

Town of Needham

NEEDHAM FIRE DEPARTMENT

STAFFING AND SERVICES ANALYSIS

Dennis Condon, Chief of Department
2/24/2017

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Needham Fire Department History

The Needham Fire Department was established over a 100 years ago having evolved from the bucket brigades of the early nineteenth century. The Department has morphed from the days of hand pumped apparatus pushed by volunteers, through the decades of horse drawn pumpers and hose wagons to open air motorized apparatus to the sophisticated modern computerized engines and ladder trucks in use today. Fire personnel have developed dramatically through the years as well. Those original volunteer bucket brigadiers induced to serve by the promise of "spirits and sugar"¹ have advanced over time to the well trained group of professional firefighters we have today. Where once brave men risked their lives and own wellbeing rushing into burning buildings donning only a mere rain shawl as fire protection with a piece of old handkerchief covering their mouth and nose in an attempt to impede contaminants from their lungs; today Fire personnel utilize Self Contained Breathing Apparatus (SCBA), Nomex hoods and insulated Bunker gear, all tested to meet industry standards and best practices approved by the National Fire Protection Association (NFPA) and other testing organizations.

The Needham Fire Department has and will continue to change as industry standards and technologies evolve, making firefighting practices and methods safer for both firefighting personnel and the public. Much of the evolution of the Department has been in response to the development of the community it is sworn to protect. Needham is no longer the small farming community it was when buckets of water were tossed on barn fires, nor is it the sleepy commuter town of the 1950's and 60's. Today Needham is a diverse community with a vibrant business center hosting internationally recognized businesses. The Town hosts an award winning hospital, a number of long term healthcare facilities; a multi lane interstate highway bisecting the Town; commuter rail and bus networks, a regional television station and an outstanding school district. It is these amenities that make Needham one of the most highly desirable residential communities within the Commonwealth of Massachusetts. However, this diversity of infrastructure and population presents numerous and sometimes unique challenges for the Needham Fire Department. The current and future demands on the Department's response capabilities necessitate a closer look at the department's facilities, equipment and staffing, so those demands for service may be met.

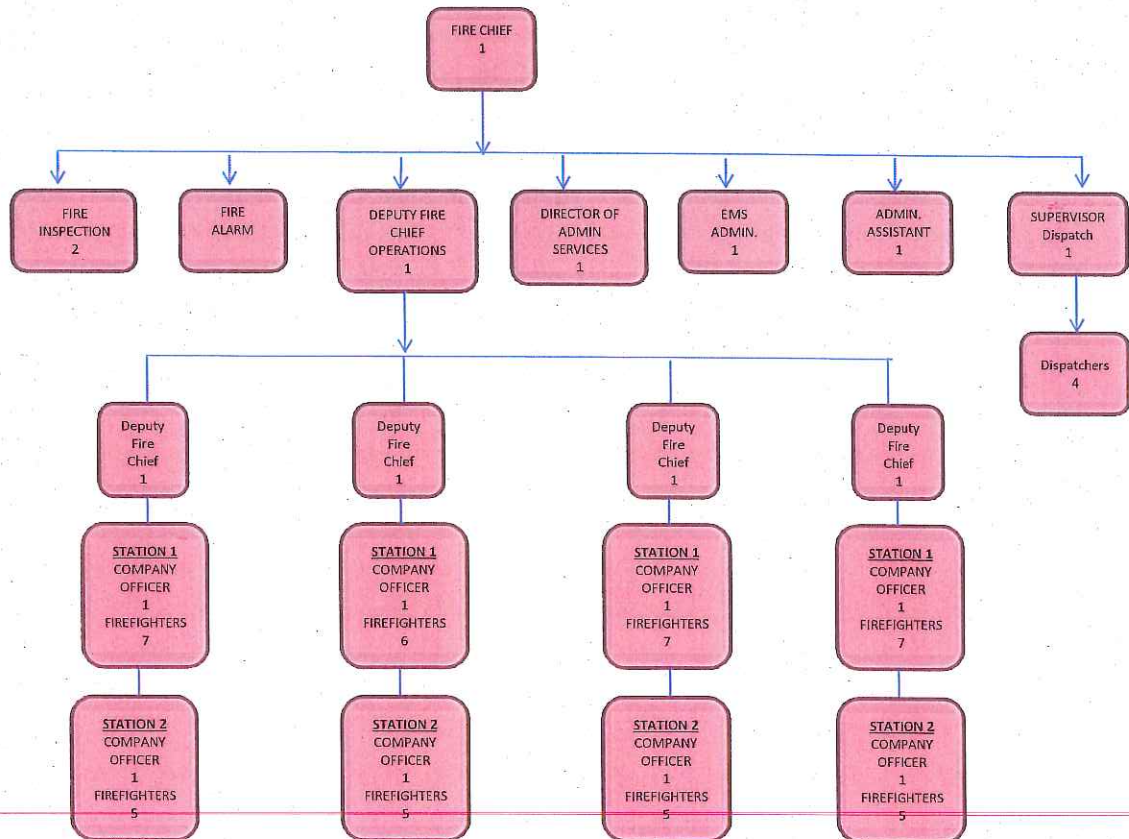
While visions of brave firefighters and days gone by may be alluring, perhaps causing one to pine for the return of "*those good ole days*," the current fire and life safety needs of the Town of Needham demand much more. Further, past studies whether developed by independent observers or department originated are no longer relevant in regards to the current and future needs of the Department and the Town as a whole due to the ever changing nature of the community. What is needed is a fresh look at the department's current capabilities and what is and will be needed to meet the Town's demands for quick and effective fire and EMS services.

¹ *History of Needham, Massachusetts, 1711-1911* Clarke, George Kuhn, p.577

Needham Fire Department Staffing

The Needham Fire Department is currently comprised of 64 sworn uniformed personnel and seven civilian employees for a total of 71 full time personnel. The organization of the department is illustrated below.

Needham Fire Department Organizational Chart



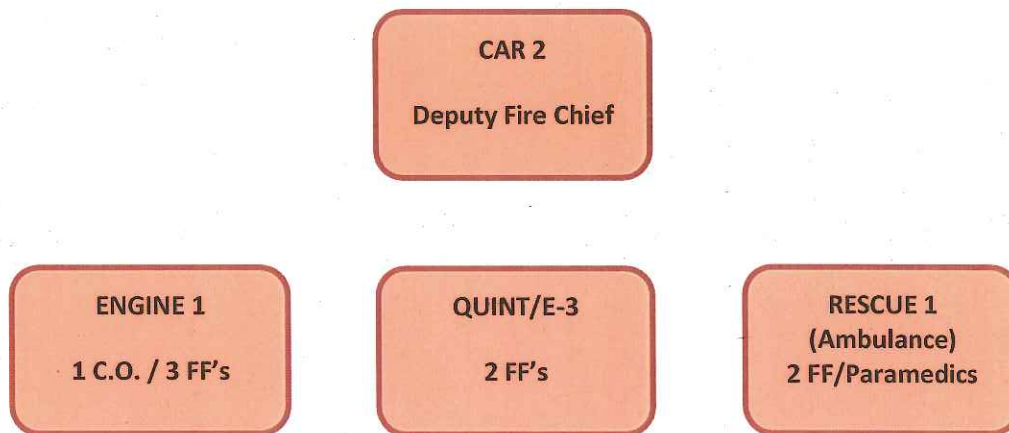
As displayed in the organizational chart above, line personnel are dispersed into four equal groups. Each group a 24 hour shift beginning at 8:00 A.M. and ending the following morning at 8:00 A.M. Shift scheduling this way allows the Town to maintain continuous fire and emergency medical services able to respond to emergency incidents regardless of the time of day. Each work group consists of 12 firefighters under the supervision of two Company Officers who report to a Deputy Fire Chief in command of the group. Each work group of 15 personnel are assigned to a specific apparatus on a daily basis, as indicated in the diagrams below. However, these assignments do not reflect provisions made for absences due to illness, job related injuries or long term vacancies resulting from retirements or termination. In those instances when daily absences occur, the reduced or "fallback" staffing results in

temporary alternative apparatus assignment configurations. In other words, the department may not have sufficient resources to fill all positions on apparatus, resulting apparatus being put out of service. These alternative assignment configurations put great strain on the Department.

Full Complement Staffing Assignments

(15 Line Personnel per Shift)

Station 1 (88 Chestnut Street)



Station II (707 Highland Avenue)



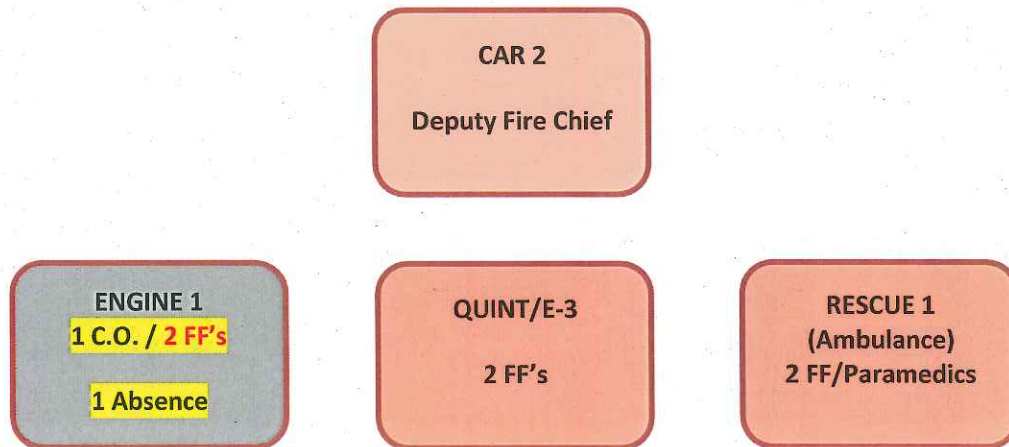
Even at full staffing (15 personnel on duty), the assignments for the Quint (Engine 3) and Ladder 1 are below the recommended fire service standards and best practices of three firefighters and one company officer per piece of apparatus. This means that when deployed to a working fire, vital lifesaving tasks will be compromised or delayed until the arrival of mutual aid companies due to the lack of available personnel to perform those duties. This is the case even when there are no absences. The ramifications of this staffing pattern cannot be overstated, as it puts the safety of those firefighters assigned to understaffed apparatus and the public at increased risk. At two separate multiple alarm fires in Needham in 2015 and 2016, several members of the initial engine and ladder companies assigned to those fires were treated on scene for stress related injuries resulting from overexertion due to reduced apparatus staffing. In each case, a member was transported to the hospital for observation and testing.

