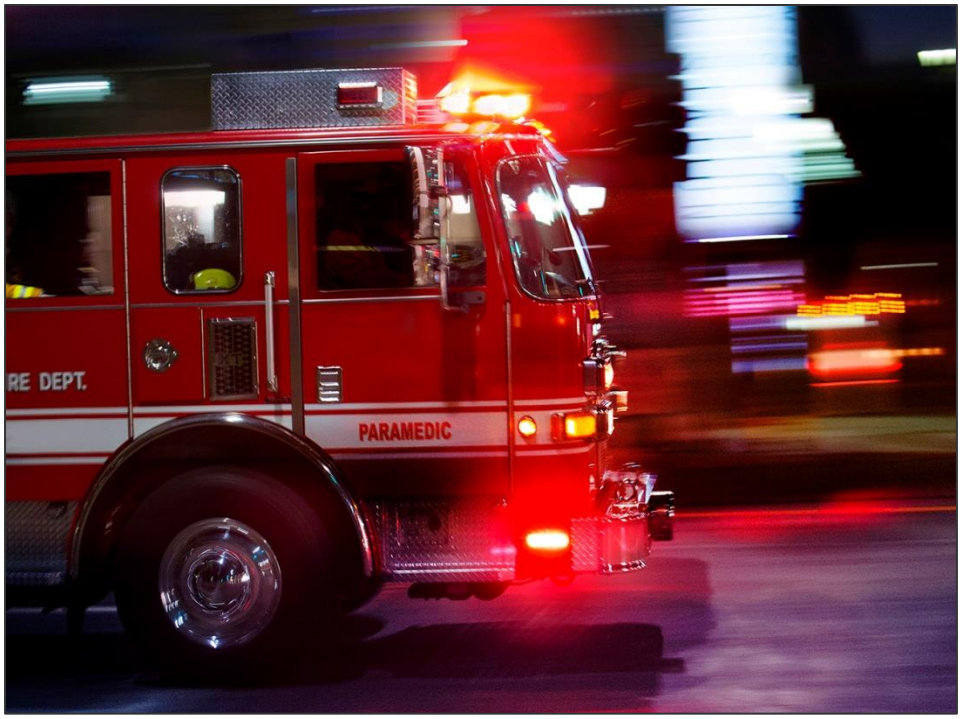
CENTER FOR PUBLIC SAFETY MANAGEMENT, LLC

Fire Operational and Administrative Analysis Report

Sugar Land, Texas

Final Report-January 2017



CPSM®

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ICMA

Exclusive Provider of Public Safety Technical Services for
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The International City/County Management Association (ICMA) is a 100-year-old, nonprofit professional association of local government administrators and managers, with approximately 9,000 members spanning thirty-two countries.

Since its inception in 1914, ICMA has been dedicated to assisting local governments in providing services to their citizens in an efficient and effective manner. Our work spans all of the activities of local government — parks, libraries, recreation, public works, economic development, code enforcement, Brownfields, public safety, etc.

ICMA advances the knowledge of local government best practices across a wide range of platforms including publications, research, training, and technical assistance. Its work includes both domestic and international activities in partnership with local, state, and federal governments as well as private foundations. For example, it is involved in a major library research project funded by the Bill and Melinda Gates Foundation and is providing community policing training in Panama working with the U.S. State Department. It has personnel in Afghanistan assisting with building wastewater treatment plants and has had teams in Central America providing training in disaster relief working with SOUTHCOM.

The **ICMA *Center for Public Safety Management* (ICMA/CPSM)** was one of four Centers within the Information and Assistance Division of ICMA providing support to local governments in the areas of police, fire, EMS, emergency management, and homeland security. In addition to providing technical assistance in these areas we also represent local governments at the federal level and are involved in numerous projects with the Department of Justice and the Department of Homeland Security. In each of these Centers, ICMA has selected to partner with nationally recognized individuals or companies to provide services that ICMA has previously provided directly. Doing so will provide a higher level of services, greater flexibility, and reduced costs in meeting members' needs as ICMA will be expanding the services that it can offer to local governments. For example, The Center for Productivity Management (CPM) is now working exclusively with SAS, one of the world's leaders in data management and analysis. And the Center for Strategic Management (CSM) is now partnering with nationally recognized experts and academics in local government management and finance.

Center for Public Safety Management, LLC (CPSM) is now the exclusive provider of public safety technical assistance for ICMA. CPSM provides training and research for the Association's members and represents ICMA in its dealings with the federal government and other public safety professional associations such as CALEA. The Center for Public Safety Management, LLC maintains the same team of individuals performing the same level of service that it has for the past seven years for ICMA.

CPSM's local government technical assistance experience includes workload and deployment analysis using our unique methodology and subject matter experts to examine department organizational structure and culture, identify workload and staffing needs, and identify and disseminate industry best practices. We have conducted more than 269 such studies in 37 states and 204 communities ranging in size from 8,000 population (Boone, Iowa) to 800,000 population (Indianapolis, Ind.).

Thomas Wieczorek is the Director of the Center for Public Safety Management. Leonard Matarese serves as the Director of Research & Program Development. Dr. Dov Chelst is the Director of Quantitative Analysis.

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SECTION 1. EXECUTIVE SUMMARY

The Center for Public Safety Management, LLC (CPSM) was retained by the city of Sugar Land to conduct a comprehensive analysis of the city's fire department operations and a detailed review of the department's overtime expenditures. This analysis considered deployment practices, workload, organization structure, training, performance measures, prevention activities and interactions with mutual aid partners. Specifically, CPSM was tasked with providing recommendations and alternatives regarding fire department operations, staffing levels, and alternative modes of operation that would improve performance and reduce overtime expenditures.

During the study, CPSM analyzed performance data provided by the Sugar Land Fire-EMS (SLF-EMS) and also examined firsthand the department's operations. Fire departments tend to deploy resources utilizing traditional approaches, which are rarely reviewed. To begin the review, project staff asked for certain documents, data, and information. The project staff used this information/data to familiarize themselves with the department's structure, assets, and operations. The provided information was supplemented with information collected during an on-site visit to determine the existing performance of the department, and to compare that performance to national benchmarks. CPSM will typically utilize benchmarks that have been developed by organizations such as the National Fire Protection Association (NFPA), Center for Public Safety Excellence, Inc. (CPSE), the ICMA Center for Performance Measurement, and other organizations.

Project staff conducted site visits on June 2-3, 2016, and October 25–27, 2016, for the purpose of observing fire department and agency-connected support operations, interviewing key department staff, and reviewing preliminary data and information. Telephone conference calls as well as e-mail exchanges were conducted between CPSM project management staff, the city, and the fire department so that CPSM staff could affirm the project scope and elicit further discussion regarding this analysis.

The Sugar Land Fire-EMS is a highly skilled and progressive organization that is making exceptional progress in dealing with a growing service population and while transitioning its service responsibilities to include EMS transport. The personnel with whom CPSM interacted are truly interested in serving the city to the best of their abilities and it was readily apparent they have unified goal of achieving excellence in service delivery. A key aspect of CPSM's analysis is providing observations regarding the delivery of emergency medical services to Sugar Land residents. The city recently assumed EMS transport services (in January 2015) and faced a number of operational, financial, and organizational challenges in this effort. The progress observed has been admirable and the department's intent to make on-going improvements in service delivery outcomes was equally impressive. As service demands increase and the fire department is required to provide expanded services, there will be a need for strategic planning, organizational team building, and goal setting in the department. These challenges however, are not insurmountable and CPSM will provide a series of observations and recommendations that we believe can allow the SLF-EMS to become ***more efficient*** and ***smarter*** in the management of its emergency and nonemergency responsibilities.

RECOMMENDATIONS

The SLF-EMS provides an excellent range of services to its citizens, local businesses, and visitors to the area. The department is well respected in the community and by city leadership. In organizations of the caliber of SLF-EMS, recommendations such as those provided in this report are minor in comparison to the department's performance; these recommendations do not denote major flaws in its day-to-day operations or overall efficiencies. In fire organizations that reach a high level of performance, the real challenge for line personnel and management staff is to maintain the continued pursuit of excellence and ongoing improvement.

Twenty-eight (28) recommendations are listed below and will also be found in the applicable sections within this report. The recommendations are based on best practices derived from the NFPA, CPSM, ICMA, the U.S. Fire Administration, the International Association of Emergency Managers (IAEM), and the Federal Emergency Management Agency (FEMA).

These recommendations are listed in order in which they appear in the report.

1. The Sugar Land Fire-EMS should establish the position of EMS Captain, with one position assigned to each shift (three positions total), and should select these positions via an open, competitive promotional process.
2. The SLF-EMS should consider assigning program management duties to field personnel and utilize these assignments for career development and consideration in promotional testing.
3. The SLF-EMS should institute a periodic meeting forum (weekly/monthly/quarterly) to discuss departmental initiatives and new directives and which includes all on-duty members of the organization and chief officers, with the forum held via an Internet-based conference calling or video conferencing format.
4. The SLF-EMS should replace, repair, and properly maintain the fire station vehicle exhaust systems.
5. The SLF-EMS should work jointly with the police department to consider the installation of in-building wireless systems in known dead spot areas of buildings so as to enable radio communications from public safety personnel to the ECC.
6. The Sugar Land Fire-EMS should conduct a formal fire risk analysis that concentrates on the city's strip commercial establishments, big-box occupancies, high-rise structures, and industrial, processing, and institutional properties.
7. The SLF-EMS should maintain its mutual aid agreements with Ft. Bend County and the city of Houston for Level II and III hazardous materials response and should continually evaluate these arrangements to ensure operational effectiveness.
8. The Sugar Land Fire-EMS should improve its preplanning process at all target hazards and ensure these documents are stored in the on-board mobile data terminals (MDTs) in order to be readily accessible to company and chief officers during a response.
9. Sugar Land should consider CPSE fire accreditation in the future.
10. The SLF-EMS should reevaluate its initial assignment of equipment and personnel to a reported structure fire.
11. The SLF-EMS should build its training regimens and tactical strategies around the exterior or transitional attack when the fire scenario and the number of responding personnel warrant this approach.

12. The SLF-EMS should work with the dispatch center to develop methodologies that improve the call screening process in order to alter response patterns when calls are determined to be minor or nonemergency.
13. The SLF-EMS should consider the dispatching of only a fire unit to those minor EMS calls that do not warrant an ALS/ambulance response.
14. The SLF-EMS should consider the option of giving responding personnel greater latitude in adjusting their mode of response (hot or cold) on the basis of the review of dispatcher notes and/or their familiarity with the call request.
15. The SLF-EMS should consider removing the power unit from service.
16. The SLF-EMS should consider the cross-staffing of its ladder companies with transport-capable ambulances.
17. The SLF-EMS should review unit availability rates and determine those measures needed to improve these outcomes.
18. The city should consider changing the City Council response time goals for Fire and EMS.
19. The SLF-EMS should work with the city's Building Department to institute a cost recovery process for fire department activities that involve fire code plans review, inspections, and new construction permitting.
20. The Sugar Land Fire-EMS should institute an in-service fire company inspection program that promotes responder familiarization, pre-incident planning, and prevention efforts.
21. The Fire Prevention Division should sufficiently train its investigators and company officers on how to determine estimated fire loss on all fires.
22. The SLF-EMS, through its Fire Prevention Division, should produce an annual fire report that identifies the number of fires, the occupancy types, estimated fire loss, and other critical information that can be utilized to guide prevention efforts.
23. The SLF-EMS should develop an overall integrated risk management plan that focuses on structure fires in the community.
24. The Sugar Land Fire-EMS should institute a formal monthly/quarterly department-wide training calendar.
25. The SLF-EMS should establish a training steering committee composed of battalion chiefs, captains, drivers, firefighters, and EMS staff to conduct a training needs assessment, develop priorities, and provide direction regarding the training efforts of the department.
26. The SLF-EMS should designate a fire Captain and at least one alternate on each shift to serve as the shift training coordinator to help facilitate in-service training activities, both for fire and EMS.
27. The Sugar Land Fire-EMS should restructure its training delivery methods and consolidate fire and EMS training under the Planning and Development Division.
28. The Sugar Land Fire-EMS should institute written and practical skills testing as part of the department's comprehensive fire training program.

SECTION 2. SCOPE OF PROJECT

The scope of this project was to provide an independent review of the services provided by the Sugar Land Fire-EMS (SLF-EMS), so that city officials, including officials of SLF-EMS, could obtain an external perspective regarding the department's fire and EMS delivery system. This study provides a comprehensive analysis of the SLF-EMS, including its organizational structure, workload, staffing, overtime, deployment, training, fire prevention, emergency communications (911), and planning and public education efforts. Local government officials often attempt to understand if their fire department is meeting the service demands of the community, and commission these types of studies to measure their department against industry best practices. In this analysis, CPSM provides recommendations where appropriate, and offers input on a strategic direction for the future.

Key areas evaluated during this study include:

- Fire department response times (using data from the city's computer-aided dispatch system and the SLF-EMS records management system).
- Deployment, staffing, and overtime.
- Organizational structure and managerial oversight.
- Fire and EMS workloads, including unit response activities.
- SLF-EMS support functions (training, fire prevention/code enforcement, and 911 dispatch).
- Essential facilities, equipment, and resources.

SECTION 3. ORGANIZATION AND MANAGEMENT

GOVERNANCE AND ADMINISTRATION

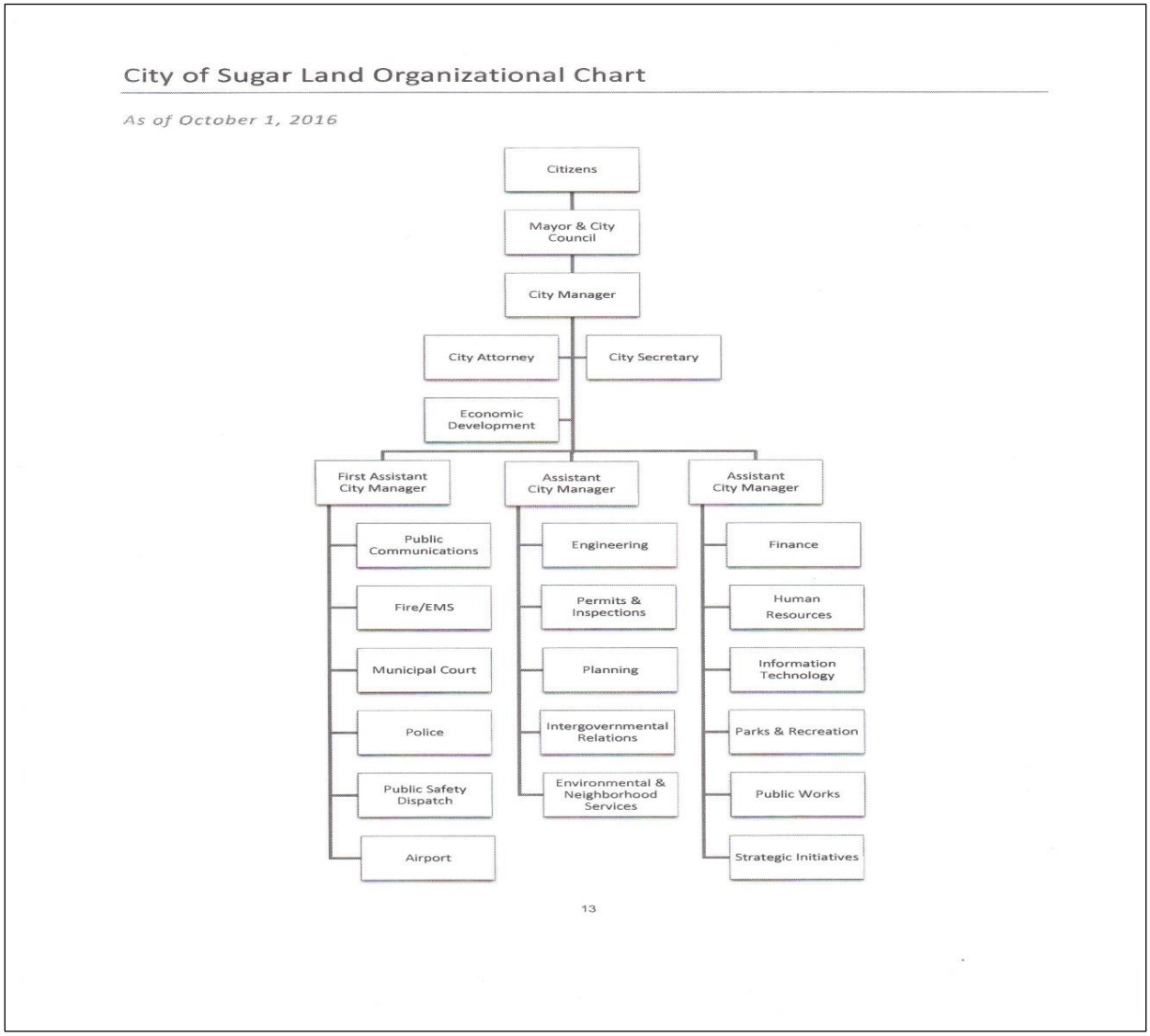
Sugar Land is located in southeastern Texas, approximately 20 miles southwest of downtown Houston, and is part of the Houston-The Woodlands-Sugar Land metropolitan area. Sugar Land is the largest city in Fort Bend County and is considered one of the fastest growing cities in Texas. In 2015 the city had an estimated population of 88,156, according to the U.S. Census Bureau. The city was first established as a sugar plantation and remains the corporate headquarters for Imperial Sugar, although all of the company's local refining and sugar cane processing were discontinued in 2003.

The corporate limits of the city encompass a land area of approximately 76.6 square miles. In addition, the SLF-EMS serves an Extra Territorial Jurisdiction (ETJ), which is primarily along the western city boundaries in the areas adjacent to Stations 6 and 7. The ETJ is estimated to be 9 square miles in area, with a service population of approximately 36,000 residents. Sugar Land is a charter city operating under a council/manager form of government. This form of government combines the political leadership of elected officials in the form of the Sugar Land City Council with the managerial experience of an appointed city administrator. The Sugar Land City Council is comprised of a Mayor and six Council Members. The Mayor is elected at-large and each City Councilor is elected from a distinct district. The Mayor and Council Members serve staggered four-year terms. The city charter is the basic law under which the city operates. The Mayor is the formal representative for the city and presides over its council meetings. The City Council serves as the legislative body for the city. Its responsibilities include enacting laws that govern the city, adopting the annual budget, and appropriating funds to provide city services. The City Council also establishes policies executed through the administration. Most transactions require only a quorum or simple majority be present.

The City Manager is responsible for the business, financial, and property transactions of the city, as well as preparation of the annual budget, appointment and supervision of personnel, enforcement of city ordinances, and the organization and general management of city departments. As chief administrator, the City Manager has no vote in the Council, but may take part in discussions of matters coming before the legislative body.

Sugar Land is typical of many cities and towns across the United States in that it operates its own public works department, parks and recreation, and several internal functions including finance and human resources. Sugar Land operates its own police department and fire department. Emergency 911 dispatch services are provided by the Sugar Land Public Safety Dispatch Center.

FIGURE 3-1: City of Sugar Land, Table of Organization



SUGAR LAND FIRE-EMS

The Sugar Land Fire-EMS (SLF-EMS) is a career fire department comprised of 122 personnel, of which 112 are sworn, uniformed fire-rescue personnel. The department has six civilian support staff. The department is led by a Fire Chief who has overall responsibility for managing the department's day-to-day operations and administrative oversight. The Fire Chief is assisted by four Assistant Fire Chiefs, who head the department's four principal divisions: Emergency Operations/EMS, Planning and Development, Prevention and Public Education, and Emergency Management.

Emergency Operations/EMS is responsible for providing the department's emergency response functions for a wide array of fire, rescue, and emergency medical incidents. The SLF-EMS operates from seven fire stations. The department staffs five engines and two quints (ladders), three EMS ambulances (rescues), and a Battalion Chief-command vehicle. These units operate 24 hours per day, 7 days a week. SLF-EMS also operates what it calls a "power unit." This is a

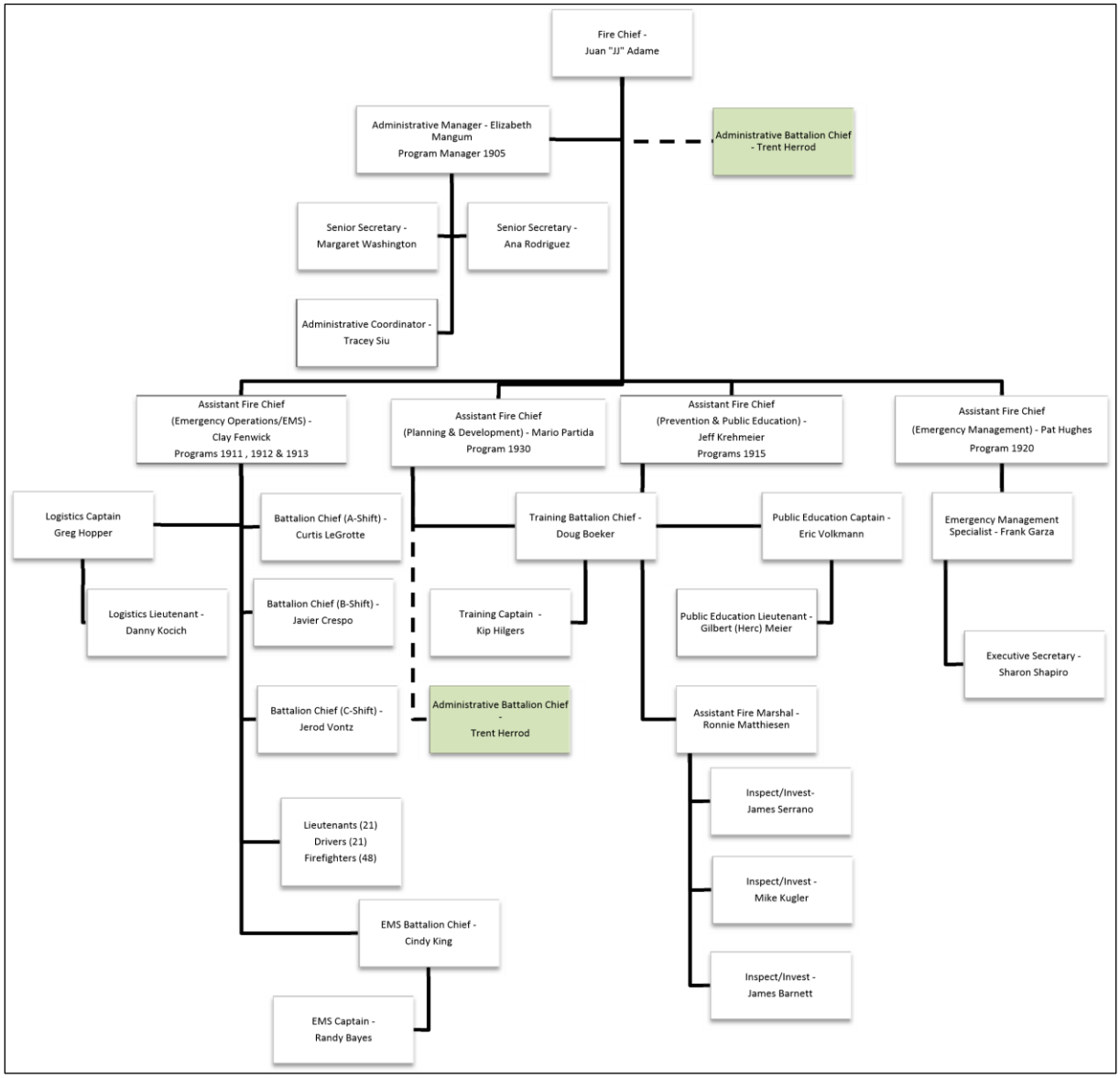
fourth transport-capable rescue truck that is in-service on weekdays (Monday-Friday) from 9:00 a.m. to 5:00 p.m. The power unit is staffed with off-duty personnel on an overtime basis. SLF-EMS staffs its engines and ladder companies each with three personnel. The rescue ambulances are staffed with two personnel.

During the one-year period from July 1, 2015 through June 30, 2016 studied by CPSM, the SLF-EMS responded to 8,043 incidents, of which 68 percent were EMS-related. A total of 2,655 patients were transported to area hospitals during this time frame. All fire department personnel are cross-trained to at least the emergency medical technician (EMT) level, with a significant number possessing advanced life support/paramedic certification. The department provides engine-based advanced life support services on all of its primary first response apparatus.

In addition to their emergency response duties, emergency services personnel also provide a wide range of customer service and community relations services, including blood-pressure screenings, tours of fire stations and apparatus, and fire and life safety presentations. However, in-service emergency personnel do not conduct annual fire inspections on a regular basis.

Operations personnel work a three-platoon system in which personnel are on duty for 48 hours followed by 96 hours off. Each 24-hour platoon is supervised by an operational Battalion Chief, who reports to the Assistant Fire Chief for emergency services. Each engine and ladder company is supervised by a Lieutenant. Figure 3-2 illustrates the current organizational structure of the Sugar Land Fire-EMS.

FIGURE 3-2: Sugar Land Fire-EMS, Table of Organization



Staffing and Deployment

Individual unit staffing and the minimum daily staffing levels are perhaps the most contentious aspect in managing fire operations in the U.S. There are a number of factors that have fueled the staffing debate. It should be noted that aside from FAA requirements for minimum staffing levels at commercial airports***, there are no state or federal requirements for the staffing of fire apparatus.*** The U.S. Occupational Safety and Health Administration (OSHA) has issued a standard that has been termed the ***"Two-in-Two-Out"*** provision. This standard affects most public fire departments across the U.S., including SLF-EMS. Under this standard, firefighters are required to operate in teams (of no less than two personnel) when engaged in ***interior structural firefighting.*** The environment in which interior structural firefighting occurs is further described as areas that are immediately dangerous to life or health (an IDLH atmosphere) and subsequently require the use of self-contained breathing apparatus (SCBA). When operating in these

conditions, firefighters are required to operate in pairs and they must remain in visual or voice contact with each other and must have at least two other employees located outside the IDLH atmosphere. This assures that the "***two in***" can monitor each other and assist with equipment failure or entrapment or other hazards, and the "***two out***" can monitor those in the building, initiate a rescue, or call for back-up if a problem arises.[1] This standard does not specify staffing on individual apparatus but instead specifies a required number of personnel be assembled on-scene when individuals are in a hazardous environment. There is, however, a provision within the OSHA standard that allows two personnel to make entry into an IDLH atmosphere without the required two back-up personnel outside. This is allowed when the personnel are attempting to rescue a person or persons in the structure before the entire team is assembled.[2]

A second factor that contributes to the staffing debate is the national Fire Protection Association (NFPA) standard 1710, *Organization and Deployment of Fire Suppression Operations, Emergency Medical Operations, and Special Operations to the Public by Career Fire Departments (2016 Edition Sec., 5.2.1.)*, which specifies that the staffing level on responding engine and ladder companies be established at a minimum of four on-duty personnel. Unlike the OSHA guideline, which is a mandatory provision, the NFPA 1710 guideline is advisory and communities (including Sugar Land) are not required to adhere to this NFPA guideline. NFPA 1710 also provides guidance regarding staffing levels for units responding to EMS incidents, however the provision is less specific and does not specify a minimum staffing levels for EMS response units. Instead the standard states; "*EMS staffing requirements shall be based on the minimum levels needed to provide patient care and member safety.*"[3] The difficulties that many agencies have is the co-utilization of fire companies and EMS companies in responding to both fire and EMS calls. Working fires involving hazardous environments are labor intensive and more personnel are needed to effectively manage these incidents. EMS calls are typically managed with fewer personnel, the majority of which can be handled with a single rescue company of two fire personnel. In the call screening process, those calls that require additional personnel are typically identified at the dispatch level and additional personnel can be assigned when needed.

Within the city there are seven fire suppression companies that are staffed on a daily basis. Normal staffing for the five engines and two ladders is set at a minimum of three personnel. In addition, in three of the seven stations (stations 1, 2, and 4), Sugar Land operates two-person ambulances. Some companies will occasionally operate with four personnel, depending upon the number of personnel on various types of leave.

The SLF-EMS delivers field operations and emergency response services through a clearly defined division of labor that includes a middle manager (Battalion Chief), first-line unit supervisors (Lieutenants), and technical specific staff: drivers, firefighters, and paramedics. CPSM was asked to evaluate the level of supervision for EMS activities. In Sugar Land as in many fire agencies, there are various levels of EMS training. The basic level is that of the EMT (Emergency Medical Technician). The EMT is trained to deliver basic life support services (BLS), which include a limited range of diagnostic and first aid treatment including CPR, airway management, bandaging, splinting, spinal immobilization, and treatment for shock. Sugar Land also utilizes to a limited degree advanced EMTs (AEMTs). These individuals have extended training and are permitted, under medical direction, to administer certain drugs, have broader diagnostic training, and can provide an enhanced level of care. Paramedics are able to deliver the highest level of prehospital emergency medical care, which is considered advanced life support services (ALS).

[1] OSHA-Respiratory Protection Standard, 29CFR-1910.134(g)(4)
[2] Ibid, Note 2 to paragraph (g).
[3] (NFPA) 1710, *Organization and Deployment of Fire Suppression Operations, Emergency Medical Operations, and Special Operations to the Public by Career Fire Departments (2016 Edition Sec., 5.3.32.)*.

At this level, there are expanded diagnostic capabilities, the ability to administer a wider array of medicines, including controlled substances, again operating under the direction of a medical doctor utilizing medical protocols to guide these efforts. Paramedics generally are in charge of overall patient care, including the determination regarding transport and the responsibility for patient reporting.

The supervision of EMS activities is separate and apart from the typical oversight provided by the Battalion Chief or the station Lieutenant. Battalion Chiefs and Lieutenants would be capable of supervising EMS activities if they are trained at the paramedic level. However, Lieutenants and chief officers in the SLF-EMS are not required to possess paramedic training and certification. Subsequently, EMS field supervision, including the adherence to medical protocols, is provided by a 40-hour EMS staff that includes one Captain and an EMS-BC. In addition to protocol compliance, there are a number of logistical considerations that warrant separate EMS supervision. These include the management of EMS supplies, medication control, and the disposal of biohazards. In addition, dealing with patient complaints, managing patient refusals for transport, oversight of EMS billing, EMS training, the quality assurance of EMS reports, performance appraisals, and interaction with the medical director and area hospitals are a few of the more notable activities. CPSM recognizes the need for additional EMS field supervision in the Sugar Land system and believes that a field EMS Captain is warranted on each shift.

> ***Recommendation: The Sugar Land Fire-EMS should establish the position of EMS Captain, with one position assigned to each shift (three positions total), and should select these positions via an open, competitive promotional process.***

Placing an EMS Captain in a field assignment will expand the supervisory oversight of EMS activities and broaden the command presence in field operations currently provided by the BC. It is critical that this individual possess the necessary training and supervisory skills to be effective in this role. This selection process should be rolled out through a formal promotional process that is open and competitive, with established prerequisites and testing to evaluate and select the appropriate candidates. CPSM further recommends that this be a working supervisor who is assigned to one of the three rescue units. In an effort to observe each of the field paramedics, there should be an ongoing rotation process that moves each field paramedic to work with the EMS Captain for a designated number of hours each year. In addition, the newly promoted EMS Captains should also spend some ride time on each of the other transport-capable rescue vehicles to ensure consistency in field operations within the various station assignments.

