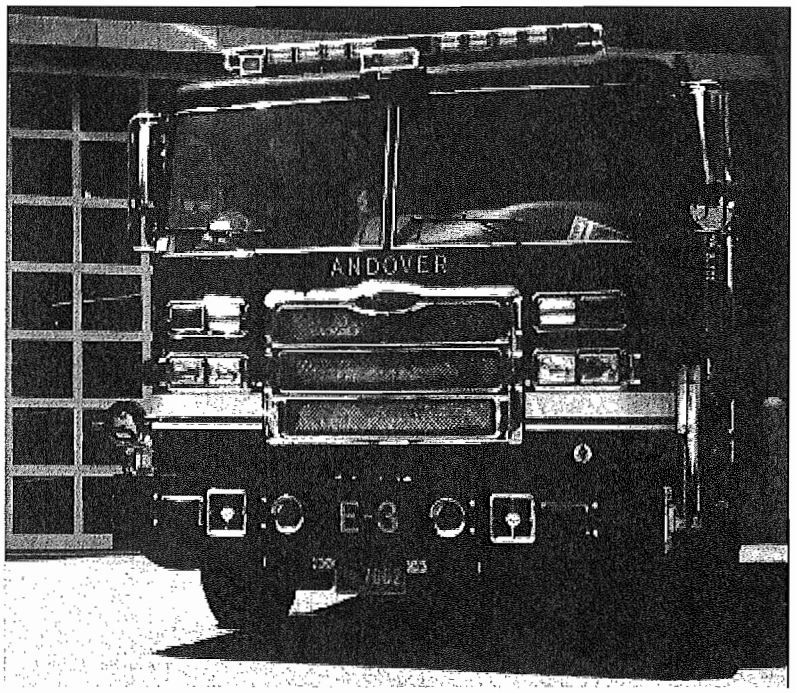
FINAL REPORT

Andover Fire Rescue
Town of Andover, Massachusetts

Fire Department Deployment Study
2007-2012



October 2007

MANITOU INCORPORATED

DRAFT REPORT

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Fire Department Deployment Study
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Acknowledgments

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Special thanks go to:

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Charles Jennings, Ph.D. MIFireE, Project Manager
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John Cochran, Consultant

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1. INTRODUCTION

1.1 Background

In recent decades the Andover Fire Rescue (AFR) has experienced a significant increase in the demands for its services. This increase is primarily due the Town of Andover experiencing a significant population and economic growth coupled with the AFR's evolution to a full-service "all hazards" agency. AFR provides not only public fire protection, but is also the primary response agency for incidents including emergency medical calls, vehicle and industrial rescues, hazardous materials spills, and other emergencies for the Town's 33,000 inhabitants. In addition, these services are also provided to the countless number of commuters that travel each day to or through Andover's boundaries via Interstates 93 and 495.

Each year new industries locate to Andover in part due to its quality of life within a semi-suburban setting. With these new businesses come the people who must fill the array of new jobs. Many of these new workers choose to not only work, but also live in Andover. Much of the undeveloped area of the community has scene drastic changes over recent years in the way of commercial, industrial, residential growth, and related socioeconomic shifts. Since 1970 Andover has increased in population by roughly 9,300 persons, a 40 percent increase.

Predictably, the increase in growth will continue to pose an increase demand for municipal services with the AFR being no exception. As an example, the AFR has seen a 47 percent increase in emergency responses over the past 20 years. In order to stay one step ahead of the growth, Andover town officials have initiated studies to determine short and long term initiatives that will insure current level of services are maintained in the most proficient and cost effective way, while addressing increasing demands on programs and services.

One such study was conducted in 2006 to evaluate the management and administration of the AFR. Conducted by Municipal Resources, Inc., the Fire Services Organizational Analysis Study addressed a broad spectrum of objectives including an evaluation of the strengths, weaknesses, efficiencies, of the AFR's overall administration and management. Specifically, the study provided recommendations for improved services in a wide range of programs and services including expanding relations between management and labor, duties and responsibilities of fire company personnel in the areas of fire prevention and level of emergency medical services provided, and improvements in overall organizational efficiency through the creation of additional administrative personnel. In addition, the study suggests the AFR management further the study of replacing current stations and providing an additional fire station in the future to provide acceptable response times, particularly in the southeastern regions of the community.

It is the focus of this Fire Station Feasibility Study to formally address the issue of AFR's station locations with regards to current and future growth and subsequent call volume and response times.

1.2 Scope of Work

The Town of Andover solicited proposals from consultants to perform a study of fire station locations based on a five-year planning horizon. Manitou, Inc. was selected in September for a one month study, focused primarily on technical issues of station location. The AFR had recently completed an outside consultant review by another firm. That study focused on management and organization. The Department is also in the final stages of completing a Five-Year Strategic Plan, which identified the issue of fire stations to be critical.

The quick turnaround for this study and the limited scope made this effort somewhat challenging and unusual. Due to the availability of data and excellent cooperation from Town staff, this project was able to achieve its objectives, of providing guidance to the Town for capital planning for potential new fire stations.

The study's scope of work is based on criteria as defined within the Town's Request for Proposals and discussions during the beginning stages of the project. The scope of work included the following:

1. Evaluate the adequacy of the two existing AFR substations for future growth and make specific recommendations related to the best locations within a geographic area for replacement of the two existing substations.

2. Determine whether there will be a need for a third substation as the Town continues to build out in the future.

3. Evaluate the AFR ability to respond with the appropriate amount of equipment and personnel in the appropriate timeframe based on the location study and in accordance with National Fire Protection Association (NFPA) Standard 1710 to allow for four minute response times for the arrival of the first arriving engine company to all reported fire suppression incidents within the Town.

4. If National Fire Protection Association (NFPA) standards and Insurance Services Office (ISO) requirements [recommendations] differ, provide rationale for specific recommendations and note the differences.

5. Determine what is sufficient for the AFR to provide emergency medical services to meet current NFPA and America Heart Association standards.

6. If the NFPA and AHA requirements differ, provide rationale for specific recommendations and note the differences.

1.3 Community Profile

The Town of Andover, incorporated in 1646, has a long and proud history, beginning as an agricultural outpost in the colonial era, and progressing to the status of a village in the 19th century. Six distinct mills operated in the town, and one of these included a model industrial community established in the area named after the mill –Shawsheen. This mill included some 200 structures, which continue in private use to this day.

The Town's population remained fairly small until the era of suburbanization, as railways and highways improved access to nearby Boston. Farmland came to be used as sites for corporate offices, manufacturing, and research facilities.[1] Population increased from 17,134 in 1960 to 25,000 in 1980 to its present estimated level of 33,300 in 2007.

The community is affluent, and enjoys a high quality of life, blending the appeal of the suburbs with settings ranging from semi-rural, to bustling village. Numerous employment opportunities within the town will continue to attract residents.

The Town, part of the Merrimack Valley region of Massachusetts, is experiencing growth at a higher rate than the State as a whole. The region is growing three times as fast as the rest of the State, according to the Merrimack Valley Planning Commission.[2] This statistic can be misleading, in that the Town, while growing, is not experiencing a dramatic rise in population. Much of the development is commercial in nature, bringing with it employment, and the economic benefits that flow to the Town in terms of taxes and vitality.

The Town's population is expected to plateau near its current level, with the possibility of a major mixed use or commercial development associated with the possible construction of a new interchange from I-93, on the southeastern border of the Town. This development will be discussed later.

1.4 Andover Fire Rescue (AFR)

The AFR is a full service agency providing fire, emergency medical and special operations services to the Town's 33,000 inhabitants. The agency employs a fire chief, four deputy fire chiefs, thirteen lieutenants, forty-four firefighters, one fulltime administrative assistant, and one full-time secretary.

The agency provides its services through the deployment of three engine companies, one aerial ladder truck company, two ambulances, and one chief officer. The six units are housed within three fire stations that are strategically located throughout the community. This includes fire headquarters located on North Main Street, the West Station located on Greenwood Road, and the Ballardvale Station located at Clark Road and Andover Street (see Figure 1.1).

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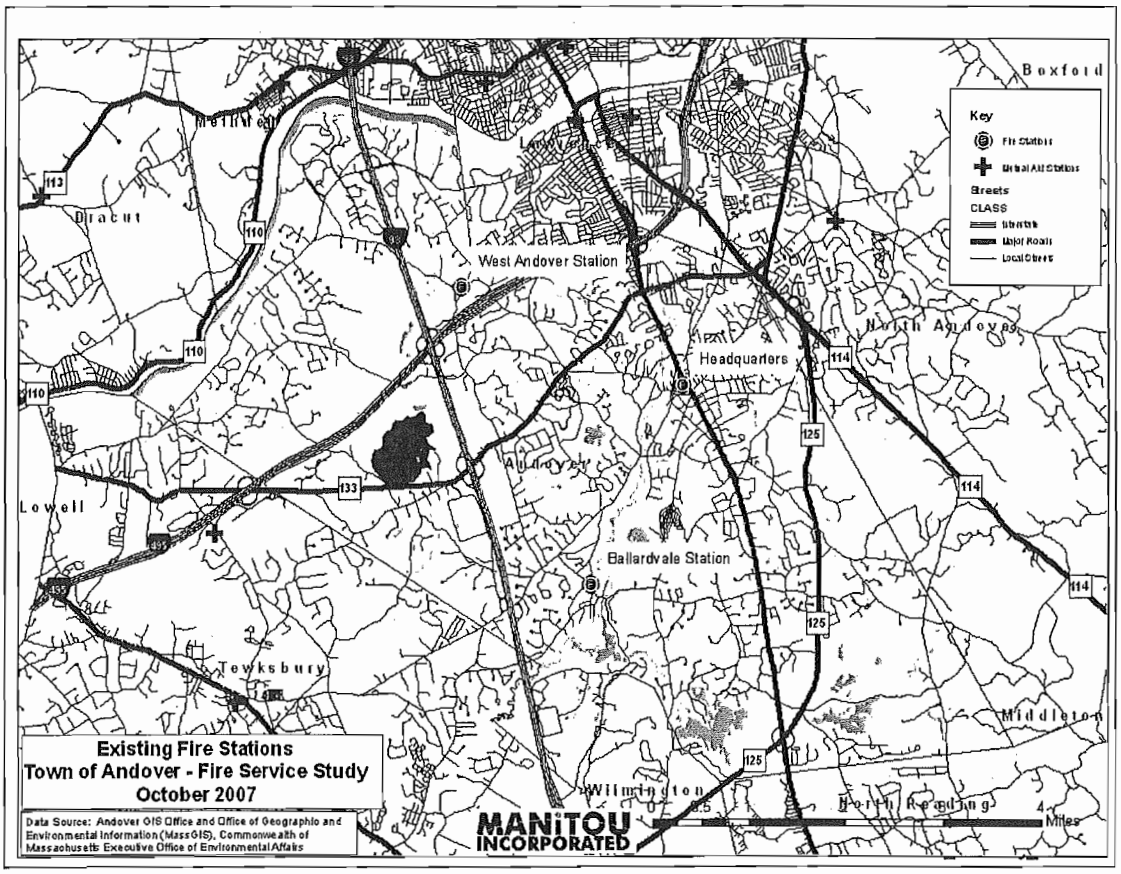
[1] Town of Andover History www.andoverma.gov/about/history.php. Retrieved October 8, 2007.
[2] Merrimack Valley Economic Development Council, Inc. *Report* vol. 2, no. 2, May/June 2001, p. 2.

