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Inquiry into a Regionalized Dispatch Center for Plymouth County

An Interactive Qualifying Project Report

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By

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Abstract

This study focuses on Plymouth County, Massachusetts and how well it complies with the standards of operation set by the National Fire Protection Association, with special attention paid to potential methods of improving service. Statistical Analysis of fire departments and personal interviews were used as data collection methods. Results demonstrate that a regionalized dispatch center has the potential to allow towns to comply with dispatching standards and that a regionalized dispatch center would be more cost effective than individual dispatching services.

Keywords: Regionalized Dispatch Center, Plymouth County, Massachusetts, Dispatching

Executive Summary

Plymouth County fire departments are responding to over 77,000 emergency service calls protecting over 661 square miles and a population of over 470,000. This population has consistently increased in all 26 communities since 1990. Plymouth County was chosen as the subject of study due to one of the author's knowledge of the region and the convenience of having close proximity to all the authors. The location allowed for easier access to interviews with fire chiefs, dispatchers and town officials.

This project came about because fire departments are relying on outdated apparatus, equipment and facilities and some chiefs have indicated that they are not confident in their abilities to handle large scale incidents in their jurisdictions. The performance levels of staffing and response times are below those recommended by industry standards, potentially increasing the severity of emergency situations. Available budgets to address these concerns are limited due to the following factors: Proposition 2½, the rate of inflation, and limited available funding on the municipal level. Because of these factors, upgrading equipment and personnel is not an option. Therefore, fire departments need to find other ways to be cost effective.

One factor uncovered by this project was that the call processing procedures of Plymouth County fire departments appear to be operating with non-standardized procedures, relying on multiple Public Service Answering Points (PSAP) and dispatchers trained to various degrees, with each department maintaining its own dispatching operations. Few fire departments employ technological resources such as Computer Aided Dispatching (CAD) software, Global Positioning System and Global Imaging System. Also, few fire departments maintain dispatching facilities with multiple dispatchers capable of handling large scale emergencies.

One solution to this issue is, the use of organizations which serve as regional dispatch centers for multiple fire departments. This is consistent with a growing interest within New England to consolidate dispatch services of fire departments. These organizations have existed for over 50 years and serve interstate agencies, multiple jurisdictions, and all types of emergency responders.

Statistical performance data for call processing and dispatch times was unavailable for both regionalized systems and individual systems. Because of this, this project report does not numerically show that response times are improved with regionalized dispatching. However, fire chiefs and dispatch coordinators across the country indicate that response times are improved by the services provided by regionalized dispatching.

These existing organizations have demonstrated that consolidating dispatch services can be effective in the following areas:

- Mutual aid coordination can be simplified by eliminating third and fourth party communication, potentially improving interoperability.
- Call processing and dispatching procedures can be standardized, improving quality and consistency.
- By consolidating funding, dispatch centers can employ the use of tools such as CAD software, GPS tracking, and GIS mapping, which are software that departments may be financially incapable of acquiring alone.
- Dispatchers can be adequately trained and monitored.
- Providing quality dispatching at a reasonable price, potentially lower than existing cost of dispatching.
- An adequate number of dispatchers (2+) would be on staff to handle extreme emergencies or multiple emergencies.

As identified in this study, one way in which towns can improve their quality of service is by switching to a regionalized dispatch center. Because the towns of Plymouth County are unable to meet with standards set by the NFPA on an individual basis, unifying

the areas fire departments under one dispatch center would, potentially, allow for this aspect of the NFPA standards to be met. Not only would a regionalized dispatch center present the possibility for meeting standards but it may also have the potential to save towns money due to the shared responsibility of providing dispatching.

Authorship Page

History of Fire Throughout Time
And in the History of Massachusetts.....*Michael Sheehan*

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1 Introduction

Massachusetts fire departments are struggling to meet the requirements for adequate fire services set by the NFPA. The problem stems from the limited amount of money a town is able to acquire over the course of a fiscal year and thus putting a limit on the amount of money given to each department within the town. These limitations are caused by government regulations such as Proposition 2½, the rate of inflation, and the amount of taxable items within a town.

Fire departments are unable to properly deliver services compliant with the national standards when they lack adequate equipment and properly staffed fire stations, both of which cost a large percentage of a town's budget. This has left many departments searching for ways to minimize costs while improving their performances and capabilities. (Dedman, 2005)

Regionalized dispatch centers have been considered by communities throughout Eastern Massachusetts and the United States. Existing Regionalized dispatch centers that where reviewed for this report have been very successful in improving fire services across their particular area, with few complaints arising about the quality of service provided. Regionalized dispatch centers offer improvements for both service quality and financial burdens such services impose on municipalities. (Coan, Interview)

Improvements in the quality of service provided by fire departments comes from the regionalized dispatch centers ability to efficiently dispatch multiple engines to the scene of an incident while not pre-occupying the individual fire station with such coordination. It also allows for better communication among fire engines in the field thus insuring the safety of the citizens and emergency service providers. Relief from financial strain can come from the shared cost of dispatching. This creates a situation where the responsibilities of maintaining

an effective system of dispatching are shared, proportionally, allowing towns, both big and small, to have access to the best service possible. (Coan, Interview)

This report reviews the fire dispatch procedures in the communities of Plymouth County by inspection of the performance levels of Massachusetts fire departments, evaluation of how to improve response time, and the proven benefits of consolidating dispatch operations. All research in this report has been collected through statistical date as well as personal interviews in an attempt to understand the issue and consequences of implementing such a system. It must be noted, however, that fire chief responses are biased and do not represent the actual capabilities of a department. This report is intended to shed light on the problems facing Plymouth County fire departments and to understand the consequences a regionalized dispatch center would have on the area.

2 Literature Review

2.1 MFIRS Report

By law, Massachusetts fire departments report any fire or explosion resulting in a dollar loss or human casualty to the State Fire Marshal's Office (MFIRS 6); this is mandated by Massachusetts General Laws, Chapter 148, Section 2 which reads:

> "All…fires or explosions by which a loss is sustained shall be reported… to the State Fire Marshal on forms furnished by the department, and shall contain a statement of all facts relating to the cause and origin of the fire or explosion that can be ascertained, the extent of damage thereof, the insurance upon the property damaged, and such other information as may be required."

Information is collected and analyzed to create a "fact sheet" summarizing the fire damage caused within the state. An in depth annual report, *Massachusetts Incident Reporting Systems: Annual Report,* is also published indicating the levels of damage resulting from fire. The information is maintained in a database that is commonly referred to as the

Massachusetts Fire Incident Reporting System (MFIRS). Massachusetts also participates in the National Fire Incident Reporting System (NFIRS) which is managed by the United States Fire Administration (USFA). The NFIRS database uses information gathered from individual states to identify the entire nation's fire problem.

The *Massachusetts Incident Reporting Systems: Annual Report* identifies the fire problem within the state. In 2004, there were 29,462 reported fires, which resulted in 52 deaths, 952 injuries and caused over $18,666,913 worth of damage (MFIRS 11). The annual report sorts fire statistics in a number of ways, pertinent to this report is sorting by county. In 2004, there were 1,777 within Plymouth County, resulting in were six fatalities, 78 reported injuries and over $9,273,321 worth of damage (MFIRS 191). Table 1 illustrates the type of response of all Plymouth County fire department emergency responses in 2004 (MFIRS 191 and MFIRS 193). According to this data, less than 5% of all emergency responses were fire related incidents. A majority of the calls, 58% were EMS responses, 9% were other operational emergency responses, 11% were false alarms and 17% were non-emergency related calls.

Fire Related Responses	Number of Calls
Structure Fires	718
Vehicle Fires	288
Other Fires	659
Total Fire Related Responses	1,665

Non-Fire Related Responses	Number of Calls
Overpressure Rupture and Explosions (No Fire)	77
Hazardous Conditions (No Fire)	2,896
Service Calls	3,534
False Alarm Calls	3,904
Severe Natural Disaster	73
Special Incident Type	169
Rescue/EMS Incidents	20,450
Good Intent Calls	2,679
Total Non-Fire Related Calls	33,782

Table 1: 2004 Plymouth County Fire Department Response (Fire and Non-Fire)

From the MFIRS findings there is a fire problem in Massachusetts and in Plymouth County and there are other hazards which endanger the well-being of the all those in the area. Fire departments work extremely hard to ensure the safety of all those who experience these hazards and are forced to do so with limited resources. In 2002 the National Fire Protection Association (NFPA) began working on evaluating the needs of fire departments, illustrating the staffing, equipment, and facility inadequacies of Massachusetts's fire departments. In June of 2004 the NFPA released, *A Needs Assessment of the Fire Service: Massachusetts*.

2.2 NFPA Needs Assessment Report

In the foreword of *A Needs Assessment of the Fire Service: Massachusetts* NFPA President James Shannon makes the following statement about the state of the fire service's needs:

> "Today's fire service is a broad-spectrum emergency-response service, as well as a leader in the drive to prevent emergencies. In area after area of critical importance to our safety, fire departments are attempting to operate with insufficient personnel, equipment, and training. Nowhere is this shortfall more evident than in the area of terrorism preparedness.
>
> Now firefighters are faced with additional needs, including specialized training and equipment to combat terrorism. In all sizes of communities, most departments don't have that training or that equipment."

Federal Law, PL 106-398, Section 1701, Sec. 33 (b) required that the director of the Federal Emergency Management Agency (FEMA) conduct a study in conjunction with the NFPA to:

- Define the current role and activities associated with the fire service;
- Determine the adequacy of current levels of funding; and
- Provide a needs assessment to identify shortfalls.

This report was initially conducted for the entire nation, then later on an individual state level. The report illustrates that a number of Massachusetts's fire departments are operating with inadequate equipment, facilities, staffing and training. A majority of departments also indicated that they are skeptical of their abilities to handle major incidents based on their personnel and equipment and very few have written plans to deal with major incidents (NFPA Needs Assessment 41, 45, 49, and 53).

Massachusetts's fire departments are struggling to meet the staffing standards of NFPA 1710: *Standard for the Organization and Deployment of Fire Suppression Operations, Medical Operations, and Special Operations to the Public by Career Fire Departments*, discussed in detail in Section 2.3. Under NFPA 1710 fire engines and related equipment are required to be staffed by at least 4 career firefighters (NFPA 1710 8). This is also required by Operational Safety and Health Administration's OSHA "two-in, two-out" fire fighter staffing for interior structural firefighting, standard number 1910.134(g)(4) (OSHA Online). Table 2, below indicates the number of career firefighters assigned to an engine in Massachusetts (NFPA Needs Assessment, 13).

Population of Community	1 to 2	3	4	5 or more
500,000 to 999,999	0%	20%	80%	0%
100,000 to 249,999	0%	54%	46%	0%
50,000 to 99,999	19%	70%	8%	3%
25,000 to 49,999	40%	48%	12%	0%
10,000 to 24,999	0%	20%	80%	0%

Table 2: Number of Career Fire Fighters Assigned to an Engine in Massachusetts

Communities are also growing in population this affects fire departments' abilities to keep pace with the demand for services. When polled by the Insurance Services Organization (ISO) fire chiefs across the country indicate that this growth does increase the

already high demand on the fire service, results can be seen in Figure 1 (Effective Fire Protection (ISO), Online).

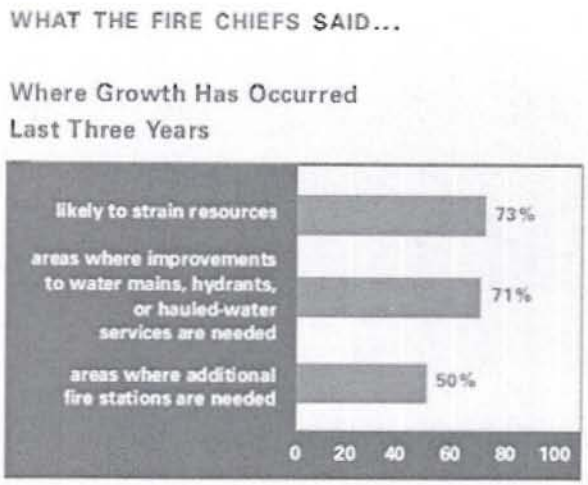

Figure 1: National Responses of Fire Chiefs Regarding the Difficulties Imposed By Growing Populations

Most alarming from the Massachusetts Needs Assessment report is fire departments' responses on their confidence to handle major incidents with the current levels of personnel and equipment, these results are seen in Table 3 (NFPA Needs Assessment, Appendices). Pertinent to this study is the third column in the proceeding table, which illustrates the percent of departments which have written plans to handle certain large scale emergencies, unfortunately this data does not disclose whether written plans include the employment of mutual aid, automatic mutual aid, or dispatching procedures.

Incident Type	Percent of Massachusetts's departments say they can handle such an incident with local personnel	Percent of Massachusetts's departments say they can handle such an incident with local equipment	Percent of Massachusetts's departments say they have a written plan on how to handle such incidents
Technical Rescue and EMS at a Structural Collapse with 50 Occupants	2%	2%	26%
Hazmat and EMS for Incident Involving Chemical/Biological	5%	3%	37%

Agents and 10 injuries			
Wildland/Urban Interface Fire Affecting 500 Acres	3%	2%	36%
Mitigation of a Developing Major Flood	6%	3%	18%

Table 3: Response of Massachusetts's Fire Departments Regarding Their Current Ability to Handle Hypothetical Large Scale Incidents

From, *A Needs Assessment of the Fire Service: Massachusetts* it is clear that fire departments within the state are struggling to meet industry benchmarking standards set by organizations like the NFPA and others. These inadequacies in equipment, facilities, training, and staffing have left fire services unconfident and incapable of handling major emergencies. Fire departments are struggling to respond to the various and numerous emergencies illustrated by the MFIRS report and their responsibilities as first responders continues to grow with the increased hazards of terrorism. As these responsibilities grow and become more and more diversified, it is necessary for fire department personnel to be equipped with specialized equipment and receive specialized training. This comes at a hefty cost in addition to every day operations. As a result fire department budgets are requiring more funding and resources from the community.

2.3 NFPA Standards

2.3.1 Response Time Benchmarking Objectives

In 2001 the National Fire Protection Association released NFPA 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 NFPA 1720: *Standard for the Organization and Deployment of Fire Suppression Operations, Emergency Medical Operations, and Special Operations to the Public by Volunteer Fire*

Departments. These documents put forth industry-benchmarking standards for fire department staffing and emergency response time.

Combining the time performance objectives of NFPA 1710 with dispatch objectives within NFPA 1221: *Standard for the Installation, Maintenance, and Use of Emergency Services Communication,* sets a 6 minute or less response time for fire departments and other emergency responders[1]. Table 4, below identifies the defined response time components and Table 5 and Table 6 identify the performance benchmarks defined by NFPA 1221 and NFPA 1710.

There are other organizations offering recommendations on response time guidelines such as the Commission on Fire Accreditation International, Inc. (CFAI) claims that the fire service has generally adopted the concept that a five minute travel time provides for a reasonable level of distribution of resources throughout the community (CFAI 74). CFAI does recognize that "not everyone agrees with this" and leave it's for individual towns, cities and communities to decide (CFAI 74). For practical purposed the term N*ational Standards* shall refer to the benchmark standards proposed by NFPA 1710 and NFPA 1221.

Response Time Components	Definition of Response Task
Answering Emergency Call	The action of the dispatcher recognizing and answering the emergency call.
Dispatch Time	The point of receipt of the emergency alarm at the public safety answering point to the point where the dispatcher knows sufficient knowledge and applicable units are notified of the emergency.
Turnout Time	The time beginning when units acknowledge notification of the emergency to the beginning point of the travel time.
Travel Time	The time that begins when units are en route to the emergency incident and ends when units arrive at the scene. This is also known as the arrival of the first engine company.

Table 4: Definitions of the Components of Response Time

[1] Call Processing (1 minute) + turnout time (1 minutes) + travel time (4 minutes) = 6 minute response.

Dispatch Procedure	Standard Objectives	Documentation:
Answering Emergency Call	95 % answer within 15 seconds and/or 99 % answer within 40 seconds	Established By NFPA 1221
Dispatch	95% shall be completed within 1 minute (60 seconds)	Established by NFPA 1221

Table 5: Performance Standards Established By NFPA 1221 (NFPA 1221, Appendix A)

Response Procedure	Standard Objectives	Documentation:
Turnout Time	1 minutes (60 seconds) 90% of the time	Established by NFPA 1710
Arrival or First Engine Company	Four minutes (240 seconds) or less 90% of the time	Established by NFPA1710
and/or	and/or	and/or
Deployment of Full First Alarm	Eight Minutes (480 seconds) or less 90% of the time	Established by NFPA1710

Table 6: Performance Standards Established by NFPA 1710 (NFPA 1710, 7)

2.3.2 Staffing Benchmarking Objectives

NFPA 1710 in combination with NFPA 1500: *Standard on Fire Department Occupational Safety and Health Program* and the Occupational Safety and Health Administration's (OSHA) standard for fire fighter staffing when participating in interior structural firefighting, standard number 1910.134(g)(4) define the staffing for fire departments. NFPA 1500 states, "it is recommended that a minimum acceptable fire company staffing level should be four members responding on or arriving with each engine and each ladder company responding to any type of fire" (NFPA 1500 9).

No one denies that staffing plays an important part for fighting fires effectively. Even the International City Managers Association (ICMA), opponent of NFPA 1710, recognizes staffing standards and the importance of having a sufficient amount of firefighters on the scene of an emergency, this is illustrated in following information released by the ICMA on their official website, http://www.ICMA.org:

> *Fire suppression operations have three basic functions:*
>
> **(1) RESCUE;**
> **(2) Work involving ladder, forcible entry, and ventilation; and**

(3) The application of water. To raise ladders, ventilate, search, and RESCUE simultaneously takes quick action by at least FOUR and often EIGHT or more firefighters, each under the supervision of an officer.

If about SIXTEEN trained firefighters are not operating at the scene of a working fire within the critical time period, then DOLLAR LOSS and INJURIES are significantly INCREASED as is fire spread.

As firefighting tactics were conducted and judged for effectiveness;

- **5 -person companies were 100% effective.**
- **4 -person companies were 65% effective.**
- **3-person companies were 38% effective.**

NFPA 1720 addresses the staffing and response time benchmark objectives of volunteer fire departments recognizing that there are significant differences in career and volunteer fire departments. The benchmarking objectives for volunteer fire departments and emergency service providers are seen in Table 7 (NFPA 1720 6).

Demand Zone	Demographics	Staffing and Response Time	Percentage of Responses	Documentation
Urban	> 1,000 people/mi^2	15 Fire Fighters within 9 minutes	90%	NFPA 1720
Suburban	500-1,000 people/mi^2	10 Fire Fighters within 10 minutes	80%	NFPA 1720
Rural	<500 people/mi^2	6 Fire Fighters within 14 minutes	80%	NFPA 1720
Remote	Travel Distance > 8 miles	4 Fire Fighters	90%	NFPA 1720

Table 7: Benchmark Objectives for Volunteer Fire Departments, Established by NFPA 1720 (NFPA 1720, 6)

As displayed in the NFPA's, *A Needs Assessment of the Fire Service: Massachusetts* fire departments are struggling to meet these industry standards. With limited budgets, as discussed in Section 2.9. It is becoming increasingly more difficult for fire departments to meet the increased and varied hazards that endanger communities, as discussed in Section 2.2.

2.4 Current Levels of Performance in terms of Staffing and Response Time

2.4.1 Current Levels of Performance: Introduction

In the development stages NFPA 1710 and NFPA 1720 created enormous controversy which pitted the International Associated of Fire Fighters (IAFF) against the International City Managers Association (ICMA), these documents are potentially the most controversial developed by the National Fire Protection Association in its 110 year history (Grant interview). Since 2001, NFPA 1710 and NFPA 1720 have been available to the public and have served as guidelines for fire departments. In January of 2006, *Response Times – Topical Fire Research Series* was released by the Department of Homeland Security (DHS) in association with the United States Fire Administration (USFA) and in January of 2005, the Boston Globe released, "Deadly Delays" an editorial by staff correspondent Bill Dedman, together these reports indicate the level of response performance of the nation, its regions, and Massachusetts.

2.4.2 United States: Regional Performances

Response Times - Topical Fire Research Series released by the DHS indicates the response time performances of fire departments across the county. This report found that "regardless of region, season or time of day, structure fire response times are generally less than 5 minutes half the time (Structure Fire Response Times, 2). The report was generated with data from 2001 and 2002 stored in the NFIRS database, which is maintained by the USFA. Data for the study was "queried in whole minutes" and is subject to error based on reporting (Structure Fire Response Times, 2). The results are plotted by region in Figure 2: Structural Fire Response Time Performances by Region in the Continental United States (By Region).

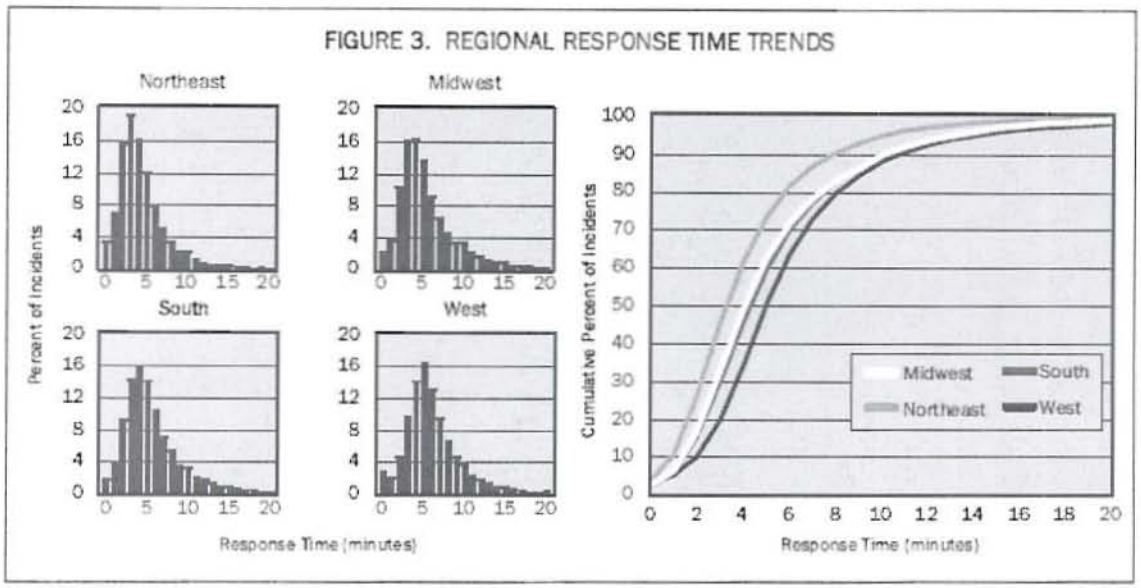

Figure 2: Structural Fire Response Time Performances by Region in the Continental United States (By Region)

Evaluating the results shows that response to structural house fires in the Northeast is slightly better than the rest of the county, regardless there is still an evident fire problem as less than the 90% of incidents in all regions are not responded to within 6 minutes. NFPA 1710 prescribes that all incidents be responded to within six minutes 90% of the time, reference Section 2.3.1. From this report the only 61% of structural fires had response times less than 6 minutes, this is 29% below the benchmarking National Standards[2].

2.4.3 Massachusetts: Community Performances

Since the publication of NFPA 1710 and NFPA 1221 a majority of Massachusetts towns are still performing at levels below those set by the NFPA standards, this was determined in 2005, by Boston Globe correspondent Bill Dedman[3]. Dedman conducted a series of studies of the arrival times of the communities in Massachusetts; this was done with the voluntary cooperation of fire departments throughout the state.

[2] 90% minus 61% = 29%. NFPA 1710 specifies that benchmarking objectives shall be met in 90% of all incidents.
[3] This was done in the ongoing Boston Globe "Special Report" known as "Deadly Delays."

The data presented by Dedman is an extremely valuable tool as it documents arrival time by community. Figure 3 is a map of Massachusetts with each community colored coded according to their arrival time performance, at right of the map is the key to the color coding and Figure 4 is an expanded map of eastern Massachusetts also color coded by response time.