SLF-EMS operates eleven emergency response units with a minimum daily staffing that has been established at 28 personnel. When the power unit is operational, the number of on-duty staffing is increased to 30 personnel. Table 3-1 identifies the equipment and personnel assigned daily to each fire station.

TABLE 3-1: SLF-EMS Fire Stations, Response Units, and Assigned Personnel

Station #	Response Units	Assigned Personnel
1	1 Engine 1 Ambulance	3 2
2	1 Ladder/Quint 1 Ambulance	3 2
3	1 Engine	3
4	1 Ladder/Quint 1 Ambulance 1 Power Unit 1 Command/BC	3 2 2* 1
5	1 Engine	3
6	1 Engine**	3
7	1 Engine	3

Note: *The power unit is operated Monday-Friday, 9:00 a.m. to 5:00 p.m. ** A Fort Bend County EMS ambulance operates from Station 6

It is critical that many of the program management duties required in the operation of a modern fire and EMS organization be delegated and under the direction of field personnel. The capability of varied personnel to properly manage key organizational duties is beneficial from a career development perspective. Many agencies often assign the oversight of program management duties to those staff officers and chief officers who are assigned to 40-hour assignments, thus 24-hour line personnel have limited involvement in these critical department functions. CPSM believes that many of these duties are better suited to and provide exposure and a learning environment for field personnel. In addition, the assumption of program management duties and the effectiveness of how individuals perform in these capacities is a viable consideration in the promotional testing process. Table 3-2 lists a number of program management duties that could be considered for field personnel.

TABLE 3-2: Program Assignment Duties

Program Description	Assignment Level
Promotional Testing	Battalion Chief
Performance Appraisals	Battalion Chief
Haz Mat/Technical Rescue	Battalion Chief
Employee Recognition/Awards	Battalion Chief
CISM/EAP	Battalion Chief
Sick Leave/Absenteeism Review	Battalion Chief
Budget Committee	Battalion Chief
Payroll/Telestaff Auditing	Battalion Chief
Police Department Liaison	Battalion Chief
EMS Protocols	Lieutenant
Station Maintenance/Upkeep	Lieutenant
Fire Reporting QA	Lieutenant
Hose Testing	Lieutenant
Hydrant Testing	Lieutenant
Radio Programing	Lieutenant
Mapping	Lieutenant
Fire Pre-Incident Planning	Lieutenant
Infectious Disease Control	Lieutenant
EMS Supplies/Decon/Bio Disposal	Lieutenant
911/MVRD Liaison	Lieutenant
Station Response Areas	Lieutenant
Response Protocols	Lieutenant
Fire Investigations	Lieutenant
Safety/ReHab/Risk Management	Lieutenant
SOP/Ops Committee	Lieutenant/Driver/FF
Fitness Committee	Lieutenant/Driver/FF
Recruit Training/Proctoring	Lieutenant
Public Information Officer	Lieutenant/Driver/FF
Driver Training /EVOC	Lieutenant/Driver
Internal Communications/Newsletter	Lieutenant/Driver/FF
Social Media/FD Web Page	Lieutenant/Driver/FF
FF/EMS Recruitment Committee	Lieutenant/Driver/FF
Car Seats Installation	Lieutenant/Driver/FF
Smoke Detector Replacement	Lieutenant/Driver/FF

Recommendation: The SLF-EMS should consider assigning program management duties to field personnel and utilize these assignments for career development and consideration in promotional testing.

The ability to communicate work assignments and new program initiatives or merely to update employees on departmental programs or the strategic direction of the organization requires ongoing outreach, specifically from the Fire Chief and the Assistant Chiefs. The SLF-EMS utilizes its Friday newsletter to address many of these issues, but the ability to have direct interaction with

the membership and to answer questions is limited in this forum. There are a number of communication tools currently available that can be used to conduct video conference calls and information exchanges among multiple work settings (See GoTo Meeting, Skype for Business, AnyMeeting, Adobe Connect, etc.). These tools are inexpensive and for some applications, once the initial software is purchased there are no recurring charges. CPSM believes that the SLF-EMS will benefit greatly from an expanded information exchange, which would also prove useful in coordinating daily training assignments, shift activities, personnel movements, etc.

Recommendation: The SLF-EMS should institute a periodic meeting forum (weekly / monthly / quarterly) to discuss departmental initiatives and new directives, and that includes all on-duty members of the organization and chief officers, with the forum held via an Internet-based conference calling or video conferencing format.

Fire Stations

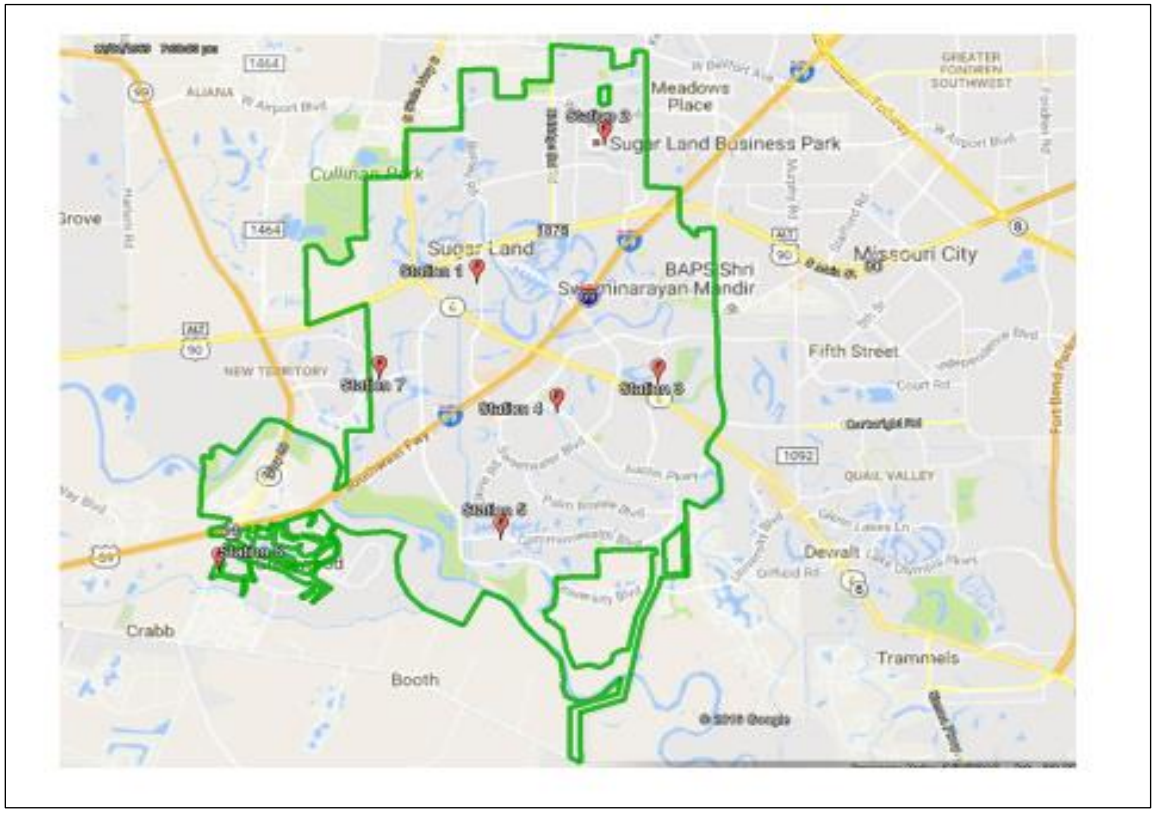
Fire department capital facilities are exposed to some of the most intense and demanding uses of any public local government facility, as they are occupied 24 hours a day and 7 days each week.4 The Sugar Land Fire-EMS operates out of seven fire stations with eleven staffed emergency response apparatus. Fire administration offices are located at 10405 Corporate Dr. A profile of the seven fire stations is provided in Table 3-3.

TABLE 3-3: Sugar Land Fire Stations Profile

Building	Address	Year Built	Size/Sq.Ft.
Fire Station #1	555 Matlage Way	2009	10,491
Fire Station #2	104 Industrial Blvd.	1986	6,440
Fire Station #3	2255 Settlers Way	1991	5,490
Fire Station #4	2100 Austin Parkway	1995	6,030
Fire Station #5	5735 Commonwealth Blvd.	2001	7,900
Fire Station #6	6625 Sansbury Blvd	2005	7,900
Fire Station #7	1301 Chatham Ave.	2011	14,638

[4] Compton and Granito, eds., *Managing Fire and Rescue Services*, 219.

FIGURE 3-3: City of Sugar Land Fire-EMS Station Locations



A review of station locations suggests that the seven fire stations are located appropriately to mitigate risk and meet response standards. Stations are designed to adequately meet the needs of housing apparatus and necessary equipment. Typically, fire stations have an anticipated service life of 50 years. In most cases facilities require replacement because of the size constraints of the buildings, a need to relocate the facility to better serve changing population centers, the absence of needed safety features or service accommodations, and the general age and condition of the facility. SLF-EMS stations range in age from 30 years of age (station 2) to 7 years of age (station 1).

SLF-EMS stations have adequate space for personnel living needs, and adequate space is available for in-house training and study needs of station personnel. In the stations visited by CPSM staff, we observed a fair amount of clutter throughout the living and work areas. In addition, the general upkeep was in need of improvement and several aspects of facility maintenance were noted. One significant concern was that the vehicle exhaust systems in all of the stations visited were not operational. This equipment is very expensive but provides a vital safety feature in fire stations.

Recommendation: The SLF-EMS should replace, repair, and properly maintain the fire station vehicle exhaust systems.

Apparatus and Fleet Maintenance

A fire department utilizes a wide range of fire apparatus, along with tools and equipment, in carrying out its core mission. Apparatus generally include emergency response apparatus such as engines (pumpers), tenders/tankers (water supply vehicles), aerial apparatus/quints,5 rescue vehicles, and ambulances. In addition, a fleet typically includes specialized apparatus such as brush trucks, off-road vehicles, and watercraft. In addition, trailers are utilized to carry specialized equipment when needed. These can include hazardous materials response/equipment, decontamination devices and diking materials, structural collapse equipment, portable air filling stations, scene lighting, foam units, and mass casualty incident supplies. Most departments also utilize a wide range of utility vehicles including command vehicles and emergency communications units, staff vehicles, and maintenance trucks as part of their fleet.

The mission, duties, demographics, geography, and construction features within the community all play a major role in the make-up of the apparatus and equipment inventory. These factors, as well as the funding available, are taken into consideration when specifying and purchasing apparatus and equipment. Additionally, every effort should be made to make new apparatus as versatile and multifunctional as possible.

The Sugar Land Fire-EMS has a comprehensive inventory of apparatus and other vehicles. The department has five front-line engines and four reserve engines; two ladder trucks and one reserve ladder truck (quint); four medic units and one reserve medic unit. In addition, the department has an adequate fleet of command and support vehicles.

Based on CPSM's review of department vehicles (see Table 3-4), it is our view that the department is well equipped to meet the types of emergency situations that it is likely to encounter. Apparatus have the necessary pumping capacity and ladder requirements, and they meet other NFPA and ISO technical standards. The average age of a front-line engines is three years, with the oldest being seven years of age. The two ladder trucks are 10 years of age and 3 years of age, respectively. The age of the reserve apparatus is well within standard; the number and type of reserve units appear to be suitable for the size of the operational fleet.

[5] A "quint" serves the dual purpose of an engine and a ladder truck. The name "quint" refers to the five functions that these units provide: fire pump, water tank, fire hose, aerial device, and ground ladders.

TABLE 3-4: Sugar Land Apparatus Inventory

	Assignment	Type	Manufacture	Year	Age
E-1	Station 1	Engine	Spartan	2009	7 yrs.
L-2	Station 2	75' Ladder	Pierce	2006	10 yrs.
E-3	Station 3	Engine	Spartan	2015	1 yr.
L-4	Station 4	103' Ladder	Spartan	2013	3 yrs.
E-5	Station 5	Engine	Spartan	2015	1 yr.
E-6	Station 6	Engine	Spartan	2015	1 yr.
E-7	Station 7	Engine	Spartan	2011	5 yrs.
RE-1	Reserve	Engine	Spartan	2005	11 yrs.
RE-2	Reserve	Engine	Spartan	2003	13 yrs.
RE-3	Reserve	Engine	Spartan	2003	13 yrs.
RL-1	Reserve	105' Quint	Pierce	2000	16 yrs.
RE-4	Reserve	Engine	Pierce	1999	17 yrs.
HM-5	Station 5	HazMat	Pierce		
M-1	Station 1	Ambulance	Road	2014	2 yrs.
M-2	Station 2	Ambulance	Road	2014	2 yrs.
M-4	Station 4	Ambulance	Road	2014	2 yrs.
M-11	Station 4	Ambulance	Road	2014	2 yrs.
M-12	Station 2	Reserve	Road	2014	2 yrs.
B-1	Station 7	Command-BC	Chevrolet	2015	1 yr.
B-2	Station 2	Reserve Command	Chevrolet	2009	7 yrs.

The Sugar Land Fire-EMS has a partnership with Fleet Services of the Public Works Department for the design, purchase, and servicing of fire apparatus. This system is led and managed jointly by the Fleet Services Manager and the Planning and Development Assistant Fire Chief. This partnership brings the two key stakeholders together to acquire vehicles to best meet the city's needs. This joint effort also manages vehicles that transition into reserve status, which maximizes the city's investment. Vehicles then move into the retirement process and are ultimately sold at auction. CPSM recognizes the cooperative arrangement between the SLF-EMS and Fleet Services to be extremely effective and is considered a ***Best Practice***.

Prior to 2016, apparatus was replaced based solely on age. Units stayed in the fleet according to the following schedule:

- 10 years front-line service.
- 5 years in reserve.
- Retired and sent to auction in year 16

In 2016, a new program was instituted; it includes an assessment of the apparatus to determine status and replacement. The new program utilizes an assessment and inspection process for moving an apparatus from frontline status to reserve and subsequently moving an apparatus

from reserve to retirement. While apparatus data and records are maintained throughout the life of the vehicle, more focused evaluations are now made in the ninth through fifteenth year. Apparatus undergo a multi-section assessment/inspection process conducted by the fire department and Fleet Services. The process includes an inspection to assess the condition and performance of the apparatus. These assessments utilize NFPA guidelines, repair and maintenance cost analysis, technology support, performance testing, and third-party inspections. A recommendation for reserve placement and/or retirement of an apparatus is made jointly by the fire department and Fleet Services to the City Management and the City Council. The newly adopted apparatus replacement program is considered by CPSM to be efficient, cost effective, and a ***Best Practice***.

NFPA 1901, *Standard for Automotive Fire Apparatus*, 2016 edition, serves as a guide in the design of fire apparatus. The document is updated every five years, using input from the public/stakeholders through a formal review process. The committee membership is made up of representatives from the fire service, manufacturers, consultants, and special interest groups. The committee monitors various issues and problems that occur with fire apparatus and attempts to develop standards that address those issues. A primary interest of the committee over the past years has been improving firefighter safety and reducing fire apparatus accidents.

The Annex Material in NFPA 1901 contains recommendations and work sheets to assist in decision making in vehicle replacement. With respect to recommended vehicle service life, the following excerpt is noteworthy:

> *"It is recommended that apparatus greater than 15 years old that have been properly maintained and that are still in serviceable condition be placed in reserve status and upgraded in accordance with NFPA 1912, Standard for Fire Apparatus Refurbishing, to incorporate as many features as possible of the current fire apparatus standard. This will ensure that, while the apparatus might not totally comply with the current edition of the automotive fire apparatus standards, many improvements and upgrades required by the recent versions of the standards are available to the firefighters who use the apparatus."*[6]

The standard goes on to state; "*Apparatus that were not manufactured to the applicable apparatus standards or that are over 25 years old should be replaced.*"[7]

In a 2004 survey of 360 fire departments in urban, suburban, and rural settings across the nation, Pierce Manufacturing reported on the average life expectancy for fire pumpers.[8] The results are shown in Table 3-5.

TABLE 3-5: Fire Pumper Life Expectancy by Type of Jurisdiction

Demographic	First-Line Service	Annual Miles Driven	Reserve Status	Total Years of Service
Urban	15 Years	7,629	10 Years	25
Suburban	16 Years	4,992	11 Years	27
Rural	18 years	3,034	14 Years	32

Note: Survey information was developed by Added Value Inc. for Pierce Manufacturing in, "Fire Apparatus Duty Cycle White Paper," Fire Apparatus Manufacturers' Association (FAMA), August 2004.

[6] NFPA 1901, Standard for Automotive Fire Apparatus, 2016 Edition. Quincy, MA.
[7] NFPA 1901, Standard for Automotive Fire Apparatus, 2016 Edition. Quincy, MA.
[8] Fire Apparatus Duty Cycle White Paper, Fire Apparatus Manufacturer's Association. August 2004.

The Sugar Land replacement program for fire apparatus is very aggressive and the replacement schedule appears somewhat faster than the schedule identified in the FAMA survey and NFPA recommendations.

In cooperation with Fleet Services the department has developed an excellent maintenance program for its apparatus. More common vehicles, such as sedans and SUVs, are maintained by the city's fleet maintenance organization with acceptable service to the department. The city's vehicle maintenance facility was recently expanded to facilitate the repair of heavy fire apparatus, including aerial devices. The chief mechanic is certified as an Emergency Vehicle Technician (EVT).

Capital Equipment

Fire apparatus are equipped with various types of tools and equipment that are utilized in providing fire and EMS services. Many of the tools and much of the equipment carried on fire apparatus are specified in NFPA and ISO guidelines. Fire and EMS equipment includes such items as hose, couplings, nozzles, various types of ladders, foam, scene lighting, oxygen tanks, AEDs, defibrillators, small hand tools, fire extinguishers, mobile and portable radios, salvage covers, and medical equipment and supplies. Many of the small tools and equipment are considered disposable items and are replaced with ongoing operating funds. However, some pieces of equipment are very expensive, and thus require ongoing planning for their useful life and replacement. The more expensive capital items include:

- Self-contained breathing apparatus (SCBA) and fill stations.
- Firefighting PPE (personal protective equipment).
- Hydraulic/pneumatic extrication equipment.
- ECG Monitors/Defibrillators/AEDs.
- Ambulance stretchers.
- Thermal imaging cameras.
- Mobile/portable and base radios.
- Mobile data computers.
- Gas monitoring and detection devices.

Much of the more expensive capital equipment is generally on a ten-year replacement cycle. The total cost of outfitting a department the size of the SLF-EMS for the capital items described is estimated to be in excess of $2,000,000. ***It is therefore imperative that these costs be included in the apparatus replacement program and be built around the anticipated life cycle of this equipment.***

Radio Interoperability and Coverage

In general, interoperability refers to seamless radio communications between emergency responders using different communication systems or products. Wireless communication interoperability is the specific ability of emergency responders to use voice and data communication in real-time, without delay. For example, police, fire, and emergency medical services responding to an incident are interoperable when they can all communicate with one another over their individual and perhaps shared communication channels. Interoperability

makes it possible for first responders from any jurisdiction to communicate with one another at larger incidents and enables emergency planners and personnel to coordinate their radio operations in advance of major events.[9]

The Sugar Land Fire-EMS has excellent radio interoperability with law enforcement and surrounding jurisdictions. No patching of radio frequencies for mutual aid responses is necessary. However, dead spots have been experienced in some buildings. It is important that first responders are aware of known dead spots and that actions are taken to alleviate the problem or protocols established to deal with the situation. One potential solution that is gaining traction nationally is to install bidirectional antennas in buildings, tunnels, and subways to provide the necessary conduit from a responder to an Emergency Communications Center (ECC). If such modifications are fiscally impossible, the first responders need to identify those buildings and locations where transmissions are blocked and develop protocols such as use of nonrepeating channels to relay through an incident commander or someone in range to the ECC.

Recommendation: The SLF-EMS should work jointly with the police departments to consider installation of in-building wireless systems in known dead spot areas of buildings so as to enable radio communications from public safety personnel to the ECC.

[9] SAFECOM, U.S. Department of Homeland Security, "Interoperability," http://www.safecomprogram.gov/SAFECOM/interoperability/default.htm.

SECTION 4. ANALYSIS OF PLANNING APPROACHES

FIRE RISK ANALYSIS

The cost of providing fire and EMS protection in many communities has increased steadily in recent years. This has been fueled in part by rising wages, additional special pay, and escalating overtime costs. In addition, funding requirements have been compounded by increasing health insurance premiums and spiraling pension contributions. At the same time the workforce has become less productive, largely because of the increases in lost time, specifically higher vacation leave, greater usage of sick leave, and increases in other miscellaneous lost time categories (workers' compensation, light duty, FMLA, holiday leave, training leave, etc.). As a result, many jurisdictions are asking the fundamental question of whether the level of risk in their jurisdiction is commensurate with the type of protective force that is being deployed. To this end, a fire risk analysis and a hazard analysis can be helpful in providing a more objective assessment of a community's level of risk.

A fire risk analysis utilizes a "fire risk score," which is a rating of an individual property on the basis of several factors, including;

- Needed fire flow if a fire were to occur.
- Probability of an occurrence based on historical events.
- The consequence of an incident in that occupancy (to both occupants and responders).
- The cumulative effect of these occupancies and their concentration in the community.

The community risk and vulnerability assessment evaluates community properties and assigns an associated risk as either a high, medium, or low hazard. The NFPA *Fire Protection Handbook*, defines these hazards as:

> **High-hazard occupancies:** Schools, hospitals, nursing homes, explosive plants, refineries, high-rise buildings, and other high life-hazard or large fire-potential occupancies.
>
> **Medium-hazard occupancies:** Apartments, offices, and mercantile and industrial occupancies not normally requiring extensive rescue by firefighting forces.
>
> **Low-hazard occupancies:** One-, two-, or three-family dwellings and scattered small business and industrial occupancies.[10]

Plotting the rated properties on a map will provide a better understanding of how the response matrix and staffing patterns can be used to ensure a higher concentration of resources for worse-case scenarios or, conversely, fewer resources for lower levels of risk.[11]

Community risk and vulnerability assessments are essential elements in a fire department's planning process. Although the city of Sugar Land and the SLF-EMS have identified a number of

[10] Cote, Grant, Hall & Solomon, eds., *Fire Protection Handbook* (Quincy, MA: NFPA 2008), 12.
[11] *Fire and Emergency Service Self-Assessment Manual,* Eighth Edition, (Center for Public Safety Excellence, 2009), 49.

potential hazards in the community, a comprehensive community risk and vulnerability assessment has not been done.

Recommendation: The Sugar Land Fire-EMS should conduct a formal fire risk analysis that concentrates on the city's strip commercial establishments, big-box occupancies, high-rise structures, and industrial, processing, and institutional properties.

HAZARDOUS MATERIALS RESPONSE

Hazardous materials spills occur frequently within the city of Sugar Land; there are about 120 hazardous materials-related calls of varying degree each year. Transportation-related spills are typically the most prevalent. This is directly attributable to the presence of an interstate highway (I-69) and several multilane highways (Hwy's. 6, 90, 99, etc.) running through portions of the city. Another concern in the city is the Union Pacific rail line that runs along Hwy 90 and the rail yard adjacent to Old Imperial Blvd. In addition, Sugar Land operates a small commuter airport. The airport primarily serves corporate travelers, but also serves as the main reliever for larger airports in the Houston area. City emergency management officials have long been concerned about a plane accident that might impact the railway or cause a hazardous materials incident and have even exercised the scenario. Fortunately, an incident of this type has never occurred.

A significant hazardous materials incident did occur on January 8, 2007. NALCO employees were offloading ethylene diamine from a DOT-407 tank trailer when an overpressure of the tank occurred, causing the frangible disk to fail. This led to the release of a large vapor cloud of the product into the air. Traffic on Highway 90A was redirected in all lanes as were several smaller roads in the area. A shelter-in-place order was issued for a one-mile radius of the accident, including all businesses, residential, and education facilities. NALCO personnel responded and directed incident response operations, and a shelter was opened to receive those ordered to evacuate with no place to go.

Another incident occurred in May 2010. A VWR Scientific employee spilled a small amount of hydrochloric acid and ethyl ether. Sugar Land Fire-EMS personnel responded to the incident, ensuring that VWR Scientific office employees sheltered in place and that the warehouse was evacuated. Fortunately, the spill was contained in the warehouse and the incident did not impact nearby roadways. Since the incident, new safety measures have been put in place by management and future incidents like this are unlikely.

The types of hazardous materials present at fixed facilities and passing through on major transportation thoroughfares in the city are many and varied. The presence of Interstate highways and other multilane highways means an unknown quantity of hazardous materials is traveling through the city of Sugar Land on a daily basis, and this situation poses a challenge in the development of adequate mitigation measures. [12]

Responses to hazardous materials incidents are defined in the department's Standard Operating Procedure 506. The city of Sugar Land is compliant with OSHA, Hazardous Waste Operations and Emergency Response, 29 CFR Part 1910.120, and NFPA 472, Professional Competence of Responders to Hazardous Materials Incidents. Level I incidents, as defined by SOP 506, can be effectively managed and mitigated by the first response personnel without a hazardous materials response team or other special unit. These Level I incidents include:

[12] City of Sugar Land, TX Hazardous Mitigation Plan, 2014.

- Spills that can be properly and effectively contained/or abated by equipment and supplies immediately accessible to the Sugar Land Fire-EMS.
- Leaks and ruptures that can be controlled using equipment and supplies accessible to the Sugar Land Fire-EMS.
- Fires involving toxic materials and which can be extinguished and cleaned up with resources immediately available to the Sugar Land Fire-EMS
- Hazardous materials incidents not requiring civilian evacuation. (Example: A small pool supply spill that can be diluted with water for cleanup.)

Previously, the Sugar Land Fire-EMS had maintained a Hazardous Materials Response Team. While a number of hazardous occupancies exist, along with Interstate transport of hazardous materials, the hazardous materials call volume suggests that the department can effectively enter into mutual/automatic aid agreements with surrounding communities to provide technician and specialist levels of service. Each SLF-EMS responder maintains Hazardous Materials Operations-level certification, which enables them to identify hazards and defensive operations for those situations requiring Level II and III capability.

Harris County and the City of Houston maintain fully qualified and equipped hazardous materials response teams that can provide Level II and III capability within an hour of notification. The SLF-EMS has entered into agreements with both jurisdictions to better leverage these mutual aid resources.

The Fort Bend County Local Emergency Planning Committee (LEPC) was formed in 1987 under federal requirements of the Emergency Planning Community Right-to-know Act (EPCRA) and the Texas Hazard Communications Act of 1986.

The LEPC works with city/county offices of emergency management to plan emergency response for a chemical release from industrial facilities and transportation sources such as pipelines, rail cars, and tanker trucks.

Membership in the LEPC comes from different organizations including industry, fire departments, emergency medical services, law enforcement, city/county emergency management, and county residents. This sharing of knowledge and resources maximizes the coordination of the LEPC.[13] The SLF-EMS Emergency Management Coordinator is an active member of the Fort Bend County LEPC.

Recommendation: The SLF-EMS should maintain its mutual aid agreements with Ft. Bend County and the city of Houston to provide Level II and III hazardous materials response and should continually evaluate these arrangements to ensure operational effectiveness.

TARGET HAZARDS AND FIRE PREPLANNING

The process of identifying target hazards and pre-incident planning are basic preparedness efforts that have been key functions in the fire service for many years. In this process, critical structures are identified based on the risk they pose. Then, tactical considerations are established for fires or other emergencies in these structures. Consideration is given to the activities that take place (manufacturing, processing, etc.), the number and types of occupants (elderly, youth, handicapped, imprisoned, etc.), and other specific aspects relating to the

[13] Fort Bend County Local Emergency Planning Committee (LEPC) website, 2016.

construction of the facility or any hazardous or flammable materials that are regularly found in the building. Target hazards are those occupancies or structures that are unusually dangerous when considering the potential for loss of life or the potential for property damage. Typically, these occupancies include hospitals, nursing homes, high-rise, and other large structures. Also included are arenas and stadiums, industrial and manufacturing plants, and other buildings or large complexes.

NFPA's 1620 standard, *Recommended Practice for Pre-Incident Planning*, identifies the need to utilize both written narrative and diagrams to depict the physical features of a building, its contents, and any built-in fire protection systems. Information collected for prefire/incident plans includes, but is certainly not limited to, data such as:

- The occupancy type.
- Floor plans/layouts.
- Building construction type and features.
- Fire protection systems (sprinkler system, standpipe systems, etc.).
- Utility locations.
- Hazards to firefighters and/or firefighting operations.
- Special conditions in the building.
- Apparatus placement plan.
- Fire flow requirements and/or water supply plan.
- Forcible entry and ventilation plan.

The information contained in pre-incident fire plans enables firefighters and officers to have a familiarity with the building/facility, its features, characteristics, operations, and hazards, thus enabling them to more effectively, efficiently, and safely conduct firefighting and other emergency operations. Pre-incident fire plans should be reviewed regularly and tested by periodic table-top exercises and on-site drills for the most critical occupancies.

The city of Sugar Land has three hospitals: CHI St Luke's Health, Hospital Memorial Hermann Hospital, and Sugar Land Methodist. Nursing homes and assisted living facilities in the city include Home Sweet Home Assisted Living, Atria Senior Living, Kindred Transitional Care Facility, Silverado Senior Living, and Silverado Hospice Care. The city has a number of chemical distributers including, but not limited to: Chemical Connection Company, Chevron Phillips Chemical Company, Fluor, Schlumberger, Nufarm, and Avalon Chemicals Inc.

One notable business that recently raised concerns is Thermo-Fisher Scientific, Inc., a neurobiology research facility located at 1410 Gillingham Rd. in Sugar Land. On April 14, 2015, a workplace accident resulted in a spill involving a small amount of cesium-137. Thermo-Fisher manufactures gauging equipment for the petrochemical industry. Initial reports of the spill were made to the Texas Department of Health, but not to the city of Sugar Land. The city was made aware of the incident by the news media. Not reporting a radioactive substance spill to local authorities was negligent on the part of Thermo-Fisher and a more directed outreach is needed to avoid these occurrences from happening again at Thermo-Fisher and other commercial and processing entities in the city.

Many fire departments establish a uniform and systematic program for the inspection of buildings and occupancies by fire company personnel. The intent of such inspections is to locate common fire hazards and initiate action for their abatement. The purpose of the program is to

increase the current level of service and accomplish inspections of all commercial occupancies annually. Fire crews will also take this opportunity to become familiar with a business's physical layout (preplan), a great benefit if called upon to respond to an actual emergency. The Sugar Land Fire-EMS does not conduct fire company inspections.

While Standard Operating Procedure 305 sets the policy and procedures for preplanning, it does not appear to be well organized at the company level. The CPSM site visit discovered that preplans are not contained in the computer-aided dispatch data base and hard copies are not well maintained on the apparatus. SOP 305 states, "Both completed plans and plans under development must be kept on a master list at each station." Further, SOP 305 directs, "Once the Assistant Chief or his delegate has approved the plan, the plan must be placed in each engine, ladder and command vehicle."

> ***Recommendation: The Sugar Land Fire-EMS should improve its preplanning process at all target hazards and ensure these documents are stored in the on-board mobile data terminals (MDTs) in order to be readily accessible to company and chief officers during a response.***

The preplanning process is critical from both an incident planning perspective and for responder familiarization. The critical aspect in preplanning is to ensure that these plans are kept up-to-date and that all critical facilities are visited and contact is made with the building manager to facilitate this information exchange. SLF-EMS has made a number of significant and constructive efforts to improve its preplanning process and has recognized the importance of following up in this effort.

