1	1	0	0	596
12:00 pm	7	509	134	1	16	2	2	2	0	0	0	0	0	673
01:00	3	474	105	0	5	2	1	2	0	0	0	0	0	592
02:00	3	475	102	0	5	2	0	1	0	0	0	0	0	588
03:00	8	439	111	0	10	3	0	0	0	0	0	0	1	572
04:00	3	483	130	0	6	3	1	2	0	0	0	0	0	628
05:00	1	442	112	0	6	2	0	2	0	1	0	0	0	566
06:00	0	305	53	0	7	0	0	1	0	0	0	0	1	367
07:00	2	234	45	0	1	0	0	1	0	0	0	0	0	283
08:00	1	166	35	0	0	0	0	0	0	0	0	0	0	202
09:00	0	159	29	0	1	0	0	0	2	0	0	0	0	191
10:00	0	127	31	0	0	0	0	0	0	0	0	0	0	158
11:00	1	112	19	0	0	0	0	0	0	0	0	0	0	132
Day Totals	41	5762	1455	7	101	30	5	21	6	3	2	*	2	7435
Totals	100	11439	3000	61	305	63	7	53	31	13	4	1	4	15081
Percent	.6%	75.8%	19.8%	.4%	2.0%	.4%	.0%	.3%	.2%	.0%	.0%	.0%	.0%	

Location : Main 210' West of Center
City/State: Hanover, MA
Counter : 23

Accurate Counts
508-664-2565
860-282-0223

Site Code : PH002002
Start Date: 10/16/97
File I.D. : PH002002
Page : 1

Thursday

Begin Time	WB A.M.		WB P.M.		EB A.M.		EB P.M.		Combined A.M.		Combined P.M.	
12:00 10/16	0		43		1		30		1		73	
12:15	1		32		4		35		5		67	
12:30	1		24		5		36		6		60	
12:45	1	3	33	132	5	15	34	135	6	18	67	267
01:00	2		40		1		30		3		70	
01:15	0		32		1		44		1		76	
01:30	0		36		0		32		0		68	
01:45	0	2	44	152	0	2	44	150	0	4	88	302
02:00	0		51		2		64		2		115	
02:15	1		52		0		70		1		122	
02:30	1		60		0		62		1		122	
02:45	0	2	46	209	1	3	72	268	1	5	118	477
03:00	1		41		0		56		1		97	
03:15	1		86		1		71		2		157	
03:30	3		54		2		78		5		132	
03:45	1	6	66	247	0	3	82	287	1	9	148	534
04:00	2		80		1		69		3		149	
04:15	1		65		0		66		1		131	
04:30	4		56		5		78		9		134	
04:45	1	8	53	254	0	6	90	303	1	14	143	557
05:00	4		48		0		90		4		138	
05:15	9		80		2		99		11		179	
05:30	10		74		5		76		15		150	
05:45	15	38	46	248	5	12	78	343	20	50	124	591
06:00	16		59		6		47		22		106	
06:15	30		34		4		67		34		101	
06:30	41		34		9		60		50		94	
06:45	46	133	48	175	10	29	56	230	56	162	104	405
07:00	108		46		30		31		138		77	
07:15	78		34		45		26		123		60	
07:30	64		25		38		28		102		53	
07:45	76	326	17	122	49	162	28	113	125	488	45	235
08:00	60		13		28		20		88		33	
08:15	73		25		20		20		93		45	
08:30	55		15		32		22		87		37	
08:45	60	248	10	63	43	123	13	75	103	371	23	138
09:00	38		18		39		28		77		46	
09:15	36		15		42		22		78		37	
09:30	32		13		28		16		60		29	
09:45	27	133	14	60	22	131	14	80	49	264	28	140
10:00	27		16		51		5		78		21	
10:15	34		3		38		5		72		8	
10:30	37		4		30		8		67		12	
10:45	38	136	5	28	38	157	2	20	76	293	7	48
11:00	30		4		50		6		80		10	
11:15	41		1		30		2		71		3	
11:30	42		4		30		4		72		8	
11:45	42	155	1	10	43	153	2	14	85	308	3	24
Totals	1190		1700		796		2018		1986		3718	
Day Totals		2890				2814				5704		
Split %	59.9%		45.7%		40.0%		54.2%					
Peak Hour	07:00		03:15		07:00		04:30		07:00		04:45	
Volume	326		286		162		357		488		610	
P.H.F.	.75		.83		.82		.90		.88		.85	

Location : Center South of Hanover
City/State: Hanover, MA
Counter : 13

Accurate Counts
508-664-2565
860-282-0223

Site Code : PH002005
Start Date: 10/16/97
File I.D. : PH002005
Page : 1

Thursday

Begin Time	EB A.M.		EB P.M.		WB A.M.		WB P.M.		Combined A.M.		Combined P.M.	
12:00 10/16	1		23		17		30		18		53	
12:15	1		36		3		33		4		69	
12:30	1		32		3		36		4		68	
12:45	1	4	28	119	3	26	31	130	4	30	59	249
01:00	1		26		3		34		4		60	
01:15	0		16		3		40		3		56	
01:30	2		32		1		42		3		74	
01:45	1	4	30	104	2	9	46	162	3	13	76	266
02:00	0		28		1		34		1		62	
02:15	1		37		0		38		1		75	
02:30	0		29		1		44		1		73	
02:45	1	2	36	130	0	2	50	166	1	4	86	296
03:00	1		23		0		50		1		73	
03:15	1		40		0		48		1		88	
03:30	1		58		2		47		3		105	
03:45	2	5	32	153	0	2	66	211	2	7	98	364
04:00	1		24		0		68		1		92	
04:15	8		43		2		60		10		103	
04:30	10		31		0		66		10		97	
04:45	7	26	36	134	1	3	70	264	8	29	106	398
05:00	18		35		3		77		21		112	
05:15	24		38		2		58		26		96	
05:30	28		55		2		56		30		111	
05:45	24	94	25	153	5	12	56	247	29	106	81	400
06:00	15		41		4		57		19		98	
06:15	22		35		6		51		28		86	
06:30	32		37		4		48		36		85	
06:45	36	105	29	142	12	26	40	196	48	131	69	338
07:00	34		30		12		39		46		69	
07:15	48		20		14		43		62		63	
07:30	54		16		21		38		75		54	
07:45	50	186	7	73	18	65	31	151	68	251	38	224
08:00	48		13		12		34		60		47	
08:15	46		14		13		32		59		46	
08:30	54		4		12		28		66		32	
08:45	42	190	12	43	16	53	28	122	58	243	40	165
09:00	48		13		17		26		65		39	
09:15	29		12		18		32		47		44	
09:30	39		11		16		29		55		40	
09:45	48	164	10	46	22	73	11	98	70	237	21	144
10:00	31		3		24		11		55		14	
10:15	32		5		24		10		56		15	
10:30	30		4		26		4		56		8	
10:45	32	125	5	17	26	100	13	38	58	225	18	55
11:00	34		2		30		7		64		9	
11:15	24		5		26		7		50		12	
11:30	32		2		26		5		58		7	
11:45	30	120	2	11	44	126	13	32	74	246	15	43
Totals	1025		1125		497		1817		1522		2942	
Day Totals		2150				2314				4464		
Split %	67.3%		38.2%		32.6%		61.7%					
Peak Hour	07:15		04:45		11:00		04:15		07:15		04:45	
Volume	200		164		126		273		265		425	
P.H.F.	.92		.74		.71		.88		.88		.94	

Location : Center South of Hanover
City/State: Hanover, MA
Counter : 13

Accurate Counts
508-664-2565
860-282-0223

Site Code : PH002005
Start Date: 10/13/97
File I.D. : PH002005
Page : 1

Begin Time	10/13 Mon. Totl	10/14 Tues. Totl	10/15 Wed. Totl	10/16 Thur. Totl	10/17 Fri. Totl	Weekday Avg.	10/18 Sat. Totl	10/19 Sun. Totl
12:00 am	*	*	*	30	*	30	*	*
01:00	*	*	*	13	*	13	*	*
02:00	*	*	*	4	*	4	*	*
03:00	*	*	*	7	*	7	*	*
04:00	*	*	*	29	*	29	*	*
05:00	*	*	*	106	*	106	*	*
06:00	*	*	*	131	*	131	*	*
07:00	*	*	*	251	*	251	*	*
08:00	*	*	*	243	*	243	*	*
09:00	*	*	*	237	*	237	*	*
10:00	*	*	*	225	*	225	*	*
11:00	*	*	*	246	*	246	*	*
12:00 pm	*	*	*	249	*	249	*	*
01:00	*	*	*	266	*	266	*	*
02:00	*	*	*	296	*	296	*	*
03:00	*	*	*	364	*	364	*	*
04:00	*	*	*	398	*	398	*	*
05:00	*	*	*	400	*	400	*	*
06:00	*	*	*	338	*	338	*	*
07:00	*	*	*	224	*	224	*	*
08:00	*	*	*	165	*	165	*	*
09:00	*	*	*	144	*	144	*	*
10:00	*	*	*	55	*	55	*	*
11:00	*	*	*	43	*	43	*	*
Totals	0	0	0	4464	0	4464	0	0
Avg. WkDay	.0%	.0%	.0%	100.0%	.0%		.0%	.0%
AM Peaks				07:00		07:00		
Volume				251		251		
PM Peaks				05:00		05:00		
Volume				400		400		
ADTs								

Location : Main 210' West of Center
City/State: Hanover, MA
Counter : 23

Accurate Counts
508-664-2565
860-282-0223

Site Code : PH002002
Start Date: 10/13/97
File I.D. : PH002002
Page : 1

Begin Time	10/13 Mon. Totl	10/14 Tues. Totl	10/15 Wed. Totl	10/16 Thur. Totl	10/17 Fri. Totl	Weekday Avg.	10/18 Sat. Totl	10/19 Sun. Totl
12:00 am	*	*	*	18	*	18	*	*
01:00	*	*	*	4	*	4	*	*
02:00	*	*	*	5	*	5	*	*
03:00	*	*	*	9	*	9	*	*
04:00	*	*	*	14	*	14	*	*
05:00	*	*	*	50	*	50	*	*
06:00	*	*	*	162	*	162	*	*
07:00	*	*	*	488	*	488	*	*
08:00	*	*	*	371	*	371	*	*
09:00	*	*	*	264	*	264	*	*
10:00	*	*	*	293	*	293	*	*
11:00	*	*	*	308	*	308	*	*
12:00 pm	*	*	*	267	*	267	*	*
01:00	*	*	*	302	*	302	*	*
02:00	*	*	*	477	*	477	*	*
03:00	*	*	*	534	*	534	*	*
04:00	*	*	*	557	*	557	*	*
05:00	*	*	*	591	*	591	*	*
06:00	*	*	*	405	*	405	*	*
07:00	*	*	*	235	*	235	*	*
08:00	*	*	*	138	*	138	*	*
09:00	*	*	*	140	*	140	*	*
10:00	*	*	*	48	*	48	*	*
11:00	*	*	*	24	*	24	*	*
Totals	0	0	0	5704	0	5704	0	0
Avg. WkDay	.0%	.0%	.0%	100.0%	.0%		.0%	.0%
AM Peaks				07:00		07:00		
Volume				488		488		
PM Peaks				05:00		05:00		
Volume				591		591		

ADTs

Location : Route 139 East of Main St
City/State: Hanover, MA
Counter : N4
JANUS File: PH002001

Accurate Counts
508-664-2565
860-282-0223

Site Code : PH002001
Start Date: 10/13/97
File I.D. :
Page : 1

Begin Time	10/13 Mon. Totl	10/14 Tues. Totl	10/15 Wed. Totl	10/16 Thur. Totl	10/17 Fri. Totl	Weekday Avg.	10/18 Sat. Totl	10/19 Sun. Totl
12:00 am	*	*	*	*	44	44	161	*
01:00	*	*	*	*	35	35	78	*
02:00	*	*	*	*	11	11	46	*
03:00	*	*	*	*	22	22	44	*
04:00	*	*	*	*	35	35	37	*
05:00	*	*	*	*	137	137	97	*
06:00	*	*	*	*	502	502	215	*
07:00	*	*	*	*	925	925	504	*
08:00	*	*	*	*	940	940	721	*
09:00	*	*	*	*	801	801	977	*
10:00	*	*	*	*	827	827	1246	*
11:00	*	*	*	*	889	889	1221	*
12:00 pm	*	*	*	*	970	970	1313	*
01:00	*	*	*	*	925	925	1224	*
02:00	*	*	*	*	1072	1072	1119	*
03:00	*	*	*	*	1188	1188	1207	*
04:00	*	*	*	*	1281	1281	1192	*
05:00	*	*	*	*	1404	1404	1061	*
06:00	*	*	*	*	1096	1096	707	*
07:00	*	*	*	*	748	748	563	*
08:00	*	*	*	*	504	504	429	*
09:00	*	*	*	*	432	432	334	*
10:00	*	*	*	*	310	310	292	*
11:00	*	*	*	*	239	239	248	*
Totals	0	0	0	0	15337	15337	15036	0
Avg. WkDay	.0%	.0%	.0%	.0%	100.0%		98.0%	.0%
AM Peaks					08:00	08:00	10:00	
Volume					940	940	1246	
PM Peaks					05:00	05:00	12:00	
Volume					1404	1404	1313	

ADTs

Location : Route 139 East of Main St
City/State: Hanover, MA
Counter : N4
JANUS File: PH002001

Accurate Counts
508-664-2565
860-282-0223

Site Code : PH002001
Start Date: 10/17/97
File I.D. :
Page : 1

Friday

Begin Time	EB A.M.		EB P.M.		WB A.M.		WB P.M.		Combined A.M.		Combined P.M.	
12:00 10/17	11		113		1		119		12		232	
12:15	10		118		1		124		11		242	
12:30	9		121		0		127		9		248	
12:45	7	37	98	450	5	7	150	520	12	44	248	970
01:00	3		99		2		139		5		238	
01:15	9		126		0		109		9		235	
01:30	8		121		2		109		10		230	
01:45	8	28	110	456	3	7	112	469	11	35	222	925
02:00	1		129		1		127		2		256	
02:15	2		129		2		115		4		244	
02:30	2		153		0		111		2		264	
02:45	2	7	185	596	1	4	123	476	3	11	308	1072
03:00	1		140		1		164		2		304	
03:15	2		164		0		121		2		285	
03:30	7		144		1		130		8		274	
03:45	7	17	195	643	3	5	130	545	10	22	325	1188
04:00	4		159		1		160		5		319	
04:15	9		172		3		134		12		306	
04:30	9		167		2		153		11		320	
04:45	4	26	180	678	3	9	156	603	7	35	336	1281
05:00	13		221		6		132		19		353	
05:15	2		183		0		188		2		371	
05:30	25		189		24		143		49		332	
05:45	28	68	194	787	39	69	154	617	67	137	348	1404
06:00	24		167		51		125		75		292	
06:15	31		145		73		115		104		260	
06:30	49		146		84		128		133		274	
06:45	60	164	144	602	130	338	126	494	190	502	270	1096
07:00	73		114		153		99		226		213	
07:15	105		111		150		97		255		208	
07:30	71		89		135		91		206		180	
07:45	99	348	57	371	139	577	90	377	238	925	147	748
08:00	81		58		149		85		230		143	
08:15	126		59		131		63		257		122	
08:30	109		59		106		59		215		118	
08:45	126	442	60	236	112	498	61	268	238	940	121	504
09:00	99		47		109		70		208		117	
09:15	113		59		87		73		200		132	
09:30	91		56		97		55		188		111	
09:45	91	394	41	203	114	407	31	229	205	801	72	432
10:00	82		38		100		40		182		78	
10:15	100		45		93		47		193		92	
10:30	103		48		134		35		237		83	
10:45	106	391	28	159	109	436	29	151	215	827	57	310
11:00	102		37		94		30		196		67	
11:15	110		24		107		31		217		55	
11:30	129		29		109		29		238		58	
11:45	128	469	29	119	110	420	30	120	238	889	59	239
Totals	2391		5300		2777		4869		5168		10169	
Day Totals		7691				7646				15337		
Split %	46.2%		52.1%		53.7%		47.8%					

	EB A.M.	EB P.M.	WB A.M.	WB P.M.	Combined A.M.	Combined P.M.
Peak Hour	11:00	05:00	07:00	04:30	07:45	05:00
Volume	469	787	577	629	940	1404
P.H.F.	.90	.89	.94	.83	.91	.94

Location : Main 210' West of Center
City/State: Hanover, MA
Counter : 23

Accurate Counts
508-664-2565
860-282-0223

Site Code : PH002002
Start Date: 10/13/97
File I.D. : PH002002
Page : 1

Begin	Mon.	10/13	Tues.		Wed.		Thur.		Fri.		Sat.		Sun.		Week	Avg.
Time	WB	EB	WB	EB	WB	EB	WB	EB	WB	EB	WB	EB	WB	EB	WB	EB
12:00 am	*	*	*	*	*	*	3	15	*	*	*	*	*	*	3	15
01:00	*	*	*	*	*	*	2	2	*	*	*	*	*	*	2	2
02:00	*	*	*	*	*	*	2	3	*	*	*	*	*	*	2	3
03:00	*	*	*	*	*	*	6	3	*	*	*	*	*	*	6	3
04:00	*	*	*	*	*	*	8	6	*	*	*	*	*	*	8	6
05:00	*	*	*	*	*	*	38	12	*	*	*	*	*	*	38	12
06:00	*	*	*	*	*	*	133	29	*	*	*	*	*	*	133	29
07:00	*	*	*	*	*	*	326	162	*	*	*	*	*	*	326	162
08:00	*	*	*	*	*	*	248	123	*	*	*	*	*	*	248	123
09:00	*	*	*	*	*	*	133	131	*	*	*	*	*	*	133	131
10:00	*	*	*	*	*	*	136	157	*	*	*	*	*	*	136	157
11:00	*	*	*	*	*	*	155	153	*	*	*	*	*	*	155	153
12:00 pm	*	*	*	*	*	*	132	135	*	*	*	*	*	*	132	135
01:00	*	*	*	*	*	*	152	150	*	*	*	*	*	*	152	150
02:00	*	*	*	*	*	*	209	268	*	*	*	*	*	*	209	268
03:00	*	*	*	*	*	*	247	287	*	*	*	*	*	*	247	287
04:00	*	*	*	*	*	*	254	303	*	*	*	*	*	*	254	303
05:00	*	*	*	*	*	*	248	343	*	*	*	*	*	*	248	343
06:00	*	*	*	*	*	*	175	230	*	*	*	*	*	*	175	230
07:00	*	*	*	*	*	*	122	113	*	*	*	*	*	*	122	113
08:00	*	*	*	*	*	*	63	75	*	*	*	*	*	*	63	75
09:00	*	*	*	*	*	*	60	80	*	*	*	*	*	*	60	80
10:00	*	*	*	*	*	*	28	20	*	*	*	*	*	*	28	20
11:00	*	*	*	*	*	*	10	14	*	*	*	*	*	*	10	14
Totals	0	0	0	0	0	0	2890	2814	0	0	0	0	0	0	2890	2814
	0		0		0		5704		0		0		0		5704	
Avg. Day	.0%	.0%	.0%	.0%	.0%	.0%	100.0%	100.0%	.0%	.0%	.0%	.0%	.0%	.0%		
AM Peaks							07:00	07:00							07:00	07:00
Volume							326	162							326	162
PM Peaks							04:00	05:00							04:00	05:00
Volume							254	343							254	343

ADTs

Worksheet for TWSC Intersection

Step 1: RT from Minor Street	NB	SB
Conflicting Flows: (vph)		510
Potential Capacity: (pcph)		764
Movement Capacity: (pcph)		764
Prob. of Queue-Free State:		0.79

Step 2: LT from Major Street	WB	EB
Conflicting Flows: (vph)		633
Potential Capacity: (pcph)		856
Movement Capacity: (pcph)		856
Prob. of Queue-Free State:		0.78
TH Saturation Flow Rate: (pcphpl)		1700
RT Saturation Flow Rate: (pcphpl)		
Major LT Shared Lane Prob. of Queue-Free State:		0.66

Step 4: LT from Minor Street	NB	SB
Conflicting Flows: (vph)		1304
Potential Capacity: (pcph)		186
Major LT, Minor TH Impedance Factor:		0.66
Adjusted Impedance Factor:		0.66
Capacity Adjustment Factor due to Impeding Movements		0.66
Movement Capacity: (pcph)		122

Intersection Performance Summary

Movement	Flow Rate (pcph)	Move Cap (pcph)	Shared Cap (pcph)	Avg. Total Delay (sec/veh)	95% Queue Length (veh)	LOS	Approach Delay (sec/veh)
SB L	220	122 >					
			188	507.0	26.1	F	507.0
SB R	157	764 >					
EB L	188	856		5.4	0.9	B	1.2

Intersection Delay = 98.8 sec/veh

Worksheet for TWSC Intersection

Step 1: RT from Minor Street	NB	SB
Conflicting Flows: (vph)		510
Potential Capacity: (pcph)		764
Movement Capacity: (pcph)		764
Prob. of Queue-Free State:		0.79

Step 2: LT from Major Street	WB	EB
Conflicting Flows: (vph)		633
Potential Capacity: (pcph)		856
Movement Capacity: (pcph)		856
Prob. of Queue-Free State:		0.78
TH Saturation Flow Rate: (pcphpl)		1700
RT Saturation Flow Rate: (pcphpl)		
Major LT Shared Lane Prob. of Queue-Free State:		0.66

Step 4: LT from Minor Street	NB	SB
Conflicting Flows: (vph)		1304
Potential Capacity: (pcph)		460
Major LT, Minor TH Impedance Factor:		0.66
Adjusted Impedance Factor:		0.66
Capacity Adjustment Factor due to Impeding Movements		0.66
Movement Capacity: (pcph)		304

Intersection Performance Summary

Movement	Flow Rate (pcph)	Move Cap (pcph)	Shared Cap (pcph)	Avg. Total Delay (sec/veh)	95% Queue Length (veh)	LOS	Approach Delay (sec/veh)
SB L	220	304 >					
			406	55.8	9.2	F	55.8
SB R	157	764 >					
EB L	186	856		5.4	0.9	B	1.2