Unfortunately, absences occur on a daily basis requiring fallback staffing arrangements since not all absences are covered with overtime staffing. The charts on the following pages depict how the Department attempts to maintain services at reduced levels of fallback staffing.

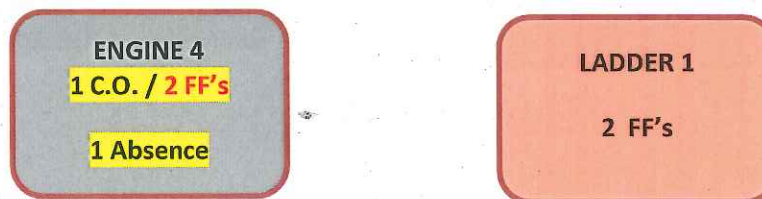
One Person Fallback Assignments

(13 Line Personnel per Shift)

Station 1



Station II

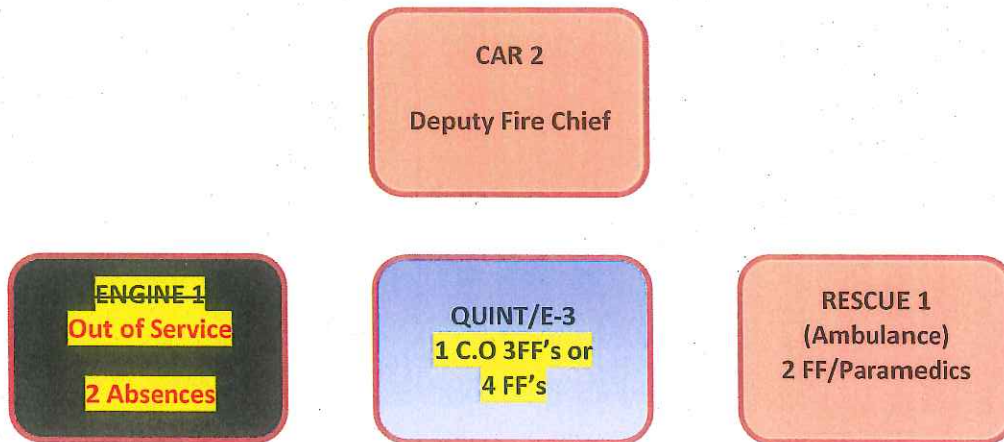


In the one person fallback scenario, the first firefighter or officer who is out at each station is not covered by overtime and the position is left vacant. This could lower the on duty personnel level to 13 or 14, depending if one or both stations are affected. While this configuration is not advantageous, it does allow the Department to maintain the routine apparatus assignments, though at a weakened level. In a one person fallback scenario, the Quint/Engine 3 and Ladder 1 remain at substandard staffing, and front line Engine 1 and/or Engine 4 fall below the recommended staffing standards of three firefighters and one company officer. It should also be pointed out the fallback may be a Company Officer and/or the Deputy Fire Chief assigned to supervise the group. If this occurs, temporary out of grade assignments are made, i.e. a firefighter works out of grade as a Company Officer (Lieutenant or Captain) or a Company Officer may work out of grade as a Deputy Fire Chief. While those critical supervisory roles are maintained, they suffer by the use of less experienced temporary personnel serving in roles they may not be truly prepared for.

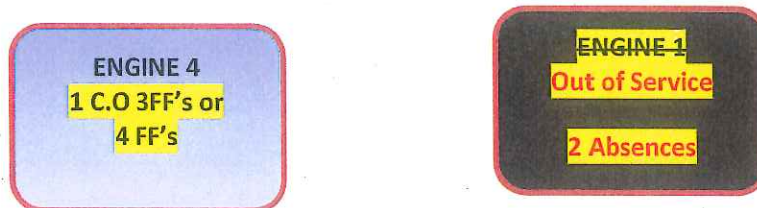
Two Person Fallback Assignments

(11 Line Personnel per Shift)

Station 1



Station II



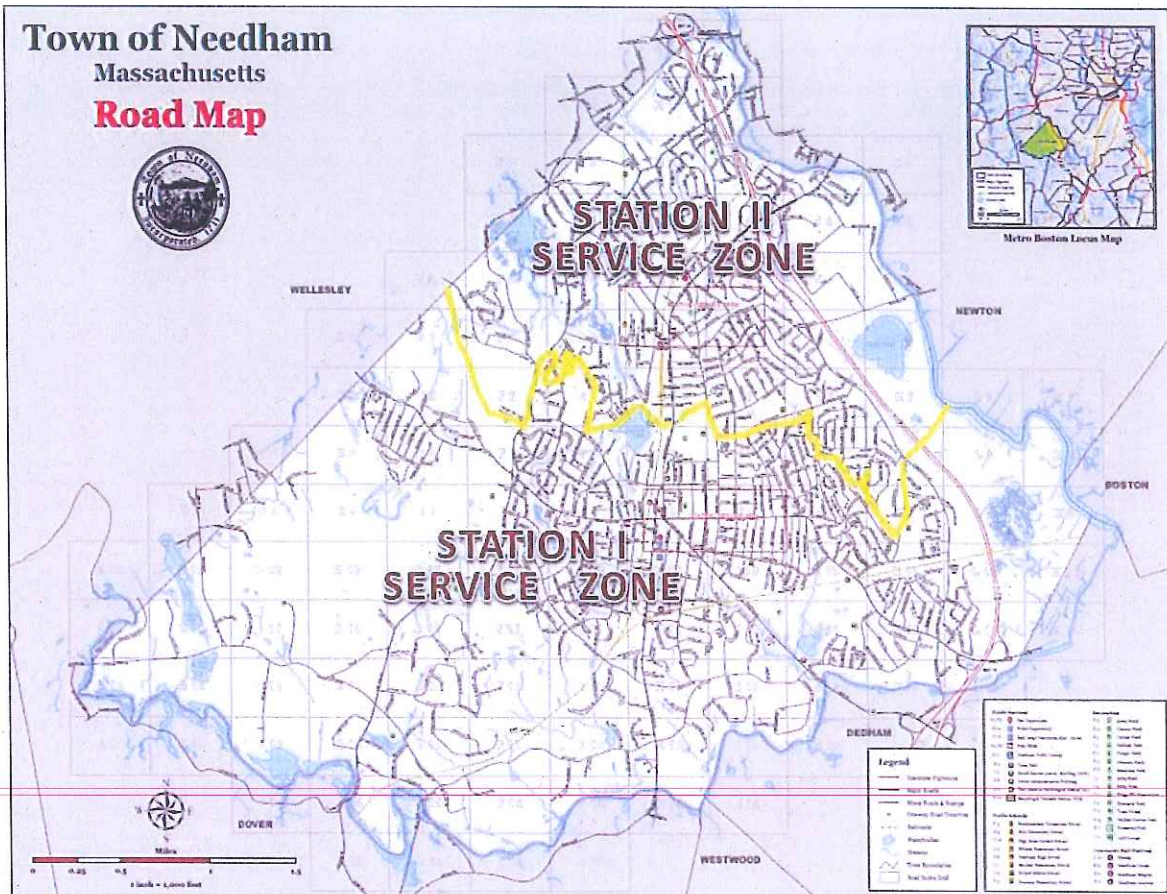
During instances where the department utilizes a two person fallback, safety and service is further compromised. As with the one person fallback one or both stations may be affected. When a two person fallback occurs at both stations, the total personnel on duty drops as low as 11 and apparatus is put out of service entirely. When both stations experience a two person fallback both Ladder 1 and Engine 1 are removed from service. This is done in an effort to maintain at least one fully manned ladder and Engine Company in service. Personnel are reassigned to the Quint/Engine 3, which acts mainly as a ladder truck and to Engine 4 which becomes the only pumper covering the entire Town. Again as in the one person fallback, one or even two officers, either a Company Officer or Deputy Fire Chief may be absent and uncovered further taxing the skills of those charged with filling those vital leadership positions by working out of their normal grade at the critical moment of reduced levels of staffing. It should be pointed out that the necessity to utilize two person fallback is not as uncommon as one might expect due to long term vacancies. It often takes upwards of one year to replace personnel lost to

retirement or termination. This is attributed in part to Fire Academy backlogs, the Civil Service process and other scheduling factors. Thus, long term vacancies become the first person out creating a constant one person fallback often lasting for months, setting the stage for a two person fallback as incidental absenteeism occurs.

Once fallback staffing is initiated, the potential for occupational injuries increases. Personnel may over stress their physical capabilities in attempts to meet greater challenges presented to them on scene, as insufficient human resources are not available to share the load. These injuries, if significant, may result in additional long-term vacancies only to exacerbate the problem further. The fallback staffing arrangements presented above have been in place for well over a decade. These procedures were developed to address fiscal constraints and to attempt to stretch overtime budgets throughout the years. Nevertheless, when a fallback is instituted, the potential for Fire personnel and the public to suffer even at smaller scale incidents is increased.

Service Zones

As was seen in the staffing charts previously presented, the Town is broken down into two service zones for fire and emergency response. Each station is designated to provide an initial response to specific regions of Town before additional help, either from the other station within the Town of Needham or mutual aid companies arrive. The yellow line on the map below shows the boundaries for each service zone served by Station I & II.