Additional specialty vehicles, including boats and equipment trucks, are staffed by on-duty personnel when needed.

Figure 1.1 Existing Fire Station Locations



The Town's fire facilities (include pictures and characterize each station).
The Department is headquartered in a 50,000 square foot building constructed in 2002 to house both fire and police functions.

Shift personnel work a four-platoon system. On duty staffing consists of the following deployment shown below (Table 1.1).

Table 1.1: Staffing Pattern, AFR

Station Number	Apparatus	Staffing
1 (Central Station) 32 North Main Street	Engine 1 Ladder 2 Ambulance 91 Car 2 (Deputy Chief)	3 2 2 1
2 (Ballardvale) 1 Clark Street	Engine 2	3-4
3 (West Station) 200 Greenwood Road	Engine 3 Ambulance 92	3 2

The Department will operate with a minimum on-duty staff of 16 personnel, although they consider "normal" staffing to be 17 positions. They anticipate returning to a staff level of 17 personnel on each shift when some vacancies are filled.

A total of 23 vehicles of various sorts make up the agency's emergency response fleet. The agency responded to 8222 emergencies in 2006. Over 50 percent of the emergencies were emergency medical in nature with the remaining being fires or other emergencies. As with most emergency service agencies, the AFR has experienced an ever increasing demand for services which often times can create a strain on existing resources. In 2007 the agency provided its services and programs with a budget of over six million dollars.

A combination of AFR's services along with the capabilities of the community's water distribution system and fire and emergency dispatch services, the Town of Andover retains an overall community-wide Insurance Services Office (ISO) Public Protection Classification of 3. This rating is an excellent rating for a community the size of Andover, especially given the large land area that must be protected by the AFR. The significance of this rating will be discussed in the next chapter.

1.5 Project Approach

Manitou, Inc. has a well-established approach to performing studies of fire and emergency medical services deployment. This approach has been honed through experience in numerous studies in Departments of various sizes and composition. Because of the short time period for this study, several steps were undertaken simultaneously.

A site visit was conducted on September 18, 2007 for purposes of meeting with the Fire Chief and observing operations, facilities, and equipment of the Fire Department. During this visit, each station was toured, the dispatch center visited, interviews held with limited fire department staff, and to follow up on requests for data made prior to the study and arising from the visit.

In addition, meetings were held with representatives of the Town's Community Development and Planning Department, and Public Works Geographic Information Systems Coordinator. Referrals to other agencies with data or information of interest were also made at this time.

The Department of Pubic Safety Network Administrator was also a key person, as she is responsible for administration and extraction of information from the Public Safety records management system software. This project represented the first intensive use of the system for analysis of fire records, and was a learning experience that should make future inquiries easier.

After this basic data is collected, which includes planning studies, population forecasts, incident records, and geographic information, we use geographic information systems

(GIS) to geocode incidents, fire stations, and apparatus. This information is used as a basis for the analytic portion of the project.

2. REFERENCED STANDARDS

Two nationally recognized fire station location and response time guidelines were referenced during the project. The guidelines included is the National Fire Protection Association (NFPA) Standard 1710, *Standard for the Organization and Deployment of Fire Suppression Operations, Emergency Medical Operations and Special Operations to the Public by Career Fire Departments* and the *Fire Suppression Rating Schedule* as published by the Insurance Services Office. As they relate to this study the guidelines, they were referenced with regard to station location and response times.

Standard Objectives

Ultimately, both guidelines share similar objectives; to insure a sufficient amount of fire department resources arrive on the scene before excess property damage occurs or loss of life due to the extension of fire within a structure. It is important to note that where the rating schedule is primarily focused on property damage due to structure fires, NFPA 1710 focuses on life and property for not only structure fires, but also emergency medical calls and other emergencies today's fire services respond to such as hazardous material spills and rescues requiring specialized response teams including high angle and confined space incidents.

NFPA 1710

Adopted by the NFPA in 2001, the standard contains minimum guidelines relating to the organization and deployment of fire suppression operations, emergency medical operations, and special operations of municipalities that are served by a substantially all career fire department. The standard addresses functions and objectives of fire department delivery of services to emergencies including the minimum amount of units and their staffing and response times to emergencies. The standard also contains guidelines for managing resources and systems, such as health and safety, incident management, training, communications, and pre-incident planning.

Structure Fire Response. The standard calls for the fire department to have the capability to deploy a total reflex time within ten minutes for 90 percent of responses. The first arriving engine company should arrive on the scene within six minutes for 90 percent of the responses. The reflex time encompasses call taking and dispatch time, unit turnout time and travel time as described below.

Table 2.1: NFPA 1710 Fire Reflex Time

NFPA 1710 – Structure Fire Reflex Time Sequence				
Notification of fire to dispatch center	**1 minute →**	**1 minute →**	**4 minutes →**	**8 minutes →**
	Dispatch of fire units	**Turnout of fire units**	**Travel time of first arriving engine** **Firefighting operations begins on arrival**	**Travel time of remaining units**

The initial response should provide for the following fire ground functions:

(1) Establishment of incident command outside of the hazard area for the overall coordination and direction of the initial assignment

(2) An uninterrupted water supply of a minimum of 400 gpm for 30 minutes

(3) An effective water flow application rate of 300 gpm from two hand lines, each of which shall have a minimum of 100 gpm

(4) A victim search and rescue team

(5) A structure ventilation team using ground and/or aerial ladders

(6) An Initial Rapid Intervention Crew

It is important to note that the above criteria are based on a response scenario of a two-story 2,000 square foot single-family dwelling with a response of two engine companies and one aerial truck company.

Emergency Medical Response. On all EMS calls, the standard establishes a turnout time of one minute and four minutes or less for the arrival of a unit with basic life support (BLS)/first responder or higher level capability at an emergency medical incident. This objective should occur 90% of the time.

If a fire department provides advanced life support (ALS) services, the standard calls for an arrival of an ALS unit within an eight-minute response time to 90% of incidents. This does not preclude the BLS four-minute initial response.

The standard recommends that a fire department's emergency medical response capability includes personnel, equipment, and resources to deploy at the BLS first responder level with automatic external defibrillator (AED) or higher treatment level. The standard also recommends that all firefighters who respond to medical emergencies be trained at the minimal level of first responder/AED level.

Fire departments can have established automatic mutual aid or mutual aid agreements to meet many of the requirements of the standard. Other emergency medical recommendations found in the NFPA 1710 standard include EMS system components, EMS system functions and quality management.

Table 2.2: NFPA 1710 EMS Reflex Time

NFPA 1710 – Emergency Medical Response Reflex Time Sequence				
Notification of emergency to dispatch center	**1 minute** →	**1 minute** →	**4 minutes** →	**8 minutes** →
	Dispatch of BLS and ALS units	**Turnout of units**	**Maximum travel time of BLS unit.** **Patient care begins on arrival**	**Maximum travel time of ALS units**

American Heart Association and NFPA 1710. As with NFPA, the AHA has implemented guidelines for the response to medical emergencies. Focused on sudden cardiac arrest incidents, the guidelines establish minimum response time criteria for BLS services utilizing an Automated External Deliberator (AED) for the cardiac arrest patients. The goal of the BLS response time criteria is to increase the rate of survival of people who have a sudden cardiac arrest. Their criteria calls for a delivery of an AED shock to a victim within 3 to 5 minutes of collapse. This is based on data showing every minute without immediate CPR and defibrillation, the odds of survival decrease 7% to 10%. In many cases this benchmark may be met using the emergency medical response criteria found within NFPA 1710. A key to patient survival is to provide for an AED program that incorporates not only a response of an AFR ambulance, but the training of citizens throughout the community in public places where stationary AEDs are made readily available to those who are properly trained in their use.

Special Operations. Those emergency responses that do not fall within the criteria of structure fire or emergency medical calls fall within the category of special operations. This normally includes emergencies such as technical rescue, hazardous material spills, man-made disasters and other responses requiring specialized skills and equipment. The standard does not call for specific response times and benchmarks, but do require

standard operating procedures and guidelines and training that provide an adequate and reasonable level of response.

ISO Fire Suppression Rating Schedule

Arguably the most referenced guideline for fire department deployment for over 90 years, practically all aspects of today's municipal fire department owes its origins to the application of the rating schedule by the insurance industry. From the location of fire stations, fire unit staffing and overall fire department organization, fire chiefs across the country for generations have applied the rating schedule's criteria as justification for improvements in their fire departments.

From a fire station location perspective, the rating schedule is straightforward in the criteria used for the location (distribution as referenced in the schedule) of fire stations and the number of needed engine and aerial ladder truck units. Below illustrates the rating schedule's criteria for unit location:

Table 2.3 ISO Fire Response Criteria

Type of Unit	Location Criteria
Engine Companies	1.5 road miles from properties served
Aerial ladder truck companies	2.5 road miles from properties served

The above location criteria are based on an assumption that fire units travel at a constant speed of 35 miles per hour. Using this speed as a constant, units will be able to arrive on the scene within 4 minutes of travel time, a similar benchmark as that which is identified within NFPA 1710. It must be noted, however, that NFPA 1710's 4 and 8 minute benchmarks are not normally measured in the same way as the response distances found within the rating schedule. Whereas the rating schedule response criteria remains the same for all parts of a community, NFPA 1710 assumes that topography, traffic congestion, and other road conditions may alter travel speeds.

Recent ISO Survey. The most recent ISO survey was conducted in 2002. The results of the survey showed the AFR received the following credit for the distribution of engine and aerial ladder truck companies:

Number of Needed Engine and Aerial Ladder Truck Companies: To receive a maximum credit of 10 points the AFR needs a total of five in service engine companies. The needed number was based a basic fire flow of 3,500 gpm and the area served by the agency. The number of in service engines counted during the survey totaled three, one in-service staffed unit at each of the three AFR stations. For the maximum credit of 5 points for the distribution of aerial ladder truck companies, the AFR needs in service one truck. At the time of the survey the AFR had in service one unit in service and thus received 4.21 points. The deficiency in accredited points is due to not the number of units in service, but due to an insufficient amount of equipment carried on the unit.

It is unclear from the survey report exactly where improvements could be made. It is apparent, however, that by using criteria as set forth within NFPA 1710, the community should experience similar results for engine and aerial ladder truck company distributions needs if not make slight improvements in future surveys.

Special Considerations. It is important to note the differences in the two referenced guidelines with regards to their response criteria. Where NFPA 1710 is designed to address the full facet of emergencies a career fire department responds to, ISO's intent is to specifically measure a fire department's response to "structure" and similar type properties. **Communities whose fire stations are strategically located using NFPA 1710's criteria for the arrival of the first due engine company for structure fires and BLS medical response generally experience adequate deployment during an ISO survey** (see Table 2.4).

Table 2.4: Comparison of NFPA1710 and ISO

Response Criteria	1710	ISO
Structure Fire		
1st Due Engine Co.	4 min./90%	1.5 miles/At all times
2nd Due Engine Co.	8 min./90%	3-4 miles/At all times
Aerial Truck Co.	8 min./90%	2.5 miles/At all times
Medical Emergency		
BLS	4 min./90%	N/A
ALS	8 min./90%	N/A
Special Operations		
Hazmat, technical rescue, etc.	Local SOGs	N/A

It is important to remember that however influential these standards are within the fire service, that the ISO standard is specifically not intended to be used as a tool for management of fire departments. Likewise, these standards are not reflective of alternative approaches to managing a community's fire problem and have been sharply criticized by many in the public policy field.