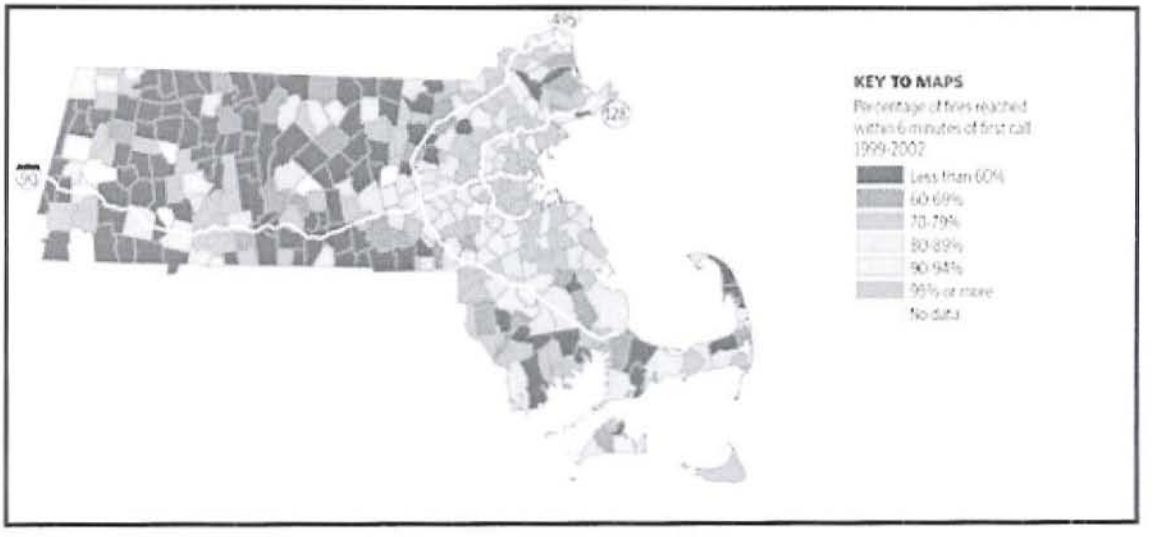

Figure 3: Color Coded Map of Response Time Performances (Massachusetts) (Deadly Delays)

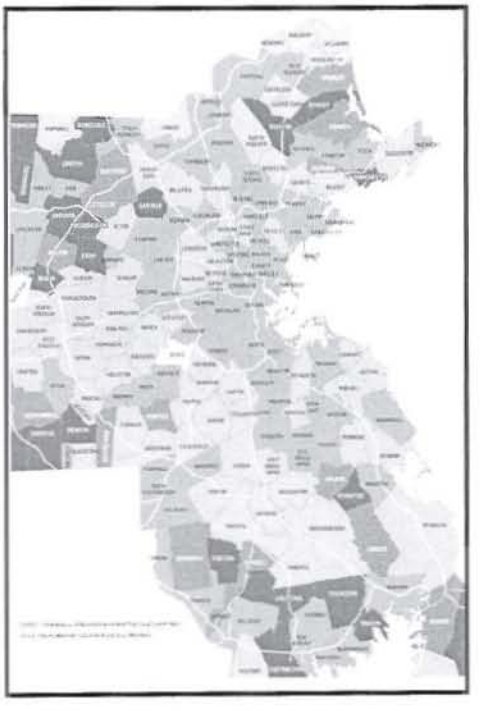

Figure 4: Expanded Map of Eastern Massachusetts Response Performances

Additional research revealed that communities in western Massachusetts are generally protected by volunteer fire departments, whereas communities in eastern Massachusetts are generally protected by career fire departments. This difference attributes to some of the performance levels reached by Dedman. As discussed in Section 2.3, volunteer and career fire fighters are covered under distinct standards; NFPA 1720 governs volunteer fire departments, whereas NFPA 1710 governs career fire departments. From the preceding maps, it is clear that a majority of Massachusetts towns are still not in compliance with the benchmarking objectives set by the NFPA 1710 and NFPA 1270 indicating that fire departments are struggling to meet industry standards and provide communities with the optimal protection.

2.5 *Significance of Response Time*

2.5.1 Fire Emergencies: Every Second Counts

For fire emergencies, research indicates that every second counts. Figure 5, used by the Commission of Fire Accreditation International, Incorporated (CFAI) illustrates fire propagation curves (CFAI 46). A fire propagation curve shows the growth of a fire with respect to time.

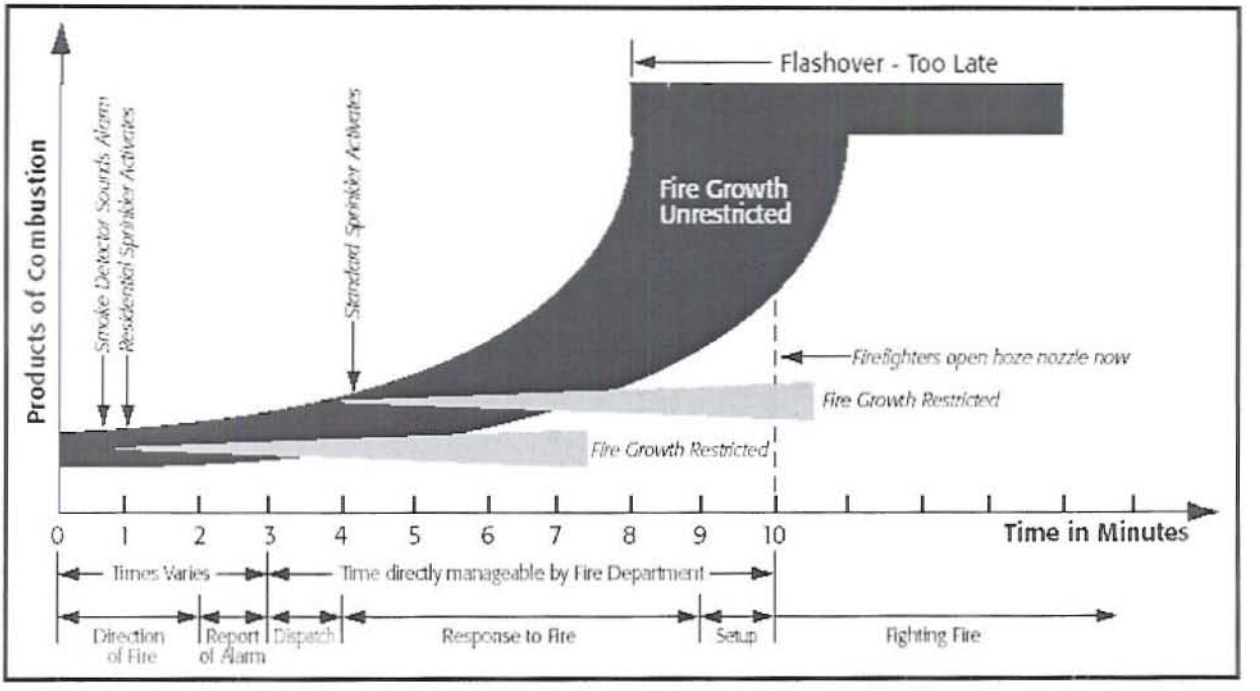

Figure 5: Products of Combustion versus Time vs. Fire Department Action

Figure 6 illustrates the rate at which fire grows. As a fire grows it's capability of causing injury and property damage increases at an alarming rate. This is illustrated in Figure 6 (NFPA 1710, Annex A 15) and Figure 7 (Deadly Delays, Part 1) which show percent property destruction in relationship to time and the average monetary loss. It is important to realize that the spread of a fire and the property destruction are components of time, thereby every second counts.

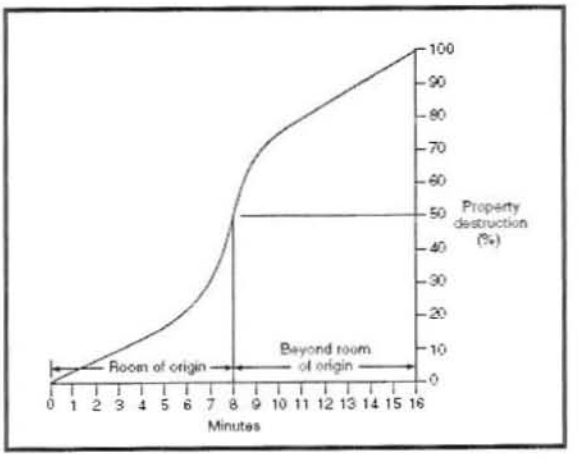

Figure 6: Property Destruction versus Time used by the NFPA

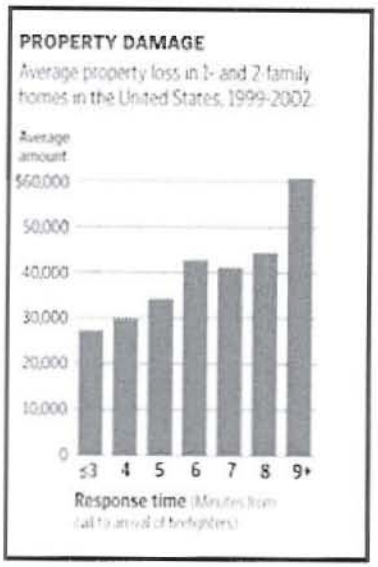

Figure 7: Property Damage versus Response Time

This information indicates the significance of time in preventing fire growth and consequently damage caused by fire. The benchmarking time requirements of NFPA 1710 and NFPA 1720 are based on this information and designed as objectives for fire departments to meet. Similar time dependent data for medical emergencies also is the base of NFPA standards.

2.5.2 Medical emergencies: Every Second Counts

The "every second counts" phrase holds true for medical emergencies as well. Research indicates that the faster the medical attention is provided to those in need, survival rates increase. This is especially true for victims of cardiac arrest. "When a person suffers a sudden cardiac arrest, for each minute that passes without defibrillation, their chance of survival decreases by 7-10 percent" (American Heart Association, 1-2). According to the American Heart Association, "where automatic defibrillation is provided within three minute the survival rates for VF (ventricular fibrillation) cardiac arrest are as high as 74%." This is important to consider because "at least 250,000 Americans die each year of severe cardiac arrest (SCA) before they reach the hospital" (American Heart Association 2). Table 8,

provided by Commission of Fire Accreditation International Inc (CFAI) illustrates the probability of survival when CPR and defibrillation are applied during cardiac arrest incidents (CFAI 49).

Collapse to CPR	Collapse to Defibrillation	Probability of Survival
≤ 5 minutes	≤ 10 minutes	37%
≥ 5 minutes	> 10 minutes	7%
> 5 minutes	≤ 10 minutes	20%
>5 minutes	> 10 minutes	0%

Table 8: CFAI Survival Guidelines for Application of Defibrillation

A medical emergency is serious medical situation that demands immediate action. In all emergencies the fire departments objective is to get to the deliver services as quickly as possible in order to minimize potential damage, injury, and loss of life. The Commission on Fire Accreditation International, Inc. states that,

> "Current medical evidence suggests that response time intervals, measured from the time of the first ring at the primary PSAP until arrival at the scene should be five minutes for responders capable of performing CPR and defibrillation, 10 minutes for providers capable of performing ALS, and 12 minutes for a transport-capable vehicle (CFAI 74)."

In 2001 medical emergencies made up 59% of the fire departments call volume, this is depicted in Figure 8. Under NFPA Standard 1710 an adequately staffed fire engine is to accompany or precede any ambulance to the scene of an emergency (NFPA 1710 7). Figure 8 and Figure 9 illustrate that fire department responses largely medical aid responses and this number is increasing.

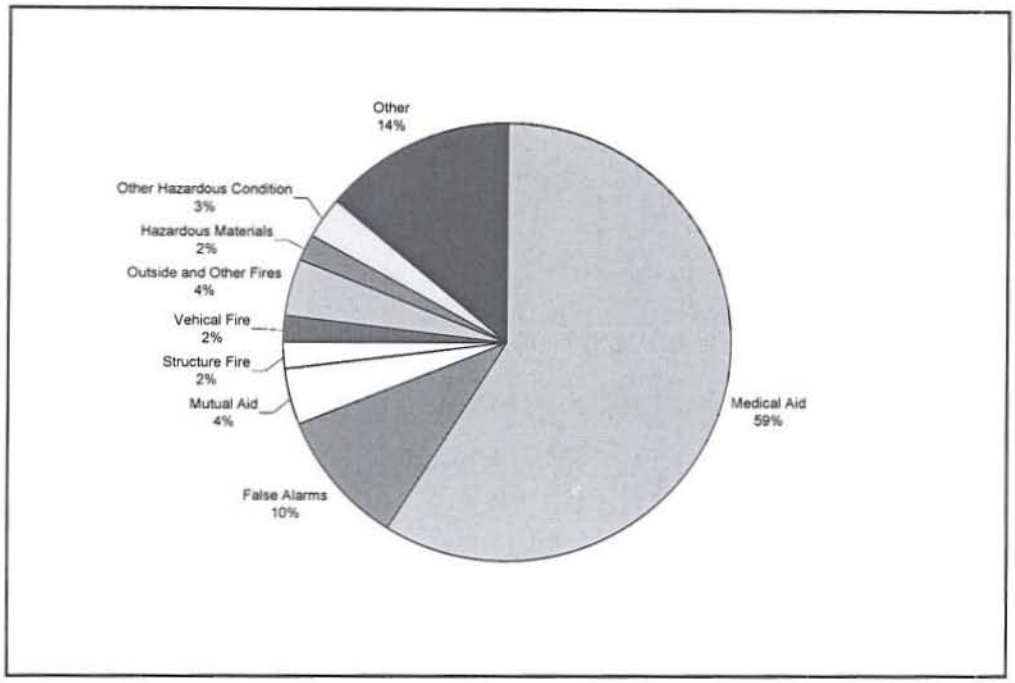

Figure 8: Call Volume of Fire Departments

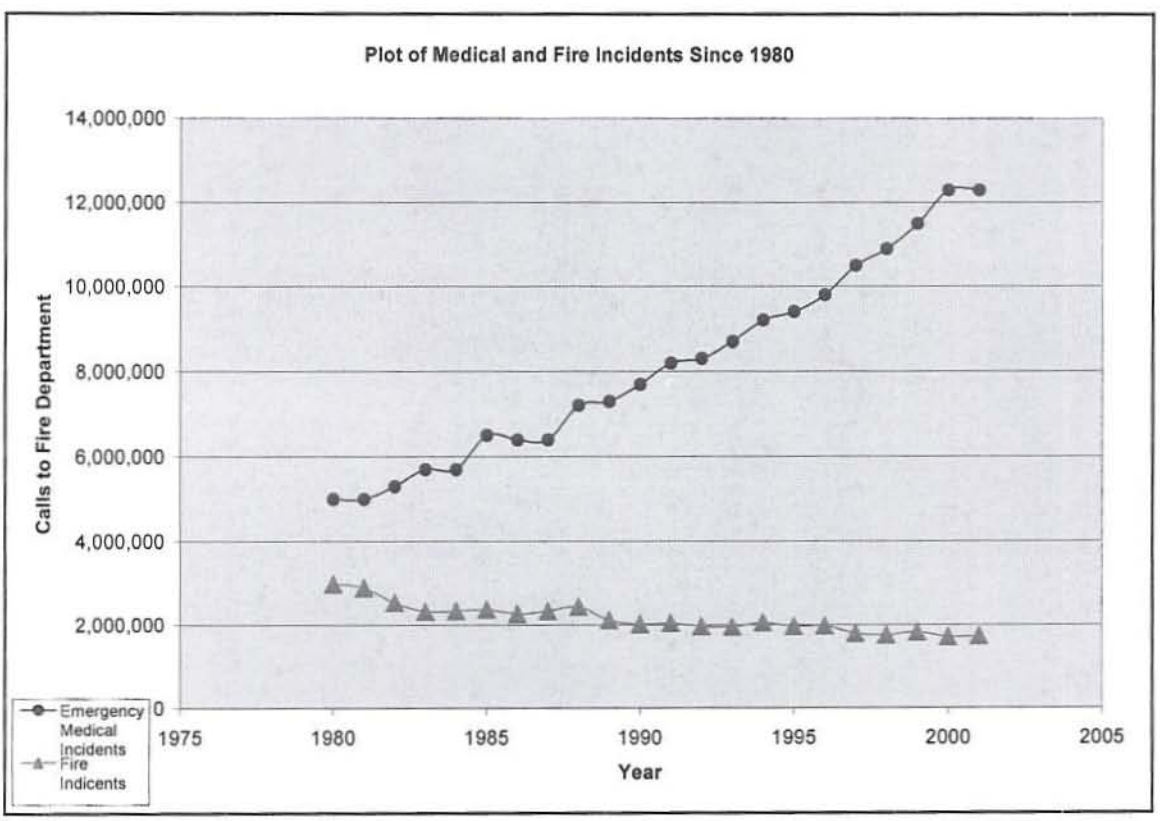

Figure 9: Plot of Medical Emergencies and Fire Incidents Since 1980

2.6 *Different Components of Response Time*

2.6.1 Components Introduction:

As documented by the NFPA 1710 and NFPA 1221 there are four different components of response time. Each component represents a unique and critical task which is carried out by various fire department personnel. Descriptions of these tasks are shown in Table 9.

Response Time Components	Definition of Response Task
Answering Emergency Call	The action of the dispatcher recognizing and answering the emergency call.
Dispatch Time	The point of receipt of the emergency alarm at the public safety answering point to the point where the dispatcher knows sufficient knowledge and applicable units are notified of the emergency.
Turnout Time	The time beginning when units acknowledge notification of the emergency to the beginning point of the travel time.
Travel Time	The time that begins when units are en route to the emergency incident and ends when units arrive at the scene. This is also known as the arrival of the first engine company.

Table 9: Descriptions of Response Time Components

Answering the emergency call and dispatch time are the responsibilities the fire department's dispatcher whereas turnout time and travel time are generally responsibilities of emergency response personnel. These components of response time are discussed at length in Section 2.6.2, Section 2.6.3, Section 2.6.4, Section 2.6.5 and Section 2.6.6.

2.6.2 Call Processing:

When a citizen reports an emergency, they dial 911. The call is received by the primary PSAP (Public Safety Answering Point). The type of call would not be discernable if whether it is a police emergency or a fire/EMS emergency, however the location of the emergency would be automatically available to the PSAP. The primary PSAP determines the type of emergency and forwards the call to the appropriate emergency dispatch located within individual communities. The appropriate dispatch may be fire dispatch offices, municipal police headquarters, or ambulance dispatch center which then dispatches appropriate emergency response personnel. Figure 10 is used by the NFPA to allocate time benchmarks in the call processing and dispatching procedures (NFPA 1221, Annex A 31).

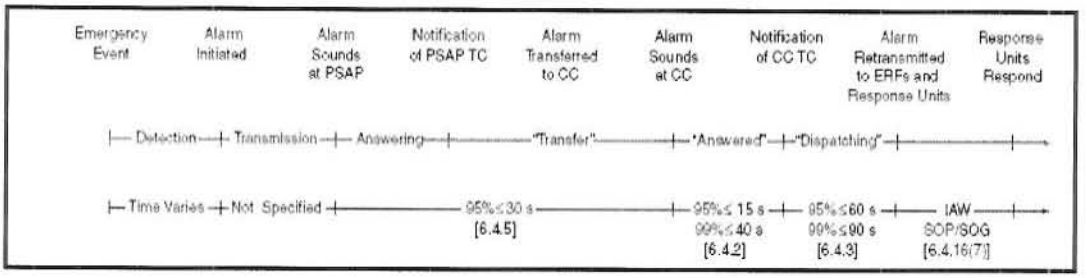

Figure 10: Alarm Time Where Primary PSAP is Other Than Communications Center

This process is also explained by the Federal Communications Commissions (FCC) in the following: "The emergency dispatcher uses location information to direct public safety personnel responding to the emergency to ensure the shortest possible emergency response time. Once the call is processed, the PSAP operator or dispatch center alerts the appropriate emergency response team" (Communicating during Emergencies, FCC Online).

2.6.3 Call Dispatching

After processing an emergency call, the dispatching procedure occurs. Emergency responses are determined by the appropriate or designated dispatch center. Appropriate responses are providing an adequate response force which has the shortest possible response time. Dispatch decisions are made in a number of unique methods which vary by community.

Traditionally fire departments have relied on pre-determined "running cards" which indicate the appropriate response personnel based the type, level and location of the emergency. These "running cards" were determined over time but fire service professionals. Other times dispatchers are familiar and well acquainted with the towns they serve and are capable of using their reason to select the appropriate response. With the advent of computers and new technology Computer Aided Dispatch (CAD) software has aided fire departments in determining equipment and staff that is available and nearest to the scene of the emergency, however many fire departments do not effectively use CAD software in their dispatching procedures, further discussion of CAD systems can be seen in Section 8.2.4.

2.6.4 Turnout time

Turnout time begins when units acknowledge notification of the emergency to the beginning point of the travel time. Fire fighters and other emergency response personnel are professionals who are dedicated to providing expedient services to the community. As professionals, they are not likely to delay and prolong a turnout time. Turnout times are limited by station characteristics and internal layout, ill-equipped fire apparatus and others factors.

2.6.5 Travel Time

Travel time begins when units are en route to the emergency incident and ends when units arrive at the scene The travel time component is limited because fire station location, inadequate municipal road systems, and outdated equipment.

ISO's Item 560 of the FSRS requires that "the built-upon area of the city should have a first-due engine within 1.5 miles and a ladder service company within 2.5 miles. These 1.5 mile and 2.5 mile radii about stations represent that particular station's "standard response district" (Response-Time Considerations, (ISO) Online). These benchmark criteria produce an expected response time of 3.2 minutes for an engine company and 4.9 minutes for a ladder-service company, based on a formula developed by the RAND Corporation, which conducted extensive studies of fire department response times. They concluded that the average speed for a fire apparatus responding with emergency lights and siren is 35 mph. That speed considers average terrain, average traffic, weather, and slowing down for intersections. Accounting for the average speed and the time required for an apparatus to accelerate from a stop to the travel speed, RAND developed Equation 1 for calculating the travel time:

$$T = 0.65 - 1.7D$$

Where:

T = time in minutes to the nearest 1/10 of a minute
0.65 = a vehicle-acceleration constant for the first 0.5 mile traveled
1.7 = a vehicle-speed constant validated for response distances ranging from 0.5 miles to 8.0 miles.

Equation 1: Travel Time Equation as a Function of Distance Traveled (Developed by RAND)

From this it is clear that travel time is fixed and likely not to be improved, a detailed analysis of Plymouth County communities can be seen in Section 8.4 and discussion of fire station location and the potential benefits of automatic aid are seen in Section 8.6.

2.6.6 Response Time Components Summary

After reviewing current call processing procedures, dispatching procedures, turnout time and travel time it is clear that turnout time and travel time are fixed due to the tremendous expenditures that would be required to improve them. Call processing and dispatching procedures appear to be un-standardized, still under development (Section 8.2), and overlooked in the reviewed literature.

2.7 Significance of Communication and Interoperability

In 2003 President Bush issued Homeland Security Presidential Directive-5 (HSPD-5), directing the Secretary of Homeland Security to develop and administer a National Incident Management System (NIMS). NIMS is to provide a consistent nationwide template to enable all government, private sector, and non-governmental organizations to work together during domestic incidents. Under the NIMS plan emergency responders are directed to work together in order to attain perpetual readiness (Garvin, 31). Two years later, the United States Congress put forth, H.R. 4119 Improve Interoperable Communications for First Responders Act of 2005. To further improve coordination between emergency providers. In

Section 2 of this Act the Congress reports the following findings detailing the current state of communications and interoperability of first responders:

- A major barrier to sharing information among police, firefighters, and others who may be call on to respond to terrorist attacks and other large scale emergencies is the lack of interoperable communications systems, which can enable public safety agencies to talk to one another and share important, sometimes critical, information in an emergency.
- Communications interoperability has been identified by the Department of Homeland Security as one of the most essential capabilities necessary for first responders to achieve the national preparedness goal of the Department of Homeland Security has established for the Nation.
- The lack of interoperability costs lives during terrorist attacks or natural disasters, but also during everyday emergency operations.
- Achieving interoperability is difficult because some 50,000 local agencies typically make independent decisions about communications systems. This lack of coordination also dramatically increases the cost of public safety communications to Federal, State, local and tribal governments.
- Achieving the level of communications interoperability that is needed will require unprecedented levels of coordination and cooperation among Federal, State, local and tribal public safety agencies. Establishing multidisciplinary, cross jurisdictional governance structures to achieve the necessary level of collaboration is essential to accomplishing this goal.
- The Intelligence Reform and Terrorism Prevention Act of 2004 requires the Secretary of Homeland Security, in consultation with other Federal officials, to establish a program to ensure public safety interoperable communications at all levels of government.
- However, much more remains to be done. For example in January 2005, the National Governors Association reported while achieving interoperability ranked as the top priority for States, obtaining the equipment and technology to fulfill this goal remains to be a challenge. The large majority of States report that they have not yet achieved interoperability in their States.

- Stronger and more effective national, statewide, and regional leadership are required to improve interoperability. The Department of Homeland Security must provide national leadership by conducting nationwide outreach to each State, fostering the development of regional leadership, and providing substantial technical assistance to State, local and tribal public safety officials, while more effectively utilizing grant programs that fund interoperable equipment and systems.
- Communications interoperability can be accomplished at a much lower cost if strong national leadership drives cooperation and adoption of smart, new technological solutions.

The Congress also cited the importance of, "promoting development of standard operating procedures for incident response and facilitating the sharing of information on best practices for achieving interoperability" and "encourage more efficient use of existing resources, including equipment." In Section 315 of H.R. 4119, Congress cited the need to "examine how current and emerging technology can make public safety organizations more effective, and how Federal, State, and local agencies can utilize this technology in a coherent and cost effective manner." The Congress also dedicated funding, known as "Interoperability Grants" which would be available for three years.

Regional dispatch centers or county dispatching is a way of life outside New England, this is displayed in Section 2.8 (Laider, Article). Responding to the national call for improved interoperability there have been increased calls for regional dispatch centers, even in New England as regional dispatch centers are being considered in Essex County[4], Norfolk County[5], the Cape and Islands[6], and parts of Western Massachusetts[7].

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[4] The Northeast Regional Homeland Security Council recently endorsed a request by a number of Essex County communities for $80,000 in federal funds to pay for a study of the idea.

[5] MMA Group and the Norfolk County Fire Chiefs Association released a study in 2003. (Detailed in the proceeding report.

[6] The Cape and Islands are the front runners in implementing regionalized dispatch operations as they have been using a system for more than 10 years. Very little literature is available. This was determined through interaction with Lieutenant Billing and www.capecodFD.com

Regionalized dispatching operations have been serving the public for over 50 years. In these dispatching centers communication is centralized and there appears to be standardized procedures and enhanced interoperability. Section 2.8 evaluates existing regionalized operations involving fire departments.

2.8 Case Studies of Current Regionalized Dispatch Procedures in the United States

2.8.1 Introduction:

Massachusetts' fire departments generally fall under the jurisdiction of town and community borders and traditionally dispatching operations are done separately by each town. Separate community dispatching is not the standard method throughout the county and in unique emergency incidents. Case studies were conducted evaluating the dispatching procedures in regional dispatch centers, regionalized mutual aid systems, automatic aid systems, and other circumstances of emergency service dispatching.

