

**“An Evaluation of the City of Avon Lake and the Emergency Response Efficiency of the
Avon Lake Fire Department”**

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CERTIFICATION STATEMENT

I hereby certify that the following statements are true:

1. This paper constitutes my own product, that where the language of others is set forth, quotation marks so indicate, and that appropriate credit is given where I have used the language, ideas, expressions, or writings of another.

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ABSTRACT

The problem was that the surging population growth of Avon Lake might be having a negative impact on the effectiveness of the Avon Lake Fire Department (ALFD) emergency customer service delivery system.

The purpose was to assemble and evaluate chronological historical data in order to determine the existence or absence of trends and compare this information with standards that have been established and accepted throughout the fire service industry.

Evaluative research was utilized for this study with the purpose of answering the three questions.

1. Is there a correlation between Avon Lake's population growth and emergency alarm call volume?
2. Is Avon Lake Fire Department's on duty and ready to respond staffing levels suitable for the needs of the community?
3. Does one centrally located fire station in Avon Lake meet the industry standard of response time?

The procedures consisted of a literature review utilizing a collection of reference materials from several fire service publications and writings, some of which were obtained via the Internet. Upon completion of the literature review, a baseline of fire service industry standards was established utilizing the published research material relevant to this study. In addition, historical information from ALFD's computer database was extracted so that the data could be analyzed and catalogued.

The results showed a definite correlation between the population growth in Avon Lake and the increase in emergencies. In addition, daily platoon-staffing levels did not appear to be

adequate for the increasing demand for emergency service. Finally, one single fire station located in the center of Avon Lake prohibits ALFD from meeting industry standards of response time.

Recommendations were made which planned for a resolution to the personnel and response time issues. The number of on duty and ready to respond firefighters would be adjusted, thereby reducing the dependence on mutual aid, which in turn will reduce response time.

Therefore, the standards of emergency care would be enhanced for the residents of the City of Avon Lake.

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INTRODUCTION

Statement of the Problem

The problem this research study focused on is whether or not the population growth of Avon Lake is having an impact on the effectiveness of the Avon Lake Fire Department (ALFD) emergency customer service delivery system since the City of Avon Lake is experiencing remarkable growth and demographic change that is leading to an increasing demand for fire, rescue, and emergency medical services (EMS).

Purpose of the Study

The purpose of this research study was to assemble and evaluate chronological historical data in order to determine the existence or absence of trends and also to make comparisons with standards that have been established and accepted throughout the fire service industry. By providing comparative information to the city's decision-makers and identifying potential problems, they [decision-makers] will be in a position to make an educated assessment in determining if any identified trends are acceptable to their constituents and whether or not ALFD resources should be expanded or restructured to match the city's growth. An evaluative research method was utilized for this study with the purpose of explaining the existing state of affairs under investigation. Evaluative research defined parameters and identified specific criteria against which to make logical comparisons after collecting, analyzing, and evaluating data. Chronological statistical data from ALFD's "FireHouse" incident reporting system, department historical files and documents, as well as various other applicable resources and publications were utilized to discern the existence of remarkable trends.

Research Questions

The following questions will be answered by this historical research:

1. Is there a correlation between Avon Lake's population growth and emergency alarm call volume?
2. Is Avon Lake Fire Department's on duty and ready to respond staffing levels suitable for the needs of the community?
3. Does one centrally located fire station in Avon Lake facilitate the ALFD to meet the industry standard of response time?

BACKGROUND AND SIGNIFICANCE

The City of Avon Lake, which is a suburb of Cleveland, is a relatively affluent and rapidly growing, suburban community. Avon Lake is about twenty-five miles west of Cleveland, Ohio. Avon Lake is supported by a tax base from residential, industrial, manufacturing, commercial, and business occupancies; and is bordered by Lake Erie on the north, the City of Avon to the south, the City of Sheffield Lake to the west, and Bay Village to the East. The city is a little over five miles (west to east) by two miles (north to south), totaling about eleven square miles. The 2000 census indicates that Avon Lake's population is 18,145. Figure 1 illustrates the location of Avon Lake in relation to its border communities.

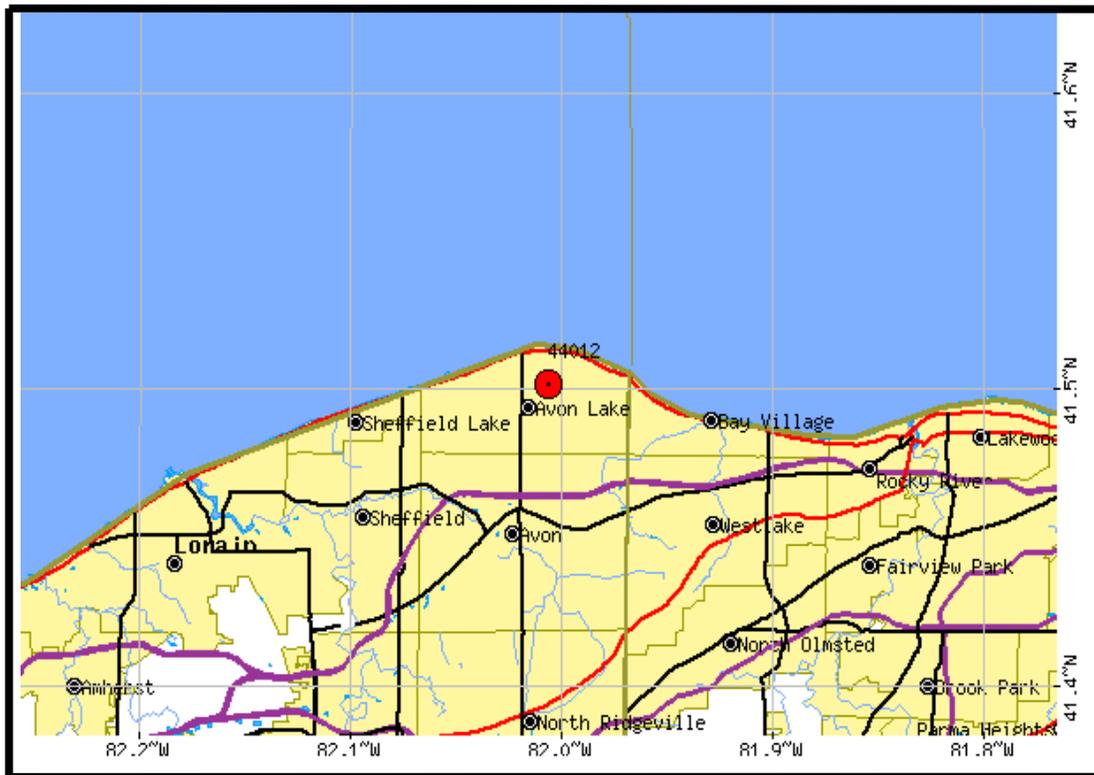


Figure 1.

This map illustrates the location of Avon Lake and bordering communities. Communities that are utilized for primary mutual aid are Sheffield Lake, Bay Village, and Avon.

Avon Lake is protected by a fulltime fire department that consists of one fire chief, two staff lieutenants, six line lieutenants, and eighteen firefighters. All of the fulltime firefighters, including the fire chief are paramedics. In addition, there are two part-time fire safety inspectors and one full time secretary/dispatcher that are part of the weekday staff. The fire department operates with three platoons, each consisting of two lieutenants and six firefighters. The platoons work a twenty-four hour rotating schedule. The maximum assigned platoon staffing level is eight firefighter/paramedics with minimum daily platoon strength of five members. The department operates out of one centrally located fire station that was constructed in 1978. The annual fire

department budget for 2004 was \$2,901,873.00. Sixty-five percent of the department's operating budget is subsidized by the general fund, which is sustained by a 1.5 % income tax. The other thirty-five percent of the department's operating budget is subsidized by a paramedic tax levy in the amount of 1.25 mills for every one dollar of property valuation. Figure 2 represents the manner in ALFD is organization and structured.