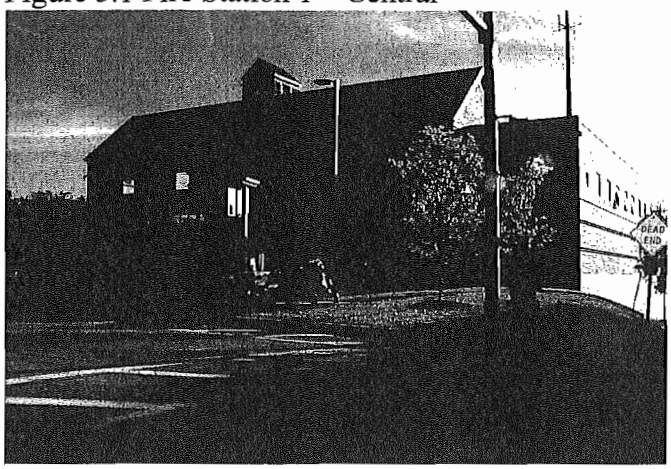
Nonetheless, they each carry weight when evaluating a community's fire defenses.

3. CURRENT SERVICE DELIVERY

3.1 Fire Stations and Apparatus

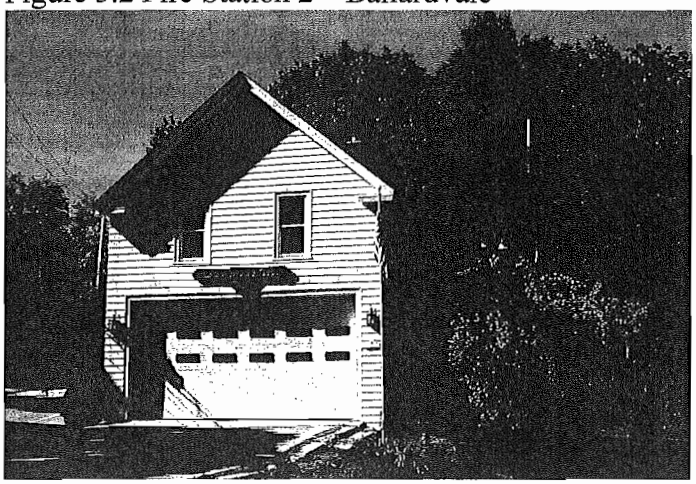
The Andover Fire Department provides services from three facilities, as indicated previously. Of these facilities, one is essentially new, having been completed a few years ago, while the other two are over 40 and over 100 years old, respectively.

Figure 3.1 Fire Station 1 – Central



Fire Station 1 is a modern facility equipped with 5 full-depth bays capable of handling an aerial device and an engine in any bay. This facility, located in the historic center of the Town along its northern border, also houses administrative offices for the Department. It is also the Town police station and dispatch facility.

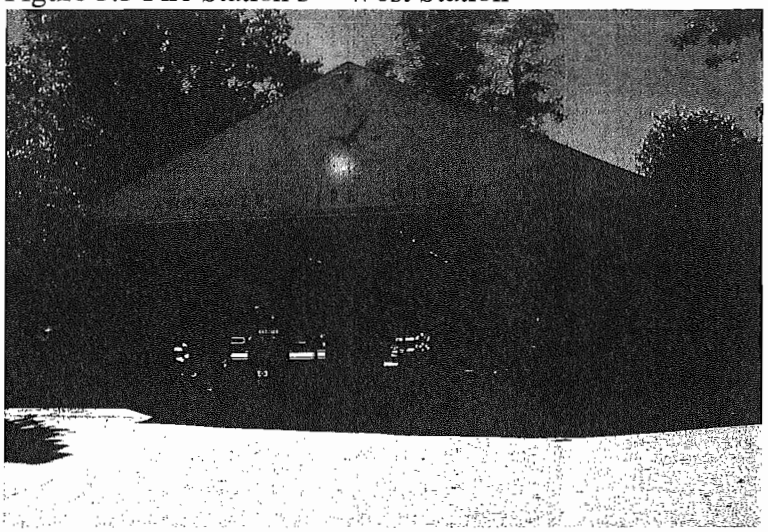
Figure 3.2 Fire Station 2 – Ballardvale



The Ballardvale fire station dates from the era of horse-drawn apparatus. A quaint facility, it serves the historic Ballardvale section of the community. It is only large enough to accommodate a single modern engine company, and is poorly sited for ingress and egress from the facility. It does not meet any modern standards for fire stations, and

is obsolete from the standpoint of the Town's needs. It is located at the intersection of Clark Road and Andover Street.

Figure 3.3 Fire Station 3 – West Station



The third station, located on Greenwood Road, has two full-length bays capable of accommodating modern fire apparatus. The facility, which is 40-years-old, is showing considerable signs of its age, and is marginally suited to continued use as a fire station without some rehabilitation. It is located very near to the Town border, which negates some of its value in terms of servicing the Town.

The Department's rolling stock is in generally good to very good condition, and consists of 4 engines, 2 skid-mounted brush units, three ambulances, four administrative vehicles, a box truck, a pick up truck, two aerial (ladder companies), 4 boats (3 inflatable, 1 aluminum), and associated trailers and a technical rescue equipment trailer.

3.2 Calls for Service

The AFR records incident numbers for all activities, including training, fire prevention inspections, education details, and administrative activities. This is a good management policy, which allows an accurate view of overall activity and productivity within the Department.

Table 3.1 presents the list of incidents taken from the Department's annual reports. The definitions of some incidents changed over the course of these statistics. While they are interesting from a managerial perspective, we are more interested in *emergency* incidents. Emergency incidents are distinguished because 1) they require an immediate response; and 2) they are sensitive to the location of facilities – timeliness is critical. Administrative, inspectional, and training activities can be rescheduled or cancelled as required. Additionally, in terms of staff utilization, these activities do not necessarily have to be performed by on-duty fire suppression or emergency medical services staff members.

Table 3.1 AFR Incidents from Annual Reports 1999-2006

Incident Type	1999	2000	2001	2002	2003	2004	2005	2006
Fires	445	420	420	552	1098	1028	1279	1159
EMS	2427	2770	2753	3038	3094	2514	2632	2743
MVA	249	283	321	403	284	253	365	279
Hazardous Condition					130	109	227	258
False Alarm and False Calls	191	50	207	163	747	744	814	796
Misc. Alarms	404	528	450	554	529	303	192	25
Good Intent					140	117	141	130
Mutual Aid Fire	35	20	47	14	17	21	21	26
Mutual Aid Ambulance	155	61	53	40	57	50	48	41
FP Activities	2040	2343	2224	2030	2204	2135	1730	1658
Service Calls	1501	2265	2958	2597	2460	2231	2421	2159
Training	180	144	177	126	138	121	225	265
CO Activation	48	45	36	24	34	25	57	77
Rescues	16	21	39	95				
Accidental Alarms	175	180	106	171				
Total	7866	9130	9791	9807	10932	9651	10152	9616

In order to better understand the emergency demand for service within the Town of Andover, we eliminated non-emergency incidents from further consideration, leaving us with a set of incidents roughly defined by the National Fire incident reporting System (NFIRS) coding scheme. This set of data is more comparable with other jurisdictions, and is suited for planning use because emergency calls are not subject to fluctuation caused by administrative or policy decisions. For example, a fire code can change, requiring a new set of premises be inspected.

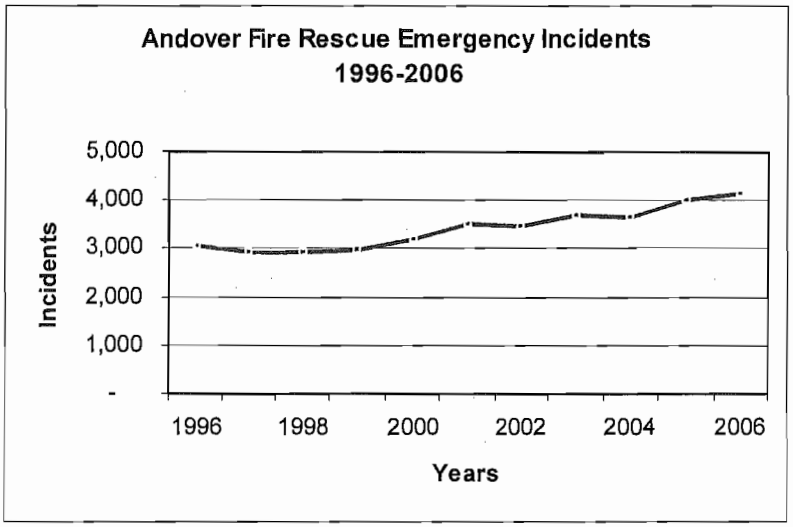
Table 3.2 lists emergency incidents used in this analysis. While this list is consistent with NFIRS categories, a restricted set of classifications was used for ease of analysis and consistency with local data and practice.

Table 3.2 AFR Emergency Incidents

Incident Type	2002	2003	2004	2005	2006
EMS	1300	2394	2379	2491	2583
Haz Cond	49	123	131	168	176
Other	597	963	922	1060	1156
Mutual Aid	20	23	18	22	25
Fire	157	194	190	251	200
Total Emergency	2123	3697	3640	3992	4140

It is important to distinguish between incidents – which are calls for service from the public received via telephone or automatic alarm; and responses – which represent a fire company response to a reported emergency. A single incident can generate multiple responses.

Figure 3.4 AFR Emergency Incidents 1996-2006



The time of day for incidents is also of interest when considering the demand on the emergency response system. Fire services typically staff with the same numbers of staff on a 24-hour basis. In systems with limited staffing or demand for service, uniform staffing is a reasonable practice, because serious fires are rare events which can be argued to occur at random. However, certain types of emergencies do not occur at a uniform rate, and are subject to systematic variation. Typical among these are emergency medical services. Private sector EMS providers often staff based on the historic demand for service.

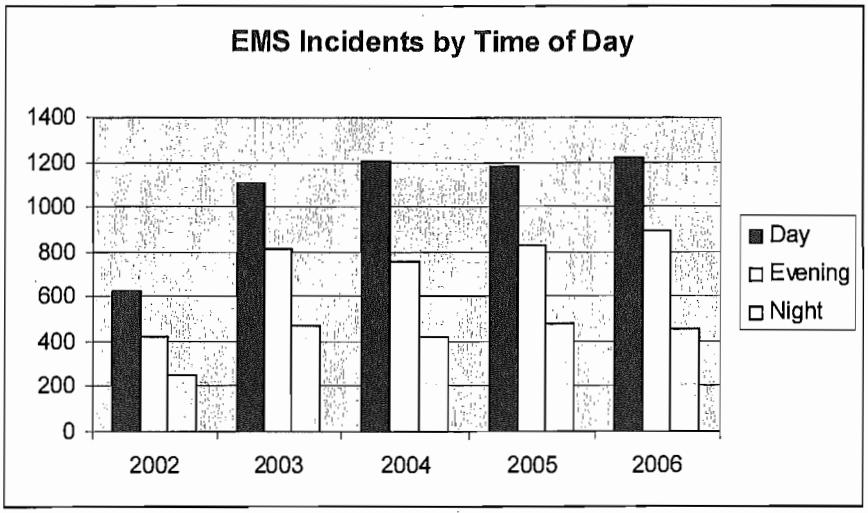
Table 3.3 shows the temporal distribution of incidents on three times of day – day, evening, and night. This distribution of incidents confirms some of our earlier statements about the variation of incidents with time of day. The percentages within the table show the relative number of incidents of each type. We would expect to see 33.3% in each column if incidents were uniformly distributed by time.