In addition to responding to alarms within their respected service zones, fire companies housed at each station regularly respond to areas outside their respective service zone to augment larger scale response requirements or to fulfill simultaneous calls for service. These situations tax the Department's response capabilities, as well as increase response times to undesirable levels. An example of this would be when Station Two apparatus is dispatched to an incident near the distant borders of the Station One's service zone; naturally the increased travel time can lead to delays in response time. Further, multiple calls for service often result in cross-manning assignments. This is the case when personnel are temporarily re-assigned from the Quint/Engine 3 to staff Rescue II in order to respond to a secondary medical emergency. While this practice addresses the situation at hand, it negatively impacts the fire response

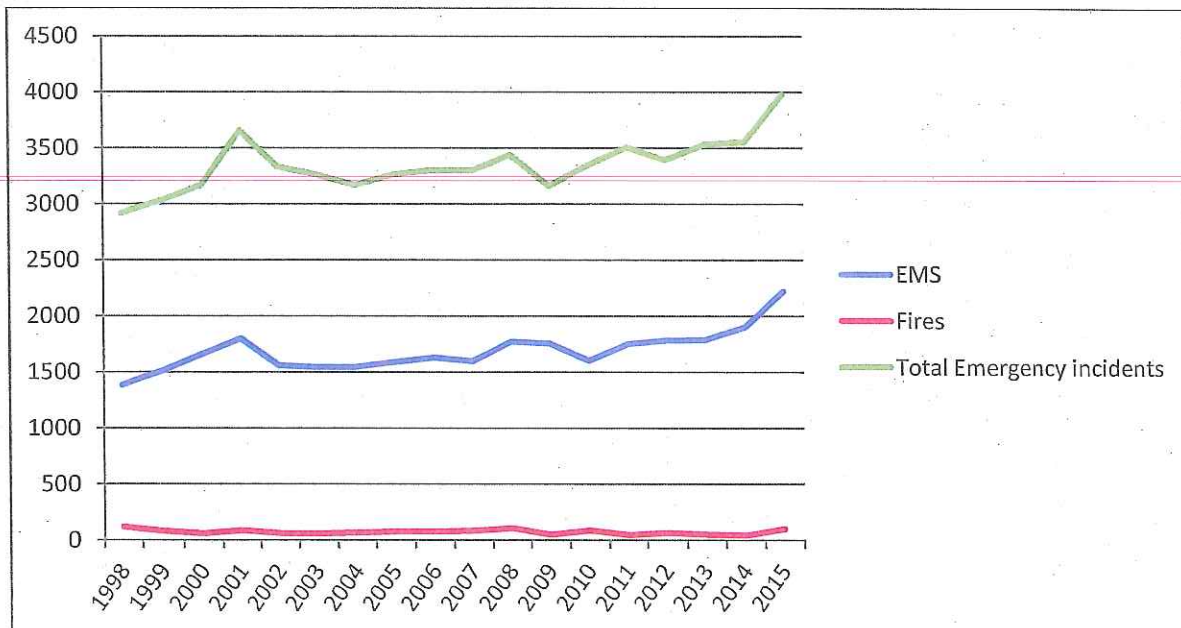
capabilities available for that period. When this occurs, personnel may be re-assigned from their firefighting duties for a considerable amount of time, often as much as an hour or more. Currently, this is the only manner Rescue II can be staffed. In those instances where a fallback is in place, the availability of personnel to be temporarily re-assigned to Rescue II for medical emergencies may not exist. Thus, not only is revenue lost, but more importantly delays in emergency medical treatment occur while out of town ambulances are deployed to the incident. To further complicate matters, out of town ambulances often respond from significant distances. The loss of precious minutes before the initiation of emergency medical treatment can have devastating consequences for the patient. A study published in *The BMJ* (formerly the British Medical Journal) concluded, "Reducing ambulance response times to 5 minutes could almost double the survival rate for cardiac arrests not witnessed by ambulance crews."² It is rare for an ambulance responding from a neighboring community to arrive on scene within five minutes.

² *Effect of Reducing Ambulance Response Times on Deaths from out of Hospital Cardiac Arrest: Cohort Study.* BMJ, The BMJ, 14 Mar. 2001, <http://www.bmj.com/content/322/7299/1385>.

Emergency Medical Services

The Needham Fire Department has been providing emergency medical services to the public since the 1970's. Initially those services were provided at the Basic Life Support (BLS) level. Then in the mid-1990's services were upgrade to the level of Advanced Life Support (ALS). The EMS services the Department provides for the Town is accomplished with one full-time ambulance (Rescue 1) and a second ambulance (Rescue 2) utilized on an as needed basis when sufficient personnel are available to staff it. Each ambulance is licensed by the Office of Emergency Medical Services for the Commonwealth of Massachusetts at the Advanced Life Support (ALS) level. This is the highest level of emergency medical care an ambulance service can provide. An ALS level ambulance offers patients access to higher levels of medical intervention including the ability to start intravenous therapy in the field, administer lifesaving drugs and use of an advanced cardiac monitor and other lifesaving equipment. During times of staffing fallbacks, Rescue 1 has always remained in service and is continuously staffed with a minimum of two EMT-Paramedics. When secondary or simultaneous emergency medical incidents occur, Rescue 2 may also be deployed as previously stated if staffing is available.

In 2015, the Needham Fire Department responded to a total of 3,914 emergency incidents, of which 2,219 were emergency medical responses. As can be seen in the chart below, fire incidents have remained relatively constant with occasional spikes from one year to another. One such spike occurred in 2015. It would appear that this increase is in keeping with incidental increases we have seen in other years and not a new upward trend. However, incidents requiring the department's emergency ambulance have increased dramatically since the late 1990's with an even sharper sustained rise since 2013.



There are a number of explanations for the rise in emergency medical incidents in Needham in recent years including an increasing number of long term care and nursing facilities within Town, an aging population, a more healthcare conscious society with greater demands for early emergency medical intervention, and ongoing community development. It is apparent the growing demand for emergency medical services will certainly continue and more likely increase dramatically in the foreseeable future. This is especially true for the Station II service zone, where a 390 unit residential complex and two hotels are scheduled for construction at Needham Crossing. In addition, the Mill Creek/Modera project will establish another 136 housing units in the Station II service zone along with a significant expansion to the Wingate long term care facility which is currently under construction. These developments and those likely to be created in reaction will significantly tax emergency services in the Station II service zone in the coming years. As the total number of emergency incidents rises there will be a corresponding increase in the number of simultaneous incidents the Department will need to address as well. As previously cited, simultaneous responses create challenges for the Department when fully staffed, and are nearly impossible to fulfill during periods of fallback staffing. Thus, the need for a second full time ambulance housed at Station II will not only offer more prompt service to that service zone, but will also be available for response during periods of simultaneous incidents. As development within the Town continues, the need for expanding the current service to two full time ambulances becomes ever more clear and should not be delayed.

Why Fire Based EMS

As stated previously, Needham residents have had the benefit of a fire based EMS system for over forty years, nearly half of which time has been at the Advanced Life Support level. Again, an advanced life support (ALS) ambulance service is the highest level of pre-hospital care currently available. Reasons to continue support for a Fire Department based EMS system in Needham are plentiful and include the following.

- Needham's two fire stations are geographically well-located; utilizing these locations as launching points insures quick response times to all areas of Town. When a life threatening medical emergency occurs the amount of time it takes to initiate ALS care becomes a critical component to survivability. Needham Fire EMS has for over four decades a strong record of providing care within expected response time standards.
- Many of Needham Firefighters/EMT's have decades of continued experience providing EMS care within the Town. They offer tremendous knowledge of the Town, its buildings, streets, fields, parks, and most importantly its residents. There is no need to depend on shaky GPS devices transient workers would require if the Needham Fire Department EMS system were to be replaced by a private concern. Further, fire personnel develop intimate relationships with sick and infirmed residents over time. These relationships help re-assure those most vulnerable in our community in their time of need and reduce the anxiety of having to re-explain medical histories in depth over and over due to changing personnel.
- A fire based EMS system allows for patient treatment to begin immediately, even if the patient is trapped in a building on fire, pinned in a rolled over car or in some other unusual circumstances requiring special equipment to free them. The same group of Fire personnel conducting extrication can also begin patient treatment during those operations.
- Firefighter/EMT's are among the most stable workforce in Town. It is commonplace for fire service personnel to remain at their jobs for well over 30 years. This stability translates into a special commitment to the Town and its people. No private ambulance service can offer the same. Private ambulance workers are generally transient in terms of career longevity, often working shifts in a number of communities over the same period of time without commitment to any town in particular. Indeed, the business model for many private ambulance companies is to turn over personnel regularly, replacing more seasoned higher paid staff with less experienced newly licensed EMT's at lower wages.

- Firefighter/EMT's assigned to the ambulance are available to respond to all types of emergencies and can offer services beyond the scope of EMS when needed, thus increasing the productivity of our department services.
- A Fire-based EMS system is seamless and timely. Once the 911 call is made, Needham Fire dispatchers need only to make one announcement to activate a single all hazards response prepared for almost any potentiality. There is no need to make a separate call to a private ambulance service, thus saving valuable time from the already tight critical time parameters available for effective response. If upon arrival circumstances surrounding the situation are beyond the capabilities of the two EMT's assigned to the ambulance, there is an engine company already on scene to assist with personnel and equipment. No need to make a time delaying call for assistance. A private ambulance company cannot offer such response capability.
- A Fire based EMS system insures there is continuity of medical training, equipment, medical direction and administration. Unity of command is always maintained, as there is no competing agency on scene with potentially conflicting protocols.
- It is not the primary function of a Fire-based EMS system to generate revenue for a community, but ambulance receipts do help to offset personnel and related equipment costs.

Why not a Private Ambulance Service

There are a number of reasons why converting to a private ambulance service – in part or in full - doesn't make sense for the Town of Needham. Among those reasons are the following.

- Private ambulance services lack the infrastructure available the Needham Fire Department already has in place. At this time there is no ambulance service situated in Town offering the geographically beneficial locations both Needham Fire stations already have in place. To acquire similarly located facilities would likely prove cost prohibitive for the introduction of a private ambulance company within town.

Meeting the critical response times would require locating a private ambulance vehicle within the existing stations. With respect to Station 2, this would result in the same size station that is proposed. With respect to Station 1, it would require an even larger structure. It should be noted that the impact of locating a second Fire-based ambulance at Station 2 has only a modest impact on the program and size of that facility.

- With a private ambulance model, the Town would receive no EMS related revenues, as only the transporting ambulance can bill for services. However, there would undoubtedly be associated costs, as Fire personnel will be required to assist the two person ambulance crew. Firefighters would be used for lift assist, extrication and other tasks a private ambulance staffed with only two persons could not provide.
- There are contractual obligations the Town has providing certain rates of pay for various levels of EMS certifications that would need to continue unless and until they are negotiated out of the collective bargaining agreement with the Firefighters Union.
- A private ambulance business model would by definition require profit to be a primary motivator, likely impacting the level of patient care our townspeople have come to expect over the past forty years with the Fire-based system. A private ambulance company must be profitable to be sustainable, putting continuity of service in jeopardy if profitability were to falter.
- The business models of most private ambulance services depend heavily on the use of newly trained EMT's, and generally offer little incentive for personnel to remain with the service. This model does not value experience in the same way the local Fire Department does, nor is it conducive to building patient relationships over time, causing the potential of anxiety for our families, friends and neighbors at those times they are most vulnerable. Having a reassuring and recognizable face treating a patient during a medical emergency is something of great value to a patient. Access to high quality medical services is one of the factors residents consider when choosing to locate in Needham.

The commitment to the Town and the obligations of a private ambulance service are only as good as that company's business model, and are subject to be disrupted at any time. This cannot be better illustrated than by the situation created by the bankruptcy of Med Corp EMS and its parent company First Med EMS. This company was one of the largest providers of ambulance services in the country at the time of their bankruptcy filing, serving more than 70 municipalities over six states. The company shut down ambulance services without notice or explanation over a weekend, firing over 2,000 paramedics and other emergency workers. The move left communities scrambling to provide EMS services at a moment's notice.