ACCREDITATION

Accreditation is a comprehensive self-assessment and evaluation model that enables organizations to examine past, current, and future service levels. It is used to evaluate internal performance and compares this performance to industry best practices. The intent of the process is to improve service delivery.

The Center for Public Safety Excellence (CPSE) provides an extensive evaluation process, on a fee basis, to member agencies and which ultimately leads to accreditation. CPSE is governed by the Commission on Fire Accreditation International (CFAI), a commission that represents a cross-section of the fire service, including fire departments, city and county management, code councils, the U.S. Department of Defense, and the International Association of Firefighters.

The CPSE Accreditation Program is built around the following key measurements:

- Determine community risk and safety needs.
- Evaluate the performance of the department.
- Establish a method for achieving continuous organizational improvement.

Local government executives face increasing pressure to "do more with less" and justify expenditures by demonstrating a direct link to improved or measured service outcomes. Particularly for emergency services, local officials need criteria to assess professional performance and efficiency.

CPSE accreditation has national recognition and is widely used throughout the fire service. The key to its success is that it allows communities to set their own standards that are reflective of their needs and a service delivery model that is specific to these needs. In addition, it is a

program that is based on ongoing improvement and continuous monitoring. The CPSE accreditation model may be well suited for Sugar Land.

Recommendation: Sugar Land should consider CPSE fire accreditation in the future.

SLF-EMS is in a developmental phase and is making critical plans for its future. Accreditation, CPSM believes, would facilitate this effort and will assist in the design of future service responsibilities and the levels of service delivery that may be considered.

SECTION 5. OPERATIONAL RESPONSE APPROACHES

As mentioned previously, many agencies incorporate the use of prefire plans to provide a response and tactical strategy for those more critical or complex occupancies in the community. Figures 5-1 and 5-2 illustrate the critical tasks and resources required on low-risk incidents and moderate-risk structure fires, respectively. Understanding the community's risk greatly assists fire department planning; then, through ongoing training these activities improve overall effectiveness and responder safety.

FIGURE 5-1: Low-Risk Response–Exterior Fire Attack

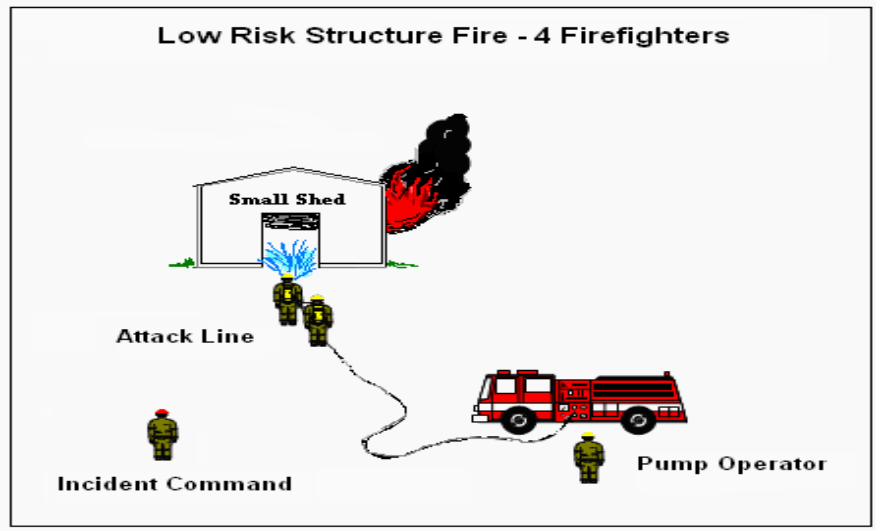
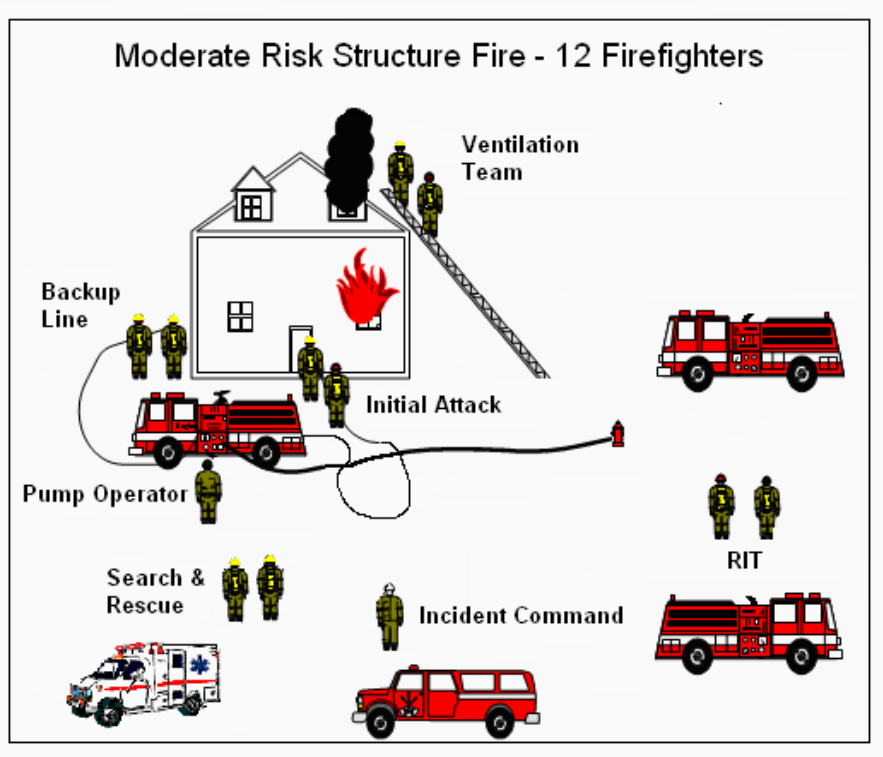


Figure 5-2 represents the critical task elements for a moderate-risk structure fire. Some jurisdictions add additional response resources to meet and in some cases exceed the national benchmarking, provided by the National Fire Protection Association (NFPA) 1710, *Standard for the Organization and Deployment of Fire Suppression Operations, Emergency Medical Operations, and Special Operations to the Public by Career Departments, 2014 Edition*. NFPA 1710 calls for the initial assignment of 14 personnel on a single family residential structure fire when an aerial ladder is not utilized. Sugar Land is able to assemble a full complement of resources for a single family residential structure fire from its on-duty resources. In fact, on the initial assignment to a residential structure fire, SLF-EMS will typically assemble upwards of 20 personnel.

FIGURE 5-2: Moderate Risk Response–Interior Fire Attack



In addition to examining risks faced by the community at large, the department needs to examine internal risks in an effort to protect all assets, particularly responding personnel. This concept is not new to the fire service and can be an excellent tool for strengthening existing health and safety guidelines. The National Fire Protection Association's *Standard for a Fire Department Occupational Safety and Health Program* (NFPA 1500) recommends the development of a separate risk management plan for fire departments.[14] The risk management plan establishes a standard of safety for the daily operations of the department. This standard of safety establishes the parameters in which the department should conduct all activities during emergency and nonemergency operations. The intent is for all members of the department to operate within this standard or plan of safety and not deviate from this process.

SUGAR LAND RESPONSE PROTOCOLS

Fire Response

The ability to assemble the necessary resources to effectively manage even a smaller residential or commercial structure fire is significant. As mentioned above, the NFPA standard (NFPA-1710) recommends a minimum of 14 personnel as the initial response to a fire at single family residential structure. An actual fire of any significance will require 14 to 17 personnel or more for extended periods of time. Fortunately, the SLF-EMS's current minimum on-duty staffing (28 to 30 personnel) is sufficient to handle one working structure fire and multiple EMS calls simultaneously. As an incident grows in size and complexity, it is not unusual to see staffing needs that can

[14] Robert C. Barr and John M. Eversole, eds., *The Fire Chief's Handbook*, 6th edition (Tulsa, OK: PennWell Books), 270.

exceed 30 to 40 personnel. This would be the case in a fire at a big-box retail center such as a Home Depot or Walmart or a fire at an apartment complex. Though these larger incidents do not occur frequently, when they do occur, the ability to assemble sufficient resources rapidly can significantly impact the outcome.

The decision as to what is the proper staffing level for a specific community's protection is perhaps the most difficult assessment that is faced by policy makers and fire department leadership across the nation. As communities adjust their level of response, the costs associated with maintaining a desired level of readiness can be significant.

CPSM believes that the Sugar Land Fire-EMS is appropriately staffed to manage its current workload. The point was made to the CPSM team that the staffing level on engines and ladders was reduced from four persons to three person in order to add the three ambulance units into service and provide ambulance transport. CPSM agrees with this redeployment of personnel and believes that the three-person staffing on engines and ladders is appropriate for the SLF-EMS system. In looking, however, at the unit assignments to a reported structure fire, CPSM believes that the current deployment of five apparatus (engines and ladders), one ambulance, one BC, and the power unit (when available) should be reevaluated.

> ***Recommendation: The SLF-EMS should reevaluate its initial assignment of equipment and personnel to a reported structure fire.***

The current dispatch protocol calls for upwards of eight units and as many as 20 personnel to a reported structure fire. Even when the power unit is out of service, the initial assignment calls for five apparatus, an ambulance, and a chief officer (minimum of 18 personnel). In most instances 14 personnel are sufficient to handle a smaller fire in a residential structure. The process of reducing this assignment will increase the residual forces that are available to handle simultaneous alarms and will also reduce the number of apparatus traveling in an emergency mode (hot) across the city. In the event that an incident is an actual fire, there is ample opportunity to increase the number of personnel responding.

When an actual fire occurs, many variables will impact the suppression outcomes. These variables include:

- The age and type of construction of the structure.
- The contents stored in the structure and the flammability of that contents.
- The presence of any flammable liquids, explosives, or compressed gas canisters.
- The time of detection, notification, and ultimately response of fire units.
- The presence of any built-in protection (automatic fire sprinklers) or fire detection systems.
- Weather conditions and the availability of water for extinguishment

Subsequently, in those situations in which there are extended delays in the notification process or the fire has progressed significantly, there is actually very little that can be done to limit the extent of damage to the entire structure and its contents. In these situations suppression efforts will focus on the protection of nearby or adjacent structures with the goal being to limit the spread of the fire beyond the building of origin. This is often termed ***protecting exposures***. When the extent of damage is extensive and the building becomes unstable, firefighting tactics typically move to what is called a ***defensive attack***, or one in which hose lines and more importantly personnel are on the outside of the structure and their focus is to merely discharge large volumes of water until the fire goes out. In these situations the ability to enter the building is

very limited, and if victims are trapped in the structure there are very few safe options for making entry.

Today's fire service is actively debating the options of interior firefighting vs. exterior firefighting. These terms are self-descriptive in that an ***interior fire attack*** is one in which firefighters enter a burning building in an attempt to find the seat of the fire and from this interior position extinguish the fire with limited amounts of water. An ***exterior fire attack*** is a tactic in which firefighters initially discharge water from the exterior of the building, either through a window or door and knock down the fire before entry in the building is made. The concept is to introduce larger volumes of water initially from the outside of the building, cool the interior temperatures, and reduce the intensity of the fire before firefighters enter the building. An exterior attack is most applicable in smaller structures, typically single family, one-story detached units that are typically smaller than 2,500 square feet in total floor area.

There are a number of factors that have fueled this debate, the first and most critical of which is staffing level. As fire departments operate with reduced levels of staffing, and this staff arrives at the scene from greater distances, there is little option for a single fire unit with two, three, or four personnel but to conduct an exterior attack. The United States Occupational Safety and Health Administration (OSHA), has issued a standard that has been termed the ***"Two-in-Two-Out"*** provision. This standard affects most public fire departments across the U.S., including SLF-EMS. Under this standard firefighters who are engaged in ***interior structural firefighting*** and enter an area that is immediately dangerous to life or health (an IDLH atmosphere) must remain in visual or voice contact with each other and have at least two other employees located outside the IDLH atmosphere. This assures that the "two in" can monitor each other and assist with equipment failure or entrapment or other hazards, and the "two out" can monitor those in the building, initiate a rescue, or call for back-up if a problem arises.[15] There is also a provision within the OSHA standard that will allow two personnel to make entry into an IDLH atmosphere without the required two back-up personnel. This is allowed when they are attempting to rescue a person or persons in the structure before the entire team is assembled.[16]

When using an exterior attack, the requirement of having the four persons assembled on-scene prior to making entry would not apply. Recent studies by UL have evaluated the effectiveness of interior vs. exterior attacks in certain simulated fire environments. These studies have found that the exterior attack to be equally effective in these simulations.[17] This debate is deep-seated in the fire service and traditional tactical measures have always proposed an interior fire attack, specifically when there is a possibility that victims may be present in the burning structure. The long-held belief in opposition to an exterior attack is that this approach may actually push the fire into areas that are not burning or where victims may be located. The counterpoint supporting the exterior attack centers on firefighter safety. The exterior attack limits the firefighters from making entry into those super-heated structures that may be susceptible to collapse. From CPSM's perspective, and given the likelihood that a single crew of three personnel will encounter a fire situation, it is prudent that SLF-EMS build its training and operating procedures around the tactical concept of the exterior fire attack when the situation warrants such an approach.

> ***Recommendation: The SLF-EMS should build its training regimens and tactical strategies around the exterior or transitional attack when the fire scenario and the number of responding personnel warrant this approach.***

[15] OSHA-Respiratory Protection Standard, 29CFR-1910.134(g)(4)
[16] Ibid, Note 2 to paragraph (g).
[17] "Innovating Fire Attack Tactics", U.L.COM/News Science, Summer 2013.

Table 5-1 shows the aggregate call totals for the 12-month period evaluated. EMS calls represent the largest percentage of calls for service at almost 68 percent. This predominance of EMS calls is not unusual and the distribution is quite similar to many communities that CPSM has observed. While fire call types represent approximately 22 percent of all calls for service, actual fire calls (structural and outside) represent only 1.9 percent of the overall calls, with the majority of these being outside or grass fires. Hazard, false alarms, good intent, and public service calls represent the largest percentage of the fire calls (92 percent). This is also typical in CPSM data and workload analyses of other fire departments.

TABLE 5-1: Call Types

Call Type	Number of Calls	Calls per Day	Call Percentage
Breathing difficulty	490	1.3	6.1
Cardiac and stroke	527	1.4	6.6
Fall and injury	896	2.4	11.1
Illness and other	2,307	6.3	28.7
MVA	458	1.3	5.7
Overdose and psychiatric	91	0.2	1.1
Seizure and unconsciousness	662	1.8	8.2
EMS Total	**5,431**	**14.8**	**67.5**
False alarm	909	2.5	11.3
Good intent	117	0.3	1.5
Hazard	207	0.6	2.6
Outside fire	94	0.3	1.2
Public service	364	1.0	4.5
Structure fire	55	0.2	0.7
Fire Total	**1,746**	**4.8**	**21.7**
Canceled	755	2.1	9.4
Mutual aid	111	0.3	1.4
Total	**8,043**	**22.0**	**100.0**

In looking in more detail at the ***55 structure fires***, it was determined that for ***37*** of these events, there was ***no reported fire damage***. When we looked at the time spent on fire incidents, we found that on 34 of the 55 structure fires and 79 of the 94 outside fires, the call duration for these incidents was 60 minutes or less. This is indicative of minor occurrences. However, 12 structure fire calls saw a duration of greater than one hour and 9 lasted for more than two hours. This would indicate more significant events.

There were 15 structure fires in which some degree of fire damage was noted in the incident report. The total fire loss (structure and contents) for all structural fires in the 12-month evaluation period was estimated to be $578,560. Fire damage estimates are done by SLF-EMS investigators who have received specialized training in fire damage estimation. For the calls in which damage was reported (structure and contents), we estimated that the average damage for each fire was approximately $10,519. In terms comparing Sugar Land's average losses to fire losses nationwide for structure fires, NFPA estimates that in 2012 the average fire loss for a

structure fire was $20,345.[18] From this perspective the average fire loss in Sugar Land is much lower than the amount of loss found in many communities across the nation. Our initial review of fire loss indicated an event in which the fire loss associated with this one structure fire was $1.1 million. However, when we questioned the Fire Marshal on this large fire loss incident, the amount of loss was revised to $400,000. This point is further discussed elsewhere in this study.

Another indicator of the severity of fire loss is the frequency of individual events in which the combined loss exceeds $20,000. The $20,000 demarcation is relevant from two perspectives; first, as indicated earlier this amount is the national average, and second, this level indicates a fire loss that from CPSM's perspective is representative of a more significant fire event that requires fire department extinguishment. In the period evaluated, there were only four structure fire events in which the combined property and contents loss exceeded $20,000. It is hard to clearly define a reasoning for the lower number of fires that resulted in significant fire loss. Much of this must be attributed to the quality of the fire suppression skills exhibited by SLF-EMS and another factor must be the fire safe attitudes of the residents and their ability to limit those factors that contribute to larger fire loss. Table 5-2 and Table 5-3 provide an analysis of the Sugar Land fire loss in the evaluation period.

TABLE 5-2: Content and Property Loss – Structure and Outside Fires

Call Type	Property Loss		Content Loss	
	Loss Value	Number of Calls	Loss Value	Number of Calls
Outside fire	$296,350	20	$233,600	9
Structure fire	$367,900	15	$210,660	13
Total	**$664,250**	**35**	**$444,260**	**22**

Note: This analysis only includes calls with recorded loss greater than 0.

Observations:

- Out of 94 outside fires, 20 had recorded property loss, with a combined $296,350 in loss.
- Nine outside fires had content loss with a combined $233,600 in loss.
- Out of 55 structure fires, 15 had recorded property loss, with a combined $367,900 in loss.
- 13 structure fires had content loss with a combined $210,660 in loss.
- The average total loss for all structure fires was $10,519.

TABLE 5-3: Total Fire Loss Above and Below $20,000

Call Type	No Loss	Under $20,000	$20,000 plus
Outside fire	74	18	2
Structure fire	37	14	4
Total	**111**	**32**	**6**

Observations:

- The average total loss for all structure fires was $10,519.

[18] Michael J. Karter Jr., *Fire Loss in the United States during 2012*, NFPA September 2013, 13.

- 74 outside fires and 37 structure fires had no recorded loss.
- Two outside fires and four structure fires had $20,000 or more in loss.
- The highest total loss for an outside fire was $300,000.
- The highest total loss for a structure fire was $400,000.

Our assessment of the mode of response of SLF-EMS units indicates a need for improvement. For EMS-related calls, SLF-EMS units are running ***"hot"*** on approximately 99 percent of all EMS incidents. A "hot" response is when units respond with lights and sirens; in this mode they may pass red lights, stop signs, and utilize other response patterns that expedite their rate of travel. This analysis indicated that only on very isolated occasions, 65 times in the evaluation period (1.2 percent), did a SLF-EMS unit run ***"cold"*** to an EMS incident. A cold response is when a unit responds without its lights and sirens and follows the normal flow of traffic, stopping for red lights, stop signs, etc. On fire calls, SLF-EMS units are running hot on nearly 68 percent of incidents and are running cold on about 32 percent of these calls. The ability to respond the fewest number of units and have these units respond in a "cold mode of response" results in the maximization of resources and improved responder safety. Emergency response units that are responding with lights and sirens are more susceptible to traffic accidents. Accidents involving fire vehicles responding to emergencies are the second highest cause for line-of-duty deaths of firefighters.[19] It is estimated that more than 30,000 fire apparatus are involved in accidents when responding to emergencies each year in the U.S.[20] Responding fewer units and having these units respond in a nonemergency mode makes sense in terms of safety and efficiency.

CPSM believes that the SLF-EMS can improve its proficiency in the management of its responding resources to the myriad of incidents that typically occur. Two key factors impact response workloads. The first is the number of units that are dispatched to the various incident types and the second is the mode in which they respond. It is important to note that in most emergency delivery systems, there are a large number of calls that are nonemergency in nature. Many of these are service-related calls in which the public utilizes emergency responders to mitigate situations that do not require an emergency response. Some of these responses are accidental or there is a perceived problem that when investigated are found to be nonemergency. Many calls, however, are public assists, in which individuals request assistance through the 911 system because they know the response will be immediate and there are typically no charges attached with these responses. It is only through the combined effort between the 911 dispatch center and the fire department that adjustments to the response protocols can result in system improvements.

> ***Recommendation: The SLF-EMS should work with the dispatch center to develop methodologies that improve the call screening process in order to alter response patterns when calls are determined to be minor or nonemergency.***

Table 5-4 is the summary of the number of units responding to the EMS and Fire calls handled in the 2015-2016 timeframe. As noted in the charts in Figure 5-3, only 36 percent of all EMS responses and 85 percent of fire calls are handled by a single unit. In discussing this issue with SLF-EMS officials, it was determined that on nearly two-thirds of all EMS calls, both an ambulance and a fire apparatus are dispatched. It was also noted that when a single unit response does occur for an EMS call, that single unit is one of the SLF-EMS ambulances. We also were advised that on minor EMS calls (nonemergency), in those station areas that are serviced with only a fire

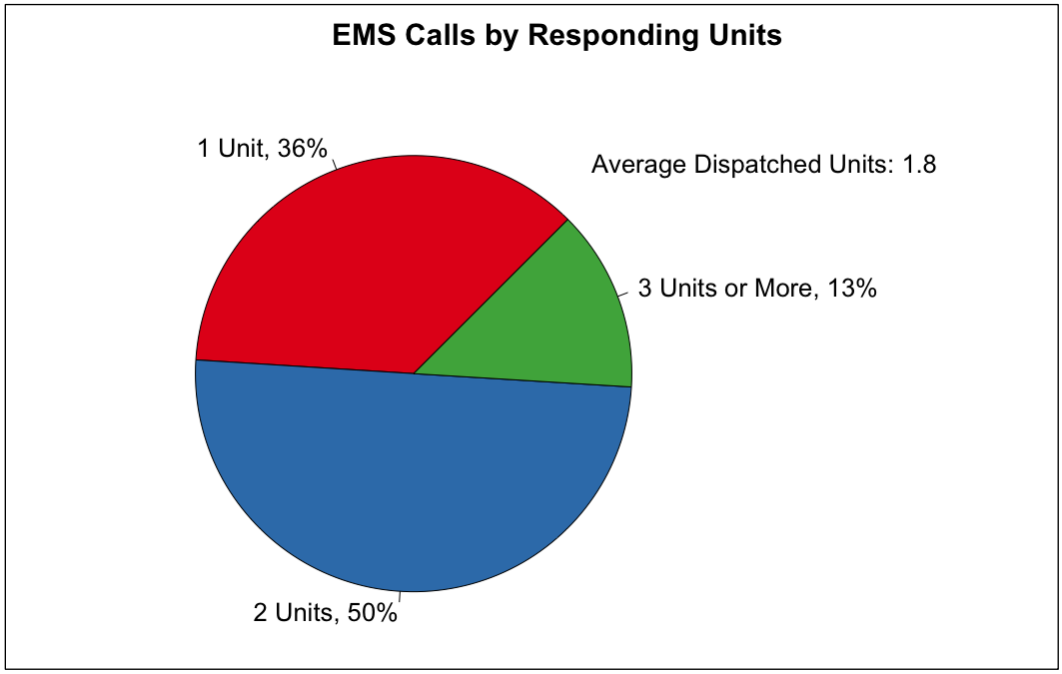
[19] "Analysis of Firetruck Crashes and Associated Firefighter Injuries in the U.S." Association for the Advancement of Automotive Medicine. October-2012.
[20] Ibid.

apparatus (stations 3, 5, 6, and 7), the single unit that responds is an ambulance. CPSM believes that the current deployment strategy being utilized in the Sugar Land system should be reevaluated.

> ***Recommendation: The SLF-EMS should consider dispatching only a fire unit to those minor EMS calls that do not warrant an ALS/ambulance response.***

The ability to respond the most appropriate level of resources is critical in the overall efficiency of the system and the safety of emergency responders. The Sugar Land public safety dispatch center is very capable of screening calls sufficiently to identify emergency and nonemergency call categories. It is essential that SLF-EMS and the dispatch center work together to adjust response assignments to improve these outcomes.

FIGURE 5-3: Number of Units Dispatched to Calls



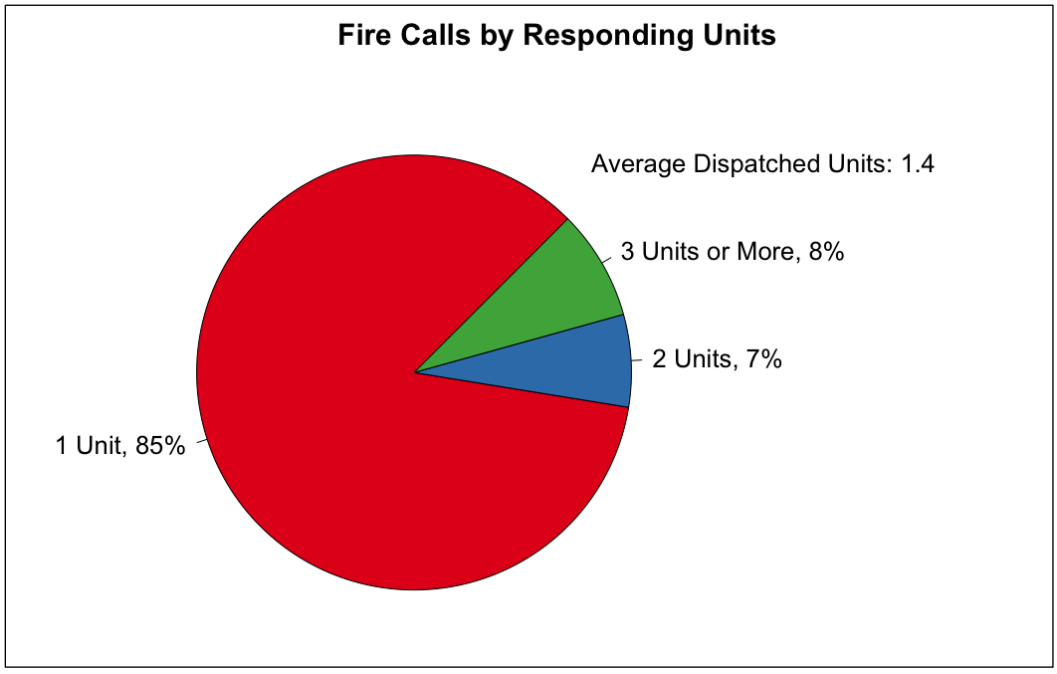


TABLE 5-4: Number of Units Dispatched to Calls by Call Type

Call Type	Number of Calls			
	One	Two	Three or More	Total
Breathing difficulty	7	440	43	490
Cardiac and stroke	8	481	38	527
Fall and injury	39	776	81	896
Illness and other	1,875	382	50	2,307
MVA	7	306	145	458
Overdose and psychiatric	36	45	10	91
Seizure and unconsciousness	10	287	365	662
EMS Total	**1,982**	**2,717**	**732**	**5,431**
False alarm	817	47	45	909
Good intent	92	11	14	117
Hazard	172	18	17	207
Outside fire	61	15	18	94
Public service	331	26	7	364
Structure fire	10	3	42	55
Fire Total	**1,483**	**120**	**143**	**1,746**
Canceled	620	95	40	755
Mutual aid	90	19	2	111
Total	**4,175**	**2,951**	**917**	**8,043**
Percentage	**51.9**	**36.7**	**11.4**	**100.0**

Observations:

Overall

- On average, 1.6 units were dispatched to all calls, and for 52 percent of calls only one unit was dispatched.
- Overall, three or more units were dispatched to 11 percent of calls.

EMS

- On average, 1.8 units were dispatched per EMS call.
- For EMS calls, one unit was dispatched 36 percent of the time, two units were dispatched 50 percent of the time, and three or more units were dispatched 13 percent of the time.

Fires

- On average, 1.4 units were dispatched per fire call.
- For fire calls, one unit was dispatched 85 percent of the time, two units were dispatched 7 percent of the time, and three or more units were dispatched 8 percent of the time.
- For structure fire calls, three or more units were dispatched 76 percent of the time.
  - Three to six units were dispatched 15 percent of the time.

- Seven units were dispatched 40 percent of the time.
- Eight or more units were dispatched 22 percent of the time.

- For outside fire calls, three or more units were dispatched 19 percent of the time.

In our discussions with Sugar Land fire officials on this issue, there was an acknowledgement that improvements were needed. Efforts are underway to effectuate these changes and SLF-EMS officials are working with the dispatch center to reviser response protocols.

CPSM has also found that a number of fire and EMS agencies are giving their officers expanded latitude to modify their response (hot or cold) on the basis of the information they obtain from the dispatcher's notes. This approach requires a high degree of coordination and appropriate field judgment, but if carried out effectively can dramatically improve outcomes.

> ***Recommendation: The SLF-EMS should consider the option of giving responding personnel greater latitude in adjusting their mode of response (hot or cold) on the basis of the review of dispatcher notes and/or their familiarity with the call request.***

EMS Response and Transport

EMS calls are the predominant workload in the SLF-EMS system. As mentioned earlier, nearly 68 percent of all call activities reviewed in our analysis involved EMS responses. SLF-EMS provides EMS response and transport to calls originating within city limits and the ETJ. The SLF first assumed transport duties in January 2015. Prior to this date, transports were provided by Fort Bend County EMS. SLF-EMS has made a commendable effort in its transition into the transport arena. In order to accommodate transport service, a number of the department's personnel completed paramedic training, In addition, new hires were made and SLF-EMS reallocated engine and ladder company personnel in order to staff and operate three EMS ambulances. SLF-EMS also put into service a fourth EMS ambulance (the power unit), which is staffed weekdays (Monday-Friday), from 9:00 a.m. to 5:00 p.m. with off-duty personnel on an overtime basis.

The EMS workload in the Sugar Land system is very manageable. On average, SLF-EMS units respond to 15 EMS calls each day. The average call duration for each non-transport EMS call is just under 33 minutes, while the length of transport calls averages approximately 61 minutes. Fire calls account for approximately five additional calls each day. Combined, fire, EMS, mutual aid and canceled calls generate an average of 22 calls each day in the Sugar Land system. Since most calls result in a response by multiple units, these 22 calls generate an average of 36 unit responses each day.

An examination of the in-service time for all units in the Sugar Land system, shows, not surprisingly that Medic 1 and Medic 4 are the busiest units, each making an average 4.1 runs per day. Both of these ambulance units (Medic 1 and Medic 4) are deployed, on average, a total of three hours each day. Due to a lesser call volume, Medic 2 is deployed on average 2 hours and 43 minutes each day. Even for the busiest fire apparatus in the system (Engine 1), we see a much lower average daily deployed time, approximately 1 hour and 28 minutes. Table 5-5 shows the workload by unit in the Sugar Land system.

TABLE 5-5: Call Workload by Unit

Station	Unit Type	Unit	Avg. Deployed Min. per Run	Total Annual Hours	Avg. Deployed Min. per Day	Total Annual Runs	Avg. Runs per Day
1	Ambulance	M-1	43.2	1,085.7	178.0	1,507	4.1
	Engine	E-1	22.9	537.5	88.1	1,407	3.8
2	Ambulance	M-2	53.1	992.9	162.8	1,122	3.1
	Ladder	L-2	25.5	518.4	85.0	1,221	3.3
3	Engine	E-3	24.7	390.8	64.1	949	2.6
4	Ambulance	M-4	45.5	1,137.4	186.5	1,501	4.1
	Ladder	L-4	23.0	487.8	80.0	1,271	3.5
	SUV	S-4	19.0	5.1	0.8	16	0.0
5	Engine	E-5	21.1	180.1	29.5	513	1.4
	Haz-Mat	H-5	66.6	17.8	2.9	16	0.0
6	Engine	E-6	21.0	380.7	62.4	1,087	3.0
7	Engine	E-7	21.4	372.9	61.1	1,048	2.9
	SUV	B-1	26.6	295.6	48.5	667	1.8
Varies	Ambulance	M-11	45.8	703.4	115.3	921	2.5
Total			**32.2**	**7,106.1**	**1,164.9**	**13,246**	**36.2**

Note: Ambulance M-11 is the power unit and was deployed from multiple stations during the study period.