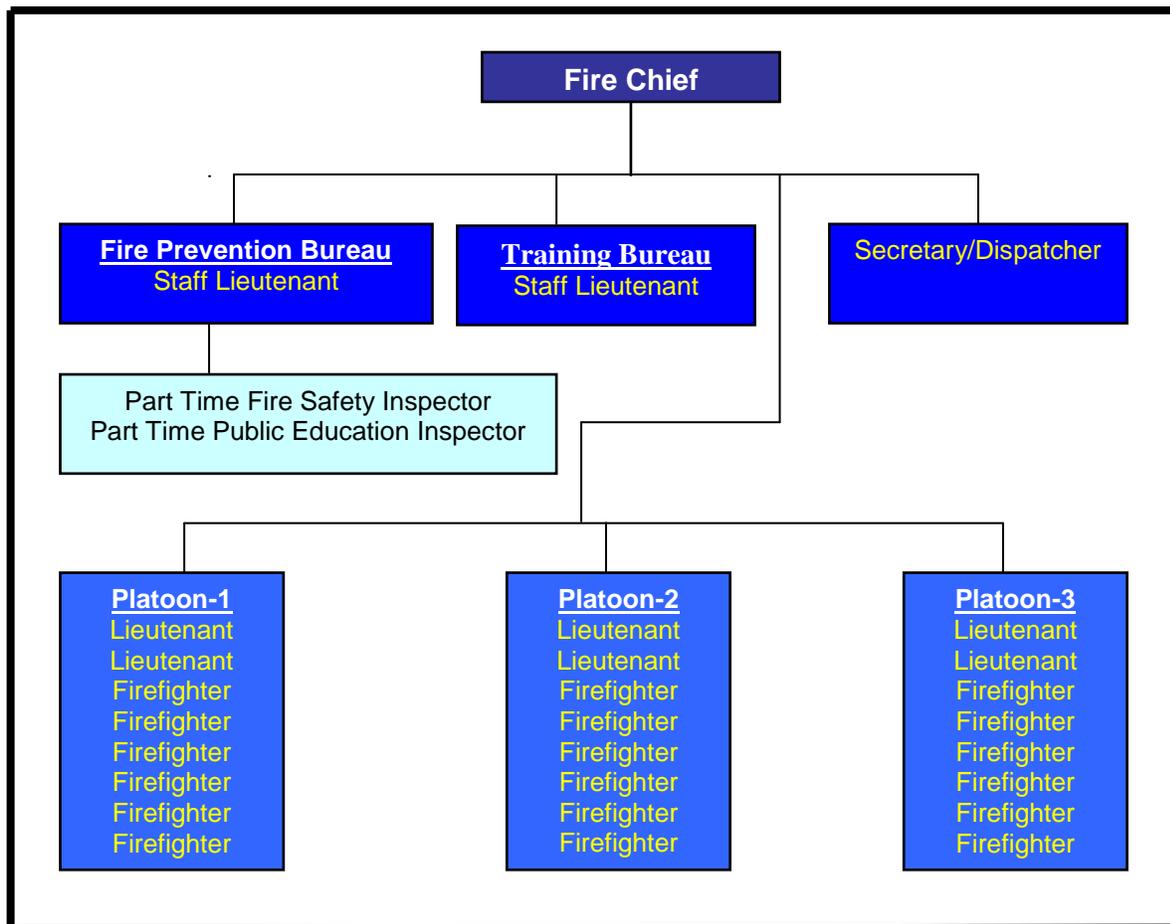


Figure 2.

This organizational chart illustrates the scalar system of structure within the ALFD.

The City of Avon Lake has been encountering a demographic transformation that the city administration has speculated will not end until the city reaches a population of approximately

30,000 residents. The general consensus and anxiety of the fire department membership is that the persistent growth is beginning to have a recognizable impact on the fire department's emergency response service capabilities. The members realize that the records indicate that emergency alarm call volume is increasing as the city's population increases. They are also attentive to the fact that the department's personnel staffing levels have not been adjusted accordingly. There is an additional awareness that as the population continues to grow, the fire department appears to be experiencing more simultaneous overlapping emergency calls that frequently cannot be responded to during minimum staff level days without the support of mutual aid. Therefore, mutual aid is often needed as a primary resource during these overlapping emergencies.

The census trend for Avon Lake shows that the population has increased from 12,262 in 1970 to 18,145 in 2000 for an increase of 47.98 % (Free Demographics, 2005). Correspondingly, the fire department annual reports show the total annual call volume has progressively increased from 1,116 in 1992 to 1,864 in 2004 for an increase of 47.67 % over twelve years (Avon Lake Fire Department [ALFD], 1992-2004). The observable reasons for the growing call volume are the steady development in residential occupancies (single and multiple family dwellings) and the addition of senior living facilities. Two independent/senior assisted living facilities have been constructed over the past three years. These facilities have yet to reach one hundred percent occupancy while plans for three additional facilities of this kind have been proposed and approved for construction. Two of the three proposed buildings will have occupancies similar to the existing senior facilities. However, a new dimension is being introduced to Avon Lake in the form of a one hundred-bed nursing home. The developer of these facilities expects construction to be completed and ready for habitation by the winter of 2006.

In contrast to the demographic growth, and the associated escalation in the demand for emergency services, is the lack of growth in the ALFD staffing levels. The fire department's staffing levels have not grown concurrently with the rise in population and subsequent emergency alarm call volume. Staffing levels have only been addressed twice since 1978. In 1978 three firefighters were added to the roster increasing platoon strength from six to seven members. The most recent staffing level increase was in 1997 when another three firefighters were added to the roster increasing platoon strength from seven to eight members (Avon Lake Municipal Council, 1997). When Avon Lake reaches its projected growth potential, which is anticipated to be 30,000 residents, the ALFD could be at risk of being incapable of meeting the increasing emergency response needs of the community with its current staffing levels and single fire station location.

A corresponding concern is that when mutual aid is necessary for a primary emergency response, the national standard of emergency response time may be exceeded. As the city continues to develop outwards, towards its borders and away from the centrally located fire station, response times appear to be increasing. Therefore, when mutual aid is utilized as primary response to Avon Lake, response times will in all likelihood be excessive as a result of the geographical locations of mutual aid fire stations.

The significance of this study was to express that the City of Avon Lake is a rapidly growing community with an increasing population that will naturally generate an increase in the demand for emergency services. The study will also suggest to the reader that an adjustment to the staffing levels may be necessary to accommodate the increasing demand for emergency services, otherwise the fire department may become overtaxed during multiple simultaneous emergency alarms. Finally, the study will determine if there is a discernible delay in emergency

responders arriving at the scene of some emergencies as a consequence of depending on mutual aid as primary responders due to inadequate daily platoon staffing levels.