Intersection Delay = 11.4 sec/veh

Worksheet for TWSC Intersection

Step 1: RT from Minor Street	NB	SB
Conflicting Flows: (vph)		498
Potential Capacity: (pcph)		774
Movement Capacity: (pcph)		774
Prob. of Queue-Free State:		0.69

Step 2: LT from Major Street	WB	EB
Conflicting Flows: (vph)		598
Potential Capacity: (pcph)		889
Movement Capacity: (pcph)		889
Prob. of Queue-Free State:		0.65
TH Saturation Flow Rate: (pcphpl)		1700
RT Saturation Flow Rate: (pcphpl)		
Major LT Shared Lane Prob. of Queue-Free State:		0.53

Step 4: LT from Minor Street	NB	SB
Conflicting Flows: (vph)		1235
Potential Capacity: (pcph)		204
Major LT, Minor TH Impedance Factor:		0.53
Adjusted Impedance Factor:		0.53
Capacity Adjustment Factor due to Impeding Movements		0.53
Movement Capacity: (pcph)		109

Intersection Performance Summary

Movement	Flow Rate (pcph)	Move Cap (pcph)	Shared Cap (pcph)	Avg. Total Delay (sec/veh)	95% Queue Length (veh)	LOS	Approach Delay (sec/veh)
SB L	160	109 >	226	399.6	25.1	F	399.6
SB R	242	774 >					
EB L	309	889		6.2	1.7	B	2.5

Intersection Delay = 87.0 sec/veh

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================================================================================

           Worksheet for TWSC Intersection
-----------------------------------------------------------
Step 1: RT from Minor Street                 NB          SB
-----------------------------------------------------------
Conflicting Flows: (vph)                     260
Potential Capacity: (pcph)                  1022
Movement Capacity: (pcph)                   1022
Prob. of Queue-Free State:                  1.00
-----------------------------------------------------------
Step 2: LT from Major Street                 WB          EB
-----------------------------------------------------------
Conflicting Flows: (vph)                     343
Potential Capacity: (pcph)                  1177
Movement Capacity: (pcph)                   1177
Prob. of Queue-Free State:                  0.90
TH Saturation Flow Rate: (pcphpl)           1700
RT Saturation Flow Rate: (pcphpl)
Major LT Shared Lane Prob.
 of Queue-Free State:                       0.88
-----------------------------------------------------------
Step 4: LT from Minor Street                 NB          SB
-----------------------------------------------------------
Conflicting Flows: (vph)                     580
Potential Capacity: (pcph)                   489
Major LT, Minor TH
 Impedance Factor:                          0.88
Adjusted Impedance Factor:                  0.88
Capacity Adjustment Factor
 due to Impeding Movements                  0.88
Movement Capacity: (pcph)                    433
-----------------------------------------------------------
```

Intersection Performance Summary

Movement	Flow Rate (pcph)	Move Cap (pcph)	Shared Cap (pcph)	Avg. Total Delay (sec/veh)	95% Queue Length (veh)	LOS	Approach Delay (sec/veh)
NB L	45	433		9.3	0.3	B	9.1
NB R	1	1022		3.5	0.0	A	
WB L	119	1177		3.4	0.3	A	1.2

Intersection Delay = 1.1 sec/veh

Worksheet for TWSC Intersection

Step 1: RT from Minor Street	NB	SB
Conflicting Flows: (vph)	182	
Potential Capacity: (pcph)	1120	
Movement Capacity: (pcph)	1120	
Prob. of Queue-Free State:	1.00	

Step 2: LT from Major Street	WB	EB
Conflicting Flows: (vph)	239	
Potential Capacity: (pcph)	1319	
Movement Capacity: (pcph)	1319	
Prob. of Queue-Free State:	0.97	
TH Saturation Flow Rate: (pcphpl)	1700	
RT Saturation Flow Rate: (pcphpl)		
Major LT Shared Lane Prob. of Queue-Free State:	0.96	

Step 4: LT from Minor Street	NB	SB
Conflicting Flows: (vph)	406	
Potential Capacity: (pcph)	616	
Major LT, Minor TH Impedance Factor:	0.96	
Adjusted Impedance Factor:	0.96	
Capacity Adjustment Factor due to Impeding Movements	0.96	
Movement Capacity: (pcph)	592	

Intersection Performance Summary

Movement	Flow Rate (pcph)	Move Cap (pcph)	Shared Cap (pcph)	Avg. Total Delay (sec/veh)	95% Queue Length (veh)	LOS	Approach Delay (sec/veh)
NB L	52	592		6.7	0.2	B	6.5
NB R	3	1120		3.2	0.0	A	
WB L	45	1319		2.8	0.0	A	0.5

Intersection Delay = 0.9 sec/veh

Worksheet for TWSC Intersection

Step 1: RT from Minor Street	NB	SB
Conflicting Flows: (vph)		587
Potential Capacity: (pcph)		698
Movement Capacity: (pcph)		698
Prob. of Queue-Free State:		0.74

Step 2: LT from Major Street	WB	EB
Conflicting Flows: (vph)		591
Potential Capacity: (pcph)		896
Movement Capacity: (pcph)		896
Prob. of Queue-Free State:		0.96
TH Saturation Flow Rate: (pcphpl)		1700
RT Saturation Flow Rate: (pcphpl)		
Major LT Shared Lane Prob. of Queue-Free State:		0.92

Step 4: LT from Minor Street	NB	SB
Conflicting Flows: (vph)		1374
Potential Capacity: (pcph)		170
Major LT, Minor TH Impedance Factor:		0.92
Adjusted Impedance Factor:		0.92
Capacity Adjustment Factor due to Impeding Movements		0.92
Movement Capacity: (pcph)		157

Intersection Performance Summary

Movement	Flow Rate (pcph)	Move Cap (pcph)	Shared Cap (pcph)	Avg. Total Delay (sec/veh)	95% Queue Length (veh)	LOS	Approach Delay (sec/veh)
SB L	149	157 >					
			272	156.1	13.4	F	156.1
SB R	179	698 >					
EB L	39	896		4.2	0.0	A	0.2

Intersection Delay = 27.8 sec/veh

Worksheet for TWSC Intersection

Step 1: RT from Minor Street	NB	SB
Conflicting Flows: (vph)		615
Potential Capacity: (pcph)		676
Movement Capacity: (pcph)		676
Prob. of Queue-Free State:		0.86

Step 2: LT from Major Street	WB	EB
Conflicting Flows: (vph)		618
Potential Capacity: (pcph)		870
Movement Capacity: (pcph)		870
Prob. of Queue-Free State:		0.95
TH Saturation Flow Rate: (pcphpl)		1700
RT Saturation Flow Rate: (pcphpl)		
Major LT Shared Lane Prob. of Queue-Free State:		0.92

Step 4: LT from Minor Street	NB	SB
Conflicting Flows: (vph)		1324
Potential Capacity: (pcph)		181
Major LT, Minor TH Impedance Factor:		0.92
Adjusted Impedance Factor:		0.92
Capacity Adjustment Factor due to Impeding Movements		0.92
Movement Capacity: (pcph)		166

Intersection Performance Summary

Movement	Flow Rate (pcph)	Move Cap (pcph)	Shared Cap (pcph)	Avg. Total Delay (sec/veh)	95% Queue Length (veh)	LOS	Approach Delay (sec/veh)
SB L	79	166 >					
			279	31.4	3.5	E	31.4
SB R	92	676 >					
EB L	45	870		4.4	0.0	A	0.3

Intersection Delay = 3.4 sec/veh

Worksheet for TWSC Intersection

Step 1: RT from Minor Street	NB	SB
Conflicting Flows: (vph)	484	
Potential Capacity: (pcph)	787	
Movement Capacity: (pcph)	787	
Prob. of Queue-Free State:	0.72	

Step 2: LT from Major Street	WB	EB
Conflicting Flows: (vph)	487	
Potential Capacity: (pcph)	1005	
Movement Capacity: (pcph)	1005	
Prob. of Queue-Free State:	0.79	
TH Saturation Flow Rate: (pcphpl)	1700	
RT Saturation Flow Rate: (pcphpl)		
Major LT Shared Lane Prob. of Queue-Free State:	0.71	

Step 4: LT from Minor Street	NB	SB
Conflicting Flows: (vph)	1180	
Potential Capacity: (pcph)	220	
Major LT, Minor TH Impedance Factor:	0.71	
Adjusted Impedance Factor:	0.71	
Capacity Adjustment Factor due to Impeding Movements	0.71	
Movement Capacity: (pcph)	155	

Intersection Performance Summary

Movement	Flow Rate (pcph)	Move Cap (pcph)	Shared Cap (pcph)	Avg. Total Delay (sec/veh)	95% Queue Length (veh)	LOS	Approach Delay (sec/veh)
NB L	36	155 >					
			502	14.6	3.0	C	14.6
NB R	223	787 >					
WB L	210	1005		4.5	0.9	A	1.3

Intersection Delay = 3.1 sec/veh

Worksheet for TWSC Intersection

Step 1: RT from Minor Street	NB	SB
Conflicting Flows: (vph)	484	
Potential Capacity: (pcph)	787	
Movement Capacity: (pcph)	787	
Prob. of Queue-Free State:	0.68	

Step 2: LT from Major Street	WB	EB
Conflicting Flows: (vph)	487	
Potential Capacity: (pcph)	1005	
Movement Capacity: (pcph)	1005	
Prob. of Queue-Free State:	0.79	
TH Saturation Flow Rate: (pcphpl)	1700	
RT Saturation Flow Rate: (pcphpl)		
Major LT Shared Lane Prob. of Queue-Free State:	0.71	

Step 4: LT from Minor Street	NB	SB
Conflicting Flows: (vph)	1180	
Potential Capacity: (pcph)	220	
Major LT, Minor TH Impedance Factor:	0.71	
Adjusted Impedance Factor:	0.71	
Capacity Adjustment Factor due to Impeding Movements	0.71	
Movement Capacity: (pcph)	155	

Intersection Performance Summary

Movement	Flow Rate (pcph)	Move Cap (pcph)	Shared Cap (pcph)	Avg. Total Delay (sec/veh)	95% Queue Length (veh)	LOS	Approach Delay (sec/veh)
NB L	9	155 >					
			689	8.3	1.9	B	8.3
NB R	250	787 >					
WB L	210	1005		4.5	0.9	A	1.3

Intersection Delay = 2.0 sec/veh

Worksheet for TWSC Intersection

Step 1: RT from Minor Street	NB	SB
Conflicting Flows: (vph)		562
Potential Capacity: (pcph)		719
Movement Capacity: (pcph)		719
Prob. of Queue-Free State:		0.76

Step 2: LT from Major Street	WB	EB
Conflicting Flows: (vph)		696
Potential Capacity: (pcph)		799
Movement Capacity: (pcph)		799
Prob. of Queue-Free State:		0.74
TH Saturation Flow Rate: (pcphpl)		1700
RT Saturation Flow Rate: (pcphpl)		
Major LT Shared Lane Prob. of Queue-Free State:		0.57

Step 4: LT from Minor Street	NB	SB
Conflicting Flows: (vph)		1434
Potential Capacity: (pcph)		156
Major LT, Minor TH Impedance Factor:		0.57
Adjusted Impedance Factor:		0.57
Capacity Adjustment Factor due to Impeding Movements		0.57
Movement Capacity: (pcph)		90

Intersection Performance Summary

Movement	Flow Rate (pcph)	Move Cap (pcph)	Shared Cap (pcph)	Avg. Total Delay (sec/veh)	95% Queue Length (veh)	LOS	Approach Delay (sec/veh)
SB L	242	90 >	142	927.5	35.5	F	927.5
SB R	173	719 >					
EB L	206	799		6.1	1.1	B	1.4

Intersection Delay = 180.5 sec/veh

Worksheet for TWSC Intersection

Step 1: RT from Minor Street	NB	SB
Conflicting Flows: (vph)		360
Potential Capacity: (pcph)		910
Movement Capacity: (pcph)		910
Prob. of Queue-Free State:		0.86

Step 2: LT from Major Street	WB	EB
Conflicting Flows: (vph)		487
Potential Capacity: (pcph)		1005
Movement Capacity: (pcph)		1005
Prob. of Queue-Free State:		0.98
TH Saturation Flow Rate: (pcphpl)		1700
RT Saturation Flow Rate: (pcphpl)		
Major LT Shared Lane Prob. of Queue-Free State:		0.98

Step 4: LT from Minor Street	NB	SB
Conflicting Flows: (vph)		555
Potential Capacity: (pcph)		505
Major LT, Minor TH Impedance Factor:		0.98
Adjusted Impedance Factor:		0.98
Capacity Adjustment Factor due to Impeding Movements		0.98
Movement Capacity: (pcph)		494

Intersection Performance Summary

Movement	Flow Rate (pcph)	Move Cap (pcph)	Shared Cap (pcph)	Avg. Total Delay (sec/veh)	95% Queue Length (veh)	LOS	Approach Delay (sec/veh)
SB L	237	494 >					
			590	15.7	4.3	C	15.7
SB R	131	910 >					
EB L	20	1005		3.7	0.0	A	0.4

Intersection Delay = 5.2 sec/veh

Worksheet for TWSC Intersection

Step 1: RT from Minor Street	NB	SB
Conflicting Flows: (vph)	286	
Potential Capacity: (pcph)	992	
Movement Capacity: (pcph)	992	
Prob. of Queue-Free State:	1.00	

Step 2: LT from Major Street	WB	EB
Conflicting Flows: (vph)	378	
Potential Capacity: (pcph)	1132	
Movement Capacity: (pcph)	1132	
Prob. of Queue-Free State:	0.88	
TH Saturation Flow Rate: (pcphpl)	1700	
RT Saturation Flow Rate: (pcphpl)		
Major LT Shared Lane Prob. of Queue-Free State:	0.87	

Step 4: LT from Minor Street	NB	SB
Conflicting Flows: (vph)	638	
Potential Capacity: (pcph)	452	
Major LT, Minor TH Impedance Factor:	0.87	
Adjusted Impedance Factor:	0.87	
Capacity Adjustment Factor due to Impeding Movements	0.87	
Movement Capacity: (pcph)	391	

Intersection Performance Summary

Movement	Flow Rate (pcph)	Move Cap (pcph)	Shared Cap (pcph)	Avg. Total Delay (sec/veh)	95% Queue Length (veh)	LOS	Approach Delay (sec/veh)
NB L	50	391		10.6	0.4	C	10.4
NB R	1	992		3.6	0.0	A	
WB L	131	1132		3.6	0.4	A	1.2

Intersection Delay = 1.2 sec/veh

Worksheet for TWSC Intersection

Step 1: RT from Minor Street	NB	SB
Conflicting Flows: (vph)		646
Potential Capacity: (pcph)		652
Movement Capacity: (pcph)		652
Prob. of Queue-Free State:		0.70

Step 2: LT from Major Street	WB	EB
Conflicting Flows: (vph)		650
Potential Capacity: (pcph)		840
Movement Capacity: (pcph)		840
Prob. of Queue-Free State:		0.95
TH Saturation Flow Rate: (pcphpl)		1700
RT Saturation Flow Rate: (pcphpl)		
Major LT Shared Lane Prob. of Queue-Free State:		0.90

Step 4: LT from Minor Street	NB	SB
Conflicting Flows: (vph)		1510
Potential Capacity: (pcph)		141
Major LT, Minor TH Impedance Factor:		0.90
Adjusted Impedance Factor:		0.90
Capacity Adjustment Factor due to Impeding Movements		0.90
Movement Capacity: (pcph)		127

Intersection Performance Summary

Movement	Flow Rate (pcph)	Move Cap (pcph)	Shared Cap (pcph)	Avg. Total Delay (sec/veh)	95% Queue Length (veh)	LOS	Approach Delay (sec/veh)
SB L	164	127 >					
			226	320.3	20.4	F	320.3
SB R	196	652 >					
EB L	42	840		4.5	0.0	A	0.2

Intersection Delay = 57.0 sec/veh

Worksheet for TWSC Intersection

Step 1: RT from Minor Street	NB	SB
Conflicting Flows: (vph)	692	
Potential Capacity: (pcph)	618	
Movement Capacity: (pcph)	618	
Prob. of Queue-Free State:	0.71	

Step 2: LT from Major Street	WB	EB
Conflicting Flows: (vph)	701	
Potential Capacity: (pcph)	794	
Movement Capacity: (pcph)	794	
Prob. of Queue-Free State:	0.63	

Step 4: LT from Minor Street	NB	SB
Conflicting Flows: (vph)	1494	
Potential Capacity: (pcph)	144	
Major LT, Minor TH Impedance Factor:	0.63	
Adjusted Impedance Factor:	0.63	
Capacity Adjustment Factor due to Impeding Movements	0.63	
Movement Capacity: (pcph)	90	

Intersection Performance Summary

Movement	Flow Rate (pcph)	Move Cap (pcph)	Shared Cap (pcph)	Avg. Total Delay (sec/veh)	95% Queue Length (veh)	LOS	Approach Delay (sec/veh)
NB L	8	90 >					
			493	11.6	1.8	C	11.6
NB R	177	618 >					
WB L	295	794		7.2	1.9	B	2.6

Intersection Delay = 2.4 sec/veh

Fay, Spofford & Thorndike, Inc.
20 Park Plaza
Suite 920
Boston, MA 02116-
Ph: (617) 426-8666

Streets: (N-S) SILVER STREET (E-W) ROUTE 139
Major Street Direction.... EW
Length of Time Analyzed... 15 (min)
Analyst................... MJH
Date of Analysis.......... 11/11/97
Other Information.........2007 WEEKDAY PM PEAK HOUR ALT 1 w/ EB LEFT TURN LANE
Two-way Stop-controlled Intersection

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	1	1	0	0	1 <	0	0	0	0	1	0	1
Stop/Yield			N			N						
Volumes	253	769			639	43				97		220
PHF	.98	.98			.98	.98				.98		.98
Grade		0			0						0	
MC's (%)	0											
SU/RV's (%)	2											
CV's (%)	1											
PCE's	1.02									1.10		1.10

Adjustment Factors

Vehicle Maneuver	Critical Gap (tg)	Follow-up Time (tf)
Left Turn Major Road	5.00	2.10
Right Turn Minor Road	5.50	2.60
Through Traffic Minor Road	6.00	3.30
Left Turn Minor Road	*6.50	3.40

Fay, Spofford & Thorndike, Inc.
20 Park Plaza
Suite 920
Boston, MA 02116-
Ph: (617) 426-8666

Streets: (N-S) CENTER ST (SB)   (E-W) ROUTE 139
Major Street Direction.... EW
Length of Time Analyzed... 15 (min)
Analyst................... MJH
Date of Analysis.......... 11/11/97
Other Information.........2007 WEEKDAY PM PEAK HOUR ALT 1
Two-way Stop-controlled Intersection

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	1	1	0	0	1 <	0	0	0	0	1	0	1
Stop/Yield			N			N						
Volumes	36	725			631	228				268		90
PHF	.9	.9			.9	.9				.9		.9
Grade		0			0						0	
MC's (%)	0											
SU/RV's (%)	3											
CV's (%)	1											
PCE's	1.02									1.10		1.10

Adjustment Factors

Vehicle Maneuver	Critical Gap (tg)	Follow-up Time (tf)
Left Turn Major Road	5.00	2.10
Right Turn Minor Road	5.50	2.60
Through Traffic Minor Road	6.00	3.30
Left Turn Minor Road	6.50	3.40

Fay, Spofford & Thorndike, Inc.
20 Park Plaza
Suite 920
Boston, MA 02116-
Ph: (617) 426-8666

Streets: (N-S) center st (E-W) Route 139
Major Street Direction.... EW
Length of Time Analyzed... 15 (min)
Analyst................... glh
Date of Analysis.......... 12/17/97
Other Information.........2007 PM PEAK HOUR ALTERNATIVE 1/20
Two-way Stop-controlled Intersection

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	0	1	< 0	1	1	0	0	> 0	< 0	0	0	0
Stop/Yield			N			N						
Volumes		616	15	260	462		6		145			
PHF		.9	.9	.9	.9		.9		.9			
Grade		0			0			0				
MC's (%)												
SU/RV's (%)												
CV's (%)												
PCE's				1.10			1.10		1.10			

Adjustment Factors

Vehicle Maneuver	Critical Gap (tg)	Follow-up Time (tf)
Left Turn Major Road	5.00	2.10
Right Turn Minor Road	5.50	2.60
Through Traffic Minor Road	6.00	3.30
Left Turn Minor Road	6.50	3.40