Another way to assess workload is by looking at the frequency in which calls are occurring.

Table 5-6 shows the frequency of call distribution throughout the year. This table indicates that, 92 percent of the time, two, one, or no calls occurring in each hour. With ten response units in service at all times (excluding the power unit), the frequency in which the closest available unit is unavailable has been minimal. CPSM estimates that on 80 percent of all responses the primary, in-district unit is available to respond.

TABLE 5-6: Frequency Distribution of the Number of Calls

Calls in an Hour	Frequency	Percentage
0	3,792	43.2
1	2,885	32.8
2	1,406	16.0
3	526	6.0
4+	175	2.0

Note: There are 8,760 hours in a normal year. However, 2016 was a leap year and thus had 8,784 hours.

To further qualify this assessment, we looked at the frequency of overlapping calls occurring in the system. An overlapping call is when a unit is dispatched to an incident and during that time frame a simultaneous call occurs in the same station service area. Table 5-7 is the representation of overlapping calls in the Sugar Land system.

TABLE 5-7: Overlapping Calls by Station District

District	Number of Calls	Average Minutes of Overlap	Total Hours
Station 1	497	22.0	103.2
Station 2	339	20.3	63.0
Station 3	217	22.6	42.9
Station 4	247	18.1	40.4
Station 5	37	12.0	3.8
Station 6	96	14.0	11.9
Station 7	71	13.8	8.7

Note: Because calls in two or more districts may overlap, citywide overlapping calls would not be the sum of the overlapping calls in each district.

It is important to note that Station 1 and Station 2 had the highest number of overlapping calls. In both of these stations, however, there are multiple units available and in most cases the secondary unit can handle the simultaneous alarm with minimal delay.

Another area of workload that CPSM analyzed was the frequency of patient transports compared to overall EMS calls. As noted above, on average, SLF-EMS unit respond to 15 EMS calls each day. In the 12-month period evaluated, there were a total of 2,655 transports, or an average of just over seven transports each day. This equates to a transport rate of approximately 49 percent of all EMS responses. This level of transport is consistent and perhaps a bit lower than the transport rates we have observed nationally (approximately 55 to 60 percent). From this analysis it was determined that each of the primary ambulances in service (Medics 1, 2, and 4) are each transporting two to three patients each day. On days that the power unit is in service, this unit will transport an estimated one to two calls during its in-service period of eight hours.

TABLE 5-8: Transport Calls and Rate by Call Type

Call Type	Number of Calls			Transport Rate
	Non-Transport	Transport	Total	
Breathing difficulty	162	328	490	66.9
Cardiac and stroke	159	368	527	69.8
Fall and injury	352	544	896	60.7
Illness and other	1,529	778	2,307	33.7
MVA	255	203	458	44.3
Overdose and psychiatric	40	51	91	56.0
Seizure and unconsciousness	279	383	662	57.9
Total	**2,776**	**2,655**	**5,431**	**48.9**

Observations:

- Overall, 49 percent of EMS calls to which SLF-EMS responded involved transporting one or more patients.
- On average, SLF-EMS responded to 14.8 EMS calls per day, and 7.3 involved transporting one or more patients.
- Cardiac and stroke calls had the highest transport rate, averaging 70 percent.

TABLE 5-9: Transport Call Duration by Call Type

Call Type	Non-Transport		Transport	
	Average Duration	Number of Calls	Average Duration	Number of Calls
Breathing difficulty	43.4	162	59.7	328
Cardiac and stroke	46.6	159	59.8	368
Fall and injury	36.3	352	60.4	544
Illness and other	27.0	1,529	61.3	778
MVA	35.6	255	64.9	203
Overdose and psychiatric	39.3	40	59.6	51
Seizure and unconsciousness	40.3	279	61.5	383
Total	**32.6**	**2,776**	**61.0**	**2,655**

Note: Duration of a call is defined as the longest deployed time of any of the SLF-EMS units responding to the same call.

Observations:

- The average duration was 33 minutes for a non-transport EMS call.
- The average duration was 61 minutes for an EMS call where one or more patients were transported to a hospital.
- On average, a transport call lasted 1.9 times as long as a non-transport EMS call.

CPSM was asked to evaluate the efficiency of maintaining the power unit in service on an overtime basis. Based on the review of the current workload and the frequency of daily transports, it does not appear that removing this unit from service will adversely impact the workloads of the remaining transport units.

Recommendation: The SLF-EMS should consider removing the power unit from service.

The current average workload of just over seven transports each day is not excessive given the three ambulances currently operational in the Sugar Land system. If the SLF-EMS were to implement a single fire unit response to those EMS calls that are nonemergency, this would significantly increase the availability of the three transport units. In addition, SLF-EMS should consider the cross-staffing of its ladder trucks with ambulances. This deployment option will further increase the number of transport units available from three to five on a full-time basis.

Recommendation: The SLF-EMS should consider the cross-staffing of its ladder companies with transport-capable ambulances.

MUTUAL AID/AUTOMATIC RESPONSE

Local governments use many types of intergovernmental agreements to enhance fire protection and EMS services. These arrangements take many shapes and forms and range from a simple automatic response agreement that will respond a single unit to a minor vehicle accident or EMS call, to a more complex regional hazardous materials team or a helicopter trauma service that involves multiple agencies and requires a high level of coordination. It is important that fire departments are able to quickly access extra and/or specialized resources to manage significant events. In addition, because these types of incidents do not respect jurisdictional boundaries, they often require coordinated response. Sharing resources also helps departments reduce costs without impacting service delivery. All of these situations point to the need for good working relationships with other fire and EMS organizations.

The SLF-EMS appears proficient in its use of mutual aid with neighboring jurisdictions. In the 12-month period evaluated a total of 189 mutual aid responses were initiated by SLF-EMS units (of the 189 mutual aid requests, 78 responses were canceled prior to arrival). During this time frame the SLF-EMS received mutual aid a total of 42 times. Those agencies most likely to give and receive mutual aid were Fort Bend EMS, Stafford, Missouri City, Rosenberg, and Richmond. As noted earlier, SLF-EMS recently entered into mutual aid agreements with Fort Bend County and the city of Houston for hazardous materials response.

WORKLOAD ANALYSIS

When looking at workload it is important to understand the distribution of call activity among the various responding units and the amounts of time each unit spends on the various call types. The key to service efficiency is maintaining the proper level of resources so that units are responding to a manageable number of assignments and the closest available unit is able to handle the majority of calls occurring in its primary response area. Table 5-10 provides an overview of the call distribution among the primary response units operated by SLF-EMS.

TABLE 5-10: Total Annual Runs by Call Type and Unit

Station	Unit Type	Unit	EMS	False Alarm	Good Intent	Hazard	Outside Fire	Public Service	Structure Fire	Canceled	Mutual Aid	Total
1	Ambulance	M-1	1,370	26	6	5	5	14	10	68	3	1,507
	Engine	E-1	915	183	23	44	26	59	41	107	9	1,407
2	Ambulance	M-2	1,041	17	6	1	2	10	6	38	1	1,122
	Ladder	L-2	746	184	18	41	20	50	30	95	37	1,221
3	Engine	E-3	549	86	29	34	18	51	39	110	33	949
4	Ambulance	M-4	1,379	18	5	7	4	5	21	62	0	1,501
	Ladder	L-4	802	183	28	48	21	47	40	98	4	1,271
	SUV	S-4	15	0	1	0	0	0	0	0	0	16
5	Engine	E-5	256	77	13	30	13	17	30	67	10	513
	Haz-Mat	H-5	1	0	0	9	0	0	0	2	4	16
6	Engine	E-6	662	92	20	26	24	107	14	127	15	1,087
7	Engine	E-7	651	132	29	38	26	29	31	105	7	1,048
	SUV	B-1	474	46	10	21	19	16	40	31	10	667
Varies	Ambulance	M-11	850	10	2	3	5	7	9	34	1	921
Total			**9,711**	**1,054**	**190**	**307**	**183**	**412**	**311**	**944**	**134**	**13,246**

Note: Ambulance M-11 is the power unit and was deployed from multiple stations during the study period.

As noted earlier, Medic 1 and Medic 4 are the busiest units in the SLF-EMS system, each responding to approximately 1,500 runs annually. It is important to note, however, the current workload of the two ladder trucks. Combined, the ladder units are responding to nearly 2,500 calls each year, the majority of which are EMS-related (62%). The number of EMS responses being handled by the two ladder trucks and the associated wear and tear on these apparatus should cause some concern.

There is a cost benefit in utilizing smaller, more fuel-efficient vehicles for the more frequent EMS call activity. In addition, the smaller units are more maneuverable and can achieve faster response times than the larger fire apparatus, especially ladder trucks. There is also a perceptional benefit in the community in responding an alternative response vehicle to EMS calls rather than larger fire apparatus. A number of communities are reexamining the deployment of ladders and fire trucks and opting instead to use an alternative response vehicle, ambulance, or squad unit (see, for example, Tualatin Valley Fire Rescue, "CARS" Program; and the Shreveport Fire Department, "SPRINT" Program). An analysis of repair costs for fire apparatus compared to lighter weight alternative response vehicle offers striking contrast. The cost estimates shown in Table 5-11 were utilized by the Shreveport Fire Department in making a cost comparison.

TABLE 5-11: Fire Apparatus-Small Vehicle Maintenance/Response Cost Comparison

Service	Fire Apparatus (Engine)	Alternative Response Vehicle
Oil and filter change	$175	$25.95
Set of tires	$1,800	$625
Complete brake job	$3,600	$270
Battery replacement	$429	$53.95
Alternator replacement	$1,195	$125
Windshield replacement	$2,400	$600
Fuel efficiency	3-5 MPG	15-20 MPG

When we look at the availability rates of the responding units in Sugar Land the pattern observed indicates that improvements are needed. Many systems attempt to achieve an availability rate of between 85 and 90 percent. This means that on 85 to 90 percent of calls, a unit is available to respond to an incident originating in its first due area. Availability rates are most often affected by simultaneous call activity, out-of-area training, vehicle maintenance, meetings, or other reasons in which a unit is temporarily unavailable to respond to a call in its primary response area. Table 5-12 shows is the availability rates for the responding units in the SLF-EMS.

TABLE 5-12: First Due Availability to Respond to Calls

Station Area	Number of Calls	Percent Responded to by First Due	Percent First Due Arrived First
1	1,690	80.7	74.6
2	1,238	85.8	82.4
3	953	60.0	50.6
4	1,084	82.7	67.6
5	448	72.1	68.4
6	994	87.5	84.9
7	773	82.3	77.7
Total	**7,180**	**79.7**	**66.3**

Note: The percent of calls where a unit from the first-due station arrived first is based off the number of calls where at least one unit arrived on scene.

It is difficult to determine the reasons for the low availability rates in the Sugar Land system. Based on the call volume and the average call durations, CPSM does not believe that the frequency of units being out of position is due to simultaneous calls. Many of the out-of-area responses are likely a product of responding EMS transport units into the response areas of stations 3, 5, 6, and 7. It is apparent however, that further evaluation is needed and efforts should be taken to improve unit availability.

Recommendation: the SLF-EMS should review unit availability rates and determine those measures needed to improve these outcomes.

SECTION 6. RESPONSE TIME ANALYSIS

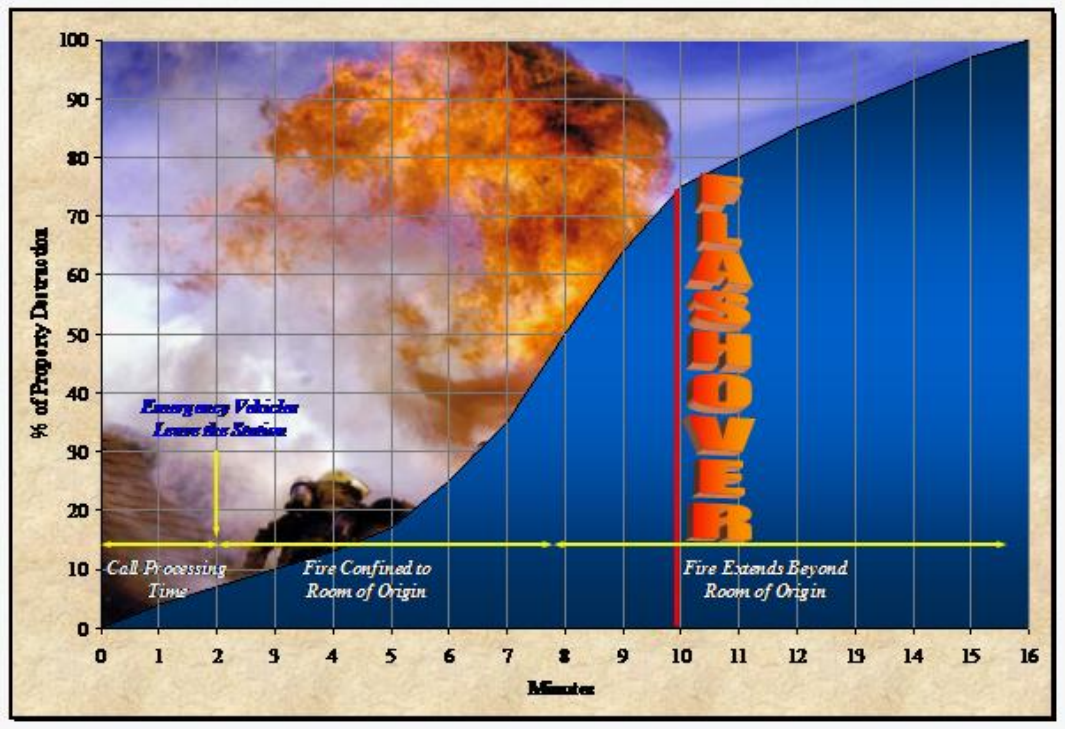
Response times are typically the primary measurement used in evaluating fire and EMS services. Most deployment models attempt to achieve a four-minute initial travel time for EMS calls and an eight-minute full-force travel time for fire calls. A full-force travel time indicates the time it takes for the initial response of all resources assigned for the call to arrive on the scene. Though these times have validity, the actual impact of a speedy response time is limited to very few incidents. For example, in a full cardiac arrest, analysis shows that successful outcomes are rarely achieved if basic life support (CPR) is not initiated within four minutes of the onset. However, cardiac arrests occur very infrequently; on average they are 1 percent to 1.5 percent of all EMS incidents.21 There are also other EMS incidents that are truly life-threatening and the time of response can clearly impact the outcome. These involve drownings, electrocutions, and severe trauma (often caused by gunshot wounds, stabbings, and severe motor vehicle accidents, etc.). Again, the frequency of these types of calls is limited.

Regarding response times for fire incidents, the frequency of actual fires in Sugar Land (structure and outside fires) is very low, approximately 1.9 percent of all responses. Actual structure fires were less than one percent of all calls, or 55 in the 12-month period evaluated. The criterion for fire response is based on the concept of "flashover." This is the state at which super-heated gasses from a fire in an enclosed structure are released rapidly, causing the fire to burn freely and become so volatile that the fire reaches an explosive state. In this situation, usually after an extended period of time (eight to twelve minutes), and a combination of the right conditions (a significant fuel load and depleted oxygen), the fire expands rapidly and is much more difficult to contain. When the fire reaches this hazardous state, a larger and more destructive fire occurs. Figure 6-1 illustrates the flashover phenomenon and its potential for increased damage.

Another important factor in the response time equation is what is termed "detection time." This is the time it takes to detect a fire or a medical situation and notify 911 to initiate the response. In many instances, particularly at night or when automatic detection systems (fire sprinklers and smoke detectors) are unavailable or inoperable, the detection process can be extended. Fires that go undetected and are allowed to expand in size become more destructive and are difficult to extinguish.

[21] Myers, Slovis, Eckstein, Goodloe et al. (2007). "Evidence-based Performance Measures for Emergency Medical Services System: A Model for Expanded EMS Benchmarking." *Pre-hospital Emergency Care*.

FIGURE 6-1: Fire Propagation Curve



MEASURING RESPONSE TIMES

There have been no documented studies that have made a direct correlation between response times and outcomes in fire and EMS events. No one has been able to show that a four-minute response time is measurably more effective than a six-minute response time. The logic has been "faster is better" but this has not been substantiated by any detailed analysis. Furthermore, the ability to measure the difference in outcomes (patient saves, reduced fire damage, or some other quantifiable measure) between a six-minute, eight-minute, or ten-minute response is not a performance measure often utilized in the fire service. So, in looking at response times it is prudent to design a deployment strategy around the actual circumstances that exist in the community and the fire problem that is perceived to exist. This requires a "fire risk assessment" and a political determination as to the desired level of protection for the community. It would be imprudent, and very costly, to build a deployment strategy that is based solely upon response times.

For the purpose of this analysis ***response time*** is a product of three components: ***dispatch time***, ***turnout time***, and ***travel time***.

- *Dispatch time* is the time interval that begins when the alarm is received at the communication center and ends when the response information is transmitted via voice or electronic means to the emergency response facility or emergency response units in the field. Dispatch time is the responsibility of the 911 center and outside the control of SLF-EMS officials.
- *Turnout time* is the time interval that begins when the notification process to emergency response facilities and emergency response begins through an audible alarm or visual announcement or both and ends at the beginning point of travel time. The fire department has the greatest control over this segment of the total response time measurement.

- *Travel time* is the time interval that initiates when the unit is en route to the call and ends when the unit arrives at the scene.
- *Response time*, also known as total response time, is the time interval that begins when the call is received by the primary dispatch center and ends when the dispatched unit arrives on the scene to initiate action.

For this study, and unless otherwise indicated, response times measure the first arriving unit only. We track only those responses in which the unit is responding with lights and sirens (hot). Excluded from these totals are canceled calls and any mutual aid calls. In addition, calls with a total response times of more than 30 minutes or more were also excluded as these are likely the result of reporting errors. Finally, we focused on units that had complete time stamps, that is, units with all components recorded so as to be able to calculate each segment of response time. Based on the methodology above, there were 624 calls responded to without lights and sirens, 866 canceled and mutual aid calls, 17 calls with response times over 30 minutes, 748 calls with missing en route or arrival times. As a result, in this section, a total of 5,788 calls are included in the analysis.

According to NFPA 1710, *Standard for the Organization and Deployment of Fire Suppression Operations, Emergency Medical Operations, and Special Operations to the Public by Career Departments, 2014 Edition*, the alarm processing time or dispatch time should be less than or equal to 60 seconds 90 percent of the time. This standard also states that the turnout time should be less than or equal to 80 seconds (1.33 minutes) for fire and special operations 90 percent of the time, and travel time shall be less than or equal to 240 seconds for the first arriving engine company 90 percent of the time. The standard further states the initial first alarm assignment (a total of 14 personnel for a single family residential structure) should be assembled on scene in 480 seconds 90 percent of the time (not including dispatch and turnout time). ***NFPA 1710 response time criterion is utilized by CPSM as a benchmark for service delivery and in the overall staffing and deployment of fire departments, and is not a CPSM recommendation.***

STATION LOCATIONS

The fire station is a critical link in service delivery and where these facilities are located is the single most important factor in determining overall response times and workload management. The Sugar Land Fire-EMS operates from seven fire stations, which are located as follows:

- Station 1: 555 Matlage Way.
- Station 2: 104 Industrial Blvd.
- Station 3: 2255 Settlers Way
- Station 4: 2100 Austin Parkway
- Station 5: 5735 Commonwealth Blvd.
- Station 6: 6625 Sansbury Blvd
- Station 7: 1301 Chatham Avenue

Assessment of Fire Station Locations

The SLF-EMS serves the city's estimated population of 88,156 people and a total service area of 76.6 square miles. This equates to an average service area for each fire station of approximately

10.9 square miles. However, this service area apportionment *does not include the area and populations in the ETJ*.

In a FY 2011 *ICMA Data Report*, ICMA tabulated survey information from 76 municipalities with populations ranging from 25,000 to 100,000 people. In this grouping the average fire station service area was 11 square miles.[22] The median service area for this grouping was 6.67 square miles per fire station.[23]

In addition, the NFPA and ISO have established different indices in determining fire station distribution. The ISO Fire Suppression Rating Schedule, Section 560, indicates that first-due engine companies should serve areas that are within a 1.5-mile travel distance.[24] The placement of fire stations that achieves this type of separation creates service areas that are approximately 4.5 square miles in size, depending on the road network and other geographical barriers (rivers, lakes, railroads, limited access highways, etc.). The National Fire Protection Association (NFPA) references the placement of fire stations in an indirect way. It recommends that fire stations be placed in a distribution that achieves the desired minimum response times. NFPA Standard 1710, Section 5.2.4.1.1, suggests an engine placement that achieves a 240-second (four-minute) travel time.[25] Using an empirical model called the "piece-wise linear travel time function" the Rand Institute has estimated that the average emergency response speed for fire apparatus is 35 mph. At this speed the distance a fire engine can travel in four minutes is approximately 1.97 miles.[26] A polygon based on a 1.97 mile travel distance results in a service area that on average is 7.3 square miles.[27]

From these comparisons, it can be seen that the average 10.9 square-mile service area per station in Sugar Land is larger than all of the noted references. Immediately obvious when examining a city map showing the location of Sugar Land's stations is that the northwestern sections of the city, areas west of State Hwy. 6 in the area of the Sugar Land airport, and areas along the Brazos River are areas that will see extended response times. CPSM estimates that of the 8,043 total calls in the year studied, approximately 441 (5.5 percent) resulted in a total response time of 10 minutes or greater. These extended times were primarily within municipal boundaries (300 or 68 percent), with 132, or 30 percent, in the ETJ.

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[22] *Comparative Performance Measurement, FY 2011 Data Report - Fire and EMS*, ICMA Center for Performance Measurement, August 2012.
[23] Ibid.
[24] Insurance Services Office. (2003) Fire Protection Rating Schedule (edition 02-02). Jersey City, NJ: Insurance Services Office (ISO).
[25] National Fire Protection Association. (2010). 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*. Boston, MA: National Fire Protection Association.
[26] University of Tennessee Municipal Technical Advisory Service, Clinton Fire Location Station Study, Knoxville, TN, November 2012. p. 8.
[27] Ibid., p. 9.

FIGURE 6-2: Sugar Land Station Locations and Municipal Boundaries

As noted, the SLF-EMS deploys its apparatus from seven fire stations. On the following pages, Figures 6-3, 6-4, and 6-5 illustrate these station locations along with 240-second (indicated by the red overlay), 360-second (indicated by the green overlay), and 480-second (indicated by the blue overlay) travel time benchmarks, respectively, from each station.

FIGURE 6-3: Sugar Land Station Locations and Travel Times (Red = 240 seconds)

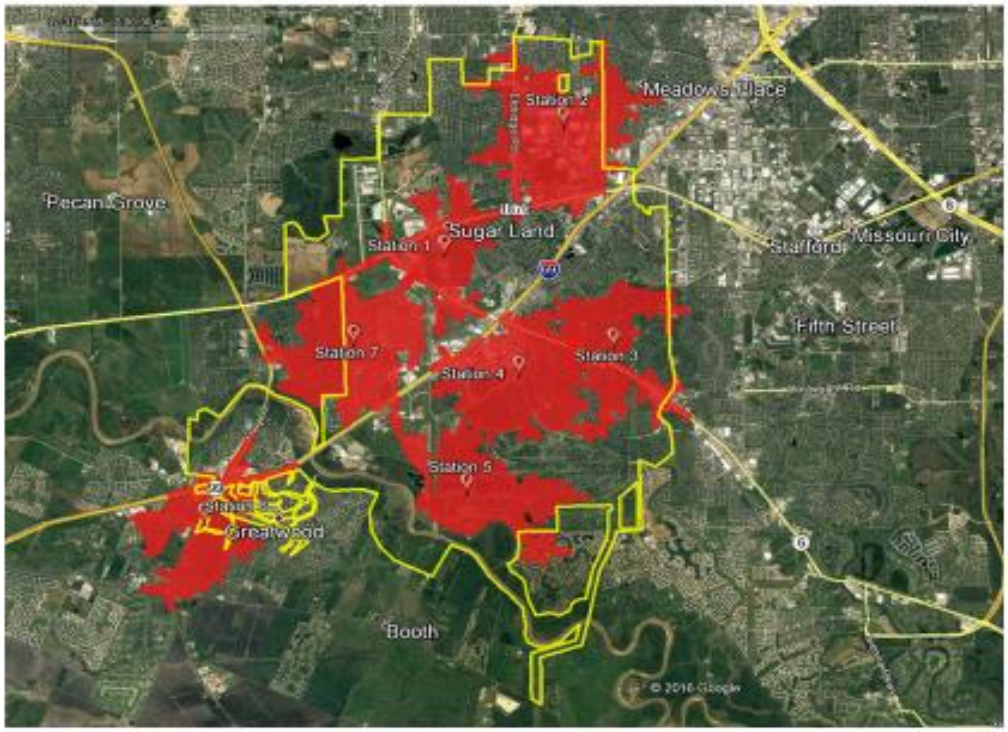


FIGURE 6-4: Sugar Land Station Locations and Travel Times (Green = 360 seconds)

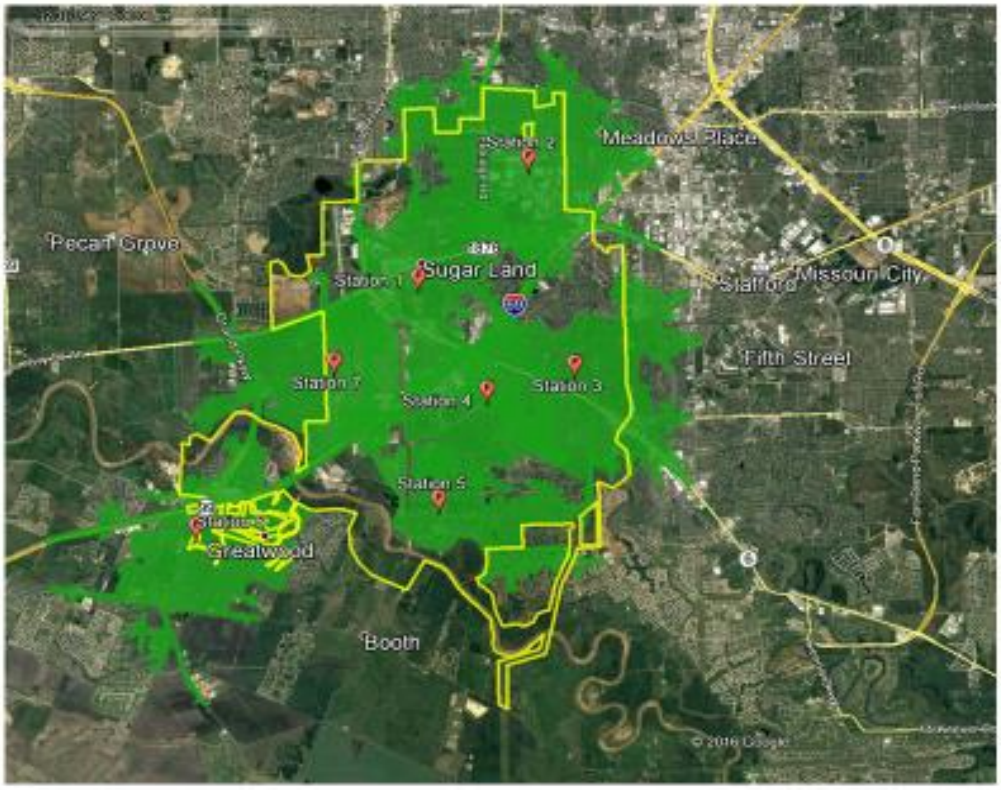


FIGURE 6-5: Sugar Land Station Locations and Travel Times (Blue = 480 seconds)

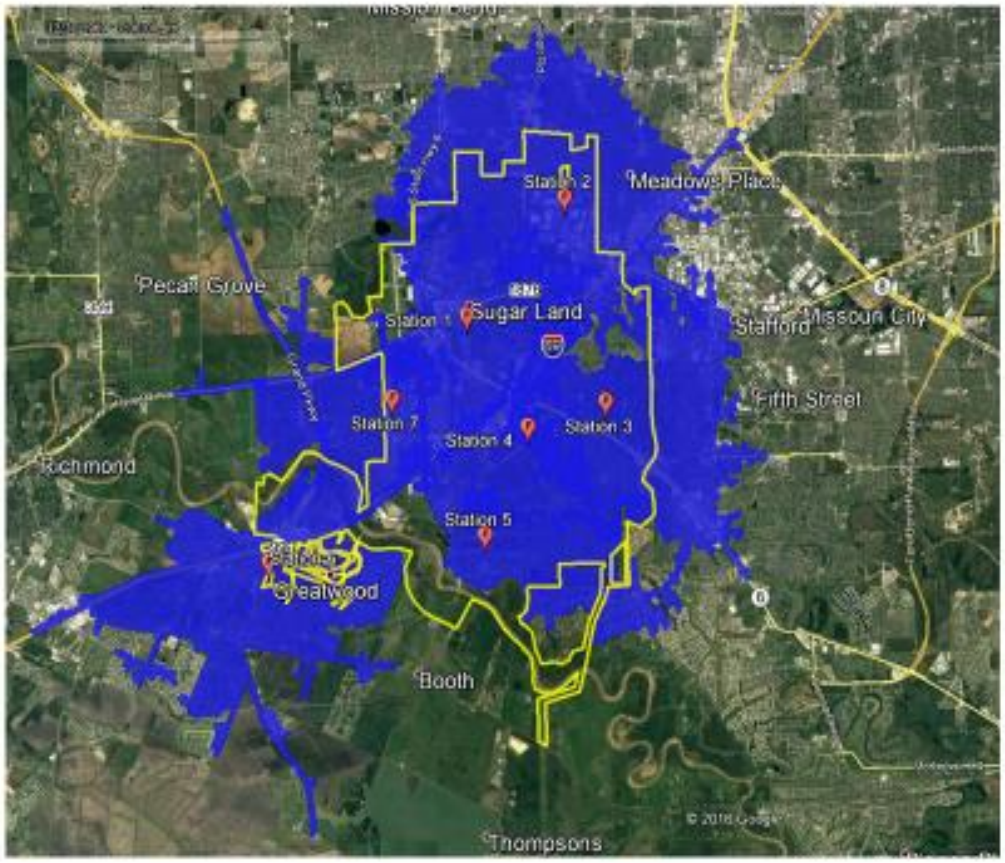


FIGURE 6-6: Sugar Land Station Locations and Composite Travel Times

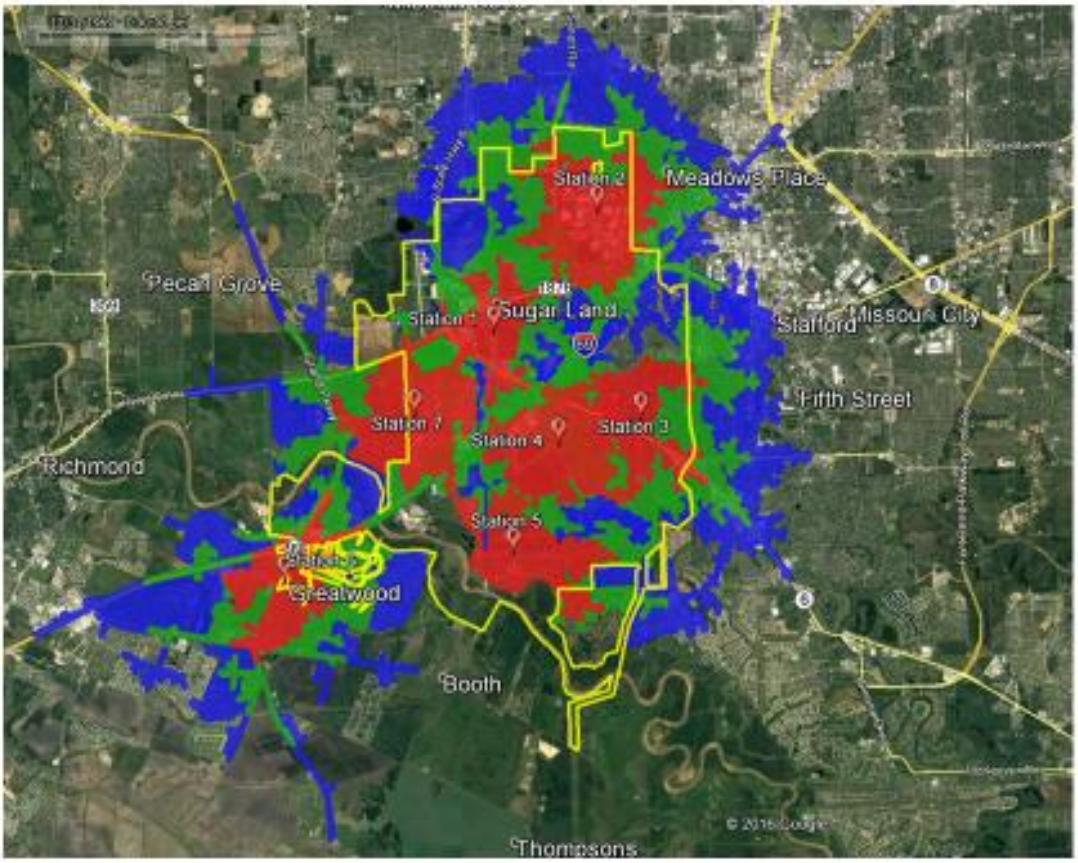


Figure 6-3 shows that approximately 40 percent of the developed areas of the city are covered under the 240-second benchmark. We would estimate that approximately 60 percent of the developed area of the city is covered under the 360-second overlay and nearly 80 percent is covered under the 480-second benchmark. The majority of the city, the commercial, and more built-upon areas are within the 360- and 480-second benchmarks. This is confirmed by the information in Table 6-2, which shows 90th percentile turnout and travel times. It can be seen that nearly 50 percent of the calls handled by SLF-EMS result in a travel time in the five- to six-minute range. Areas in the city not covered under the travel time benchmarks are beyond an eight-minute travel time; however, these areas are mostly on the western and southwestern sections of city in the areas around the Brazos River and on the west side of the city in areas adjacent to the Sugar Land airport. ***These maps only depict travel distances and not actual response times.***

Figures 6-7 to 6-9 represent the actual locations of fire, EMS, and other emergency responses carried out by SLF-EMS. It is apparent that most responses are within five to six minutes of travel time from the SLF-EMS fire stations. It is also revealing that there are a large number of calls located outside city limits on the west side of town. Many of these calls result in extended response times. CPSM estimates that approximately 400 alarms during the year studied, primarily EMS-related, resulted in total response times that were in excess of 10 minutes.