The reality is that all available primary mutual aid communities (Avon, Sheffield Lake, and Bay Village) could potentially be involved with their own emergencies at a time when Avon Lake needs them for mutual aid. If ALFD's resources are taxed and they were to have one more emergency alarm call, the dispatcher would be required to request secondary mutual aid from a private ambulance service and/or non-bordering fire departments. This practice would result in an exceptionally long response time, which could be a critical factor in the final outcome of the emergency. Two outstanding examples that underscore the concern that customer service is in jeopardy of becoming substandard are identified below:

(1) On November 4, 2003 at 1135 hours, run #1386-03 occurred resulting in the following situation. It was a minimum platoon strength day of five members. One ambulance (Medic-8) and three firefighter/paramedics were out of service at the emergency department. Only one off duty member was available to be recalled back to the station and he had not yet arrived. Sheffield Lake Fire Department (SLFD) and Avon Fire Department (AFD) were unavailable due to emergencies in their own jurisdictions. That left two platoon members, one staff lieutenant, and the fire chief on station. A second emergency was received from 911 for a technical rescue – a man with a broken leg trapped on the roof of his house. The four personnel left on station, as noted above, responded to this second 911 emergency with an ambulance (Medic-9) and heavy rescue truck. Medic-8 was dispatched to the scene from the hospital. A third emergency call was then received from 911 for another medical emergency. Bay Village Fire Department (BVFD) was dispatched for mutual aid to this incident. At this point all of our bordering fire departments were committed. A fourth emergency call was then received from 911 for a motor vehicle

accident (MVA) with injuries. Medic-8 and two firefighter/paramedics were dispatched from the scene of the technical rescue to the MVA. There wasn't any mutual aid available from bordering communities at this time. When Medic-8 arrived on the scene of the MVA, they requested a second ambulance. Fortunately, AFD had just returned to their station so they were able to respond to our request for another ambulance.

(2) When mutual aid becomes the primary source of emergency response for Avon Lake's emergencies, there is no control over the quality of customer service that will be provided to the residents of Avon Lake, particularly concerning alarm response time to the scene. An unusually long response time could be a critical factor in the final outcome of an emergency. On January 6, 2005 at 0803 hours, run #21-05 occurred resulting in the following situation. Avon Lake had depleted their resources and requested mutual aid from SLFD for a medical emergency just across the street from Avon Lake's fire station. Although ALFD was fortunate enough to be able to dispatch a basic life support (BLS) vehicle with two firefighter/paramedics, the response time for the ambulance from SLFD was sixteen minutes. This emergency was for a patient in respiratory distress that desperately needed definitive care at the emergency department (ED).

Traditionally, the procedure in which ALFD has facilitated emergency responses when resources are depleted as a result of simultaneous calls has been: during an emergency, the dispatcher will attempt to contact off-duty members in order to backfill the fire station with the minimum platoon strength of five members so as to prepare to respond to overlapping incidents. When this isn't possible, ALFD relies on primary mutual aid from our bordering fire departments for emergency response. There are several reasons listed below that show that this strategy may not be a reasonable practice:

(1) Contractually, off duty members are not required to be on standby at home. Therefore, members cannot be expected to be available to return to the station for supplemental platoon strength purposes every time they are called. When off duty members are called and if they are available to return to the station, there is typically at least a fifteen-minute lag time for them to respond from their homes to the fire station. During this delay a subsequent emergency call may be received and primary mutual aid from bordering cities may be unavailable or delayed.

(2) Sheffield Lake Fire Department (a primary mutual aid department) should not be depended upon to be available to Avon Lake every time they are requested for mutual aid. The minimum platoon staffing is unpredictable for SLFD depending on the time of the year and budgetary constraints, or the fact that they may not be able to re-staff their own station when they are committed to an emergency in another community.

(3) Avon Fire Department (a primary mutual aid department) should not be depended upon because they are experiencing a drastic increase in call volume due to population growth, so they may not always be available to us for mutual aid. Additionally, when AFD transitioned to a fulltime fire department in 2003, North Ridgeville Fire Department (NRFD), which is south of Avon, began utilizing AFD for mutual aid.

(4) Bay Village Fire Department (a primary mutual aid department) should not be depended upon because their call volume is also increasing. This is because the City of Westlake (Bay Village's southern bordering community) is a rapidly growing community and as a result BVFD is responding for West Lake Fire Department (WLFD) for mutual aid at a startling rate.

If the ALFD is unable to adequately supplement platoon strength during emergencies, on minimum staffing level days, and do it in a timely manner, response times may suffer.

When ALFD resorts to using mutual aid as a primary emergency response source, response time to the victims' emergency will ultimately suffer. If primary mutual aid is unavailable and secondary mutual aid is required from non-bordering communities, and/or private ambulance services, response time will consequently be exceptionally longer. The residents of Avon Lake should understand the significance a quick response from the fire department has on their well-being. A successful rescue of a victim from a burning building requires a swift response from firefighters. When a patient is suffering from a cardio-pulmonary arrest (heart attack) or is experiencing a cerebral vascular accident (stroke or brain attack), his/her survival requires prompt advance life support and transport by paramedics.

More residents will probably generate an increasing demand for more customer service. The increasing demand for emergency service will likely create a rise in overlapping emergency alarms that could tax daily platoon strength. Concurrently, as the city develops further away from the fire station, it will take longer to arrive at emergencies. If staffing levels aren't addressed to keep pace with the community's growth, there may be occasions that ALFD's resources are overtaxed to the point of being incapable of responding to emergencies until such time as the affected platoon is supplemented with off duty personnel. Therefore, during times that the on duty platoon is overtaxed, mutual aid assistance will be required for primary emergency response.

The concern is that when mutual aid is relied upon for primary response to Avon Lake, the result is that response times for Avon Lake residents will be excessive. What will be considered in this study are the potential aforementioned snowball effects that may result as the community continues to grow without corresponding growth in the fire department.

The impact this study may have on the ALFD and on the residents of Avon Lake could simply be informative in nature if no deficiencies exist. On the other hand, the study could be monumental if factors show that issues exist. If deficiencies are nonexistent this study may be utilized as a reference for long range planning goals. If deficiencies in the standards of care are considered to be real in the realm of staffing and or emergency alarm response time or if it is recognized that the deficiencies may have the potential to develop in the future, one or two outcomes may take place. First, the ALFD may experience an increase in total personnel staffing for each of the three platoons. Additionally, the minimum daily platoon staffing levels may be increased as well. The benefit of additional staffing is more protection and better service to the community. Second, one or two substations may be strategically placed on either end of the city. Substation(s) would be beneficial in that response time will be lessened, consequently, better service for the community. Both of these outcomes would result in the reduction of emergency alarm response times, thereby improving the emergency services for Avon Lake residents.

LITERATURE REVIEW

McLaughlin (2004) reveals a recent survey conducted by the Insurance Services Office (ISO). Five hundred top fire officials, including fire chiefs, commissioners, and fire prevention officers from around the United States were randomly surveyed. The survey sought information concerning the current operational conditions, the strain placed on fire departments by way of their ability to protect the communities they serve, as well as projections of future developments and needs within their organizations. The result of the survey indicates that among 81 % of fire chiefs responsible for areas experiencing growth, that “growth is likely to strain the resources of their departments even further” over the next three years. There is a genuine risk of deterioration

of fire services without careful planning by the administrations. An exceptionally high percentage of the nations fire departments are experiencing similar tribulations as ALFD. Community development around the nation is currently having an impact on emergency services. The continued demographic growth without a balanced modification to the fire department's resources will surely weaken a local fire department's emergency alarm response capabilities. Although Avon Lake continues to grow, the personnel strength of the ALFD has not been increased since 1997.

Coleman (2003) defines a "fire company" as a unit that is staffed by a company officer and one or more firefighters. An independent agency survey was conducted nationwide on 250 U.S. cities in 2001. The survey showed that the average personnel per fire company in communities with populations under 100,000 are 3.09 members for engine companies and 2.4 members for ladder companies. However, the 2001 edition of the National Fire Protection Association (NFPA) 1710 has established that a minimum of four personnel are required for each fire company serving high hazard jurisdictions. By comparison, ALFD always meets these survey results and national standards for engine company staffing. However, ALFD only meets these survey results and national standards for both engine and ladder company staffing when the secretary/dispatcher and at least six platoon members are on duty or on days when there are seven or eight platoon members on duty regardless if the secretary/dispatcher is working (note that on any day, one platoon member must function as the dispatcher after 1500 hours and on weekends and holidays, when the secretary/dispatcher is off duty.). On the other hand, when the platoon is staffed with the contractual minimum of five members, which allows for time off of three platoon members, and the secretary/dispatcher is not working, the ladder truck is not operated due to insufficient staffing.