```
HCM: SIGNALIZED INTERSECTION SUMMARY   Version 2.4e        01-13-1998
                   Fay, Spofford & Thorndike, Inc.
=======================================================================
Streets: (E-W) ROUTE 139                   (N-S) CENTER ST SB
Analyst: MJH                               File Name: H4PMA1B.HC9
Area Type: Other                           12-16-97 PM
Comment: 2007 PM PEAK HOUR ALTERNATIVE 1 (SIGNIZED-LT & TH LANES SB)
=======================================================================
             |  Eastbound    |  Westbound    |  Northbound   |  Southbound   |
             | L    T    R   | L    T    R   | L    T    R   | L    T    R   |
             | ---- ---- ----| ---- ---- ----| ---- ---- ----| ---- ---- ----|
No. Lanes    |  1    1    0  |  0    1  < 0  |  0    0    0  |  1    0    1  |
Volumes      |   36  725     |      631  228 |               |  268       90 |
PHF or PK15  | 0.90 0.90     |     0.90 0.90 |               | 0.90      0.90|
Lane W (ft)  | 12.0 12.0     |     12.0      |               | 12.0      12.0|
Grade        |        0      |        0      |               |         0     |
% Heavy Veh  |    1    1     |        1    1 |               |    0        0 |
Parking      | N         N   | N         N   |               | N         N   |
Bus Stops    |             0 |             0 |               |             0 |
Con. Peds    |             0 |             0 |             0 |             0 |
Ped Button   | (Y/N) N       | (Y/N) N       |               | (Y/N) N       |
Arr Type     |    3    3     |        3      |               |    3        3 |
RTOR Vols    |             0 |             0 |               |             0 |
Lost Time    | 3.00 3.00     |     3.00 3.00 |               | 3.00      3.00|
Prop. Share  |               |               |               |               |
Prop. Prot.  |               |               |               |               |
-----------------------------------------------------------------------
                          Signal Operations
Phase Combination 1    2    3    4 |                5    6    7    8
EB  Left          *                |NB  Left
    Thru          *                |    Thru
    Right                          |    Right
    Peds                           |    Peds
WB  Left                           |SB  Left        *
    Thru          *                |    Thru
    Right         *                |    Right       *
    Peds                           |    Peds
NB  Right                          |EB  Right
SB  Right                          |WB  Right
Green           38.0A              |Green     14.0A
Yellow/AR        4.0               |Yellow/AR 4.0
Cycle Length:   60 secs  Phase combination order: #1 #5
-----------------------------------------------------------------------
                    Intersection Performance Summary
     Lane  Group:   Adj Sat    v/c     g/C                  Approach:
     Mvmts   Cap     Flow     Ratio   Ratio    Delay  LOS   Delay  LOS
     -----  ----   -------   -----   -----    -----  ---   -----  ---
EB   L       125      193    0.319   0.650      3.5   A      5.0   A
     T      1223     1881    0.659   0.650      5.1   B
WB   TR     1057     1626    0.903   0.650     13.5   B     13.5   B
SB   L       451     1805    0.660   0.250     15.5   C     14.6   B
     R       404     1615    0.248   0.250     11.7   B
                Intersection Delay =   10.4 sec/veh Intersection LOS = B
Lost Time/Cycle, L =     6.0 sec   Critical v/c(x)     = 0.835
-----------------------------------------------------------------------
```

Streets: (E-W) ROUTE 139 (N-S) CENTER ST SB
Analyst: MJH File Name: H4PMA2.HC9
Area Type: Other 12-16-97 PM
Comment: 2007 PM PEAK HOUR ALTERNATIVE 1 (SIGNIZATION)

Volume Adjustment Worksheet

Direction/ Mvt	Mvt Vol	PHF	Adj Vol	Lane Grp	Lane Grp Vol	No. Ln	Lane Util Fact	Growth Fact	Adj Grp Vol	Prop LT	Prop RT
EB											
Left	36	0.90	40	L	40	1	1.000	1.000	40	1.00	0.00
Thru	725	0.90	806	T	806	1	1.000	1.000	806	0.00	0.00
WB											
Thru	631	0.90	701	TR	954	1	1.000	1.000	954	0.00	0.27
Right	228	0.90	253								
SB											
Left	268	0.90	298	L	298	1	1.000	1.000	298	1.00	0.00
Right	90	0.90	100	R	100	1	1.000	1.000	100	0.00	1.00

Saturation Flow Adjustment Worksheet

Direction /LnGrp	Ideal Sat Flow	No. Lns	f W	f HV	f G	f p	f BB	f A	f RT	f LT	Adj Sat Flow
EB											
L	1900	1	1.00	0.99	1.00	1.00	1.00	1.00	1.00	0.09	175
T	1900	1	1.00	0.99	1.00	1.00	1.00	1.00	1.00	1.00	1881
WB											
TR	1900	1	1.00	0.99	1.00	1.00	1.00	1.00	0.86	1.00	1626
SB											
L	1900	1	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.95	1805
R	1900	1	1.00	1.00	1.00	1.00	1.00	1.00	0.85	1.00	1615

HCS: Signalized Intersection Version 2.4e 01-16-1998 4

Streets: (E-W) ROUTE 139 (N-S) CENTER ST SB
Analyst: MJH File Name: H4PMA2.HC9
Area Type: Other 12-16-97 PM
Comment: 2007 PM PEAK HOUR ALTERNATIVE 1 (SIGNIZATION)

Capacity Analysis Worksheet

Direction /LnGrp	Adj Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	Lane Group Capacity (c)	v/c Ratio	
EB							
L	40	175	0.229	0.717	125	0.319	
T	806	1881	0.428	0.717	1348	0.598	
WB							
TR	954	1626	0.587	0.717	1165	0.819	*
NB							
SB							
L	298	1805	0.165	0.183	331	0.901	*
R	100	1615	0.062	0.183	296	0.338	

Sum (v/s) critical = 0.752
Lost Time/Cycle, L = 6.0 sec Critical v/c(x) = 0.835

Level of Service Worksheet

Direction /LnGrp	v/c Ratio	g/C Ratio	Delay d 1	Del Adj Fact	Lane Group Cap	Calib d 2	Delay d 2	Lane Grp Del	Lane Grp LOS	Delay By App	LOS By App
EB											
L	0.319	0.717	2.4	0.850	125	16	0.5	2.5	A	3.2	A
T	0.598	0.717	3.2	0.850	1348	16	0.5	3.3	A		
WB											
TR	0.819	0.717	4.4	0.850	1165	16	3.3	7.1	B	7.1	B
NB											
SB											
L	0.901	0.183	18.2	0.850	331	16	18.5	34.0	D	29.0	D
R	0.338	0.183	16.2	0.850	296	16	0.3	14.0	B		

Intersection Delay = 9.6 sec/veh Intersection LOS = B

Streets: (E-W) ROUTE 139 (N-S) CENTER ST SB
Analyst: MJH File Name: H4PMA1B.HC9
Area Type: Other 12-16-97 PM
Comment: 2007 PM PEAK HOUR ALTERNATIVE 1 (SIGNIZED-LT & TH LANES SB)

Volume Adjustment Worksheet

Direction/ Mvt	Mvt Vol	PHF	Adj Vol	Lane Grp	Lane Grp Vol	No. Ln	Lane Util Fact	Growth Fact	Adj Grp Vol	Prop LT	Prop RT
EB											
Left	36	0.90	40	L	40	1	1.000	1.000	40	1.00	0.00
Thru	725	0.90	806	T	806	1	1.000	1.000	806	0.00	0.00
WB											
Thru	631	0.90	701	TR	954	1	1.000	1.000	954	0.00	0.27
Right	228	0.90	253								
SB											
Left	268	0.90	298	L	298	1	1.000	1.000	298	1.00	0.00
Right	90	0.90	100	R	100	1	1.000	1.000	100	0.00	1.00

Saturation Flow Adjustment Worksheet

Direction /LnGrp	Ideal Sat Flow	No. Lns	f W	f HV	f G	f p	f BB	f A	f RT	f LT	Adj Sat Flow
EB											
L	1900	1	1.00	0.99	1.00	1.00	1.00	1.00	1.00	0.10	193
T	1900	1	1.00	0.99	1.00	1.00	1.00	1.00	1.00	1.00	1881
WB											
TR	1900	1	1.00	0.99	1.00	1.00	1.00	1.00	0.86	1.00	1626
SB											
L	1900	1	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.95	1805
R	1900	1	1.00	1.00	1.00	1.00	1.00	1.00	0.85	1.00	1615

flt=[fm+0.91(N-1)]/N	0.12

APPROACH	NB
Cycle Length, C	80
Actual Green Time for Lane Group, G	28
Effective Green Time for Lane Group, g	29
Opposing Effective Green Time, go	29
Number of Opposing Lanes, No	1
Number of Lanes in Lane Group, N	1
Adjusted Left-Turn Flow Rate, Vlt	7
Proportion of Left Turns in Lane Group, Plt	0.04
Left Turns per Cycle: LTC=Vlt*C/3600	0.16
Adjusted Opposing Flow Rate, Vo	100
Opposing Flow per Lane, Per Cycle: Volc=VoC/3600No	2.22
Opposing Platoon Ratio, Rpo	1
Lost time per phase, tl	3
gf=Gexp(-0.860*LTC^0.629)-tl	18.44
Opposing Queue Ratio: qro=1-Rpo(go/C)	0.64
gq = Volc * qro / (.5 - Volc * (1 - qro) / go)-tl	0.00
gu=g-gq (or g-gf)	10.56
fs=(875-0.625Vo)/1000	0.81
Pl=Plt[1+{(N-1)g/(fs*gu+4.5)}]	0.04
El1	1.63
fmin	0.07
fm,(min=fmin;max=1.00)	0.99
flt=[fm+0.91(N-1)]/N	0.99

APPROACH	SB
Cycle Length, C	80
Actual Green Time for Lane Group, G	28
Effective Green Time for Lane Group, g	29
Opposing Effective Green Time, go	29
Number of Lanes in Lane Group, N	1
Proportion of Left Turns in Lane Group, Plt	1.00
Proportion of Left Turns in Opposing Flow, Plto	0.04
Adjusted Left-Turn Flow Rate, Vlt	298
Left Turns per Cycle: LTC=Vlt*C/3600	6.62
Adjusted Opposing Flow Rate, Vo	168
Opposing Flow per Lane, Per Cycle: Volc=VoC/3600No	3.73
Opposing Platoon Ratio, Rpo	1
Lost time per phase, tl	3
gf=Gexp(-0.882*LTC^0.717)-tl	0.00
Opposing Queue Ratio: qro=1-Rpo(go/C)	0.64
gq=4.943volc^0.762*qro^1.061-tl	5.37
gu=g-gq (or g-gf)	23.63
n=(gq-gf)/2	2.68
Ptho=1-Plto	0.96
El2	2.59
El1	1.68
fmin=2(1+Pl)/g	0.14
flt=[fm+0.91(N-1)]/N	0.56

MassHighway
QUEUE LENGTH ANALYSIS
SIDRA Model by R. Akcelik   Version 2.0

PROJECT: Hanover
LOCATION: 139/Center
SCENARIO: 2007 PM
FILE: Hanov2
DATE: January 15, 1998

INPUT PARAMETERS

Cycle Length =	75 sec.
Vehicle Spacing =	25(ft.)
Units : English (E) Metric (M) =	E

Approach	qe Ln Grp Vol (vph)	L Number Lanes	PHF Peak Hr. Factor	S Saturation Flow	Qe Capacity (vph)	Flow Ratio (qe/S)	Ge Eff. Green (sec.)	Unbunched Lane Factor
EB LT	8	1	0.900	221	94	0.040	31.9	0.998
EB TH/RT	693	1	0.900	1,874	875	0.411	35.0	0.825
WB LT	240	1	0.900	1,989	336	0.134	12.7	0.936
WB TH/RT	715	1	0.900	1,781	1,092	0.446	46.0	0.820
NB LTR	168	1	0.900	1,499	543	0.125	27.2	0.954
SB LT	298	1	0.900	1,057	383	0.313	27.2	0.921
SB TH/RT	100	1	0.900	1,755	636	0.063	27.2	0.973
	0	1	1.000	1,900	0	0.000	ERR	1.000
	0	1	1.000	1,900	0	0.000	ERR	1.000
	0	1	1.000	1,900	0	0.000	ERR	1.000
	0	1	1.000	1,900	0	0.000	ERR	1.000
	0	1	1.000	1,900	0	0.000	ERR	1.000

Hanover - 139/Center - 2007 PM   January 15,

Approach	Eq. Xo	Eq. X	Eq. No (veh.)	Eq. Nu (veh.)	Max. Back Nb (veh.)	95th% Queue (veh.)	Average Q Len./Lane (ft.)	95th% Q Len./Lane (ft.)
EB LT	0.458	0.095	0.000	0.11	0.11	0.26	3	6
EB TH/RT	0.715	0.880	0.718	15.17	15.89	26.05	397	651
WB LT	0.590	0.794	0.512	5.41	5.92	11.55	148	289
WB TH/RT	0.747	0.728	0.000	12.14	12.14	20.96	303	524
NB LTR	0.650	0.344	0.000	2.88	2.88	6.06	72	152
SB LT	0.606	0.865	0.919	6.63	7.55	14.19	189	355
SB TH/RT	0.671	0.175	0.000	1.59	1.59	3.48	40	87
	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR
	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR
	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR
	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR
	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR

Streets: (E-W) ROUTE 139 (N-S) CENTER ST SB
Analyst: MJH File Name: H4PMA2C.HC9
Area Type: Other 12-16-97 PM
Comment: 2007 PM PEAK HOUR ALTERNATIVE 2 (SIGNALIZATION-MINIMUM)

Volume Adjustment Worksheet

Direction/ Mvt	Mvt Vol	PHF	Adj Vol	Lane Grp	Lane Grp Vol	No. Ln	Lane Util Fact	Growth Fact	Adj Grp Vol	Prop LT	Prop RT
EB											
Left	7	0.90	8	L	8	1	1.000	1.000	8	1.00	0.00
Thru	608	0.90	676	TR	693	1	1.000	1.000	693	0.00	0.02
Right	15	0.90	17								
WB											
Left	216	0.90	240	L	240	1	1.000	1.000	240	1.00	0.00
Thru	416	0.90	462	TR	715	1	1.000	1.000	715	0.00	0.35
Right	228	0.90	253								
NB											
Left	6	0.90	7								
Thru	29	0.90	32	LTR	168	1	1.000	1.000	168	0.04	0.77
Right	116	0.90	129								
SB											
Left	268	0.90	298	L	298	1	1.000	1.000	298	1.00	0.00
Thru	44	0.90	49	TR	100	1	1.000	1.000	100	0.00	0.51
Right	46	0.90	51								

Saturation Flow Adjustment Worksheet

Direction /LnGrp	Ideal Sat Flow	No. Lns	f_W	f_{HV}	f_G	f_p	f_{BB}	f_A	f_{RT}	f_{LT}	Adj Sat Flow
EB											
L	1900	1	1.00	0.99	1.00	1.00	1.00	1.00	1.00	0.11	215
TR	1900	1	1.00	0.99	1.00	1.00	1.00	1.00	1.00	1.00	1874
WB										0.11	213
L	1900	1	1.00	0.98	1.00	1.00	1.00	1.00	1.00	0.95	1770
TR	1900	1	1.00	0.99	1.00	1.00	1.00	1.00	0.95	1.00	1781
NB											
LTR	1900	1	1.00	1.00	1.00	1.00	1.00	1.00	0.80	0.99	1498
SB											
L	1900	1	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.54	1022
TR	1900	1	1.00	1.00	1.00	1.00	1.00	1.00	0.92	1.00	1755

Streets: (E-W) ROUTE 139 (N-S) CENTER ST SB
Analyst: MJH File Name: H4PMA2C.HC9
Area Type: Other 12-16-97 PM
Comment: 2007 PM PEAK HOUR ALTERNATIVE 2 (SIGNALIZATION-MINIMUM)

Capacity Analysis Worksheet

Direction /LnGrp		Adj Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	Lane Group Capacity (c)	v/c Ratio	
EB								
	L	8	215	0.037	0.467	100	0.080	
	TR	693	1874	0.370	0.467	875	0.792	
WB	Lsec.	99	213	0.465	0.467	99	1.000	*
	Lpri.	141	1770	0.080	0.147	260	0.543	*
	Ltot.	240				359	0.669	
	TR	715	1781	0.401	0.613	1092	0.655	
NB								
	LTR	168	1498	0.112	0.307	459	0.366	
SB								
	L	298	1022	0.292	0.307	313	0.951	*
	TR	100	1755	0.057	0.307	538	0.186	

Sum (v/s) critical = 0.836
Lost Time/Cycle, L = 6.0 sec Critical v/c(x) = 0.909

Level of Service Worksheet

Direction /LnGrp		v/c Ratio	g/C Ratio	Delay d 1	Del Adj Fact	Lane Group Cap	Calib d 2	Delay d 2	Lane Grp Del	Lane Grp LOS	Delay By App	LOS By App
EB												
	L	0.080	0.467	8.4	0.850	100	16	0.0	7.2	B	14.4	B
	TR	0.792	0.467	12.9	0.850	875	16	3.5	14.5	B		
WB												
	L	0.669	0.613	19.6	0.850	359	16	3.3	19.9	C	10.3	B
	TR	0.655	0.613	7.1	0.850	1092	16	1.0	7.1	B		
NB												
	LTR	0.366	0.307	15.4	0.850	459	16	0.2	13.3	B	13.3	B
SB												
	L	0.951	0.307	19.3	0.850	313	16	27.6	44.1	E	36.1	D
	TR	0.186	0.307	14.5	0.850	538	16	0.0	12.4	B		

Intersection Delay = 16.4 sec/veh Intersection LOS = C

HCS: Signalized Intersection Version 2.4e 01-15-1998 5

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Streets: (E-W) ROUTE 139 (N-S) CENTER ST SB
Analyst: MJH File Name: H4PMA2C.HC9
Area Type: Other 12-16-97 PM
Comment: 2007 PM PEAK HOUR ALTERNATIVE 2 (SIGNALIZATION-MINIMUM)

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Supplemental Uniform Delay Worksheet

Approach	Westbound
Adj. LT Vol (v)	240
v/c ratio (x)	0.67
Primary phase effective green	11.00
gq from Supplemental LT Worksheet	22.04
gu from Supplemental LT Worksheet	12.96
Red time (r)	29.00
Arrivals qa = v/(3600(max(x,1)))	0.07
Primary Ph. Departures Sp=s/3600	0.49
Secondary Ph. Departures Ss=S(Gq+Gu)/(Gu*3600)	0.16
Xperm	2.06
XProt	N/A
Case	5
Queue at begining of green arrow (Qa)	2.20
Queue at beginning of unsaturated green (Qu)	3.40
Residual queue (Qr)	0.00
Uniform Delay	19.58

HCS: Signalized Intersection Version 2.4e 01-15-1998 1

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Boston, MA 02116 (617) 426-8666

Streets: (E-W) ROUTE 139 (N-S) CENTER ST SB
Analyst: MJH File Name: H4PMA2A.HC9
Area Type: Other 12-16-97 PM
Comment: 2007 PM PEAK HOUR ALTERNATIVE 2 (SIGNALIZATION-MINIMUM)

Traffic and Roadway Conditions

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	1	1 <	0	1	1 <	0	0 >	1 <	0	1	1 <	0
Volumes	7	608	15	216	416	228	6	29	116	268	44	46
PHF or PK15	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
Lane W (ft)	12.0	12.0		12.0	12.0			12.0		12.0	12.0	
Grade		0			0			0			0	
% Heavy Veh	1	1	2	2	1	1	0	0	0	0	0	0
Parking	N	N		N	N		N	N		N	N	
Bus Stops			0			0			0			0
Con. Peds			0			0			0			0
Ped Button	(Y/N)	N		(Y/N)	N		(Y/N)	N		(Y/N)	N	
Arr Type	3	3		3	3			3		3	3	
RTOR Vols			0			0			0			0
Lost Time	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00

Signal Operations

Phase Combination		1	2	3	4
EB	Left	*			
	Thru	*			
	Right	*			
	Peds				
WB	Left	*	*		
	Thru	*	*		
	Right	*	*		
	Peds				
NB	Right				
SB	Right				
Green		33.0A	7.0A		
Yellow/AR		4.0	4.0		

		5	6	7	8
NB	Left	*			
	Thru	*			
	Right	*			
	Peds				
SB	Left	*			
	Thru	*			
	Right	*			
	Peds				
EB	Right				
WB	Right				
Green		28.0A			
Yellow/AR		4.0			

Cycle Length: 80 secs Phase combination order: #2 #1 #5

```
HCS:  Signalized Intersection    Version 2.4e            01-15-1998  3
========================================================================
Streets: (E-W) ROUTE 139                 (N-S) CENTER ST SB
Analyst: MJH                             File Name: H4PMA2A.HC9
Area Type: Other                         12-16-97 PM
Comment: 2007 PM PEAK HOUR ALTERNATIVE 2 (SIGNALIZATION-MINIMUM)
========================================================================
Supplemental Permitted LT Worksheet

  APPROACH                                                EB
Cycle Length, C                                            80
Actual Green Time for Lane Group, G                        33
Effective Green Time for Lane Group, g                     34
Opposing Effective Green Time, go                          45
Number of Opposing Lanes, No                               1
Number of Lanes in Lane Group, N                           1
Adjusted Left-Turn Flow Rate, Vlt                          8
Proportion of Left Turns in Lane Group, Plt                 1.00
Left Turns per Cycle: LTC=Vlt*C/3600                        0.18
Adjusted Opposing Flow Rate, Vo                            715
Opposing Flow per Lane, Per Cycle: Volc=VoC/3600No         15.89
Opposing Platoon Ratio, Rpo                                1
Lost time per phase, tl                                    3
gf=Gexp(-0.882*LTC^0.717)-tl                                0.00
Opposing Queue Ratio: qro=1-Rpo(go/C)                       0.44
gq = Volc * qro / (.5 - Volc * (1 - qro) / go)-tl          20.06
gu=g-gq (or g-gf)                                          13.94
fs=(875-0.625Vo)/1000                                       0.43
Pl=Plt[1+{(N-1)g/(fs*gu+4.5)}]                              1.00
El1                                                         8.20
fmin                                                        0.12
fm,(min=fmin;max=1.00)                                      0.12
flt=[fm+0.91(N-1)]/N                                        0.12