FIGURE 6-7: SLF-EMS Fire Runs

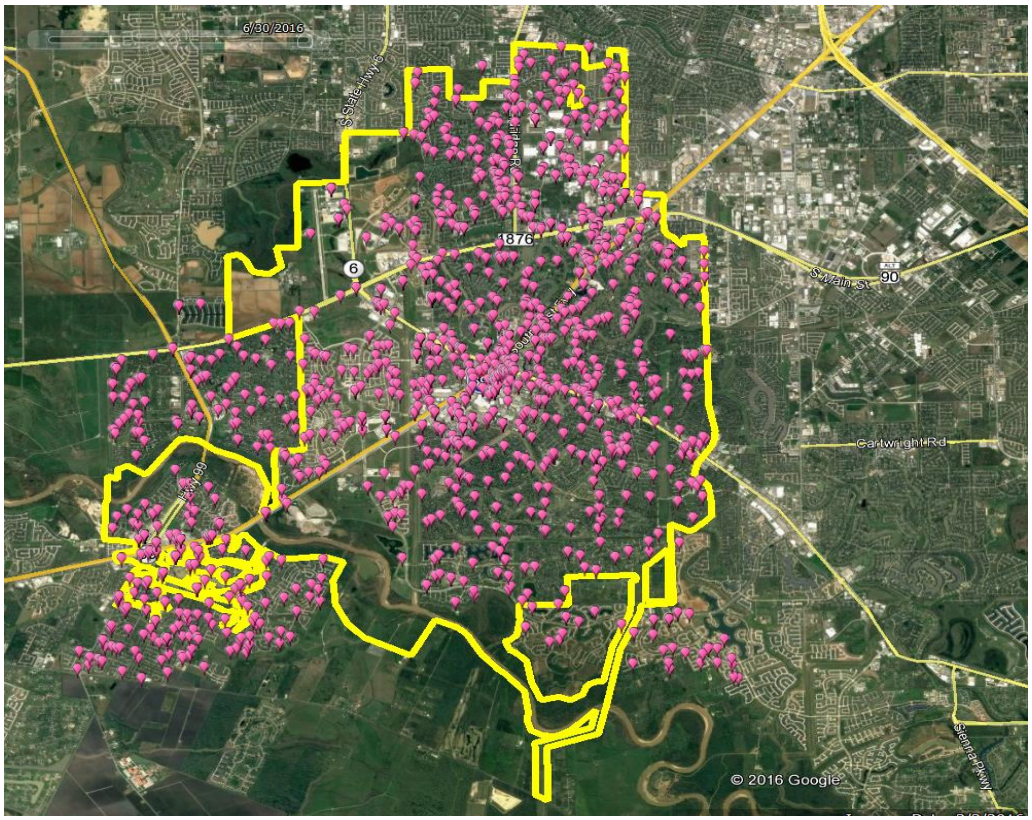
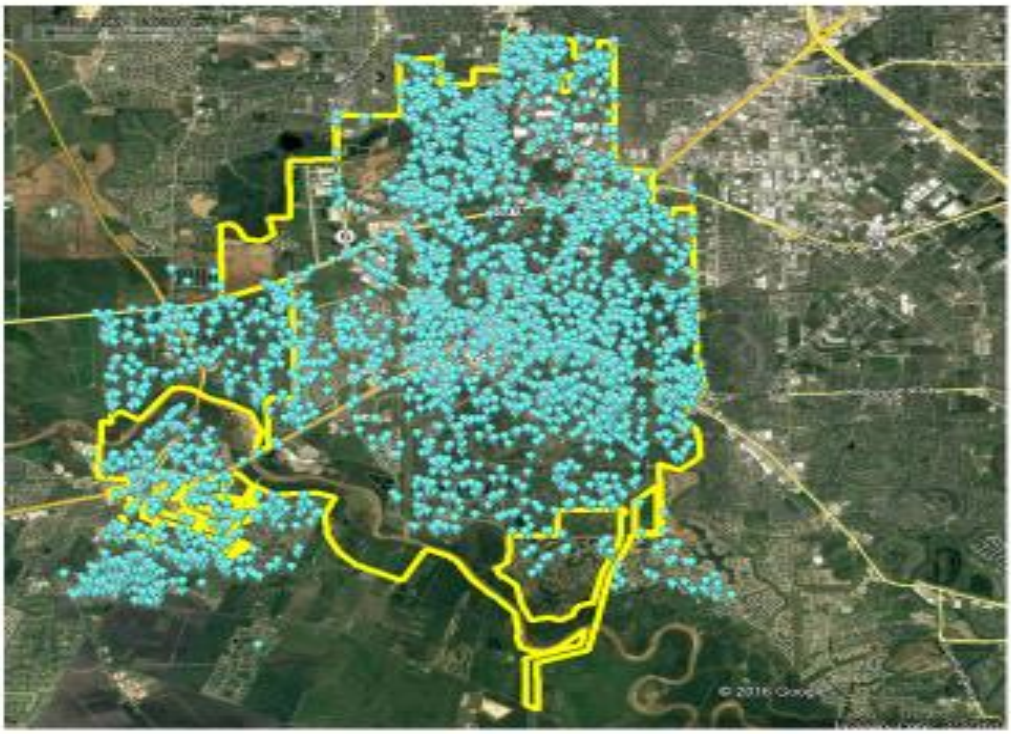
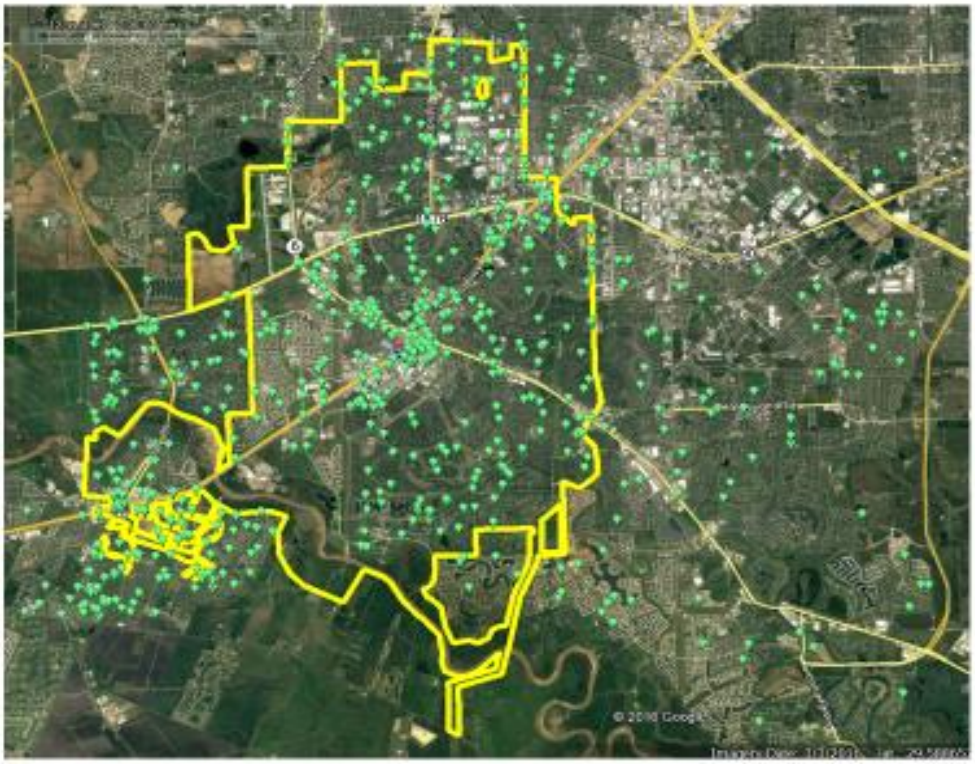


FIGURE 6-8: SLF-EMS EMS Runs



EMS Runs

FIGURE 6-9: SLF-EMS Other Runs



Other Runs

SLF-EMS RESPONSE TIMES

This section focuses on response time analysis for approximately 5,788 responses that occurred between July 1, 2015 and June 30, 2016 in both the city and ETJ. The average dispatch time was 1.0 minute (60 seconds). The average turnout time was 1.3 minutes (78 seconds). The average travel time was 4.3 minutes. The average response time for EMS calls was 6.5 minutes. The average response time for fire category calls was 7.5 minutes. The average response time for structure fire calls was 6.8 minutes. The average response time for outside fire calls was 6.9 minutes.

TABLE 6-1: Average Response Times of First Arriving Unit, by Call Type (Minutes)

Call Type	Dispatch	Turnout	Travel	Total	Number of Calls
Breathing difficulty	0.8	1.4	3.7	5.9	447
Cardiac and stroke	0.9	1.3	3.7	5.9	478
Fall and injury	0.9	1.3	3.7	5.9	799
Illness and other	1.1	1.3	4.8	7.2	1,976
MVA	0.9	1.3	4.0	6.2	395
Overdose and psychiatric	0.9	1.3	5.6	7.9	69
Seizure and unconsciousness	0.8	1.3	3.7	5.8	592
EMS Total	**0.9**	**1.3**	**4.2**	**6.5**	**4,756**
False alarm	1.1	1.4	5.1	7.6	496
Good intent	1.2	1.3	5.0	7.4	90
Hazard	1.2	1.4	5.2	7.8	156
Outside fire	1.0	1.4	4.5	6.9	71
Public service	1.1	1.5	4.8	7.4	178
Structure fire	1.0	1.4	4.4	6.8	41
Fire Total	**1.1**	**1.4**	**5.0**	**7.5**	**1,032**
Total	**1.0**	**1.3**	**4.3**	**6.6**	**5,788**

The 90th percentile measurement, often referred as a "fractile response," is a more conservative and stricter measure of total response time. Simply explained, for 90 percent of calls, the first unit arrives within a specified time. Table 6-2 depicts the 90th percentile response times in Sugar Land for fire and EMS responses.

TABLE 6-2: 90th Percentile Response Times of First Arriving Unit, by Call Type (Minutes)

Call Type	Dispatch	Turnout	Travel	Total	Number of Calls
Breathing difficulty	1.3	2.2	5.5	7.8	447
Cardiac and stroke	1.4	2.1	5.6	8.0	478
Fall and injury	1.5	2.0	5.7	8.1	799
Illness and other	1.8	2.2	7.5	10.2	1,976
MVA	1.8	2.1	6.4	8.9	395
Overdose and psychiatric	1.9	2.0	12.2	13.9	69
Seizure and unconsciousness	1.3	2.0	5.4	7.7	592
EMS Total	**1.6**	**2.1**	**6.6**	**9.1**	**4,756**
False alarm	1.7	2.3	8.0	10.7	496
Good intent	2.0	1.9	8.2	10.6	90
Hazard	2.0	2.2	8.7	11.0	156
Outside fire	1.4	2.2	6.7	9.5	71
Public service	1.8	2.2	7.9	10.8	178
Structure fire	1.7	2.1	7.4	9.4	41
Fire Total	**1.8**	**2.2**	**8.1**	**10.7**	**1,032**
Total	**1.7**	**2.1**	**6.9**	**9.5**	**5,788**

Observations:

- The average dispatch time was 1.0 minutes.
- The average turnout time was 1.3 minutes.
- The average travel time was 4.3 minutes.
- The average response time was 6.6 minutes.
- The average response time was 6.5 minutes for EMS calls and 7.5 minutes for fire calls.
- The average response time for structure fires was 6.8 minutes, and for outside fires was 6.9 minutes.
- The 90th percentile dispatch time was 1.7 minutes.
- The 90th percentile turnout time was 2.1 minutes.
- The 90th percentile travel time was 6.9 minutes.
- The 90th percentile response time was 9.5 minutes.
- The 90th percentile response time was 9.1 minutes for EMS calls and 10.7 minutes for fire calls.
- The 90th percentile response time for structure fires was 9.4 minutes, and for outside fires was 9.5 minutes.

In summary, response times for SLF-EMS units are high but this can be attributed to the extended service area covered by its response units. Several points should be noted. Dispatch handling and turnout times should be monitored, as CPSM believes that nearly one minute can be

shaved off the combined dispatch handling and turnout time if there is greater vigilance and a directed effort towards reducing these numbers. In addition, it is notable that when we isolate the EMS travel times for the call types involving "Illness and Other" and "Overdose and psychiatric," we see two of the highest times recorded (7.5 minutes and 12.2 minutes). It is possible that because of the frequency of nonemergency outcomes in these call types, response personnel are intentionally slowing their responses and this is reflected in the overall times. As indicated in an earlier recommendation, the effort to respond to nonemergency call types in a cold response mode may in fact improve overall response times. Finally, the lower availability rates should be reviewed more thoroughly. Though CPSM believes that the reduced availability rates may be a product of responding too many units to both fire and EMS calls, we also feel that adjustments in the response protocols may improve these outcomes.

SECTION 7. PERFORMANCE MEASUREMENT

Fire suppression, prevention programs, and EMS service delivery need to be planned and managed so that these efforts achieve specific, agreed-upon results. This requires establishing a set of goals for the activities of any given program. Determining how well an organization or program is doing requires that these goals be measurable and that they are measured against desired results. This is the goal of performance measurement.

Simply defined, performance measurement is the ongoing monitoring and reporting of progress toward pre-established goals. Performance measurement captures data about programs, activities, and processes, and displays data in standardized ways that help communicate to service providers, customers, and other stakeholders how well the agency is performing in key areas. Performance measurement provides an organization with tools to assess performance and identify areas in need of improvement. In short, what gets measured gets improved.

The need to continually assess performance requires adding new words and definitions to the fire service lexicon. Fire administrators need to be familiar with the different tools available and the consequences of their use. In *Managing the Public Sector*, business professor Grover Starling applies the principles of performance measurement to the public sector. He writes that the consequences to be considered for any given program include:

Administrative feasibility: How difficult will it be to set up and operate the program?

Effectiveness: Does the program produce the intended effect in the specified time? Does it reach the intended target group?

Efficiency: How do the benefits compare with the costs?

Equity: Are the benefits distributed equitably with respect to region, income, gender, ethnicity, age, and so forth?

Political feasibility: Will the program attract and maintain key actors with a stake in the program area?[28]

Performance measurement systems vary significantly among different types of public agencies and programs. Some systems focus primarily on efficiency and productivity within work units, whereas others are designed to monitor outcomes produced by major public programs. Still others track the quality of services provided by an agency and the extent to which citizens are satisfied with these services.

Within the fire service, performance measures tend to focus on inputs (the amount of money and resources spent on a given program or activity) and short-term outputs (the number of fires, number of EMS calls, response times, etc.). One of the goals of any performance measurement system should be also to include efficiency and cost-effectiveness indicators, as well as explanatory information on how these measures should be interpreted. An explanation of these types of performance measures are shown in Table 7-1.

[28] Grover Starling, *Managing the Public Sector*, (Cengage Learning), 396.

TABLE 7-1: The Five GASB Performance Indicators[29]

Category	Definition
Input indicators	These are designed to report the amount of resources, either financial or other (especially personnel), that have been used for a specific service or program.
Output indicators	These report the number of units produced or the services provided by a service or program.
Outcome indicators	These are designed to report the results (including quality) of the service.
Efficiency (and cost-effectiveness) indicators	These are defined as indicators that measure the cost (whether in dollars or employee hours) per unit of output or outcome.
Explanatory information	This includes a variety of information about the environment and other factors that might affect an organization's performance.

One of the most important elements of performance measurement within the fire service is to describe service delivery performance in a way that both citizens and those providing the service have the same understanding. The customer will ask, "Did I get what I expected?"; the service provider will ask, "Did I provide what was expected?"

Ensuring that the answer to both questions is "yes" requires alignment of these expectations and the use of understandable terms. The author of the "Leadership" chapter of the 2012 edition of ICMA's *Managing Fire and Emergency Services* "Green Book" explains how jargon can get in the way:

> *Too often, fire service performance measures are created by internal customers and laden with jargon that external customers do not understand. For example, the traditional fire service has a difficult time getting the public to understand the implications of the "time temperature curve" or the value of particular levels of staffing in the suppression of fires. Fire and emergency service providers need to be able to describe performance in a way that is clear to customers, both internal and external. In the end, simpler descriptions are usually better.*[30]

The SLF-EMS has recently implemented a very comprehensive and robust effort to measure and monitor its performance. The measures are broken out as City Council Goals or Department Service Level Measures. City Council Goals relate to response time measures for fire and EMS (Fire Response: 90% within 8:00 minutes and EMS Response: 90% within 6:00 minutes or less). Department Service Level Measures address a whole host of activities including:

[29] From Harry P. Hatry et al., eds. *Service Efforts and Accomplishments Reporting: Its Time Has Come* (Norwalk, CT: GASB, 1990).
[30] I. David Daniels, "Leading and Managing," in *Managing Fire and Emergency Services* (ICMA: Washington, DC: 2012), 202.

Budget & Expenditures	Employee Turnover	Training and Certifications
Review of Larger Incidents	Physical Performance	Hiring and Recruitment
Citizen Complaints	Lost-time Injuries	Citizen Contacts (Pub. Ed.)
No. of Field Paramedics	Plans Review–Processed/Timed	Arson Investigations
Distribution–Smoke Detectors	Inspections–Processed/Timed	EOC Activations
Large-scale Drills/Exercises		

As part of this effort, the city and SLF-EMS have developed a series of internal reporting processes that provide a direct link to department goals and the specific service level measures. This type of ongoing analysis and the monitoring of trends are most useful in justifying program budgets and in measuring specific service delivery levels. CPSM recognizes the city and SLF-EMS for implementation of the City Council Goals and Department Service Level Measures and considers this effort as a ***Best Practice***.

CPSM has estimated that the 90th percentile Fire response times in the city during this period of evaluation was 10.3 minutes and the corresponding EMS response time was 8.9 minutes. Both times are higher than the Council goals that were initially established. It is not uncommon however to adjust performance targets once actual measures are obtained and these outcomes are reviewed in terms of the desired performance that is to be achieved. It is unlikely that SLF-EMS can meet the 90th percentile measure of 6:00 minutes for EMS calls given the size of the service area and the current deployment of resources. It is also unlikely, though possible, that SLF-EMS can meet the 8:00 minute 90th percentile measure for fire either, however there should be an on-going effort to seek improvements towards the response time targets.

Recommendation: The city should consider changing the City Council response time goals for Fire and EMS.

The establishment of performance measures are critical in providing key indicators that guide service delivery in a community. It is important that these measures be achievable and are reflective of an outcome that is appropriate. Clearly the level of service for Fire and EMS in Sugar Land is outstanding. This is indicative in the lower than average fire loss levels currently being achieved and the general acceptance and high regard with which EMS services are perceived in the community. As noted earlier, many non-emergent calls are included in the response time calculations. These calls result in higher response times because units often adjust response speeds because of the realization that an emergent response is unnecessary. Once these calls are moved to a non-emergent response category, they can be excluded from the response time tabulation. CPSM believes that this action will lower overall times. It is also possible to utilize a performance measure that is based on an 80 percent or 85 percent target level rather than the current 90 percentile level. Many communities have adopted 75 percent to 85 percent performance goals because the 90 percentile level is unrealistic or unachievable. In addition, there is little indication that achieving the 90 percentile level for an 8-minute response time for fire or 6-minutes for EMS, will result in any measurable improvement in actual service outcomes. These are considerations that Sugar Land should evaluate in sizing its performance goals to a more appropriate level. Along with these considerations, Sugar Land should also evaluate the option of utilizing response time measures for only structure fires and outside fire responses in its performance goal calculations. CPSM believes that these are the more critical measures and by eliminating those typically non-emergent call types as false alarms, hazard calls and public service assist, you are then measuring the more critical emergency events.

SECTION 8. ESSENTIAL RESOURCES

FIRE PREVENTION AND CODE ENFORCEMENT

The SLF-EMS Fire Prevention Division provides code enforcement, fire/arson investigations, plans review, and public safety education services to the city of Sugar Land with a staff of seven employees. In addition, the Fire Marshal (Assistant Chief) administers the SLF-EMS's human resource function including oversite of the Telestaff payroll system. Sugar Land utilizes the International Fire Code (2015 version) to guide its code enforcement and plans review process. The Fire Prevention Division works in conjunction with the city's building department in the administration of fire and building code requirements. The city has adopted a one-stop permitting process and both departments work cooperatively in managing a significant workload. SLF-EMS has established a ten business day turn-around for fire plans review in the permitting process and utilizes a two business day time frame to carry out required new construction inspections. Though SLF-EMS is actively involved in fire plans review, permitting, and new construction inspections, the SLF-EMS does not charge nor are any of the building permit revenues utilized to offset fire department inspection and plans review costs. The Fire Prevention Division reviews approximately 1,200 plans each year, focusing specifically on fire protection systems, site plans, access control, and life safety issues.

> ***Recommendation: The SLF-EMS should work with the city's building department to institute a cost recovery process for fire department activities that involve fire code plans review, inspections, and new construction permitting.***

In addition to new construction inspections, the division is required to inspect an estimated 4,000 occupancies throughout the city. At present, the division is able to complete approximately 400 of these routine or maintenance inspections each year. Many of these inspections are required by state regulations at daycare and elder-care centers, foster homes, hospitals, hotels, and motels. The division receives an estimated $50,000 to $60,000 in annual permit fees from state licensing inspections. Maintenance inspections are performed exclusively by division staff; fire companies do not conduct any in-service fire inspections. CPSM was advised that there are state restrictions on fire companies doing inspections and that operations personnel are not trained sufficiently to conduct inspections. Fire Prevention staff also expressed concerns that visits by the engine companies may conflict with permit inspections performed by Fire Prevention staff, and this could lead to confusion by building owners and occupants.

CPSM believes that a fire company inspection program, if managed properly, can yield significant benefits to the system. Most fire agencies in the U.S. require in-service fire companies to conduct various levels of inspections. In many cases when fire companies identify suspected code violations they report these to the fire prevention staff for follow-up. The key to in-service inspection efforts is identifying problems before an emergency response is needed. In addition, when conducting these inspections, operations personnel gain a tactical advantage by familiarizing themselves with the building and any fire suppression systems. This knowledge could be beneficial during an emergency. In addition, building owners are made aware of issues when these issues are small so they can be resolved early and potentially prevent future problems. The program can also facilitate improved interaction between the fire department and businesses.

Recommendation: The Sugar Land Fire-EMS should institute an in-service fire company inspection program that promotes responder familiarization, pre-incident planning, and fire prevention efforts.

The Fire Prevention Division is also charged with fire investigations to determine cause and origin. Fire prevention staff expressed a reluctance in making fire loss estimates in its fire incident reporting (NFIRS). Their rationale is that fire investigators do not have the expertise to determine actual losses. CPSM believes that this is a shortcoming in the investigative process that should be resolved.

Recommendation: The Fire Prevention Division should sufficiently train its investigators and company officers on how to determine estimated fire loss on all fires.

Fire loss is a key measurement in assessing fire operations and indicates trends or patterns that, if reviewed, can provide guidance in directing fire prevention efforts. Most fire agencies produce an annual fire loss report that shows the amount of loss, the occupancies in which this loss occurred, and how effective suppression efforts were in restricting loss. Other components also reviewed are: whether smoke detectors were present and operable, if there were automatic fire sprinklers, the cause of the fire, and the type of occupancy in which the fire occurred. When reported annually, this information provides an overview of the fire problem in the community and any trends that are occurring.

Recommendation: The SLF-EMS, through its Fire Prevention Division, should produce an annual fire report that identifies the number of fires, the occupancy types, estimated fire loss, and other critical information that can be utilized to guide prevention efforts.

INTEGRATED RISK MANAGEMENT

Fire suppression and response, although necessary in minimizing property damage, have little impact on preventing fires. Rather, public fire education, fire prevention, and built-in fire protection and notification systems are essential elements in protecting citizens from death and injury due to fire. The term integrated risk management, first developed in the United Kingdom, refers to a planning methodology that focuses on citizen safety and the protection of property and the environment through a community-wide fire reduction effort. This is accomplished by assessing the risk faced, taking preventive action, and deploying the proper resources in the right place at the right time.[31]

An integrated risk management model uses incident data (location, construction types, population density, demographics, etc.) to assess all types of fire, health, and safety risk in the community. The model is then used to manage risk through targeted, community-based risk reduction strategies and flexible approaches to incident response (See, for example, Merseyside Fire and Rescue Service and Nanaimo Fire Rescue). The model helps deploy the fire department's response and prevention resources to best meet the frequency and location of incidents. It also aids in all-hazard risk assessment, and increases the value of risk reduction efforts (such as fire prevention education for the elderly and children, the populations that are the most vulnerable to fire). Finally, the model measures the fire department services' workload, and assesses the efficiency and outcome of the delivery of each service, making adjustments as needed. In essence, integrated risk management pulls together all the different planning aspects of community hazard and vulnerability analysis, fire department risk management,

[31] National Fire Protection Association, *Fire Protection Handbook* (2008 Edition), 12-3.

resource allocation, and performance measurement into one unified, cohesive whole. ***The end product of this effort is the reduction of fire incidents.***

> ***Recommendation: The SLF-EMS should develop an overall integrated risk management plan that focuses on structure fires in the community.***

ISO RATING

ISO collects data in more than 48,000 communities and fire districts throughout the country. The data are then analyzed using a proprietary Fire Suppression Rating Schedule (FSRS). This analysis then results in a PPC (Public Protection Classification) score between 1 and 10 for the community, with Class 1 representing "superior property fire protection" and Class 10 indicating that an area doesn't meet the minimum criteria set by the ISO. In 2013, the revised FSRS was released; it adds an emphasis on a community's effort to limit loss before an incident occurs (fire prevention).

In developing a PPC, the following major categories are evaluated:

- Emergency Communications: Fire alarm and communication systems, including telephone systems, telephone lines, staffing, and dispatching systems.
- Fire Department: The fire department, including equipment, staffing, training, and geographic distribution of fire companies.
- Water Supply: The water supply system, including the condition and maintenance of hydrants and the amount of available water compared to the amount need to suppress fires.
- Fire Prevention: Programs that contain plan review; certificate of occupancy inspections; compliance follow-up; inspection of fire protection equipment; and fire prevention regulations related to fire lanes on area roads, hazardous material routes, fireworks, barbecue grills, and wildland-urban interface areas.
- Public Fire Safety Education Programs: Fire safety education training and programs for schools, private homes, and buildings with large loss potential or hazardous conditions and a juvenile fire setter intervention program.

The city of Sugar Land was last reviewed by the ISO in February 2013 and received a Class 2 rating. The Class 2 rating is an outstanding achievement for a community the size of Sugar Land and is a tribute to the city agencies, the city leadership, and the water utility system. ISO estimates that in 2015 fewer than 1,000 agencies nationwide received a Class 2 rating

The scoring that Sugar Land received in the 2013 review was comfortably within the Class 2 designation, with the city receiving an overall score of 83.23. It is also important to note that SLF-EMS received excellent scoring in the areas of fire training, receiving 7.92 points out of 9. In Emergency Communication (911), the review was scored at 9.9 points out of a possible 10. The water utility system was scored at 39.78 out of a possible 40. It was in the area of company personnel that the SLF-EMS lost the most points, receiving 7.02 points out of a total of 15 points available. Overall, CPSM recognizes the city's achievement in its most recent ISO review as a ***Best Practice***.

EDUCATION AND TRAINING PROGRAMS

Training is one of the most important functions that a fire department should be performing on a regular basis. One could even make the argument that training is, in some ways, more important than emergency response. A department that is not well trained, prepared, and operationally ready will be unable to effectively and safely fulfill its emergency response obligations. A comprehensive, diverse, and ongoing training program is absolutely critical to the fire department's level of success.

An effective fire department training program must cover all of the essential elements of that department's core missions and responsibilities. The program must include an appropriate combination of technical/classroom training, manipulative or hands-on/practical evolutions, and training assessment to gauge the effectiveness of these efforts. Most of the training, but particularly the practical, hands-on training evolutions should be developed based upon the department's own operating procedures while remaining cognizant of widely accepted practices and standards.