One does not need to go back to the problems caused by the sudden 2013 bankruptcy of Med Corp EMS and their parent First Med EMS nor as far away as the Midwest to witness similar situation caused by profit seeking private EMS providers. The Wellesley Fire Chief provided the following information: *"AMR" (Wellesley's EMS provider) "has informed Wellesley of their intent not to renew the contract set to expire June 2017. This issue presents challenges to service quality and the continuity of experienced personnel to serve our citizens. We are working toward finding a new provider to rebuild the continuity and experience with our community as we move toward 2017. The value of a fire based system is clear in that the experience level, community familiarity and quality of services improves every year given the retention of town employees."* It seems apparent AMR's move was driven by profit concerns, as they could no longer retain the senior more experienced Paramedics Wellesley Fire Department required in its contract in order to maintain citizen expectations and continuity of services.

Wellesley is not the only nearby community to be faced with service disruptions recently. The Towns of Medfield, Millis, Medway and Holliston suddenly and without notice in early September of 2016, lost their private Advanced Life Support service provider, as Events EMS went out of business leaving those communities without proper emergency medical service coverage. These communities must now enter into agreements with an ever decreasing pool of private EMS service providers or create/upgrade their own Fire-based EMS systems, both very time consuming processes. What will be the impact on the residents of those communities in the meantime? To stray from the excellence of service and the stability of the EMS system our Townspeople now enjoy and to shift to a model carrying the levels of risk and uncertainty associated with private ambulance companies does not appear to be in the best interest of our community and its residents.

Support Services

The Needham Fire Department has had two fulltime Fire Inspectors in the Fire Prevention Bureau for over thirty years. Their duties are designed to lessen the fire and life safety burden for the Fire Department, but for the community as a whole through the enforcement of fire protection codes and regulations. They do this through a process of permitting, fire prevention inspections, plan review, fire drills and assisting in fire investigations. Similar to the evolution the rest of the Department has experienced through the years, the Needham Fire Prevention Bureau has evolved as well. Today the department's Fire Inspectors are highly trained vital employees dedicated to the life safety of the community. As with most things in our society, fire codes continue to be more sophisticated and complex, requiring greater knowledge and expertise by personnel. These professionals are constantly improving their knowledge and expertise by attending seminars, meetings and conferences to keep up with code changes and technological advances, thereby, helping to create a safer community.

The Department participates in the Student Awareness of Fire Education (S.A.F.E.) program and the Senior S.A.F.E program focused on the elderly population of Town. Both of these State sponsored programs are vehicles for personnel to engage with targeted populations concerning fire safety education. In addition to both S.A.F.E. programs, the department has begun to leverage technologies and social media to get the word out on a number of safety topics. The Department's website is one of the ways in which public safety information is disseminated with 24 hour availability for the public. Another way of using technology is by having a part-time employee gather and enter pre-fire planning information into the CAD system for both public and private buildings, thereby making site specific critical information available to firefighters in the field.

All incidents begin in the department's dispatch center where calls for service are received and apparatus is dispatched. Technology has had a dramatic effect on the way the Department's dispatchers perform their duties. The role of today's Fire Dispatcher is far more complex than simply answering the phone or counting bells struck by a telegraph reporting system. Modern dispatchers are trained to use a sophisticated software suite to track, account and assign apparatus and personnel to each emergency incident, thereby allowing the Department the ability to process data to identify emerging trends and assure quality control. Each dispatcher is also trained in Emergency Medical Dispatch (EMD) protocols. Being EMD trained, dispatchers can begin EMS intervention at the moment calls are received. In some instances this ability has had dramatic impacts on patient survivability.

The Department's personnel are rounded out by the administrative staff and special assignment part-timers. These positions are just as vital to the success of the Needham Fire Department as the line personnel. As can be expected, the administrative staff is involved in procurement of equipment and needed services, budgeting, payroll and personnel benefit administration. What may not be apparent is how the administrative staff plays a direct role in all line services. Whether it is by maintaining the department's website, administrating the two S.A.F.E. programs, scheduling relevant training and education modules for line personnel or writing grants, it is the administrative staff that keeps the machine that is the Needham Fire Department functioning and moving forward.

National Standards and Best Practices

To arrive at a proper level of human resources available for Fire and EMS deployment, communities often use the comparable approach. An assessment is made of what surrounding communities have established as an acceptable level of public safety personnel, and that model is compared to the local town. However, this approach is flawed when used for this purpose. The comparable approach is quite effective in determining value. It is often used to determine the market price of a piece of property and for arriving at competitive pay scales. When determining the price of a home for instance, it is logical to compare a subject home with homes of the same size and quality in similar locations which have sold recently and adjust for differences to obtain a value conclusion. Here the comparable approach is logical, effective and used on a regular basis. Likewise, when a community establishes an appropriate wage to pay employees who perform additional service, such as working as paramedics, it is entirely reasonable to garner information from comparable communities to establish a rate of pay for such services. In both of these instances, the comparable approach is functions well as an estimate of value is being established. This is not the case when determining fire department staffing levels.

Fire staffing levels are not a function of value, but rather a function of risk a community is willing to accept. Thus, using staffing data from comparable communities for the purpose of developing an appropriate level of fire department staffing is at best questionable and may even be irrelevant. Further, using a comparable approach to determine proper staffing levels is based on the assumption that other communities are correct in their assessments. Some comparable communities may be willing to accept higher levels of risk and liability by under-staffing fire department resources, putting both the firefighters and public in jeopardy. Other communities may feel uncomfortable with even a small level of risk and over staff their departments in an attempt to prepare for any eventuality. How then would it be relevant to use data from those communities to determine the acceptable level of risk and potential liability Needham is comfortable with? Communities occasionally use this method as justification for cuts in service in order to meet fiscal constraints; money can be saved by reducing personnel to the level of a neighboring community. It lacks validity. Fire department staffing levels are not unlike an insurance policy. Individuals choose the level of insurance they purchase or forgo based on the risk they are willing to accept in relation to their own needs and not what may work for others. Further, communities may be comparable in terms of population, area and economics, but there are countless other factors to be considered to determine the human resources to provide public safety. So why would only one or two factors indicate one community is truly comparable to another? How can those factors be adjusted for and if they are not then is the comparable approach fair and reasonable?

If the comparable approach is not valid then how should a community determine an appropriate level of staffing? First, a level of risk needs to be established and then the amount of resources to mitigate the risk in the event of an emergency can be established. This is not to imply proper staffing levels are determined based on the most catastrophic event that can strike a community; rather what is the level of resources needed to respond to those events most likely to occur. The needed levels of resources for those events, once established can be developed by looking at national standards and best practices.

This way the proper staffing level is established based on the needs of the specific community in relation to the specific risks of the community and not what the town next door is doing.

The pre-eminent national standard for fire department staffing is the *National Fire Protection Association (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*. The standard is based on specific functional needs on the fire ground or emergency medical incidents and the time frames those needs must be met to ensure safety and effectiveness.

This NFPA standard was developed through a consensus-based public review process. The technical committee included city managers, fire chiefs, union representatives and representatives from Universities, Homeland Security and other public and private entities.³ The standard is universally accepted within the Fire Service meeting the approval of both the *International Association of Fire Chiefs (IAFC)* and the *International Association of Fire Fighters (IAFF)*. Such united acceptance by these two groups is indicative of the legitimacy of the standard. Moreover and perhaps of greater importance, when submitting reports on firefighter fatalities, the *National Institute for Occupational Health and Safety (NIOSH)* cites this standard and the associated staffing requirements it contains as being the proper staffing levels fire departments must provide on scene. NIOSH routinely indicates failure to adhere to the staffing levels mandated by NFPA 1710 as being a contributing cause to firefighter deaths. This is the case regardless of whether the standard is adopted by the State or local jurisdiction the incident occurs in. In other words, the staffing and deployment requirements found in NFPA 1710 are the recognized levels of service all communities must provide at defined incidents.

The reputation of the National Fire Protection Agency in developing this standard must be given considerable weight. The NFPA was first formed in 1896 as a non-profit organization dedicated to the purpose of developing fire, electrical and various life safety standards. The standards the NFPA develops are recognized and adopted worldwide. These standards are the basis of countless National and International safety codes, regulations and laws. In fact, *527 CMR 1:00: Massachusetts Comprehensive Fire Safety Code* adopts in large part NFPA 1, 2012 edition.⁴ There can be no valid questioning as to the enormous impact the NFPA has and continues to make when it comes to keeping people safe for the ravages of fire worldwide. What are the staffing and deployment recommendations of NFPA 1710? The standard is complex with a number of recommendations, some of which the Needham Fire Department currently meets, especially those concerning emergency medical response. In the instances of EMS, the standard calls for a first responder to be on scene with an Automated External Defibrillator (AED) within a 240 second travel time to 90% of incidents.⁵ The Needham Fire Department generally accomplishes this, as all of our personnel are not only first responders, but have at least EMT-Basic status or the more advanced EMT-Paramedic designation. In addition, the Department outfits AED's on all apparatus. For emergency medical incidents requiring Advanced Life Support (ALS), NFPA 1710 calls for an ALS unit to

³ 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* 2016 Edition

⁴ 527 CMR: *Board of Fire Prevention Regulations, Commonwealth of Massachusetts*

⁵ 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* 5.3.3.3.2 2010 Edition

be on scene within 480 second travel time, provided that a first responder with an AED or a Basic Life Support (BLS) unit is on scene within 240 seconds.⁶ Further, the standards identifies the staffing requirements for both ALS & BLS units as being two emergency medical technicians assigned to the ambulance trained to the appropriate level of service.⁷ Again, the Needham Fire Department meets or exceeds the standard, as we staff our ambulance (Rescue 1) to the ALS level every day, thus providing the residents and those who work or travel through Town with the highest level of emergency care currently available. Finally, the service zones presented previously were scrutinized during the Needham Police & Fire Headquarters; Needham Fire Station II feasibility study and were found to be true to the time frame requirements of NFPA 1710 for emergency medical incidents in most instances.⁸

It is important to point out at this juncture, while the Needham Fire Department is presently positioned well in regards to the parameters set forth by NFPA 1710 concerning emergency medical incidents, future development is projected to have a significant impact on service delivery. It is abundantly clear that incident response trends have been increasing steadily for a number of years, but the level of that increase is about to gain significant momentum in the near term due to current plans in the Needham Crossing area, Wingate long-term care expansion and the Mill Creek project. Projections for Fire/EMS services for these projects alone are conservatively in the vicinity of 250-350 additional emergency incidents annually, perhaps more. The issue here is not the number of additional incidents itself; it is when those incidents occur. When incidents occur simultaneous with another incident, service response capabilities quickly become over taxed. The addition of several hundred incidents over current trends will result in a great number of simultaneous calls for service. Additional development on either side of Interstate I-95 seems inevitable and with development will be the need for greater emergency response capabilities heightening the concern. Thus, while the Needham Fire Department can currently address much of the fundamental essence of NFPA 1710 for emergency medical incidents that level of service may be short lived without the institution of a second full time ambulance staffed at Station II as the primary provider to the Station II service zone.