Table 3.3 Incidents by Type and Time of Day, 2006

	Day (0800-1700)	Evening (1700-2400)	Night (0000-0800)	Totals % of all alarms
EMS	1225 (47.4%)	899 (34.8%)	459 (17.8%)	2583 (62.4 %)
Fire	89 (44.5%)	85 (42.5%)	26 (13%)	200 (4.8%)
Hazardous Condition	84 (48%)	76 (43%)	16 (9%)	176 (4.3%)
Other	588 (51%)	374 (32%)	194 (17%)	1156 (27.9%)
Mutual Aid	10 (40%)	10 (40%)	5 (20%)	25 (0.6%)
	1996	1444	700	4140

Most incident types are overrepresented during daytime hours. Highest among these are EMS, "Other", and hazardous condition alarms. Other alarms primarily include fire alarm system activations, elevator rescues and hazardous condition alarms include gas leaks, wires down, and related emergencies. Figure 3.1 shows EMS (medical) incidents by time of day.

Figure 3.5 EMS Incidents by Time of Day



3.3 Mutual Aid

The Andover Fire Department participates with other fire departments in the Essex County region in a mutual aid network. A separate agreement is in effect for ambulance mutual aid. Consistent with regional practices, mutual aid is initiated on a special request, and is generally only engaged after a municipality or Department has fully committed its existing fire or EMS response resources.

The mutual aid plan provides for fire responses through the tenth alarm. The AFR recalls its off-duty personnel on the second alarm. They are used to staff reserve apparatus as required, to cover empty Andover Fire Stations or to respond to the scene. For each alarm above the second alarm, units that would otherwise respond to the fire on the next highest alarm (see table) are used to cover Andover Fire Stations. That is, mutual aid companies move to cover Andover stations, and proceed to the fire on the next highest alarm.

Ambulance mutual aid is used more frequently, with North Andover being the most commonly used mutual aid ambulance (27 times in 2006), as opposed to only 7 times for a North Andover engine company. The operation of the current system appears to be satisfactory.

Table 3.4: Mutual Aid Running Fire Response List for Town of Andover

Alarm	Engine	Engine	Engine	Ladder
1	Andover	Andover		Andover
2	Andover	Andover		
3	North Andover	Tewksbury	Lawrence	
4	North Reading	Wilmington	Methuen	Lawrence
5	Reading	Billerica	Lowell	North Andover
6	Haverhill	Middletown	Dracut	Tewksbury
7	Chelmsford	Boxford	Salem, NH	Topsfield
8	Groveland	Woburn	Georgetown	Stoneham
9	Peabody	Burlington	Lynnfield	Ipswich
10	Danvers	Wakefield	Pelham	Newburyport

Automatic aid, or closest unit response is not generally practiced in this region. For purposes of this study, the Town's political boundaries were considered to be serviced on a first-response basis only by Andover's internal resources. The practice of automatic aid could provide economies in scale and potentially improve response times to emergencies, but an evaluation of such a system was beyond the scope of this study.

The Department's use of mutual aid is fairly limited – in 2006 mutual aid was received 57 times and given 100 times. These numbers do not include advanced life support "chase car" services provided to the Town by Lawrence General Hospital.

3.4 Summary of Current Service Level

Response times are a critical measure of service for fire and rescue. Total response time is composed of call processing time, plus turnout time, plus driving time. Call processing time is the time from when a caller dials the fire department to when the call is dispatched to the appropriate units. National standards suggest that this should be done within one minute. Turnout time is the time from when a station is alerted to when they are aboard the apparatus and ready to respond. The final element of response time is the driving time, that time from leaving the station to arriving at the emergency.

We begin by examining the current driving coverage form the existing Andover fire stations. This time is driving only, and does not reflect turnout or call processing. Figure 3.4 shows 4-minute driving times for engine companies. The color contours show 1-minute gradations in driving time from each station. The NFPA 1710 standard requires a 4-minute driving time to 90 percent of incidents, which should be roughly reflected in these maps.

The areas furthest from existing stations – the far southeast and southwest sections of Andover, have driving times of greater than five minutes. This is not exceptional, given the geography of the Town and the relatively low demand for service in some of these areas.

Figure 3.4 Existing Engine Coverage

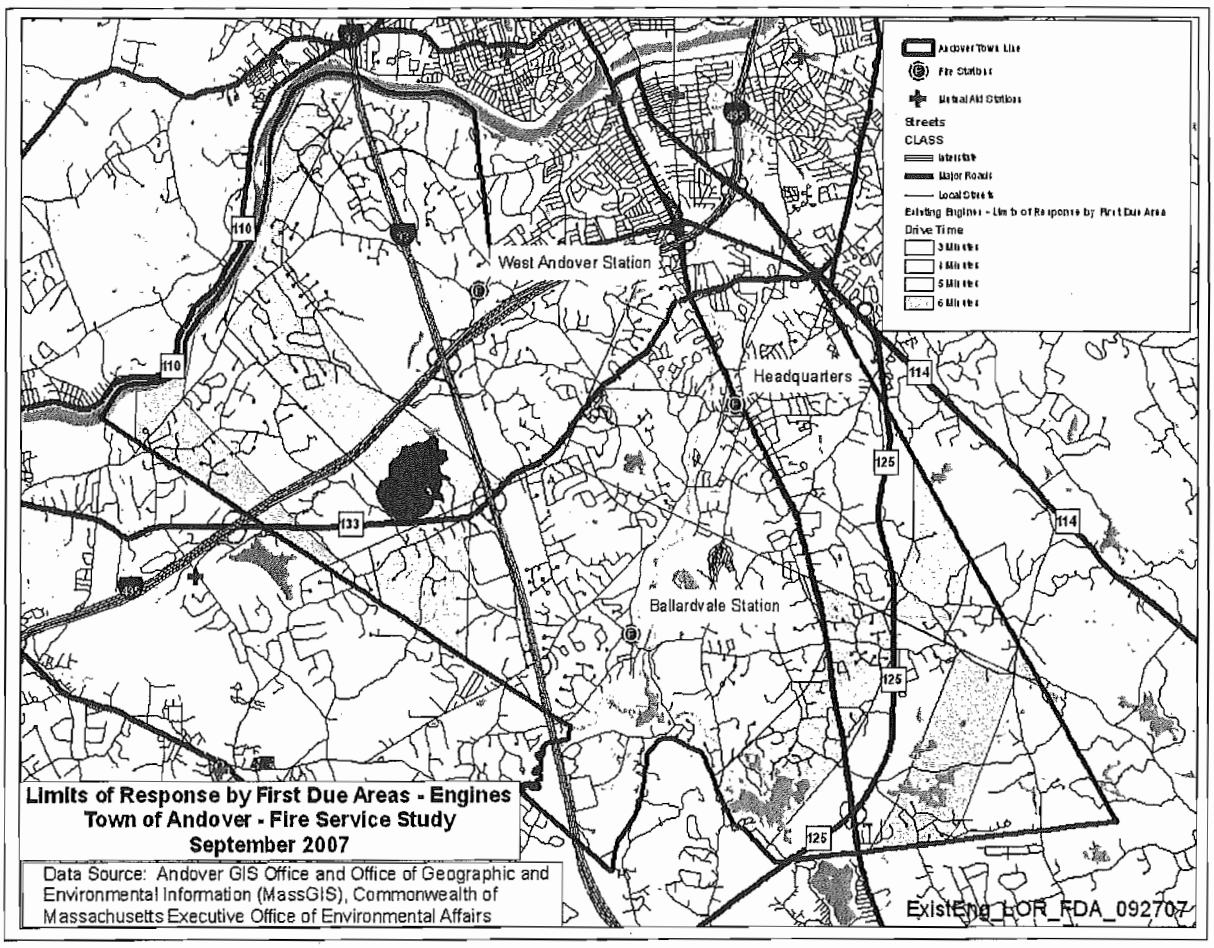


Figure 3.5 shows ambulance coverage using the same time contours. The map shows that significant portions of the Town are beyond the 4-minute response from an ambulance. The use of an engine company as a first-response vehicle mitigates this issue, but does not address the potential time required to wait for a transport unit (ambulance) to arrive, especially when one of the existing units is unavailable.

Figure 3.6 shows ladder coverage in the Town. Not surprisingly, response times are longest for the ladder company because it is covering the entire Town from one location. Generally, it can reach almost any part of the town within 8 minutes, meaning that even if it were the last unit to arrive at an incident, it would meet the requirements of NFPA 1710.