2.8.2 DuPage Public Safety Communications

In an issue of Fire Chief Magazine (September 2003) Du-Page Public Safety Communications (DU-COMM) was featured in an article which claimed that, "DU-COMM demonstrates how shared dispatching can save money for a department while expanding its capabilities, improving its performance and shifting the day-to-day burden of maintaining an operations center (Bodony 34)."

DuPage Public Safety Communications is a dispatching facility located in Glendale Heights, Illinois. DU-COMM was established in 1975 and has drastically grown in the past 31 years. Currently the organization provides dispatching and emergency communications

[7] This was determined in correspondence with State Fire Marshal, Steve Coan and SWNHMA Director, Paul Scoz.

for 27 police and fire agencies covering a population over 650,000[8] operating on a $5 million operating budget (DuPage Public Safety Communications, Online). Over seven-hundred 911 calls are received daily (250,000 per year) and are handled by 50 full-time telecommunicators and 6 part time telecommunicators. The 2,600 square-foot operations center[9] is staffed at any time with about least 10 dispatchers[10].

The facility is aided by Computer Aided Dispatch (CAD) technologies[11] which are interfaced with mobile data terminals (MTDS) located in police and fire apparatus. Mobile data terminals are GPS devices which also have the capability of conveying information relevant to the emergency, such as incident location, available hydrants, sewer lines, building schematics and other information. Interfaced with the CAD system GIS technology is put into use. The Executive Director of DU-COMM, George Longmeyer states, "I'm a firm believer in using technology to increase efficiency of operations, reduce costs, and provide better information", by interfacing CAD systems with GPS and GIS technologies DU-COMM demonstrates effectively how this can be done (Bodony 35). All this technology and expertise cost more than any department should shoulder alone. But by pooling their resources, departments pay less to get more.

In 1983 DU-COMM's first CAD system was implemented. Prior to 1983 the dispatching was done by using hand-written paper cards. Computer Support Technician Shaun Lang stated that the "hand-written paper cards" method, "allowed us to send information to responding units, but vastly limited its functionality. The call-takers weren't able to enter multiple calls in the system at the same time and viewing officer activity or locations of units wasn't the greatest (Bodony 36)." DU-COMM is still trying to improve

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[8] Emergency communications include coordinating mutual aid between multiple agencies.
[9] The entire facility is 12,700 square-feet, however communication operations are limited to the "operations-center."
[10] 3 are assigned to fire dispatching and 6 or 7 are assigned to police dispatching.
[11] Motorola Printrak Premier CAD system, designed for multi-jurisdictional agencies.

communication abilities as it looks to add the capacity to support streaming video, which would allow real-time images to be broadcasted to emergency responders.

All dispatchers in the DU-COMM system are trained for 6-8 weeks on how to effectively answer 911 calls and emergency communications[12], after receiving this training telecommunicators practice under the guidance of a supervisor for up to three months. This training helps create standardized call processing and dispatching procedures

DU-COMM is an example that regionalized communication facilities can be effective in providing call processing, dispatch, and coordination for emergency response personnel. DU-COMM's high levels of performance and proven efficiency has shown the value of implementing CAD, GPS, and GIS technologies as well as standardizing emergency communications.

2.8.3 Massachusetts: Statewide Fire Mobilization

In 1950, as a result of large-scale forest fires in the early 1950's the Commonwealth of Massachusetts under Governor Foster Furcolo signed an Executive Order creating Fire Mobilization Districts. 14 districts were formed to create a better organization to deal with large-scale fires and other large scale disasters. The statutory authority for the executive order was contained in Chapter 639 of the Acts of 1950. This law made the Governor responsible for the protection of life and property from natural and man-made disasters, the law is commonly referred to as the State Civil Defense Statute (Billings Interview). Since 1950, the Statewide Fire Mobilization plan has been revised[13].

The Statewide Mobilization Plan comes into effect only when the local community resources and those of the normal mutual aid system have been exhausted. When put into

[12] Trainees are required to pass written exams throughout the process of training.
[13] There are now 15 fire districts and modified control points as well as many other technical changes.

effect fire apparatus and personnel are sent in task forces or strike teams from sections normally outside the mutual aid system of that town in need.

Strike teams consist of a Chief Officer and a group of fire pieces of the SAME apparatus, for example (5 ambulances, 5 ladder trucks, 5 forestry trucks). Task forces are an assortment of equipment provided by the Statewide Mobilization Plan that varies upon the incident type, there are three types of task forces (there is flexibility in these ensembles):

- Task Force Disaster: A Chief Officer and assorted rescue equipment
- Task Force Forestry: A Chief Officer, six forestry trucks and one tanker, although some forestry task forces consist of brush breakers and other forestry resources.
- Task Force Structural: Two Chief Officers, six engines, and two ladder trucks.

Dispatching and Coordination of the Statewide Mobilization Plan is performed by district control centers, which communicate on the National Air Warning Alert System (NAWAS)[14] (Massachusetts: Statewide Fire Mobilization Plan). Upon implementation of the Mobilization Plan, the Massachusetts Emergency Management Association (MEMA) is to be contacted. MEMA also plays a role in coordinating resources in times of disaster and emergencies (Massachusetts Emergency Management Association - Executive Office of Public Safety, Online).

On December 3, 1999 the Statewide Mobilization Task Force responded to a fire in Worcester, now referred to as the "Cold Storage Fire." The fire started in an abandoned cold storage facility located in Worcester and eventually became a five alarm fire exhausting the capabilities of the Worcester Fire Department and other communities which had pre-established mutual aid agreements with Worcester. Task forces responded from around the

[14] NAWAS is for radio communication and is not used except in times of extreme emergencies.

entire state responded aiding the fire ground operations and providing needed coverage of Worcester fire stations. Task forces which aided Worcester responded to 100 alarm responses, 274 emergency medical calls, 71 motor vehicle accidents, 13 outside fires, 50 service calls, 15 structural fires, and 12 vehicle fires within the jurisdiction of the Worcester Fire Department (Cady, 63). The "Cold Storage Fire" was the first time that the Statewide Fire Mobilization Plan had been tested to this magnitude. The plan was efficient as fire resources were coordinated and used to aid the city of Worcester.

The Statewide Fire Mobilization Plan of Massachusetts requires coordination and cooperation between multi-jurisdictional agencies. Dispatching procedures for this coordination is not available in the literature, however, will be determined by this report, Section 4.4.1.2.

2.8.4 Norfolk County, Massachusetts proposed regionalized dispatch from 2003 report, "Study Relating to Consolidation of Fire Department Dispatch Services and other Consolidating Discussion in New England

In September of 2003 the MMA Consulting Group, Inc. released a study evaluating the viability of consolidating fire and emergency medical dispatch services. Norfolk County and the Norfolk County Fire Chief's Association hired the MMA Consulting Group, Inc to conduct this study.

The study found that "In Norfolk County, each city and town maintains its own independent emergency communication systems for police, fire, and emergency medical services. Each jurisdiction designs its response protocols, there are "limited automatic mutual aid (automatic response to selective areas)" and, "communication is essentially decentralized." MMA Consulting Group suggests that there are several weaknesses in the current resource deployment arrangement and these include:

- *Insufficient resources to effectively perform all* services – No one fire and rescue agency can afford the necessary resources for all emergencies.
- *Lack of coordination in the deployment of resources* – This is substantial fire response capability in the County, but the current communication system does not provide a mechanism to ensure that needed resources are automatically available on a timely and coordinated basis in the event of a major incident.
- *Lack of coordination in deployment of emergency medical resources* – The current communication structure does not provide a systematic method to identify and make resources available to one community should it have multiple incidents or a multiple casualty incident.
- *Lack of automatic mutual aid* – Automatic mutual aid is not as fully developed in the County as desirable. Preplanned automatic aid is used occasionally, for specific locations, rather than as a routine part of emergency response.
- *Inability to meet emerging standards and service benchmarks* – Meeting service delivery benchmarks for emergency medical services or making progress in reaching NFPA Standards (1500, 1710, and 1720) is difficult for most departments. Developing a deployment strategy linked to dispatching will allow for movement toward meeting standards. Moreover, it will allow for improved ISO ratings, since ISO credit is granted for automatic aid.
- *Constraints of current governmental framework* – Custom and history have resulted in a number of independent fire departments designed to meet individual community needs. As a consequence, some duplication of resources occurs and there is limited ability to pay for needed resources (MMA Consulting Group, Inc. and Norfolk County Fire Chiefs Association, 2).

The study claims that, "a regional dispatch model corrects the weaknesses in the current response system." The study reported that 8 fire departments have their own dispatch system, 8 have joint police and fire dispatch systems, and five had separate dispatch departments and it appears that "there are at least 24 dispatchers working at any one time (MMA Consulting Group, Inc. and Norfolk County Fire Chiefs Association, 10)."

The study then evaluated the feasibility of a regionalized dispatch center, which would be based on communities participating in automatic aid responses. Two different size dispatch operations would be considered, one with the capability of handling 22,000 calls and the other for 42,000 calls[15]. Based on these predicted call volumes the MMA group estimated the cost of establishing and maintaining such an operation.

Initial expenditures would be required to provide a facility and equipment; the study assumed that an existing facility would be rehabilitated. It also assumed that 4-8 dispatch/consoles would be needed. The MMA Consulting Group estimated that initial expenditures for both dispatching systems (22,000 calls and 42,000 calls) would cost approximately $1,674,500; allocations of initial expenditures are seen in Table 10 (MMA Consulting Group, Inc. and Norfolk County Fire Chiefs Association, 41).

Item	Estimated Cost
Radio Consoles	$325,000
Fire Alarm Consoles	$370,000
Radio Equipment	$65,000
Telephone System	$60,000
Software	$100,000
Radio Console Furniture	$70,000
Computer Work Stations	$12,500
Office Equipment	$15,000
Back-Up Power Generation	$50,000
Building Rehabilitation	$525,000
Contingency	$50,000
Initial Training	$12,000
Initial Training Wages	$20,000
Total Cost	**$1,674,500**

Table 10: Estimate of Initial Expenses for Norfolk County Consolidated Dispatch Facility

The study also predicted the costs of staffing and maintaining the proposed dispatch operations. Staffing predictions are based on the assumption that there would be three shifts

[15] These numbers were the call volume of fire departments and communities which indicated interest in creating a regionalized dispatch center. Towns which indicated that they were "very interested" had 22,000 emergency calls and towns which indicated that they were "Very interested and/or remotely interested" had 42,000 emergency calls.

and these shifts would overlap at times of peak activity. Dispatchers are assumed to work 40 hours per week. Table 11, indicates the predicted staffing needs of each proposed dispatching system (MMA Consulting Group, Inc. and Norfolk County Fire Chiefs Association, 37).

Position	Number of Positions Needed for 18,000 to 24,000 Emergency Calls for Service	Number of Positions Needed for 37,000 to 45,000 Emergency Calls for Service
Director	1	1
Assistant Director	1	1
Lead Dispatcher	1	1
Dispatcher	10	13
Office Support	1	1
Total	**16**	**19**

Table 11 : Staffing Estimates for Norfolk County Consolidated Dispatch

The personnel costs were then determined based on the staffing estimates. The study assumed that a lead dispatcher's salary would be between $37,440 and $42,640 and ordinary dispatcher's salary would be between $31,200 and $36,816[16]. Yearly required personnel costs are seen in Table 12 and Table 13 (MMA Consulting Group, Inc. and Norfolk County Fire Chiefs Association, 39). The study also assumed an indirect cost of 35%; this includes basic benefits, cost of leave, and $25,000 in overtime and training costs. The personnel costs of the dispatch system (Model #1) which would the capability of handling 22,000 calls would be $842,681 and the personnel costs of the dispatch system (Model #2) which would have the capability of handling 42,000 calls would be $980,413. Additional costs which would be a part of the yearly operating budget would include the expenses detailed in Table 14 (MMA Consulting Group, Inc. and Norfolk County Fire Chiefs Association, 40).

Position	Number of Positions Needed for 22,000 Emergency Calls for Service	Estimated Wage
Director	1	$70,000
Assistant	1	$60,000

[16] Lead Dispatcher: $18.00 to $20.50 per hour. Ordinary Dispatcher: $15.00 to $17.00 per hour. Middle wages are used in the estimates.

Director		
Lead Dispatcher	1	$120,120
Dispatcher	10	$340,080
Office Support	1	$34,008
Total	**19**	**$624,208**

Table 12: Estimated Personnel Costs for Model #1 of Norfolk County Consolidated Dispatch

Position	Number of Positions Needed for 42,000 Emergency Calls for Service	Estimated Wage
Director	1	$70,000
Assistant Director	1	$60,000
Lead Dispatcher	1	$120,120
Dispatcher	13	$442,040
Office Support	1	$34,008
Total	**19**	**$726,168**

Table 13: Estimated Personnel Costs for Model #2 of Norfolk County Consolidated Dispatch

Category	Model 1 Expenses	Model 2 Expenses
Utilities (heating, cooling, electric, water & sewer)	$22,000	$25,000
Building Maintenance & Janitorial	$10,000	$10,000
Radio Support	$5,000	$5,000
Computer Support	$5,000	$5,000
Telephones	$10,000	$12,000
Office Supplies	$5,000	$6,000
Training	$10,000	$12,000
Miscellaneous	$12,000	$12,000
Total	**$79,000**	**$87,000**

Table 14: Estimated Additional Costs for Norfolk County Consolidated Dispatch

Based on these estimates the yearly operating budget of Model #1 would be $921,681 and the yearly operating budget of Model #2 would be $1,067,413. Initial start-up expenditures of both models are estimated to be $1,674,500 (MMA Consulting Group, Inc. and Norfolk County Fire Chiefs Association 42). The cost of these dispatching systems would be divided between the 8 (Model #1) or 16 (Model #2) communities which would be participating in the system (MMA Consulting Group, Inc. and Norfolk County Fire Chiefs Association, 48). At least six communities would be needed to justify the regional dispatch center's establishment.

By creating an automatic aid system, communities can pool their various resources in order to effectively perform all services and be more adequately prepared to meet the conditions stated by the industry benchmarking standards, see Section 2.3. A centralized dispatch center will be better prepared to coordinate the deployment of resources in the county. Also in creating an automatic aid system, insurance ratings could potentially be improved as ISO does give credit for automatic aid systems (Automatic Aid, ISO Online), however certain criteria must be met[17].

Automatic aid systems also have the ability to improve response times. Often times due to station location a community may be better served by the fire services of another community. Under an automatic aid system there are no jurisdictional boundaries, this would allow the nearest fire apparatus to respond to emergencies. The Norfolk County Consolidation Study evaluated station location and travel distances and current jurisdictional boundaries. The guide for evaluation used ISO's criteria which states, "A built-upon area of a community should have a first-due engine company within 1.5 road miles of the protected properties and a ladder-service company within 2.5 road miles" (Response-Time Considerations, ISO Online). An evaluation of travel distances, station location and jurisdictional boundaries of Plymouth County is seen in Section 8.4. The Norfolk County study found that automatic aid responses would provide improvements in response times; however they would be minimal improvements.

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[17] 1.) It must be prearranged for first-alarm response according to a definite plan. It is preferable to have a written agreement, but ISO may recognize demonstrated performance. 2.)The aid must offset a need in the community ISO is surveying. For example, if a community needs a ladder company and the fire department does not have one, but a neighboring community's ladder company responds by automatic-aid agreement, credit may be available. 3.) The aiding ladder company must cover at least 50% of the needed ladder company Standard Response District by hydrant count in the community being graded.

The proposed study indicates that consolidated dispatching would improve fire departments dispatching operations with standardized procedures, improve multi-jurisdictional communication, and help departments pool their resources so they can effectively perform all services. This can all be done at a reasonable price when divided among communities.

Resulting from the Norfolk County Consolidation Study, Fire Chiefs say, "A combined dispatching center offers the potential for savings in some communities. But they say its larger benefit would be enhanced public safety. The system could reduce response times and allow more fire fighters to participate in responses" (Laidler Article 2004). Chief Ronayne of Canton indicated that he believes the regional center could shorten response times because, "We will have professional, certified dispatchers answering the calls. Their only responsibility will be answering the calls and dispatching the apparatus" (Laidler Article 2004). In January of 2004, State Representative William C. Galvin filed legislation to establish the center. The bill would allow the county to borrow up to $1.7 million to launch the facility, and Norfolk County director, Jack Dacey said the county would seek federal and state grant money to cover an estimated $1.0 million to cover initial expenditures.

Essex County is also in the process of creating a similar study. Topsfield Fire Chief Giovannacci indicated the study will "examine both the potential benefits and any drawbacks of a regional facility. It will also help explore issues such as how costs would be apportioned among communities, where it would be located, and whether it would handle all public safety calls or just emergency ones" (Laidler, Article 2006). Giovannacci also noted that the potential benefits of a regional facility would increase savings in labor as well as capital equipment, and will improve the levels of training, which, "most local dispatchers don't have." He claims that it "could be more efficient and more effective to dispatch on a regional basis." Essex Police Chief, Peter Silva commented on regionalized dispatch as, "absolutely

worth pursuing further because of the potential for saving money and offering a more 'professional, standardized' way of dispatching calls." Similar considerations are being taken in areas of Connecticut where a group of fire chiefs has identified a few of the potential benefits provided by a regionalized dispatch facility (Gay, Online):

- An increase in operational efficiency because of in-house emergency medical dispatching and having multiple dispatchers available to assist in crisis. Regional dispatch might also help with response times in mutual aid.
- The ability to use a single dispatch software and have radio interoperability among all towns.
- Towns would be eligible to apply for regional dispatch center state and federal funding.
- Would be less expensive to run and the current individual systems.

The Phoenix Regional Automatic Aid System is regarded as a model and an evaluation of the literature pertaining to this system can be seen in Section 2.8.5.

2.8.5 Phoenix Regional Automatic Aid Dispatch Center

In 1982 the Phoenix Fire Department updated its dispatching services going from a manual process to using a Computer Aided Dispatch system. This technology has enabled the Phoenix Fire Department to provide dispatching services to twenty (20) jurisdictions. The service area is over 2,000 square miles and encompasses the City of Phoenix as well as the surrounding areas (MMA Consulting Group, Inc., Appendix). In 1996 the Phoenix Fire Department's Regional Dispatch Center was relocated to its current location. The dispatching facility remains up to date CAD system (interfaced with E911 and 911 systems), telephone equipment and communication equipment.

An "Automatic Aid" system "erases the jurisdictional boundaries for all participating agencies. This ensures first and foremost that the customer is receiving the highest level of care available at all times. Secondly it allows all participating agencies better use of their resources. This seamless cooperative effort ensures that the closest most appropriate resources are dispatched without a time or distance delay" (PFD: Regional Dispatch Center, Online).

In the dispatch center personnel is on duty 24 hours a day 7 days a week. Dispatchers are adequately trained (EMD certified) and ready to answer incoming 911 calls or assisting units on-scene using a radio. On busier shifts the staffing levels are increased and the department maintains the ability to call in additional personnel if activity levels require it (PFD Regional Dispatch Center, Online).

When the 911 phone rings in the dispatch center one of the dispatchers will answer and confirm the location of the emergency, the phone number, and determine what the emergency is. After determining the incident is "sent off via the CAD system to another dispatcher, Fire Communications Operator or "Channel One Operator" who dispatches the call. This dispatcher informs responding units where they are to respond, what type of emergency they are responding to, the tactical radio channel the incident will be worked off of and remains on the call handling all administrative radio traffic, ensuring additional resources are dispatched and that the incident is properly documented (Phoenix Regional Standard Operating Procedures, Online).

Dispatchers are aided by a CAD system which "knows where every piece of equipment is at all times due to global positioning satellite" (PFD Regional Dispatch Center, Online). GPS technology interfaced with GIS mapping enables the CAD system to select the

most appropriate unit closest to the location of the emergency. The CAD system knows what "appropriate units" are because specific response requirements for each type of call have been programmed into the system[18]. Additional discussion on Phoenix's automatic aid system can been seen in Section 8.6.3

2.9 Revenue Sources

2.9.1 Municipal Budgets: Introduction

Local governments around the country, including Massachusetts, are currently facing pressure to cut costs from various departments without reducing the level of services communities provide. City officials are struggling to balance funding for community services with limited revenue sources due to restrictions and ever increasing expenditures. Community fiscal budgets are understood by evaluating the revenue sources, revenue restrictions and expenditures.

2.9.2 Revenue Sources:

Massachusetts communities obtain their budgets through taxes, fines, fees, and state aid. Most often the state will subsidize the town for school programs, thus relieving the burden of having to fund education on tax revenue. The Massachusetts General Laws Chapter 70 Base Aid is designed to reduce the amount of tax dollars a town must use to fund its schools by providing a designated amount of money to each town based on a complex equation. Towns in Massachusetts also receive reimbursement from the state for any charter schools that are under their jurisdictions in accordance with Chapter 352 of the Acts of 2004. Chapters 645 and 871 reimburse towns for school construction and school lunches, respectively. All of these laws are designed to ease the burden of funding schools and allow the town's tax dollars to be used for other departments such as Fire, Police and Department

[18] The information programmed would be similar to the information stored on "Run Cards" discussed in Section 8.5 and Figure 17: Structural Run Card (Pembroke).

of Public Works (DPW) (Worcester Fiscal Budget 2006 III-1 4), however school departments still compose the majority of a community's spending.

Towns also are able to receive unrestricted state aid which can be used on anything they choose, however these funds are limited. This aid comes from the Massachusetts State Lottery, additional aid and state owned land. The lottery aid is distributed among towns in Massachusetts based on the equalized valuation per capita formula. The formula assigns aid based on the average amount of tax base revenue and local income of a community

Additional Aid was created to offset the hardships introduced by Proposition 2½, which limited the amount of money a town was able to raise in taxes, for an in depth discussion of Proposition 2 ½ refer to Section 2.9.3. With proposition 2½ in place, many towns were threatened by municipal collapses due to immanent under funding and therefore additional aid was given to each town so they could maintain their basic municipal functions (Worcester Fiscal Budget 2006 III-1 5).

Chapter 58, Section 13 of the Massachusetts General Laws states that it will reimburse the town approximately sixty percent of land that is used for the purpose of hospitals, wildlife, forest and waste treatment plants. The state will reimburse the town in accordance with the property value of the given parcel of land and the latest three year state wide tax rate (Worcester Fiscal Budget 2006 III-1 6).

Restricted aid is given to towns for use on items designated by the state. Programs such as public libraries, regional public libraries, veterans' benefits and other needs specific to the town (i.e. urban revitalization) are areas to which state money is allocated.

Towns can also use a source of revenue called "free cash" which comes from the surplus of funds from the previous year's budgeting. The Department of Revenue is in charge of approving the amount of free cash a town has based on the June 30th balance sheet. Towns are then notified of the amount they are allowed. Many towns will use this free cash to pay

off their snow removal debt (which is the only debt allowed to be carried over year to year) or to purchase a new piece of equipment, i.e. a fire engine (Worcester Fiscal Budget 2006 III-1 7; Ansai, 2005; Hart, 2006).

A town's main revenue source comes from property taxes. Properties that are eligible to be taxed are personal, residential, commercial and industrial properties. Due to Proposition 2½ towns are limited by the amount they are able to collect due to property tax. A town assessor is in charge of determining the tax value of all personal and real properties. By law the properties are to be assessed at 100% of their market value and the value must be determined by January 1st (Worcester Fiscal Budget 2006 III-2 4).

Towns also receive money through issuing permits and collecting fines. Hunting permits, boating permits, and liquor licenses are all areas of revenue for towns. Towns can also create deals with other towns to by agreeing to process waste or use of a transfer station for small fees. The amount of revenue generated through these measures is minimal compared to those generated by property taxes and state aid (Worcester Fiscal Budget 2006 III-3 9; Ansai, 2005).

2.9.3 Revenue Restrictions:

Proposition 2½ is the most significant revenue restriction towns in Massachusetts face in regards to the budgeting process. Proposition 2½ is the initiative petition adopted by the voters of the Commonwealth of Massachusetts in 1980 (Taxpayer Information - Proposition 2½, Online). Proposition 2½ artificially lowers the amount a town is able to collect in a single fiscal year through two separate means.

The first method Proposition 2½ constrains the municipal budget with is by restricting the amount a community can levy ("revenue raised through real and personal property taxes") "A community cannot levy more than 2.5 percent of the total full and fair

cash value of all taxable real and personal property in the community" also know as the levy ceiling.

The second method Proposition 2½ uses to limit a town's levying capacity is by creating a restriction on the amount the community is allowed to increase their levy by, generally, 2.5 percent of last year's levy.

There are several ways towns are able to increase the amount that is collected each year. A community can choose to vote on an override. An override is a term used to describe a situation where the assessed taxes are greater than the automatic 2.5 percent plus new growth in the town. An override is permanent unless otherwise specified. As long as the levy limit is below 2.5 percent of the full and fair cash value of the property or the levy ceiling the override is allowed. The override is then added to the levy limit where it is part of the annual 2.5 percent increase.

A community also has the option of extending its levy limit or ceiling to increase its budget for a temporary amount of time. This can only happen when the town votes on a debt exclusion or capital outlay expenditure exclusion. Debt exclusion is when money is raised for the sole purpose of repaying a town debt. Capital outlay expenditure exclusion is when a town raises money for the purpose of a new development for a municipal need. Once the agreed upon time period is up, the ceiling or limit is recalculated without the exclusion.

There is a relatively simple formula that can be used to determine a town's levy limit.