NFPA 1710 goes beyond response parameters for emergency medical incidents, covering a broader set of emergency responses, including *Airport Rescue and Fire-Fighting (ARFF)*; *Services Marine Rescue and Fire-Fighting (MRFF)*; *Services Wildland Fire Suppression Services*; *Special Operations*; as well as *Fire Suppression*.⁹ The standard does not call for all fire departments to provide sufficient resources to respond to every category of incidents. Some fire department may indeed encounter all of the response categories the standard addresses, but most do not. Fire departments aren't required to have resources to be readily deployable to all possible incidents. It is up to the local jurisdiction to determine the types

⁶ 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 5.3.3.3 2010 Edition

⁷ 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 5.3.3.3.4 2010 Edition

⁸ Response Time Map Developed for the Needham Police & Fire Headquarters; Needham Fire Station II Feasibility Study. June 2016 Study by David McKinley; Landscape Architect, Kaestle Boos Associates 325 Foxborough Blvd. Suite 100 Foxborough, MA 0203

⁹ 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 4.1 through 4.7 2010 Edition

of responses likely to be encountered. NFPA 1710 simply sets the minimum staffing and response time parameters necessary to address those incidents a community is likely to encounter in a safe and effective manner.

In the case of the Town of Needham, the focus should be on single family residential homes, which are plentiful. It is true the town has a vibrant downtown retail district, as well as some significantly large office buildings in the Needham Crossing district. In addition, Needham supports nursing/long term care facilities, a hospital, a college campus, an interstate highway, numerous schools, churches and homes for citizens with special needs. All of these structures pose special considerations and response requirements for the Needham Fire Department, but the vulnerabilities of these structures to fire are often tempered by numerous fire protection and life safety codes and regulations. Codes and regulations providing for automatic fire sprinklers, fire alarm systems, safe practices, flammable substance storage requirements, exit lighting and fire detector placement. Codes like 527 CMR 1:00: Massachusetts Comprehensive Fire Safety Code, which as previously stated was developed by the National Fire Protection Association.¹⁰ While all of these buildings deserve and receive special consideration, it is the single family residential fire where the staffing and deployment requirements of NFPA 1710 should be focused. So what are the requirements NFPA 1710 makes in regards to the correct resources needed to fight a single family residential fire?

When addressing firefighting staffing, NFPA 1710 states, *"The number of on-duty fire suppression personnel shall be sufficient to perform the necessary fire-fighting operations given the expected fire-fighting conditions."*¹¹ As previously established, the focus on "those expected conditions" should be concentrated on the single family residential structure. The standard defines a single family home as a 2,000 square foot dwelling without basement or exposures.¹² Here in Needham many homes are significantly greater than 2,000 square feet of living area and most have basements. Thus, often times Needham firefighters are challenged with fires in structures greater than what the standard identifies. Further, the initial response guidelines developed in the standard are for a room and contents fire in the previously defined structure and not the structure itself fully involved in fire upon arrival, which would require an even greater response.

The standard goes on to require fire personnel and equipment to arrive on scene within certain time parameters. The initial engine company shall be deployed to provide for arrival within a 240-second travel time to 90 percent of the incidents.¹³ Further, the initial full alarm assignment must be deployed within a 480-second travel time to 90 percent of the incidents.¹⁴ Generally those travel time requirements are achievable by the Needham Fire Department due to the strategic locations of the Town's two fire stations. This is the case for standalone incidents when apparatus is responding from

¹⁰ 527 CMR: Board of Fire Prevention Regulations, Commonwealth of Massachusetts

¹¹ 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 5.2.2 2010 Edition

¹² 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 5.2.4.2.2 2010 Edition

¹³ 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 5.2.4.1.1 2010 Edition

¹⁴ 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 5.2.4.2.1 2010 Edition

either or both fire stations. At times of multiple simultaneous incidents occurring or for some outlying streets located near the Town's borders, such time frames may be out of reach. Nevertheless the ability for apparatus to arrive on the scene of fire incidents within NFPA 1710 response time parameters is largely achievable.

The number of responding personnel NFPA 1710 requires for this initial response is listed at a minimum of 15¹⁵ and is based on the need to fulfill certain critical tasks. Failing to have sufficient resources available during the initial timeframes of an incident can result in negative consequences to the overall success of the operation and lead to overly unsafe practices. These critical tasks are listed as follows:

1-Incident Commander

1-Fire personnel to establish and maintain a supply line

4-Fire personnel to establish and operate two hand lines (attack & back-up) 2 personnel assigned to each line

2- Fire personnel to support/supervise each hand line.

2- Fire personnel per search and rescue team (minimum per S&R team)

2- Fire personnel ventilation team to begin building ventilation operations

1-Fire personnel to operate the aerial device if one is required to access upper stories of the structure

2-Fire personnel to establish an Initial Rapid Intervention Crew (IRIC)

15- Total Fire Personnel

To be clear the above response is the "Minimum" initial response required within the travel time requirements set forth by the standard. Again, this response is for a simple room and contents fire, more complex and multiple alarm fires require significantly greater resources. For fires in small commercial establishments such as those located in downtown Needham, the standard requires 24 fire personnel on the initial response.¹⁶ This is where the Town's mutual aid agreements with surrounding communities come into play. As the fire incident grows in size and complexities additional alarms are sounded and with each additional alarm greater resources are deployed from within the Departments mutual aid network. However, no mutual aid agreement can nor should be relied upon for the initial response within those critical time frames. It is incumbent for each community to provide their own initial response, especially for structures that can be expected to be regularly encountered, such as the single family residential dwelling so abundant in Needham.

Finally, NFPA 1710 defines the number of personnel needed to fully staff an engine company or ladder truck. In both instances the standard requires four personnel per unit, composed of three firefighters and a company officer.¹⁷ This number should not be taken as some random number without merit and based on extensive research. "A joint report from the International Association of Fire Fighters (IAFF) and Johns Hopkins University concluded, after a comprehensive analysis of the minimum staffing levels and firefighter injury rates in U.S. cities with populations of 150,000 or more, that jurisdictions operating

¹⁵ NFPA® 1710.5 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 5.2.4.1.1 2016 Edition. NFPA (2015)

¹⁶ NFPA® 1710.5 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 5.2.4.2.1 2016 Edition NFPA (2015)

¹⁷ 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 5.2.3.1.1 & 5.2.3.2.1 2016 Edition NFPA (2015)

with crews of less than four firefighters had injury rates nearly twice the percentage of jurisdictions operating with crews of four-person crews or more (IAFF, JHU 1991).¹⁸ Further, the requirement of four personnel engine and truck companies and the initial response assignment of 15 may in fact be a modest numbers. The International City Management Association states in their publication *Managing Fire Services* "Various controlled and statistically based experiments by some cities and universities reveal that if 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 are the square feet of fire spread. As firefighting tactics were conducted for comparative purposes, five-person fire suppression companies were judged to be 100% effective in their task performance, four-person companies 65% effective and three-person companies 38% effective; six-person companies are judged 20% faster than four-person companies."¹⁹ In addition, the United States Department of Commerce's National Institute of Standards and Technology (NIST) has done extensive research into the relationship between firefighting crew size and the effect on the ability to protect lives and property in residential fires. The NIST study found four person crew sizes could complete essential firefighting tasks at residential fires 30% faster than two person crews and 25% faster than three person crews.²⁰ In their research NIST conducted more than 60 controlled experiments to determine relative crew size effectiveness.²¹ The speed associated with the completion of the 22 essential fire ground tasks studied is of great importance, as each minute of delay becomes critical in terms of life safety for both occupants and responding personnel.

Achieving the 15 personnel initial response requirement set forth by NFPA 1710 is only possible with the current daily shift staffing if there are no vacancies. With only one absence created by retirement, illness or long term injury, the department cannot meet the initial requirement of 15. To exacerbate the situation further, during periods when the department falls back 2 personnel at each station, the greatest possible initial response would only be 11, significantly below the 15 set forward by the standard and corroborated by other Fire Service organizations and experts. Furthermore, even at full staffing, the Department does not meet the required engine/ladder truck minimums of four personnel per unit, as the Quint/Engine 3 and Ladder 1 are only staffed at best by two fire personnel and often put out of service all together during fallbacks. This insufficient staffing of both pieces of aerial apparatus and not back filling personnel not only jeopardizes the public and fire personnel, but creates the potential for liability for the Town by not adhering to industry standards clearly requiring greater staffing models. "A criminal case was brought against Assistant Chief Alan Baird of the Lairdsville (NY) Fire Department in 2002 for the fatal training fire that occurred on September 25, 2001 that claimed the life of rookie firefighter Bradley Golden and caused burns to firefighters Benjamin Morris and Adam Croman (2). A large part of the prosecution's case rested on NFPA 1403 Standard on Live Fire Training Evolutions. The defense argued that New York was not an NFPA state and therefore was not bound to follow NFPA. The court ruled that where it not be a state requirement to follow NFPA standards, said standards represent a 'best practice' or 'industry standard' and that Lairdsville Fire Department and namely the

¹⁸ *Report on Residential Fireground Field Experiments*, Published April 27, 2010, Technical Note (NIST TN) - 1661 102 pp.

¹⁹ *Managing Fire Services: 2nd Ed.* Washington, DC: International City Management Association, 1988. Print., pp 119-120.

²⁰ *Report on Residential Fireground Field Experiments*, Published April 27, 2010, Technical Note (NIST TN) - 1661 102 pp.

²¹ *Landmark Residential Fire Study Shows How Crew Sizes and Arrival Times Influence Saving Lives and Property*. NIST. N.p., 16 Aug. 2016. Web. 15 Aug. 2016.

defendant, Asst. Chief Baird, should have not only been familiar with, the standard, but also should have followed its mandates."²²

²² Hamilton, Steven C Civ Usa Imcom. (n.d.): n. pag. Web.
<<https://assets.documentcloud.org/documents/2648013/IFD.pdf>>.

Hazard Assessment

There are many factors that have a noteworthy impact on the assessment of effective staffing levels of the Needham Fire Department. These factors fall under the general heading of potential hazards that may be encountered. The mixes of structures that comprise the Town of Needham are varied and complex, ranging from residential homes to small retail businesses to high rise office buildings. There are forested lands, waterways and an interstate highway. The populations the Department protects on a daily basis is equally varied, from preschoolers in day care facilities to tradesmen to senior citizens in assisted living facilities. All of these factors present a myriad of possibilities the Department must be prepared to respond to effectively and deserve closer inspection.