National Fire Protection Association [NFPA] (2001) has established minimum standards for fire departments to provide protective services, for which it is responsible, to its community. It calls for fire administrators to plan and situate resources in order to meet minimum initial company response times. The first responding fire company shall arrive on the emergency scene within four-minutes to ninety percent of the emergencies and the first responding emergency medical service (EMS) unit capable of providing an automatic external defibrillator (AED) shall arrive on scene within four-minutes to ninety percent of the incidents as well. As Avon Lake develops toward its eastern and southeastern borders and away from the centrally located fire station, the NFPA standard may become difficult to achieve. Not only does the distance from the fire station affect the response time, but the fact that the new developments have winding roadways with no direct route to any residence may affect response time as well.

NFPA (1997) indicates in the Fire Protection Handbook that, “mutual aid or mutual response should not be relied upon for routine emergencies, since there could be times local commitments will preclude the anticipated assistance”. When evaluating the adequacy of fire protection, administration must give consideration to the anticipated workload of the organization, including multiple and simultaneous emergencies beyond the routine. Mutual aid agreements do not excuse the organization of the responsibility to provide its jurisdiction with adequate resources. Additionally, time is a critical factor in the evaluation of public fire protection. The general axiom is that the first arriving fire apparatus should arrive at the emergency scene within five minutes of the sounding of the alarm. The five minutes includes one minute for firefighters to don their personal protective equipment (PPE); mount the fire apparatus; and roll out of the fire station; and four minutes to arrive on the scene of the emergency. Keep in mind that additional minutes are needed to size up the situation upon arrival,

establish command, deploy ladders and hose, as well as initiate search and rescue operations of the premises. “The first five minutes of most fires is the determining factor as to whether that fire will remain a small fire or become a large fire”. Avon Lake’s population is steadily growing and in addition to this is there is a coexisting steady rise in emergency calls as well as the frequency of simultaneous overlapping emergency calls. Contrary to this increasing demand for services is the fact that the ALFD has not augmented the platoon staffing levels. Therefore, when the platoons are taxed and the demand for service exceeds the resources, Avon Lake residents become dependant on mutual aid for response to their emergencies with a resultant increase in response time to the emergency scene.

Federal Emergency Management Agency [FEMA], National Fire Protection Association [NFPA], and United States Fire Administration [USFA] (2002) conducted a study in the form of a national survey called “A Needs Assessment of the U.S. Fire Service”. The purpose was 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”. Within the category of “Personnel and Their Capabilities”, the study suggests that the average number of career paid firefighters per department on duty and available to respond to emergencies for communities with populations protected of 10,000 to 24,999 should be 7.3 firefighters. The average number of career paid firefighters per department on duty and available to respond to emergencies climbs to 18.8 for communities with populations protected of 25,000 to 49,999. Within the category of “Facilities, Apparatus, and Equipment”, the data suggests that the average number of fire stations for communities with populations protected of 10,000 to 24,999 is 2.98. The average number of fire stations increases to 3.36 for communities with populations protected of 25,000 to 49,999. In contrast with the results of this needs assessment survey, ALFD

often has only five firefighters on duty and available to respond to emergencies in a community whose population protected are 18,145. This is well below the national average. Five firefighters is the ALFD contractually mandated minimum daily platoon staffing level. This allows for scheduled vacation, paid holiday, personal leave time off. Also, in contrast to the needs assessment survey is the fact that Avon Lake has only one centrally located fire station to protect the community with a population of 10,000 to 24,999 and approximately eleven square miles as opposed to the national average of 2.98 for comparable sized communities.

American Heart Association [AHA] (2004) defines cardiac arrest as “the stopping of the heartbeat” and it defines sudden death as “the unexpected death resulting from various causes including cardiac arrest, ventricular fibrillation (VF) or pulseless, ventricular tachycardia. A victim in VF can die within minutes if the victim receives no treatment and brain damage can begin within just four to six minutes in the absence of treatment. Ventricular fibrillation can be reversed if the victim is treated with an electrical shock to the heart (defibrillation) within a few minutes. Survival is directly linked between the times of onset of VF to defibrillation. For every minute that defibrillation is delayed, the victims’ chances of survival are reduced seven to ten percent and after twelve minutes the chances of survival after defibrillation is only two to five percent. The AHA claims that when communities strategically place automatic external defibrillators (AED’s) throughout the city, response times can be significantly reduced. Studies further conclude that if communities place AED’s in police vehicles, response time can be cut by about three minutes. Therefore, the combination of early cardio pulmonary resuscitation (CPR), rapid defibrillation, and advanced life support (ALS) can generate increased long-term survival rates. In fact, if CPR and the first electrical shock are administered within three to five minutes, the survival rates for VF victims are an astounding forty-eight to seventy-four percent. When this

information is associated with the use of mutual aid for primary emergency alarm response in the form of ALS, to a victim with a cardiac emergency, the chances for survival of the victim may be significantly reduced if he or she is in VF due to the extended response time from ALS units coming from another jurisdiction.

Vincent Dunn Consultants (2004) posted a letter to Honorable Jeffrey Klein, Assembly Standing Committee on Oversight, Analysis, and Investigation. This letter discusses the significance of emergency response times and how an increase in response time translates into danger to life, limb, and property. Essentially, firefighters must get to a fire before the fire reaches “flashover”. Flashover is when an entire room and its contents burst into flames at the same time. A typical room can reach flashover within only four minutes. Now consider a victim who is trapped or rendered unconscious in a room of a house. Being exposed to temperatures of 212 degrees Fahrenheit (F) for only fifteen seconds will cause second-degree burns to that person. Inhaling a couple of breaths of air that is 300 degrees F will kill that person. Ordinary combustibles such as furniture, drapes, sheets, blankets, paper, etc., ignite at about 500 degree F. During flashover, the temperature reaches 1,000 to 1,200 degrees F. If firefighters don’t arrive at the scene of a fire quickly enough to stop flashover, the results are lethal to life and limb of any victims and devastating to property. As Avon Lake develops away from the centrally located fire station and toward its borders, response time may be impacted. When ALFD relies on mutual aid for primary emergency response, response time will probably be impacted.

Dedman (2005) wrote an article entitled “Slower arrival at fires in US is costing lives”. The author’s investigation reveals that on average, someone dies once a day in this country when firefighters arrive too late, giving fires a longer head start. In 2002 only fifty-eight percent of full-time fire departments consistently met the fire industry goal of arriving within six minutes of

the first alarm to ninety percent of building fires. A swift response is more critical now than ever before for avoiding tragedy. It has always been understood that a fire doubles in size about every minute that it has a supply of oxygen, fuel, and heat. However, today fires burn hotter because of the abundance of synthetic materials present and because buildings are designed to be energy efficient. Buildings are designed to keep the cold out and keep the heat in. In the 1970's scientist from the National Institute of Standards and Technology (NIST) found that people had about seventeen minutes to escape a fire before being overcome by heat and smoke. However, today the estimate is three minutes. "If you get there early, you get there before flashover," states Vincent Dunn (retired New York deputy fire chief) in the article. This saves the lives of the occupants and firefighter as well as saving property. The National Fire Protection Association (NFPA) has set a six-minute standard for communities with full-time fire departments: one minute for the dispatcher taking the call to alert firefighters; one minute for firefighters to get up, don their turnout gear and begin the response; and four minutes to drive to the fire. The International Association of Fire Chiefs (IAFC) has endorsed this standard. In the article Billy Goldfeder, a battalion chief for Loveland-Symmes Fire Department in Ohio cites the following incident. The cost of late arrival was demonstrated on a Sunday morning last September in Prairie Township, a suburb of Columbus, Ohio. Smoke and flames in their apartment building awakened an extended family. The closest fire engine was on another call, so it took 8 minutes for the first responders to arrive. By then flames were shooting through the roof. Four more fire departments were called, arriving 16 to 22 minutes after the original call. Ten relatives and friends died, including three children. Most of the bodies were just inside the door. The response time of the ALFD should be evaluated against the industry standard so as to determine if a shortfall exists and if so, determine if the cost of one or more additional fire stations, additional

personnel, and additional equipment prevails over the risk of the potential loss of life and property.