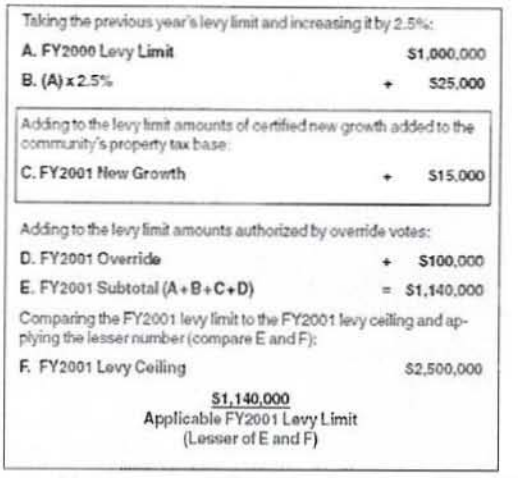

Figure 11: Town Levy Formula for Proposition 2.5

By taking 2.5 percent of the last years levy limit and adding it to the last years levy limit, plus all new growth and overrides will equal the current years levy limit. Then all debt or capital outlay expenditure exclusions are implemented to obtain the actual amount of revenue a town is able to spend.

New growth is added to the equation because new development in a town means added municipal costs which further deplete the town's ability to run an effective system. There are three major provisions that constitute as new growth: reassessed properties, previously exempt and new properties being put on the tax roll and, and new construction, i.e. subdivisions and condominiums. The new growth is then multiplied by the previous year's tax rate. In the case of reassessed properties the increased value is not included in the calculation.

Increases in Assessed Valuation = $1,000,000
Prior Year's Tax Rate = $15.00/1000
$1,000,000 x ($15.00/1000) = $15,000
New Growth Addition to Levy Limit = $15,000

Proposition 2½ is particularly harsh on towns when inflation rates begin to rise. Proposition 2½ is excellent for stimulating growth of a community due to low tax rates, but causes many headaches for town officials when there is not enough money to keep all parties happy. This creates problems for towns when artificially low tax revenues force unpopular

decisions to be made. Such as to choose between the departments the will be adequately funded and the ones that will be under-funded. (Taxpayer Information - Proposition 2½, Online)

2.9.4 Municipal Expenditures:

As towns increase in size so do there municipal expenses. Citizens want to feel safe in their city, have good schools, and not loose there car in a pot hole. It takes an extraordinary amount of money to keep a city in proper working order. It is the job of the town manager to make sure that each department is adequately funded. Each department submits a budget estimate to the town manager for their approval. This budget is based on previous years numbers and trends as well as any expenses foreseen by the department head; thus the importance of maintaining precise and accurate records within each department. The city manager then must take what is given to them and try to accommodate that budget to their given yearly revenue. Town managers will try to satisfy the needs of every department.

An intelligent department head will warn the town manager of any major expenses a few years before it is necessary to have the item so the town manager is able to plan for it. If the fire chief notices that they firefighters under his command are staying busy through out the year, he/she might want to warn the town manager that in a few years they will be asking to expand the staffing of the fire department. (Hart, 2005)

The school system will use up about half of the town's budget. The rest, except for a small portion, will be divided up amongst the police department, fire department and department of public works. The police department will receive the most amount of money, followed closely by the fire department, then the department of public works. During the course of the year, if one department is running short on funds, the town manager will try to rearrange a little to help out the struggling department. Unions make it difficult for a town

manager to significantly under fund departments because many times, in order to meet safety standards, significant funding is necessary however with limited resources unions are not always able to succeed. The DPW has the only expense that is able to be carried over from year to year, snow removal. This is due to the unpredictable nature of snow accumulation. (Ansai, 2005)

2.9.5 Overview of Fire Department Budgets:

Fire department budgets traditionally have taken up less than one-sixth of a town's budget. In Massachusetts communities especially in Plymouth County fire departments consume less than 10% of a community's budget, for additional discussion of this consumption percent refer to Table 16 in Section 4.3.2. The majority of funds go towards staffing which requires salaries, pensions and insurance needs, the NFPA Handbook estimates that 85-90% of fire department budgets are based on the costs of staffing (Tokle, Section 7 page 18).

2.10 Summary

This section has illustrated five significant components of the damage caused by fire and the problems in addressing the hazards presented by fire these are seen in the following:

- The history of fire throughout time and in the history of Massachusetts demonstrated that fire has been a threat and has caused damage throughout the history of the world and in the history of Massachusetts (Section 8.1).
- The MFIRS annual report illustrated that fire is still a threat and continues to cause enormous damage in Massachusetts (Section 2.1).
- NFPA's Needs Assessment of Massachusetts' Fire Departments show that community fire departments are under-staffed, under-trained, and often times operating with outdated equipment while attempting to fight the fire problem (Section 2.2).

- NFPA Standards put forth the performance objectives for fire departments showing the levels of performance to ensure adequate safety for communities (Section 2.3).
- Municipal budgets show that it is not likely budgets will increase. Communities are struggling to provide resources to the growing number of competing priorities, and available funds are restricted by Proposition 2 ½ (Section 2.9).

Based on the information drawn from background research, fire departments need to improve the level of service they are providing to minimize the devastation caused by fire. These improvements need to be made in ways that will not increase spending, because money is simply not available. Any action taken by the fire department should be with the objective of satisfying performance objectives put forth by the NFPA standards.

Increasing personnel, upgrading fire department equipment, vehicles, and facilities, relocating firehouses, improving training are all steps which fire departments could consider to improve the safety within the community. These actions come at great expense, as explained in Section 2.9.5, and funding for these types of upgrades is often not available due to competing priorities and limited funding (Section 2.9.3). Fire Chiefs nationally indicated that "getting the necessary funding" is the significant obstacle in making improvements in 91% of all circumstances (Effective Fire Protection (ISO) Online).

The proceeding literature review uses existing literature to determine the following five aspects related to fire departments:

- Identify fire departments' current performance levels in terms of staffing and response times (Reference Section 2.1).
- Identify the significance of response time (Reference Section 2.5).
- Identify the different components of response time, (Reference Section 2.6).
- Identify current dispatch procedures throughout the United States (Reference Section 2.7).

- Identify the history of dispatching, advent of the fire alarm box, introduction of telephones, 9-11, E9-11, and additional resources which aid dispatch procedures (Reference Section 8.2).

3 Methodology

Plymouth County was chosen due to one of the author's knowledge of the region and the convenience of being within close proximity to all the authors. This allowed for easier access to interviews with fire chiefs and dispatchers and town officials. The goal of this study was to determine the fire department dispatch procedures in the communities of Plymouth County, Massachusetts, the effectiveness of the dispatch procedures, and potential methods to improve those dispatching procedures, namely through a regionalized dispatch center.

3.1 Determine the Community and Fire Department Profiles of Plymouth County

3.1.1 Interview with Fire Chiefs

Fire Chiefs from Massachusetts and other New England communities where contacted and questioned about there dispatching procedures, use of Computer Aided Dispatching software, mutual aid agreements, and potential interest and effectiveness of regionalized dispatching. Interaction with Chiefs where used to determine the services fire departments in Plymouth County offer and where used to verify information in the background and literature review of this report.

3.1.2 Use of Additional Fire Resources

Additional fire resources where used to determine profiling information. These resources include:

- Appendices information of the MFIRS report.
- Fire Department websites.
- Profiling information determined for the "Deadly Delays" special report.

- Website http://www.capecodFD.com.

3.2 Interview Plymouth County Dispatchers to determine dispatch procedures within communities

Dispatchers where contacted by telephone to determine the existing dispatch procedures in the communities of Plymouth County and the level of technology used in each department and any potential problems which currently exist in the dispatching process.

3.3 Interview Regional Dispatch Coordinators to determine current dispatch procedures in these Regions

Regionalized dispatch coordinators where interviewed to verify that regionalized dispatching is effective and has a long history of providing emergency services across the country, even in the New England region. Operating budgets and yearly activities where detailed and additional suggestions that these dispatching professionals gave where used in the consideration of a Plymouth County dispatch facility.

3.3.1 South Western New Hampshire

A Personal interview with coordinator Paul Scoz and a tour of the South Western New Hampshire Mutual Aid System dispatching facility with lead dispatcher Phil Tirrel was conducted. This interview was to determine the history, effectiveness and area served by this mutual aid system and single dispatching center and the feasibility of creating such an organization in the New England region.

3.3.2 Lakes Region New Hampshire

Correspond with Lake Region Fire Mutual Aid System staff via e-mail to determine procedures, history and effectiveness of the dispatching operations. Used information provided by other dispatching officials to verify that this system is effective.

3.3.3 Phoenix Regional Automatic Aid Dispatch System

Conducted a telephone interview with Robert Barr, a Fire Protection Engineer of the Phoenix Fire Department, to determine the effectiveness of the Phoenix Regional Automatic Aid Dispatch System.

3.4 Interview Plymouth County Mutual Aid Dispatch Coordinator

Personal interview with Lieutenant Scott Billings, coordinator of Plymouth County Control which is the organization that maintains radio communication towers in Plymouth County and coordinates mutual aid operations between communities. This interview was to determine the procedures of the current mutual aid system, interoperability between communities, and the feasibility of creating a regionalized dispatch center.

3.5 Investigate improved methods of dispatch

After talking to fire chiefs and dispatchers the various types of dispatching procedures where analyzed and suggestions of how to improve each method were considered. Suggestions mainly included improvements of the existing technology (AutoCAD, GPS) and streamlining the dispatching procedure (avoiding a police primary PSAP).

4 Findings

4.1 Travel time is fixed

The town administrator of Hingham commented on the travel times in his town by saying, "We have an elongated geography. In some areas it is quite good. At the outskirts it is not so good; without changing the location of our stations there is not much we can do about it" (Cristello, Interview). This is the case in most communities and was the general consent of fire officials within Plymouth County. Section 8.8, Appendix, looks at the response time

performances for actual incidents of each community within Plymouth County separately. From this evaluation it is clear that travel time is limited by the geography of towns and the fact that emergency response apparatus is only capable of traveling at limited speeds.

4.2 Turn out time is fixed

Turnout time begins when units acknowledge notification of the emergency to the beginning point of the travel time. Fire fighters and other emergency response personnel are professionals who are dedicated to providing expedient services to the community. As professionals, they are not likely to delay and prolong a turnout time. Turnout times are limited by station characteristics and internal layout, ill-equipped fire apparatus and others factors.

4.3 Profile of Communities and Fire Departments in Plymouth County

4.3.1 Community Profile

Plymouth County is one of fourteen counties in the state of Massachusetts; this is represented in Figure 12. The county is composed of 26 towns representing a wide range of characteristics from rural towns to cities. The population within the county is currently 472,822, although this number is increasing. According to the U.S. Census Bureau (2000) the country covers an area of roughly 661 square miles (U.S. Census Bureau: State & County Quick Facts, Online). The municipal governments in these towns spend over a combined, $1,016,047,914 (Deadly Delays, Database). A map of Plymouth County is seen in Figure 12, and characteristics specific to each town can be seen in Table 15.

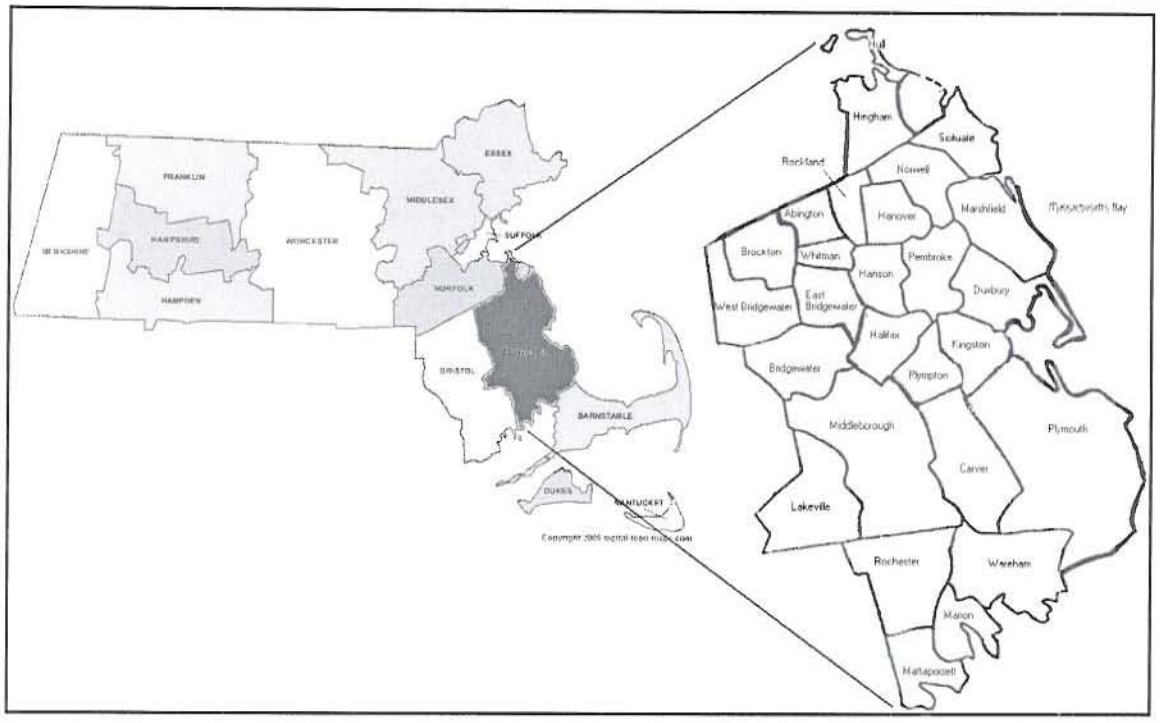

Figure 12: Plymouth County, Massachusetts

Community	Population 2004	Square Miles	Persons/ Sq. Mile	Population Growth 1990-2000	Municipal Spending
Abington	14,920	10.2	1462.75	5.7%	$ 28,952,965
Bridgewater	26,759	28.2	948.9	18.5%	$ 31,807,359
Brockton	94,910	21.6	4393.98	1.6%	$ 243,934,710
Carver	11,392	39.8	286.23	5.4%	$ 25,102,846
Duxbury	14,389	24.2	594.59	2.5%	$ 37,826,717
E. Bridgewater	13,722	17.5	784.11	16.8%	$ 28,445,040
Halifax	7,890	17.3	456.07	14.9%	$ 13,193,455
Hanover	13,665	15.7	870.38	10.5%	$ 34,046,830
Hanson	9,682	15.7	616.69	5.2%	$ 27,748,192
Hingham	19,906	22.7	876.92	0.3%	$ 52,879,767
Hull	11,284	3.1	3640	5.6%	$ 26,590,114
Kingston	12,874	18.9	681.16	30.2%	$ 23,799,153
Lakeville	10,635	36.1	294.6	26.2%	$ 16,078,615
Marion	5,374	14.7	365.58	13.9%	$ 14,254,714
Marshfield	25,441	28.6	889.55	13.0%	$ 56,125,015
Mattapoisset	6,436	60.5	106.36	7.1%	$ 14,481,357
Middleborough	20,771	72.3	387.29	11.6%	$ 45,556,024
Norwell	9,959	21.2	469.76	5.2%	$ 27,748,192
Pembroke	17,880	23.5	760.85	16.4%	$ 37,640,327

Plymouth	54,138	102	530.76	13.4%	$	119,989,416
Plympton	2,738	15.1	181.32	10.6%	$	5,080,500
Rochester	4,845	36.4	166.1	16.8%	$	11,172,273
Rockland	18,289	10.1	1810.79	9.6%	$	34,225,129
Scituate	18,294	17.4	1051.38	6.4%	$	37,479,724
W. Bridgewater	6,732	15.8	426.08	3.8%	$	16,543,841
Wareham	20,776	37.3	557	5.7%		n/a
Whitman	14,139	7	2019.86	4.8%	$	18,225,948

Table 15: Characteristics of Plymouth County Communities

4.3.2 Fire Department Profiles and Fire Problem

27 fire departments serve the 26 towns within Plymouth County[19]. Collectively there are 67 fire stations [20] [21] serving the 472, 822 people spread over 661 square miles (U.S. Census 2000) [22]and these fire departments spend around $74,000,000 per year[23]. Information specific to each department can be seen in Table 16.

Community	Number of Stations	Department Type	ISO Rating	Fire Spending 2003	Fire Spending as a % of 2003
Abington	2	Career	4	$1,650,319	5.7%
Bridgewater	1	Career	5	$2,926,277	9.2%
Brockton	6	Career	2	$16,831,495	6.9%
Carver	3	Volunteer	5	$326,337	1.3%
Duxbury	2	Career	4	$1,740,029	4.6%
E. Bridgewater	1	Career	4	$14,222,252	5.0%
Halifax	1	Volunteer	4	$435,384	3.3%
Hanover	5	Career	3	$1,600,201	4.7%
Hanson	1	Career	4	$1,174,563	7.9%
Hingham	3	Career	4	$3,172,786	6.0%
Hull	2	Career	4	$2,339,930	8.8%
Kingston	2	Career	4	$1,404,150	5.9%

[19] Marion (regarded as a town in this report) is actually a section of Wareham, however Marion maintains its own fire services, as does Wareham.

[20] This information was obtained through community maps, available to the public and verified in interviews with the dispatchers of Plymouth County communities.

[21] As discussed in Appendix 8.58.8, not all fire stations are staffed, equipped or operation. Additional research to determine the actual capabilities of these fire stations should be done in the future.

[22] Information regarding population and area of the country was obtained through the U.S. Census Bureau's, census.

[23] Information on fire departments budgets were determined using Bill Dedman's Deadly Delay's database and verified by interaction with community dispatchers, fire chiefs, and fire department websites.

Lakeville	1	Volunteer	5	$627,066	3.9%
Marion	2	Volunteer	6	$299,349	2.1%
Marshfield	3	Career	3	$3,648,126	6.5%
Mattapoisset	1	Volunteer	4	$202,739	1.4%
Middleborough	3	Career	5	$1,867,797	4.1%
Norwell	3	Career	4	$1,442,906	5.2%
Pembroke	4	Career	5	$1,957,297	5.2%
Plymouth	7	Career	4	$7,559,333	6.3%
Plympton	1	Volunteer	5	$91,449	1.8%
Rochester	3	Volunteer	5	$12,895	1.1%
Rockland	1	Career	5	$2,395,759	7.0%
Scituate	3	Career	4	$3,260,736	8.7%
W. Bridgewater	1	Volunteer	5	$1,042,262	6.3%
Wareham	4	Volunteer	3	n/a	n/a
Whitman	1	Career	4	$1,749,691	10%

Table 16: Plymouth County Fire Department Characteristics

There is a considerable "fire problem[24]" within Plymouth County, this is represented by the number of incidents each town in Plymouth County received in 2004[25]. Call volumes of each community can be seen in Table 17. Additionally, the Massachusetts Fire Incident Reporting System (MFIRS) annual report shows supports this conclusion, see Section 2.2 and specifically Table 1 for information specific to the "fire problem" within Plymouth County.

Town	Number of Calls
Abington	1,400
Bridgewater	2,000
Brocton	20,000
Carver	1,800
Duxbury	2,100
E. Bridgewater	1,600
Halifax	1,600
Hanover	1,893

[24] The term "fire problem" infers not problems limited to fire, but those problems addressed by the fire service, including Emergency Medical Services, Hazardous Materials responses, Confined Space responses, and the numerous and growing number of tasks which fire departments are responsible for. For additional discussion on the growing number of responsibilities see Section 2.2.

[25] These numbers were approximations given by fire chiefs and dispatchers and they represent fire, EMS, and all other fire service related calls (including false alarms). For additional discussion on types of calls and relative percentages see Section 2.2 and Figure 8.

Hanson	1,400
Hingham	3,700
Hull	1,500
Kingston	2,300
Lakeville	1,500
Marion	650
Marshfield	3,400
Mattapoisett	632
Middleborough	2,800
Norwell	500
Pembroke	2,400
Plymouth	11,000
Plympton	300
Rochester	800
Rockland	3,100
Scituate	2,700
W. Bridgewater	2,700
Wareham	2,195
Whitman	1,500
Total	**77,470**

Table 17: Call Volumes of Plymouth County Fire Departments

4.4 Dispatch procedures

4.4.1 Current Community Procedures of Plymouth County Fire Departments

4.4.1.1 Inter-Community Dispatching

There are three dispatching procedures that communities within Plymouth County utilize: police dispatch, police to fire dispatch and/or a dispatch center.

Police dispatch:
1. Call received by 911
2. Call transferred to police department
3. Police dispatchers send out fire apparatus

Police/Fire:
1. Call received by 911
2. Call is transferred to the police department
3. Call transferred to fire department
4. Fire dispatchers send out appropriate equipment

Dispatch Center:
1. Call received by 911
2. Call transferred to dispatch center

3. Dispatch center sends out appropriate equipment

Town	Police Dispatch	Police PSAP - Fire Dispatch	Dispatch Center
Abington[26]			
Bridgewater		X	
Brockton		X	
Carver		X	
Duxbury	X		
E. Bridgewater		X	
Halifax			X
Hanover			X
Hanson			X
Hingham		X	
Hull	X		
Kingston	X		
Lakeville		X	
Marion[27]	X	X	
Marshfield		X	
Mattapoisett	X		
Middleborough		X	
Norwell	X		
Pembroke		X	
Plymouth		X	
Plympton	X		
Rochester		X	
Rockland		X	
Scituate		X	
W. Bridgewater		X	
Wareham		X	

Table 18: Dispatching Procedures of Plymouth County Communities[28]

[26] No Data
[27] 8-4 FD dispatch - All other times PD dispatch
[28] As explained in the methodology, this information was determined by telephone interviews with Plymouth County Dispatchers.

4.4.1.2 Intra-Community Dispatching (Mutual Aid Coordination)

Addressing the fire problem within individual communities is generally handled by the fire department of that particular jurisdiction. There appears to be a limited number of automatic aid agreements between communities[29] [30], for additional discussion on automatic aid see Section 2.8.5. All communities within Plymouth County have pre-existing mutual aid agreements with other communities located in Plymouth County as learned in the Billings interview and dispatcher interviews.[31] State Fire Marshall Steve Coan indicated that, only as of late have mutual aid agreements become widely used and accepted as a legitimate alternative to increase public safety. (Coan, 2006). In the event that mutual aid resources are exhausted the Statewide Fire Mobilization Plan exists, reference Section 2.8.3. Mutual aid and automatic aid in times of emergency are permitted by Chapter 48, Section 59A of the General Laws of the Commonwealth of Massachusetts which allows a fire department from one community to work within the jurisdiction of another while rendering aid.

Plymouth County Control Fire/EMS Mutual Aid System is the control point for Fire District 2 of the Statewide Fire Mobilization plan. Plymouth County Control coordinates mutual-aid responses from one community to another within Plymouth County[32] [33]. The fundamental goals of Plymouth County Control are the following[34]:

- Provide coordination for all fire and EMS incidents within the County.

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[29] The Marshfield fire department has an automatic aid agreement with Scituate to cover the section of Marshfield referred to as Humarock. However, Marshfield also responds as part of the first alarm to all incidents in the Humarock region.

[30] The Hanson fire department has an automatic aid agreement with Pembroke to respond to two industrial zones located within Hanson, Pembroke and Hanson would simultaneously receive the alarm if a pull-station or fire alarm box were activated. For discussion on fire alarm boxes see Section 8.2.2.

[31] Mutual aid coordination in handled by an Plymouth County Control, District 2 in the Statewide Fire Mobilization Plan. For additional discussion on Plymouth County Control (PCC) see Section 8.8.

[32] Plymouth County Control also is responsible for the mutual aid coordination of Cohasset, which is not actually part of Plymouth County.

[33] This includes interaction with private Emergency Medical Service Providers.

[34] This was determined during a Power Point presentation given by Lieutenant Scott Billings.

- Facilitate the interoperable radio communications network with base station, mobile and portable radio communications, as well as the Sheriff's Department's Mobile Communications Unit that responds automatically to all three-alarm fires.
- Assist local departments with outside resources such as state and federal agencies.
- Coordination of specialty services, such as the Technical Rescue Team, Plymouth County Dive Team, Critical Incident Stress Debriefing (C.I.S.D.) and Juvenile Fire setters Program.
- Maintain daily contact with surrounding mutual-aid centers, such as Barnstable County Control and Norfolk County Control, as well as the Massachusetts Emergency Management Agency Headquarters in Framingham (MEMA).
- Remain updated on Policies and procedures for the Southeastern Massachusetts Emergency Medical Services/Region 5, and the Department of Fire Services for Haz/Mat incidents and Statewide Mobilization Plan.

Plymouth County Control maintains the radio network for fire departments. Plymouth County has 7 radio site locations[35] and maintains fours different frequency bands.[36] Incidents which require mutual aid are reported to Plymouth County Control who designates a "Mutual Aid Channel" to that particular incident. The fire departments from multiple jurisdictions are able to communicate on this dedicated channel. Plymouth County Control also broadcasts the incident, location, district and response to all fire departments in Plymouth County. PCC then works with responding departments to ensure adequate response and adequate station coverage, each fire department still maintains the ability to communicate on their dedicated frequencies, for a list of dedicated frequencies reference Table 22. This coordination is done with the aid of "run cards" which specify the order of mutual aid response, for additional discussion and examples of "run cards" see Figure 17, Figure 18 and Figure 19 in Section 8.5.

[35] Located in Hanson, Plymouth, Cohasset, Brockton, Middleborough, Marshfield and Mattapoisett.
[36] VHF Low Band (29.7 MHz – 50.0 MHz), VHF High Band(148.0 Mhz-174.0 MHz), UHF Band (450 MHz-512 MHz with 6 channels) and 800 MHz (800 MHz) and has a channel guard (PL tone) which reduces/eliminates interference from other systems operating on the same channel

Plymouth County Control does not employ the use of Computer Aid Dispatch software, however it does attempt to maintain the locations of available resources and ensure that all areas within the county are covered by adequate type and number of apparatus[37] [38]. Plymouth County is effective in providing fire departments with interoperability and enhanced communication by providing dedicated mutual aid channels. PCC's dispatching procedures are done over radio communication or telephone communication and done without the aid of CAD software, GPS or GIS. Dispatching is primarily reliant on pre-determined run cards.