Figure 3.5 Existing Ambulance Coverage

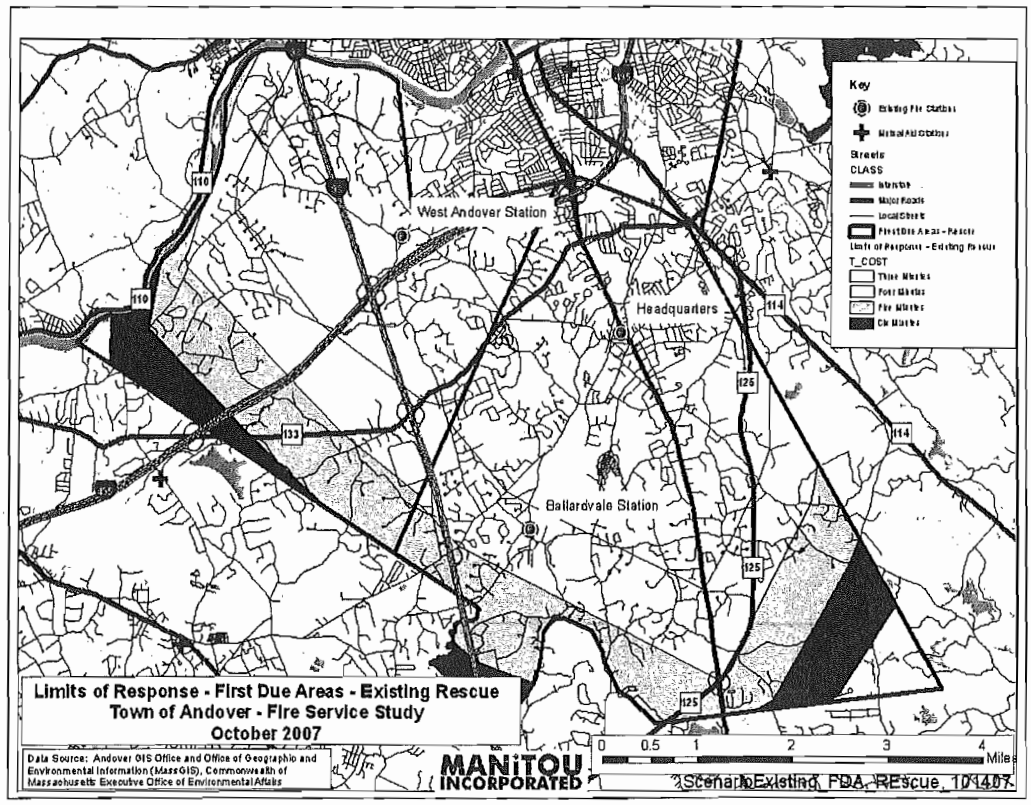
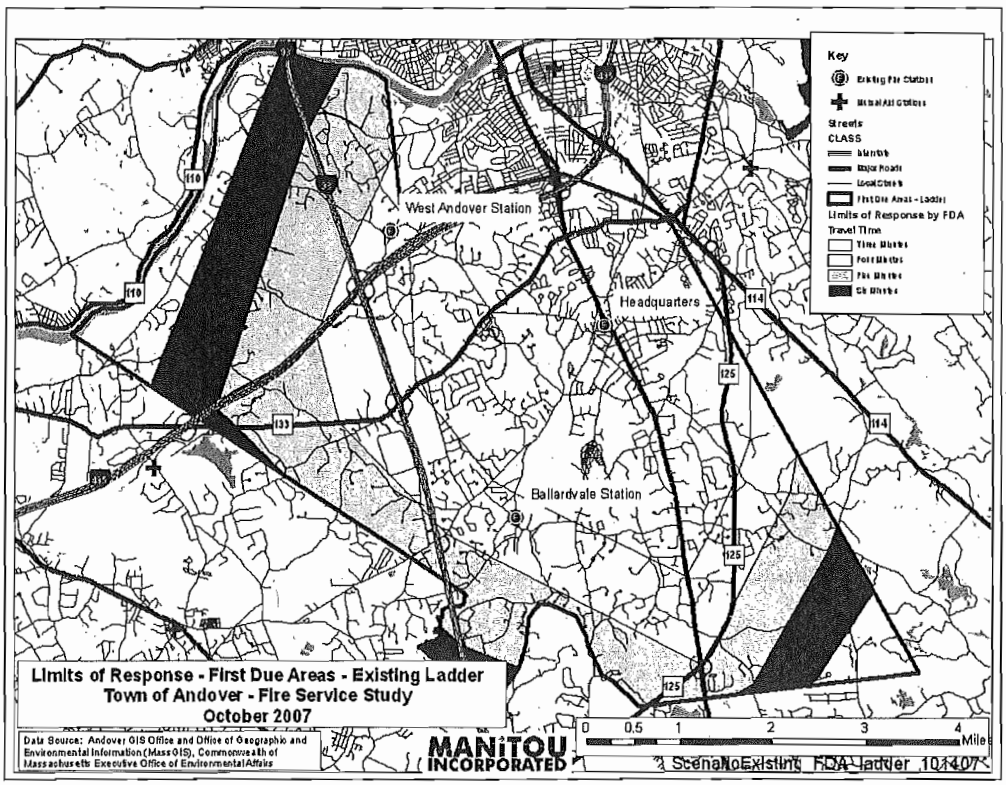


Figure 3.6 Existing Ladder Coverage



For purposes of this analysis, we will confine our discussion to time from when a unit is dispatched to an incident to when they arrive on the scene. Average response times for incidents by type are shown in Table 3.5. These times include what is termed "turnout" time, so we should generally deduct up to one minute from these averages to reflect driving time.

Table 3.5 Average Response Times AFR, 2006

Incident Type	Number of Responses	Average Response Time
EMS	3714	6:22
Fire	3183	5:06
Hazardous Condition	298	6:06
Other	231	6:34

Average response times are only one way to summarize this information. For compliance with NFPA 1710, we need to examine the 90th percentile response times. The 90th percentile times to all incidents in 2006 was 9:00. This is not in compliance with NFPA 1710, which requires a 4:00 response time to 90 percent of incidents.[3]

Given Andover's large area, and the fact that almost 32 square miles are being covered with three stations, this figure should not be surprising. The NFPA 1710 standard is very demanding, and even urban fire departments have difficulty meeting its requirements. The 90th percentile figures appear to be consistent with the average response time numbers that we developed.

To summarize, the Town is covered by a minimal number of units to meet the staffing component of NFPA 1710. This, however, assumes that all units are available. This is not an unrealistic assumption for units with relatively low response volumes (<1000), but as units get busier, they cannot always be assumed to be available.

We can better understand the availability of units by studying the amount of time that they are committed on emergencies and otherwise unavailable to respond. This figure can be referred to as unit hour utilization, meaning the percentage of time that a unit is on an incident divided by the total time that it is in service. For 24-hour staffed units, there are 8760 hours in a year.

We calculate the unit hour utilization by multiplying the number of responses by the average amount of time spent on each response. For ambulances, they spend about 55 minutes out of service on each EMS response. That means, for example, that ambulance 91, which made 1600 EMS responses in 2006, was out of service for 1334 hours, for a 15.2 percent unit hour utilization. Ambulance 92 has a 7.5 percent utilization. What this means is that over 15 percent of the time, one of the ambulances, which are critical to

[3] Our analysis included all incident types. It is possible that we have included some non-emergency incidents which may be skewing the response time data in a higher direction.

making up the necessary staff for firefighting purposes, are unavailable. A complete table of out of service times for emergency calls is included in the appendix.

The situation is most severe for ambulances because of the large number of responses, and the long periods that they spend on calls for service. Average amounts of time spent for calls by type for all units is given in Table 3.6.

Table 3.6 Average Out-of-Service Times by Type of Incident

Type of incident	Average Time OOS (minutes)
EMS	39
Fire	23
Hazardous Condition	32
Other	33

Based solely on unit hour utilization, none of the Andover units is making an excessive number of responses, but overall, it is not safe to assume that all units will be available to respond to a structural fire incident requiring all on-duty personnel.

4.POPULATION AND DEMOGRAPHIC DATA AND FORECAST METHODOLOGY

4.1 Data Sources

The supporting data for the Fire Study was collected from a variety of sources in the Massachusetts area. The primary Geographic Layers used were from the Office of Geographic and Environmental Information (MassGIS), Commonwealth of Massachusetts Executive Office of Environmental Affairs. These files were downloaded from the MassGIS web site and used throughout the project. The layers included were:

i. Image reference File
ii. Ortho Images
iii. Town and political boundaries
iv. Fire Stations
v. Census Boundaries
vi. Street Centerline files
vii. Hydro Files

A second source that was used was the Town of Andover GIS Department. Data included from this source included:

viii. Zoning layers
ix. Parcel information
x. Town boundary

A third source was the Merrimack Valley Regional Council, the local Metropolitan Planning Council. They provided a Layer of Traffic Analysis Zones that contained the baseline census data by small area polygons and the forecasted 2030 values based on their modeling efforts.

4.2 Interstate 93 Interchange Proposal

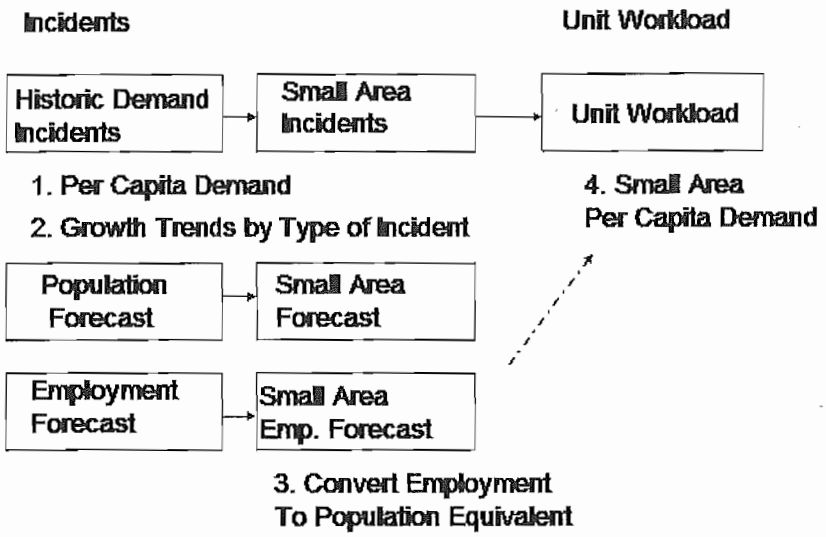
The I-93 Project presents an interesting challenge for services within the Town. On one hand the opportunity for growth of commercial and industrial real estate is great and all three towns adjacent to the proposed location will benefit from this roadway improvement. At the same time the concern is how the new interchange will affect traffic in Ballardvale. Additionally for the Town, the increased traffic puts a strain on the ability of the service to respond to calls for service in this potentially crowded area. The three remaining design options for the interchange - a trumpet, diamond and loop shape - will all be advanced for preliminary design purposes. This study has not taken a preferred design roadwork configuration. Rather the incident projection high forecast covers the projected growth from this interchange and the increase in EMS calls that typically are associated with the type of development that will be associated with the interchange will be addressed in the recommendations chapter.

4.3 Forecast Methodology

Manitou has developed and refined a methodology for forecasting incidents based on empirical information and consistent with theories on relationships between community characteristics and demand for services. The methodology can be adjusted for available data and the planning horizon used, and is very robust.

Conceptually, the forecasting process begins with historic demand for service, population, and employment data. Figure 4.1 illustrates the process. Once information is received or estimated for the entity being studied, the data is disaggregated by smaller areas. These small areas are aligned with existing fire company response districts to produce individualized functions for responses versus incidents.

Figure 4.1 Conceptual Forecast Process



After moving top-down for demand, we build up unit workloads from the bottom up, building from small area forecasts based on population and response information. Change in the forecast is achieved through changes in 1) population and 2) per capita demand for service.

5. INCIDENT AND UNIT RESPONSE FORECAST

One of the key tasks in assessing the Department's long-term capabilities and needs is estimating demand for service. For this project, we produced 5-year forecasts of incidents. These forecasts were produced using a proprietary methodology developed and used over the course of several fire department studies and discussed previously in this report.

We begin by estimating the annual population of the Town, and by using records of fire incidents by type to produce estimates of per capita demand for service by type of incident. This process allows us to differentiate changes in demand for service attributable to growth in population versus changes in the per capita utilization of services. Both characteristics are likely to play an important role.

Several sources of data were used to produce the forecasts. These included long-range population and employment forecasts produced by local planning agencies. AFR incident data was also used.

The starting point for any forecast is to examine the population trends within the Town. Andover, because of its role as an employment center, requires that we also consider employment in demand for service. We do this by attributing some of the demand for service to people employed in the Town. We start with resident population, ad then apply an adjustment based on workers being present for 40 hours a week, or 40 hours divided by 168 hours in a week. This produces an adjusted population, which we use to generate per capita rates of demand by type of incident.