Coleman (1997) writes that there are many variables that determine the point of flashover. Flashover can occur in less than four minutes to more than ten minutes. The variables are based on the construction features and the contents within the structure. Today's structures burn with a higher British thermal unit (BTU) yield. They burn hotter because of the plastics and other synthetics that go into the construction materials and furnishings such as: furniture, appliances, floor coverings, drapes, etc. Plastics and synthetic materials also produce a significant amount of toxic smoke. Additionally, today's buildings have significantly more insulating properties with the use of thermal pane windows and therefore, retain more heat than building of the past. These factors directly affect the survivability of victims. "The more fire and smoke present on arrival, the less likely it is that savable victims will be found". The concern here is that ALFD may not be capable of an effective response time to all of the community due to the strategic location of its single fire station.

International Fire Service Training Association [IFSTA] (1993) discusses emergency response distance and response time. The results of their surveys indicate that respondents have differences in opinion as to what is an acceptable response distance for built upon residential areas. For example, seventy-one percent of the survey respondents say that travel distance for the first due engine company should be one to three miles. Eleven percent said travel distance should be four miles. Only eight percent said response distance should be less than one mile. Another study of 1,400 fire departments showed that response times for full time fire departments averaged 3.8 minutes. Some studies report a conversion factor to translate miles into minutes. There does appear to be a consistent pattern of two minutes for every one-mile traveled, although

there is some inconsistency from city to city. The variability in this conversion factor is the time of day and the pattern of the streets. That being said, the average conversion factor is three minutes for every one-mile traveled. The Insurance Services Office (ISO) rating scale stipulates that built upon areas of a city should have a first due Engine Company within 1.5 miles to any potential response location and a Ladder Company within 2.5 miles. One can extrapolate from this information that an average emergency response time should be 4.5 minutes for the first due Engine Company to any built upon area of a given city for full time fire departments. This is only thirty seconds greater than the NFPA 1710 standard of four minutes. This information is directly related to the question, does one centrally located fire station in Avon Lake meet the industry standard of response time?

Summary statement

The findings of others demonstrate that there is nationwide crisis with growing communities and the failure or inability of local administrators to balance their fire service's workforce. Extensive research has also been conducted in order to determine an appropriate emergency response time for positive outcomes and what potential negative outcomes can occur as a result of delayed emergency response. Finally, parallel research has established appropriate population to staffing and fire station ratios as well as travel distance for emergency response vehicles. This report will evaluate the emergency service provided to the community of Avon Lake base on the aforementioned literature review material.

PROCEDURES

Before any conclusions could be made from this study, some sort of relevant comparison criterion had to be established so that a baseline of values could be formed. Only then could an

objective assessment of ALFD's emergency services be conducted. To begin with, a literature review was conducted using a collection of reference materials from several fire service publications and writings, some of which were obtained via the Internet. The research focused primarily on: (1) Alarm response times for full time fire departments; (2) Use of mutual aid; (3) Daily on duty personnel strength; and (4) Fire station location in relation to demographic change. Upon completion of the literature review, a baseline of fire service industry standards was established utilizing the published research material relevant to this study.

The author extracted historical information from ALFD's computer database so that the data can be analyzed. Avon Lake Fire Department utilizes "FIREHOUSE" Software from Visionary Systems, Ltd., Des Moines, Iowa for its fire and EMS records management and state incident reporting. The software provides the user with preformatted queries that can be printed as reports from the incident report file. Data that were evaluated was comprised of: (1) Response times; (2) Annual emergency call volume; (3) Overlapping incidents; (4) Mutual aid received and provided; and (5) Response to senior living facilities. This data encompassed a five-year period from January 1, 1999 to December 31, 2003 (Grizzell, 2004). The compilation of statistics that were extrapolated from ALFD's database was cataloged and reviewed so that a determination of ALFD's current emergency customer service delivery could be determined. At this point in the study a comparison was made between national fire service industry standards and ALFD's current customer service capabilities. This comparison was intended to facilitate the determination of the existence of any trends that currently have an impact on ALFD's emergency customer service capabilities now or in the future.

Definition of Terms

Advanced life support (ALS). Functional provisions of advanced airway management, including intubation, advanced cardiac monitoring, manual defibrillation, establishment and maintenance of intravenous access, and drug therapy (National Fire Protection Association [NFPA], 2001, page 1710-5).

Alarm. A signal or message from a person or device indicating the existence of a fire, medical emergency, or other emergency response activity (NFPA, 2001, page 1710-5).

Basic life support (BLS). Functional provisions of patient assessment, including basic airway management; oxygen therapy; stabilization of spinal, musculo-skeletal, soft tissue, and shock injuries; stabilization of bleeding, and stabilization and intervention for sudden illness, poisoning and heat/cold injuries, childbirth, cardio-pulmonary resuscitation (CPR), and automatic external defibrillator (AED) capability (NFPA, 2001, page 1710-6).

British thermal unit (BTU). The quantity of heat required to raise the temperature of one pound of water by one degree Fahrenheit (American Heritage dictionary, 1982).

Customer service. The delivery of services to citizens (Brunacini, 2000).

Mutual aid. Reciprocal assistance by emergency services under a prearranged plan (NFPA, 2001, page 1710-5).

Overlapping emergency alarms. Any second, third, and greater emergencies that are received simultaneously with or subsequent to an initial emergency call and prior to completion of the first emergency (Grizzell, 2004, page 6)

Response time. The time that begins when units are en route to the emergency incident and ends when units arrive at the scene (NFPA, 2001, page 1710-6).

Scalar system. “Having an uninterrupted series of steps” or a “Chain of authority” (International Fire Service Training Association [IFSTA], 1989, page 25).

Limitations of the Study

One must consider the fact that law does not govern the national fire service industry standards that are indicated throughout this report. Therefore, city government officials are not legally mandated to accept or abide by these principles when determining what are acceptable and unacceptable criteria for managing their local fire jurisdictions. However, since fire service leaders throughout the country recognize the industry standards identified herein, city government officials should consider them as a baseline from which to make responsible decisions concerning the safety, welfare and standards of care of their constituents. In addition, the statistical data collected for this report is subject to multiple interpretations depending on the readers' opinions.

RESULTS

An examination of past census survey results, which were conducted in 1970, 1980, 1990, and 2000 as displayed in Table 1, revealed that the population in Avon Lake has steadily increased from 12,262 to its present population of 18,145 residents (Free Demographics, 2005).

Table 1*City of Avon Lake Population Trend from 1970 to 2000*

Year	Population	Percentage
1970	12,262	-
1980	13,221	07.82 ^a
1990	15,066	13.96 ^a
2000	18,145	20.44 ^a
TOTAL	5,883 ^b	47.98 ^c

Note. For 1970 there were no comparison data from which to make a percentage calculation.