  APPROACH                                                WB
Cycle Length, C                                            80
Actual Green Time for Lane Group, G                        44
Effective Green Time for Lane Group, g                     34
Opposing Effective Green Time, go                          34
Number of Opposing Lanes, No                               1
Number of Lanes in Lane Group, N                           1
Adjusted Left-Turn Flow Rate, Vlt                          240
Proportion of Left Turns in Lane Group, Plt                 1.00
Left Turns per Cycle: LTC=Vlt*C/3600                        5.33
Adjusted Opposing Flow Rate, Vo                            693
Opposing Flow per Lane, Per Cycle: Volc=VoC/3600No         15.40
Opposing Platoon Ratio, Rpo                                1
Lost time per phase, tl                                    3
gf=Gexp(-0.882*LTC^0.717)-tl                                0.00
Opposing Queue Ratio: qro=1-Rpo(go/C)                       0.57
gq = Volc * qro / (.5 - Volc * (1 - qro) / go)-tl          25.80
gu=g-gq (or g-gf)                                           8.20
fs=(875-0.625Vo)/1000                                       0.44
Pl=Plt[1+{(N-1)g/(fs*gu+4.5)}]                              1.00
El1                                                         8.20
fmin                                                        0.12
fm,(min=fmin;max=1.00)                                      0.12
```

HCS: Signalized Intersection Version 2.4e 01-15-1998 5

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Streets: (E-W) ROUTE 139 (N-S) CENTER ST SB

Analyst: MJH File Name: H4PMA2A.HC9

Area Type: Other 12-16-97 PM

Comment: 2007 PM PEAK HOUR ALTERNATIVE 2 (SIGNALIZATION-MINIMUM)

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Supplemental Uniform Delay Worksheet

Approach	Westbound
Adj. LT Vol (v)	240
v/c ratio (x)	0.71
Primary phase effective green	11.00
gq from Supplemental LT Worksheet	25.80
gu from Supplemental LT Worksheet	8.20
Red time (r)	35.00
Arrivals qa = v/(3600(max(x,1)))	0.07
Primary Ph. Departures Sp=s/3600	0.49
Secondary Ph. Departures Ss=S(Gq+Gu)/(Gu*3600)	0.25
Xperm	2.22
XProt	N/A
Case	5
Queue at begining of green arrow (Qa)	2.53
Queue at beginning of unsaturated green (Qu)	4.05
Residual queue (Qr)	0.00
Uniform Delay	22.48

Streets: (E-W) ROUTE 139 (N-S) CENTER ST SB
Analyst: MJH File Name: H4PMA3B.HC9
Area Type: Other 12-16-97 PM
Comment: 2007 PM PEAK HOUR ALTERNATIVE 3

Volume Adjustment Worksheet

Direction/ Mvt	Mvt Vol	PHF	Adj Vol	Lane Grp	Lane Grp Vol	No. Ln	Lane Util Fact	Growth Fact	Adj Grp Vol	Prop LT	Prop RT
EB											
Thru	761	0.90	846	T	846	1	1.000	1.000	846	0.00	0.00
WB											
Thru	564	0.90	627	T	627	1	1.000	1.000	627	0.00	0.00
SB											
Left	364	0.90	404	L	404	1	1.000	1.000	404	1.00	0.00
Right	311	0.90	346	R	346	1	1.000	1.000	346	0.00	1.00

Saturation Flow Adjustment Worksheet

Direction /LnGrp	Ideal Sat Flow	No. Lns	f W	f HV	f G	f p	f BB	f A	f RT	f LT	Adj Sat Flow
EB											
T	1900	1	1.00	0.99	1.00	1.00	1.00	1.00	1.00	1.00	1881
WB											
T	1900	1	1.00	0.99	1.00	1.00	1.00	1.00	1.00	1.00	1881
SB											
L	1900	1	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.95	1805
R	1900	1	1.00	1.00	1.00	1.00	1.00	1.00	0.85	1.00	1615

MassHighway
QUEUE LENGTH ANALYSIS
SIDRA Model by R. Akcelik Version 2.0

PROJECT: Hanover
LOCATION: 139/Center
SCENARIO: 2007 PM
FILE: Hanover3
DATE: January 15, 1998

INPUT PARAMETERS

Cycle Length =	60 sec.
Vehicle Spacing =	25 (ft.)
Units : English (E) Metric (M) =	E

Approach	qe Ln Grp Vol (vph)	L Number Lanes	PHF Peak Hr. Factor	S Saturation Flow	Qe Capacity (vph)	Flow Ratio (qe/S)	Ge Eff. Green (sec.)	Unbunched Lane Factor
EB TH	846	1	0.900	1,881	1,223	0.500	39.0	0.791
WB TH	627	1	0.900	1,881	1,223	0.370	39.0	0.840
SB LT	404	1	0.900	1,805	451	0.249	15.0	0.894
SB RT	346	1	0.900	1,615	404	0.238	15.0	0.908
	0	1	0.900	0	0	ERR	ERR	1.000
	0	1	0.900	0	0	ERR	ERR	1.000
	0	1	0.900	0	0	ERR	ERR	1.000
	0	1	1.000	1,900	0	0.000	ERR	1.000
	0	1	1.000	1,900	0	0.000	ERR	1.000
	0	1	1.000	1,900	0	0.000	ERR	1.000
	0	1	1.000	1,900	0	0.000	ERR	1.000
	0	1	1.000	1,900	0	0.000	ERR	1.000

Hanover - 139/Center - 2007 PM January 15,

Approach	Eq. Xo	Eq. X	Eq. No (veh.)	Eq. Nu (veh.)	Max. Back Nb (veh.)	95th% Queue (veh.)	Average Q Len./Lane (ft.)	95th% Q Len./Lane (ft.)
EB TH	0.731	0.769	0.089	11.54	11.63	20.25	291	506
WB TH	0.731	0.570	0.000	6.72	6.72	12.87	168	322
SB LT	0.599	0.995	3.377	7.67	11.05	19.43	276	486
SB RT	0.586	0.952	2.192	6.47	8.66	15.92	217	398
	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR
0	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR
0	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR
	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR
	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR
	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR
	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR
	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR

HCS: Signalized Intersection Version 2.4e 01-15-1998 1

Fay, Spofford & Thorndike, Inc.
20 Park Plaza
Suite 920
Boston, MA 02116 (617) 426-8666

Streets: (E-W) ROUTE 139 (N-S) CENTER ST SB
Analyst: MJH File Name: H4PMA3.HC9
Area Type: Other 12-16-97 PM
Comment: 2007 PM PEAK HOUR ALTERNATIVE 3

Traffic and Roadway Conditions

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	0	1	0	0	1	0	0	0	0	1	0	1
Volumes		761			564					364		311
PHF or PK15		0.90			0.90					0.90		0.90
Lane W (ft)		12.0			12.0					12.0		12.0
Grade		0			0						0	
% Heavy Veh		1			1					0		0
Parking	N	N		N	N					N	N	
Bus Stops			0			0						0
Con. Peds			0			0			0			0
Ped Button	(Y/N)	N		(Y/N)	N					(Y/N)	N	
Arr Type		3			3					3		3
RTOR Vols			0			0						0
Lost Time		3.00			3.00					3.00		3.00

Signal Operations

Phase Combination		1	2	3	4
EB	Left	*			
	Thru	*			
	Right				
	Peds				
WB	Left				
	Thru	*			
	Right	*			
	Peds				
NB	Right				
SB	Right				
Green		34.0A			
Yellow/AR		4.0			

		5	6	7	8
NB	Left				
	Thru				
	Right				
	Peds				
SB	Left	*			
	Thru				
	Right	*			
	Peds				
EB	Right				
WB	Right				
Green		18.0A			
Yellow/AR		4.0			

Cycle Length: 60 secs Phase combination order: #1 #5

HCS: Signalized Intersection Version 2.4e 01-15-1998 3

Streets: (E-W) ROUTE 139 (N-S) CENTER ST SB
Analyst: MJH File Name: H4PMA3.HC9
Area Type: Other 12-16-97 PM
Comment: 2007 PM PEAK HOUR ALTERNATIVE 3

Capacity Analysis Worksheet

Direction /LnGrp	Adj Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	Lane Group Capacity (c)	v/c Ratio
EB						
T	846	1881	0.450	0.583	1097	0.771 *
WB						
T	627	1881	0.333	0.583	1097	0.571
NB						
SB						
L	404	1805	0.224	0.317	572	0.707 *
R	346	1615	0.214	0.317	511	0.677

Sum (v/s) critical = 0.674
Lost Time/Cycle, L = 6.0 sec Critical v/c(x) = 0.748

Level of Service Worksheet

Direction /LnGrp	v/c Ratio	g/C Ratio	Delay d 1	Del Adj Fact	Lane Group Cap	Calib d 2	Delay d 2	Lane Grp Del	Lane Grp LOS	Delay By App	LOS By App
EB											
T	0.771	0.583	7.2	0.850	1097	16	2.4	8.5	B	8.5	B
WB											
T	0.571	0.583	5.9	0.850	1097	16	0.5	5.6	B	5.6	B
NB											
SB											
L	0.707	0.317	13.7	0.850	572	16	2.8	14.4	B	14.2	B
R	0.677	0.317	13.5	0.850	511	16	2.5	14.0	B		

Intersection Delay = 9.6 sec/veh Intersection LOS = B

HCS: Signalized Intersection Version 2.4e 01-16-1998 1

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Streets: (E-W) ROUTE 139 (N-S) CENTER ST SB
Analyst: MJH File Name: H4PMA3D.HC9
Area Type: Other 12-16-97 PM
Comment: 2007 PM PEAK HOUR ALTERNATIVE 3

Traffic and Roadway Conditions

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	0	1	0	0	1	0	0	0	0	1	0	1
Volumes		761			564					364		311
PHF or PK15		0.90			0.90					0.90		0.90
Lane W (ft)		12.0			12.0					12.0		12.0
Grade		0			0						0	
% Heavy Veh		1			1					0		0
Parking	N	N		N	N					N	N	
Bus Stops			0			0						0
Con. Peds			0			0			0			0
Ped Button	(Y/N)	N		(Y/N)	N					(Y/N)	N	
Arr Type		3			3					3		3
RTOR Vols			0			0						0
Lost Time		3.00			3.00					3.00		3.00

Signal Operations

Phase Combination	1	2	3	4		5	6	7	8
EB Left	*				NB Left				
Thru	*				Thru				
Right					Right				
Peds					Peds				
WB Left					SB Left	*			
Thru	*				Thru				
Right	*				Right	*			
Peds					Peds				
NB Right					EB Right				
SB Right					WB Right				
Green	40.0A				Green	12.0A			
Yellow/AR	4.0				Yellow/AR	4.0			

Cycle Length: 60 secs Phase combination order: #1 #5

HCS: Signalized Intersection Version 2.4e 01-16-1998 3

Streets: (E-W) ROUTE 139 (N-S) CENTER ST SB
Analyst: MJH File Name: H4PMA3D.HC9
Area Type: Other 12-16-97 PM
Comment: 2007 PM PEAK HOUR ALTERNATIVE 3

Capacity Analysis Worksheet

Direction /LnGrp	Adj Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	Lane Group Capacity (c)	v/c Ratio
EB						
T	846	1881	0.450	0.683	1285	0.658 *
WB						
T	627	1881	0.333	0.683	1285	0.488
NB						
SB						
L	404	1805	0.224	0.217	391	1.033 *
R	346	1615	0.214	0.217	350	0.989

Sum (v/s) critical = 0.674
Lost Time/Cycle, L = 6.0 sec Critical v/c(x) = 0.748

Level of Service Worksheet

Direction /LnGrp	v/c Ratio	g/C Ratio	Delay d 1	Del Adj Fact	Lane Group Cap	Calib d 2	Delay d 2	Lane Grp Del	Lane Grp LOS	Delay By App	LOS By App
EB											
T	0.658	0.683	4.2	0.850	1285	16	0.9	4.4	A	4.4	A
WB											
T	0.488	0.683	3.4	0.850	1285	16	0.2	3.2	A	3.2	A
NB											
SB											
L	1.033	0.217	17.9	0.850	391	16	44.5	59.7	E	54.9	E
R	0.989	0.217	17.8	0.850	350	16	34.1	49.3	E		

Intersection Delay = 21.1 sec/veh Intersection LOS = C

Worksheet for TWSC Intersection

Step 2: LT from Major Street	WB	EB
Conflicting Flows: (vph)		696
Potential Capacity: (pcph)		799
Movement Capacity: (pcph)		799
Prob. of Queue-Free State:		0.67
TH Saturation Flow Rate: (pcphpl)		1700
RT Saturation Flow Rate: (pcphpl)		
Major LT Shared Lane Prob. of Queue-Free State:		0.31

Intersection Performance Summary

Movement	Flow Rate (pcph)	Move Cap (pcph)	Shared Cap (pcph)	Avg. Total Delay (sec/veh)	95% Queue Length (veh)	LOS	Approach Delay (sec/veh)
EB L	263	799		6.7	1.6	B	1.5

Intersection Delay = 0.9 sec/veh

Worksheet for TWSC Intersection

Step 1: RT from Minor Street	NB	SB
Conflicting Flows: (vph)		416
Potential Capacity: (pcph)		852
Movement Capacity: (pcph)		852
Prob. of Queue-Free State:		0.57

Intersection Performance Summary

Movement	Flow Rate (pcph)	Move Cap (pcph)	Shared Cap (pcph)	Avg. Total Delay (sec/veh)	95% Queue Length (veh)	LOS	Approach Delay (sec/veh)
SB R	367	852		7.4	2.3	B	7.4

Intersection Delay = 2.8 sec/veh

Worksheet for TWSC Intersection

Step 2: LT from Major Street	WB	EB
Conflicting Flows: (vph)		378
Potential Capacity: (pcph)		1132
Movement Capacity: (pcph)		1132
Prob. of Queue-Free State:		0.70

Intersection Performance Summary

Movement	Flow Rate (pcph)	Move Cap (pcph)	Shared Cap (pcph)	Avg. Total Delay (sec/veh)	95% Queue Length (veh)	LOS	Approach Delay (sec/veh)
EB L	337	1132		4.5	1.4	A	2.5

Intersection Delay = 1.5 sec/veh

HCS: Unsignalized Intersections Release 2.1e H5PMA3.HC0 Page 1

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Streets: (N-S) CENTER ST (NB) (E-W) ROUTE 139
Major Street Direction.... EW
Length of Time Analyzed... 15 (min)
Analyst................... MJH
Date of Analysis.......... 11/11/97
Other Information.........2007 WEEKDAY PM PEAK HOUR ALTERNATIVE 3
Two-way Stop-controlled Intersection

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	0	1 <	0	1	1	0	0 >	0 <	0	0	0	0
Stop/Yield			N			N						
Volumes		616	15	260	462		6		145			
PHF		.9	.9	.9	.9		.9		.9			
Grade		0			0			0				
MC's (%)				0								
SU/RV's (%)				3								
CV's (%)				1								
PCE's				1.02			1.10		1.10			

Adjustment Factors

Vehicle Maneuver	Critical Gap (tg)	Follow-up Time (tf)
Left Turn Major Road	5.00	2.10
Right Turn Minor Road	5.50	2.60
Through Traffic Minor Road	6.00	3.30
Left Turn Minor Road	6.50	3.40

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Ph: (617) 426-8666

Streets: (N-S) MAIN STREET (E-W) ROUTE 139
Major Street Direction.... EW
Length of Time Analyzed... 15 (min)
Analyst.................. MJH
Date of Analysis.......... 11/11/97
Other Information.........2007 WEEKDAY PM PEAK HOUR ALTERNATIVE 4
Two-way Stop-controlled Intersection

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	0	1	0	0	0	0	0	0	1	0	0	0
Stop/Yield			N			N						
Volumes		253							682			
PHF		.98							.98			
Grade		0						0				
MC's (%)												
SU/RV's (%)												
CV's (%)												
PCE's									1.10			

Adjustment Factors

Vehicle Maneuver	Critical Gap (tg)	Follow-up Time (tf)
Left Turn Major Road	5.00	2.10
Right Turn Minor Road	5.50	2.60
Through Traffic Minor Road	6.00	3.30
Left Turn Minor Road	6.50	3.40

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Boston, MA 02116-
Ph: (617) 426-8666

Streets: (N-S) SILVER ST (E-W) MAIN ST
Major Street Direction.... EW
Length of Time Analyzed... 15 (min)
Analyst.................. MJH
Date of Analysis.......... 12/17/97
Other Information.........2007 WEEKDAY PM PEAK HOUR ALTERNATIVE 4
Two-way Stop-controlled Intersection

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	0	0	0	0	1	0	0	0	0	0	0	1
Stop/Yield			N			N						
Volumes					675							317
PHF					.95							.95
Grade					0						0	
MC's (%)												
SU/RV's (%)												
CV's (%)												
PCE's												1.10

Adjustment Factors

Vehicle Maneuver	Critical Gap (tg)	Follow-up Time (tf)
Left Turn Major Road	5.00	2.10
Right Turn Minor Road	5.50	2.60
Through Traffic Minor Road	6.00	3.30
Left Turn Minor Road	6.50	3.40

Fay, Spofford & Thorndike, Inc.
20 Park Plaza
Suite 920
Boston, MA 02116-
Ph: (617) 426-8666

Streets: (N-S) CENTRAL ST (E-W) MAIN ST
Major Street Direction.... EW
Length of Time Analyzed... 15 (min)
Analyst................... MJH
Date of Analysis.......... 12/17/97
Other Information.........2007 WEEKDAY PM PEAK HOUR ALTERNATIVE 4
Two-way Stop-controlled Intersection

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	0	0	0	0	1	0	0	0	0	0	0	1
Stop/Yield			N			N						
Volumes					727							359
PHF					.95							.95
Grade		0			0			0			0	
MC's (%)												
SU/RV's (%)												
CV's (%)												
PCE's												1.10

Adjustment Factors

Vehicle Maneuver	Critical Gap (tg)	Follow-up Time (tf)
Left Turn Major Road	5.00	2.10
Right Turn Minor Road	5.50	2.60
Through Traffic Minor Road	6.00	3.30
Left Turn Minor Road	6.50	3.40

Fay, Spofford & Thorndike, Inc.
20 Park Plaza
Suite 920
Boston, MA 02116-
Ph: (617) 426-8666

Streets: (N-S) CENTER ST (SB) (E-W) ROUTE 139
Major Street Direction.... NS
Length of Time Analyzed... 15 (min)
Analyst................... MJH
Date of Analysis.......... 11/11/97
Other Information.........1997 WEEKDAY PM PEAK HOUR ALTERNATIVE 4
Two-way Stop-controlled Intersection

	Northbound			Southbound			Eastbound			Westbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	0	0	0	0	1	0	0	0	1	0	0	0