Certain U.S. Occupational Safety and Health Administration (OSHA) regulations dictate that minimum training must be completed on an annual basis on the following areas:

- A review of the respiratory protection standard, self-contained breathing apparatus (SCBA) refresher and user competency training, SCBA fit testing (29 CFR 1910.134).
- Blood Borne Pathogens Training (29 CFR 1910.1030).
- Hazardous Materials Training (29 CFR 1910.120).
- Confined Space Training (29 CFR 1910.146).
- Structural Firefighting Training (29 CFR 1910.156).

In addition, National Fire Protection Association (NFPA) standards contain recommendations for a minimum of 24 hours of structural firefighting training annually for each fire department member. State of Texas training guidelines require a minimum of 20 hours of refresher training annually for firefighter certification.

Education and training programs also help to create the character of a fire service organization. Agencies that place a real emphasis on their training have a tendency to be more proficient in carrying out day-to-day duties. If it is clear that training has a priority, this fosters an image of professionalism and instills pride in the organization. Overall, the Sugar Land Fire-EMS has a very good training program and there exists a dedicated effort focused on a wide array of training activities.

The training functions of the SLF-EMS are primarily handled by two Battalion Chiefs; one is designated as the department's Fire Training Officer, reporting to the Assistant Chief of Planning and Development. The other is the EMS Battalion Chief, who reports to the Assistant Chief in charge of Emergency Operations. Both training functions also have an assigned Captain to assist in training and support functions in their respective areas. In addition, SLF-EMS will utilize an administrative Battalion Chief to assist in training delivery, professional standards, employee development and departmental safety. The Fire Training Battalion Chief handles the general fire-related training while the EMS Battalion Chief focuses on EMS-related training and certifications. The Fire Training Captain's primary role is to facilitate training for department personnel, coordinate group training activities, and serve as a liaison between the Fire Training Chief and

the training groups. EMS training incorporates direction from the Medical Director and the SLF-EMS EMS Q/A process.

In its fire-related training the department tries to follow the appropriate NFPA standards and recommendations necessary for personnel to achieve proficiency in the various emergency response and support disciplines. It also seeks to meet the ISO requirements of a minimum of 20 hours of training per member per month.

The SLF-EMS conducts in-house basic firefighter training for all new personnel. The state of Texas has specific guidelines regarding entry firefighter training and certification that employing agencies must adhere to. Once employed, the SLF-EMS will conduct a training and orientation session for all new recruits prior to any field assignments.

The SLF-EMS does not utilize a formal training calendar to coordinate its training activities. There is little guidance nor are training outlines regularly provided to coordinate departmental training efforts. Much of the training carried out in the organization is initiated individually by the company officer or the shift Battalion Chief.

Recommendation: The Sugar Land Fire-EMS should institute a formal monthly/quarterly department-wide training calendar.

CPSM believes it is essential that the training effort ensure consistency in the competencies of its employees to perform those activities that are needed to operate successfully in emergency settings. This requires a comprehensive review of training activities and a more regimented process to ensure that all employees receive consistent updates and refresher training in those activities that are not regularly performed in day-to-day operations.

The CPSM team was informed that the department uses a number of ad hoc or informal groups to develop training-related programs and materials. There does not appear to be a coordinated, department-wide focus on how training needs are determined and the priorities that guide overall training. CPSM believes that it is beneficial for an organization to utilize a key group of its leadership to identify and direct the training efforts of the organization.

Recommendation: The SLF-EMS should establish a training steering committee composed of battalion chiefs, captains, drivers, firefighters, and EMS staff to conduct a training needs assessment, develop priorities, and provide direction regarding the training efforts of the department.

The training steering process must be a dynamic effort that is constantly reviewing training priorities and aligning the focus of training to organizational needs.

The training process requires daily coordination among the various shifts and the multiple work sites in the SLF-EMS system. It is critical to have a centralized training program that is orchestrated and administered by the Training and Safety Division and guided by a training steering committee. It is also important that there be a training liaison and at least one alternate on each shift to help facilitate this effort and monitor overall effectiveness. SLF-EMS does not utilize a shift training coordinator in its training process and CPSM believes that assigning this responsibility to select individuals on each shift will greatly improve the delivery of training outcomes. Earlier in the report, CPSM recommended that SLF-EMS consider a number of individual program management assignments to aid in the delegation of the workload and to provide career development among line personnel. The training liaison role is one such assignment that should be considered for this purpose.

Recommendation: SLF-EMS should designate a fire Captain and at least one alternate on each shift to serve as the shift training coordinator to help facilitate in-service training activities, both for fire and EMS.

At the time of this assessment, EMS training was being accomplished primarily through the on-line service Target Solutions. CPSM found there to be a high level of dissatisfaction from many levels of the SLF-EMS organization regarding EMS training. In discussions with the city's Medical Director, we found there is a noted frustration with the current delivery methods for in-service EMS training. Once again, in this area there is not an orchestrated training effort department-wide, and there is little focus on remediation or problem areas elevated through the Q/A process. There is also concern because of the lack of hands-on EMS training and because the department does not utilize an in-service run-review process that examines field incidents or problems arising from actual settings as a basis for training and improvement.

Recommendation: The Sugar Land Fire-EMS should restructure is training delivery methods and consolidate fire and EMS training under the Planning and Development Division.

The training efforts in the SLF-EMS require a comprehensive review and restructuring so that all facets of the training effort are orchestrated to address department-wide training needs. CPSM believes that SLF-EMS should utilize a training steering committee to guide the overall training efforts. More emphasis should be placed on hands-on, practical training and an expanded use of skills assessments. A comprehensive and on-going training calendar should be utilized; field training liaisons on each shift are needed to monitor participation, training delivery, and skills assessment. Lastly, CPSM believes that it is critical that the Medical Director play a larger role in the development of EMS training curriculum and take a more active role in training delivery and EMS skills assessments.

Recommendation: The Sugar Land Fire-EMS should institute written and practical skills testing as part of the department's comprehensive fire training program.

The ability to monitor and record training test scores is beneficial from an overall proficiency stand point. In addition, training scores should be incorporated into the annual performance appraisal process for employees, their supervisors, and the training staff. In addition, the concept of adding a testing process to each training evolution adds to the importance and seriousness in which these activities are carried out.

EMERGENCY MANAGEMENT

Emergency management is the discipline and profession of applying science, technology, and planning to deal with extreme events that can injure or kill large numbers of people, do extensive damage to property, and disrupt community life. When such events do occur and cause extensive harm, they are called disasters.[32]

The Sugar Land area is vulnerable to a number of extreme natural or man-made occurrences. In the Hazard Mitigation Plan and Threat Hazard Identification Risk Assessment (THIRA) for the city it was determined that the greatest vulnerability in the area was related to the following events:

- Floods (riverine flooding and shallow flooding).

[32] *Emergency Management: Principles and Practice for Local Government*. Eds. Thomas E. Drabek, Gerard J. Hoetmer. International City Management Association, 1991. p. xvii.

- Coastal storms (hurricanes and tropical storms).
- Severe thunderstorms, tornadoes, and lightning.
- Dam failure and levee failure.
- Drought and heat emergencies.
- Winter storm/extreme cold/ice.
- Wildfire/brush fire.

Man-made events such as transportation accidents involving hazardous material spills, releases and explosions, airplane crashes, pandemics, and terrorism also have the potential to impact the area. Consequently, the ability to plan and exercise these type of events is the essence of the emergency management process.

The emergency management program in the city of Sugar Land has been lauded by the state of Texas as exceptional, providing an advanced level of preparedness. Effective emergency management begins with a basic Emergency Operations Plan (EOP). The city of Sugar Land EOP outlines the approach to emergency operations. It provides general guidance for emergency management activities and an overview of prescribed methods of mitigation, preparedness, response, and recovery. The plan describes the city's emergency response organization and assigns responsibilities for various emergency tasks. The EOP is intended to provide a framework for more specific functional annexes that describe in greater detail who does what, when, and how. This plan applies to all local officials, departments, and agencies. The primary audience for the document includes: the chief elected official and other elected officials, the emergency management staff, department and agency heads and their senior staff members, leaders of local volunteer organizations that support emergency operations, and others who may participate in mitigation, preparedness, response, and recovery efforts.

The plan is based upon the concept that the emergency functions that must be performed by many departments or agencies generally parallel their normal day-to-day duties. To the extent possible, the same personnel and material resources used for day-to-day activities will be employed during emergency situations. Because personnel and equipment resources are limited, some routine functions that do not contribute directly to the emergency may be suspended for the duration of an emergency. The personnel, equipment, and supplies that would normally be required for those functions will be redirected to accomplish emergency tasks.[33]

The EOP appears compliant with all local, state, and federal requirements and is aligned in accordance with the FEMA Comprehensive Preparedness Guide 101 (CPG 101), which prescribes the processes involved in developing and maintaining Emergency Operations Plans.

During a declared emergency, the governmental organization includes: an Executive Group, Emergency Services Group, an Emergency Management Coordinator, and a Support Services Group.

Along with maintaining an up-to-date EOP, the Emergency Management Coordinator maintains a current Hazard Mitigation Plan and Threat Hazard Identification Risk Assessment (THIRA) for the city. The THIRA is compliant with all local, state, and federal requirements and is aligned in accordance with the FEMA Comprehensive Preparedness Guide 201 (CPG 201), which provides guidance for the preparation of a THIRA.

[33] City of Sugar Land, Texas Emergency Operations Plan. 2016.

Each city department has a Continuity of Operations (COOP) Plan, and these individual plans are incorporated into the overall Continuity of Government (COG) Plan. The city has taken a proactive approach to emergency management, including developing contingencies for providing essential services during an emergency.

Technology is leveraged to conduct EOC operations and for public notifications. Skype for Business is used to share information that, oftentimes, would be shared only in an active EOC. The Blackboard messaging system is linked with social media platforms such as Twitter and Facebook to alert the public of impending emergencies and to provide protective measures. The city of Sugar Land and its emergency management functions are state of the art, coordinated with county state and regional services, are well organized, and proficient. CPSM considers the SLF-EMS emergency management efforts as a ***Best Practice.***

Emergency Operations Center

The Emergency Operations Center is co-located with the police department and the Emergency Communications Center. Plans are underway to build a new facility for the EOC and ECC in the next three years, funded through an Emergency Management Preparedness Grant (EMPG) award. The current EOC is certainly functional as a multi-agency coordination center; however, it is commendable that the city is leaning forward and developing better capability for the future. Co-locating the EOC with the ECC is an excellent way to maintain situational awareness and to share information among disciplines and jurisdictions.

EOC operations are conducted using the Incident Command System, as are field operations. The EOC and the Incident Management Team work closely together and provide situational awareness to each other and the Executive Group while pushing critical strategic decisions outside the scope of the incident to the Executive Group. This process is a best practice and facilitates decision making at the right level.

EMERGENCY COMMUNICATIONS CENTER (ECC)

The city of Sugar Land developed a Public Safety Dispatch Business Plan for 2016. One of the midterm goals is to "Develop Effective Public Safety Communications with Adequate Staffing and Using Appropriate Technology." The Dispatch Director is very knowledgeable in the field of public safety communications and understands the advantages and challenges of the next generation of 911 (NextGen911) in the U.S. She and her staff are highly capable and efficient in managing emergency communications.

Authorized staffing for the Public Safety Dispatch Center (PSDC) is currently 26 full-time employees and three part-time employees. This includes the Dispatch Director, a Deputy Dispatch Manager, a Quality Assurance Supervisor, four Dispatch Shift Supervisors, six Public Safety Dispatcher IIs, thirteen Public Safety Dispatchers, and three part-time Public Safety Dispatchers. The Dispatch Center is staffed 24 hours a day, seven days a week, with a minimum staffing of four personnel. During major incidents, it is common practice for a senior fire officer to assist in the PSDC.

Emergency medical dispatch protocols are defined using the PowerPhone EMD product. Calls are categorized as low, medium, or high acuity. Medium and high acuity calls generate a medic unit and an engine company response. Quality assurance (Q/A) is performed by the supervisors on higher acuity calls as well as on randomly selected calls. The center is working with SLF-EMS to improve and expand the call prioritization process and alter response protocols to reflect call severity.

Interdepartmental Policy P.D. 103 provides guidance to all city staff on the use of the emergency notification system that includes standard procedures and protocol for the activation of the city of Sugar Land's Emergency Notification System. The Public Safety Dispatch Director maintains the user and contact database in the emergency notification system. Department personnel regularly test the system to ensure functionality. Public safety dispatch operators utilize the system during emergency situations to call out the SWAT team and to notify residents of hazardous situations. Statistics regarding use of the system and success of message transmission are recorded in the Public Safety Dispatch Monthly Performance Measures report. The service objective is successful delivery of 85 percent or more of emergency notification messages.[34]

The quality assurance section of dispatch reviews police, fire, and EMS calls for service as well as radio transmissions. In addition, quality assurance checks are performed to ensure all operators are exhibiting CHAMPS values while processing phone calls and during radio transmissions. The quality assurance program assists call takers and radio operators in meeting department and industry standards. The quality assurance process measures the average time it takes personnel to process and dispatch calls for service. It also ensures that calls are being handled according to the proper protocol and being coded properly for dispatch. Quality assurance reports assist in identifying trends. Negative trends are then addressed by call review, and if deemed necessary, additional training, while positive trends are rewarded. Continuing education and advanced training are also part of the quality assurance process. This enables all operators to maintain and improve skills necessary for their complex and ever-evolving work environment. The service objective is an average quality assurance review score of 80 percent or greater.[35]

Computer-aided dispatch and records management system software licenses were purchased and deployed in FY14 as part of the city of Sugar Land's initiative to join the League City, Texas, Consortium and move to the SunGard CAD/RMS platform. The League City Consortium is comprised of several municipal/governmental entities in the area (Galveston, LaPorte, Friendswood, Webster, Deer Park, Alvin, Nassau Bay, and League City) that have come together as a group to provide cost-effective and reliable CAD/RMS. CAD/RMS hosting is a cost-effective and efficient way to provide the necessary platform for a public safety communications agency.

[34] Ibid.
[35] Ibid.

SECTION 9. OVERTIME ANALYSIS

The Center for Public Safety Management, LLC (CPSM), was retained by the city of Sugar Land to conduct a review of overtime expenditures by the Sugar Land Fire-EMS (SLF-EMS). Specifically, CPSM was tasked with identifying the primary causes of overtime and providing recommendations and alternatives that may be utilized to reduce overtime expenditures.

Project staff conducted a site visit on June 2-3, 2016, for the purpose of observing the fire department and agency-connected support functions, interviewing key department staff, and reviewing preliminary data and operations. Telephone conference calls as well as e-mail exchanges were conducted between CPSM project management staff, the city's financial staff, and the SLF-EMS so that CPSM staff could affirm the key drivers of overtime and elicit further discussion regarding containment options.

The Sugar Land Fire-EMS operates from seven fire stations, each providing full-time emergency response to an array of fire, EMS and other emergency calls for assistance. SLF-EMS operates with a minimum daily staffing that has been established at 28 personnel. In addition, a power unit, which is an ambulance, is operated Monday through Friday, eight hours a day, during peak hours of demand. Table 9-1 identifies the equipment and personnel assigned daily to each fire station.

TABLE 9-1: SLF-EMS Fire Stations, Response Units, and Assigned Personnel

Station #	Response Units	Assigned Personnel
1	1 Engine 1 Ambulance	3 2
2	1 Ladder/Quint 1 Ambulance	3 2
3	1 Engine	3
4	1 Ladder/Quint 1 Ambulance 1 Power Unit	3 2 2*
5	1 Engine	3
6	1 Engine	3
7	1 Engine 1 Command/BC	3 1

*__Note:__ The Power Units is currently operated Monday-Friday, eight hours each day.

SLF-EMS responds to an estimated 8,000 alarms annually, with the majority of these calls (approximately 65 percent) being EMS calls. Sugar Land medic units (ambulances) respond to the majority of the EMS incidents. In 2015, 5,051 calls were handled by the city's four medic units, resulting in 2,655 transports. Table 9-2 shows the annual EMS call activity of each SLF-EMS medic unit.

TABLE 9-2: Medic Unit Response and Transport Activity (2015)

Unit #	Total Responses	Calls Per Day	Daily Transports	Daily Deployed Time
Medic 1	1,507	4.1	2.2	3.0 hours
Medic 2	1,122	3.1	1.6	2.7 hours
Medic 4	1,501	4.1	2.2	3.1 hours
Power Unit	921	2.5	1.3	1.9 hours
Total	**5,051**	**13.8**	**7.3**	**10.7 hours**

As can be seen in the table, the overall response activity and resulting transports do not generate an overly heavy workload when considering the number of transport units available and the call volume. In addition, when we look at the time spent on these calls (call duration) our assessment is further substantiated. On average, each non-transport call has a duration of 32.6 minutes. Transport calls typically last 1.01 hours (approximately 61 minutes). These averages include travel to and from the scene and, during transports, travel time to the hospital for patient off-loading. On average, all medic units combined are deployed for 10.7 hours daily. The busiest unit in the system, Medic 4, is deployed for approximately three hours each 24-hour day.

Based on CPSM's evaluation of the non-EMS workload, our assessment is again that the SLF-EMS workload is quite manageable. SLF-EMS units responded to a total of 1,746 non–EMS-related calls in the 12-month period evaluated. The majority of these calls were not fire events (92 percent), and involved hazard situations, service calls, good intent calls, and false alarms. These types of calls are typically managed by one responding unit and the call duration for these events is usually in the 20 to 25 minute range, including travel to and from the incident. During the year, SLF-EMS responded to 55 fires in structures, but only 18 of these events had any recorded fire damage. In addition, of those 18 calls in which fire damage was recorded, only four of these events had a combined structure and content damage of $20,000 or more. CPSM was advised that the dollar loss estimates provided by SLF-EMS were not verified and may be unreliable. The average fire loss for a structure fire nationally as reported by the National Fire Protection Association (NFPA) in 2012 was $20,345.[36] The average fire loss for a structure fire in Sugar Land was estimated to be $10,519, with the largest single event accounting for an estimated $400,000 in combined damage.

The amount of overtime in the SLF-EMS has varied dramatically since 2010. In FY 2010 total overtime hours for shift personnel were estimated at 9,815 hours. In FY 2011 this total was 10,401 hours, in FY 2012 the amount was 13,747 hours, and in FY 2013 the amount was 8,760 hours. In FY 2015 the overtime total reached 25,510 hours, nearly a 260 percent increase over the FY 2010 level. It is estimated that overtime hours in FY 2016 will increase to 33,984 hours.

In addition to overtime hours for additional time worked, firefighters are also afforded FLSA (Fair Labor Standards Act) overtime for the hours that are worked as part of the normal workweek. FLSA specifies that firefighters can work up to 53 hours weekly before an overtime premium rate is applied. This overtime premium is typically time and one-half the employee's regular rate of pay. Most agencies, including Sugar Land, which have a 56-hour schedule, are required to pay three hours each week at the overtime premium wage. Sugar Land pays FLSA as a combined straight time rate for the hours worked in the FLSA cycle and an additional half-time rate for hours 54, 55, and 56 in the regular workweek. In FY 2015 an estimated nearly 40,000 hours of FLSA

[36] Michael J. Karter Jr., *Fire Loss in the United States during 2012*, NFPA September 2013, 13.

overtime was paid, adding an additional $460,000 to the amount of overtime paid. Subsequently, in FY 2015, total overtime expenditures were nearly $1.6 million.

TABLE 9-3: SLF-EMS FY 2015 Overtime

Regular Overtime	49,139 hours	$1,098,737
FLSA Overtime	39,150 hours	$460,416
Total Overtime	88,289 hours	$1,559,153

Overtime is driven by two primary factors that are directly related to one another.

The first factor is the amount of employee lost time, or the frequency of employee absences. Employee absences can be categorized in two ways: scheduled and unscheduled leave. Scheduled leave includes vacation time, training time, military leave, etc. Unscheduled leave is that time for which an employee is scheduled to work but for unexpected reasons is unable to work. This is primarily caused by sick leave or workers' compensation injuries, bereavement, FMLA, etc.

Lost time in itself is not the real driver for overtime. The second, related, factor is the staffing policy adopted by an organization that requires the replacement of absent personnel regardless of whether the lost time is scheduled or unscheduled. SLF-EMS follows a 28-person minimum staffing policy. This means that regardless of the number of absentees, a minimum of 28 people on duty are maintained to provide fire and EMS response. In most instances of employee absences, this minimum staffing level is maintained by overtime worked by off-duty personnel.

With the advent of EMS transport duties in January 2015, SLF-EMS reallocated personnel from existing engines and the ladder company, as well as hired additional personnel to operate three new transport-capable medic units. Also, in anticipation of the transport workload, SLF-EMS recommended and was approved to operate a peak-period, fourth transport unit (the power unit), which is staffed entirely on an overtime basis.

In most fire departments, in anticipation of employee absences, additional people are assigned to each shift to provide coverage when absences occur. Most fire departments experience a 15 to 20 percent lost-time ratio within their workforce. When the number of coverage positions is set, this ratio means that for every five people assigned, an additional person is needed to provide coverage. Thus, a factor of 1.2 is utilized to determine the total number of coverage personnel needed for any given level of assigned staffing. For example, in the SLF-EMS system, in which the minimum daily staffing level is 28, applying a factor of 1.2 would suggest that 33.6 personnel, or five to six more than the assigned minimum, are needed for each shift for coverage. This equates to 15-18 department-wide. SLF-EMS maintains a coverage factor of 3.6 personnel for each of its three shifts or 11 total coverage positions.

RECOMMENDATIONS FOR OVERTIME REDUCTIONS

The SLF-EMS provides an excellent service to its citizens, visitors to the area, and local businesses. The department is well respected in the community and by city leadership. The city of Sugar Land is the largest city in Fort Bend County, with a municipal population of nearly 88,000 residents. The SLF-EMS also provides services into the adjacent Extra Territorial Jurisdiction, which encompasses an additional nine square miles of service area and an additional service population of approximately 36,000 people. CPSM was extremely impressed with the transition that occurred in the SLF-EMS system over the last 18 months as it moved from a BLS (Basic Life Support) first responder agency to an ALS (Advanced Life Support) provider, fully responsible for 911 ambulance transports.

Sixteen recommendations are listed below. These recommendations attempt to provide the basis for understanding why overtime levels in the SLF-EMS system appear so high and more importantly, offer a series of options that will ultimately contribute to a reduction in these levels. These options address both minimum staffing levels and deployment practices, including the staffing of the power unit. In addition, CPSM identifies methods that can be employed to reduce the amount of lost time being incurred by fire personnel; this lost time has a direct impact on overtime. Finally, we address efforts that can be used to redistribute the workload and offer options that reduce the frequency of excessive response practices. For the purpose of estimating overtime savings, CPSM used an average overtime rate of $38.70 per hour, which was provided by the Sugar Land Finance Department.

1. **Discontinue the Deployment of the Power Unit:** SLF-EMS has deployed a power unit five days a week for eight hours each day, with staffing accomplished entirely using overtime. This equates to 80 hours of overtime each week or an estimated 4,160 hours annually. Eliminating the power unit from service will reduce annual overtime expenditures by an estimated $160,000.
2. **Institute Cross-Staffing Deployment at Two Fire Stations:** SLF-EMS operates three full-time medic units from stations 1, 2, and 4. In addition, a fourth unit (power unit) is operated during peak demand periods. SLF-EMS maintains five medic vehicles, four as first-line units and one as a reserve apparatus. CPSM proposes that two fire apparatus (either engines or ladders) move to cross-staffing deployment. In this deployment model, depending on the call type (fire or EMS), the crew responds on the most appropriate vehicle. If the power unit is removed from service as proposed in recommendation 1, the cross-staffing process will mitigate the impacts of this action. In addition, the EMS call load and transport activity can then be distributed among five full-time medic units rather than the current situation in which three first-line medic units and one power unit respond to all EMS calls. This action would not have a direct impact on reducing overtime expenditures, but it will increase the number of transport-capable units that are operational.
3. **Change the Minimum Daily Staffing Level from 28 (daytime) to 26 (nighttime)**: SLF-EMS currently maintains its minimum staffing level at 28 personnel at all times. In order to maintain 28 personnel on duty, overtime is required regularly. On average, SLF-EMS is hiring two personnel for 24 hours each day on an overtime basis. CPSM proposes that SLF-EMS continue to utilize a 28-person minimum staffing level, but only during the first 12 hours of each shift (7:00 a.m. to 7:00 p.m.). On those days that overtime is needed to maintain minimum staffing, this would be done only during the first 12 hours of the shift. For the 12-hour period between 7:00 p.m. and 7:00 a.m., CPSM proposes that the minimum staffing level be reduced to either 26 or 27 personnel, depending on the number of people working overtime. When personnel strength is at 26 personnel, both of

the cross-staffed units will only staff the two-person medic unit. If overtime is not needed to maintain the 28-person minimum staffing, then the deployment model will remain the same throughout the 24-hour period and the two-person medic companies can operate as three-person cross-staffed units. If only one person is on overtime, then the minimum staffing level will drop to 27 and the city will operate with one two-person medic unit. CPSM estimates that by reducing daily minimum staffing levels during nonpeak periods (7:00 p.m. to 7:00 a.m.), the result will be a reduction in overtime spending that exceeds $300,000 annually (24 hrs. X 365 days = 8,760 hours @ $38.70 per/hr. = $339,812).

4. **Do Not Return Daily Minimum Staffing to 29 Personnel**: CPSM was advised that there is a proposal to return the daily minimum staffing level to 29 personnel. The logic for this increase is to have additional staffing available in the event that an on-duty employee must leave his or her assignment mid-shift because of personal illness or some other emergency situation. CPSM believes that this effort will exacerbate overtime use and will result in even more overtime then is currently occurring. In addition, the use of a dynamic minimum staffing model that alters the 28 level to 27 or 26 would minimize the need for this action.

5. **Maintain a Pool of New Hire Firefighter Candidates**: SLF-EMS has had difficulties in recruiting and hiring new firefighter candidates. Recently, SLF-EMS has modified its minimum hiring criteria from a prerequisite of all new candidates holding firefighter/paramedic certification to holding firefighter/EMT certification with the caveat that a new hire complete paramedic training as a condition of employment. This action should increase the number of candidates in the pool and enable the city to rapidly hire from a prequalified new hire pool as vacancies arise. The ability to maintain the budgeted authorized number of field positions has a direct impact on overtime. It is essential that SLF-EMS have a ready pool of new firefighter candidates to be able to move rapidly to fill vacant positions as they become open. CPSM believes that four coverage people is sufficient to maintain a minimum staffing level of 28 personnel during peak periods and 26 personnel in nonpeak times.

6. **Reduce the Number of Earmarked Vacation Slots from Four to Three**: At present, the SLF-EMS authorizes a total of four vacation slots that may be utilized by employees on any given day. Each shift is scheduled to work a total of 121, 24-hour shifts each year. If just three vacation slots are made available for each of the 121 shift days, this would provide an estimated 363, 24-hour slots annually. With a maximum of 32 personnel on each shift, if evenly divided this number of slots will would provide for 11.4, 24-hour vacation days each year per employee. This equates to 273 hours of vacation or an estimated five weeks off annually. Reducing the number of earmarked slots for vacation ensures more people on duty on any given day and a subsequent reduction in overtime.

7. **Do Not Exceed Three People Off on Scheduled Leave**: SLF-EMS SOP # 1911.004.001 allows the number of people off on scheduled leave (vacation, holiday comp, etc.) to exceed the prescribed maximum and to exclude those situations described as "beyond the control of the department." In these situations, employees who are on military leave, workers' comp, training, FMLA, or administrative reassignment would not count towards the established limits prescribed in policy. In these situations, supervisors are allowed to approve more people off then the authorized number of slots prescribed in policy. CPSM believes it is imprudent to authorize vacation or holiday comp time leave at the time it is known that this leave will result in overtime. If an individual has previously scheduled a leave period and then an FMLA leave or military leave is required, we would not propose rescinding the previously scheduled leave. However, approval of additional time off knowing that overtime will occur should not be permitted.

8. **Move to a Payout Process for Holiday Comp Time**: Currently, the city provides holiday comp time for those fire department employees who work on the city's ten designated holidays. Employees who work a full 24 hours of a holiday receive 12 hours of leave time that can be scheduled throughout the year. CPSM estimates that an estimated 3,600 hours of holiday comp time is earned annually. In FY-2016, SLF-EMS is projecting that nearly 3,500 hours of holiday comp time will be used. When an employee uses holiday comp time, this adds to the time-off totals and often results in overtime at a time and one-half rate. CPSM believes that by paying holiday time at a straight time rate when it is earned will ultimately result in a savings to the city.

9. **Institute more Stringent Monitoring Efforts for Sick Leave Use**: The amount of sick leave used by SLF-EMS personnel is significant, second only to vacation time. In 2015, shift personnel used 10,705 hours of sick leave. This equates to approximately 30 hours of leave every day and nearly 120 hours of sick leave used per person annually. Though SLF-EMS has policy directives that require evaluation for excessive use, there is little evaluation done on a consistent basis regarding individual use. CPSM believes that the level of sick leave being used is excessive and can be reduced with proper monitoring and the establishment of clear guidelines and enforcement. SLF-EMS should monitor department sick leave on a monthly basis. Reports should be provided to all supervisory staff and directives established regarding expectations and counseling that would be imposed with excessive use.

10. **Conduct an Annual Audit of the SLF-EMS TeleStaff Payroll Process**: SLF-EMS uses the TeleStaff system to do its payroll and scheduling. TeleStaff is a very robust system and is very effective in managing fire department scheduling. However, the TeleStaff system in Sugar Land does not undergo an annual auditing to ensure that city payroll and administrative procedures are being followed. The TeleStaff process does not undergo approval by the city finance and payroll departments. Instead, any authorizations made by SLF-EMS supervisory personnel are automatically approved in the payroll system. CPSM does not believe that there are intentional improprieties that are taking place; however, errors in processing are likely to be made and the current procedures do not provide a check and balance. An annual audit done by a city staff member from outside the fire department will provide the needed oversight to ensure the system's accuracy and adherence with city policies.

11. **Institute EMS Field Supervision on Each Shift**: Each shift is supervised by an on-duty Battalion Chief. This individual is charged with both the administrative oversight of upwards of 32 personnel, including the coordination of the training schedule, payroll, and shift scheduling, as well as field command duties. The Battalion Chief is assigned to station 4 and has a command vehicle in which he travels throughout the city for both for administrative and command duties. With the recent expansion of EMS transport, the effort required for oversight of both field and administrative functions has increased markedly. Much of this oversight requires EMS knowledge, including the understanding of patient treatment protocols, billing procedures, interaction with the hospitals and medical control, and pharmacological oversight. The Battalion Chief, in many instances, does not have the clinical training nor understanding of EMS field procedures to properly manage this oversight. Much of this oversight is currently being provided by the 40-hour EMS Captain, sometimes on an overtime basis. CPSM believes that there should be an intermediary on each shift to facilitate the directives of the EMS chief and to provide EMS field supervision when needed. CPSM does not believe that this should be an independent EMS supervisory unit but instead this position (preferably a Captain) should be assigned to one of the EMS transport units. It would also be our recommendation that this position be selected through a formal promotional testing process.