^a = Percentage increase from the previous year. ^b = Total population increase from 1970 to 2000.

^c = Total percentage increase from 1970 to 2000.

The data listed the ALFD annual reports (see appendix) indicate that the total annual emergency call volume has progressively increased from 1,116 to 1,864 calls (Avon Lake Fire Department, 1992-2003). Community development around the nation is currently having an impact on emergency fire and EMS services. In Avon Lake there has been a steady and equal increase in both population and emergency alarm call volume that actually parallel each other. The population has increased 47.98 % since 1970 and the emergency alarm call volume has similarly increased 47.67 % since 1992. Therefore, one can conclude that there is in fact a correlation between Avon Lake's population growth and emergency alarm call volume for the fire department. Continued growth in demographics and emergency service such as this, without a balanced modification to the ALFD's resources may have a weakening effect to the fire department's emergency alarm response capabilities.

Although data demonstrates that there has been nearly a 50 % increase in emergency alarm call volume over the past twelve years, ALFD's staffing levels have not been adjusted proportionately to contend with the escalating demand for services. As illustrated in Figure 3, staffing levels have only been addressed twice since 1977. (Avon Lake Municipal Council, 1997). There has been a 42.68 % increase in emergency alarm call volume from 1997 to 2004 without an associated increase in personnel.

The rising emergency alarm call volume that ALFD is experiencing is worrisome because it affects the ability of the fire department to effectively respond to multiple emergencies with the current daily minimum platoon staffing level, which is five firefighters. The affects are evident by the number of times mutual aid is relied upon to respond to Avon Lake's emergencies, on minimum platoon strength days, during double and/or triple overlapping emergency calls. Data shows that ALFD experiences an annual average of 203 overlapping emergencies and 5% of the total annual emergencies alarms require mutual aid assistance from bordering fire departments for mitigation (Grizzell, 2004).

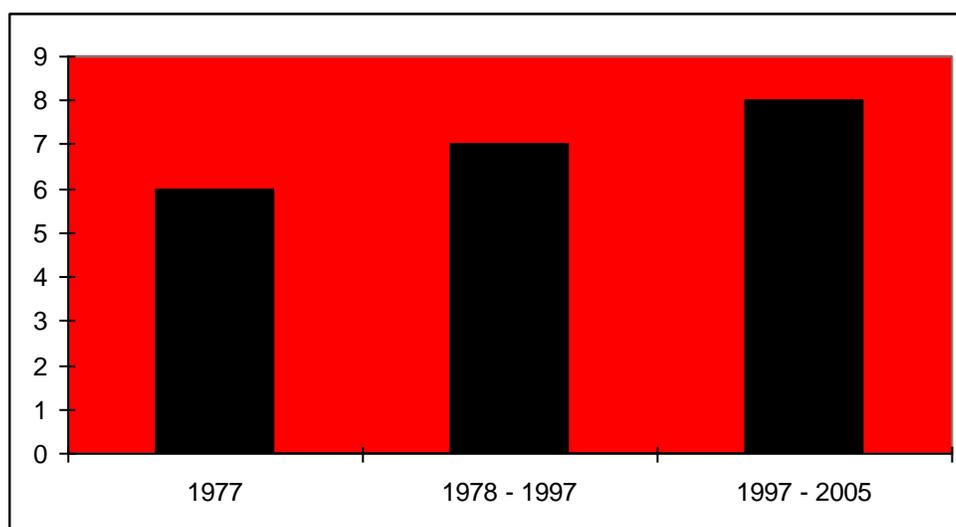


Figure 3.

This bar graph illustrates the relationship between platoon strength and the years that increases occurred.

The Fire Protection Handbook proposes that mutual aid or mutual response should not be relied upon for routine emergencies, since there could be times local commitments will preclude the anticipated assistance. Between 1999 and 2003 ALFD's primary mutual aid resources have experienced an increased demand for services in their respective communities. AFD has experienced a 103 % increase in emergency call volume; SVFD has experienced an 81 % increase in emergency call volume; SLFD has experienced a 12 % increase in emergency call volume; and BVFD has experienced a 5 % increase in emergency call volume (Grizzell, 2004).

When evaluating the adequacy of fire protection, administrators should give consideration to the anticipated workload of their organization, to include multiple and simultaneous emergencies beyond the routine. Mutual aid agreements do not excuse the organization of the responsibility to provide its jurisdiction with adequate resources.

Finally, FEMA, NFPA, and the USFA have stipulated in their needs assessment of the fire service, that the average number of career paid firefighters per department on duty and available to respond to emergencies for communities with populations protected of 10,000 to 24,999 should be 7.3 firefighters. Avon Lake's current population is 18,145 and the fire department is at times staffed with only five firefighters on duty and available to respond to emergencies on days that three of the eight platoon members are not present due to scheduled time off or when the platoon is committed to emergencies and the station cannot be re-staffed because of off duty firefighter availability. Based on the fire service industry standards, it appears that ALFD's current on duty and ready to respond staffing levels are unsuitable for the needs of the community.

Avon Lake Fire Department is housed in and is dispatched from one centrally located fire station located at 32811 Walker Road. Emergency alarm response time statistics were extracted

from the ALFD computer database for the interval from January 1, 1999 through December 31, 2003. The data reveals that the overall average alarm response time for the city is six minutes and thirty eight seconds (Grizzell, 2004).

The NFPA has established minimum standards for fire departments to provide protective services to its community. The standard is that the first responding fire and EMS units shall arrive on the emergency scene within four minutes to ninety percent of the emergencies. The AHA warns that a victim in ventricular fibrillation (VF) can die within minutes if the victim receives no treatment and brain damage can begin within just four to six minutes in the absence of treatment. Vincent Dunn Consultants warns that an increase in response time translates into danger to life, limb, and property. Data retrieved from ALFD's database from January 1, 1999 through December 31, 2003 indicates that the industry standard response time was only accomplished once during this time frame. In the year 2000 ALFD was able to meet the four-minute response time standard for 92 % of the emergencies in the community. However, during the years 1999, 2001, 2002, and 2003 the percentages were 65.86 %, 87.86 %, 85.53 %, and 86.65 % respectively. The Insurance Services Office (ISO) rating scale specifies that built upon areas of a city should have a first due engine company within 1.5 miles to any potential response location. Furthermore, a ladder company should be within 2.5 miles to any potential response location. Organizations such as FEMA, NFPA, and the USFA have conducted studies in which the data suggests that the average number of fire stations for communities with populations protected of 10,000 to 24,999 is 2.98.

Considering the fact that Avon Lake is just over five miles wide and the only fire station is located in the center of the city, the ISO parameter for the first due engine company being 1.5 miles to any potential response location is not obtainable with this single fire station because the

distance to the either west or the east borders of the city are approximately 2.5 miles from the fire station. The 2.5 miles is for straight line of travel. The reality is that the winding roads in the newer developments don't allow for a direct travel route to any one location. Therefore, the travel distance to any potential response location in the western and eastern areas of the city may actually be farther than 2.5 miles. Base on this information, it doesn't appear that one centrally located fire station in Avon Lake can meet the industry standard of response time or travel distance.

DISCUSSION

In a recent survey conducted by the ISO, McLaughlin (2004) discloses that top fire officials, including fire chiefs, commissioners, and fire prevention officers from around the United States were randomly surveyed. The intent of the survey was to determine how current fire department operational conditions were being strained as a result of population growth. Eighty-one percent of fire chiefs responsible for areas experiencing growth imply that population growth is in fact currently affecting the operations of their departments and they expect their department's operations to continue to deteriorate without careful planning by the city administrations.