4.4.2 Regional Dispatch Center Procedures

Regionalized dispatch centers serve as the primary PSAP for all communities which are served by the dispatch center[39]. A dispatcher receives the call, processes the information and uses predetermined information to determine which emergency response units will respond to the emergency.

In the Southwestern New Hampshire Mutual Aid System and the Lakes Region Mutual Aid System predetermined information and available units are maintained on paper copies, similar to the run cards discussed in Section 4.4.1.2 (no CAD software is currently being used), which are updated regularly. Dispatchers will physically use this information and dispatch the appropriate units. The Southwestern New Hampshire Mutual Aid System is currently in the process of installing a Vallor CAD system that will eliminate the paper trail, and aid dispatchers in immediately identifying appropriate response units.

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[37] For example, PCC attempts to ensure that all areas/sections of the county are within a reasonable range of a ladder truck or other equipment. Generally this equipment is "specialty" equipment that not all departments would regularly have.

[38] This was determined in a personal interview with Lieutenant Scott Billings.

[39] As is the case for the Lakes Region, Phoenix Regional Automatic Aid System, and the Southwestern New Hampshire Mutual Aid System.

In the Phoenix Regional Automatic Aid System a CAD system identifies the closest emergency unit (regardless of jurisdiction) and dispatches them to the scene of the emergency[40]. The CAD system is able to do this because all apparatus in this system are equipped with GPS tracking which enables CAD software and dispatchers to locate all units are that immediate time. This system acts as one seamless fire department, therefore jurisdictions are not relevant

5 Analysis/Conclusions

5.1 Foreword

This report determined Massachusetts does not comply with the NFPA's standard of what qualifies as a safe and efficient fire service. (Section 2.2) This does not mean that Massachusetts fire departments are incapable of providing adequate service to the citizens of the community. It also does not mean that the citizens in a community are entirely safe and being provided with the best possible service. Assuming that the NFPA standards set by the *Needs assessment of Fire Service: Massachusetts* (section 2.2) is a minimum for the quality of service a department should be providing the community it serves, it might possible to draw a conclusion that Massachusetts towns are at a higher risk than if the standards set by the NFPA are met. In no way are the authors of this report accusing Massachusetts of having a less than adequate fire service, but rather, that the services that are provided have the potential to be even more efficient in their duty of saving lives.

To meet the standards suggested by the NFPA, a town would be required to spend a large sum of money revamping its systems, building more stations and obtaining more personnel and equipment. Very few towns have the resources to follow through with such a

[40] Currently the system does not use actual road distances, but uses actual straight line distance to determine the closest emergency response unit. Robert Barr indicated that improved GIS technology is being interfaced with GPS technologies in order that actual road distances are used.

large undertaking and thus the concern of how to increase the quality of service without increasing costs. This report suggests that one way in which towns can improve their quality of service is by switching to a regionalized dispatch center.

5.2 Fire Problem within Plymouth County

Plymouth County Departments are responding to over 77,000 emergency service calls (Table 17) protecting over 661 square miles and a population of over 470,000. This population has consistently increased in all 26 communities since 1990 (Table 16). Available budgets are limited as discussed in Section **Error! Reference source not found.** and fire departments are using outdated apparatus, equipment and facilities (Section 2.2). Due to these factors fire departments are becoming less confident in their abilities to handle large scale incidents, reference Table 3. Staffing and response time performance levels are below those recommended by industry standards, as shown in Section 2.4.3. As Section 2.5 outlines, every second counts when saving a life.

Fire departments within the county are operating with limited personnel and equipment. Improving equipment and personnel is not an easy option because community and fire department budgets are limited due to revenue restrictions, namely Proposition 2 ½ (Section 2.9.3) and an increasing number of competing priorities in communities (Section 2.9.4). Therefore fire departments need to find other ways to improve. (Ansai, Interview)

5.3 Potential Area of Improvement with Current Resources

As indicated, response time performances of Plymouth County fire departments were below industry standards. In order to improve response time, the components of response time (Table 4) needed to be evaluated separately. In this evaluation it was determined that "travel time" (Section 4.1) and "turn-out time" (Section 4.2) could not be improved without drastic expenditures. "Travel time" was restricted by a number of factors specifically station

location, apparatus capability, road infrastructures within the community and the understanding that emergency response units can only travel are only able to travel so fast. "Turnout time" is fixed due to the assumption that the emergency service personnel of Plymouth County are professionals dedicated to providing the most expedient level of service and understand the significance that "every second counts", Section 2.5.

Upon evaluating the call processing objectives specified by NFPA 1221, "answering emergency call" and "dispatch time", within Plymouth County there appeared to be little standardization between town departments, Section 4.4.1.1. Call processing procedures varied between communities, relying on multiple PSAPs and various organizations (Table 18), differently qualified telecommunicators[41], and the use of different levels of technologies[42]. The actions taken by President George Bush in 2003 and the United States Congress in 2005, as discussed in Section 2.7, vividly illustrate that there needs to be enhanced cooperation and coordination between multiple agencies. The results illustrated in Table 18 indicate that local agencies are still making independent decisions about communication systems and that no "multidisciplinary, cross jurisdictional governance structures" has been established "to achieve the necessary level of collaboration is essential to accomplishing this goal (improved interoperability)" (H.R. 4119 Sec. 2).

The numerical data detailing the performance levels of call processing times was not available from fire departments[43]. Because of this, it was impossible to factually state the current "call processing" performance levels of communities. The observed current

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[41] Some department dispatchers were dedicated fire telecommunicators while others were police telecommunicators, civilians, State police dispatchers, or various fire department personnel.

[42] This is indicated in a number of ways. The radio capabilities of departments is somewhat displayed in the list of radio frequencies, Table 22. Additional work would need to be done to truly specify the extreme variation between the technologies found between departments and jurisdictions. Interaction, while not detailed in this report revealed that there is extreme variation between departments in the County.

[43] This information was requested from a number of departments and it was found that this information was not available. The times are recorded by "time stamps" however the information, in most systems, is not compiled indicating these levels of performance. Times could be evaluated incident by incident in this report.

procedures indicate that systems could be standardized and simplified, potentially improving the quality and speed at which calls are processed and dispatched. Additionally, fire chiefs have already presumed that this is a potential benefit due to improved dispatcher training, qualifications and the use of technology, as discussed in Section 2.8.4.

Upon researching and observing *other* dispatching procedures (Section 2.7 and Section 8.6) there is reason to believe that fire department[44] dispatching procedures could benefit from being consolidated with surrounding communities. There are a number of regionalized dispatch operations effectively operating across the entire country. Evaluation of Southwestern New Hampshire Mutual Aid System (Section 8.6.1), Phoenix Regional Automatic Aid System (Section 2.8.5 and Section 8.6.3), DuPage Public Safety Communications (Section 2.8.2), Norfolk County Consolidated Dispatch (Section 2.8.4) and the Lakes Region Mutual Aid System (Section 8.6.2) reveals that:

- Mutual aid coordination can be simplified by eliminating third and fourth party communication. Potentially improving interoperability[45].
- Call processing and dispatching procedures can be standardized, improving quality and consistency.
- By consolidating funding, dispatch centers can employ the use of valuable tools such as CAD software, GPS tracking, and GIS mapping, these are things that departments may be financially incapable of accomplishing alone[46].
- Dispatchers can be adequately trained and monitored.
- An adequate number of dispatchers (2+) would be on staff to handle extreme emergencies or multiple emergencies.

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[44] And other emergency service providers.
[45] Communities are already working together through mutual aid agreements. A regionalized dispatch center would push departments from jurisdictions to work together on a more frequent basis and not rely on third party organizations, such as Plymouth County Control.
[46] The United States Congress has already declared that, "Communications interoperability can be accomplished at a much lower cost if strong national leadership drives cooperation and adoption of smart, new technological solutions" (H.R. 4119)

This investigation demonstrated that because of limited budgets on the municipal level fire departments cannot make improvements through financial expenditures. Departments are likely not able to relocate fire stations, improve road structures, obtain new equipment, and even improve levels of staffing, because of this the fire service needs to find other ways to improve the level of services they provide to the community. Consolidating dispatch operations have been proven to be successful across the country, for more than 50 years. These consolidated dispatch operations have standardized dispatching procedures, implemented technologies, and provided levels of personnel capable[47] of handling major or multiple incidents. These consolidated operations have reasonable expenses, similar if not lower than current dispatching operations[48].

6 Recommendations

This work was effective in qualitatively showing that regionalized dispatch operations are effective and would offer an improvement over current dispatching operations. Additional work could be done in the following areas:

- Financially show that consolidated dispatching operations would be an improvement over the current system, after initial expenditures.
- Quantitatively show the differences between call processing times of the existing regionalized dispatch centers and the current community dispatch centers.
- Detail the differences in the professional qualifications of the existing regionalized dispatch centers and current community dispatch centers.
- Encourage interaction between communities and fire departments

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[47] Capable refers to both the staffing levels (actual numbers of dispatchers) and the levels of training and additional qualifications.
[48] This neglects the initial expenditures, likely incurred over a two year process.

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8 Appendix

8.1 Appendix: History of Fire throughout time and in the History of Massachusetts

8.1.1 World Wide Fires Incidents through History

For as long as fire has existed it has posed a potential hazard and a valuable resource to mankind. Early humans undoubtedly experienced natural fire phenomenon caused by lightning, volcanic eruptions, and sources of ignition. While an essential resource that continues to grow today, it has presented dangers to all whether due to natural hazards, arson, or terrorist attacks.

Greek civilization experienced the destructive forces of fire as it destroyed the temple of Artemis in 356 B.C. Egyptians suffered the destruction of the Library of Alexandria in 50 B.C. In July of 64 A.D. the Great Fire of Rome occurred destroying 10 or Rome's 14 districts. The city of Constantinople was destroyed during the battles of the Fourth Crusade in 1204. In 1666 the "Great Fire of London destroys over 436 acres, 13,200 houses and 87 churches. Fire has affected every civilization throughout history.

8.1.2 American Fire Incidents through History[49]

The United States of America has also had a significant fire problem since its inception. In January of 1608 the Jamestown settlement was lost to fire, and the early settlers were forced to abandon the settlement until 1610 (Maybee Collection). Cities throughout the U.S. have experienced the devastation caused by fire.

In 1776, portions of Long Island, New York are destroyed leaving occupying British soldiers searching for shelter (McCullough. Audio Book). In 1814, the British in the war of 1812 burn the White House and the Treasury Building (Maybee Collection). The Great Chicago Fire destroyed over 2,000 acres, 17,500 buildings causing $222 million dollars and leaving 100,000 people (a third of the city homeless) in 1871 (Maybee Collection). 296 people die in a blaze at the Brooklyn Theater in 1876 and at least 600 die in the Chicago Iroquois Theater fire in 1903 (Maybee Collection). An earthquake in San Francisco causes a number of fires that go on to devastate the city. In 1911, a fire at the Triangle Shirt Waste factory results in 146 deaths all devastating losses (Maybee Collection). In 1977, the Beverly Hills Supper Club ignited, 165 people perished. Modern fire catastrophes are still occurring. In 2003, the Station Night Club fire claims the lives of 100 people (Farragher, online). This short list of fire incidents represents part of the fire problem in the United States throughout history.

8.1.3 Massachusetts Fire Problem through History[50]

The Commonwealth of Massachusetts has a long and ongoing history with fire dating back to 1623 when a fire destroys seven dwellings and the provisions of the town of

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[49] Historical Information was mainly taken from unpublished information compiled by Walter W. Maybee. Maybee's collection is referred to as "A Chronology of U.S. Fire and Fire Protection." In this collection, each year between 1608 and 2006 has an entry which contains general information of that year as well as fire extinguishing, fire losses and influential people in the fire community. Information is referenced. Maybee regards himself as a future historian.

[50] Again, much of the historical information for this Section was taken from the collection of Walter Maybee, see previous footnotes for additional information.

Plymouth. Conflagration fires plagued early settlers in Massachusetts as major fires occurred in the city of Boston in 1631, 1653, 1676, 1679, 1683, 1711, 1736, 1760, 1761 and 1773 (Maybee Collection), there were undoubtedly other fires however fires noted are those which resulted in significant destruction.

Fires because of acts of war are responsible for a large number of fires, most notably in 1755 when the British ignite 400 buildings in Charlestown, MA. In 1778, the British destroyed the entire town of New Bedford (McCullough. Audio Book).

In November of 1872 a fire monstrous fire nearly destroyed Boston's business district raging for over 15 hours before firefighters led by Chief John Damrell prevented further spread of the fire and destruction (Damrell's Fire, Video). Fire has affected every aspect of life especially in Boston, in 1926, a fire at Fenway Park destroyed the left field grandstand and another fire in 1934 ravaged the facility (Fenway Park Milestones, Online) . In 1942, a fire at the Coconut Grove Club kills over 400 people in downtown Boston.

Fortunately, there have been few major incidents within the city in recent year; however the fire problem and potential hazards still exist within Boston and the entire Commonwealth of Massachusetts. The National Fire Protection Association's report; (NFPA) *Needs Assessment of Massachusetts Fire Service* and the Massachusetts' State Fire Marshal's report; *Massachusetts Incident Reporting Systems: Annual Report* illustrates the current fire problem within the state.

8.2 Appendix: Evolution of Dispatching

8.2.1 Introduction

As discussed in Section 8.1, fire has posed a significant threat and caused damage for thousands of years, the history of reporting those hazards to "emergency responders" has also

existed throughout history. The proceeding sections show the evolution of fire reporting through fire alarm boxes, telephones, and new technologies.

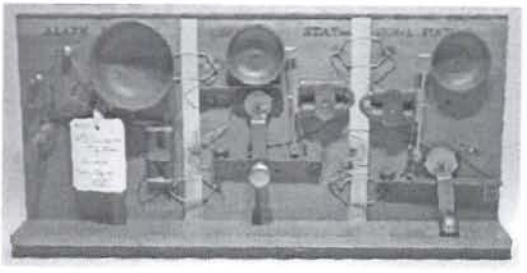
8.2.2 Fire Alarm Boxes[51]

In 1839, Dr. William F. Channing of Boston invented the first fire telegraph. Then in 1847, Dr. Channing and Professor Moses G. Farmer developed the world's first municipal fire alarm system (Patent #19,335). Their invention is later installed in Boston becoming the world's fires fire alarm telegraph system. The system consisted of 45 boxes, connected to 16 fire bells in the city; all bells would ring at once.

The first fire alarm is turned in during 1852 by J.H. Goodale, however the alarm system did not work because Goodale turned the handle too fast, fortunately damage from the fire was minimal (Maybee Collection). In 1855, John N. Gamewell secures the southern patent rights for Dr. Channing's Alarm System and created the Gamewell Fire Alarm Company, which is now a part of Honeywell International's Automation & Control Solutions Group and known as Gamewell – Fire Control Instruments (Gamewell - FCI - Our Company. Online). Additional discussion on the history and evolution of fire alarms can be seen in Section 8.1.

Today fire alarm boxes are still in existence and are still a major method of reporting emergencies are reported to fire departments, technology has drastically changed but the concept is still the same. An illustration Dr. Channing's original system is seen in Figure 13 and of a modern day pull station is seen in Figure 14.

[51] As in other historical sections, the content is taken from the "Chronology of U.S. Fires and Fire Protection", the unpublished collection of Walter Maybee. Information was verified through online sources.



MODEL AT THE SMITHSONIAN INSTITUTION

Figure 13: Original Fire Alarm Box

Figure 14: Modern Fire Alarm Box / Pull Station

8.2.3 Telephones, 911, E911

The evolution of telephones and the 911 system have drastically changed the way that emergencies are reported and dispatched. While technologies continue to evolve dispatching facilities are struggling to keep pace with the technologies. Gabe Elias, a senior systems engineer at a Virginia call center says that, "technology and communications are evolving really fast and 911 doesn't keep up really well with that" and Kim-Mai Cutler, Boston Globe correspondent reports that, "telecommunications have become exponentially more complicated, requiring cost upgrades to thousands of call centers around the country" (Kim-Mai Cutler, Article). The proceeding historical timeline indicates that emergency communication operations are still trying to adjust to the technologies of the 90's (Kim-Mai Cutler, Article).

As discussed in Section 8.2.2 fire alarm boxes revolutionized emergency reporting. Prior to 1847 methods of emergency/fire reporting including large stationary bells located in public areas, church bells, fire rattles, and word of mouth

(Fire Alarm Division. Online). Another invention which drastically changed the way emergencies were reported was the invention of the telephone. In 1876, Alexander Graham Bell invents the first telephone just hours before Elisha Gray (Maybee Collection). In 1880 telephones were added to transmit alarms to fire fighters (Maybee Collection). It wasn't until 1922 that the Gamewell Co. provided a telephone jack in boxes enabling two way communications between the chiefs at the fire and the fire alarm office (Maybee Collection). Over the next 15 years telephones improved interoperability of the fire department and the regular communications between citizens.

In 1937 Britain implements its 999 emergency telephone system which served police and fire departments (The History of 911, Online). This is the same concept as the modern day 911 system used in the United States[52]. In 1957 the National Association of Fire Chiefs suggest a single number for reporting emergencies in the United States. Ten years later in 1967, the Commission on Law Enforcement and Administration recommends a single number for emergencies. The next year AT&T designates 911 as the universal number for emergency call reporting (AT&T Units Plan '911', Wall Street Journal). B.W. Gallagher, President of Alabama Telephone Company, was offended that AT&T and the FCC had overlooked the views of the independent telephone industry and decided to make the Alabama Telephone Company the first to implement 911 (World's First 9-1-1 Call, Online).

Since 1968 the 911 system has expanded to incorporate calls from cell phones, the modified system is referred to as E911. Cell phones complicated the 911

[52] New Zealand implements a similar system in 1958, Canada in 1959, and Australia in 1961.

system because the phones are mobile and not fixed to a particular location. In order to locate emergency calls coming from cell phones call centers locate callers based on signals from cell towers and by GPS features of phones. In a 2006 article the Boston Globe reported that about 25 percent of all call centers cannot provide both the location and number of wireless callers (Cutler, Kim-Mai, Article).

8.2.4 Technologies that aid in fire department dispatching

Computer Aided Dispatching software is an enormous benefit to fire departments and dispatching processes. Combined with Global Positioning Systems (GPS) and Global Information Systems (GIS) technologies dispatching procedures can be drastically simplified if fire department's take advantage of these resources.

On June 26, 1993 the U.S. Aid Force launched the 24th Navistar satellite into orbit, completing a network of 24 satellites known as the Global Positioning System, or GPS. With a GPS receiver, individuals can instantly learn their latitude, longitude and even altitude to within a hundred feet (The History of GPS, Online). This technology is available to the public and is currently used in many industries. This technology can greatly improve fire service dispatching as it allows users to identify where particular fire apparatus are located (even if that apparatus is in the field).

GIS's past history goes back hundreds of years in the fields of cartography and mapping, GIS as such began in the 1960s. Today Geographic Information Systems (GIS) are computerized systems for the storage, retrieval, manipulation, analysis, and display of geographically referenced data. These systems contain physical, biological, cultural, demographic, or economic information.

(Mark, David M, Nicholas Chrisman, Andrew U. Frank, Online)

Interfacing CAD software, GPS locating, and GIS mapping the fire service is able to systematically detail important characteristic in their communities, locations of fire apparatus, as well as thousands of other features. These technologies can drastically improve the current dispatch processes existent in many fire departments. These systems have already been implemented in a number of departments and have shown great success, see Section 8.6.3 for additional discussion.

There are three different levels of Computer Aided Dispatch Classifications, class1, class 2 and class 3. The differences between classifications can be seen in Table 19.

Classification	Requirements	From NFPA 1221 Section:
Class 1	Shall be equipped with a level of computer technology and equipment that selects and recommends to the telecommunicator the appropriate units to be dispatched.	9.4.1.1
Class 2	Shall be equipped with a level of computer technology that is used in communication centers to support dispatching operations	9.4.2.1
Class 3	Shall be equipped with a level of computer technology that is used as a support function to emergency service dispatching and that is used for status and logging information	9.5.3.1

Table 19: Descriptions of CAD Capabilities and Classifications

Together CAD software, GPS and GIS technologies have the ability to drastically improve the dispatching process, readily identifying the most available units and selecting the optimal route. Interfacing these three technologies could drastically improve the rate at which units are dispatched as well as improving the quality of dispatch decisions.

8.3 Appendix: Fire Alarm History Timeline (work taken from future Historian Walter Maybee and a History of NFPA 72: National Fire Alarm Code)

Year	Historical Event	Historical Event
1839	Dr. William F. Channing of Boston invents the fire telegraph, although it won't be used until 1851.	

Year	Historical Event	Historical Event
1847	Dr. William F. Channing and Professor Moses G. Farmer develop the first municipal fire alarm system. It is patent number 19,335 of May 19, 1847	
1851	The first fire alarm telegraph system is installed in Boston by Dr. William F. Channing. The system has 45 boxes, connected to 16 fire bells in the city; all bells ring at once. Done on a $10,000 contract. The Channing alarm system is built by Moses G. Farmer. An 1852 Gamwell article states that there were 41 cast iron boxes, painted black, and including 49 miles of wire. The bells for striking machines weigh from 300 to 3,700 pounds and are struck by hammers weighing up to 40 pounds.	The fire alarm telegraph system was patented and later sold to Gamewell Co. in 1857
1852	William F. Channing installs a central office and 45 street boxes in Boston. The first alarm is turned in at 8:25pm by J.H. Goodale when he saw a fire in a wood barber shop. However, he turns the handle too fast and an alarm is not registered. Not hearing any bells, he runs to the central fire alarm office to report the fire which was fortunately small.	
1855	John N. Gamewell secures southern patent rights for Dr. Channing's alarm system. He becomes enthused after attending a Smithsonian lecture by inventor Channing, and with financial backing of a jeweler friend, purchases marketing rights for the south and southwest.	Philadelphia becomes the second city with a fire alarm telegraph system.
1858	St. Louis becomes the third city with an alarm telegraph system.	
1859	John Gamwell acquires Channing's telegraph alarm system rights for all of the U.S. The accuisitions of all right cost Gamewell $30,000	
1860	New Orleans and Baltimore become the fourth and fifth cities with telegraph fire alarm systems.	Cincinnati installs its first fire alarm telegraph.
1861	Washington D.D. installs its first telegraph fire alarm system.	Boston changes the color of its fire alarm boxes from black to red, which will become the national standard.
1867	Spring-driven fire alarm boxes begin to replace those driven by weights.	
1870	Rogers patents the first automatic repeater for receiving and retransmitting fire alarms from boxes.	

Year	Historical Event	Historical Event
1871	The Chicago fire is first sighted by a passerby, William Lee, who passes several alarm boxes and runs three blocks to where the druggist had the key to Box 296. When operated, the alarm is never received at Courthouse alarm headquarters. After half an hour with no response, the druggist turns in the alarm again, with still no response. The fire alarm operator has his attention called to the visible fire but thinks it is a minor rekindling of a previous nights' fire. Finally the first response is misdirected a mile, south of the fire and the alarm operator refuses to correct, thinking it will confuse the firemen and they will respond to the right location when they see the flames. They do, -- too late.	
1873	At the Cincinnati Exposition, judges cite the Gamewell alarm system as: "the most ingenious and finest piece of telegraphic mechanism ever exhibited."	
1874	The American District Telegraph Company is founded in Baltimore. It provided messengers within 3 minutes of any point served by its office. With 22 blue coated messenger boys, an alarm (or other signals) dispatches a boy to the nearest fire house.	William Watkins merges with a competitor named the U.S. Electric Fire signal company and converts a station to a central station, receiving approval of the Boston Board of Fire Underwriters.
1875	Gardiner patents a non-interfering system for fire alarm telegraphs.	Charles Tooker patents a "keyless" fire alarm box that sounds an alarm when the door is open (intended to allow unlocked boxes and still control false alarm problem). Unfortunately, so many people thought the "open-the-door" alarm was the fire alarm, that the NBFU eventually ordered their use to be discontinued.
1876	Alexander Graham Bell invents the telephone, just a few hours before Elisha Gray's.	The Joker fire alarm is invented and developed. With an alarm register, telegraph sounder, bell, polarized relay, and a telephone, it allows the telephone or telegraph key to be operated without interrupting a fire alarm signal being received. (716)
1879	Gamewell forms the Gamewell Fire Alarm Telegraph Company, with John N. Gamewell, proprietor, American Fire Alarm Telegraph.	
1881	The first auxiliary fire alarm system, the Rogers, is developed in Providence, RI. It connects interior alarms to a street box. San Francisco claims the first extensive use.	

Year	Historical Event	Historical Event
1889	John Ruddick develops "successive" fire alarm systems. Now multiple alarm boxes, pulled about the same time will not have their signals interfere. (101)	
1894	N.H Suren invents a self starting automatic door for street alarm boxes. Turning of the handle sends the alarm. The alerting bell does not ring until the code wheel is operating. (716)	
1896	Gamewell introduces coded street boxes to minimize false alarms. (69)	
1898	The first NFPA standard on signaling systems is adopted.	
1901	Guglielmo Marconi (1874-1937), Italian electrical engineer sends the first radio signal from England to Newfoundland. It is considered the birth of the radio industry. (597)	
1904	Gamewell introduces a positive, non-interfering street box. (69)	
1906	A census bureau report issued this year notes the following on municipal fire alarm systems: From 1852-1862, four cities are installed. From 1862-1872, 40 systems are installed. From 1872-1882, 62 systems are installed. From 1882-1892, another 359 systems/ After the 1904 census bureau reported some of the 764 fire alarm systems in operation, including 37,739 fire alarm boxes.	
1906	The New England Insurance Exchange lists 13 makes of watchman's clocks in the first edition of the Handbook of the Underwriter's Bureau of New England. The same volume includes the	Cole patents a fire alarm box key guard, the "Cole Key" in which the key is enclosed in a glass enclosure projecting out from the door. It prevents freezing of the box and will be the standard until 1922.
1913	NYC tries telegraphing communications with the fireboat "James Duane", but abandons the experiment as the operators are too costly.	
1922	The Gamewell Co. offers an optional telephone jack in its boxes for two-way communication between chiefs at the fire and the alarm office. (716)	The NYCFD opens its Manhattan Fire Alarm Office in Central Park. The system includes 1,528 alarm boxes, 212 circuits, and is to become one of the world's busiest and famous offices. (716)
1923	The first FD radio system is installed in Boston, from the alarm office to the fire boats. The first use in October was soon expanded to include land apparatus. With call letters WEY, the two way system is part of the Bristol Street Office fire alarm equipment.	