The state of Texas has established "***The Texas Ambulance Supplemental Payment Program (TASPP)"*** is a State and federally approved program that allows governmental ambulance service providers to offset losses related to treating and transporting Medicaid beneficiaries and Uninsured patients. Sugar Land should consider its participation in this program to supplement EMS transport revenue.

12. **Revisit the Requirement for Supervisory Notification for Patient Transport Refusals**: Under current SLF-EMS policy whenever a patient refuses treatment or transport a patient refusal form must be processed. In addition, field personnel must notify either the Battalion Chief or the EMS Supervisor to document this activity. In many instances, the 40-hour EMS captain is notified for this purpose and this notification is done after normal business hours. CPSM believes that it is important to document when patient refusals occur; however, it is unnecessary to include medical supervision in this process. If both field personnel attending to the patient acknowledge that the patient has refused treatment or transport, and this has been documented by a signed patient refusal form, it is not necessary to contact off-duty personnel to verify this action. All patient refusals can be reviewed after the fact by EMS supervisory staff to ensure proper documentation and adherence to medical directives.

13. **Institute EMS Call Prioritization and Altered Response Modes for Minor EMS Call Types**: All 911 dispatching is performed by the Sugar Land Public Safety Dispatch Center. The center utilizes the Power-Phone Emergency Medical Dispatching (EMD) system to screen calls and establish the prioritization of call types. Dispatchers at the center ask a series of questions of the 911 caller to identify the severity of the call and symptoms demonstrated by the patient. From this inquiry the EMD system recommends a call priority. The Dispatch Center is part of a regional dispatching network; response protocols are reviewed by the city's Medical Director. The system, however, does not recommend an altered response for minor EMS call types and an SLF-EMS medic unit responds to all EMS calls in a "hot" mode of response (lights and sirens). CPSM believes that, on minor EMS calls or patient assists, the call should be handled by the closest available unit, which can include fire apparatus. The logic behind call prioritization is to send the most appropriate unit to a particular call type. This means that the more severe cases receive the highest level of care (i.e., Paramedic) and the lower call types receive a lower level of care (EMT-Basic). SLF-EMS's current process of sending a medic unit to all EMS calls results in a higher call volume for the medic units and can tie up these advanced life support units on calls that are typically minor in nature.

14. **Consider the Cross-Staffing of EMS Squad Units with Fire Apparatus**: SLF-EMS currently operates four of its seven stations with a single fire apparatus (engine or ladder). From these stations, the fire apparatus will respond to only the more severe EMS calls to assist the medic unit that is responding into their station areas. On minor EMS calls only the medic unit will respond. As mentioned above, CPSM recommends that fire apparatus should respond to minor EMS calls in their station response area. This will reduce the workload of the medic units and maintain their availability for more critical patient care. Many communities have raised concerns regarding larger fire apparatus responding to minor EMS or nonemergency call types. The perception is that this is wasteful and creates unnecessary wear and tear on larger, more costly fire apparatus. A number of communities are reexamining the deployment of ladders and fire trucks on EMS calls and opting for a more efficient, less costly vehicle type to handle minor EMS or nonemergency call types. There are a number of configurations that are being utilized in the deployment of smaller, more cost-efficient, non-transport response vehicles. Generally, a light-weight truck chassis with outside compartmentation has been very effective and is available at a cost under $100,000. Such a vehicle can be expected to

operate for upwards of 100,000 to 120,000 miles and it serves to reduce the wear and tear on larger, more costly fire apparatus.

15. **Reduce the Number of Units Responding to Residential Structure Fires**: SLF-EMS assigns nine units and upwards of 22 personnel to a reported structure fire. This complement of resources includes an assignment of a mutual aid response of one engine (three personnel) and a mutual aid battalion chief. CPSM believes that this level of response is excessive and should be reduced. NFPA's1710, its standard for staffing and deployment of fire apparatus in career organizations, recommends the assignment of 14 personnel for the initial response to a structure fire when an aerial apparatus is not utilized. In many smaller organizations, the assignment of 12 personnel for an initial response to a single family structure fire is very common. CPSM believes that SLF-EMS should reduce the number of units assigned to the initial response to structure fires to four engines/ladder, one medic unit, and one chief officer (15 personnel total). Responding fewer units increases the availability of the remaining units to respond to simultaneous calls. Also, responding fewer units reduces the probability that responding units may be involved in vehicle accidents. In the event that additional resources are needed, these may be requested after the arrival of the assigned units and this delay would not typically impact outcomes.
16. **Increase Ambulance Transport Rates**: Proceeds from ambulance transport services are currently less than 20 percent of the billable charges. CPSM estimates that collections for ambulance transports in the Sugar Land area should be in the 60 to 65 percent range. The major factor contributing to the extremely low collection rate is the current moratorium on Medicare billing in the area. CPSM was told that Medicare patients account for nearly 40 percent of the billings in the Sugar Land system. The moratorium was instituted in July 2013 and subsequently the revenues from EMS transport have been reduced. Sugar Land has the ability to adjust its transport rates in an effort to ensure greater cost recovery for these services. CPSM believes that the city should consider a 25 percent increase in ambulance transport rates and associated charges until the Medicare moratorium is lifted.

CONCLUSION

CPSM believes that overtime expenditures in SLF-EMS can be reduced. The primary drivers of overtime are the operation of the power unit, the 28-person minimum staffing, and the amount of employee lost time. Through a series of adjustments that alter deployment practices, expand employee productivity, and elevate system monitoring efforts, significant reductions in overtime can be achieved. These actions, if implemented, will result in significant cost savings and will have limited, if any, impact on service delivery.

SECTION 10. DATA ANALYSIS

This data analysis was prepared as a key component of the study of the Sugar Land Fire-EMS (SLF-EMS), which was conducted by the Center for Public Safety Management, LLC. This analysis examines all calls for service between July 1, 2015, and June 30, 2016, as recorded in the computer-aided dispatch (CAD) system and the National Fire Incident Reporting System (NFIRS).

This analysis is made up of five sections. The first section focuses on call types and dispatches. The second section explores time spent and workload of individual units. The third section presents an analysis of the busiest hours in the year studied. The fourth section provides a response time analysis of SLF-EMS units. The fifth and final section analyzes transports.

During the year covered by this study, SLF-EMS operated out of seven stations utilizing five engines, two quints/ladders, four ambulances, two support vehicles, one hazmat unit, and 12 administrative units.

During the twelve months studied, the Sugar Land Fire-EMS responded to 8,043 calls, of which 68 percent were EMS calls. The department transported patients in 2,655 EMS calls. The total combined workload (deployed time) for all SLF-EMS units was 7,106 hours. The average dispatch time for the first arriving SLF-EMS unit was 1.0 minute and the average response time of the first arriving SLF-EMS unit was 6.6 minutes. The 90th percentile dispatch time was 1.7 minutes and the 90th percentile response time was 9.5 minutes.

METHODOLOGY

In this report, we analyze calls and runs. A call is an emergency service request or incident. A run is a dispatch of a unit. Thus, a call might include multiple runs.

We received CAD data and NFIRS data for the Sugar Land Fire-EMS. We first matched the NFIRS and CAD data based on incident numbers provided. Then, we classified the calls in a series of steps. We first used NFIRS incident type to identify canceled calls and to assign EMS, motor vehicle accident (MVA), and fire category call types. EMS calls were then assigned detailed categories based on the CAD incident nature. Mutual aid calls were identified based on the NFIRS mutual aid code and on the CAD mutual aid incident nature. Transport calls were identified as calls where at least one SLF-EMS ambulance recorded both a "begin transport time" and an "arrive at hospital time."

Finally, units with no corresponding call, with no en route time and no arrival time, or with a dispatch-to-clear time of less than 30 seconds were removed. Then, calls with no responding units were removed. In addition, a total of seven incidents to which administrative units were the sole responders are not included in the analysis sections of the report. However, the workload of administrative units is documented in Attachment III.

In this report, canceled and mutual aid calls are included in all analyses except for overlapping calls by station area and the response time analyses.

AGGREGATE CALL TOTALS AND DISPATCHES

In this report, each citizen-initiated emergency service request is considered a call. During the year studied, SLF-EMS responded to 8,043 calls. Of these, 55 were structure fire calls and 94 were outside fire calls within SLF-EMS's jurisdiction. Each dispatched unit is a separate "run." As multiple units are dispatched to a call, there are more runs than calls. The department's total runs and workload are reported in the second section of this analysis.

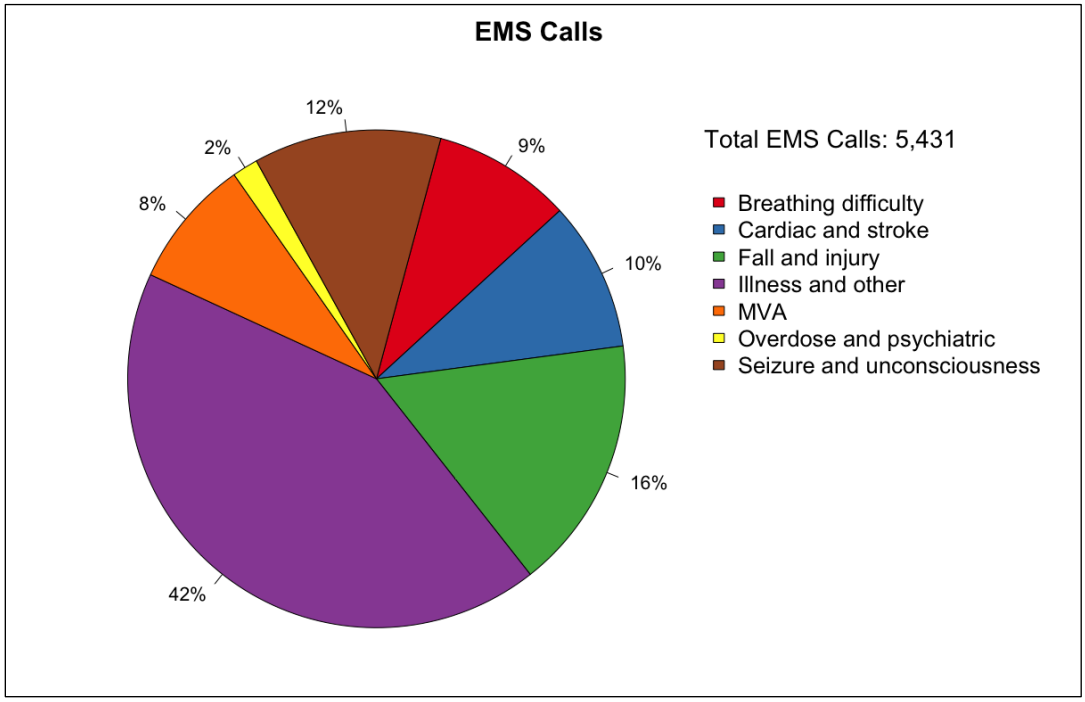
Calls by Type

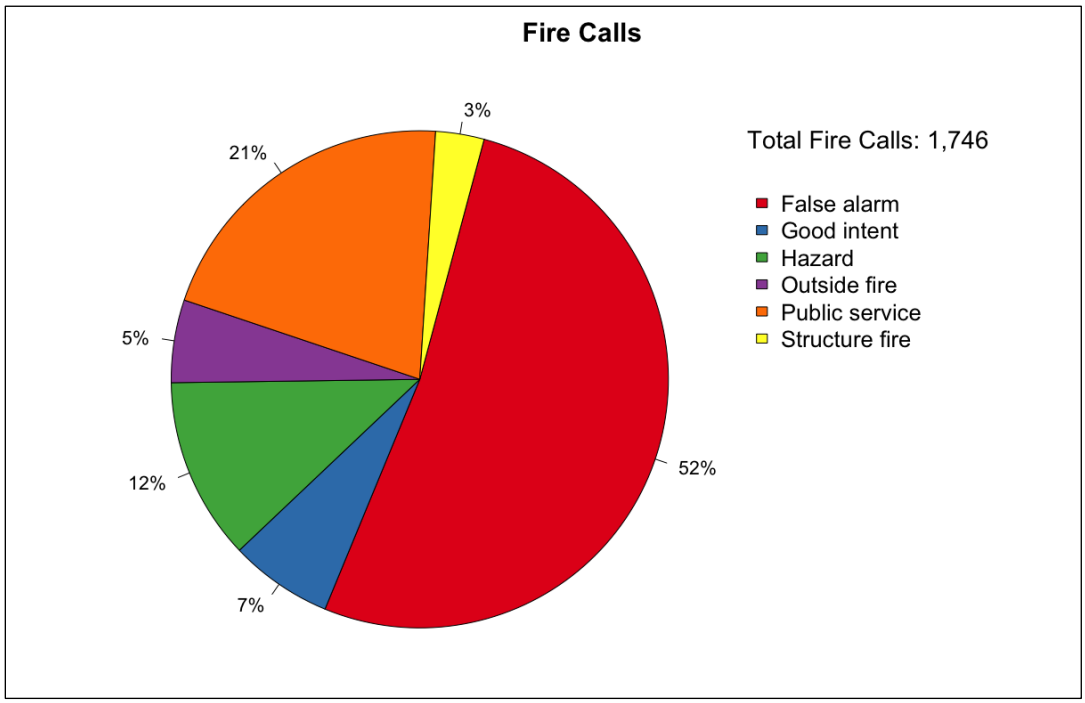
Table10-1 and Figure 10-1 show the number of calls by call type, average calls per day, and the percentage of calls that fall into each call type category.

TABLE 10-1: Call Types

Call Type	Number of Calls	Calls per Day	Call Percentage
Breathing difficulty	490	1.3	6.1
Cardiac and stroke	527	1.4	6.6
Fall and injury	896	2.4	11.1
Illness and other	2,307	6.3	28.7
MVA	458	1.3	5.7
Overdose and psychiatric	91	0.2	1.1
Seizure and unconsciousness	662	1.8	8.2
EMS Total	**5,431**	**14.8**	**67.5**
False alarm	909	2.5	11.3
Good intent	117	0.3	1.5
Hazard	207	0.6	2.6
Outside fire	94	0.3	1.2
Public service	364	1.0	4.5
Structure fire	55	0.2	0.7
Fire Total	**1,746**	**4.8**	**21.7**
Canceled	755	2.1	9.4
Mutual aid	111	0.3	1.4
Total	**8,043**	**22.0**	**100.0**

FIGURE 10-1: EMS and Fire Calls by Type





Observations:

Overall

- The department received an average of 22 calls per day, which includes 2.1 canceled and 0.3 mutual aid calls.
- EMS calls for the year totaled 5,431 (68 percent of all calls), an average of 14.8 per day.
- Fire calls for the year totaled 1,746 (22 percent of all calls), an average of 4.8 per day.

EMS

- Illness and other calls were the largest category of EMS calls at 42 percent of EMS calls.
- Cardiac and stroke calls made up 10 percent of the EMS calls.
- Motor vehicle accidents made up 8 percent of the EMS calls.

Fires

- Structure and outside fires combined for a total of 149 calls during the year, an average of one call every 2.5 days.
- A total of 55 structure fire calls accounted for 3 percent of the fire calls.
- A total of 94 outside fire calls accounted for 5 percent of the fire calls.
- False alarm calls were the largest fire call category, making up 52 percent of the fire calls.

Calls by Type and Duration

Table 10-2 shows the duration of calls by type using four duration categories: less than 30 minutes, 30 minutes to one hour, one to two hours, and more than two hours.

TABLE 10-2: Calls by Type and Duration

Call Type	Less than 30 Minutes	30 Minutes to One Hour	One to Two Hours	More than Two Hours	Total
Breathing difficulty	60	252	173	5	490
Cardiac and stroke	44	300	178	5	527
Fall and injury	192	413	283	8	896
Illness and other	1,081	783	429	14	2,307
MVA	143	179	128	8	458
Overdose and psychiatric	15	48	28	0	91
Seizure and unconsciousness	105	343	206	8	662
EMS Total	**1,640**	**2,318**	**1,425**	**48**	**5,431**
False alarm	836	62	9	2	909
Good intent	100	15	1	1	117
Hazard	128	43	26	10	207
Outside fire	53	26	10	5	94
Public service	318	35	10	1	364
Structure fire	22	12	12	9	55
Fire Total	**1,457**	**193**	**68**	**28**	**1,746**
Canceled	746	7	1	1	755
Mutual aid	47	26	25	13	111
Total	**3,890**	**2,544**	**1,519**	**90**	**8,043**

Observations:

EMS

- A total of 3,958 EMS category calls (73 percent) lasted less than one hour, 1,425 EMS category calls (26 percent) lasted between one and two hours, and 48 EMS category calls (1 percent) lasted more than two hours.
- On average, there were 4.0 EMS category calls per day that lasted more than one hour.
- A total of 344 cardiac and stroke calls (65 percent) lasted less than one hour, and 183 cardiac and stroke calls (35 percent) lasted more than an hour.
- A total of 322 motor vehicle accidents (70 percent) lasted less than one hour, and 136 motor vehicle accidents (30 percent) lasted more than an hour.

Fire

- A total of 1,650 fire category calls (95 percent) lasted less than one hour, 68 fire category calls (4 percent) lasted between one and two hours, and 28 fire category calls (2 percent) lasted more than two hours.

- On average, there were 0.3 fire category calls per day that lasted more than one hour.
- A total of 34 structure fires (62 percent) lasted less than one hour, 12 structure fires (22 percent) lasted between one and two hours, and 9 structure fires (16 percent) lasted more than two hours.
- A total of 79 outside fires (84 percent) lasted less than one hour, 10 outside fires (11 percent) lasted between one and two hours, and 5 outside fires (5 percent) lasted more than two hours.
- A total of 898 false alarms (99 percent) lasted less than one hour, and 11 false alarms (1 percent) lasted more than an hour.

Average Calls per Day and per Hour

Figure 10-2 shows the monthly variation in the average daily number of calls handled by SLF-EMS during the year studied. Similarly, Figure 10-3 illustrates the average number of calls received each hour of the day over the course of the year.

FIGURE 10-2: Average Calls per Day, by Month

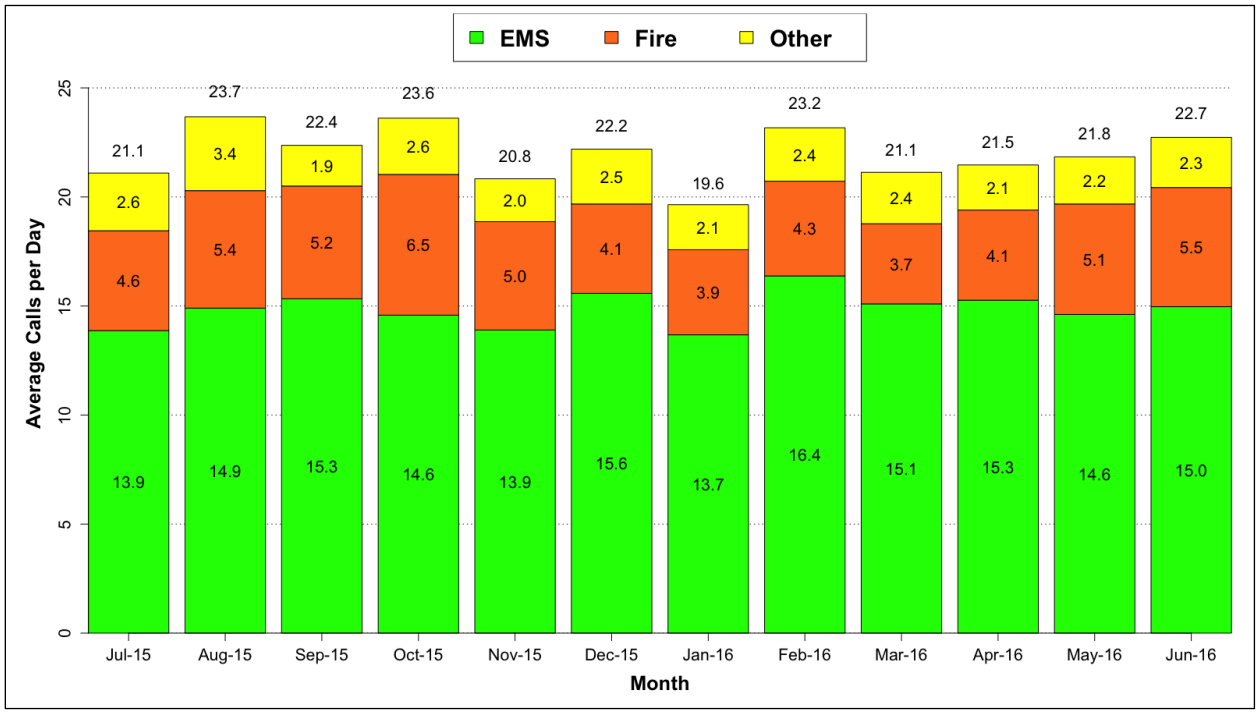
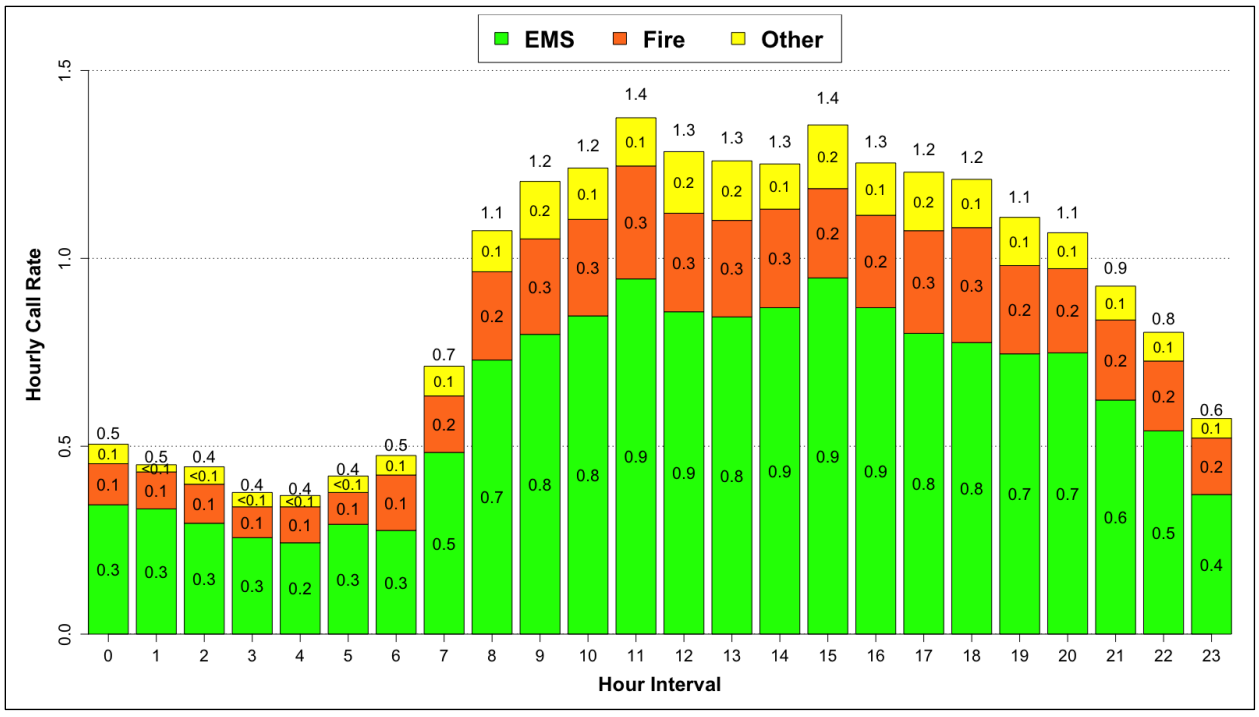


FIGURE 10-3: Calls by Hour of Day



Observations:

Average Calls per Day

- Average calls per day ranged from a low of 19.6 calls per day in January 2016 to a high of 23.7 calls per day in August 2015. The highest monthly average was 21 percent greater than the lowest monthly average.
- Average EMS calls per day ranged from a low of 13.7 calls per day in January 2016 to a high of 16.4 calls per day in February 2016.
- Average fire calls per day ranged from a low of 3.7 calls per day in March 2016 to a high of 6.5 calls per day in October 2015.
- Average other calls per day ranged from a low of 1.9 calls per day in September 2015 to a high of 3.4 calls per day in August 2015.
- The highest number of calls received in a single day was 37, which occurred twice: on August 11, 2015, and on October 31, 2015.

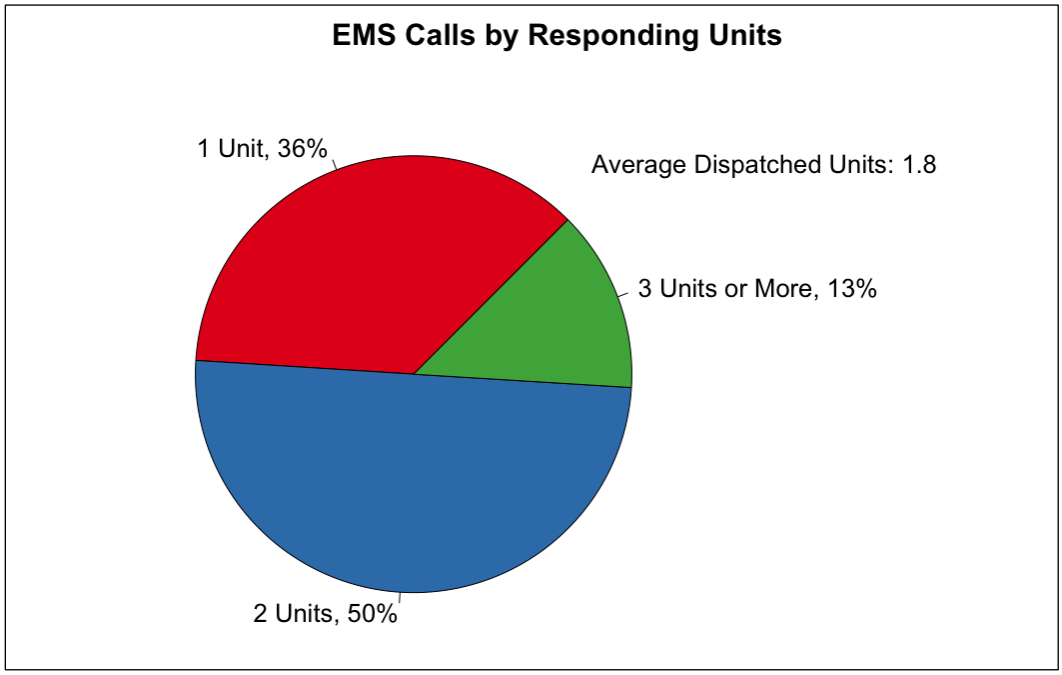
Average Calls per Hour

- Average hourly call rates ranged from 0.4 to 1.4 calls per hour.
- Call rates were highest between 11:00 a.m. and noon, averaging 1.4 calls per hour.
- Call rates were lowest between 2:00 a.m. and 6:00 a.m., averaging 0.4 calls per hour.

Units Dispatched to Calls

Figure 10-4 and Table 10-3 detail the number of SLF-EMS units dispatched to calls overall and broken down by call type.

FIGURE 10-4: Number of Units Dispatched to Calls



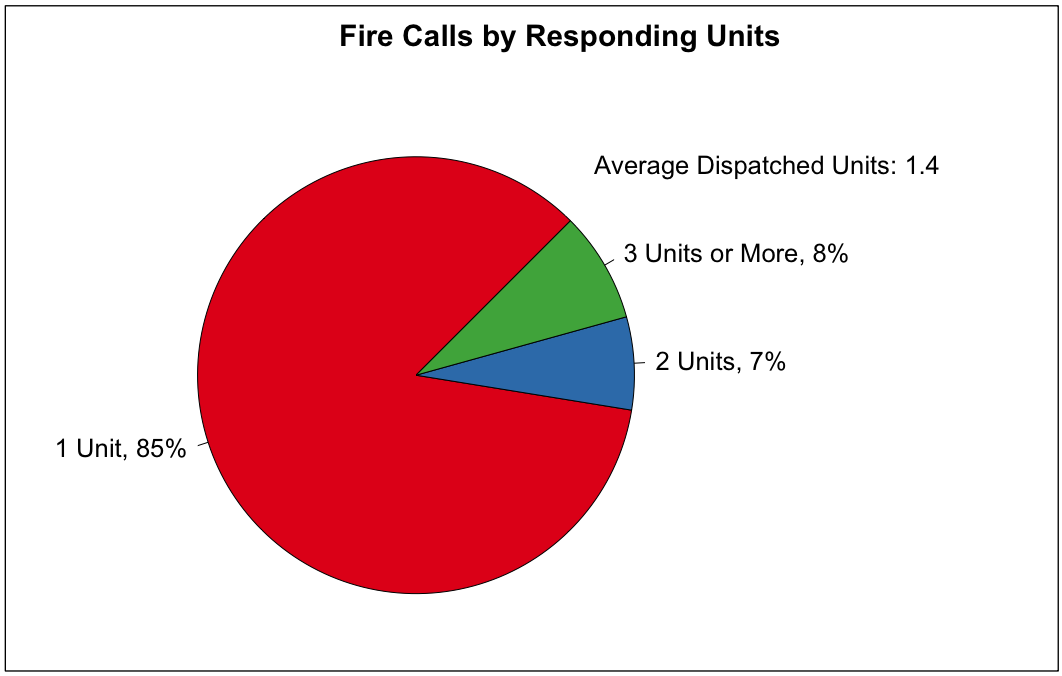


TABLE 10-3: Number of Units Dispatched to Calls by Call Type

Call Type	Number of Calls			
	One	Two	Three or More	Total
Breathing difficulty	7	440	43	490
Cardiac and stroke	8	481	38	527
Fall and injury	39	776	81	896
Illness and other	1,875	382	50	2,307
MVA	7	306	145	458
Overdose and psychiatric	36	45	10	91
Seizure and unconsciousness	10	287	365	662
EMS Total	**1,982**	**2,717**	**732**	**5,431**
False alarm	817	47	45	909
Good intent	92	11	14	117
Hazard	172	18	17	207
Outside fire	61	15	18	94
Public service	331	26	7	364
Structure fire	10	3	42	55
Fire Total	**1,483**	**120**	**143**	**1,746**
Canceled	620	95	40	755
Mutual aid	90	19	2	111
Total	**4,175**	**2,951**	**917**	**8,043**
Percentage	**51.9**	**36.7**	**11.4**	**100.0**

Observations:

Overall

- On average, 1.6 units were dispatched to all calls, and for 52 percent of calls only one unit was dispatched.
- Overall, three or more units were dispatched to 11 percent of calls.

EMS

- On average, 1.8 units were dispatched per EMS call.
- For EMS calls, one unit was dispatched 36 percent of the time, two units were dispatched 50 percent of the time, and three or more units were dispatched 13 percent of the time.

Fires

- On average, 1.4 units were dispatched per fire call.
- For fire calls, one unit was dispatched 85 percent of the time, two units were dispatched 7 percent of the time, and three or more units were dispatched 8 percent of the time.
- For structure fire calls, three or more units were dispatched 76 percent of the time.
  - Three to six units were dispatched 15 percent of the time.

- Seven units were dispatched 40 percent of the time.
- Eight or more units were dispatched 22 percent of the time.

- For outside fire calls, three or more units were dispatched 19 percent of the time.

WORKLOAD: CALLS AND TOTAL TIME SPENT

In this section, the workload of each unit is reported in two ways: deployed time and runs. A dispatch of a unit is defined as a run; thus, one call might include multiple runs, which results in a higher total number of runs than total number of calls. The deployed time of a run is from the time a unit is dispatched through the time the unit is cleared.