Stop/Yield			N			N						
Volumes					364				761			
PHF					.95				.95			
Grade		0						0				
MC's (%)												
SU/RV's (%)												
CV's (%)												
PCE's									1.10			

Adjustment Factors

Vehicle Maneuver	Critical Gap (tg)	Follow-up Time (tf)
Left Turn Major Road	5.00	2.10
Right Turn Minor Road	5.50	2.60
Through Traffic Minor Road	6.00	3.30
Left Turn Minor Road	6.50	3.40

HCS: Unsignalized Intersections   Release 2.1e   H4PMA4B.HC0   Page 1

Fay, Spofford & Thorndike, Inc.
20 Park Plaza
Suite 920
Boston, MA   02116-
Ph: (617) 426-8666

Streets: (N-S) CENTER ST (SB)   (E-W) ROUTE 139
Major Street Direction.... EW
Length of Time Analyzed... 15 (min)
Analyst................... MJH
Date of Analysis.......... 11/11/97
Other Information.........1997 WEEKDAY PM PEAK HOUR ALTERNATIVE 4
Two-way Stop-controlled Intersection

	Eastbound			Westbound			~~Northbound~~ SOUTHBOUND			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	0	1	0	0	0	0	0	0	1	0	0	0
Stop/Yield			N			N						
Volumes		761							364			
PHF		.95							.95			
Grade		0						0				
MC's (%)												
SU/RV's (%)												
CV's (%)												
PCE's									1.10			

Adjustment Factors

Vehicle Maneuver	Critical Gap (tg)	Follow-up Time (tf)
Left Turn Major Road	5.00	2.10
Right Turn Minor Road	5.50	2.60
Through Traffic Minor Road	6.00	3.30
Left Turn Minor Road	6.50	3.40

Fay, Spofford & Thorndike, Inc.
20 Park Plaza
Suite 920
Boston, MA 02116-
Ph: (617) 426-8666

Streets: (N-S) ROUTE 139 (E-W) Main Street
Major Street Direction.... NS
Length of Time Analyzed... 15 (min)
Analyst................... glh
Date of Analysis.......... 1/15/98
Other Information......... 2007 WEEKDAY PM PEAK HOUR ALTERNATIVE 4 /Rte. 139 Mainline
Two-way Stop-controlled Intersection

	Northbound			Southbound			Eastbound			Westbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	0	1	0	0	0	0	1	0	0	0	0	0
Stop/Yield			N			N						
Volumes		682					253					
PHF		.95					.95					
Grade		0						0				
MC's (%)												
SU/RV's (%)												
CV's (%)												
PCE's							1.10					

Adjustment Factors

Vehicle Maneuver	Critical Gap (tg)	Follow-up Time (tf)
Left Turn Major Road	5.00	2.10
Right Turn Minor Road	5.50	2.60
Through Traffic Minor Road	6.00	3.30
Left Turn Minor Road	6.50	3.40

Hanover Town Center
1993-1995
Reported Accident Data

Case #	Type	Date	Hour	#Veh.	#Inj.	#Kill.	Veh. Dir.	Manner	Light	Weather	Surface	Major Street	Minor Street
2074563	Prop	1/23/93	16	2	0	0	E S	Angle	Daylight	Clear	No_Defects	MAIN	RTE 139
2085182	Inju	2/8/93	13	2	1	0	W W	Rear_end	Daylight	Clear	No_Defects	CENTER ST	RT 139
2125234	Inju	4/23/93	21	1	2	0	N	Unknown	Darkness	Clear	No_Defects	CENTER ST	MAIN ST
2164828	Inju	7/12/93	9	2	1	0	E E	Rear_end	Daylight	Clear	No_Defects	CENTER ST EXT	HANOVER ST RT 139
2197445	Prop	9/21/93	8	2	0	0	W E	Angle	Daylight	Clear	No_Defects	MAINE SILVER	
2240851	Prop	12/2/93	19	2	0	0	E W	Angle	Darkness	Clear	No_Defects	MAIN ST.	RTE. 139
2289831	Prop	2/15/94	20	2	0	0	W S	Angle	Darkness	Cloud	No_Defects	HANOVER ST	MAIN ST
2343848	Prop	5/22/94	12	2	0	0	W W	Rear_end	Daylight	Clear	No_Defects	CENTER ST	139
2336840	Prop	5/24/94	16	2	0	0	E W	Angle	Daylight	Clear	No_Defects	MAIN ST. RT. 139	
2347193	Inju	6/4/94	14	2	1	0	S W	Angle	Daylight	Clear	No_Defects	HANOVER ST	MAIN ST
2344342	Prop	6/11/94	10	3	0	0	W W	Rear_end	Daylight	Clear	No_Defects	CENTER	HANOVER ST
2353619	Prop	6/29/94	13	2	0	0	N E	Angle	Daylight	Cloud	No_Defects	CENTER ST	RT 139 HANOVER ST
2362141	Prop	7/15/94	18	2	0	0	E E	Rear_end	Daylight	Cloud	No_Defects	CENTER ST.	HANOVER ST.
2378316	Prop	8/19/94	13	2	0	0	N S	Angle	Daylight	Cloud	No_Defects	CENTER ST	RT 139
2405417	Prop	10/11/94	14	3	0	0	N N	Rear_end	Daylight	Clear	No_Defects	CENTRE STREET	MAIN STREET
2429526	Prop	11/19/94	14	2	0	0	S W	Angle	Daylight	Clear	No_Defects	HANOVER ST	MAIN ST
2463939	Prop	1/30/95	17	2	0	0		Unknown	Not_Spec	Other	Unknown	MAIN ST	RT 133
2497581	Prop	4/5/95	16	2	0	0	W W	Rear_end	Daylight	Clear	No_Defects	CENTER ST.	HAMOVER ST./RTE.
2502849	Prop	4/19/95	15	2	0	0	W W	Angle	Daylight	Rain	No_Defects	CENTER ST.	RTE. 139
2522095	Prop	4/28/95	21	2	0	0	N S	Angle	Not_Spec	Cloud	No_Defects	CENTER ST	MAIN ST
2565013	Prop	7/20/95	9	2	0	0	E N	Angle	Daylight	Clear	No_Defects	CENTER ST	HANOVER ST
2559925	Inju	8/7/95	24	1	1	0	N	Unknown	Daylight	Clear	No_Defects	CEMETERY	CENTRAL/MAIN STS
2555444	Inju	7/28/95	12	2	3	0		Angle	Daylight	Clear	No_Defects	RTE 139 MAIN ST	SILVER ST
2570011	Inju	8/18/95	18	2	1	0	W E	Angle	Not_Spec	Clear	No_Defects	HANOVER ST RT 139	MAIN ST
2607480	Prop	11/7/95	18	2	0	0		Angle	Darkness	Rain	No_Defects	HANOVER ST	MAIN ST

CITY/TOWN Hanover, Massachusetts
INTERSECTION Main Street at Hanover Street
STUDY YEAR 1997

TRAFFIC SIGNAL WARRANTS (Cont.)

Warrant 8 - Combination of Warrants

Meets 80 % of Warrants 1 and 2. Yes X No ___

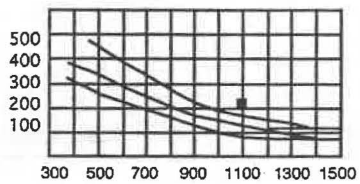
Satisfied? Yes X No __

Warrant 9 - Four Hour Volumes

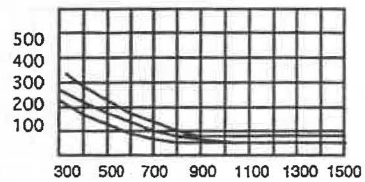
Meets plotted values:

Top Lines 2 lanes major & 2 lanes minor
Middle Lines 2 lanes major & 1 lane minor
Bottom Lines 1 lane major & 1 lane minor

GENERAL



LESS THAN 10,000 POPULATION OR 40+ MILES PER HOUR MAJOR STREET



Satisfied? Yes X No __

Warrant 10 - Peak Hour Delay

a) Exceeds 4 vehicle hours on one lane minor street approach
b) Exceeds 5 vehicle hours on two lane minor street approach

and 100 vehicles per hour for one lane; 150 vehicles per hour for two lanes.
and total entering volumes exceed 650 vehicles per hour for three approaches or 800 vehicles per hour for four approaches.

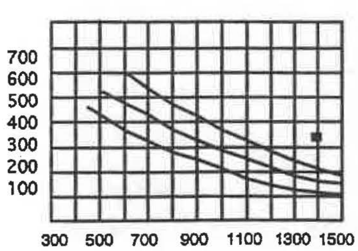
Satisfied? Yes X No __

Warrant 11 - Peak Hour Volume

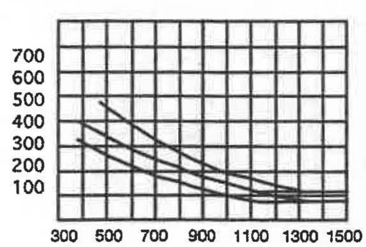
Meets plotted values:

Top Lines 2 lanes major & 2 lanes minor
Middle Lines 2 lanes major & 1 lane minor
Bottom Lines 1 lane major & 1 lane minor

GENERAL



LESS THAN 10,000 POPULATION OR 40+ MILES PER HOUR MAJOR STREET



Satisfied? Yes X No __

CITY/TOWN **Hanover, Massachusetts**
INTERSECTION **Center (NB) at Hanover Streets**
STUDY YEAR **1997**

TRAFFIC SIGNAL WARRANTS (Cont.)

Warrant 8 - Combination of Warrants

Meets 80 % of Warrants 1 and 2. Yes X No ____

Satisfied? Yes X No __

Warrant 9 - Four Hour Volumes

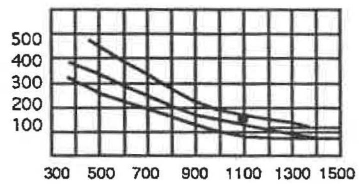
Meets plotted values:

Top Lines
2 lanes major &
2 lanes minor

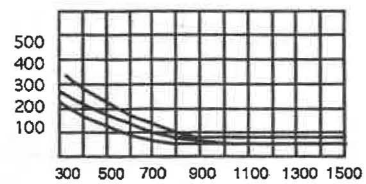
Middle Lines
2 lanes major &
1 lane minor

Bottom Lines
1 lane major &
1 lane minor

GENERAL



LESS THAN 10,000 POPULATION OR 40+ MILES PER HOUR MAJOR STREET



Satisfied? Yes X No __

Warrant 10 - Peak Hour Delay

a) Exceeds 4 vehicle hours on one lane minor street approach
b) Exceeds 5 vehicle hours on two lane minor street approach

and 100 vehicles per hour for one lane; 150 vehicles per hour for two lanes.
and total entering volumes exceed 650 vehicles per hour for three approaches or 800 vehicles per hour for four approaches.

Satisfied? Yes __ No X

Warrant 11 - Peak Hour Volume

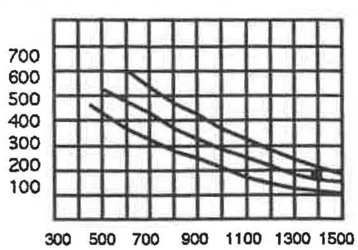
Meets plotted values:

Top Lines
2 lanes major &
2 lanes minor

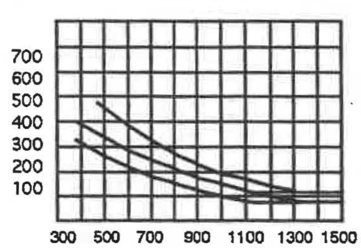
Middle Lines
2 lanes major &
1 lane minor

Bottom Lines
1 lane major &
1 lane minor

GENERAL



LESS THAN 10,000 POPULATION OR 40+ MILES PER HOUR MAJOR STREET

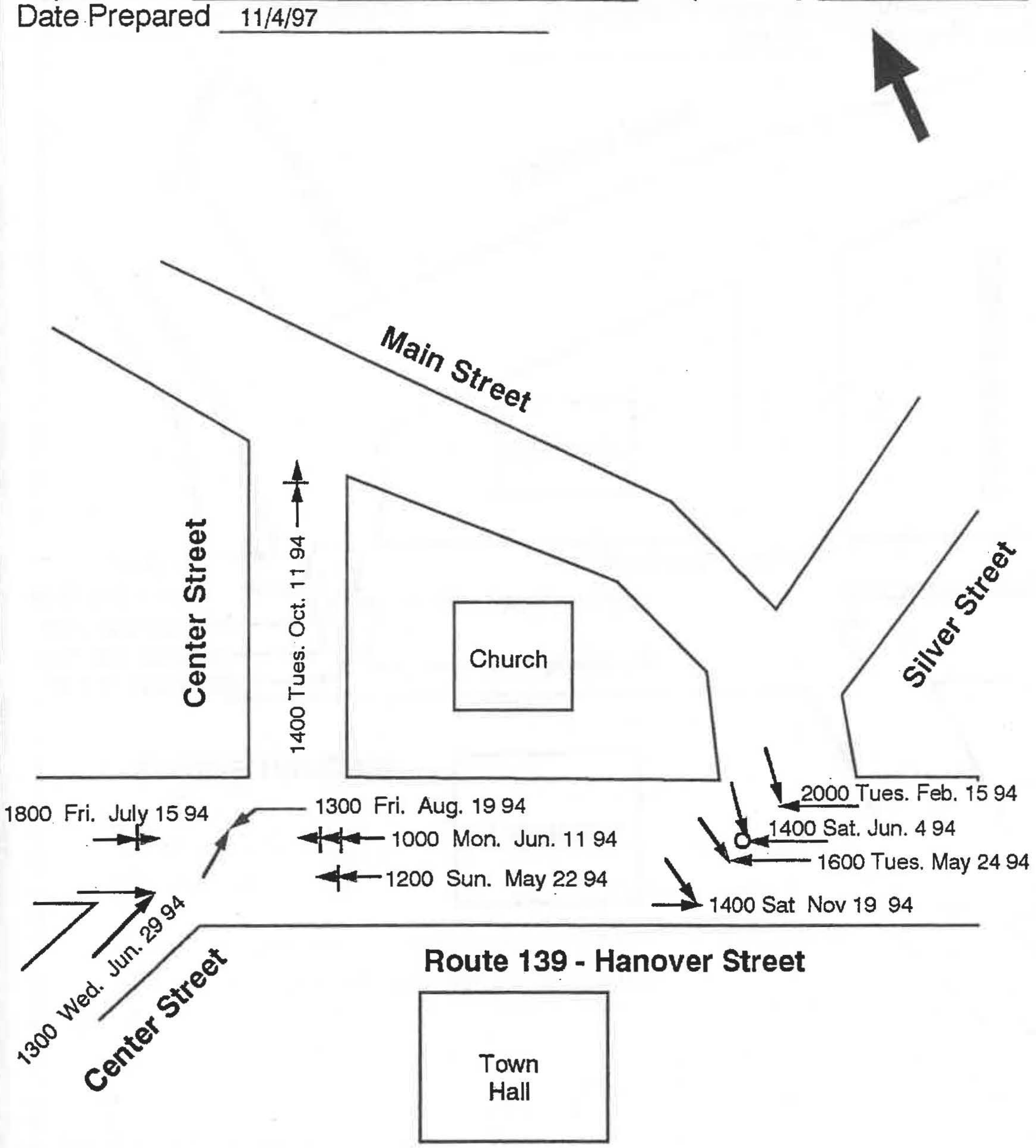


Satisfied? Yes X No __

Fay, Spofford & Thorndike, Inc.
Engineers • Planners • Scientists

Collision Diagram

Intersection: Town Center Streets and ____
Period: 1994 from 1/1/94 to 12/31/94
City or Town: Hanover, Massachusetts Prepared By: GLH
Date Prepared: 11/4/97



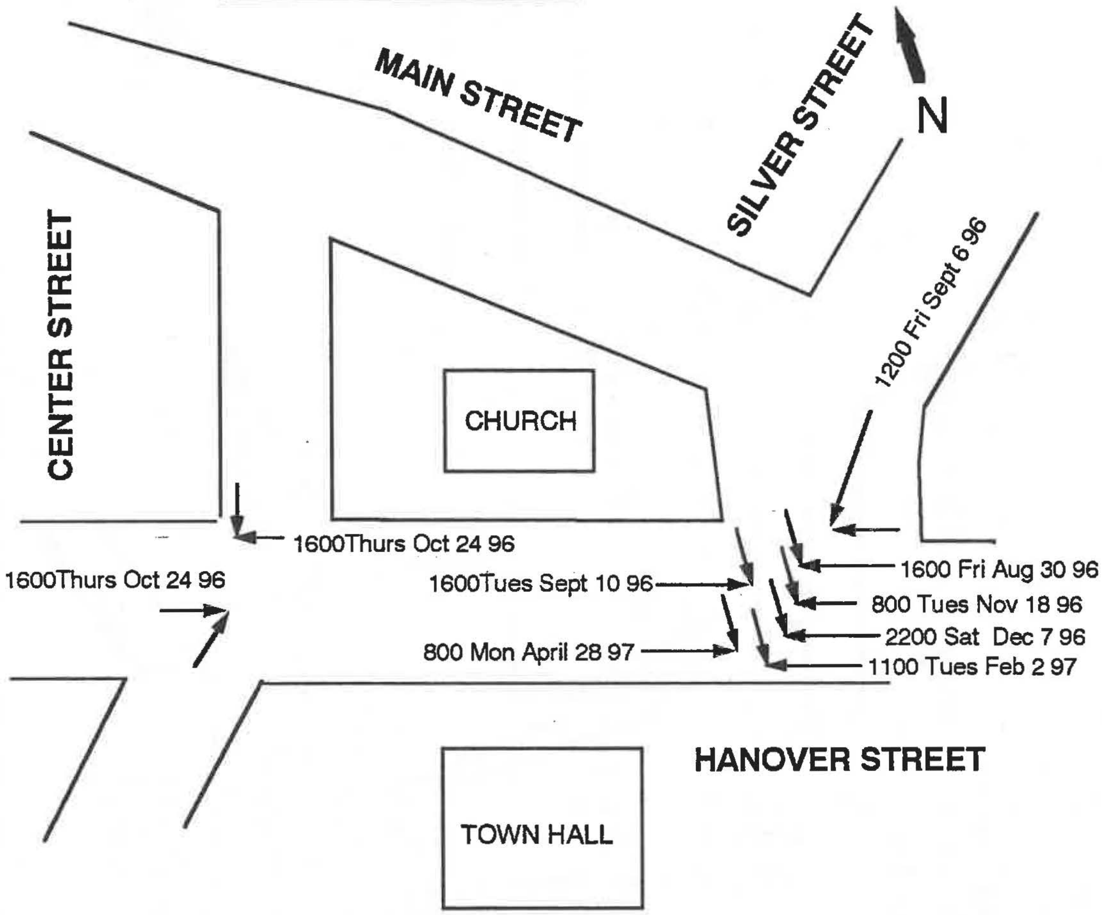
Schematic: NOT TO SCALE

Number of Accidents	Symbols	Types Of Collisions	Data For Each Accident
9 Property Damage Only 1 Injury 0 Fatal **10** TOTAL	Moving Vehicle Backing Vehicle Non-Involved Vehicle Pedestrian Parked Vehicle Fixed Object Fatal Accident Injury Accident	Rear End Head-on Side-swipe Out of Control Left Turn Right Angle	1. TIME, DAY, DATE 2. WEATHER AND ROAD SURFACE IF UNUSUAL

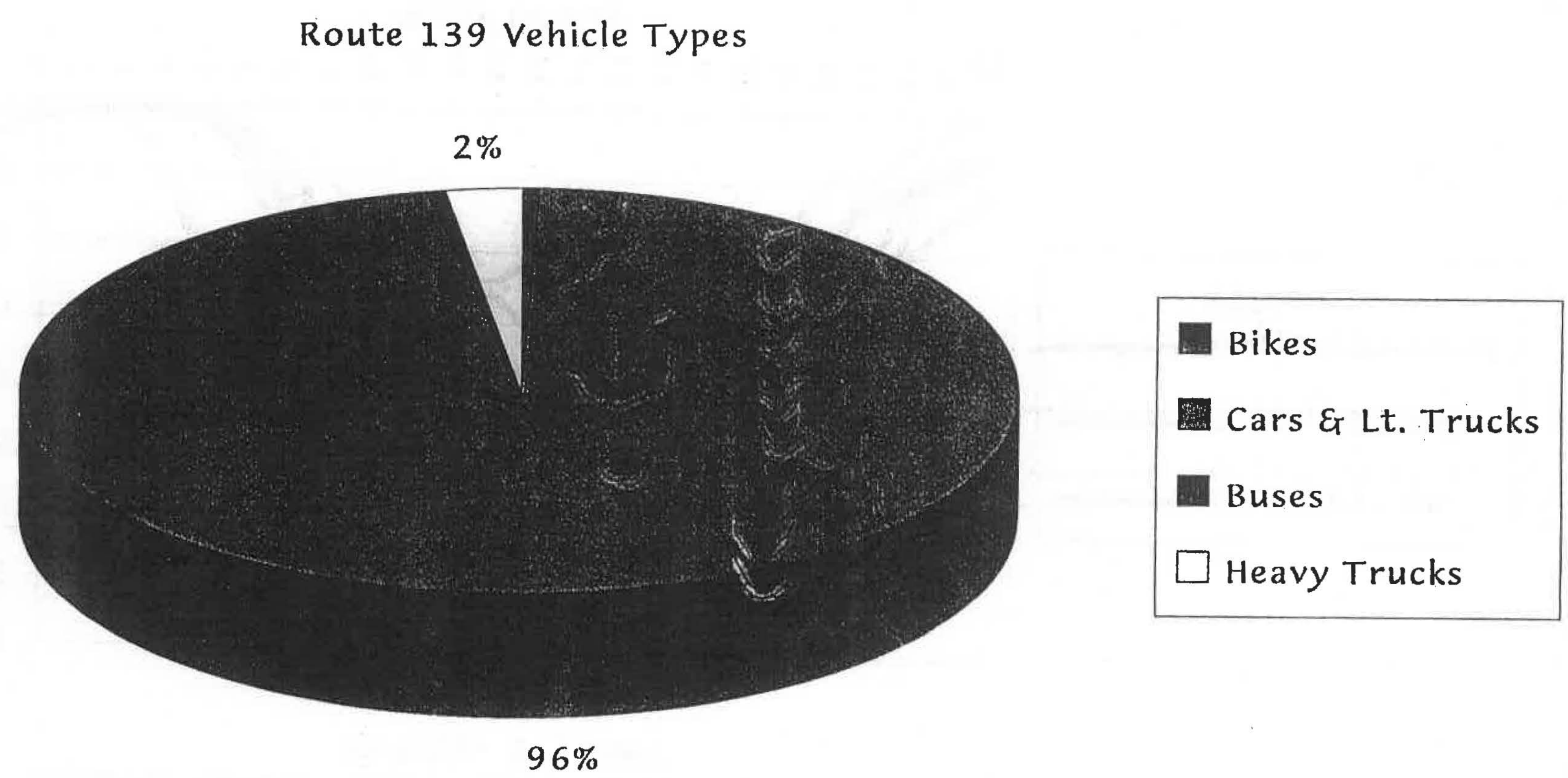
Fay, Spofford & Thorndike, Inc.
Engineers • Planners • Scientists

Collision Diagram

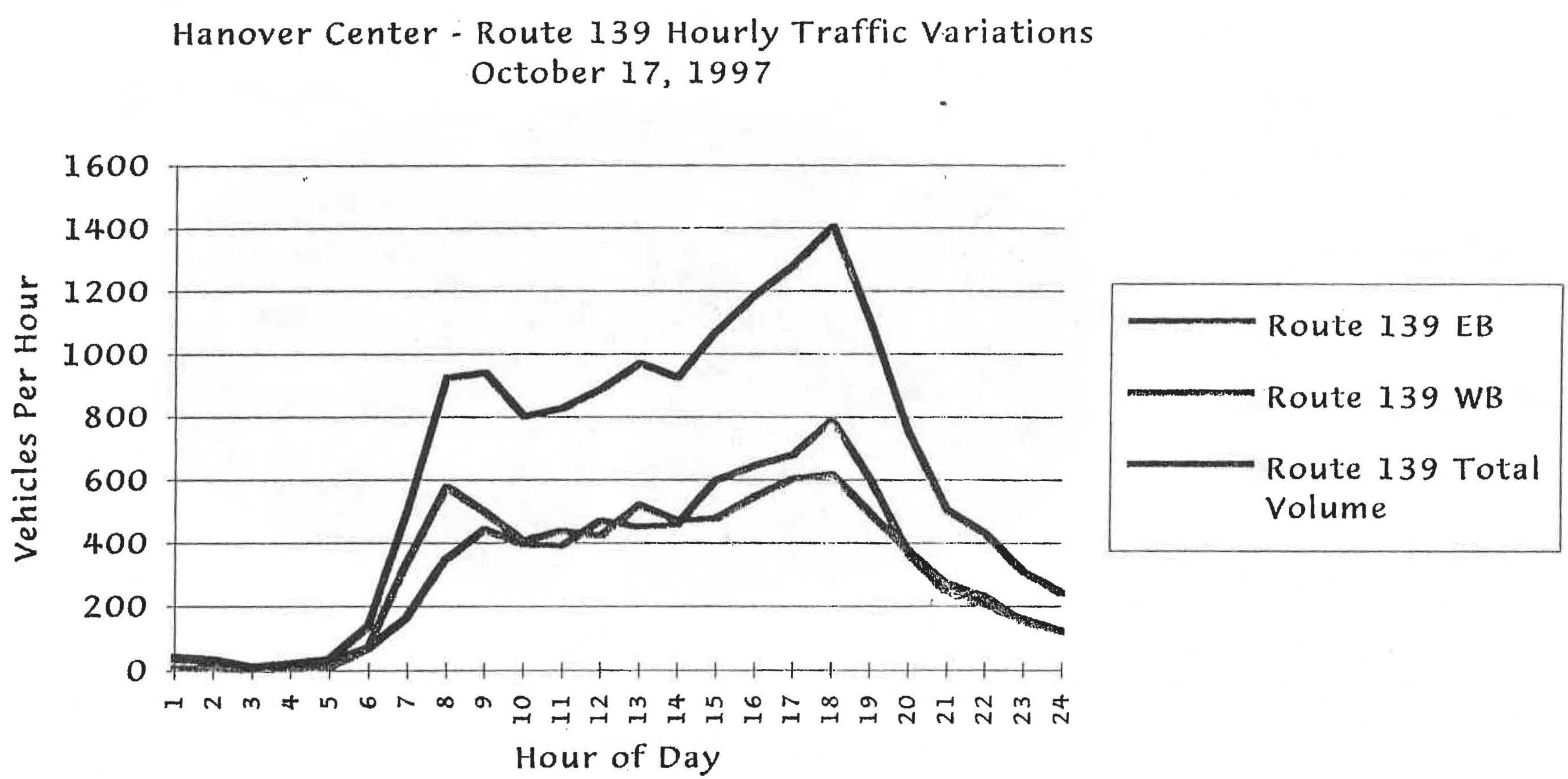
Intersection: Hanover Town Center and ____
Period: 1 year from 6/1/96 to 5/30/97
City or Town: Hanover, Massachusetts Prepared By: GLH
Date Prepared: 11/16/97



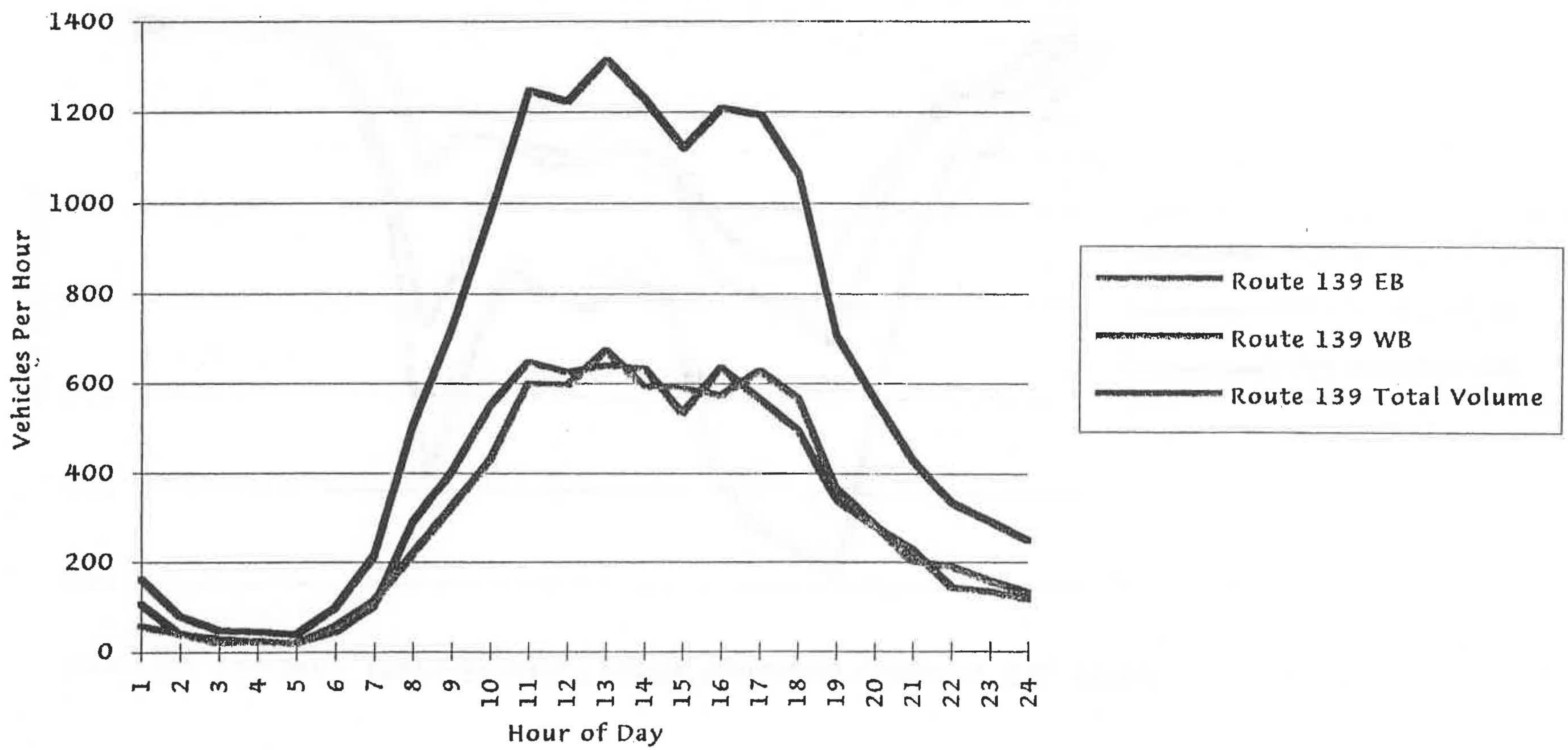
Number of Accidents	Symbols	Types Of Collisions	Data For Each Accident
9 Property Damage Only ___ Injury ___ Fatal 9 TOTAL	Moving Vehicle Backing Vehicle Non-Involved Vehicle Pedestrian Parked Vehicle Fixed Object Fatal Accident Injury Accident	Rear End Head-on Side-swipe Out of Control Left Turn Right Angle	1. TIME, DAY, DATE 2. WEATHER AND ROAD SURFACE IF UNUSUAL



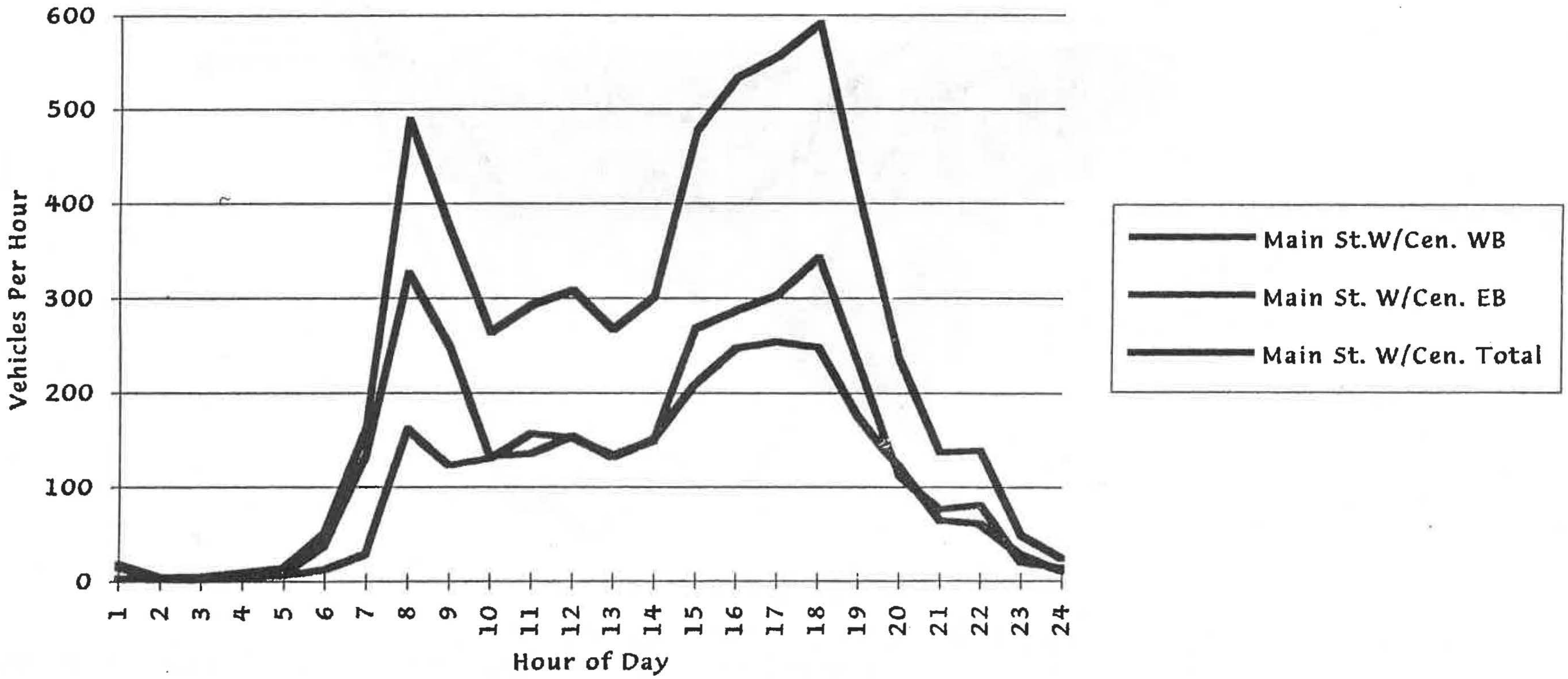
Route 139 Vehicle Types
2%
96%
Bikes
Cars & Lt. Trucks
Buses
Heavy Trucks


Hanover Center - Route 139 Hourly Traffic Variations
October 17, 1997
Vehicles Per Hour
1600
1400
1200
1000
800
600
400
200
0
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24
Hour of Day
Route 139 EB
Route 139 WB
Route 139 Total Volume

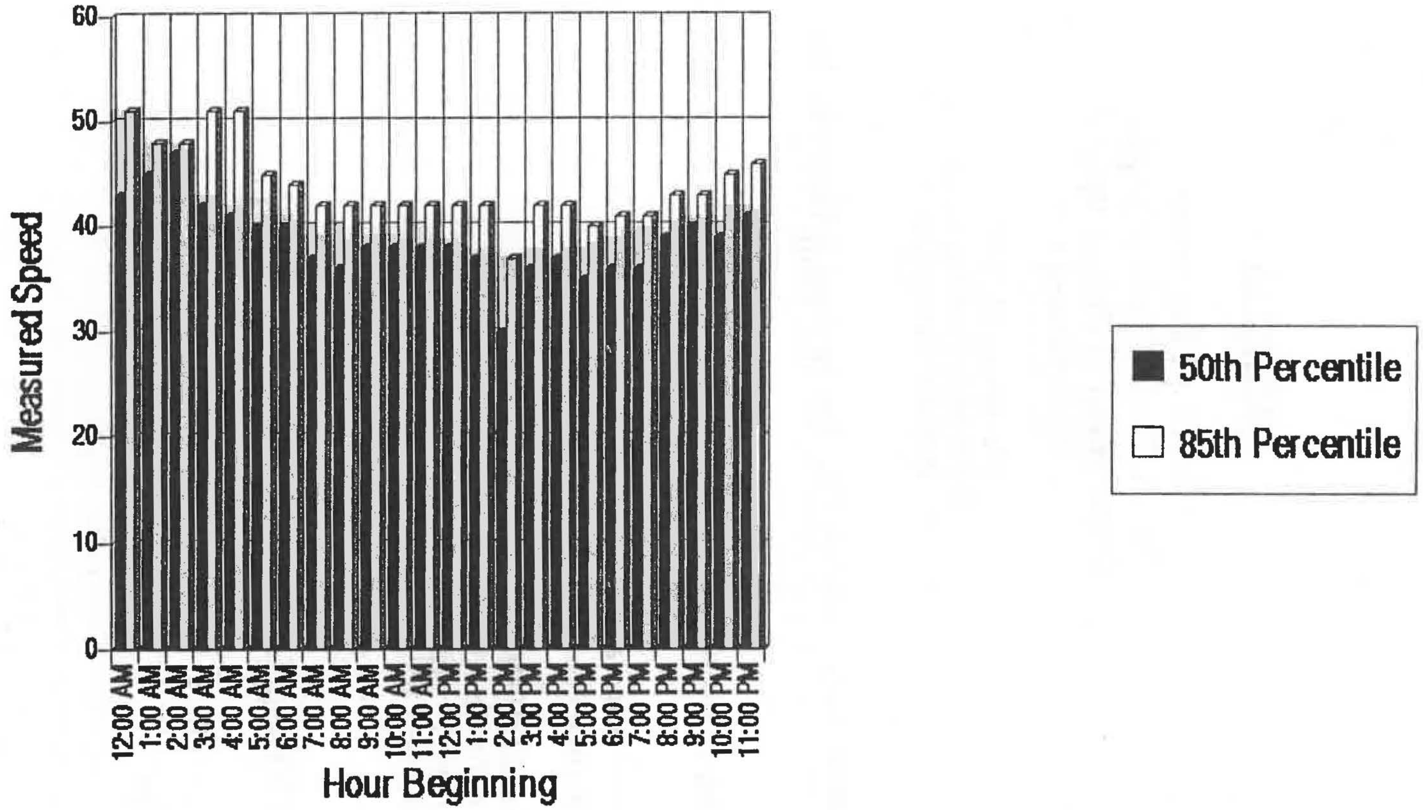
Hanover Center - Route 139 Traffic Volumes Saturday October 18, 1997



Hanover Center - Main Street Traffic Volumes October 16, 1997



Hanover Town Center WB Route 139 Speeds Friday, October 17, 1997



AGENDA

Town of Hanover
Town Center Traffic Study
Department of Public Works
Public Meeting 1

November 12, 1997
7:30 PM Main Hearing Room
Hanover Town Hall

Introduction - Gary L. Hebert, P.E., Fay, Spofford & Thorndike, Inc.

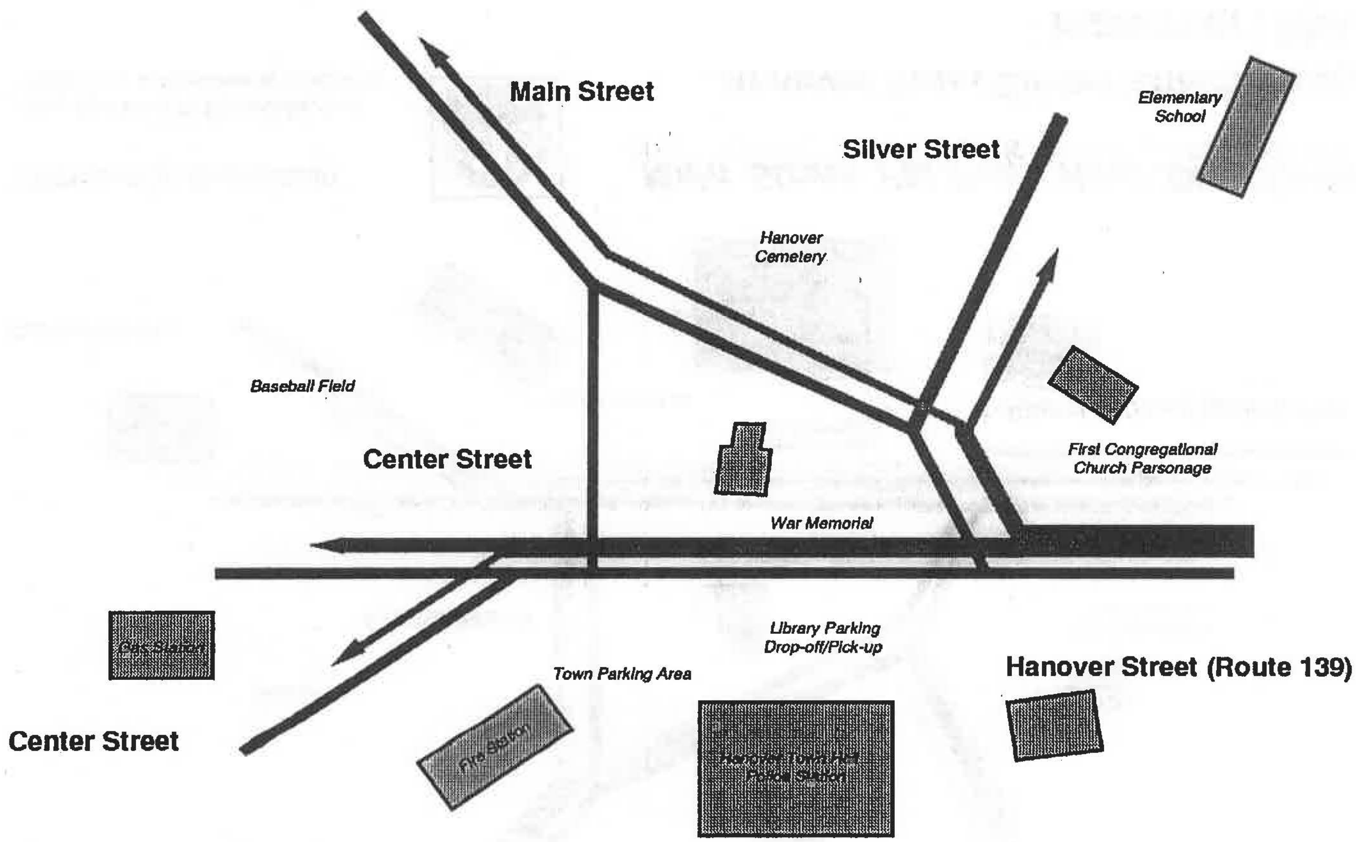
Discussion of Study Objectives and Expectations

Data Collection Findings

Automatic Traffic Recorder Counts
Traffic Observations - Weekday Vs. Saturday
Manual Traffic Counts
Accident Analysis (1993-95)

Informal Discussion of Alternatives To Be Considered

Next Steps



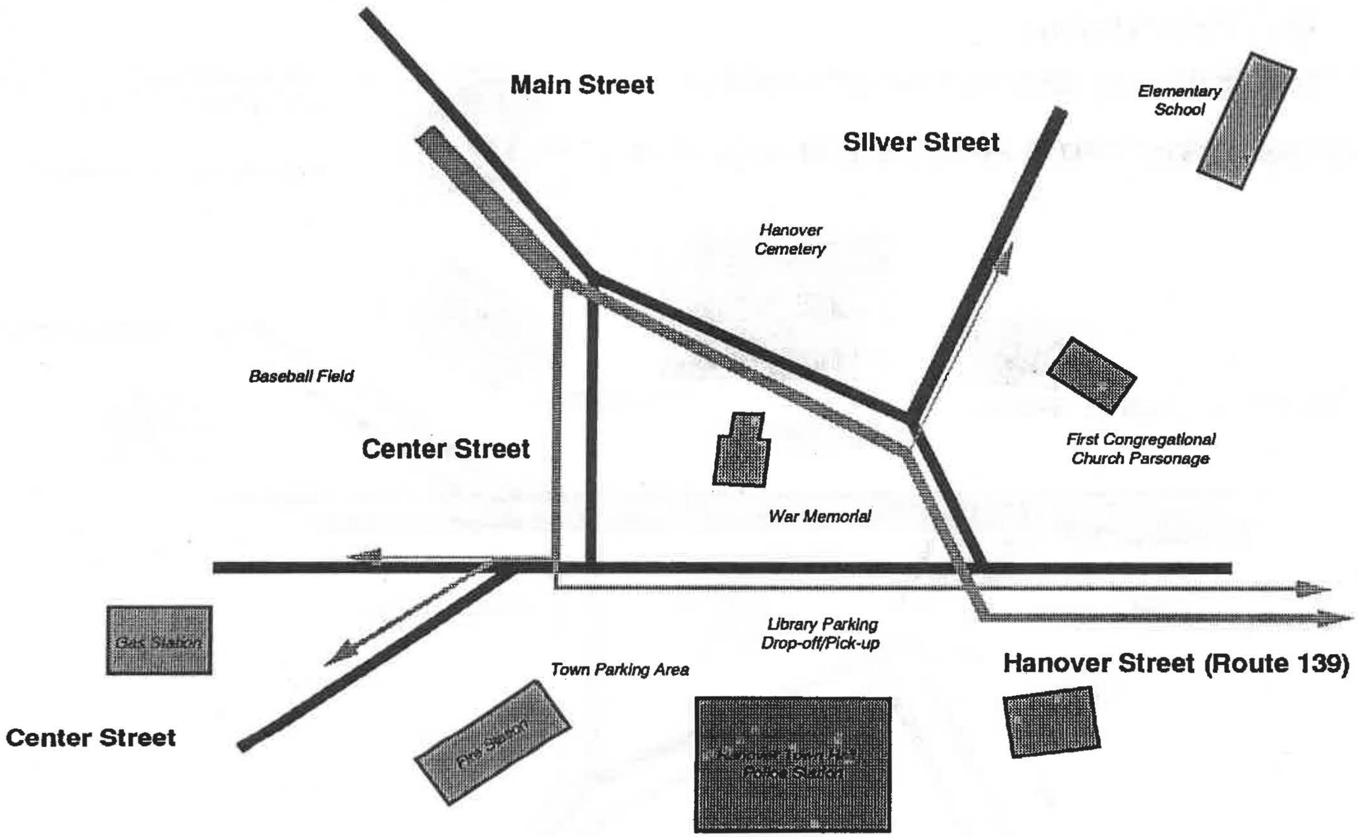
Schematic Illustration

Fay, Spofford & Thorndike, Inc.
Engineers ● Planners ● Scientists

Rte. 139 WB PM Peak Hour Distribution

Hanover Town Center Traffic Study

Hanover, MA

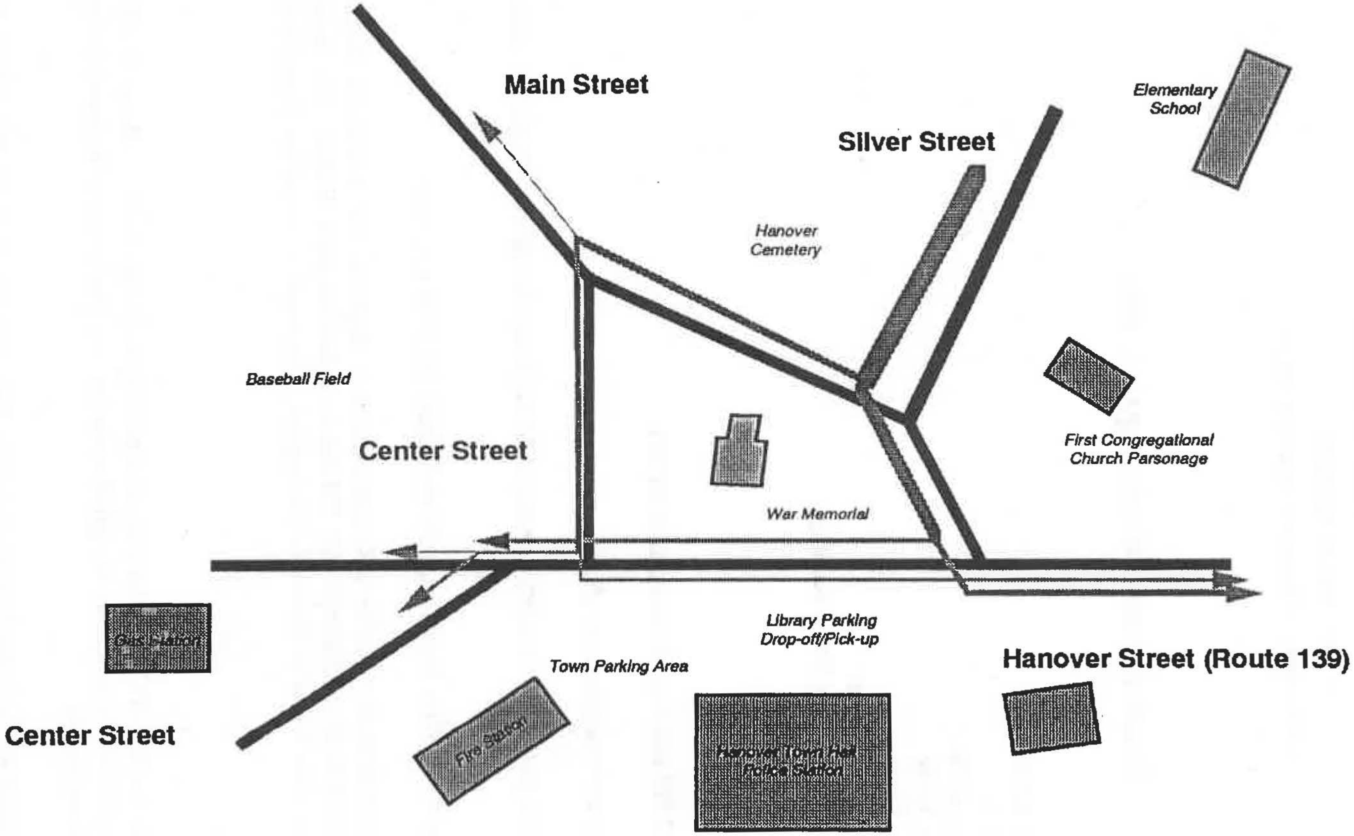


Schematic Illustration

Fay, Spofford & Thorndike, Inc.
Engineers ● Planners ● Scientists

Main Street PM Peak Hour Distribution

Hanover Town Center Traffic Study
Hanover, MA



Schematic Illustration

Fay, Spofford & Thorndike, Inc.
Engineers • Planners • Scientists

Silver Street PM Peak Hour Distribution

Hanover Town Center Traffic Study

Hanover, MA

TELEPHONE
826-3189

TOWN OF HANOVER

BOARD OF PUBLIC WORKS

40 POND STREET
HANOVER, MASSACHUSETTS 02339

Board of Public Works, April 1, 1998

Attendance: Michael Gallant, BPW
John Homan, BPW
Benjamin Kruser, BPW
Michael Racicot, DPW
Nancy Jacobson, DPW
James Toomey, Town Counsel
List attached for Town Center Study Meeting

DPW Administration:

1. The meeting began at 7:00 PM and was adjourned at 10:45 PM.

2. The Board signed bills and reviewed correspondence.

3. MIIA, the Town's insurance carrier, held a safety meeting at the Highway Garage on "Preventing Slips & Falls".

4. The Board approved the minutes of the March 16, 1998 and March 18, 1998 meetings.

5. Mr. Homan moved to go into Executive Session to discuss an issue in litigation. Mr. Kruser, Mr. Gallant, and Mr. Homan voted to go into Executive Session at 9:45 PM and to reopen into Open Session. Mr. Toomey, Mr. Racicot, and Mrs. Jacobson were invited to the Executive Session. The Board reopened the Open Session at 10:15 PM.

Highway:

1. Mr. Racicot spoke with Mr. Caputo of Coler & Colantonio regarding the design fee for Webster St. He stressed that the Board expects the project completed for the agreed upon fee. Mr. Racicot also requested the list of properties that will require easements.

2. The employees are working on repairs to catchbasins, manholes and gateboxes on streets that will be resurfaced this year. The main focus has been on Old Town Way and Main St. Basins and new drain lines have been added along some streets in areas which were questionable.

3. Mr. Racicot spoke with Mr. Perry of WATD giving the BPW's side of the Town Center Study. Mr. Perry had stopped and talked to Mr. Finneran, when he saw him out with the "Save our Ballfield" sign.

4. At the Conservation Agent's request the department filed a Notice of Intent to clean the brook along Ames Way. The hearing is scheduled for tonight at 8:30 PM. Mr. Racicot went to the Conservation Commission Meeting at 8:30, but the Commission was involved with another issue.

5. Mr. Homan does not want sidewalks dumped on the DPW. Mr. Gallant is concerned that people do not understand the process that needs to occur. He feels that the Planning Board is putting the cart before the horse. It was decided that the Planning Board will be asked to meet with the BPW for a two hour block of time in the near future to discuss sidewalk issues.

6. Because of the need to get Main St. repaired, the Board has decided not to put in a sidewalk at this time. Issues that would have to be dealt with before a sidewalk is put in include: the need of a survey, stone walls, trees, property owners, and the fact that Main St. is a scenic road. A sidewalk can be put in, if the Sidewalk Committee votes for one.

7. Mr. Kruser began the Town Center Study Meeting by giving an overview of the project to this point.

8. Mr. Hebert expanded on Mr. Kruser's overview and described the advantages of Alternative 2 including: more green space; two intersections instead of five; the turn from Route 139 to Silver St. would be sharpened to slow down traffic; and new sidewalks. Center St. would be realigned with lights. There would be no lights at Route 139 and Silver St. There would be a crosswalk at the church, and new sidewalks in the green area. The ball field could be moved to the new green space. He emphasized the current danger of accidents. Most of the accidents occur where Main St. and Silver St. merge.

9. Mr. Kruser continued by addressing the concerns raised at the previous meeting The first concern he addressed was the grading by the Dougherty's house. Mr. Kruser pointed out the topographical survey the Board had done. There is a 4 ½ to 5 foot drop. The road would have to be raised 4 feet to meet Route 139. The road drainage could be piped from the road down Main St. to the wetlands, causing no problem for the Dougherty's.

10. The second concern Mr. Kruser addressed was losing the ball field. If Alternative 2 is used, the ball field could be moved to the new green space, or be moved to another location in town. The BPW is proposing a reconfiguration of the road, not eliminating the ball field. The aesthetics can be preserved.