Year	Historical Event	Historical Event
1928	Gamewell introduces the "successive box" system allowing transmission of multiple boxes pulled simultaneously. (69)	Gamwell introduces an aluminum -alloy Herculite box, with inner case of Bakelitre plastic, reducing box weights from around 75 pounds to 25 pounds. (716)
1931	The NFPA standard on Central Signaling Systems is issued as a separate standard.(5)	
1935	Los Angeles introduces the "Hold-Out" system whereby fire station bells are first separated into two types, the larger sounding the alarm numbers only at the responding stations. A smaller bell sounds at all other stations. Previously, all alarms sounded at all stations and firemen could not distinguish their response from others until at least one round was completed. Also in large cities, the sounding of all alarms at all stations was more than a little nuisance on night shifts.	
1936	Gamewell introduces the "Vitaguard" alarm system, designed for communities with volunteer fire departments and who alarm requirements could be met by a system with one firebox circuit.	
1938	The "Bell Club", a group of NYC fire buffs is organized. They will be incorporated in 1939 and eventually operate their own alarm center and elite membership.(504)	
1939	The NYC Fire Department opens a radio laboratory above its headquarters of Engine 39 and Ladder 16, to develop pack radios for field use. (477)	
1942	A fire alarm for the Coconut Grove fire in Boston is very promptly transmitted to a pumper company just around the corner, completing work on a vehicle fire.(1,588)	
1946	William Gamwell, with Gamwell, installs a vibrator power supply for a fire alarm system in Beverly, MA (101)	
1949	The International City Managers Association reports that there are combined police and fire departments in 5 cities, all of similar size. (3) The NFPA adopts a formal standard against combined police-fire departments. (179)	
1950	And NFPA standard on fire alarm systems for private dwellings is published.(179)	
1955	Gamwell introduces the "Flexalarm" system, the first industrial/commercial modular alarm system (69)	
1960	The NFPA standard on remote signaling systems is issued as a separate fire alarm system standard. (5)	

Year	Historical Event	Historical Event
1962	An NFPA false alarm study shows that cities of more than one million population averaged over 10,000/year	
1965	The NFPA Standards on auxiliary and proprietary fire alarm systems are published with separate standards.	The interagency Fire Center is established at Boise, ID for forest firefighting coordination.
1969	NFPA TC on Fire Reporting has its standard adopted as NFPA 901, replacing NFPA 3.	Of 1,221 fire departments surveyed by NFPA, only 179 maintain an average manning of four per company. Only 42 departments maintain an average manning of more than 5 per company. (44)
1970	The Joint Council of National Fire Service Organizations is formed in Williamsburg, VA (152)	
1978	California voters approve proposition 13, a measure severely limiting tax increases and residential property taxes. The effect on fire departments is a major article in the NFPA "Fire Journal." (110)	
1994	The IAFC somewhat mollified by official NFPA interpretations and revisions in NFPA 1500 regarding manning levels, and rejoins the NFPA.	
1996	Congress passes the Defense Against Weapons of Mass Destruction Act, which leads to the formations of the Interagency Board for Equipment Standardization and Interoperability (IAB). The IAB promulgates a Standardized Equipment List to help the Department of Defense Provide Support required by the act. (669)	
1997	Congress passes the Volunteer Protection Act of 41977, PL-105-19. It provides increased protection against individual volunteers acting in emergency capacities, including volunteer fire-rescue services. (458)	
1999	Congress officially designates the telephone number 9-11 are the national emergency number. Initial systems allow for a free call from pay phones, but do not deliver the caller's address and telephone number. (920)	
2006	Congress passes legislation that opens the 700MHz spectrum for public safety communications. Feb. 19, 2009 is set as a deadline for commercial broadcasters to complete the conversion from analog to digital technology and clear the channels that have been designated public safety. (964)	

Table 20: Fire Alarm Historical Timeline[53]

[53] This information is directly taken from the work of Walter W. Maybee's "A Chronology of U.S. Fire and Fire Protection."

Origin and Development Summary of NFPA 72: National Fire Alarm Code

Document:	NFPA 72
Title and Current Edition:	National Fire Alarm Code (2002)
Initial Publication:	Installation, Maintenance, and Use of Proprietary, Auxiliary and Local Systems for Watchman, Fire Alarm and Supervisory Service (1931)
Editions:	1931, 1941, 1950, 1952, 1954, 1955, 1956, 1957, 1958, 1959, 1960, 1961, 1962, 1963, 1964, **See additional notes **, 1990, 1993, 1996, 1999,2002
Additional Notes:	• Prior to 1931 NBFU / NFPA 72 was included in the document NBFU 71A (Installation, Maintenance and Use of Protective Signaling systems). • NBFU 71A had editions in 1905, 1907, 1911, 1918, 1920, 1926, 1929, in 1931 the document became NBFU 71 (not related to current code) and NBFU 72 • NBFU 71A was formerly NBFU 71C (editions in 1903), NBFU 71B (editions in 1903), NFPA 71D (editions in 1899), NFPA 71E (editions in 1901). • In 1965 NBFU 72 split and became NFPA 72B (editions in 1965,1967, 1972, 1974, 1975, 1979, 1986) and NFPA 72D (editions in 1965, 1967, 1972, 1973, 1974, 1975, 1979, 1986) • In 1990 5 documents came together to form the current NFPA 72. • 1.) NFPA 72A (editions in 1964, 1967, 1972, 1974,1 975, 1979, 1985) • 2.) NFPA 72C (editions in 1960, 1961, 1962, 1963, 1964, 1967, 1972, 1974, 1975, 1982, 1986) • 3.) NFPA 72B (editions in 1965, 1972, 1974, 1975, 1979, 1986) • 4.) NFPA 72D (editions in 1965, 1967, 1972, 1973, 1974, 1975, 1979, 1986) • 5.) NFPA 72F (editions in 1985)
Areas of Potential Confusion:	• This document has often been released by the National Board of Fire Underwriters (NBFU); however the NBFU was working with the NFPA and therefore NBFU documents are regarded as NFPA publications.

Table 21: Origin and Development of NFPA 72: National Fire Alarm Code[54]

8.4 Appendix: Analysis of Plymouth County Communities – Fire Station Location and 1.5 mile / 2.5 mile fire station response radii.

As previously discussed, the Insurance Services Organization (ISO) recommends that fire departments' adequate response areas extend 1.5 miles and 2.5 miles from the station. Using this recommendation, 1.5 mile and 2.5 mile radii were drawn around each fire station within Plymouth County. This roughly indicates the effectiveness of fire station locations, and where response radii of communities extend into other jurisdictions.

A list of stations mapped is seen in the table below, and the actual maps with indicated response radii are seen in the proceeding figures. This method is not the most effective as actual road distances should be used (future work might entail using GPS or GIS mapping) and this method does not consider whether or not all stations are adequately staffed or equipped to respond to emergencies.

Community	Number of Stations	Address:
Abington	2	1040 Bedford Street
		Rockland Street
Bridgewater	1	22 School Street
		Plymouth Street
Brockton	6	52 Pleasant Street
		560 West Street
		Pleasant Street
		40 Central Street
		Crescent Street
		North Cary Street
Carver	3	112 Main Street
		1 Green Street
		120 South Main Street
Duxbury	2	668 Tremont Street
		794 Franklin Street
East Bridgewater	1	268 Bedford Street
Halifax	1	438 Plymouth Street
Hanover	5	1160 Main Street

[54] This information was compiled by Michael Sheehan for the NFPA's Origin and Development Project in the summer of 2006. Information was taken from a number of sources including historical codes, NFPA directories and other publications.

		207 Broadway
		925 Circuit
		King Street
		32 Center Street
Hanson	1	Liberty Street
		Main Street
Hingham	3	339 Main Street
		847 Main Street
		230 North Street
Hull	2	67 Nantasket Ave.
		235 Atlantic Avenue
Kingston	2	105 Pembroke Street
		82 Smith Lane
Lakeville	1	346 Bedford Street
Marion	2	50 spring Street
		Point road, Creek road
Marshfield	3	60 S. River Street
		Marshfield Hills
		Ocean Street
Mattapoisett	1	26 County Road
Middleborough	3	125 N. Main Street
		566 Wareham Street
		58 Bedford Street
Norwell	3	40 River Street
		677 Main Street
		300 Washington Street
Pembroke	4	172 Center St
		station 1
		station 2
		station 3
Plymouth	7	Bourne Road
		Cedarville
		Sandwich Road
		Manomet
		North Plymouth
		Pinehills
		West Plymouth
Plympton	1	3 Palmer Road
Rochester	3	4 Pine Street
		Marion Neck Road
		200 Ryder Road
Rockland	1	360 Union Street
Scituate	3	149 First Parish Road
		Humarock
		Branch Street
West Bridgewater	1	99 W Center St # 1
Wareham	4	273 Main Street
		142 Minot Ave

		2368 Cranberry Highway
		281 Glen Charlie Road
		72 Sandwich Road
Whitman	1	56 Temple Street

To illustrate the significance of each station being adequately staffed and equipped to respond to emergencies and the affect that it potentially has on response time an incident in Pembroke will be evaluated. The expected travel time will be computed using the ISO and NFPA formulas, road distances were determined with www.mapquest.com.

The example evaluation of an incident in northeastern Pembroke shows the hypothetical responses from the N. Pembroke Station, located at 380 Washington Street and the Pembroke Center Station, located at 172 Center Street.

Expected Response from Pembroke Center Station:

Figure 15 was generated by Map Quest and identifies the most direct route to the scene of the emergency and also indicates the total estimated distance required for travel. Using this data the expected response time can be determined using the ISO formula, as demonstrated in Equation 2.

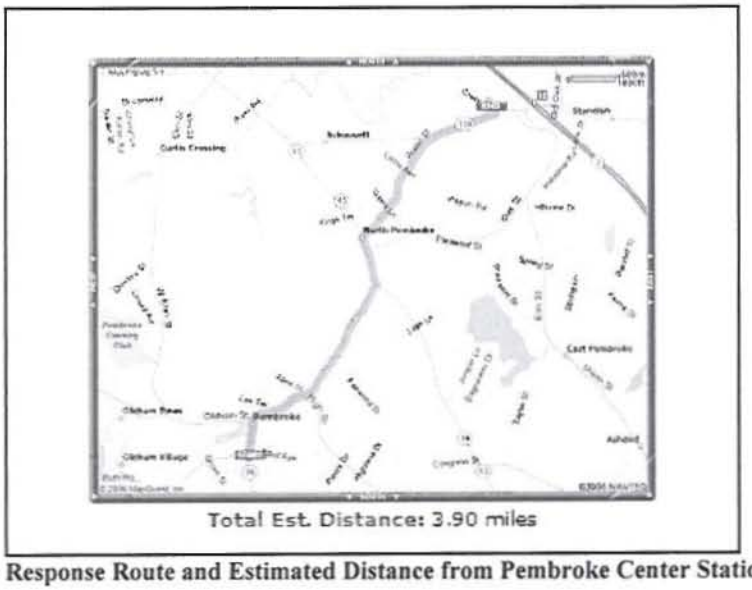


Figure 15 - Response Route and Estimated Distance from Pembroke Center Station (career)

Calculation of ISO Travel Distance Formula with Response from Pembroke Center Station:

$T = 0.65 + 1.7 * D$

$D = 3.90$ miles

$T = 0.65 + 1.7 * 3.9$

$T = 7.28$ minutes

Equation 2 - Calculation of Expected Response Time from Pembroke Center Station

From this evaluation the expected response time is over 7.28 minutes, this estimation does not account for call processing, dispatch, or turnout time. The optimal expected level of performance for a response from the Pembroke Center station would be around 10 minutes.

Expected Response from N. Pembroke Station:

As performed in "Expected Response from Pembroke Center Station" the expected response time is 4.033 minutes. This is on par with those set by the standards set by the NFPA 1710.

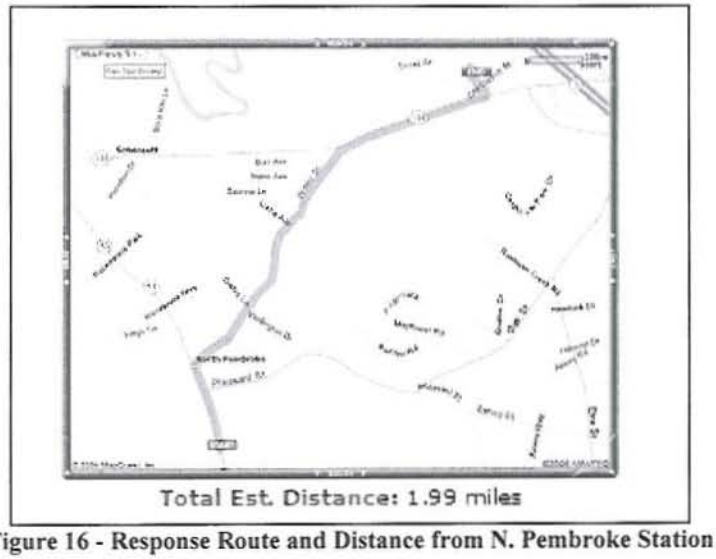


Figure 16 - Response Route and Distance from N. Pembroke Station

Calculation of ISO Travel Distance Formula with Response from N. Pembroke Station:

$T = 0.65 + 1.7 * D$

$D = 1.99$ miles

$T = 0.65 + 1.7 * 1.99$

$T = 4.033$ minutes

Equation 3 - Calculation of Expected Response Time from N. Pembroke Station

However, the N. Pembroke station is not regularly staffed so the response would need to come from the station located on Centre Street and the actual initial response time to this emergency would be nearly 10 minutes. From Section 2.5, four minutes makes a significant amount of difference in minimizing damage caused by fire or medical emergencies. There are a number of un-staffed stations throughout Plymouth County; additional work would need to be done to determine which stations these are.

8.5 Appendix: Plymouth County FD Radio Frequencies and Mutual Aid Run Card Example

Fire departments within Plymouth County all operate on different radio frequencies, as displayed in the proceeding table. In mutual aid emergencies, responding jurisdictions communicate on a dedicated mutual aid channel and are aided by Plymouth County Control in communication and mutual aid operations.

Department	Radio Frequency	PL Tone
Plymouth County Control Mutual Aid Channel 1	483.1	203.5
Plymouth County Control Mutual Aid Channel 2	483.2	114.8
Plymouth County Control Mutual Aid Channel 3	483.4	127.3
Plymouth County Control Mutual Aid Channel 4	483.475	141.3
Plymouth County Control Mutual Aid Channel 5	483.775	156.7
Plymouth County Control Mutual Aid Channel 6	483.925	173.8

Abington FD	483.95	D754
Bridgewater FD	460.525	107.2
Brockton FD	154.31	94.8
Brockton FD Ch. 2	154.145	94.8
Carver FD	471.25	192.8
Duxbury FD	460.575	203.5
East Bridgewater FD	483.6875	192.8
Halifax FD	453.1875	203.5
Hanover FD	484.4	107.2
Hanson FD	483.55	203.5
Hingham FD	154.265	203.5
Hull FD	159.12	110.9
Kingston FD	460.6	203.5
Lakeville FD	460.1625	100
Marion FD	483.425	173.8
Marshfield FD	453.4375	Trunk
Mattapoisett FD	453.075	192.8
Middleboro FD	470.7	203.5
Norwell FD	453.175	203.5
Pembroke FD	33.68	203.5
Plymouth FD	154.43	173.8
Plymouth FD1	470.1	210.7
Plymouth FD2	470.75	210.7
Plympton FD	453.4125	203.5
Rochester FD	471.425	162.2
Rockland FD	482.675	D754
Scituate FD	151.175	203.5
Wareham FD	460.2375	118.8
West Bridgewater FD	453.3875	203.5
Whitman FD	472.4	203.5

Table 22: Plymouth County Fire Department Radio Frequencies

Run cards are maintained by Plymouth County Control (PCC) and are prepared by each town while working with PCC. Cards vary based on incident type (structural, ambulance, or special call) and by the district of each town. The proceeding images illustrate

the "structural card", the "ambulance card" and the "special call card" for district #1 in Pembroke. These cards indicate the order of response in terms of alarm. Communities providing aid either are dispatched to the scene of the incident or to cover the "would be" empty fire station.

In a personal interview with Lieutenant Billings, the coordinator of PCC stressed that while responding to the scene is important, it is essential to maintain adequate fire service coverage in the event that another emergency occurs. Maintaining coverage is one of the major challenges for Plymouth County Control.

PLYMOUTH COUNTY CONTROL MUTUAL AID FIRE 1 **STRUCTURAL CARD**

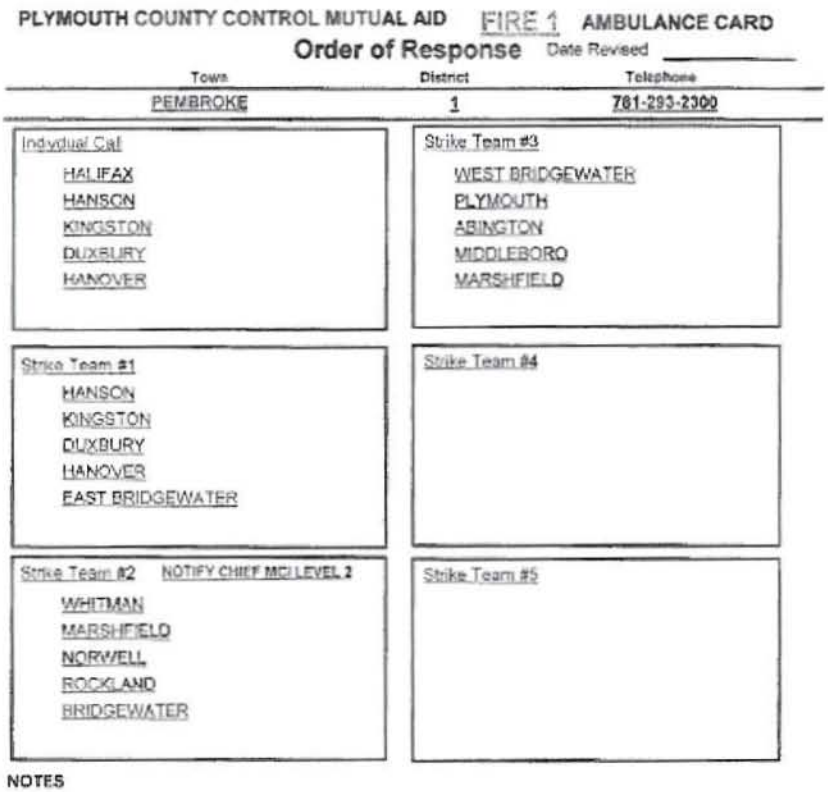
Order of Response Date Revised _____

Town	District	Telephone
PEMBROKE	1	781-293-2300

Page #1

To The Scene		Cover	
1ST Alarm			
Engine	PEMBROKE	Engine	
Engine	PEMBROKE	Engine	
Ladder	PEMBROKE	Engine	
Special		Ladder	
Special			
Working Fire			
Engine		Engine	
Ladder		Ladder	
Special			
2ND Alarm			
Engine	PEMBROKE	Engine	HALIFAX TO STATION
Engine	PEMBROKE	Engine	HANSON TO STATION
Ladder		Engine	
Special	RESCUE PEMBROKE	Ladder	
Special	PEMBROKE AMBULANCE	Engine From	To
		Engine From	To
3RD Alarm	CALL CHIEF TO MUTUAL CENTER	Engine	KINGSTON TO STATION
Engine	HALIFAX FROM COVERAGE	Engine	DUXBURY TO STATION
Engine	HANSON FROM COVERAGE	Engine	
Ladder	HANSON	Ladder	
Special	PEMBROKE COMPRESSOR	Engine From	HANOVER To HANSON
Special		Engine From	To
4TH Alarm		Engine	MARSHFIELD TO STATION
Engine	KINGSTON FROM COVERAGE	Engine	DUXBURY TO STATION
Engine	DUXBURY FROM COVERAGE	Engine	
Ladder	HALIFAX	Ladder	
Special		Engine From	PLYMOUTH To KINGSTON
Special		Engine From	MARSHFIELD To DUXBURY
5TH Alarm		Engine	HANOVER TO STATION
Engine	MARSHFIELD FROM COVERAGE	Engine	HANOVER TO STATION
Engine	DUXBURY FROM COVERAGE	Engine	
Ladder	KINGSTON	Ladder	
Special		Engine From	ABINGTON To HANOVER
Special		Engine From	ROCKLAND HANOVER

Figure 17: Structural Run Card (Pembroke)



PLYMOUTH COUNTY CONTROL MUTUAL AID FIRE 1 AMBULANCE CARD

Order of Response Date Revised _____

Town	District	Telephone
PEMBROKE	1	781-293-2300

Indvdual Call
- HALIFAX
- HANSON
- KINGSTON
- DUXBURY
- HANOVER

Strike Team #3
- WEST BRIDGEWATER
- PLYMOUTH
- ABINGTON
- MIDDLEBORO
- MARSHFIELD

Strike Team #1
- HANSON
- KINGSTON
- DUXBURY
- HANOVER
- EAST BRIDGEWATER

Strike Team #4

Strike Team #2 NOTIFY CHIEF MCI LEVEL 2
- WHITMAN
- MARSHFIELD
- NORWELL
- ROCKLAND
- BRIDGEWATER

Strike Team #5

NOTES

Figure 18: Ambulance Run Card (Pembroke)

PLYMOUTH COUNTY CONTROL MUTUAL AID FIRE 1 SPECIAL CALL CARD #1

Order of Response Date Revised _____

Town	District	Telephone
PEMBROKE	1	781-293-2300

Boats	BrushBreakers-Med /Large	Ladder	Rescue Tools Jaws/Air Bags
HANSON HALIFAX KINGSTON DUXBURY	KINGSTON DUXBURY PLYMPTON PLYMOUTH	HANSON HALIFAX KINGSTON DUXBURY	HANSON HALIFAX KINGSTON DUXBURY Command Vehicles
Divers Teams	**Forestry Trucks**	**Towers**	**Foam- CLASS A**
HALIFAX DUXBURY KINGSTON PLYMOUTH	HANSON HALIFAX KINGSTON PLYMPTON DUXBURY	HANSON	
Cascade System	**Tankers**	**Lighting Plants**	**Foam- CLASS B**
	PLYMPTON CARVER PLYMOUTH	Rehab Unit	

Figure 19: Special Call Run Card (Pembroke)

8.6 Appendix: Effectiveness of Existing Regionalized Dispatch Centers

8.6.1 Southwestern New Hampshire Mutual Aid System

The Southwestern New Hampshire District Mutual Aid System has existed since 1961 and currently dispatches over 22,500 calls per year with ten full time and six part time dispatchers. Serving over 126 communities and 23 EMS providers operating off a budget of approximately $918,000[55], see the SWNHMA estimated budget in Figure 20 and Figure 21, located in Section 8.6. Table 1 shows the performance statistics of the Southwestern New Hampshire Mutual Aid System. In this system it costs approximately $40.80 per call and it is

[55] This is information from the 2005 operating budget, provided by Paul Scoz in a personal interview (November 2005).

claimed by SWNHMA personnel that this is less expensive than if communities were to individually maintain their own independent dispatch operations[56].

	Southwestern New Hampshire Dispatch
Total # of Calls	22,500
Total Budget	$918, 000
# of Dispatchers	13
Calls Handled / Dispatcher	1730.8
Price / Call	$40.80

Table 23: Southwestern New Hampshire Statistics 2005

Paul Scoz, the coordinator of the system indicated that this organization was developed because the small communities throughout New Hampshire were struggling to provide fire service (Scoz 2006). Communities regionalized not only their dispatch centers but their entire fire service.

Over the past 45 years this organization has grown serving communities throughout New Hampshire and Vermont. Communities in northern Massachusetts are currently considering joining the system and others have contacted the system for advice in setting up their own regionalized dispatch center.

8.6.2 Laconia/Lakes Region Mutual Aid System

The Lakes Region Mutual Fire Aid Association has been operating since 1971 and recently moved into a new facility. The organization currently dispatches over 21,441 calls per year with ten full time and eight part time dispatchers. And currently serves 36 communities, composed of 37 fire and EMS providers operating off a budget of approximately $820,000 in 2005 (Lakes Region Fire Mutual Aid-Quick Facts. Online). Table 24 illustrates he performance statistics of the Lakes Region Mutual Aid System. As in the case of the Southwestern New Hampshire Mutual Aid System, authorities claim that this

[56] The cost per call for communities in Plymouth County was unavailable, with additional research a comparison between independent and regionalized dispatch centers' cost be call could be analyzed.

method is less expensive than if communities were to individually maintain their own independent dispatch operations.