Figure 5.1 Andover Population and Employment 2000-2006

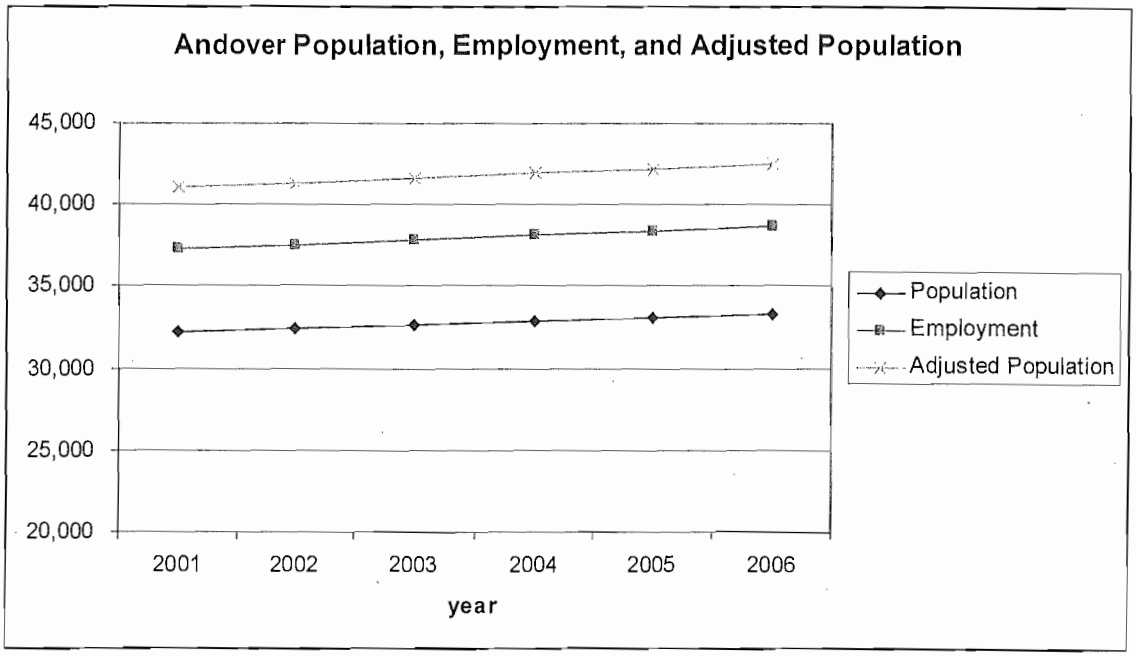


Figure 5.1 shows employment and population from 2000-2006. Both are increasing, with employment consistently larger than population.

Two sets of demand estimates were produced for the period 2007 – 2012. These estimates are dependent on two main characteristics of the Town: its population growth and the utilization rates for fire and other emergency services by the public. The demand forecast therefore was developed in two major steps.

First, the population of the Town was estimated for each forecast period. Due to the availability of good population estimates from the Merrimack Valley Planning Commission and other sources, this step was straightforward. The populations from 2000 and 2020 were used and a straight interpolation was used to estimate intervening years.

The second step in the methodology is to compute the trend in calls per capita by type of call. Figure 5.2 shows the calls per 1,000 population by type of call for 2002-2006, based on the data shown in Table 5.1. We base this table on that of incidents by type presented earlier in the report.

Table 5.1 Per Capita Demand for Service (Adjusted Population)

	2002	2003	2004	2005	2006
BLS	0.0635	0.0575	0.0568	0.0590	0.0608
Haz Cond	0.0012	0.0030	0.0031	0.0040	0.0041
Other	0.0144	0.0231	0.0220	0.0251	0.0272
Mutual Aid	0.0005	0.0006	0.0004	0.0005	0.0006
Fire	0.0042	0.0047	0.0045	0.0060	0.0047
Total	0.0837	0.0888	0.0868	0.0946	0.0974

Next, we determine trends in per capita demand for service by looking at the change in per capita demand from year to year. Because there was a change in NFIRS definitions, and therefore data consistency in 2002, we went form 2003 forward in this phase.

Table 5.2 Annual Percentage Change in Per Capita Rates

Year	2003	2004	2005	2006	Last 3 yrs
EMS	0.9061	0.9869	1.0399	1.0298	1.0189
Haz Cond	2.4930	1.0577	1.2736	1.0404	1.1239
Other	1.6020	0.9509	1.1418	1.0831	1.0586
Mutual Aid	1.1421	0.7772	1.2138	1.1286	1.0400
Fire	1.1202	0.9727	1.3120	0.7914	1.0253
Total Emergency	1.0605	0.9778	1.0892	1.0300	1.0323

Selecting a rate for the forecast is a function of judgment based on stability of the rates, their magnitude, length of forecast, community characteristics and national experience. In this case, we used three year average rates of change. In the low forecast, we assume that per capita rates will remain unchanged. In the high forecast, we apply an annual growth

factor to the per capita rates, which are multiplied by per capita demand to generate a forecast of incidents.

In reality, we expect the actual demand for service to fall somewhere between the low and high forecast. They should be considered as credible lower and upper bounds. Given the five-year nature of the forecast, we would expect the actual demand to be closer to the high forecast.

Table 5.3 shows the Low Forecast of incidents. In the low forecast, EMS remains the predominant source of demand, though increases are only about 30-30 incidents per year. Total incidents increase by less than 200 over the forecast.

Table 5.3 Low Forecast of Incidents

LOW						
Year	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**
EMS	2630	2678	2697	2717	2731	2743
Haz Cond	198	201	203	204	205	206
Other	1223	1245	1254	1264	1270	1275
Mutual Aid	26	26	27	27	27	27
Fire	205	209	210	212	213	214
Total Emergency	4282	4359	4391	4424	4445	4465

Table 5.4 shows the high forecast of incidents. In this forecast, overall incidents increase by over 1,000, with EMS and "Other" alarms increasing almost the same amount in absolute terms. Overall demand for service would exceed 5,000 emergency incidents per year by 2012.

Table 5.4 High Forecast of Incidents

HIGH						
Year	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**
EMS	2630	2728	2800	2874	2943	3011
Haz Cond	198	226	256	290	327	370
Other	1223	1318	1405	1499	1594	1695
Mutual Aid	26	28	29	30	32	33
Fire	205	214	221	228	235	242
Total Emergency	4282	4514	4712	4921	5131	5351

These incident forecasts are then translated into unit response forecasts (see Tables 5.5, and 5.6). Using a threshold of 3,000 responses to reflect a unit that is becoming overloaded with activity, only Ambulance 91 begins to approach this level of utilization in the high forecast in 2012, with 2800 responses. The next busiest company is Engine 1, with just over 1900 responses annually.

Table 5.5 Low Forecast Unit Responses

LOW	2007	2008	2009	2010	2011	2012
AMB91	2241	2282	2299	2315	2327	2337
AMB92	1192	1213	1222	1231	1237	1242
CAR2	742	755	761	766	770	773
ENG 1	1547	1575	1587	1599	1606	1613
ENG 2	804	818	824	830	834	838
ENG 3	837	852	858	864	869	872
LAD 2	728	741	747	752	756	759

Table 5.6 High Forecast Unit Responses

HIGH	2007	2008	2009	2010	2011	2012
AMB91	2241	2363	2466	2576	2686	2801
AMB92	1192	1256	1311	1369	1428	1489
CAR2	742	782	816	852	889	927
ENG 1	1547	1631	1703	1778	1854	1934
ENG 2	804	847	884	924	963	1004
ENG 3	837	882	921	962	1003	1046
LAD 2	728	768	801	837	873	910

Although we were asked to forecast for five years, there are some long-term trends that will bear upon the Department in the future. The overall population will remain fairly stable, in part due to decreasing household size. Employment may grow, and retailing may attract additional visitors that can have an impact on additional demand for service.

The percentage of population over the age of 65 is projected to increase as a percentage of the town's population from under 10 percent in 1980 to over 12 percent in 2000. This population 65 or over is expected to reach 14 percent by 2010, and continue to increase both in absolute and relative terms. [4]

Tracking this population demographic is important because national data show that seniors are disproportionate users of emergency medical services. This means that even given a relatively stable overall population within the Town, the potential for increasing demand for service exists and is likely.

Overall, we believe that these forecasts paint an orderly future for the Department, presenting ample opportunity for reasoned reflection and anticipation of needs to maintain or improve fire and emergency medical services going into the future.

[4] Massachusetts Institute for Social and Economic Research, Population Estimates, December 10, 2003.

6. RECOMMENDATIONS

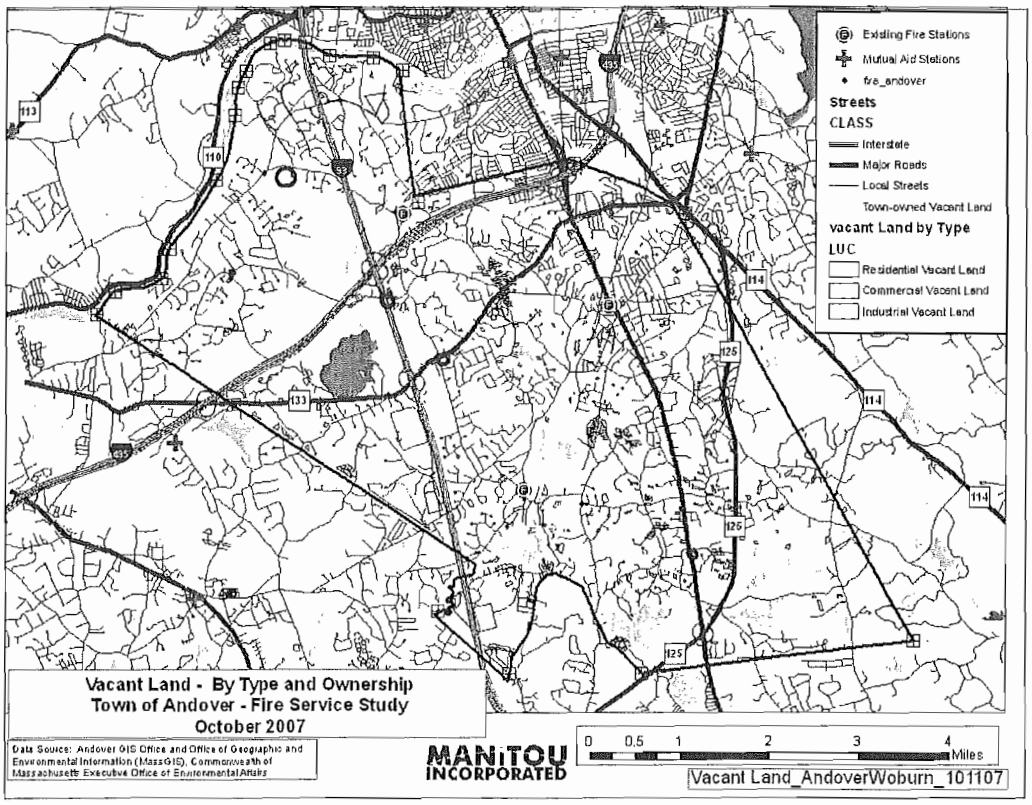
Based on the foregoing discussion and analysis we offer the following recommendations.

1. Relocate Stations 2 and 3

Both Stations 2 and 3 suffer from inadequate space, poor location, or both. Station 2 is too small to accommodate necessary equipment, and Station 3 is poorly located to maximize its impact on serving the Town.

We evaluated several alternatives for stations, aided by a map of vacant and Town-owned land. Like most studies, there are practical limitations to where facilities can be located, and acquisition of built-upon property in an affluent community may be prohibitively expensive and politically infeasible. We attempted to identify locations where there was 1) good street access; 2) vacant property; and 3 not extremely sensitive areas on their face (i.e, adjacent to waterways, on parkland, etc.). Figure 6.1 shows vacant and Town-owned land.