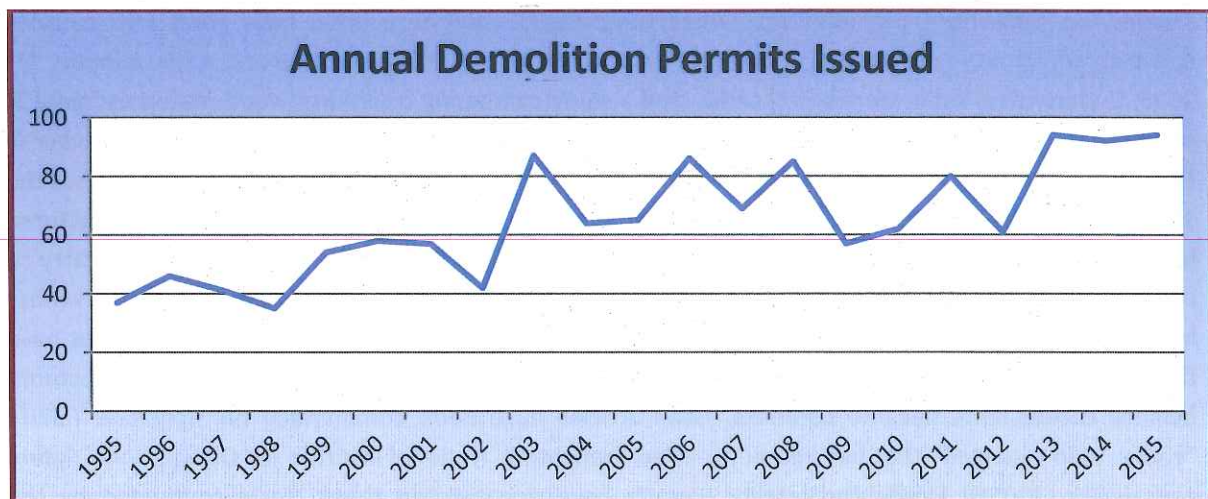
Interstate 95 bisects the eastern side of the town running approximately 7 miles on both the north and south bound lanes for a total of 14 miles of highway. According to MassDOT, the stretch of the Highway between Highland Avenue and Great Plain Avenue averages 149,000 trips per day (both southbound and northbound). Like all highways, Route 128/I95 presents a hazard threat for vehicle accidents. Being in the Northeast this threat is exacerbated by inclement winter weather, which adds to the likelihood of accidents. However, this stretch of I-95 has an additional hazard impacting the staffing levels of the Needham Fire Department, in that all hazardous cargo travelling north or south of the City of Boston is prohibited from any thoroughfare through the borders of the city. Hazardous cargo is re-directed away from I-93 and associated tunnels so as to avoid the City of Boston and travel directly through Needham on I-95. The potential for a large scale event on the highway is genuine. Indeed, on July 12th, 2008 a ten thousand gallon gasoline tanker was involved in an accident causing the entire vehicle and its load to become fully involved in fire resulting in extensive damage to the highway's surface and surrounding area. Numerous other tractor trailer rollovers and accidents occur each year, if one of these trucks carrying extremely hazardous cargo through Needham becomes involved in an accident the ramifications could be broad if exacerbated by an insufficient initial response. Clearly, the size of the Needham Fire Department staff will not prevent such accidents, but the level of immediate response within the early minutes of an incident is vital to the final outcome. This initial response may require instituting evacuation zones, diverting product from waterways or other procedures lessening the impact of a release on the environment or the population. Such activities are labor intensive and require sufficient resources to complete.

Another consideration effecting staffing levels is the effect modern building construction has had on fire ground activities and decision making. Over the past decade, groups like Underwriters Laboratory (UL), the Department of Commerce's National Institute of Standards and Technology (NIST), National Fire Protection Association and many large city fire departments including the Fire Department of New York, in conjunction with the International Association of Firefighters and the International Association of Fire Chiefs have done extensive scientific based research into the relationship between modern building practices and fire dynamics. The research shows the cumulative effects of larger homes, open floor plans, increased fire loads and new construction materials yielding faster fire propagation, shorter time to flashover, rapid changes in fire dynamics, shorter escape times, as well as shorter times to collapse.

These research studies scientifically prove what Fire Service professionals have noticed in the field over the past 15-20 years, which is that the need for quick and effective fire ground practices and resources has never been greater.

The Town of Needham has undergone a tremendous amount of revitalization and building over the past twenty years. Large structures many of which are residential or assisted living have been erected or expanded, some of which is still underway. This is in addition to housing complexes, hotels, high rise office buildings and the reconstruction of many municipal buildings and schools. In accordance with Massachusetts building and fire codes, rules and regulations, most of these structures have fire detection and suppression systems installed. Thus, while these structures have significant fire loads and life safety concerns, their fixed fire detection and suppression systems somewhat augment the resource needs of the Needham Fire Department. However, this is not the case with single family residential structures which have also seen significant revitalization, remodeling and construction over the past twenty years.

Between 1995 and 2015, data gathered from the Town of Needham Annual Report and the Needham Building Department shows 1,336 demolition permits had been issued. These demolition permits are partially responsible for the construction of 1,404 new single family homes and 142 two family homes over the same period.²³ The trend over this period is one of upward momentum over time with some leveling off in the past three years, as indicated in the chart below. This recent leveling off trend seems to indicate either saturation in the real estate market or the limited ability of developers to keep up with demand. No matter the case, this leveling off is at a pace of over 90 demolition permits annually for the past three years.



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²³ Extracted from data supplied from the Building Department for the Town of Needham

²⁴ *Annual Needham Town Reports 1995-2007*; 2007-2015 Demolition permitting data provide by the Needham Building Department

The vast majority of these demolition permits were to raze existing single family residential dwellings. While it may be argued that such revitalization of the single family residential inventory in Needham may be beneficial in advancing home values and the overall desirability of the Town within the Metrowest Real Estate market, this comes at a significant burden on the resources needed to fight residential fires. Where once stood 1,100 square foot ranch or cape style homes now exist significantly larger more spacious colonials. Many of these newer dwellings are in excess of 3,500 or 4,000 square feet of above ground living space. Some new single family homes can even exceed 6,000 square feet of above ground living area. The vast majority of these newly constructed replacement homes are erected on lots not originally designed for these substantially more robust structures. This creates an increased exposure concern in the event of fire where neighboring homes are put at risk. In some instances the exposure distances between some of these homes is not unlike what might be expected in more urban settings where there are fire departments with far greater available resources. While the greater size of newer homes may be visible to the casual passerby, the modern building techniques used to construct these buildings pose a number of other concerns and challenges for the Fire Department.

All of the greater than 1,500 homes built over the past twenty years, either single or two family, were constructed with at the very minimum some modern construction components and techniques. "Modern" construction components include lightweight trusses, laminated structural supports, stamped metal fasteners, petroleum based siding, drywall interior walls and open floor plans to name but a few items. These components and design features while sturdy and fully compliant with building codes and accepted practices fail quickly under fire loads. Stamped fasteners, like gusset plates may have as little as ¼ inch penetration into a structural member, as compared to 3" or 4" of steel nails once used. Thus the amount of time for one of these fasteners to fail under fire conditions has been greatly reduced. Trusses use lightweight members that when compressed upon each other have great load carrying capability under non-fire conditions, but once exposed to fire will collapse within only a few minutes. "In 2008, Underwriters Laboratories (UL) conducted a study comparing traditional wood materials found in older homes with lightweight construction. The UL report, *"Structural Stability of Engineered Lumber in Fire Conditions,"* indicated that the lightweight construction assembly collapsed in six minutes versus the 18-and-a-half minutes it took for the "legacy materials" to collapse."²⁵ Similarly, manufactured laminated beams can carry massive amounts of weight, but again fire can quickly attack this carrying capacity. "The manufactured lumber components (I-joists, trusses, plywood, OSB, laminated veneer lumber) do not have the mass of the sawn lumber and boards they replace, and therefore do not have the inherent fire resistance of these earlier materials. Since the use of lightweight and manufactured building components became common, news articles have been commenting on structural failure "earlier than expected" that has injured or killed firefighters. National Institute for Occupational Safety and Health (NIOSH) Firefighter Fatality Reports have documented these. Tests conducted by the National Institute of Standards and Technology (NIST) and Underwriters Laboratories (UL) in the laboratory and in acquired structures with recordings of instrument readings, photographic and ultraviolet camera photos and videos, and notes from technicians have shown that assemblies of these

²⁵ *Fire Dangers of Today's Building Materials - Fire Sprinkler Initiative. Fire Sprinkler Initiative: Bringing Safety Home.* NFPA, 2016. Web. 03 Sept. 2016.

lightweight and manufactured components can be expected to fail within five to seven minutes of ignition.”²⁶ Failure of structural components within such a short time frame after ignition only solidifies the need for sufficient fire personnel on scene in the earliest moments of a fire.

Newer homes tend to have open floor plans, allowing for greater circulation throughout the first floors. However, this open geometry often features high cathedral ceilings, exposed beams, two story entry foyers and great rooms. The lack of compartmentation within these modern homes, as compared to legacy homes built prior to 1980, add volume and contribute to rapid smoke and fire spread throughout the structure. Two story foyers create chimney effects during fires allowing smoke to spread quickly to second floor bed room areas trapping victims and dramatically increasing the need for the proper amount of resources on the fire ground early to conduct search and rescue functions. In commercial buildings where lobby atriums extend beyond the first floor, building and fire codes require fire and smoke separations to limit the effect of fire on the occupants above, no such life safety considerations are provided for in single family homes despite the similarity of the hazard. By combining rooms that once were separated by walls, doors and lower ceilings into voluminous open areas requires more water and resources to extinguish when impinged by fire.²⁷ These modern home features are common within Needham.

Much like modern construction features and techniques, modern furnishings also add significantly to the rapid fire progression now witnessed on the fire ground. Wooden furniture stuffed with cotton batting has been replaced by engineered and glued wooden composites with polyurethane foam padding and synthetic coverings. Carpeting, drapery and other interior features are constructed of plastic and synthetic materials, all petroleum based. The increased fuel loads associated with these modern furnishings and interior components, coupled with open floor geometries dramatically add to the rapid spread of smoke and fire, thereby decreasing the time from fire onset to immediate life threatening conditions. Results from fire behavior experiments conducted by Underwriter Laboratories comparing “legacy” room furnishings to “modern” furnishings in similar size rooms found that “legacy” rooms transitioned over to flashover at 29 minutes and 30 seconds after ignition, while “modern” rooms experienced flashover at 4 minutes and 45 seconds.²⁸ A dramatic YouTube video of the test illustrating the extraordinary differences between burning “legacy” and “modern” furnishings can be found at: <https://www.youtube.com/watch?v=IEOmSN2LRq0> Flashover is the period in fire development when all contents of a room, whether directly impinged by fire or not burst into flames, engulfing the entire room. Thermal radiation will cause flashover at about 500°F and rapidly rise towards 1,000° as all combustibles within the room spontaneously ignite. This period is untenable for human life after only a few seconds. Firefighters have been trained for many years to understand that being more than five feet away from a means of escape in a room undergoing flashover will mean certain death, even if full structural firefighting personal protective gear and self-contained breathing apparatus is donned.