11. The third concern Mr. Kruser addressed was the traffic signals. He showed a sketch of how the poles could be ornamental. Other catalogs were available to look at.

12. Mr. Kruser said that there would be no impact on the church's cess pool, since the work would not be near enough or deep enough to affect the cess pool.

13. Mrs. Paul, the daughter of the Dougherty's, felt that the scale is off on Alternative 2. It looks like a huge area, but the road would be under her parent's window. She felt that a letter should have been sent to her parents outlining the Board's ideas. Mr. Kruser stated that the drawings were based on a topographical survey.

14. Mrs. Dougherty said that the signals should be put where the problem already exists at Silver St. and Route 139. Eventually there would be two lights within 300 feet. Alternative 2 does not address the problem. Mr. Kruser explained that there would be a change from 5 to 2 intersections. The traffic pattern would change at Silver St. Mr. Hebert said that in ten years the Silver St. intersection would still be a Level C with Alternative 2, which is still good. Mr. Hebert also explained that the curvature of Main St. by the intersection would not allow for clear visibility for a signal, and the problem at Silver and Main Sts. would still exist.

15. Mrs. Rose asked how Mr. Hebert knew that so many of the accidents happened with drivers coming down Main St. Now drivers coming down Main St. have a choice to turn onto Route 139 from Center St. or Silver St.

16. Mrs. Brugnoli had several questions about the study. She referenced an E-1 traffic chart and asked about traffic counts at Silver St. and Route 139. She asked what the peak hours are. They are from 5:00 to 6:00 PM on weekdays. She asked what the queue would be on Main St. Mr. Hebert indicated that it would be 11 or 12 cars

Pending:

1. DPW Administration

2. Highway

    A. Setting up and implementing a town-wide GIS system
    B. Computerization of fleet records and a data base on repairs and preventative maintenance

3. Snow and Ice.

4. Park

    A. Park & Recreation expansion - work with Park & Recreation to get funding for increased maintenance

5. Cemetery

    A. Regulations update - do in August
    B. Review capacity on master plan and assess long term needs
    C. Burial of indigents under MGL 114

6. Water

    A. Aquifer Protection Zone compliance - need list of businesses in zone with current compliance - non-compliance status
    B. Parts stores and gas stations - need list of what they store and how disposed of to monitor - could be part of WQCC monitoring
    C. Backflow preventer installation status
    D. Treatment of Broadway and Hanover Street wells
    E. Management plan for treatment plant sludge
    F. Wastewater treatment, especially in the Aquifer Protection District and commercial zones, done in conjunction with the Board of Health

7. Transfer Station

    A. Operations
    B. Curb side collection of waste using contracted services. Use station for recycling and composting.

8. Developments

    A. Rewrite Subdivision Rules and Regulations with the Planning Board, providing sectional details

Scheduling:

1. The next Board of Public Works meeting will be held on Wednesday, April 15, 1998 in the Water Treatment Plant at 7:00 PM.

with worst case scenario. She asked who would pay for signals. Mr. Kruser stated that the project would be a State or State/ Federal TIP project. Mrs. Brugnoli said that the State promised lights for Shaw's, but they have never been seen. She also asked about the four trees on Route 139. Mr. Kruser said that some of them would go. Mrs. Brugnoli felt that all of them would go.

17. Mr. Briggs indicated that the Town center is in no worse shape than many town centers. It is better than Bridgewater. He asked why blocking off Main St. for a couple of weeks wasn't tried like it was in 1982. A couple of barrels is all that is needed. The issue with Alternative 2 is a quality of life issue. The relocated road would be too close to the Dougherty's house. The Board is trying to reinvent the wheel. He guesses that 75% of the traffic on Main St. uses Center St. to turn onto Route 139. He hopes Town Meeting turns down the proposal. He suggested having accurate plans for Town Meeting. Mr. Kruser believes that putting in barrels to block Main St. in back of the church is hazardous. Signs would be needed.

18. Mr. Casey pointed out that Silver St. does not intersect with Route 139, Main St. does. He mentioned that there are probably 9 million trees in Hanover. The four at the ball field are the ugliest trees in town in winter. He feels that the ball field should be dumped, because there are unused fields at Center School.

19. Mrs. Ryerson praised the Board's efforts, but she is against Alternative 2. If the road is moved to the fence, people will have to look at the gas station when they come out Main St. She likes to look at Town Hall and the church. The ambiance would be destroyed with Alternative 2.

20. Mr. Thomson was concerned that, when the project is done it, it won't look like the plan. He is concerned that the State will take control of the design. He is also concerned that lights will increase the speed, because people will try to run the lights. He felt that Main St. could be closed for a trial period with blinking barrels. His recommendation is that the roads be left the way they are. He's not convinced that Alternative 2 would be an improvement. Mr. Kruser commented that the State would pay for the project, but that the Town would do the design with State approval.

21. Mrs. Paulin asked the time of day of accidents. Mr. Hebert indicated that they were spread out according to the volume of traffic. The records he obtained from the Police Department were for a 4 year period.

22. Mrs. Hannigan asked what the elevation would be of the new section of Main St. It seems that the new section would be 110 to 111. The existing is 112. She is concerned about the drainage. She feels that the bottom line is courtesy. Everybody needs to slow down a little bit.

23. Mrs. Maibach feels that the drainage will end up in her front yard.

24. Mr. Terlecki suggested running computer models on the blocked off section of Main St. He suggested lights at Spring St. and Grove St. to slow down the traffic. He also emphasized courtesy. Mr. Kruser stated that the Town cannot control the speed on a State road. He also indicated that Mr. Hebert's scope of work did not include Spring St. and Grove St. Mr. Hebert said that he had looked at only blocking Main St. There would be some improvement, but not significant. It would not offer the same level of safety as Alternative 2.

25. Mr. Roach, the Safety Officer, said that the State will not lower the speed on Route 139. A pedestrian light at the library is possible. Most of the accidents are angle accidents, because people don't wait.

26. Mr. Dillon indicated that his concerns are the same as other residents. The number of accidents do not seem out of line. He suggested putting a police officer at the center to direct traffic. Mr. Kruser said he does not know why a police officer isn't used. Mr. Roach said that there is too much traffic for a police officer. Mr. Hebert believes that the accidents happen many hours of the day, making it difficult to use a police officer.

27. Mr. Elliott suggested blocking off the street on a trial basis before Town Meeting. Mr. Kruser reiterated that it was unsafe and said that MA Highway approval would be needed.

28. Mrs. DiNatale, a resident and Quincy police officer, said that in her experience most fatal accidents occur at intersections. She suggested that the accident rates at other intersections like Routes 139 and 53 be looked at.

Mr. Kruser said that that was not in funding. Mrs. DiNatale said that the public information statistics could be obtained at no cost. Mr. Kruser stated that the statistics would still have to be analyzed.

29. Mr. Lewald indicated that having a police detail in the center would be a manpower problem, but might be helpful. There are no major tie-ups at the intersections. The Board of Selectmen had presented similar plans 5 years ago, and they were turned down. The DPW refuses to temporarily block off behind the church to diminish the intersections.

30. Mr. Finneran said, "We don't want it". The ball field is part of the history of the town. Duxbury and Norwell are laughing. The center is our front yard.

31. Mrs. Hannigan asked what statute Mr. Kruser was citing about notifying the State, if a road is blocked off. Mr. Kruser said it is a courtesy, not law. He said that signs cannot be put on the State highway. Mrs. Hannigan suggested putting them only on the Town roads. Mr. Kruser feels it cannot be done without signs.

32. Mrs.Ryerson asked if there were more accidents going east or west. Mr. Hebert indicated west. Mrs. Ryerson suggested putting signals near Spring St. to slow traffic.

33. Mr. Briggs said that the State was not involved when Washington St. and Pine St. were closed. He feels that the DPW needs to meet citizens half way, and that the DPW is afraid blocking off behind the church will work.

34. Mr. Terlecki also suggested traffic lights at Spring St. There needs to be a courtesy awareness campaign. The Board needs to take another look.

35. Mr. Kruser said that there is no money for another look. He is not pushing his plan. Alternative 2 was a Board decision. The Board will go with Town Meeting vote.

36. Mrs. O'Brien asked when the road was blocked before. It was in 1982. She stated that Birchwood Dr. and Maplewood Dr. did not exist as a potential cut through in 1982. It would be used as one now. More money is needed from Town Meeting for more studies.

37. Mr. Dougherty said that the field would have to be raised 5 ½ feet for a new road connecting to Route 139. The drainage dumping into the swamp would be a problem. The existing plans are the most logical. He reviewed the history of the ball field. There would be problems with the horses, if there is a new road. The property would be devalued. The house was deeded to Briggs by the church in 1854. The trees are almost 200 years old. What we have should be appreciated. Our forefathers put roads in where they did because it works. Lights would cause more of a problem with accidents, pollution and back-ups.

38. Mrs. Dougherty suggested that the scope was too narrow. It should be from Route 53 to West Hanover. The Board needs to go back to the drawing board.

39. The meeting ended with Mrs. Ryerson thanking Mr. Finneran for his efforts.

40. After the Town Center Study meeting ended, Mr. Gallant said that he voted to withdraw the article from Town Meeting. Mr. Kruser said that the article will have to stay in. The Board should report how the money was spent. Mr. Gallant feels that the Board has done its job, but the residents did not want to listen. Mr. Kruser said that he would speak on Town Meeting floor. The other two Board members suggested that Mr. Homan speak for the Board.

41. The Board discussed with Mr. Hebert how the problems do exist, but the Town wants to do nothing. It is not the right time to make changes. Mr. Hebert will change his executive summary in his report to reflect tonight's meeting.

42. Mr. Hebert was thanked by the Board for the effort he put into this study. They also expressed hope of being able to work with Mr. Hebert in the future.

Snow & Ice:

Park:

Cemetery:

1. The Fire Department approved the changes in the Firemen's Memorial grave locations. Chief Tucker thought the changes were reasonable.

2. A request has been made, through the Veteran's Agent, for a WW II veteran to be allowed to purchase graves in the Hanover Center Cemetery. His only family is buried in Hanover. The Board approved the request for the veteran to purchase a four grave lot.

Water:

1. The Board signed Water Commitments # 98-26 and #98-27 and abatements.

2. Ten bids were received for painting and repairing the Union St. Water Tanks. Hroma Corporation was the lowest bidder. Mr. Billings checked references and found them acceptable. Mr. Racicot recommended that the bid be awarded to Hroma Corporation.

3. It was moved by Mr. Gallant, seconded by Mr. Homan and unanimously voted to award the contract for painting and repairs to the Union Street tanks to Hroma Corporation and that the Superintendent is authorized to sign the contract for the Board. The alternate portion of the bid is for the outside of the large tank, which was not painted two years ago, when the inside was done, due to lack of funds. The amount available for the project is $250,000. Pit welding will cost $2.00 per pit. The project will start in May with a finishing date of July 15th. The large tank will be emptied and painted first, so that it can be put back in service for the summer.

4. It was moved by Mr. Homan, seconded by Mr. Gallant and unanimously voted to award the contract for inspection of the painting to Robert L. Merithew, Inc. Mr. Kruser asked on what basis he would be paid. He will be paid on a daily cost basis. Mr. Gallant asked if he will inspect every day that the painter is there. He will.

5. Mr. Racicot spoke with Mr. Toomey regarding the Hanner property case. Mr. Racicot also met with Mr. DiGregorio, a wetlands scientist working for Mr. Toomey's office, about the case. Mr. GiGregorio was given map copies and access to the property.

6. Weston & Sampson have been sent plans of the new Police Station for review, because of the location within Zone II of the Broadway wells. Comments will be used for the WQCC.

7. Employees have been inspecting the water and drainage work at the Hanover Mall.

8. Spring water main flushing has begun. There is still high amounts of manganese in the water, possibly due to the higher pH going out.

Transfer Station:

1. Mr. Racicot and Ms. Swete, planner for SSRRDPB, took inventory of old pesticides and hazardous waste at the Highway Garage. The material will be disposed of at the Household Hazardous Waste Day in May.

Developments:

1. Mr. Donovan, Town Planner, contacted Mr. Racicot to discuss the Planning Board's proposal to require the developer of Holly Farms V to construct a sidewalk on Whiting St. from Homestead Lane to the Middle School. The Planning Board wants a sense of the BPW's feelings on the issue. Mr. Kruser and Mr. Racicot feel that a survey would need to be done. Mr. Kruser feels that a sidewalk design needs BPW approval.

Meeting
Portion of Minutes

Highway:

1. Mr. Racicot and Mr. Kruser met with Coler & Colantonio to give review comments on the Webster St. 75% draft submittal.