Figure 6.1:Town-owned and vacant land



While specific locations are given for the proposed stations, some variance from these locations (1/4 mile) may be acceptable without having a major impact on their efficacy.

We propose that Stations 2 and 3 be relocated to the intersections of Andover and Woburn Sts. And Bellevue and Lowell Rd., respectively. Figure 6.2 shows the proposed station locations with response time contours. The improvements should be contrasted with Figure 3.5. This alternative moves Station 2 to the east, providing better coverage for more of the Town, and Station 2 is moved southward away from the border of the Town and adjacent to an interchange for I-93, giving it quick access to the interstate highways for response to accidents, and for faster response to the north or south during non-rush hours.

Figure 6.2 Proposed Station Locations, Alternative One

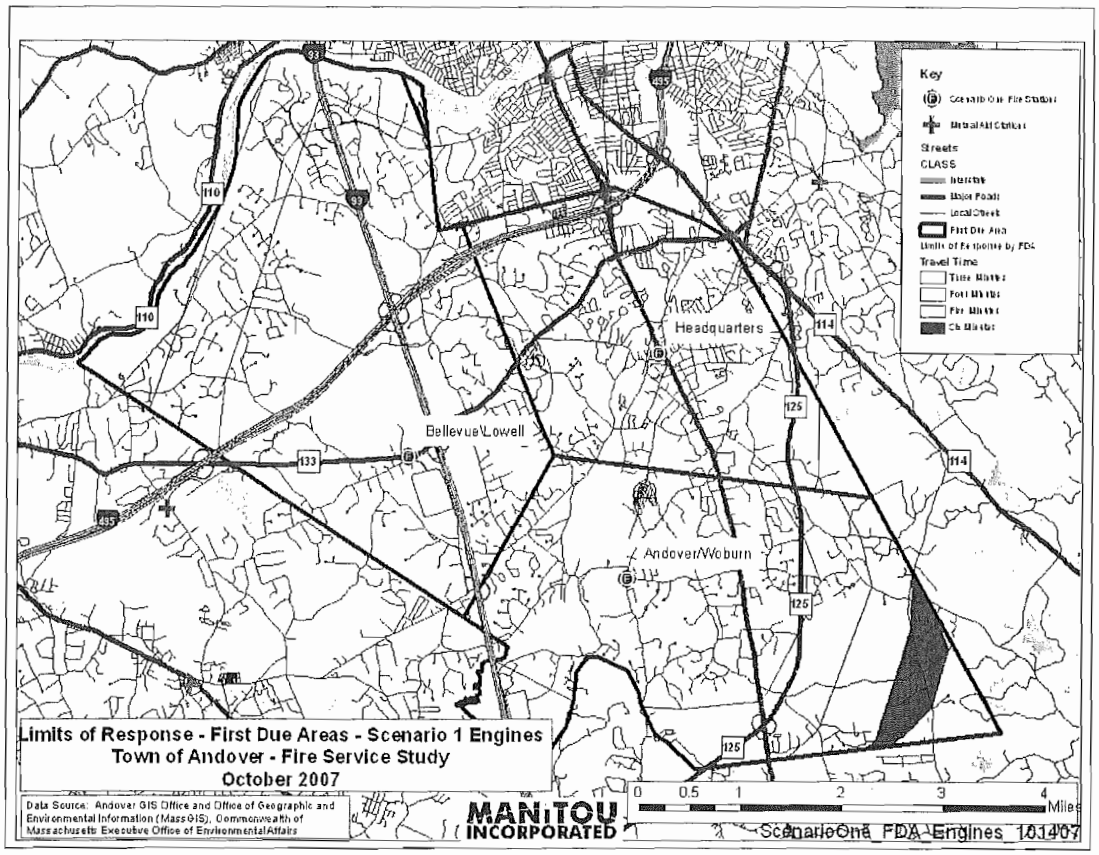


Table 6.1 Change in Coverage with Scenario One

	Existing Station	Scenario One	Difference	Difference Percent
Acres	1551	1737	186	12
Households	11443	12096	653	6
Population	27306	29037	1731	6
Employment	39872	39978	106	<1

These coverage statistics would be even better assuming that there is development in the I-93 interchange area. Increased development in that area might also be better served from a revised location for the Ballardvale station.

Long Term Trends

As demand for service increases, additional staffing will become necessary to maintain the current level of service. As demand for service increases, this increases the amount of time that a fire unit may be out of service. While this is desirable from the standpoint of utilizing resources, the trend will be that on any given time period, the available staffing for a fire emergency may be less than recommended in NFPA 1710. Another concern is that a very productive administrative and fire prevention inspection program is maintained by the AFR. Because emergency incidents take precedence, these duties will begin to suffer as less time is available.

We believe that a gradual approach to increasing staffing be undertaken. This approach is a reflection of the marginal nature of growth in the Town, and an effort to be efficient in allocation of resources.

2. Add an ambulance at Station 2

This ambulance could be phased in as a daytime-only unit. This would add resources when demand for service was highest, and could allow the impact of adding this unit to be demonstrated and monitored in terms of overall system performance and unit workload. We expect that rising demand for service will require that this unit eventually be staffed on a 24-hour basis.

Section 7.4 of the appendix presents a forecast of demand assuming that a third ambulance is placed into service in 2008.

3. Add a third position to the Ladder Company

The existing ladder company staffing limits the effectiveness of this unit, ad requires that an engine be sent with it on most calls for service. In order to increase its ability to function as an independent company, a third position should be added after the ambulance is staffed on a full-time basis.

4. Engine company staffing alternatives

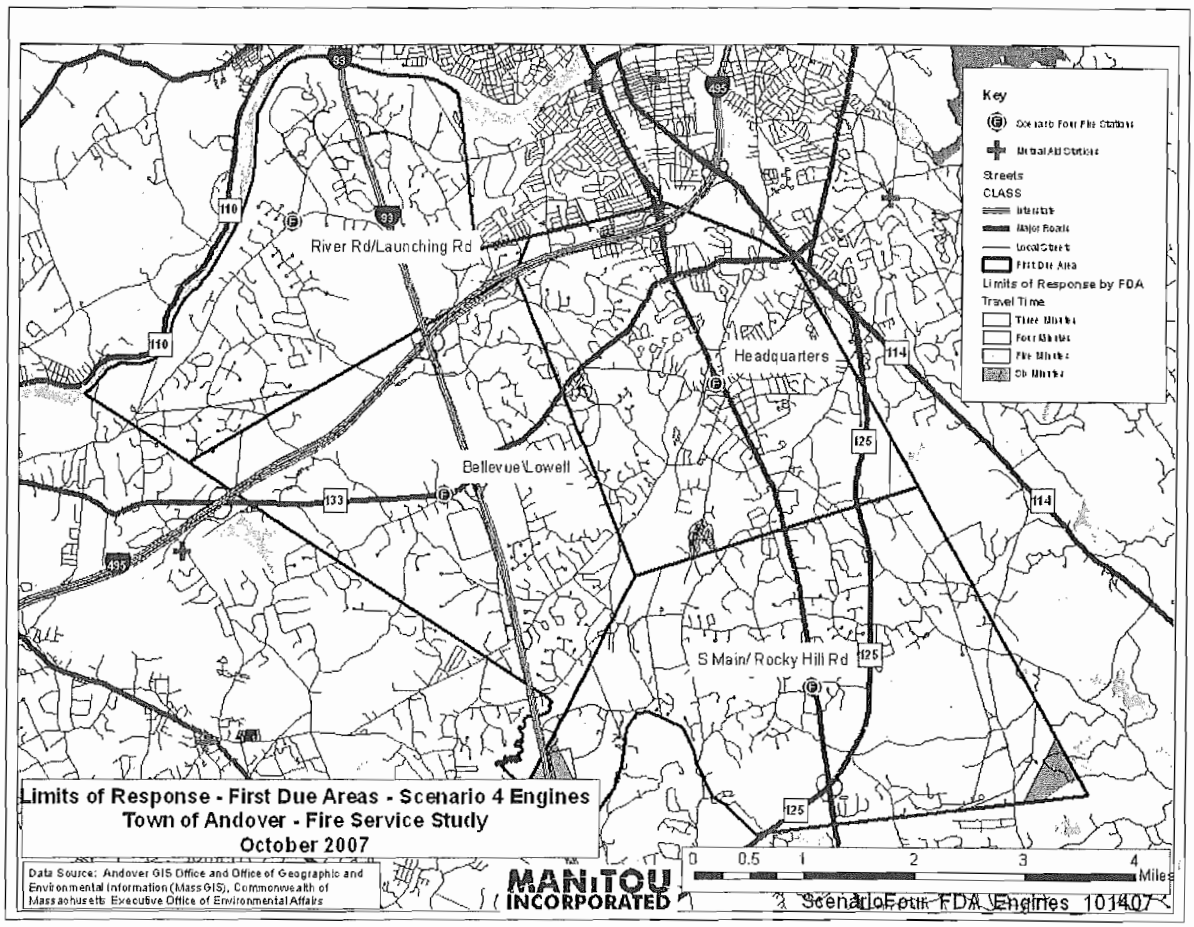
We believe that the addition of a third 24-hour ambulance should decrease workloads for existing engines and ambulances, leading to both better response times and high unit availability. Because of this availability, the need to add a fourth position to outlying engine companies is not acute, in our opinion. In fact, we believe that the expense of adding a fourth position to each of the three engine companies might be better spent on placing an additional company in service to better improve response times.

A four station configuration for the Department's stations was examined, and an alternative was developed. Figure 6.3 shows the resulting response time impact. In this scenario, a station would be located at River Road and Launching Road, while a fourth station would be located at Bellevue and Lowell Roads. Station 2 could be positioned at Andover and Woburn, or at Main and Rocky Hill. We do not see a need for a fourth station by 2012, although we developed a proposed location scheme should a fourth station become necessary in the future.

A fourth station would diminish the workload of existing companies, and add considerable expense. We find the current level of service acceptable, but understand that this is a local political determination, and any decision to formally strive for NFPA 1710 compliance would overrule any judgment by a dispassionate outsider.

One alternative to adding a fourth engine company would be to purchase 2 quints, and place them at Central and the Bellevue and Lowell locations, allowing them to serve either as engines or ladders, depending on their arrival order on the scene of an incident.

Figure 6.3 Four Station Configuration



A quint apparatus, designed to fulfill the role of an engine or ladder company, would require staffing of at least an officer and three firefighters in order to be effective at their enhanced mission.

5. Continue to monitor response time and unit utilization data to fine-tune deployment.

The new Chief has invigorated the planning process within the Fire Department. This study, coupled with numerous internal initiatives, are symbols of an effort to shift the Department's management to locally gathered evidence, rather than reliance solely on doctrine or past practices.

The use and development of management information should continue. Implementation of mobile computer terminals in vehicles should provide another level of sophistication and precision in tracking unit activity and workloads. Planning should be undertaken now to leverage these investments to make sure those data capabilities of these and other investments is maximized.

Summary

In summary, we believe that relocation of two of Andover's fire stations should be undertaken in accordance with the Town's Capital planning process. Additional efficiencies can be gained by developing new, better-located facilities that can provide improved response time coverage and accommodate the needed mix of apparatus and equipment.

While a fourth station was considered and its response time impact modeled, we did not fully elaborate on this scenario because we felt that the demand for service would not justify this change given the planning horizon for the study and the relatively flat growth in population throughout the Town.