National Fire Protection Association 1710 stipulates that fire departments should be capable meeting a response time of four minutes for the initial responders to ninety percent of the emergencies (NFPA, 2001). The industry standard of personnel on duty and ready to respond to emergencies for communities with a population from 10,000 to 24,999 residents is 7.3 members. Additionally, the industry standard for the number of fire stations in communities with populations from 10,000 to 24,999 is 2.98 fire stations (FEMA, NFPA, USAF, 2002). The ISO

grading scale specifies that the first due fire company should not have to travel greater than 1.5 miles to any location in the build up area of the city (IFSTA, 1993).

Study results prove that there is a clear correlation between Avon Lake's increasing population (Free Demographics, 2005) and the increasing number of annual emergencies calls (Grizzell, 2004). Avon Lake's population has increased 47.98 % over thirty years. Likewise, the fire department's total annual call volume has increased 47.67 % over a twelve-year period (Avon Lake Fire Department [ALFD], 1992-2004). Avon Lake administrators have made adjustments to ALFD's staffing levels in the past (Avon Lake Municipal Council, 1997) so as to cope with the increasing demand for service. In 1978, three firefighter/paramedics were added to the staff and 1997 an additional three firefighter/paramedics were added to the roster. However, ALFD has seen an additional 42.68 % increase in emergency calls from 1997 to 2003 and there has not been a movement to balance the department staffing level again, in order to contend with this mounting demand for services.

Data shows that ALFD is unable to accomplish the industry standard of meeting a four minute response time to 90 % of its emergencies and in fact hasn't been capable of meeting this requirement since the year 2000. This is due to the demographic growth of the city and the fact that the city is developing outward and away from the centrally located fire station. The ALFD also experiences an annual average of 203 overlapping emergencies and has come to depend on mutual aid from bordering fire departments to completely mitigate 5 % of the city's total annual emergencies alarms (Grizzell, 2004). This is because ALFD sometimes only has five on duty and ready to respond firefighter/paramedics available to be dispatched from one centrally located fire station. One significant shortcoming of using mutual aid is that when mutual aid is utilized as a primary response resource, response times to Avon Lake's emergencies are going to be

excessive. This is the reality of using an outside agency. Finally, ALFD responds to all emergencies from one central fire station. The city is five miles from west border to east border. It is impossible to meet the ISO criteria of a 1.5-mile travel distance for the first responding fire engine.

The implications this comparative study information has on the ALFD is that it shows that as the population in Avon Lake continues to grow, the demand for emergency service will also certainly grow. Avon Lake Fire Department is presenting with a dependency on mutual aid to mitigate a number of their emergencies because of insufficient staffing and if the staffing levels aren't augmented, the department's customer service operations may deteriorate. Avon Lake Fire Department is incapable of accomplishing the national industry standard response time 90 % of the time, especially when mutual aid is utilized. In summary, ALFD does not seem to meet any of the fire service industry standards relative to: (1) Response time to emergencies for initial fire an EMS response units; (2) Travel distance for initial responding fire apparatus; (3) Staffing levels for on duty and ready to respond personnel for the population being protected; and (4) The number of fire stations for the population being protected. These are all deficiencies that can have negative consequences to the residents of Avon Lake.

RECOMMEDATION

The purpose and focus of this study is to evaluate the operations of the ALFD and compare the current operations with the national fire industry standards. The results of this report will ultimately be presented to the decision makers for the City of Avon Lake so that they have the data wherein to make educated organizational decisions pertaining to the ALFD within the scope of public safety. The goal of the decision making process will be aimed at determining if

the ALFD is meeting the needs of the Avon Lake's growing community, and if the needs are not being met, choose the appropriate course of action to take in providing the residents of Avon Lake with the quality of service they deserve.

After this report is submitted to the Safety Committee of Council through the Safety Director, a waiting period should be anticipated before any productive dialogue begins. The decision makers need time to study and digest this material so that they can formulate their opinions and questions. They [Safety Committee] can be expected to proceed cautiously, largely due to the budget impact that can potentially be incurred with the thought of additional personnel, wages, benefits, equipment, and/or facilities. The reader(s) should consider the three questions this study poses when evaluating the emergency response efficiency of the ALFD.

The first question posed is: Is there a correlation between Avon Lake's population growth and emergency alarm call volume? The answer is a resounding yes. Data indicates that the population in Avon Lake is growing and the emergency call volume of the fire department is growing as well. The operations of the ALFD are directly affected by this parallel growth in demographics and emergencies. Mutual aid is relied upon as the on duty minimum platoon strength of five personnel becomes overtaxed. Emergency response times have also steadily increased because residential development is occurring on the outer areas of the city and because outside agencies (mutual aid) are being utilized as primary response agents.

The second question in the study asks: Is ALFD's on duty and ready to respond staffing levels suitable for the needs of the community? Data indicates that ALFD simply does not meet national industry standards when it comes to staffing. To further emphasize the fact that current platoon staffing levels are not suitable for the needs of the community is that ALFD counts on mutual aid to mitigate approximately 5 % of its annual emergency call volume.

This is due to the increase in overlapping calls which is a by-product of the increasing call volume, which in turn is a direct result of the increasing population. Avon Lake provides its community with a minimum of five on duty and ready to respond firefighter/paramedics daily. This is not a sufficient number of personnel to mitigate two simultaneous EMS calls with the standard of care the residents of Avon Lake have been told they can expect and in which they are paying for through their persistent support of a paramedic levy. The standard of care just mentioned is that ALFD routinely staffs each ambulance with three paramedics for the finest patient care possible.

The third and final question in this study is: Does one centrally located fire station in Avon Lake meet the industry standard of response time? The average response time for the ALFD is over six minutes. This is far from the national industry standard of four minutes. Recall that research stresses that response times greater than four minutes translates into danger to life, limb, and property. The fact is that with one central fire station, the industry response time standard as well as the recommended travel distance of 1.5 miles for the initial responding engine can never be accomplished. Compounding this dilemma is the fact that when mutual aid is called in from bordering communities for primary emergency response, the response time simply will always be potentially life threatening based on the nature of the emergency.

Although the recommendations in the 2004 report (Grizzell, 2004) have merit, they are subjective in nature based on the Fire Chief's perception of what is in the best interests of the community and the fire department. Therefore, the five-year plan proposed in the 2004 report may not be amiable or realistic in the minds of the cities administration. For that reason, a multiparty decision making process based on the 2004 report may be a better approach to resolving any safety issues and/or restructuring the fire department.

A logical method of addressing the fire department organizational restructuring would be to develop a focus group to study the current fire department organization and its operations. The focus group may consist of: The Safety Director, the Fire Chief, the Safety Committee of Council, the Union Safety Committee, and a Citizens Advisory Committee. Additional sources of information that could be of value with the study are the recommendations of the International Association Fire Fighters (IAFF) and an independent consulting firm.

The focus group should explore the issues assembled in this research paper, which are: daily on duty and ready to respond staffing levels, emergency response time, and fire station location(s). The objective would be to ensure that the community is provided with the standard of emergency care that meets their needs; fulfills the national fire industry standards as closely as practical; and is sensitive to the budgetary burden that will be imposed on the city.

Seventy-one percent of the emergency calls ALFD responds to are for EMS as illustrated in Figure 4. Therefore, the first recommended objective of the focus group should be to ensure that the fire department has enough personnel on duty so as to be capable of responding to two simultaneous EMS calls. A staffing issue that should be considered is increasing the daily minimum on duty and ready to respond staffing level from the current five personnel to six. This would require hiring three additional firefighter/paramedics thereby creating nine person platoons rather than the existing eight person platoons. This platoon staffing level allows for three members to be off duty for scheduled time off and provide for six on duty, ready to respond members to staff the fire station. The purpose of this recommendation is to ensure that ALFD is prepared to respond to two simultaneous emergency calls before necessitating the use of mutual aid. In doing so, the response time issue would also be indirectly addressed to some degree simply because mutual aid would not be required as often. As was previously acknowledged in

this report, when mutual aid is utilized, there is no control over that specific emergency's response time.