2. Mr. Kruser opened the Town Center Study meeting by presenting an overview of the four alternatives to the existing conditions that Mr. Hebert had developed. Mr. Hebert of Fay, Spofford, and Thorndike was unable to attend the meeting due to hospitalization. Mr. Kruser said that the input from this evening's meeting will be used to develop one proposal. This proposal will then be presented to Town Meeting for consideration. He encouraged people to fill out the evaluation on the last page of the packet to help with the decision. He then opened the meeting for questions and comments.

3. Mr. Brown asked what was driving the project. Mr. Kruser said the heavy traffic was a concern. Trying to turn at Main St. and Route 139 requires a gap in both directions of traffic. When you can't get a gap in each direction, traffic starts to back up.

4. Mr. Finneran said that the street lighting is not good in the town center area. Some kind of signals are needed. He feels more police enforcement is needed. He does not feel that a 45 second wait to get out of Main St. is too long. The only frustration comes from this building, not others. This study is all much ado about nothing. He is surprised the Board held the meeting without Mr. Hebert.

5. Mr. O'Brien feels that it is only a matter of time before there is a fatal accident in the Town Center. He is frustrated having to deal with the intersection, especially on Saturday afternoon, when residents are headed to the transfer station. He asked who decides on signals. Mr. Kruser indicated that recommendations have to be made to the State. It is a State road.

6. Mrs. Dougherty feels that the section of Center St. next to the church should be made right turn only. If there are going to be lights, they should be put near the memorial. The lights should be put where the problem is.

7. Mr. Casey said that lights at Grove St. may help. Perhaps the Civil War Monument could be moved. It was pointed out that there will not be lights at Grove St., just a new mast arm for the blinking lights.

8. Mr. Dougherty said that it would be difficult for the horses at the stable, if Center St. is moved. As an abutter he will feel that the road goes through his house.

9. Mr. Kruser indicated that Center St. needs squaring up, especially for the Fire Department.

10. Mr. Finneran cited Article 97 of the Environmental Law which may prohibit the moving of the ball field. Mr. Kruser pointed out that the ball field is not the basic issue of this meeting.

11. Mr. Itz said that he is one of the people frustrated by the intersections. Alternative # 2 looks nice, but his favorite is Alternative # 1. He questioned parking for the church. Pedestrian crossing on Route 139 from the Parish Hall to the Library, for example, is a problem. Traffic signals are a possible solution. Alternative # 1 is the best.

12. A woman stated that driving on Hanover St. is a nightmare. Turns are awful.

13. Mr. Dougherty questioned the type of lights that would be used. Mr. Kruser said that the State would be encouraged to use a new style like a Boston lamppost.

14. Mrs. Remick is in favor of going from 5 to 2 intersections. The options should at least be limited. She likes the idea of the church and ball field being together.

15. Officer Roach has spoken with the State about a pedestrian light at the library. He feels that lights that fit the character of the town could be negotiated.

16. Mr. Thomson liked Alternative # 1 the best and maybe Alternative # 2. More information is needed for Town Meeting. He asked if State funding would be available. He mentioned that by moving Center St. the Dougherty's would be looking at hubcaps. He doesn't feel that Town Meeting should vote without more detail. What is done will be dictated by the State, if more detail is not provided.

17. Mr. Kruser said that the State tries not to shove plans down the throats of residents.

18. Mr. Finneran asked if there was a projection of cost for Alternative # 2. Mr. Kruser said no. Mr. Racicot indicated that nothing has been settled yet. Mr. Finneran would like to see facts and figures on cost and time. Mr. Racicot said that the project is on the State TIP program for funding. Mr. Kruser believes that cost is not the issue at this time, safety is the first issue. The design of the alternatives is not at a level for costs.

19. Mr. Itz indicated that he has been on the TIP board. The State is looking for the town's wishes.

20. Mrs. Barker asked if Main St. in back of the church could be closed, as it is in Alternative # 1, to see what happens. Mr. Kruser said that some money would have to be spent to do that.

21. Mr. Casey also suggested doing some blocking off and to have a right turn lane on Route 139 to turn into Main St.

22. Officer Roach indicated that Assinippi Park in Norwell has added more traffic to Main St. than the opening of Shaw's.

23. One resident indicated that Shaw's opening has exacerbated the situation.

24. Mr. Itz stated that there has been some impact from Shaw's, but not a tremendous amount.

25. Mr. Brown feels that the traffic speed and direction needs to be moderate. He feels that residents should exercise their fancy in planning the aesthetics of the area.

26. Mr. Homan indicated that he has lived in town 13 years and has had 4 or 5 near misses at the intersection. He feels that something needs to be done before there is a fatal accident. He especially does not want to see a car go into the ball field, when there are children there.

27. Mrs. DuBois asked, if the town does not make plans for the money, will the State dictate what is to be done. Mr. Kruser said that the State would take the money for another project.

28. Mr. Dougherty questioned safety. He feels that putting a signal at Center St. by the gas station does not resolve safety for pedestrians. Mr. Kruser said that it provides a gap in the traffic for vehicles. Mr. Dougherty feels that the big problem is safety at Main St. and Route 139.

29. Mrs. Navitskis was concerned that with Alternative # 2 vehicles could not get directly from Main St. to Silver St. without going onto Route 139.

30. Mr. Thomson liked Alternative # 1 the best but questioned a light at Center St. by the church.

31. Mr. Johnson stated that traffic has not grown very much. The fatalities that do occur in town happen on Main St. Residents need to keep perspective. Being able to look at the type of signals that would go in would be helpful. He asked it the lights would be like Whiting St. Mr. Kruser said no. Whiting St. lights are the way they are because of the skew in the layout. Mr. Johnson feels that what the town wants in 30 years needs to be considered. He believes that Alternatives # 1 and # 2 give an opportunity for better safety.

32. Mr. Itz asked if traffic lights at Spring St. had been considered. Mr. Kruser said it was out of the scope of the Town Meeting article.

33. Mr. Thomas asked if the speed limit could be lowered.

34. Mr. Lewald said that the Board of Selectmen were trying to get the speed limit in the center reduced to 30 MPH. He asked for details of the study. Mr. Kruser said that that information was presented at the first meeting. Mr. Racicot said that a copy of the information was sent to Mr. Rollins.

35. Mr. Dougherty suggested that an officer patrol the area during peak hours to reduce speeding. Mr. Kruser and Mr. Racicot suggested he speak with the Police Chief.

36. Mrs. O'Brien said that she times getting out of Main St. when she brings her son to football practice. One wait she timed at 4 minutes, 45 seconds. She has almost been rear-ended turning into Sylvester School. She also suggests trying some of the alternatives before a decision is made.

37. Officer Roach said that he has been working on the school lights with the State. The State will not change the speed limits. When the Police patrol the area for speeders, town residents and teachers are the worst offenders.

38. Mr. Gallant stated that there is a sense that something needs to be done. He asked for some direction from residents with the issues and options.

39. Mr. Finneran asked what the church issues were. Mr. Kruser feels their issues are primarily for pedestrians. Mr. Itz asked if barrels could be used in the crosswalks. Mr. Kruser said he would have to write to the State about that issue. Officer Roach said that barrels on the State highway can only be used if the Board of Selectmen sign off on liability.

40. Mr. Brown asked if it would be appropriate to send letters. Mr. Racicot said that it was, and that Mr. Hebert has spoken with a number of people.

41. A resident indicated he preferred Alternative # 1, but he questioned a potential parking problem.

42. The meeting ended with the Board asking residents to fill out the evaluation sheet with the Alternatives packet.

Snow & Ice:

1. Mr. Racicot reported that crews have spent considerable time battling lingering snow and ice storms. The crews have worked very hard. There have been only two complaints.

2. Mr. Racicot met with the Fire and Police Chiefs to review the snow and ice operations today. Both men are very satisfied with the operation. Mr. Tucker requested that satellite fire stations receive earlier attention when plowing is needed.

3. Mr. Gallant asked about the Fire Department's concern that it was slippery on Webster St. Mr. Racicot addressed this issue with Mr. Tucker. It should have been handled by the Police shift supervisor.

4. Mr. Gallant raised the issue that he thought it had been agreed that contract plowers would be called out when the DPW plows go out. Mr. Racicot's reply was "Because you want to take care of the plowers". He then said, "Put that in the minutes". Mr. Racicot then said that a campaign promise was made regarding snow plowers. Mr. Racicot said that he would not call out the contract plowers for a little bit of slush, like the 12/23 storm. He said it is his decision to make. He is the superintendent. Mr. Kruser asked why Mr. Gallant wants the plows called out all the time. Mr. Gallant responded that, if you want the contract plowers for an 8 inch storm, you need to call them out for the 3 inch storms. Mr. Racicot agreed with 3 inches, but not 1 1/2 inches. Mr. Gallant also explained that when one truck is used the snow is thrown into the middle of the road. If trucks plow in tandem, the whole road gets cleared. He also said that large trucks cannot do intersections. Mr. Homan is concerned that, if the plowers are not called out, they will go to other towns. Mr. Racicot said that every storm is different. When there is 1 1/2 inches of snow, he uses 10 town trucks in tandem. Mr. Racicot said that Mr. Gallant and Mr. Homan would have called out the plowers on 1/19 for only a small amount of snow. He said that the rest of the taxpayers are not here. Mr. Homan does not want the Board to bury its head in the sand. Mr. Racicot said that snow plowing was the one reason Mr. Homan ran for the Board, and that Mr. Homan does not care what the plowing costs. He further said that this issue comes up every two weeks. He indicated that, according to Mr. Gallant and Mr. Homan, he never does the plowing right. He feels that Mr. Gallant and Mr.

SIGN IN SHEET

NAME	ADDRESS	COMMITTEE OR BOARD	PHONE #
Mike Gailhot	83 Broadway	DPW	829-9145
Thomas Brown	111 Karen Road		826 8573
George Reich	64 Lincoln Lane		878-7628
Sue Remick	515 Hanover St		8262642
Rev Don Remick	515 Hanover		826 2642
Joan DuBois	312 Union St.		826-6826
Charles DuB	"		"
Joseph P. Casey	404 Center St		826-4606
Alfred B. [illegible]	709 Hanover St.		826-6773
Barbara Barker	417 Main St	Hist. Commission	
Barbara V [illegible]	137 Main St.		878-6284
Elizabeth Krueser	138 Laurie Ln		
[illegible]	1 Hanover Mariner		
LARRY FINNERAN	43 BAiley rd HAN. MA.		
LINDA FINNERAN	43 BAILEY RD. HANOVER MA.		
PAUL ROACH	54 - WINTER ST " "		
Tom Thomas	854 B'way		826-7952
Hal Thomas	"		"
Jean Navitskis	8 Wade Way		878-6287
G. Lendal	1010 Broadway		
JOHN DOUGHERTY	579 HANOVER ST.		826-3191
PETER JOHNSON	168 BROADWAY		826-5636
Karen Pritchard	633 Main St.		8787757
Charles Minott	994 Broadway		8269516
KENNETH BLANchard	323 King ST.		
Jeffrey Blanchard	157 Silver St		826-5076
Barbara Connor	150 Briarwood Dr.		871-5289
Kathie O'Brien	79 Maplewood Dr.		826-5671
Joe O'Brien	79 Maplewood Dr.		826-5671

TELEPHONE
826-3189

[redacted] PH-002

DiGuy
GLHwy
MJHwy
GAL/FILES

TOWN OF HANOVER

BOARD OF PUBLIC WORKS

40 POND STREET
HANOVER, MASSACHUSETTS 02339

Board of Public Works, November 12, 1997

Attendance: Michael Gallant, BPW
John Homan, BPW
Benjamin Kruser, BPW
Michael Racicot, DPW
Nancy Jacobson, DPW
Gary Hebert, Fay, Spofford & Thorndike, Inc.
List attached for Public Meeting on Town Center Study

DPW Administration:

1. The meeting began at 7:00 PM and adjourned at 10:15 PM. The Town Center Study public meeting portion of the meeting began at 7:35 PM and ended at 8:50 PM.

2. The Board signed bills and reviewed correspondence.

3. The Board approved the minutes of the October 29, 1997 meeting.

4. The BPW has been scheduled to meet with the Capital Improvement Committee on Monday, November 24th at 8:00 PM at Town Hall in the upstairs hearing room.

Highway:

1. Mr. Racicot met with Mr. Rollins regarding background information on the Town Center intersection. Mr. Rollins gave the DPW all materials and documents related to the project.

2. The large number of invoices for changing tires at the garage was questioned. Mr. Racicot said that the DPW does not have the equipment to mount the tires. The amount is high because he has had recapped snow tires put on the dump trucks. Also, all four tires needed to be changed on the JCB, because they were the wrong size and required a matched set.

3. Mr. Homan had received a call from a resident who was dissatisfied with the response he received regarding a street opening permit for a driveway onto his property. Mr. Racicot explained that where the resident wanted to put the driveway was right at a catch basin. Continually driving back and forth over the catch basin would damage the basin.

4. It was moved by Mr. Homan, seconded by Mr. Kruser and unanimously voted to award the contract for restoration of bituminous concrete pavement to Felix A. Marino Co., Inc. and that the Superintendent is authorized to sign the contract for the Board. The DPW participated in the Town of Falmouth and Metropolitan Consortium bid.

5. Mr. Kruser introduced the public meeting by giving an overview of the history of trying to have the Town Center intersections reconfigured for safer travel. He then introduced Mr. Hebert, who is the engineer from Fay, Spofford & Thorndike, Inc. doing the current study.