²⁶ *Construction Concerns: The 20-Minute Rule*. Havel, Gregory. Fire Engineering (2013): n. pag. Fire Engineering. 11 June 2013. Web. 3 Sept. 2016.

²⁷ *Analysis of Changing Residential Fire Dynamics and Its Implications on Firefighter Operational Time Frames* Kerber, Stephen. (n.d.): 4. *New Science UL*. Underwriters Laboratories, Apr. 2014. Web. 28 Jul. 2016.

²⁸ *Analysis of Changing Residential Fire Dynamics and Its Implications on Firefighter Operational Time Frames* Kerber, Stephen (n.d.): pp. 5-10. *New Science UL*. Underwriters Laboratories, Apr. 2014. Web. 31 Aug. 2016.

The early onset of flashover associated with modern building construction and synthetic furnishings demands a more rapid attack by firefighters upon arrival, as the fire growth timeframes have been reduced to the point where fire ground conditions may deteriorate shortly after the arrival of the first pieces of apparatus. Lightweight structural components fail early when exposed to fire causing collapse dangers for firefighters. A 2003 report sponsored in part by the Department of Homeland Security, FEMA and NIST concluded that "compared to limited historical data, the percentage of collapse fatalities that had occurred in residential properties has increased." Further the report found that a "majority (over 65%) of collapse fatalities occurred during fire attack."²⁹ The data clearly corroborates what NFPA 1710 requires, which is having an adequate number of firefighters on scene early in the incident. This is necessary not only to ensure a successful conclusion, but to do so safely. Awareness of the over 1,500 new homes built in Needham over the past twenty years and the countless others added to or altered with modern building components causes firefighters concerns when one of these homes is attacked by fire. The assistance of mutual aid companies in these situations is often a case of too little too late due to the rapid fire progression that occurs. Without the proper resources available early on the fire ground to advance hose lines and rescue trapped residents dire consequences can and should be expected.

Since 1980 the number of emergency incidents the Needham Fire Department responds to has increased dramatically, although the number of fire personnel on duty has dropped. In 1980, the Department had four work groups of 20 line personnel. Currently, a work group consists of 15 and can drop down to 11 on duty during fallback staffing. This seems incongruous to the needs presented previously. It is true this downward trend of staffing began at a time when the main duties of the Department were to extinguish fires, assist at motor vehicle accidents and conduct rudimentary fire prevention activities. While it may have been appropriate to cut staffing in response to the number of incidents at that time, it is no longer the case. The Needham Fire Department over the past twenty years has expanded its scope of work beyond fire suppression to include Emergency Medical Services at the ALS level, extensive fire prevention, inspectional services, and daily responses to a myriad of other services the public requests. Not only has the Department's annual incident volume more than quadrupled since 1980, but as outlined previously the need for proper fire ground staffing has never been greater due to the changes associated with modern construction and furnishings. Again, the likelihood of incident volume dramatically rising due to the tremendous growth and revitalization along the 128 corridor will result in even greater resource demands. So how can these challenges be met and what are the solutions for Needham's present and future public safety needs?

²⁹ *Trends in Firefighter Fatalities Due to Structural Collapse, 1979-2002*. Brassell, Lori D., and David D. Evans. Gaithersburg, MD: U.S. Dept. of Commerce, Technology Administration, National Institute of Standards and Technology, 2003. Print.

Needham Fire Department Staffing Options

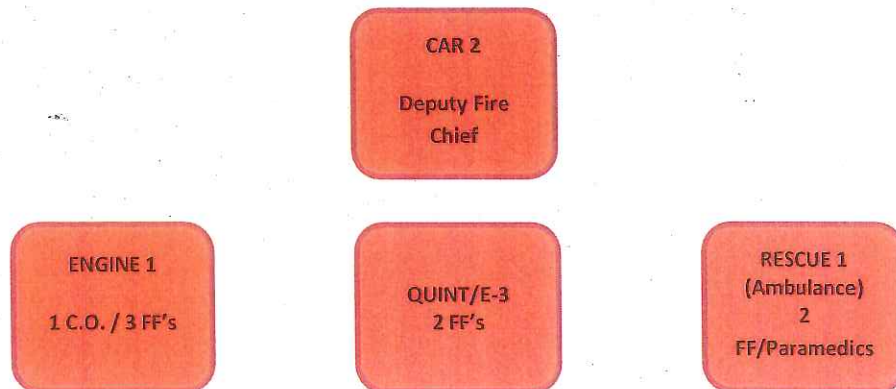
The Needham Fire Department has had a solid record spanning over one hundred years addressing the daily public safety challenges it faces. However, the Department's ability to maintain the accustomed level of service is currently being stressed due to many factors previously discussed including, increased incident volume, modern fire dynamics and increased demands for services. All indications point towards exponentially greater stresses on the ability of the Department to provide fire and rescue services over the next several years with new development. It is unlikely this trend will reverse or even slow in the decades to come. In order to ensure sufficient line personnel exists to meet these mounting demands a number of staffing options should be considered. Failure to do so will increase risk to Townspeople and emergency responders since doing more with less is becoming an untenable position for the Department.

Staffing Option 1

The first option to consider, while clearly inadequate, would be to maintain the status quo with no increase in line personnel from current levels. Presently the Needham Fire Department staffs 15 line personnel to each work group, but regularly will fall back to 11 on duty. Fallback staffing of this magnitude is far below what NFPA 1710 requires and what most fire service experts agree is needed to safely and effectively fight a small residential room and contents fire. When modern building construction techniques are introduced into the equation this becomes even more evident and dangerous.

(15 Line Personnel per Shift- Fallback to 11)

Station 1 (88 Chestnut Street)



Station II (707 Highland Avenue)



The rising number of emergency incidents annually, as previously stated and perhaps more importantly the corresponding number of simultaneous incidents encountered only exacerbates the staffing dilemma by spreading personnel between responses. Thus, the likelihood of deploying a sufficient number of firefighters to the scene of even a small fire in those critical initial moments is highly questionable under current staffing configurations. It is clear at this time the increased number of emergency incidents is driven by greater demands for emergency medical response by a more safety conscious public. This demand, as pointed out previously, will increase dramatically in the Station II service zone with ongoing and planned future development. Therefore, stationing a second full time ambulance at Station II is warranted. To address all of these demands for service, the prerequisite of additional staffing is clear. To simply re-assign the current pool of personnel to other apparatus would be insufficient to meet both greater demand and safety standards as the staffing chart on the previous page indicates.

Option 1, maintaining the status quo, though provided here should not be considered to be a thoughtful or true option. By not adding personnel, the Department is unable to provide a second fulltime ambulance in the Station II service zone and continues to understaff the Town's two aerial pieces of apparatus below recognized standards. During periods of fallbacks apparatus may be understaffed or even put out of service. To be clear, Option 1 will neither meet the greater demands for services nor well known safety standards going forward.

Staffing Option 2

In the chart below illustrating Option 2, personnel are re-assigned to staff a second full time ambulance at Station II. Thus, the populations of that service zone are better served. However, re-assigning two personnel to staff a second ambulance would require the elimination of all fallback scenarios to ensure either Ladder 1 or the Quint/Engine 3 (aerial pieces of apparatus) would always remain in service. It is critical to fire ground operations to have a piece of aerial apparatus staged in front of the fire building from the onset of operation to have the advantage of an aerial ladder for rescue and other vital purposes. Once apparatus is committed to a fire scene it cannot be relocated to accommodate incoming units. In other words, mutual aid agreements cannot be relied upon to provide aerial apparatus to the front of the fire building later in the incident, as other apparatus will likely be already committed in position.

(15 Line Personnel per Shift- Fallback to 11)

Station 1 (88 Chestnut Street)



Station II (707 Highland Avenue)



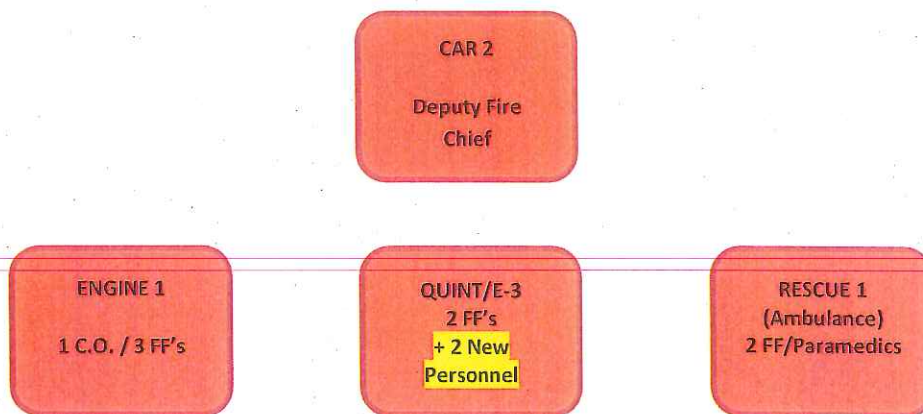
Even at full staffing with all vacancies covered by overtime, this Option 2 would require either Ladder 1 or the Quint/Engine 3 to be permanently put out of service due to the re-assignment of personnel to a second ambulance. Utilization of this option would not move the Department any closer towards meeting the requirements of NFPA 1710 in regards to the total number of personnel needed for fire response, as well as the proper number of personnel to staff each piece of apparatus. Thus, despite the benefit of putting a second ambulance permanently in service at Station II, doing so in this way comes at a price, the elimination of an aerial piece of apparatus.

Staffing Option 3

To fully meet the fire ground requirements of NFPA 1710, which as previously stated requires four personnel per engine and ladder companies, one of which is in a supervisory role, the Department would need to increase the staffing levels by four personnel per work group or a total of 16 new firefighters overall including 8 new company officers. Even with this increase, a second ambulance could not be staffed without an addition of another two firefighter/paramedics per group or an additional eight overall. Achieving both of these goals simultaneously would require an increase of 24 new members to the Needham Fire Department. This option would yield work groups of 21 personnel, which would be only marginally larger than the 20 personnel utilized prior to 1980 when there were far fewer incidents and EMS responses were only at the Basic Life Support (BLS) level. With on duty work groups of this size not only would the requirements of NFPA 1710 be met, but the Town's increasing EMS demands would be addressed as well. However, increasing staffing levels to this extent would likely be prohibitively costly. In addition, current station configurations are inadequate to house the additional on duty staff. The illustration below depicts this staffing model.