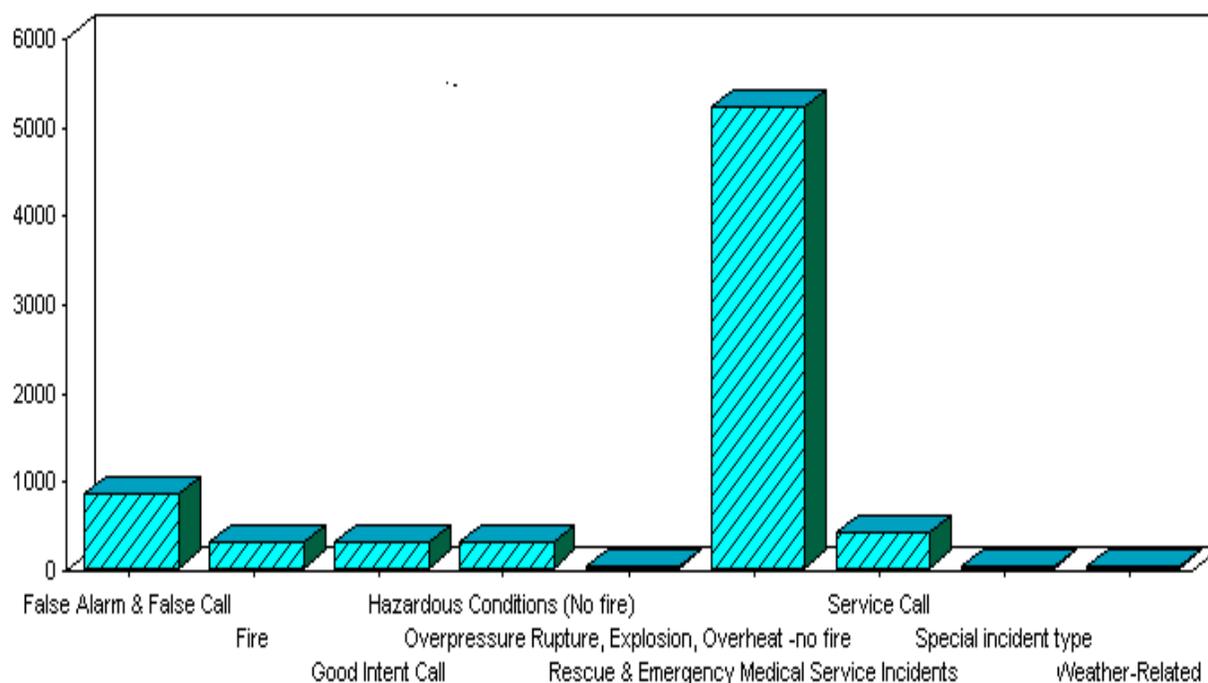


Figure 4.

This bar graph demonstrates the relationship between EMS emergency calls as compared to all other calls responded to from January 1, 1999 through December 31, 2003.

The other issue the focus group should consider is the emergency response time and travel distance issues identified in this research. This will be a monumental undertaking compared to the personnel staffing issues and as such will require careful planning. In view of the information presented in this report, it is apparent that one centrally located fire station in Avon Lake does not meet the industry standards of response and travel times to the west and east borders of the city. The average emergency alarm response time for the ALFD is greater than six minutes and the travel distance for the first responding fire apparatus is greater than 2.5 miles depending on the location of the residential development. Therefore, the second recommended

objective should be a plan to acquire land, plan for the construction of one or possibly two additional fire stations (one on each side of the city), plan to provide apparatus and equipment for the fire station(s), and finally plan to provide personnel so as to staff the fire station(s).

Through 2003, only 39 % of the emergencies were occurring on the east side of the city with the remainder on the west side. However, beginning in 2004 a shift in this pattern occurred with 46 % of the emergencies having been mitigated on the east side of the city since January 1, 2004 as illustrated in Figure 5.

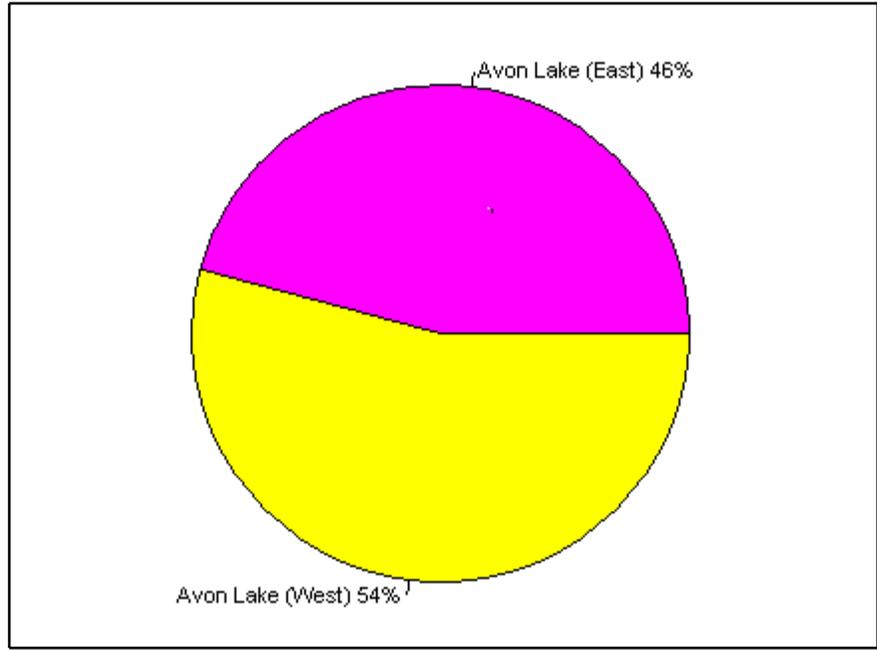


Figure 5.
This pie chart exhibits the relationship between emergency calls that have occurred on both sides of the City of Avon Lake from January 1, 2004 through March 30, 2005.

A significantly greater amount of property remains available to be developed on the eastern border of the city and this is where the bulk of residential development is occurring as

distinguished by the shift in the location of emergencies. Therefore, the recommendation is to plan for a fire station on the east side of the city first, so as to address the needs of that section of the city because this is where the greater demand for emergency service is projected for the future.

Finally, the ALFD organization should plan to continue to monitor and document the emergency call statistics so that they can be extracted, studied, and referred to at a later date. This will enable future fire chiefs and administrators to track and establish trends so as to plan for further organizational growth as the population and emergency call volume continues to undergo change.

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Consultants'

APPENDIX

Annual Call Volume Comparison From January 1, 1992 to December 31, 2003

Year	Volume	Percentage
1992	1116	-
1993	1113	00.27 ^a
1994	1119	00.54 ^b
1995	1048	06.34 ^a
1996	1063	01.43 ^b
1997	1155	08.65 ^b
1998	1220	05.63 ^b
1999	1396	14.43 ^b
2000	1351	03.22 ^a
2001	1412	04.52 ^b
2002	1505	06.59 ^b
2003	1648	09.50 ^b
TOTAL	532^c	47.67^d

Note. For 1992 there were no comparison statistics from the previous year from which to calculate a percentage increase or decrease.

^a = Percentage decrease from previous year. ^b = Percentage increase from previous year. ^c = Total increase in calls from 1992 to 2003. ^d = Total increase in percentage from 1992 to 2003.