	Lakes Region Dispatch
Total # of Calls	21,441
Total Budget	$820,000
# of Dispatchers	14
Calls Handled / Dispatcher	1531.5
Price / Call	$38.25

Table 24: Lakes Region Statistics 2004

The system operates almost identically to the Southwestern New Hampshire Mutual Aid System. Since 1971 this system has effectively carried out the dispatching operations of the region at a relatively low cost. This has enabled constituent communities to focus on actually providing emergency services, rather than call processing and dispatching.

8.6.3 Phoenix Regional Automatic Aid Dispatch System

As discussed in Section 2.8.5, the Phoenix Fire Department maintains a regional dispatching system known as the Phoenix Fire Department's Regional Dispatch Center (PFDRDC) which serves over 20 jurisdictions, covering an area over 2,000 square miles. The system operates as a "seamless" fire department due to its implementation of "automatic aid." The significant benefits of this consolidated automatic aid system and dispatch center are improved response times and the ability of departments to "pool resources" and implement cutting edge technologies such as CAD systems interfaced with GPS and GIS features, see Section 8.2.4. Additionally, high tech communication equipment can be purchased and standardized in a region enabling interoperability between jurisdictions, as called for by President Bush and the U.S. Congress, Section 2.7.

Phoenix appears to be the leading organization in providing regionalized dispatching. The system has successfully implemented cutting edge technologies, simplified communication between communities, and gotten different jurisdictions to coordinate to provide enhanced cooperative responses to emergencies.

This has been accomplished at a reasonable price, Robert Barr, a Fire Protection Engineer with the Phoenix Fire Department in the Research and Planning Division estimated that the cost per call is approximately between $8 and $9[57], currently there are over 900 calls per day. This call volume is handled by appropriate number of personnel. At any one time there are 7 dispatch personnel on duty, typical shifts are staffed with 13. At times where there are high call volumes up to 18 dispatch consoles are staffed and provided with adequate support personnel. All dispatchers are certified Emergency Medical Dispatchers (EMD).

Barr indicated that the key to success in the Phoenix system, and any regionalized system is the standardization of all processes and the implementation of three features:

- Centralized dispatching operations
- Use of technologies, CAD software, Automatic Vehicle Location (AVL)[58], and GIS mapping (as discussed in Section 8.2.4).
- Training Academy for all personnel

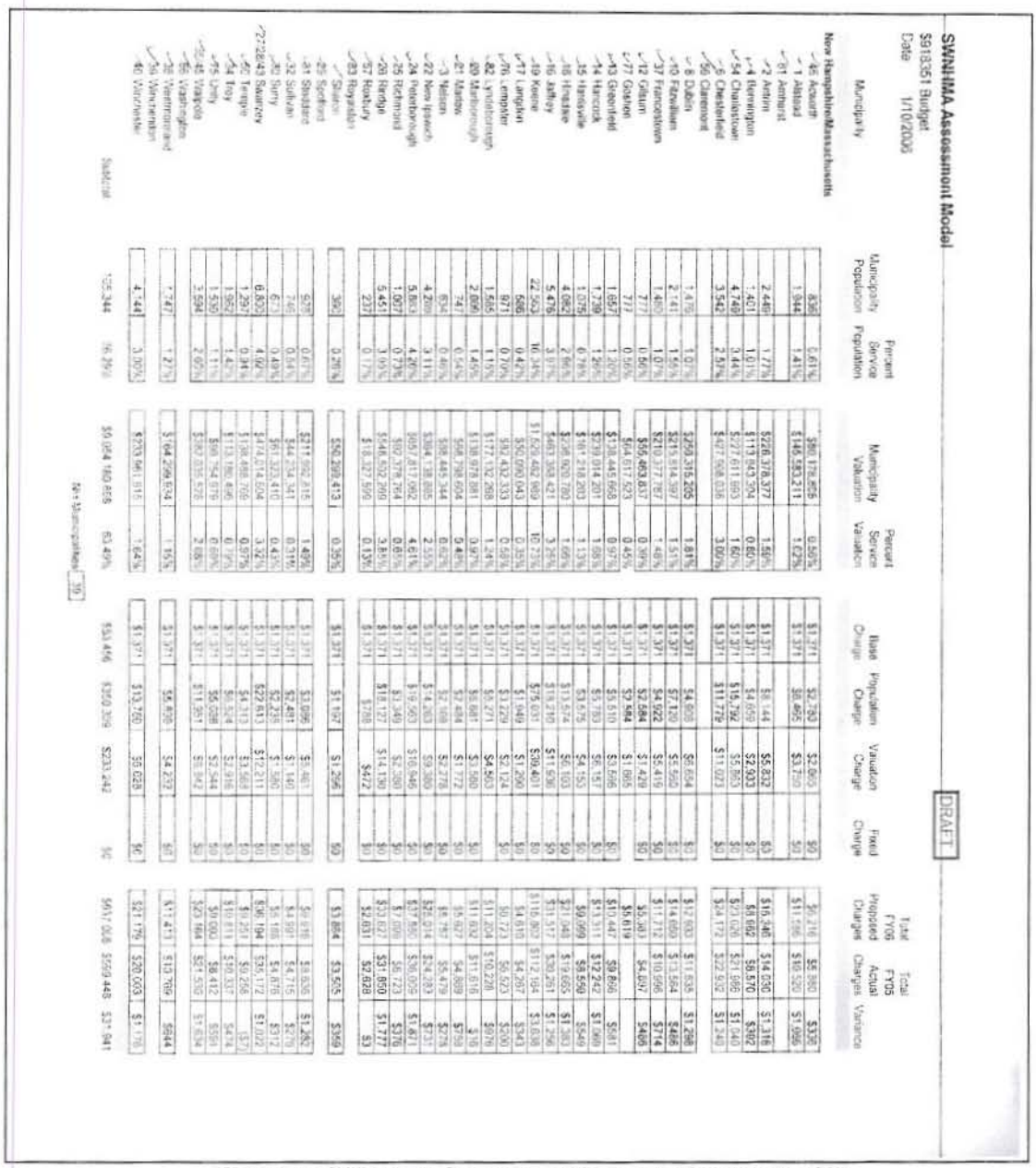
The automatic aid system in the Phoenix area has standardized and used these processes to create their system. Any jurisdiction is allowed to join the automatic aid system; however before joining they must meet 4 pre-requisites:

- Staff each fire engine with at least 4 fire fighters (as required by industry standards, Section 2.3.
- Get portable radios / new transmitters capable of communicating with the rest of the automatic aid system.

[57] This is an estimate, and it was also inferred that the cost per call would be increasing (not drastically) in the near future.
[58] Referred to as GPS in this report.

- Command officers must be trained in the automatic aid system and understand the standardized procedures[59].
- Communication systems and procedures must be standardized.

8.7 Appendix: SWNHMA Operating Budget and Allocations



SWNHMA Assessment Model

DRAFT

5913351 Budget
Date 1/10/2005

Municipality	Municipality Population	Percent Service Population	Municipality Valuation	Percent Service Valuation	Base Charge	Population Charge	Valuation Charge	Fixed Charge	Total FY05 Proposed Charges	Total FY05 Actual Charges	Variance
New Hampshire/Massachusetts											
45 Acworth	836	0.61%	$80,178,858	0.56%	$1,371	$2,780	$2,065	$0	$6,216	$5,880	$336
1 Alstead	1,944	1.41%	$145,583,211	1.02%	$1,371	$6,465	$3,730	$0	$11,566	$10,520	$1,046
61 Amherst											
2 Antrim	2,449	1.77%	$228,376,377	1.59%	$1,371	$8,144	$5,832	$0	$15,346	$14,030	$1,316
4 Bennington	1,401	1.01%	$115,843,304	0.80%	$1,371	$4,659	$2,933	$0	$8,962	$8,570	$392
54 Charlestown	4,749	3.44%	$227,611,893	1.60%	$1,371	$15,792	$5,803	$0	$23,026	$21,986	$1,040
5 Chesterfield	3,542	2.57%	$407,508,038	3.00%	$1,371	$11,779	$11,023	$0	$24,172	$22,932	$1,240
56 Claremont											
8 Dublin	1,476	1.07%	$258,316,205	1.81%	$1,371	$4,908	$6,604	$0	$12,883	$11,635	$1,248
10 Fitzwilliam	2,141	1.55%	$215,914,597	1.51%	$1,371	$7,120	$5,550	$0	$14,040	$13,564	$486
37 Francestown	1,480	1.07%	$210,377,787	1.48%	$1,371	$4,922	$5,419	$0	$11,712	$10,998	$714
12 Gilsum	777	0.56%	$56,453,837	0.39%	$1,371	$2,584	$1,429	$0	$5,383	$4,887	$496
77 Goshen	717	0.52%	$64,617,923	0.45%	$1,371	$2,384	$1,665	$0	$5,419		
13 Greenfield	1,657	1.20%	$138,445,968	0.97%	$1,371	$5,510	$3,566	$0	$10,447	$9,866	$581
14 Hancock	1,739	1.26%	$239,014,201	1.68%	$1,371	$5,783	$6,157	$0	$13,311	$12,242	$1,069
15 Harrisville	1,075	0.78%	$161,218,203	1.13%	$1,371	$3,575	$4,153	$0	$9,099	$8,550	$549
16 Hinsdale	4,082	2.96%	$256,900,783	1.80%	$1,371	$13,574	$6,613	$0	$21,948	$19,665	$1,283
18 Jaffrey	5,476	3.97%	$463,383,421	3.25%	$1,371	$18,210	$11,926	$0	$31,127	$29,291	$1,836
19 Keene	22,563	16.34%	$1,620,482,969	10.73%	$1,371	$75,031	$30,401	$0	$116,903	$112,104	$3,698
77 Langdon	686	0.42%	$50,090,043	0.35%	$1,371	$1,949	$1,290	$0	$14,610	$4,267	$343
76 Lempster	971	0.70%	$92,432,333	0.64%	$1,371	$3,229	$2,124	$0	$6,723	$6,523	$200
82 Lyndeborough	1,585	1.15%	$177,132,268	1.24%	$1,371	$5,271	$4,503	$0	$11,204	$10,228	$976
69 Marlborough	2,896	1.40%	$138,978,881	0.97%	$1,371	$9,681	$3,580	$0	$14,632	$11,816	$316
21 Marlow	741	0.54%	$58,788,604	0.41%	$1,371	$2,464	$1,772	$0	$5,607	$4,809	$798
3 Nelson	834	0.46%	$38,445,344	0.62%	$1,371	$2,169	$2,278	$0	$5,787	$5,479	$278
22 New Ipswich	4,200	3.11%	$384,138,885	2.55%	$1,371	$14,263	$9,380	$0	$25,014	$24,283	$731
24 Peterborough	5,803	4.26%	$697,817,092	4.61%	$1,371	$19,503	$16,946	$0	$37,820	$36,009	$1,811
25 Richmond	1,007	0.73%	$92,378,764	0.61%	$1,371	$3,349	$2,280	$0	$7,000	$6,723	$376
28 Rindge	5,451	3.95%	$548,532,960	3.81%	$1,371	$18,127	$14,130	$0	$33,627	$31,850	$1,777
57 Roxbury	237	0.17%	$18,327,896	0.13%	$1,371	$788	$472	$0	$2,631	$2,628	$3
83 Royalston											
Sharon											
25 Spofford	392	0.28%	$50,269,413	0.35%	$1,371	$1,197	$1,296	$0	$3,864	$3,505	$359
31 Stoddard											
32 Sullivan	938	0.67%	$211,982,215	1.48%	$1,371	$3,096	$5,461	$0	$9,928	$9,635	$293
32 Surry	746	0.54%	$44,734,341	0.31%	$1,371	$2,461	$1,140	$0	$4,972	$4,715	$257
32 Sullivan	613	0.43%	$61,323,410	0.43%	$1,371	$2,023	$1,580	$0	$4,974	$4,676	$297
72,2843 Swanzey	6,833	4.92%	$474,014,504	3.32%	$1,371	$22,543	$12,211	$0	$36,125	$35,172	$1,022
60 Temple	1,297	0.94%	$134,488,706	0.97%	$1,371	$4,313	$3,468	$0	$9,151	$9,256	-157
84 Troy	1,962	1.42%	$113,180,846	0.79%	$1,371	$6,524	$2,916	$0	$10,811	$10,337	$474
75 Unity	1,530	1.11%	$99,754,679	0.69%	$1,371	$5,088	$2,544	$0	$39,002	$38,412	$590
48 Walpole	3,594	2.60%	$390,035,578	2.68%	$1,371	$11,961	$10,042	$0	$23,164	$21,530	$1,634
66 Washington											
28 Westmoreland	747	1.27%	$164,299,844	1.15%	$1,371				$11,471	$10,709	$944
36 Winchester											
40 Winchester	4,144	3.00%	$733,961,915	1.64%	$1,371	$13,760	$5,028	$0	$21,179	$20,003	$1,176
Subtotal	135,344	16.39%	$9,084,160,855	63.49%	$53,456	$269,359	$233,242	$0	$561,058	$529,448	$31,941

Net Municipalities 39

Figure 20: SWNHMA Operating Budget and Allocation (1 of 2)

[59] All recruits attend a 12 week Phoenix Fire Academy and then are monitored in a 9 month field training program.

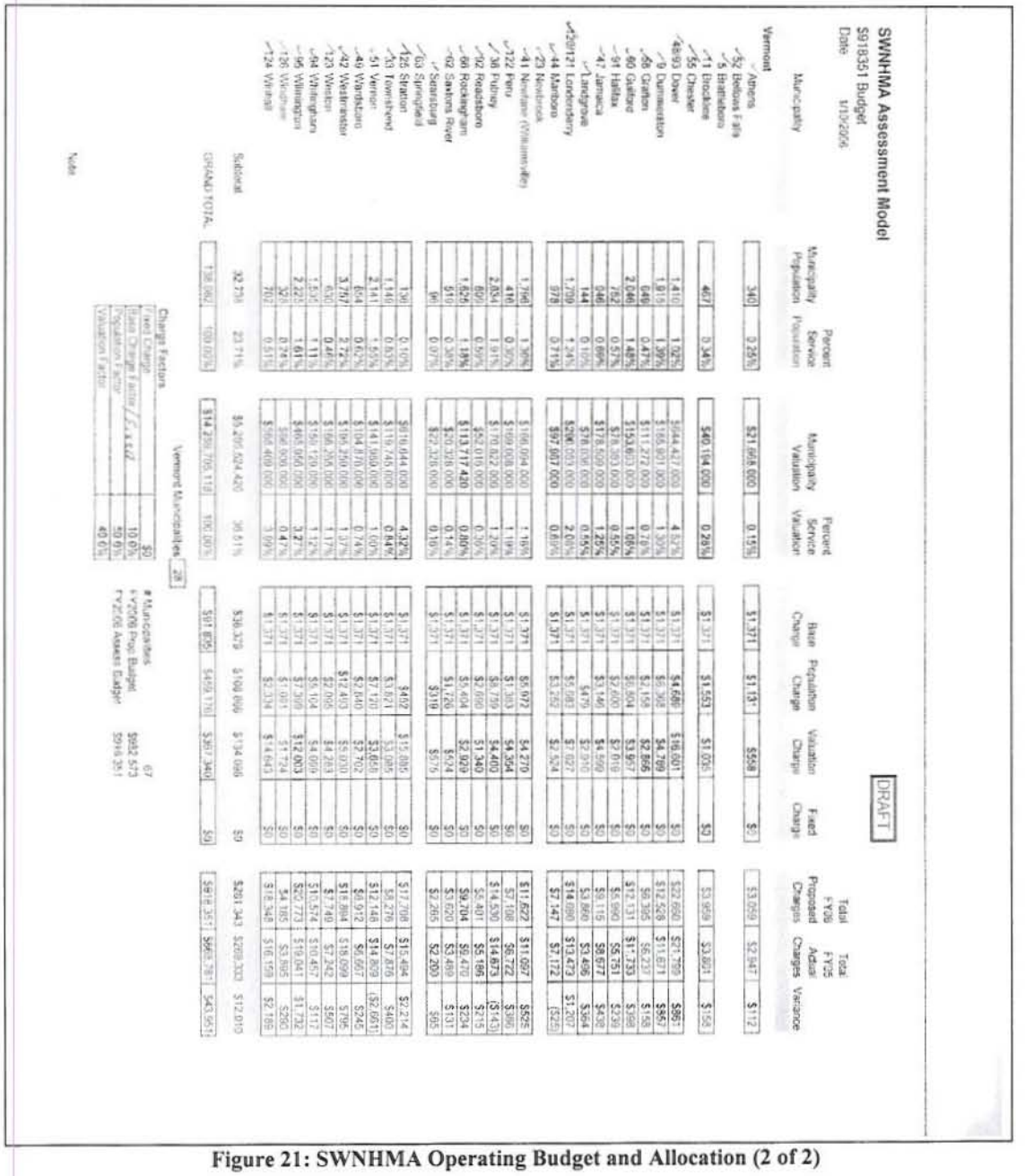


Figure 21: SWNHMA Operating Budget and Allocation (2 of 2)

8.8 *Appendix: Analysis of Plymouth County Communities – Fire Station Location / Cross Jurisdictional Response / Automatic Aid*

By mapping fire station locations within Plymouth County and plotting the 1.5 mile and 2.5 mile response radii prescribed by the Insurance Services Organization the "response districts" can be seen, Figure 17: Structural Run Card (Pembroke), Figure 18: Ambulance Run Card (Pembroke), Figure 19: Special Call Run Card (Pembroke). Many "response districts"

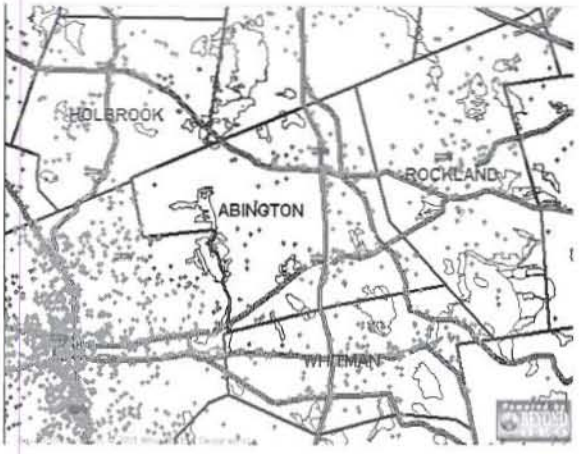
extend into sections of neighboring communities, which are often not protected." The term "protected" refers to whether or not an area of a community is within the "response district" of a fire station located within that town. When a "response district" of a fire station extends into an unprotected area of another town, this report assumes that an automatic aid agreement would improve the safety in the other town.

In the Boston Globe's special report: *Deadly Delays* maps of each town were created, which indicate station locations and locations of 89% (78,502 of 87,750) of building fires in Massachusetts between 1986 and 2002. Fire incidents are color coded by response time, the color coding scheme is shown in Figure Figure 22: Color Coded Response Time Key. Address information of fire incidents was extracted from the National Fire Incident Reporting System database. Evaluating maps for each community revealed sections of the town with a fire problem which the communities fire department could not reach within times prescribed by industry standards.

Figure 22: Color Coded Response Time Key

By combining these two resources this report determined which towns' response time performances would benefit by automatic aid agreements with neighboring communities. This report recognizes that many of the fire stations mapped may not be staffed or equipped and may be incapable of effectively responding to emergencies. The report also does not consider that some communities already have automatic aid agreements in place with neighboring towns. Additional work, outside this study, should be done to determine these factors, see Section 6 for additional recommendations. For analysis and discussion on each town see Section 8.4, proceeding.

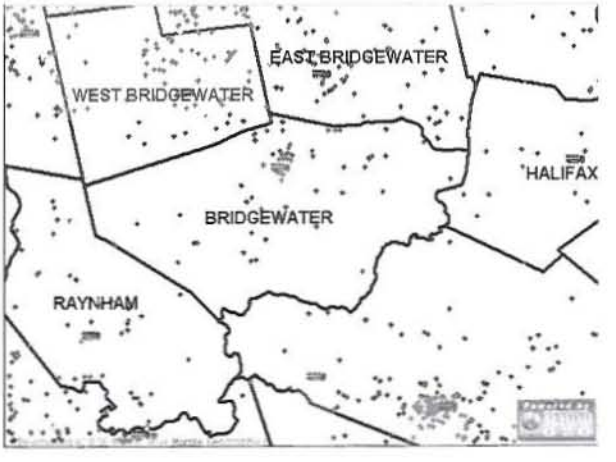
Safety Improvements: via Response Time (Town by Town Analysis)



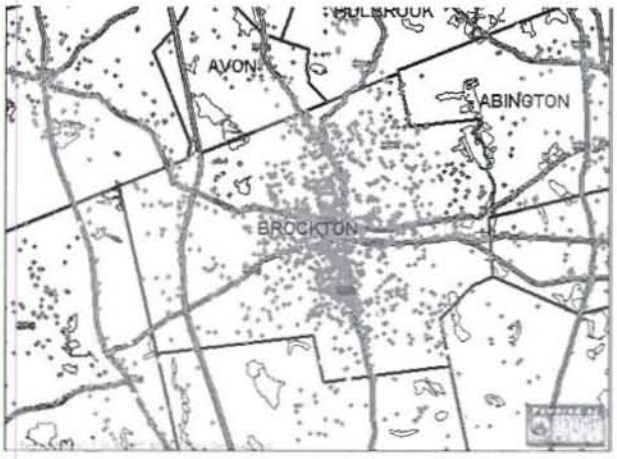
Abington:

A map of Abington's station locations and color-coded response performances indicate that the northwestern section of the community could potentially benefit from an automatic aid agreement with the city of Brockton. This assumption is based on the observation that a fire station in Brockton is more appropriately located to respond to emergencies in west Abington. This is also depicted, as the "response radii" of Brockton fire stations extend into western Abington. Likewise, an automatic aid agreement between Abington and Weymouth ad/or Rockland would benefit these communities' response capacities.

Bridgewater:



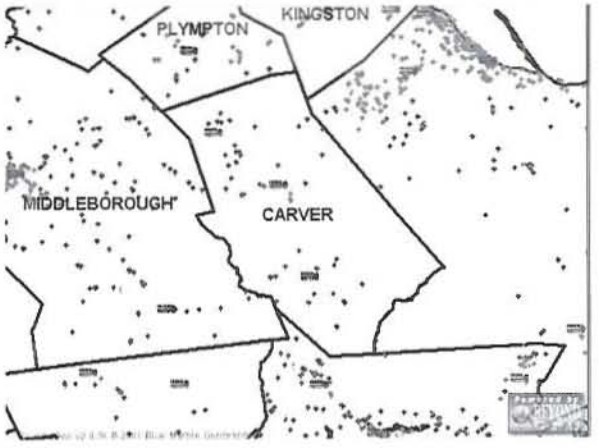
After evaluating the station locations and response performances for Bridgewater it is clear that an automatic aid system would provide minimal to no benefit in the area of response time performances. However, an automatic aid system with regionalized dispatch operations would provide additional benefits as discussed in Section 5.3.



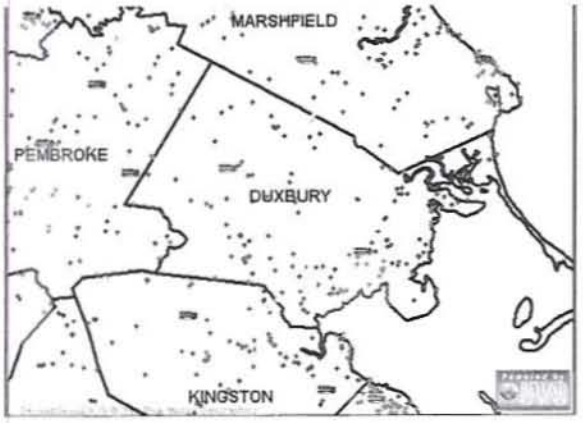
Brockton:

As previously discussed, the Brockton Fire Department would provide additional response coverage to Abington improving the safety and security within the neighboring community. However it is possible for Brockton to benefit from automatic mutual aid agreements with Avon, Holbrook and Easton (regardless of whether or not these communities are a part of Plymouth County. The map, does not show these conclusions because the fire stations of Avon, Holbrook and Easton are not included in the map.

Carver:



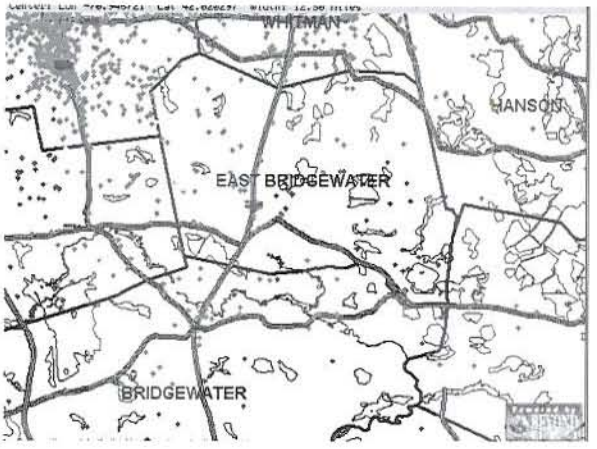
Carver would be benefited most by an automatic mutual aid agreement with Wareham; this is seen in the southern sections of Carver which could potentially be aided by the fire station in north western Wareham. Carver could also provide emergency response support to eastern sections of Middleborough and southern Plympton which are outside of the 1.5 mile/2.5 mile station response radii.