7. Appendix

7.1 Discussion of Speeds And Adjustments

INTRODUCTION

The streets file used in the Analysis for this project was taken from the original *MASSGIS* datasets. This ARCGis file was converted to an *ESRI* Shapefile and the network was created to run Network Analyst with the ESRI network extension. This file was used to create limits of response by type of unit based on the speeds contained in this document and revised based on discussions with the AFR.

ALTERATIONS

The file was altered in the following ways: A field called ONEWAY was added to allow for designation of from-to (FT) or to-from (TF) status of the arcs for one way streets. This was verified on the interstates for most of the northern half of the city. Given more time for this project, the remainder would have been completed. Another category for feature code was added to denote represent the code value for speeds.

SPEED ASSUMPTIONS

The following table was used to create a "cost" in seconds for each link in the network. This table was applied to each link with the length of the link determining the time it takes for each type of vehicle to travel the length of the link. Every city has special characteristics which make travel patterns and speeds unique. Manitou has used speed tables that are roughly based on functional classification of the roadway and the historic knowledge of fire operations. Other models use Computer Aided Dispatch (CAD) system data to develop predictive response times for types of incidents. Neither of these methodologies, speed estimation or historical response data, fully explain the travel times of emergencies vehicles. The complexity of city-wide traffic patterns, acceleration and deceleration are extremely volatile and hard to model. CAD data is inherently inconsistent both in the definition of "on scene" and the application of consistent times when a multitude of operators are involved.

We feel that for systemic review of response times and city wide analysis of alternatives, that the speed estimations presented below are well suited to approximate the network coverage expected from certain deployment strategies. The speeds below have been reviewed with regard to Andover and we feel they accurately demonstrate the average travel speeds for the various units traveling at safe speeds.

CLASS (Based on road network Classification)	MPH ENG	MPH LAD	MPH EMS	GIS CODES
Limited Access Highway (LAH)	60	53	81	1
Primary or Major Highways (PMH)	43	38	58	2,3
Secondary or Minor Highways (SMH)	34	30	46	4
Access Ramp Associated with LAH	34	30	46	9
Andover Local Roads	30	26	40	5,6

7.2 Average OOS Time

Average Out of Service Time by Call Type and Unit 2006 Emergency Incidents by Unit Responding			
call Type	Unit	Num of Responses	Avg Out of Service Time
EMS	AMB91	1600	0:50:46
EMS	AMB92	782	0:52:34
EMS	BOATS	5	1:56:44
EMS	CAR 1	1	0:14:22
EMS	CAR 2	40	0:25:35
EMS	CAR 3 & CAR 4	16	0:12:34
EMS	ENGINE 1	389	0:20:19
EMS	ENGINE 2	129	0:27:40
EMS	ENGINE 3	149	0:25:46
EMS	ENGINE 4 +	14	0:46:28
	EMS – Total	**3125**	**0:38:24**
FIRE	AMB91	401	0:14:43
FIRE	AMB92	241	0:18:16
FIRE	BOATS	2	1:23:03
FIRE	CAR 1 & 2	630	0:28:33
FIRE	CAR 3 & CAR 4	26	0:20:58
FIRE	ENGINE 1	803	0:22:16
FIRE	ENGINE 2	520	0:22:01
FIRE	ENGINE 3	450	0:28:21
FIRE	ENG 4,5 6	60	0:35:09
FIRE	LADDER 1 & 2	620	0:17:26
	FIRE – Total	**3753**	**0:22:34**
HAZ	AMB91	15	0:16:56
HAZ	AMB92	11	0:33:34
HAZ	CARS	33	0:36:22
HAZ	ENGINE 1	123	0:26:39
HAZ	ENGINE 2	47	0:34:16
HAZ	ENGINE 3 +	67	0:43:09
HAZ	LADDER	13	0:23:30
	HAZ Total	**309**	**0:31:48**
Other	AMB91	173	0:43:11
Other	AMB92	146	0:36:32
Other	BOATS	3	0:19:44
Other	CARS	48	0:38:48
Other	ENGINE 1	209	0:34:49
Other	ENGINE 2	107	0:27:13
Other	ENGINE 3 +	195	0:30:46
Other	LADDER	38	0:32:03
	Other Total	**919**	**0:32:16**
Note: Out of Service refers to time that a Unit is engaged in responding to an incident from the time dispatched to the time return to their quarters.			

7.3 Average Response Times

Average Response Time by Call Type and Unit 2006 Emergency Incidents by Unit Responding			
call Type	**Unit**	**Num of Responses**	**Average Response Time**
EMS	AMB91	1754	0:04:45
EMS	AMB92	883	0:06:12
EMS	BOATS	7	0:07:58
EMS	CARS	80	0:04:09
EMS	ENGINE 1	493	0:04:22
EMS	ENGINE 2	184	0:05:23
EMS	ENGINE 3	268	0:06:02
EMS	LADDER	45	0:07:01
	EMS – Total	**3714**	**0:06:22**
FIRE	AMB91	45	0:07:01
FIRE	AMB92	354	0:04:21
FIRE	BOATS	2	0:00:02
FIRE	CARS	588	0:04:27
FIRE	ENGINE !	733	0:04:58
FIRE	ENGINE 2	454	0:05:29
FIRE	ENGINE 3+	479	0:05:50
FIRE	LADDER 1 & 2	528	0:05:21
	FIRE – Total	**3183**	**0:05:06**
HAZ	AMB91	11	0:04:41
HAZ	AMB92	11	0:06:56
HAZ	CARS	30	0:06:54
HAZ	ENGINE 1	121	0:05:34
HAZ	ENGINE 2	46	0:05:45
HAZ	ENGINE 3 +	68	0:06:57
HAZ	LADDER	11	0:04:58
	HAZ Total	**298**	**0:06:06**
Other	AMB91	7	0:05:27
Other	AMB92	6	0:03:31
Other	BOATS	1	0:00:01
Other	CARS	15	0:03:06
Other	ENGINE 1	82	0:07:29
Other	ENGINE 2	43	0:07:32
Other	ENGINE 3 +	61	0:06:38
Other	LADDER	16	0:04:09
	Other Total	**231**	**0:06:34**
Note: Response Time refers to time that a Unit is engaged in responding to an incident from the time dispatched to the time "arrive at Scene"			

7.4 Projected Unit Demand Forecasts Assuming Addition of a Third Ambulance in 2008

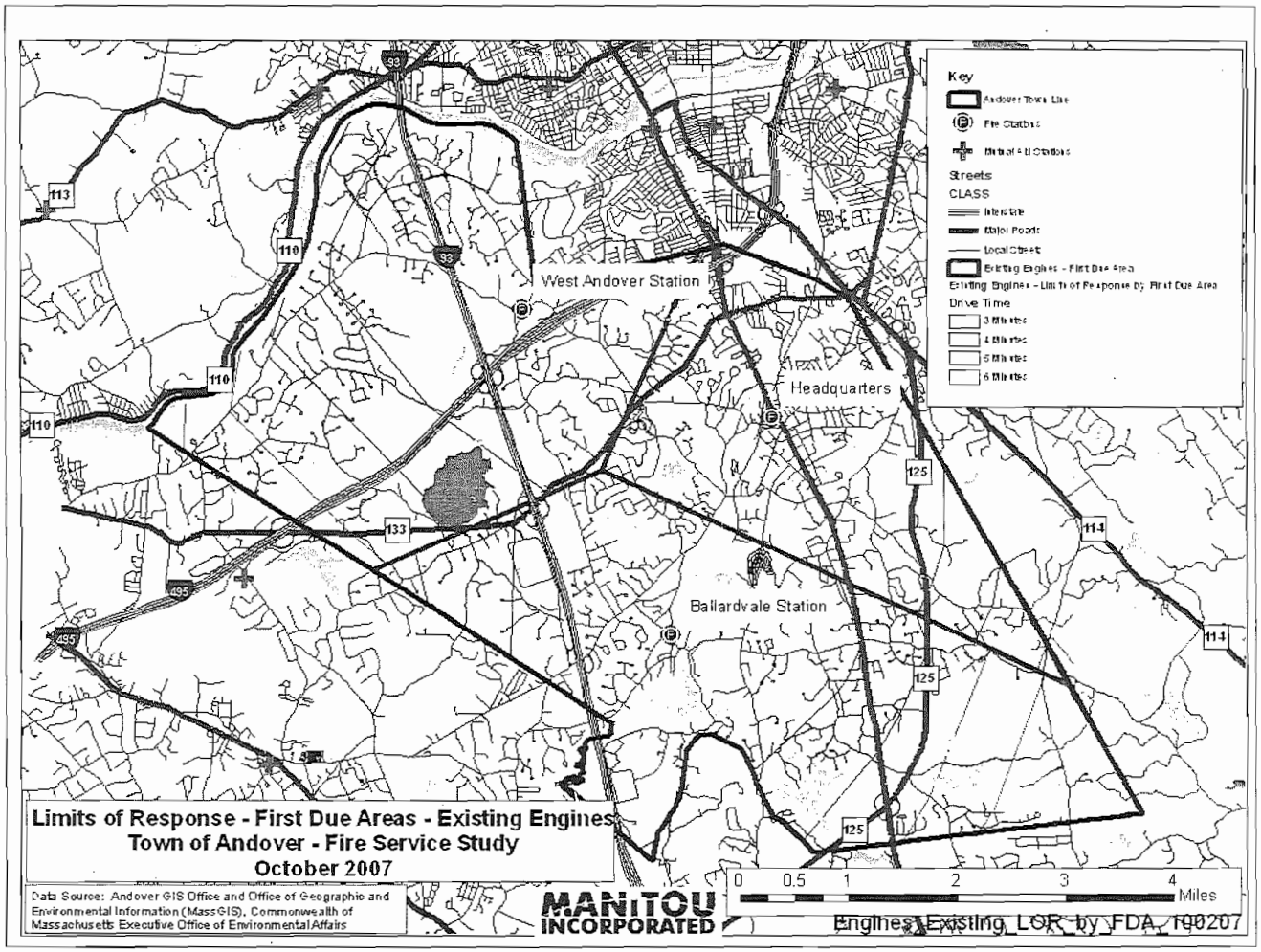
Low Forecast

LOW	2007	2008	2009	2010	2011	2012
AMB91	2241	1694	1670	1646	1617	1587
AMB92	1192	1213	1222	1231	1237	1242
CAR2	742	755	761	766	770	773
ENG 1	1547	1575	1587	1599	1606	1613
ENG 2	804	613	619	625	629	632
ENG 3	837	852	858	864	869	872
LAD 2	728	741	747	752	756	759
AMB93	0	588	629	669	710	750

High Forecast

HIGH	2007	2008	2009	2010	2011	2012
AMB91	2241	1649	1676	1709	1743	1782
AMB92	1192	1256	1311	1369	1428	1489
CAR2	742	782	816	852	889	927
ENG 1	1547	1631	1703	1778	1854	1934
ENG 2	804	642	679	718	757	799
ENG 3	837	882	921	962	1003	1046
LAD 2	728	768	801	837	873	910
AMB93	0	714	790	867	943	1019

7.5 Full-Page Format Response Time Maps: Current Engine Coverage



7.6 Full-Page Format Response Time Maps: Scenario One – Two Relocated Stations