(21 Line Personnel per Shift- Fallback to 17)

Station 1 (88 Chestnut Street)



Station II (707 Highland Avenue)

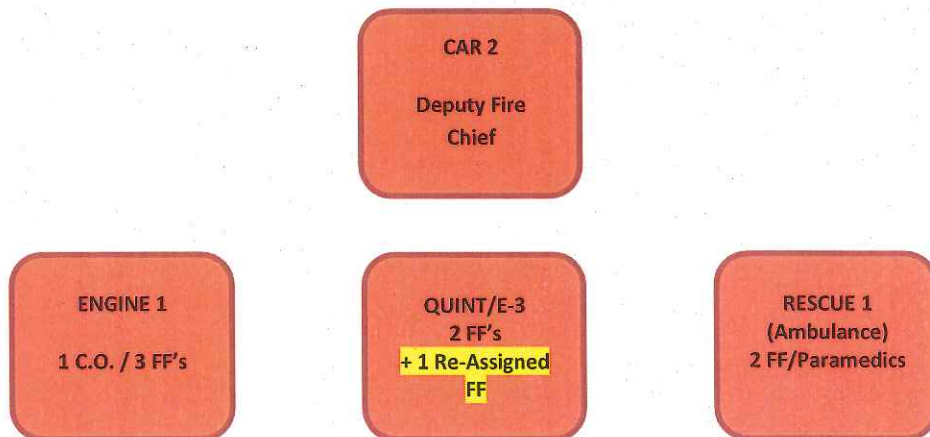


Staffing Option 4

In Option 4 depicted in the chart below, each work group would expand by the addition of one new firefighter/paramedic, thus providing for a staffing configuration for a new full time ambulance for the Station II service zone. This is achieved by the re-assignment of one personnel to the new second ambulance. However, staffing a second full time ambulance in this manner, while seemingly more cost effective, doesn't come without some consequences.

(16 Line Personnel per Shift- Fallback to 14)

Station 1 (88 Chestnut Street)



Station II (707 Highland Avenue)



As can be seen in the staffing chart above Ladder 1 would be placed permanently out of service since only one member would be available to be assigned to that piece of apparatus. Not only would it be a gravely unsafe practice having one member designated to drive a forty-six foot ladder truck alone, but it would serve no useful purpose on the fire ground once arrived. This is because one person cannot perform necessary ladder company operations alone. However, a side benefit of this scenario would be realized by re-assigning a member from Ladder 1 to the Quint/Engine 3 as the efficiency and

effectiveness of that piece of apparatus would be increased.³⁰ If this option were to be adopted, current fallback practices should be closely re-examined if not curtailed entirely. Even in cases of only a one person fallback at each station, maintaining both Rescue's in service would require engine or ladder company level staffing to drop to levels of reduced effectiveness. On the fire ground members of Rescue 1 or 2 could be re-assigned to fulfill firefighting duties. However, the options available for on scene re-assignment would be limited to only those pieces of apparatus deployed and subject to fallback configurations. To be more specific, in this configuration if Ladder 1 is out of service, Rescue personnel cannot be re-assigned to it at a fire.

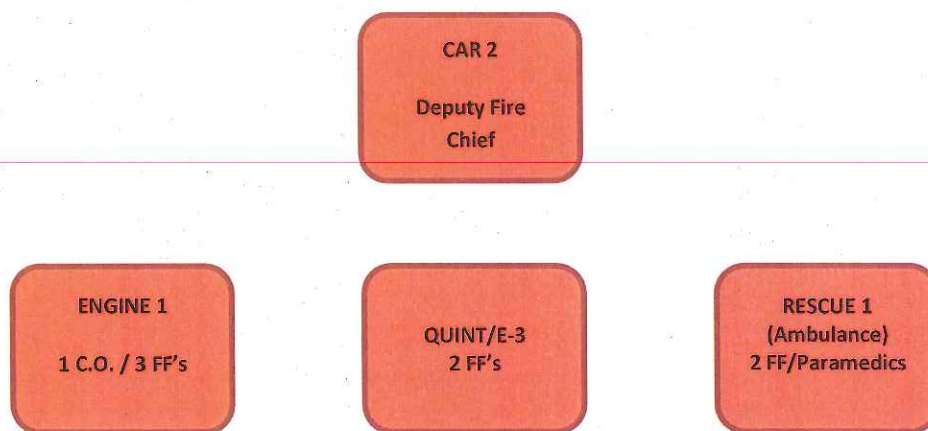
³⁰ *"Managing Fire Services: 2nd Ed.* Washington, DC: International City Management Association, 1988. Print.

Staffing Option 5

A fifth option would be to add an additional two new firefighter/paramedics to each work group. This option would properly staff a second fulltime ambulance (Rescue 2) at Station II while maintaining all apparatus currently available in service. Thus, no apparatus would be permanently put out of service as in Options 2 & 4 allowing for on scene re-assignment. Even during a one person fallback scenario no apparatus would need to be put out of service with this option. Option 5 is fiscally more prudent as compared to Option 3 while responding to the growing emergency needs of the Town in a responsible way. Depending on which service zone an incident may occur in, ambulance personnel could be re-assigned on the fire ground to augment staffing of an aerial piece of apparatus either Quint/Engine 3 of Ladder 1. Thereby meeting NFPA 1710 standard of having four personnel to staff those companies, though falling short of having a company officer in the corresponding supervisory role. Not only would the standard for ladder truck companies be better addressed, but the greater effectiveness for the critical task of search and rescue would be achieved during those critical early moments of a fire incident. Adopting this option would be best served if a maximum fallback of only one per station be adopted in order to maintain proper staffing at all times. Even if the current two person fallback policy was continued, though not recommended due to the associated removing of apparatus from service, a minimum fire ground staffing of 13 would be achieved, two greater than the current level of 11. The figure below displays the apparatus assignment configuration under Option 5.

(17 Line Personnel per Shift- Fallback to 15)

Station 1 (88 Chestnut Street)



Station II (707 Highland Avenue)



If a two person fallback at each station is given consideration, it must be realized that one rescue and one piece of aerial apparatus would be required to be put out of service, since a minimum of one piece of aerial apparatus and one ambulance would be needed to cover the Town at all times. Not only would this reduce service capability, it would put a greater burdeon on personnel and may correspondingly increase the risk of injury. Option 5 would achieve a greater superiority of service by falling back only one person per station and back filling additional vacant positions with over time personnel so all services would remain intact at all times. Even with a one personnel fallback, temporary re-assignment of ambulance personnel on the fire ground could augment the effieceny and effectiveness of those engine companies depleted of personnel due to illness or injury. Thus NFPA 1710 standards would be met for both engine company staffing and overall personnel available to accomplish all identified critical tasks at small residential fires.

Conclusion

Of the options provided only two, Options 4 & 5 offer real benefits to the citizens who live, work and travel through the Town of Needham. This will become especially true as more and larger scale development occurs in Town and more specifically in the Station II service zone.

Options 1 & 2 must not be considered if staffing a much needed second fulltime Rescue in the Station II service zone is to be achieved. Either sufficient staffing resources would not be available to maintain the current apparatus assignments while re-assigning personnel to a second ambulance or at any level of fallback a secondary ambulance would be put out of service. Thus, a false sense of protection would be implied since the secondary ambulance would be put out of service on a regular, if not constant basis. Residents would never be certain if an ambulance was staffed or not. In both Options 1 & 2 it is unlikely, except at full staffing configurations, sufficient initial fire ground resources would be available to properly and safely address all vital firefighting tasks needed to extinguish even a room and contents fire in a small home. Furthermore, with Option 2, Ladder 1 would be permanently put out of service and not available for immediate assignment should a fire occur.

Option 3 favorably addresses the flaws of Options 1 & 2. This option would fully staff each piece of apparatus with proper personnel and supervision, while adding a second full time ambulance. This option would allow the Needham Fire Department to fully meet the requirements of NFPA 1710 in regards to the type of residential fires defined in the standard and those most likely encountered in the Town of Needham. However, regardless of the extraordinary level of service this option would provide the populations the Needham Fire Department serves, the associated financial impact of this option would be great and cost prohibitive.

Therefore, Options 4 & 5 appear to make the most financial sense while increasing the Department's ability to meet current and future demands for service in a safe and effective manner. However, there are certain considerations with both options that must be understood.

Option 4 is accomplished by adding four new firefighter/paramedics, one per shift. In choosing Option 4 a secondary ambulance can be put into service and a more effective initial fire ground presence can be assembled if no fallback overtime funding becomes available. This option more favorably increases the staffing of the Quint/Engine-3 from two firefighters to three, but requires Ladder 1 to be permanently put out of service. If any more than a one person fallback at both stations is continued the new second fulltime ambulance might be put out of service quite often, thereby negating any advantage afforded by placing a second full time ambulance in the Station II service zone. If funding allows for the fallback to stop at one at each station, then both Rescues would remain in service at all times. In addition if the Department maintain a shift of 14 (one person fallback) then functionality and safety on the fire ground would be improved, though falling below NFPA standard 1710 during times of personnel shortages.

Option 5 would require the addition of eight new firefighter/paramedics creating shifts of 17. This option would allow for engine companies to be staffed with four personnel at full complement and be

able to add a second fulltime ambulance at Station 11 without putting either the Quint/Engine 3 or Ladder 1 out of service permanently. Moreover, with fire ground re-assignments Rescue personnel could be shifted to either piece of aerial equipment as needed, thus meeting the standard of a four personnel per ladder company at fire incidents. This would greatly improve the Departments firefighting proficiencies and associated safety when needed, while affording better EMS services at all times. With this level of staffing, a third Rescue could also be staffed by re-assigning personnel temporarily on an as needed basis, thus reducing the number of times out of Town ambulance services are called. Even with a one person fallback, the Departments capabilities for both Fire and EMS would be greatly enhanced. If a two person fallback were to continue under this staffing option, then it would be likely one of the aerial pieces of apparatus or one ambulance would be required to be put out of service during those periods of shortage.

Thus, Option 5 offers the best overall improvement for fire ground operations, while providing enhanced EMS services. This is especially true if only a one person fallback is allowed at each station. Option 4 is a less costly choice and would afford somewhat improved overall greater fire protection and EMS, but this can only be the case if a one person fallback is allowed.