Duxbury:

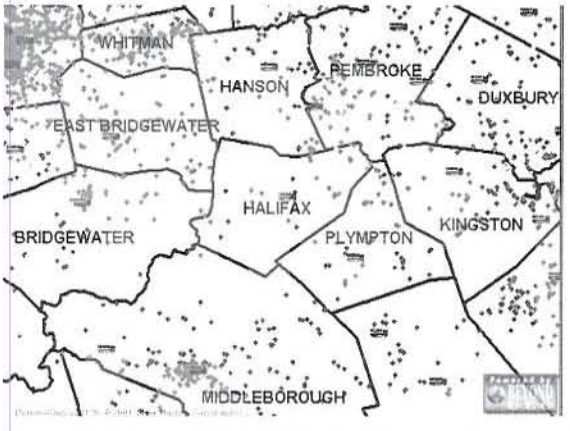
From this computer generated map, it is predicted that incident response times

within Duxbury, namely those on the Kingston, Pembroke and Marshfield borders could potentially be improved with automatic aid agreements enhancing the safety of the community. However, as noted before additional work (outside of this study) needs to be conducted to determine which stations are staffed and capable of serving as first responders.



East Bridgewater:

Mapping response times geographically for East Bridgewater reveals that some perimeter regions of the community are not within the 1.5 or 2.5 mile response radii. East Bridgewater's response time performances would benefit from automatic aid agreements with neighboring communities. This is in addition to the increased capacity provided by communities having pooled their resources and by the various benefits provided by a regionalized dispatch center.

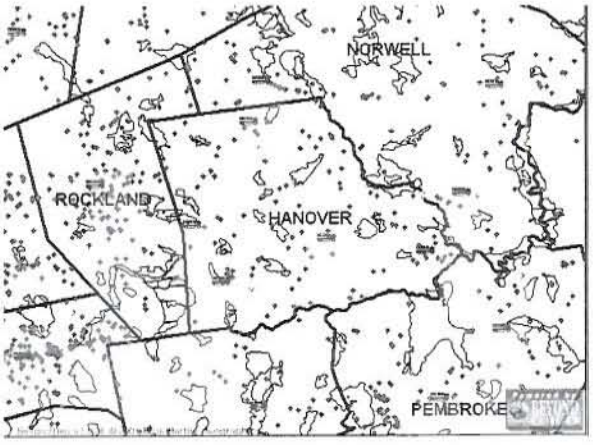


Halifax:

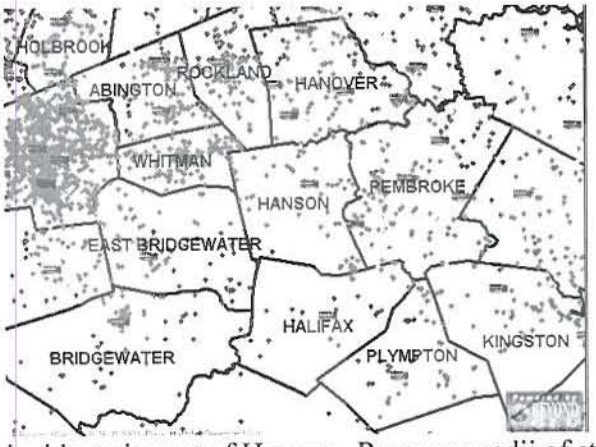
It is apparent that Halifax is not NFPA 1710 compliant n regards to response time performances. Northern portions of the community on the Pembroke and Hanson border are plagued by excessive response times. This could be attributed to countless factors; one factor revealed by the map is that these regions are outside the 1.5/2.5 mile response radii of the Halifax fire department, they

are also outside the radii of surrounding towns' fire stations. However, northern sections of Halifax could improve response times with an automatic aid agreement with Pembroke. This is one factor provided by an automatic aid system served by regionalized dispatch.

Hanover:



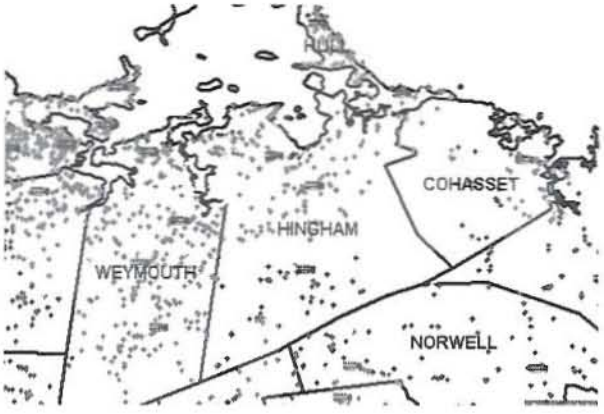
According to Bill Dedman's article, Hanover is among the leading towns in regards to response time performances. Evaluating the map reveals that despite being proficient in response capabilities there could still be improvement in response times in the north-eastern and eastern parts of the town. An automatic aid agreement with Norwell would enhance the safety of citizens in Hanover. Under this agreement Hanover could reciprocate this safety improvement expanding the response radii coverage zone into parts of Norwell, as response areas of Hanover fire stations extend into "unprotected" areas in Norwell.



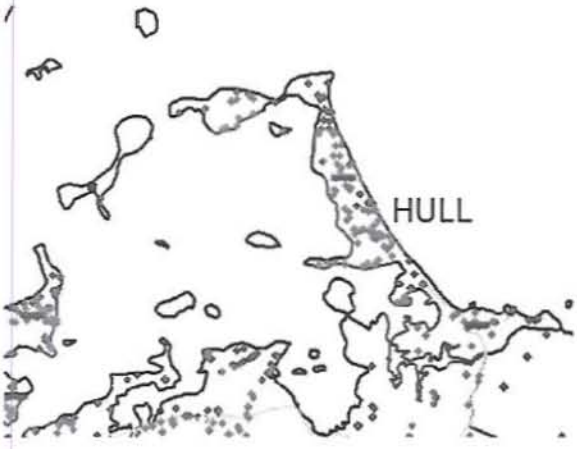
Hanson:

Hanson would be benefited by automatic aid agreements with Hanover and Pembroke. Fire stations in Pembroke and Hanover were more appropriately located to response to emergencies incidents in part of Hanson. Response radii of stations in Pembroke and Hanover extend into "unprotected" areas in Hanson.

Hingham:



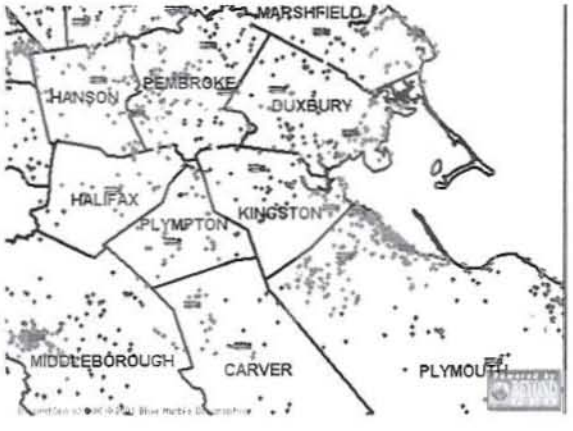
Evaluating station location, past response time data, and the ISO 1.5/2.5 mile response radii recommendations it is clear that Hingham could benefit from automatic aid agreements with Weymouth, Hull and Norwell.



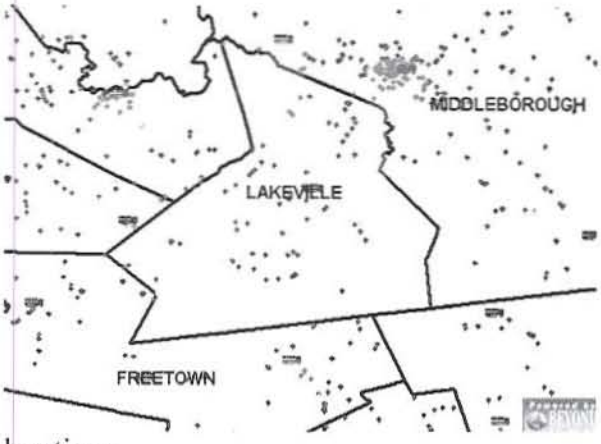
Hull:

Because of the unique peninsula type geography of Hull community response time would not be improved with automatic aid agreements. This does not mean that Hull would not benefit in terms of safety from an automatic aid system, under such a system the vast amount of equipment and resources of the county would be available and easily dispatched. For additional discussion see Section 8.4 and 8.8.

Kingston:

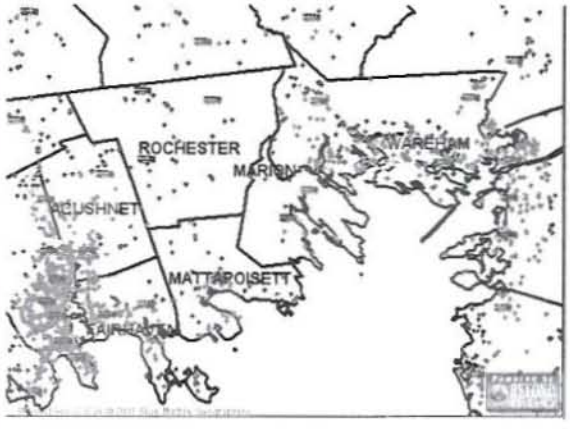


Kingston response times could potentially be improved by an automatic aid agreement with Plymouth. The two fire stations in northern Plymouth are more appropriately located to respond to emergencies in areas of southern Kingston.



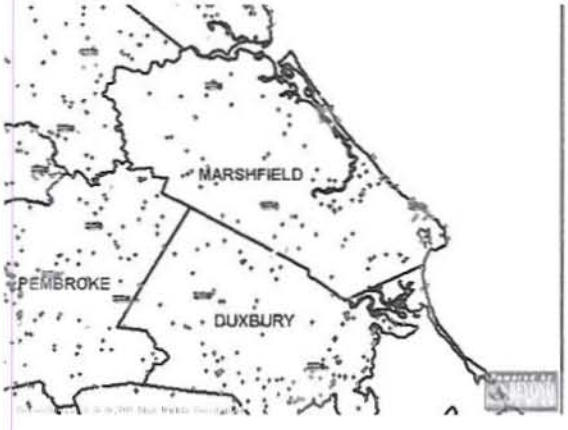
Lakeville:

Response time performances in Lakeville could potentially be improved by automatic aid agreements with Middleborough, Freetown and Rochester. This is apparent by evaluating station locations.



Marion:

Marion response times would not be improved with automatic aid agreements. This does not mean that Marion would not benefit in terms of safety from an automatic aid system, under such a system the vast amount of equipment and resources of the county would be available and easily dispatched. For additional discussion see Section 8.4 and 8.8.

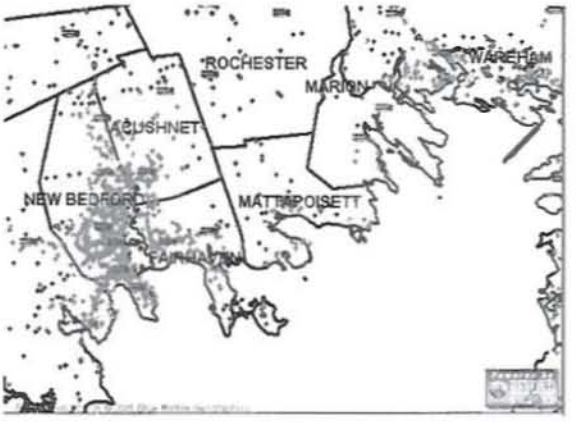


Marshfield:

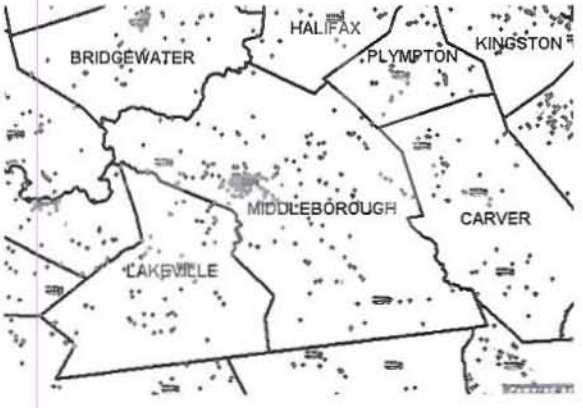
According to Bill Dedman's research, Marshfield has exceptional response time performances that would be in compliance with the industry time objectives

set by NFPA 1710. Marshfield response times would not be improved by automatic aid agreements with neighboring communities.

Mattapoisett:



Mattapoisett response times would not be improved by automatic aid agreements with communities of Plymouth County (an agreement with Fairhaven could potentially improve response times in western sections of Mattapoisett). This does not mean that Mattapoisett would not benefit in terms of safety from an automatic aid system, under such a system the vast amount of equipment and resources of the county would be available and easily dispatched. For additional discussion see Section 8.4 and 8.8.



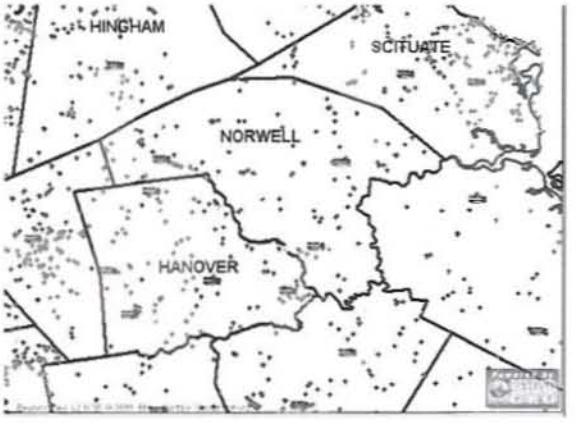
Middleborough:

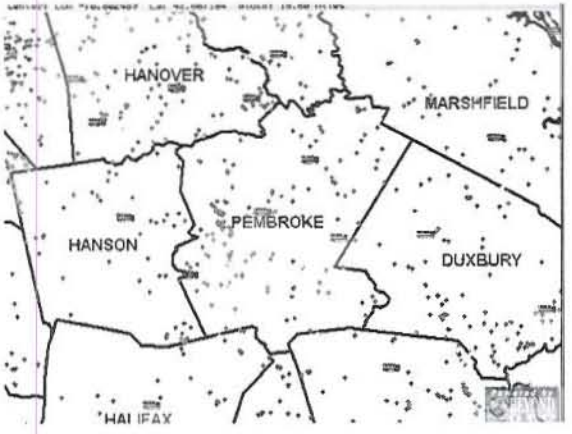
Middleborough could improve response time by establishing an automatic aids agreement with Rochester and Carver. Response radii of fire stations located in Carver and Rochester extend into slightly into north-eastern and south-western Caver and would respond to some emergencies within the prescribed 6 minutes as well as improving overall response times in

significant areas of Middleborough. Stations located in Middleborough could provide enhanced safety for Lakeville, Taunton, and Raynham.

Norwell:

Norwell would be benefited by automatic aid agreements with Scituate, Marshfield and Hanover. This is seen by observing station locations and each community's boundaries.

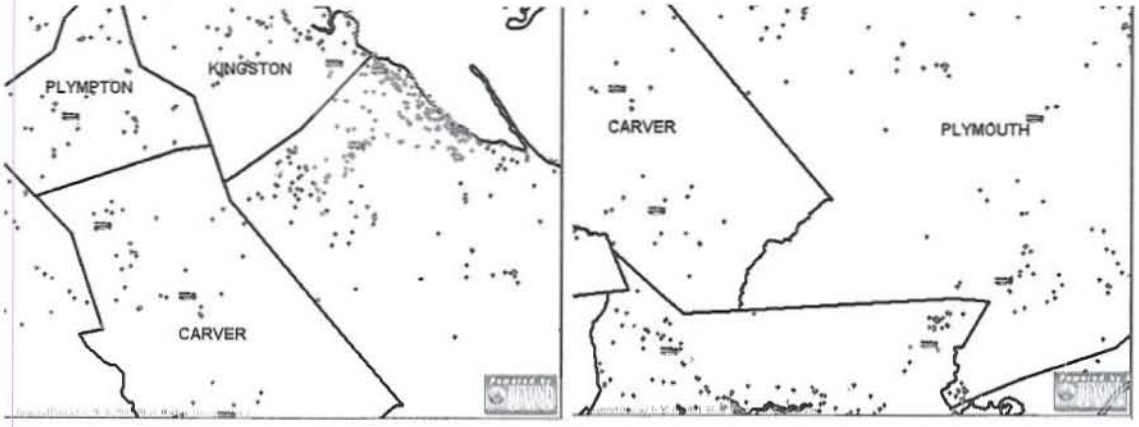




Pembroke:

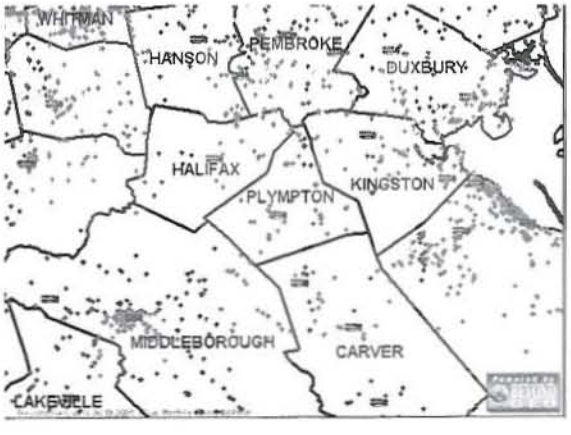
Automatic aid agreements with Hanover, Duxbury, Kingston, and Hanson would improve response time performances and ultimately the safety of areas located on the perimeters of Pembroke. Pembroke would also provide improved response time performances in Hanson, Duxbury, Plympton, and Norwell.

Plymouth:

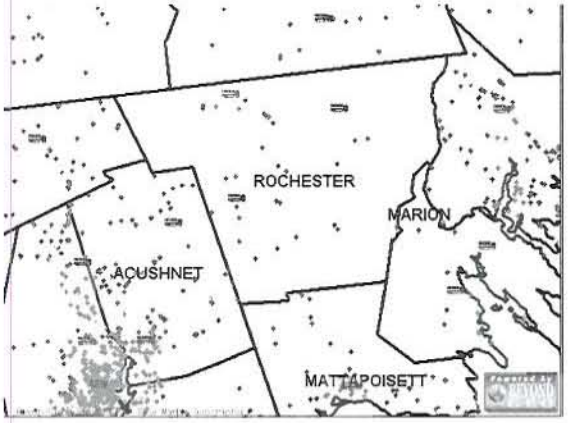


The response time performance and station locations for north Plymouth and south western Plymouth. These figures indicate that Plymouth response times could be improved by automatic aid agreements with Kingston and Wareham. These agreements would affect a very small area as Plymouth fire stations are located in near locations, however improved response times are not the only safety improvement provided by a regionalized dispatch center and an automatic aid system, for additional discussion reference Section 8.6.

Plympton:



Large areas in Plympton are outside of fire department adequate response radii as set by the ISO. Only an automatic aid agreement with Carver would improve response times. As a small community the fire department has limited resources, but with a regional automatic aid system Plympton's safety would be enhanced by having the county's vast array or fire resources immediately available.

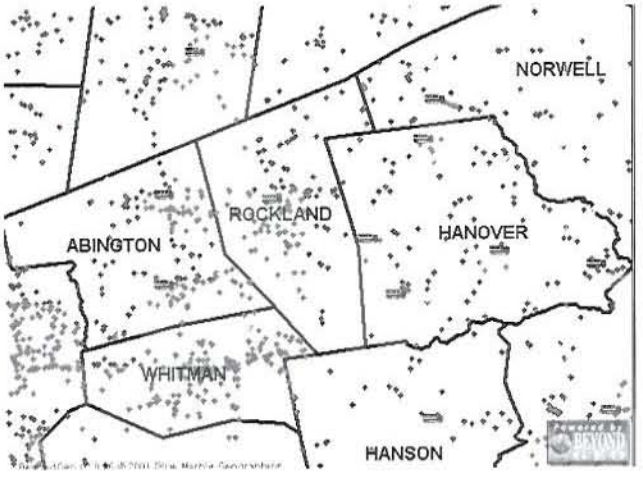


Rochester:

Rochester's response times would minimally be affected by automatic aid agreements with neighboring communities. However, this does not mean that there would not be safety improvements provided by an automatic aid system with regionalized dispatch operations. For additional discussion on enhanced security reference Section 8.6.

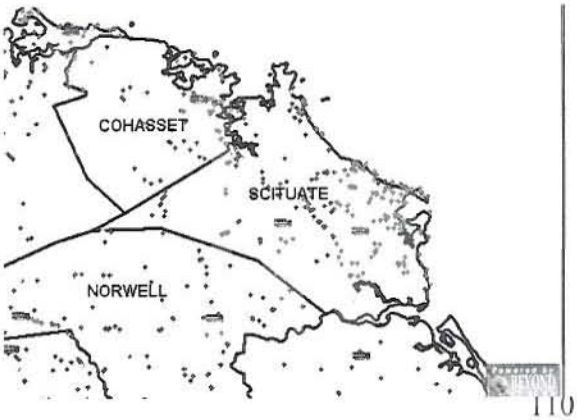
Rockland:

Rockland response times would benefit from automatic aid agreements with Norwell and Hanover. This could improve areas that have historically had fires with excessive response times.

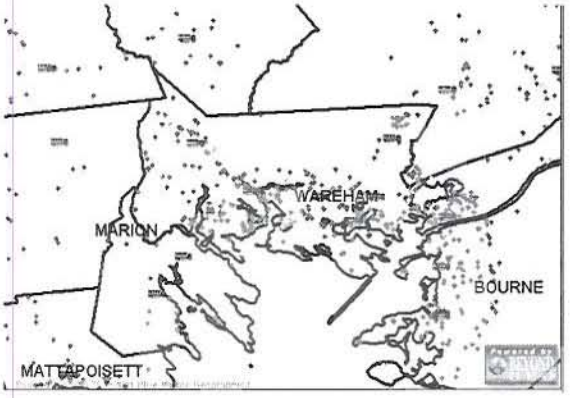


Scituate:

Scituate response times would be improved by automatic aid agreements with Marshfield and Cohasset. The response radii

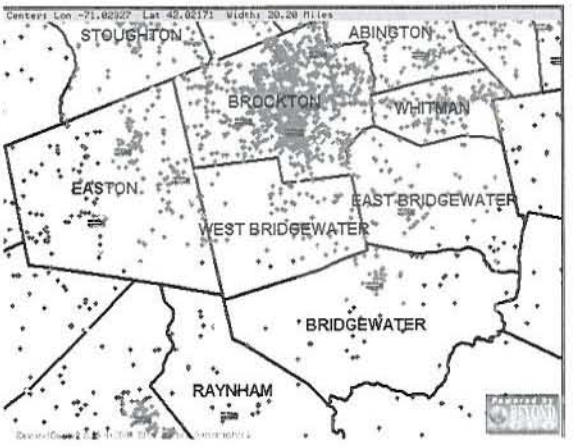


of Marshfield and Cohasset fire stations extend into perimeter section of Scituate.



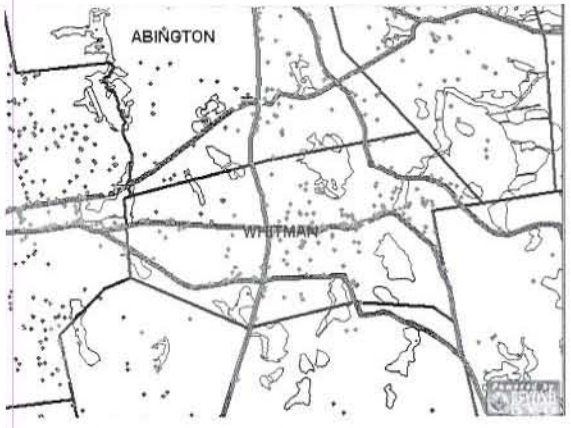
Wareham:

Wareham response times would be improved with automatic aid agreements with Plymouth and Marion. This would benefit sections of Wareham, which recently experienced excessive response time performances, these areas are located in northeast and southwest Wareham.



West Bridgewater:

West Bridgewater emergency response time to fire incidents would be improved with automatic aid agreements with Easton and Brockton as determined by fire station response radii. Areas in which response times could be improved have a history of excessive response times.



Whitman:

Whitman response times could be improved by an automatic aid agreement with Abington. The "response district" of southern Abington's station extends into regions of Whitman that were previously "unprotected" by Whitman fire services.

8.9 Appendix: Literature Review Summary

In reviewing literature regarding fire department response time performances, significance of time in medical and fire emergencies, the components of response time, the evolution of dispatching and technologies, and case studies of other dispatching methods the following was determined:

- From Section 2.5 it was clear that in medical, fire and other related emergencies time is of the essence. Every second counts in these emergencies, in order to provide maximum safety to communities and to minimize destruction caused by fire (and other emergencies) response personnel needs to get to the scene in as little time as possible, and at least should aim to meet the objectives set by industry standards discussed in Section 2.3.
- Fire department response times across the entire country are behind industry standards as discussed in Section 2.4.2, including fire departments in Massachusetts as discussed in Section 2.4.3.
- There are drastically different components of response time, call processing, dispatch, turnout time, and travel time (reference Section 2.6. Travel time, turnout time, and call processing time are fixed. And there appears to be little standardization in the way that calls are dispatched.
- Research into the evolution of fire alarms, telephones, 911, e911 and other dispatch related technologies reveals that dispatching is in an ongoing process of improvement (reference Section 8.2). It also appears that little has been done in Massachusetts to implement Computer Aided Dispatch, GPS and GIS technologies.
- The is a national outcry for improved cooperation, coordination and interoperability among agencies and jurisdictions in providing emergency services, pushing state and regional action, reference Section 2.7.
- Case studies of other dispatching systems reveal that there are alternative ways to effectively dispatch emergency services, namely regionalized dispatch centers (reference Section 2.8.2, Section 2.8.4 and Section 2.8.5. And that these dispatch organizations are ahead of the current dispatching operations existent within Massachusetts communities in terms of technology and standardized procedures reference Section 2.8.3.

Based on these five findings, dispatching procedures need to be improved in order to expatiate the rate at which fire service responds to emergencies and a potentially effective way of accomplishing this goal is through regionalized dispatching.