6. Mr. Hebert presented his findings from traffic studies, police reports, and on site observations. He stated that the center is a mixture of 5 intersections. Using traffic counts he found the two busiest times of day to be between 5:00 to 6:00 PM weekdays and midday on Saturdays. The speed is the lowest around 2:00 PM, probably because of the schools. Most of the time the speed averaged 40 mph or above. 96% of the vehicles are cars, 3% are buses and trucks, and 1% are bicycles. Most accidents occur during peak times. The backup onto Silver St. during peak times is nine to ten cars, which is lower than statistically expected. The accident rate is lower than the State would find appropriate for signalization. The State rate is five per year. The volume however, is high enough for signalization. The Main St. intersection with Route 139 has a volume of over one hundred turns per hour during peak hours. The State uses over 750 turns per eight hours in determining the need for signals. More than half the traffic going west on Route 139 turns at Main St. or Center St. More eastbound traffic goes straight. At Silver St. Mr. Hebert found more vehicles turning right onto Main St. than in 1986. The total counts were 2 1/2% lower than 1986. Mr. Hebert suggested that traffic calming could be used by making a one way traffic pattern around the church. Among the problem areas Mr. Hebert identified were:

   a. Sight distance from Center St. at the church onto Route 139
   b. Pedestrian crossing at the church
   c. Center St. at church is narrow, in poor condition, and poorly lit
   d. Main St. in back of the church is narrow
   e. Ball field
   f. Left turn on Silver St. has fence obstruction
   g. Left turn at Main St. and Route 139 is difficult

7. Areas Mr. Hebert would like to look at are looping around the church, moving Center St. to go through the ball field, and closing Main St. in back of the church.

8. Mrs. Barker would like to see options clarified as to what alternative will have the least impact. She is also concerned, particularly because of the historical character of the center, that traffic signals not be used. Mr. Hebert expressed concern about installing signals, since that might increase the incidences of rear end collisions.

9. Mr. Hebert asked if Briggs field was untouchable. Mr. Finneran felt it should be left alone. He feels the field is used year round and should be kept available for residents. Other attendees expressed that the field was used primarily in the spring.

10. A gentleman from the Historical Commission said that he would like to see a range of options for changes. He feels the ball park is important and another option to using that space should be found. He is pleased to hear about traffic calming. He asked if any federal funds would be available for the project.

11. Mr. Kruser explained that the project was on the State TIP list. The Town could use Chapter 90 money to pay for the design.

12. Mr. Hebert stated that it will be difficult to improve the intersection with no changes.

13. Mr. Ceurvels asked if funds would be available to make baseball field improvements. Mr. Kruser said that funding was possible if it was essential. Mr. Ceurvels suggested blocking the section of Center St. next to the field.

14. Mrs. Franzosa expressed concerns about having lights in the center of town. She asked about the possibility of making Silver St. one way.

15. Mr. Kruser said that he believed that the Police and Fire Departments would not like street closings and one way streets.

16. Mr. Pervane asked if one plan would be to make Main St. one way around the church. He suggested making Silver St. and Main St. one way turns meeting on Center St. and then going out to Route 139.

17. Mr. Hebert indicated that newer styles of signals can be made to look half way decent.

18. Mr. Briggs felt that the only problem was during commuting hours. The back of the church was blocked in 1983 or 1984. He felt it worked well. He also mentioned that the triangle of land across from the Fire Department on Center St. was a gift to the town. He questioned what restrictions were placed on this property and the ball field, when they were given to the town.

19. Mr. Thomson expressed his concern that the ball field would need six to eight feet of fill to bring it up to grade for sight distance. Two or three historic ash trees would have to be taken down. The road could be made acceptable, but not perfect. Widening and radii on Center St. need to be looked at. He feels that the circular driveway at Town Hall should be eliminated. The turn at Center St. by the Fire Department should be squared off. He does not want to see the ball field moved. He is concerned about getting involved with the State and requirements that may have to be met. Mr. Thomson does not want signals. His first reaction is to do nothing.

20. Mr. Kruser said that the Board is working to improve safety.

21. Mr. Briggs reiterated that congestion is not that bad except for a couple of times during the day.

22. Mr. Kruser indicated that the BPW's charge to all firms that submitted proposals was for the need to be sensitive to the historic nature of the center.

23. The Reverend Sue Remick, wife of the pastor of the church, asked if the study incorporated the Sylvester School Zone. On Sunday mornings there is a pedestrian problem for people parking in the parish hall parking lot and walking across to the church. Getting in and out of the parsonage is difficult because of the speed. Usually they back in, but that is dangerous too. Drivers do not see pedestrians.

24. Mr. Hebert stated that he was aware of the conditions that Reverend Remick spoke about. He has looked at the worst.

25. Reverend Remick asked if options to slow the traffic at Spring St. and Grove St. had been looked into. Perhaps the traffic could be slowed at these intersections to keep it slowed down for the Historic District.

26. Mr. Kruser said that the BPW petitioned the state for three lanes of traffic in the center, so that there could be a turning lane for left turns. The Board will follow up on this option with Landers.

27. Mrs. Powers said, that as a resident of Donna Dr., she frequently goes Silver St. to Route 53 to get to Shaw's rather than make the left turn at Main St. and Route 139.

28. Mr. Nyman indicated that the Board of Selectmen had a meeting on this issue a year ago and the consensus was to leave it alone.

29. Mr. Kruser stated that the BPW asked the May Annual Town Meeting for money for the study. It is a safety problem that will not go away. The good versus the adverse needs to be weighed.

30. Mr. Thomson asked if the issue will go back to Town Meeting. Will residents have an opportunity to vote or will it breeze by Town Meeting?

31. Mr. Kruser felt that there is no answer to this question until the project is down the road a bit. Chapter 90 money could be used with the Board of Selectmen's approval.

32. Mr. Casey expressed his opinion that the town should get as much money from the State as possible, then do the rest in small bits.

33. From looking at the plans for the current work on Route 139 Mr. Kruser believes that signals will be going in at Grove St. The impact that this will have on center traffic can be observed. Lights away from the historical area may help.

34. Mr. Itz asked about having traffic cones used in pedestrian walk ways. It was generally felt that cones did not increase the safety and are difficult to monitor.

35. Mr. Hebert felt that the danger is from speed.

36. Mr. Casey indicated that there is a saga about crosswalks at the church.

37. Mr. Kruser assured the residents that any plans presented will take pedestrians into account.

38. Mr. Tucker said that the Fire Department makes about 1900 calls per year. They depend on access to both Silver St. and Main St. He feels closing the road behind the church is the best option. He would like to see more of a right angle turn on the Fire Department side of Center St. Turning right from Silver St. to Main St. and then left onto Center St. at the church is a problem for fire apparatus.

39. Mr. Hebert indicated that he will look closely at turning radii.

40. Mr. Tucker said that he has templates for turning radii.

41. The meeting ended with a commitment from the Board to hold another meeting in about a month, when some suggested plans have been developed.

42. After the meeting Mr. Gallant and Mr. Kruser expressed interest in having copies of Mr. Tucker's templates.

43. Mr. Gallant complemented Mr. Hebert on a great presentation, an opinion that had already been expressed by several residents.

44. There was a discussion with Mr. Hebert and the Board as to what to do next. The rate of accidents was discussed. Mr. Hebert indicated that more than one accident per million is considered high. Hanover Center's rate is 1.2 per million. There does not seem to be strong data for signals. Mr. Hebert will focus on non-signaled options. The issue of the possible use of the ball field will be analyzed. It was agreed that the Board will meet with Mr. Hebert at the 12/17 meeting. Mrs. Jacobson suggested postponing the next public meeting until after the holidays, which was agreed upon by the Board.

45. Mr. Kruser said that Mr. White investigated the conditions of ownership for Briggs' field when the Board of Selectmen was looking at the center issue. Mr. Racicot will check with Mr. Rollins as to what information has been found. He will also check on the triangle of land across from the Fire Station.

Snow & Ice:

1. Employees have been preparing equipment for the winter. The emergency generator at Ames Way is ready. Mr. Racicot thanked Mr. Homan for his donation of time, labor, and materials for the shed enclosing the generator. The DPW can now run all necessary systems at the garage on the generator.

Park:

1. The fall tree trimming and tree removal with the bucket truck is completed. There are several tree trunks remaining that will be cut down during the winter, when the ground is frozen.

Cemetery:

1. The latest revisions of the proposed regulations for memorial sections have been given to Mr. MacLean to give to the Police and Fire Departments.

Water:

1. The Board signed Water Commitment # 98-14 and abatements.

2. The pump motor at the Pond St. # 1 well had to be repaired at the cost of approximately $2,500.00. The well was out of operation for five days. Mr. Racicot commended the treatment plant staff in keeping the price down. Mr. Homan asked if the pumps for all the wells should be standardized. Mr. Racicot felt that such an approach would be very expensive and impractical because of the individual needs of each well.

3. The business owner at 231 Broadway has requested an abatement on a high water bill dating from June. The Board asked that the meter be tested. If the meter tests as working accurately, the owner will be expected to pay the full bill. If the meter tests defective, an abatement will be considered.

4. Representatives from Sprint are pressing to meet with the Board again regarding an antenna on the Walnut Hill water tower. Mr. Kruser suggested that they be asked to send drawings for review, rather than come in to talk. Mr. Racicot said that what they are looking for at this time is a hold harmless release to do engineering. He will bring the paperwork to the next meeting for the Board to review. Mrs. Jacobson expressed Mr. Billings' and Mr. Diniak's concern about the tower being used. DEP has expressed strong reservations about this use. Mr. Billings and Mr. Diniak will be attending a meeting on November 24th about this issue. The Board asked that the two men submit a report for the 12/3 Board meeting.

Transfer Station:

1. Employees had to clean up a large amount of trash dumped over the weekend at the gate of the station. It probably amounted to two dump truck loads. Information on a resident was found in the trash and the resident has been billed for the DPW's time for cleanup.

Developments:

1. Requests for street acceptance at the next Annual Town Meeting have been received for Meeting Hill Lane and Thorny Meadow Way.

2. The Planning Board has submitted a number of plans to the DPW for review. The largest is Holly Farms Phase V with 62 lots.

Pending:

1. DPW Administration

2. Highway

    A. Setting up and implementing a town-wide GIS system
    B. Computerization of fleet records and a data base on repairs and preventative maintenance

3. Snow and Ice.

4. Park

    A. Park & Recreation expansion - work with Park & Recreation to get funding for increased maintenance

5. Cemetery

A. Regulations update - do in August
B. Review capacity on master plan and assess long term needs

6. Water

A. Aquifer Protection Zone compliance - need list of businesses in zone with current compliance - non-compliance status
B. Parts stores and gas stations - need list of what they store and how disposed of to monitor - could be part of WQCC monitoring
C. Backflow preventer installation status
D. Treatment of Broadway and Hanover Street wells
E. Management plan for treatment plant sludge
F. Wastewater treatment, especially in the Aquifer Protection District and commercial zones, done in conjunction with the Board of Health

7. Transfer Station

A. Operations
B. Curb side collection of waste using contracted services. Use station for recycling and composting.

8. Developments

A. Rewrite Subdivision Rules and Regulations with the Planning Board, providing sectional details

Scheduling:

1. The next Board of Public Works meetings will be held on Wednesday, December 3, 1997 and Wednesday, December 17, 1997 at 7:00 PM in the Water Treatment Plant.

SIGN IN SHEET

NAME	ADDRESS	COMMITTEE OR BOARD	PHONE #
Elizabeth Minnery		Patriot Ledger	786-7026
Barbara Barker	417 Main	Historical Commission	
John Bain		Mariner	585 0586
LARRY FLINNERAN	43 BAILEY		
JOAN DUBOIS	312 UNION ST.		
Shay Du Bois	312 Union		
Fred Burgo	149 MAIN ST		
Paul Rourke	54 Winter St	Safety officer T. Hanover	
M. CLAIRE WARD	80 HACKETTS POND		
PATRICK DONOVAN	PEMBROKE	TOWN PLANNER	826 7641
Rev. Sue Remick	515 Hanover St		826 8642
Peggy Powers	98 Donna Dr.		826-6106
Dick Powers	98 Donna Dr.		826-6106
[illegible]	32 King Phillip		826-9806
Cheryl Ardini	178 Silver St.		826-6776
Steve TUCKER	66 GROVE ST.	Fire Chief	826-4922
DAVID W. LUCE	17 YOKE Rd BRIDGEWATER	FIRST CONGO CHURCH TRUSTEE	508-697-8368
BORA PERVANE	227 Center ST		826-2909
Russell + Barbara Fitz	1137 Main St	FIRST CONGREG. CHURCH	878-6284
Joseph Casey	404 Center		826-4606
Karen B Pritchard	633 Main St	Walnut Hill Garden Club	878 7751
ART CEUEVELS	79 Birch Dr.		826-8657
PETER JOHNSON	168 BROADWAY		826-5636
Dan Pallotta	160 Old Forge Rd		871-6100
Bob Nyman	Selectman		826-2261
Carol Franzosa	Hist Comm		871 6035