Runs and Deployed Time – All Units

Deployed time, also referred to as deployed hours, is the total deployment time of all the units deployed on all calls. Table 10-4 shows the total deployed time, both overall and broken down by type of call, for SLF-EMS units during the year studied.

TABLE 10-4: Annual Runs and Deployed Time by Call Type

Call Type	Avg. Deployed Min. per Run	Total Annual Hours	Percent of Total Hours	Avg. Deployed Min. per Day	Total Annual Runs	Avg. Runs per Day
Breathing difficulty	39.0	661.7	9.3	108.5	1,019	2.8
Cardiac and stroke	39.5	717.2	10.1	117.6	1,088	3.0
Fall and injury	36.2	1,118.1	15.7	183.3	1,854	5.1
Illness and other	35.6	1,657.6	23.3	271.7	2,797	7.6
MVA	35.9	656.5	9.2	107.6	1,098	3.0
Overdose and psychiatric	40.6	105.6	1.5	17.3	156	0.4
Seizure and unconsciousness	34.7	983.1	13.8	161.2	1,699	4.6
EMS Total	**36.5**	**5,899.9**	**83.0**	**967.2**	**9,711**	**26.5**
False alarm	16.2	284.6	4.0	46.7	1,054	2.9
Good intent	16.4	52.0	0.7	8.5	190	0.5
Hazard	32.0	163.5	2.3	26.8	307	0.8
Outside fire	30.8	93.9	1.3	15.4	183	0.5
Public service	20.4	140.3	2.0	23.0	412	1.1
Structure fire	48.6	251.8	3.5	41.3	311	0.8
Fire Total	**24.1**	**986.1**	**13.9**	**161.7**	**2,457**	**6.7**
Canceled	6.1	95.4	1.3	15.6	944	2.6
Mutual aid	55.8	124.5	1.8	20.4	134	0.4
Total	**32.2**	**7,106.1**	**100.0**	**1,164.9**	**13,246**	**36.2**

Observations:

Overall

- Total deployed time for the year was 7,106 hours. The daily average was 19.4 hours for all units combined.
- There were 13,246 runs, including 134 runs dispatched for mutual aid calls. The daily average was 36.2 runs.

EMS

- EMS calls accounted for 83 percent of the total workload.
- The average deployed time for runs to EMS calls was 36.5 minutes. The deployed time for all units dispatched to EMS calls averaged 16.1 hours per day.

Fires

- Fire calls accounted for 14 percent of the total workload.
- There were 494 runs for structure and outside fire calls, with a total workload of 346 hours. This accounted for 5 percent of the total workload.
- The average deployed time for runs to structure fire calls was 48.6 minutes, and the average deployed time for outside fire calls was 30.8 minutes.

FIGURE 10-5: Average Deployed Minutes by Hour of Day

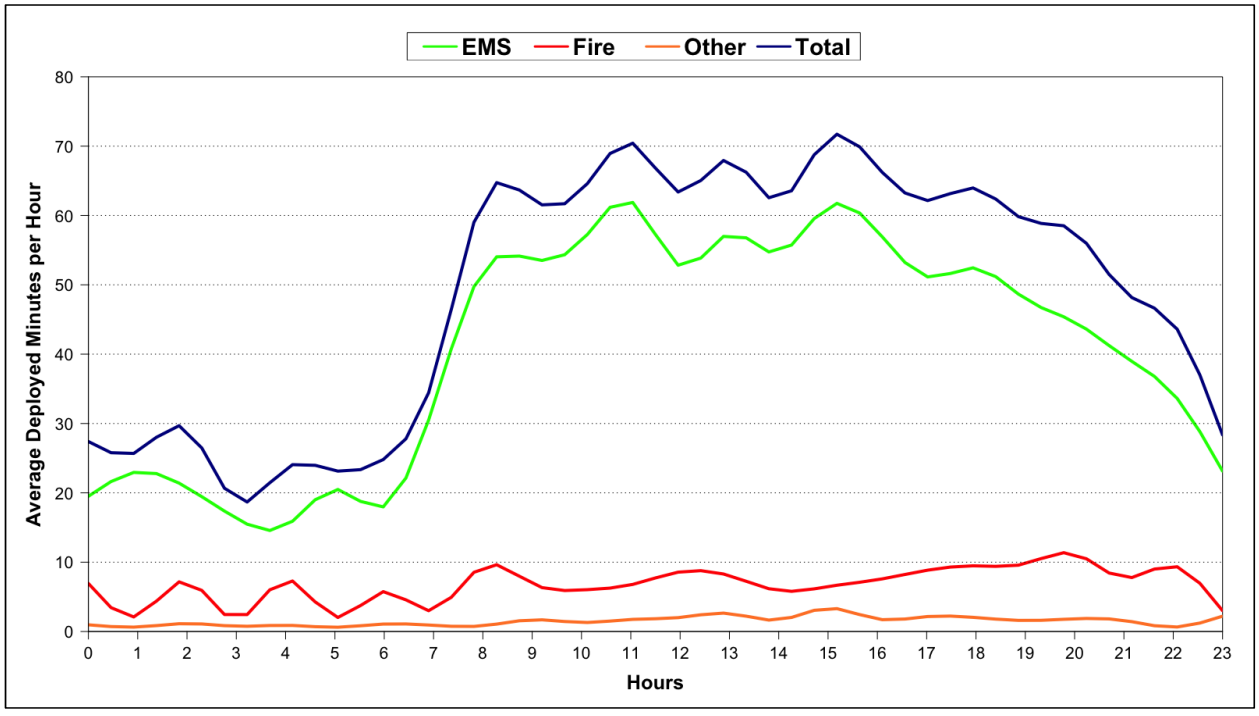


TABLE 10-5: Average Deployed Minutes by Hour of Day

Hour	EMS	Fire	Other	Total
0	19.5	6.9	1.0	27.4
1	23.0	2.2	0.7	25.9
2	20.8	7.3	1.2	29.2
3	16.3	1.7	0.8	18.8
4	15.2	7.5	0.9	23.6
5	20.5	2.1	0.6	23.2
6	18.0	5.8	1.1	24.9
7	32.7	3.1	0.9	36.6
8	52.1	9.4	0.8	62.4
9	53.7	6.9	1.7	62.2
10	56.3	6.0	1.3	63.6
11	62.1	6.7	1.7	70.5
12	52.7	8.6	2.0	63.3
13	57.4	8.1	2.6	68.1
14	54.6	5.9	1.7	62.1
15	61.3	6.5	3.4	71.2
16	57.8	7.5	1.8	67.0
17	51.2	8.8	2.2	62.1
18	52.4	9.5	2.0	63.9
19	48.0	9.8	1.6	59.3
20	44.6	11.2	1.8	57.7
21	39.7	7.7	1.6	49.0
22	34.3	9.5	0.6	44.4
23	23.1	3.0	2.2	28.4

Observations:

- Hourly deployed time was highest during the day between 8:00 a.m. and 7:00 p.m., averaging between 62 minutes (1 hour and 2 minutes) and 71 minutes (1 hour and 11 minutes).
- Average deployed time peaked between 3:00 p.m. and 4:00 p.m., averaging 71 minutes.
- Hourly deployed time was lowest between 3:00 a.m. and 4:00 a.m., averaging 19 minutes.

Workload by Unit

Table 10-6 provides a summary of each unit's workload overall. Tables 10-7 and 10-8 provide a more detailed view of workload, showing each unit's runs broken out by call type (Table 10-7) and the resulting daily average deployed time by call type (Table 10-8).

Two reserve engines (E-2 and E-4) are used by L-2 and L-4 respectively when a reserve ladder is not available. The workload of the reserve engines has been included with the corresponding ladder's workload.

There is also a reserve ambulance (M-12). When the unit is in service, it temporarily assumes the identifier of the unit that it is replacing. However, four runs were recorded as M-12 during the year studied. These four runs were included with M-11's workload.

TABLE 10-6: Call Workload by Unit

Station	Unit Type	Unit	Avg. Deployed Min. per Run	Total Annual Hours	Avg. Deployed Min. per Day	Total Annual Runs	Avg. Runs per Day
1	Ambulance	M-1	43.2	1,085.7	178.0	1,507	4.1
	Engine	E-1	22.9	537.5	88.1	1,407	3.8
2	Ambulance	M-2	53.1	992.9	162.8	1,122	3.1
	Ladder	L-2	25.5	518.4	85.0	1,221	3.3
3	Engine	E-3	24.7	390.8	64.1	949	2.6
4	Ambulance	M-4	45.5	1,137.4	186.5	1,501	4.1
	Ladder	L-4	23.0	487.8	80.0	1,271	3.5
	SUV	S-4	19.0	5.1	0.8	16	0.0
5	Engine	E-5	21.1	180.1	29.5	513	1.4
	Haz-Mat	H-5	66.6	17.8	2.9	16	0.0
6	Engine	E-6	21.0	380.7	62.4	1,087	3.0
7	Engine	E-7	21.4	372.9	61.1	1,048	2.9
	SUV	B-1	26.6	295.6	48.5	667	1.8
Varies	Ambulance	M-11	45.8	703.4	115.3	921	2.5
Total			**32.2**	**7,106.1**	**1,164.9**	**13,246**	**36.2**

Note: Ambulance M-11 is used during peak demand periods and for special events and is not always deployed from the same station.

TABLE 10-7: Total Annual Runs by Call Type and Unit

Station	Unit Type	Unit	EMS	False Alarm	Good Intent	Hazard	Outside Fire	Public Service	Structure Fire	Canceled	Mutual Aid	Total
1	Ambulance	M-1	1,370	26	6	5	5	14	10	68	3	1,507
	Engine	E-1	915	183	23	44	26	59	41	107	9	1,407
2	Ambulance	M-2	1,041	17	6	1	2	10	6	38	1	1,122
	Ladder	L-2	746	184	18	41	20	50	30	95	37	1,221
3	Engine	E-3	549	86	29	34	18	51	39	110	33	949
4	Ambulance	M-4	1,379	18	5	7	4	5	21	62	0	1,501
	Ladder	L-4	802	183	28	48	21	47	40	98	4	1,271
	SUV	S-4	15	0	1	0	0	0	0	0	0	16
5	Engine	E-5	256	77	13	30	13	17	30	67	10	513
	Haz-Mat	H-5	1	0	0	9	0	0	0	2	4	16
6	Engine	E-6	662	92	20	26	24	107	14	127	15	1,087
7	Engine	E-7	651	132	29	38	26	29	31	105	7	1,048
	SUV	B-1	474	46	10	21	19	16	40	31	10	667
Varies	Ambulance	M-11	850	10	2	3	5	7	9	34	1	921
Total			**9,711**	**1,054**	**190**	**307**	**183**	**412**	**311**	**944**	**134**	**13,246**

Note: Ambulance M-11 is used during peak demand periods and for special events and is not always deployed from the same station.

TABLE 10-8: Daily Average Deployed Minutes by Call Type and Unit

Station	Unit Type	Unit	EMS	False Alarm	Good Intent	Hazard	Outside Fire	Public Service	Structure Fire	Canceled	Mutual Aid	Total
1	Ambulance	M-1	173.3	0.8	0.2	0.2	0.3	0.4	1.6	1.1	0.1	178.0
	Engine	E-1	61.8	7.4	0.9	3.7	2.0	3.3	6.3	1.4	1.3	88.1
2	Ambulance	M-2	159.2	0.6	0.1	0.0	0.7	0.6	0.9	0.5	0.0	162.8
	Ladder	L-2	56.7	7.9	0.7	4.7	2.3	3.1	4.0	1.2	4.5	85.0
3	Engine	E-3	39.8	4.2	1.4	3.4	0.9	2.8	5.2	2.2	4.1	64.1
4	Ambulance	M-4	182.2	0.5	0.2	0.1	0.1	0.3	2.0	1.1	0.0	186.5
	Ladder	L-4	53.3	8.6	1.5	5.3	1.4	2.2	5.2	1.3	1.2	80.0
	SUV	S-4	0.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.8
5	Engine	E-5	16.5	3.2	0.4	1.7	1.3	1.0	2.0	1.6	1.8	29.5
	Haz-Mat	H-5	0.1	0.0	0.0	0.8	0.0	0.0	0.0	0.2	1.9	2.9
6	Engine	E-6	39.6	4.0	1.4	2.5	2.4	5.2	2.7	2.3	2.2	62.4
7	Engine	E-7	40.5	7.2	1.1	2.2	1.9	1.9	3.2	1.9	1.2	61.1
	SUV	B-1	30.6	1.9	0.5	2.0	1.9	1.6	7.5	0.5	1.9	48.5
Varies	Ambulance	M-11	112.7	0.2	0.0	0.3	0.2	0.5	0.8	0.5	0.2	115.3
Total			**967.2**	**46.7**	**8.5**	**26.8**	**15.4**	**23.0**	**41.3**	**15.6**	**20.4**	**1,164.9**

Note: Ambulance M-11 is used during peak demand periods and for special events and is not always deployed from the same station.
Some units had such low total deployed time that average minutes per day, when rounded to the nearest one-tenth, appears to be zero.

Observations:

- Ambulance 1 made the most runs (1,507 or an average of 4.1 per day) and had the second highest total annual deployed time (1,086 hours or an average of 178 minutes per day).
- Ambulance 4 made the second most runs (1,501 or an average of 4.1 per day) and had the highest total annual deployed time (1,137 hours or an average of 186 minutes per day).
- Engine 1 made third most runs, and the most runs of the engines and ladders, (1,667 or an average of 3.9 per day) and had the most deployed time (641 hours or an average of 90 minutes per day).
  - EMS calls accounted for 65 percent of the runs and 70 percent of deployed time.
  - Structure and outside fires combined accounted for 5 percent of the runs and 9 percent of deployed time.
- Engine 5 was the least busy of the engines and ladders with 513 runs and 180 hours of deployed time.

ANALYSIS OF BUSIEST HOURS

There is significant variability in the number of calls from hour to hour. One special concern relates to the resources available for hours with the heaviest workload. We tabulated the data for each of the 8,784 hours in the year. Table 10-9 shows the number of hours in the year in which there were zero to four or more calls during the hour. Table 10-10 shows the 10 one-hour intervals during the year with the most calls.

TABLE 10-9: Frequency Distribution of the Number of Calls

Calls in an Hour	Frequency	Percentage
0	3,792	43.2
1	2,885	32.8
2	1,406	16.0
3	526	6.0
4+	175	2.0

Note: There are 8,760 hours in a normal year. However, 2016 was a leap year and thus had 8,784 hours.

TABLE 10-10: Top 10 Hours with the Most Calls Received

Hour	Number of Calls	Number of Runs	Total Deployed Hours
08/11/2015 – 6:00 p.m. to 7:00 p.m.	11	23	6.6
08/11/2015 – 7:00 p.m. to 8:00 p.m.	9	20	32.8
10/13/2015 – 4:00 p.m. to 5:00 p.m.	8	23	6.7
10/26/2015 – 9:00 a.m. to 10:00 a.m.	8	15	7.8
11/05/2015 – 11:00 a.m. to Noon	7	12	6.2
03/10/2016 – 10:00 a.m. to 11:00 a.m.	7	12	6.4
05/14/2016 – 4:00 p.m. to 5:00 p.m.	7	12	5.1
11/23/2015 – 3:00 p.m. to 4:00 p.m.	6	18	8.8
05/31/2016 – 1:00 p.m. to 2:00 p.m.	6	17	6.7
04/05/2016 – 8:00 a.m. to 9:00 a.m.	6	14	7.5

Note: Total deployed hours is the total time spent responding to calls received in the hour, and which may extend into the next hour or hours.

Observations:

- During 175 hours (2 percent of all hours), four or more calls occurred; in other words, the department responded to four or more calls in an hour roughly once every two days.
- The highest number of calls to occur in an hour was 11, which happened once.
- The hour with the most calls was 6:00 p.m. to 7:00 p.m. on August 11, 2015. The hour's 11 calls involved 23 individual dispatches resulting in 6.6 hours of deployed time. These eleven calls included six false alarm calls, one canceled call, one hazard call, one illness and other call, one public service call, and one structure fire call.
- The hour with the second most calls was 7:00 p.m. to 8:00 p.m. on August 11, 2015. The hour's nine calls involved 20 individual dispatches resulting in 32.8 hours of deployed time. These nine calls included three canceled calls, two public service calls, one false alarm call, one illness and other call, one mutual aid call, and one structure fire call.

Overlapping Calls

An overlapping call is defined as a call that starts (based on dispatch time) while another call is still active. Each call is counted only once, even if it overlaps with multiple other calls. In the analysis, calls with fewer than 30 seconds of overlap were excluded.

TABLE 10-11: Overlapping Calls by Station District

District	Number of Calls	Average Minutes of Overlap	Total Hours
Station 1	497	22.0	103.2
Station 2	339	20.3	63.0
Station 3	217	22.6	42.9
Station 4	247	18.1	40.4
Station 5	37	12.0	3.8
Station 6	96	14.0	11.9
Station 7	71	13.8	8.7

Note: Because calls in two or more districts may overlap, citywide overlapping calls would not be the sum of the overlapping calls in each district.

Observations:

- During the year studied, Station 1's district had the most overlapping calls (497) and the highest total hours of overlap (103 or 1.2 percent of all hours in the year).
- The highest average overlap was 22.6 minutes in Station 3's district, and the lowest average overlap was 12 minutes in Station 5's district.

RESPONSE TIME

This section presents response time statistics for different call types.

Different terms are used to describe the components of response time. Dispatch time is the difference between the time a call is received and the time a unit is dispatched. Dispatch time includes call processing time, which is the time required to determine the nature of the emergency and types of resources to dispatch. Turnout time is the difference between dispatch time and the time a unit is en route. Travel time is the difference between the time en route and arrival on scene. Response time is the total time elapsed between receiving a call to arriving on-scene.

In this section, we analyzed calls to which SLF-EMS units responded with lights and sirens, excluding canceled and mutual aid calls. In addition, calls with a total response time of more than 30 minutes or where no non-administrative unit arrived were also excluded. Finally, we focused on units that had complete time stamps, that is, units with all components recorded so as to be able to calculate each segment of response time.

Based on the methodology above, 866 canceled and mutual aid calls, 624 non-emergency calls, 17 calls with response times over 30 minutes, and 748 calls with missing or invalid time stamps were excluded. Invalid time stamps include time stamps that were the same for dispatch and en route, and time stamps showing negative response times (e.g., dispatch before call received). As a result, in this section, a total of 5,788 calls were used in the analysis.

Response Times by Type of Call

Table 10-12 provides average dispatch, turnout, travel, and total response time for the first arriving unit to each call, broken out by call type. Figures 10-6 and 10-7 illustrate the same information. Table 10-13 gives the 90th percentile time broken out in the same manner. A 90th percentile time means that 90 percent of calls had response times at or below that number.

TABLE 10-12: Average Response Times of First Arriving Unit, by Call Type (Minutes)

Call Type	Dispatch	Turnout	Travel	Total	Number of Calls
Breathing difficulty	0.8	1.4	3.7	5.9	447
Cardiac and stroke	0.9	1.3	3.7	5.9	478
Fall and injury	0.9	1.3	3.7	5.9	799
Illness and other	1.1	1.3	4.8	7.2	1,976
MVA	0.9	1.3	4.0	6.2	395
Overdose and psychiatric	0.9	1.3	5.6	7.9	69
Seizure and unconsciousness	0.8	1.3	3.7	5.8	592
EMS Total	**0.9**	**1.3**	**4.2**	**6.5**	**4,756**
False alarm	1.1	1.4	5.1	7.6	496
Good intent	1.2	1.3	5.0	7.4	90
Hazard	1.2	1.4	5.2	7.8	156
Outside fire	1.0	1.4	4.5	6.9	71
Public service	1.1	1.5	4.8	7.4	178
Structure fire	1.0	1.4	4.4	6.8	41
Fire Total	**1.1**	**1.4**	**5.0**	**7.5**	**1,032**
Total	**1.0**	**1.3**	**4.3**	**6.6**	**5,788**

FIGURE 10-6: Average Response Times of First Arriving Unit, by Call Type – EMS Calls

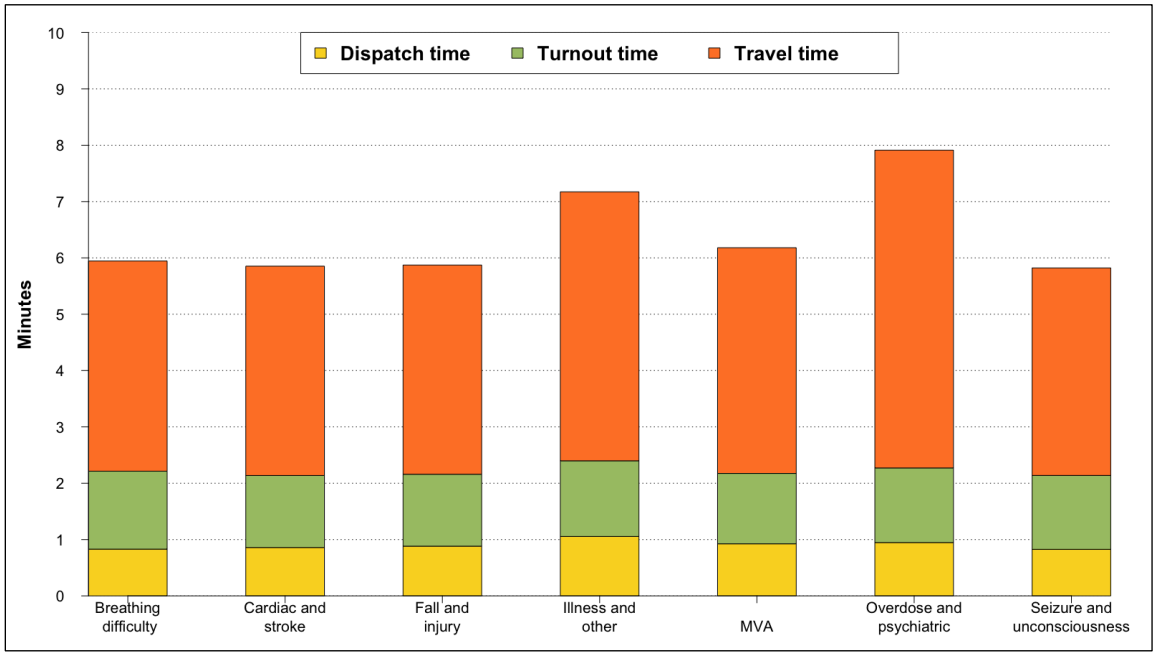


FIGURE 10-7: Average Response Times of First Arriving Unit, by Call Type – Fire Calls

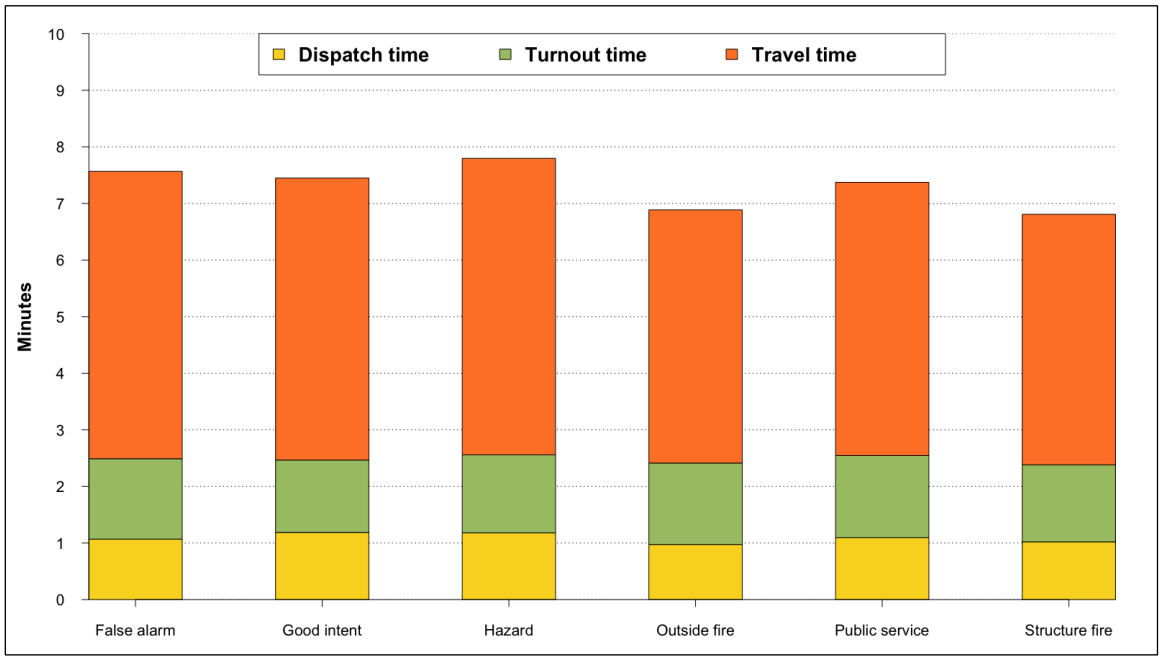


TABLE 10-13: 90th Percentile Response Times of First Arriving Unit, by Call Type (Minutes)

Call Type	Dispatch	Turnout	Travel	Total	Number of Calls
Breathing difficulty	1.3	2.2	5.5	7.8	447
Cardiac and stroke	1.4	2.1	5.6	8.0	478
Fall and injury	1.5	2.0	5.7	8.1	799
Illness and other	1.8	2.2	7.5	10.2	1,976
MVA	1.8	2.1	6.4	8.9	395
Overdose and psychiatric	1.9	2.0	12.2	13.9	69
Seizure and unconsciousness	1.3	2.0	5.4	7.7	592
EMS Total	**1.6**	**2.1**	**6.6**	**9.1**	**4,756**
False alarm	1.7	2.3	8.0	10.7	496
Good intent	2.0	1.9	8.2	10.6	90
Hazard	2.0	2.2	8.7	11.0	156
Outside fire	1.4	2.2	6.7	9.5	71
Public service	1.8	2.2	7.9	10.8	178
Structure fire	1.7	2.1	7.4	9.4	41
Fire Total	**1.8**	**2.2**	**8.1**	**10.7**	**1,032**
Total	**1.7**	**2.1**	**6.9**	**9.5**	**5,788**

Observations:

- The average dispatch time was 1.0 minutes.
- The average turnout time was 1.3 minutes.
- The average travel time was 4.3 minutes.
- The average response time was 6.6 minutes.
- The average response time was 6.5 minutes for EMS calls and 7.5 minutes for fire calls.
- The average response time for structure fires was 6.8 minutes, and for outside fires was 6.9 minutes.
- The 90th percentile dispatch time was 1.7 minutes.
- The 90th percentile turnout time was 2.1 minutes.
- The 90th percentile travel time was 6.9 minutes.
- The 90th percentile response time was 9.5 minutes.
- The 90th percentile response time was 9.1 minutes for EMS calls and 10.7 minutes for fire calls.
- The 90th percentile response time for structure fires was 9.4 minutes, and for outside fires was 9.5 minutes.

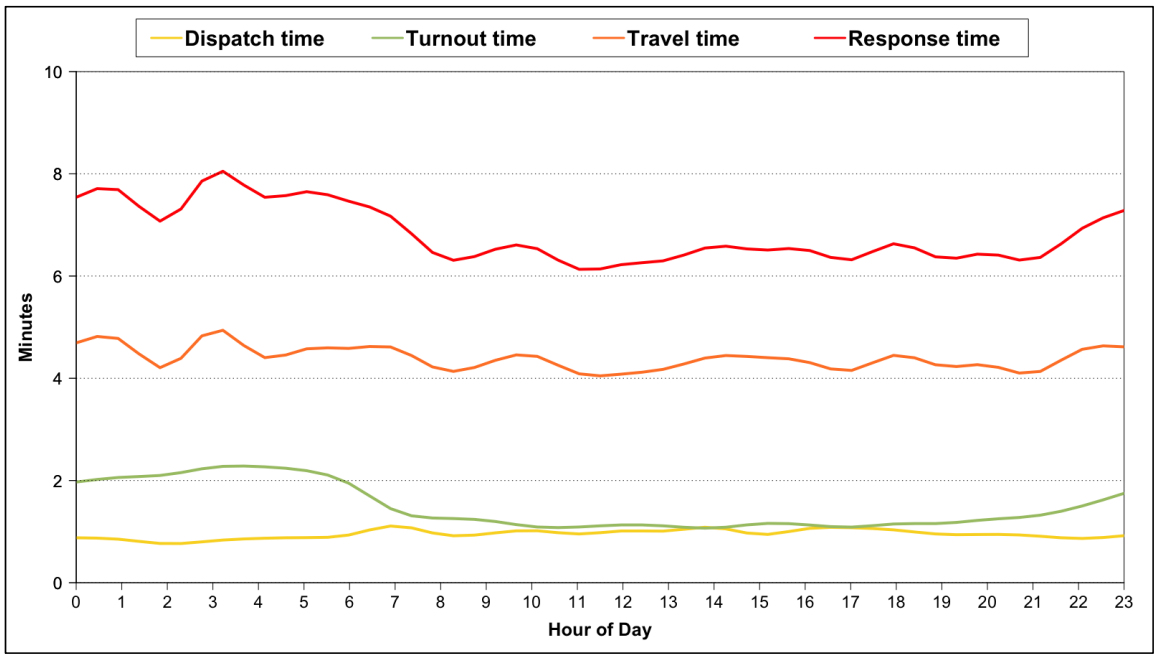
Response Times by Hour

Average dispatch, turnout, travel, and total response times by hour are shown in Table 10-14 and Figure 10-8. The table also shows 90th percentile times.

TABLE 10-14: Average and 90th Percentile Response Times of First Arriving Unit, by Hour of Day

Hour	Dispatch	Turnout	Travel	Response Time	90th Percentile Response Time	Number of Calls
0	0.9	2.0	4.7	7.5	10.5	140
1	0.8	2.1	4.7	7.7	10.7	140
2	0.8	2.1	4.2	7.1	9.4	128
3	0.8	2.3	5.0	8.0	11.0	107
4	0.9	2.3	4.4	7.6	10.0	108
5	0.9	2.2	4.6	7.6	10.3	114
6	0.9	1.9	4.6	7.5	10.1	132
7	1.1	1.4	4.6	7.1	10.0	190
8	0.9	1.3	4.2	6.4	9.4	290
9	1.0	1.2	4.3	6.5	9.0	315
10	1.0	1.1	4.5	6.6	9.4	316
11	1.0	1.1	4.1	6.1	8.7	361
12	1.0	1.1	4.1	6.2	9.1	317
13	1.0	1.1	4.2	6.3	9.3	308
14	1.1	1.1	4.4	6.6	9.6	324
15	0.9	1.2	4.4	6.5	9.5	323
16	1.1	1.1	4.3	6.5	9.2	329
17	1.1	1.1	4.2	6.3	9.0	316
18	1.0	1.2	4.5	6.6	9.6	309
19	0.9	1.2	4.2	6.3	9.0	294
20	0.9	1.2	4.3	6.4	9.0	298
21	0.9	1.3	4.1	6.3	8.5	252
22	0.9	1.5	4.5	6.9	10.6	221
23	0.9	1.7	4.6	7.3	9.6	156

FIGURE 10-8: Average Response Time of First Arriving Unit, by Hour of Day



Observations:

- Average dispatch time by hour ranged from 0.8 minutes (1:00 a.m. to 3:00 a.m.) to 1.1 minutes (7:00 a.m. to 8:00 a.m., 2:00 p.m. to 3:00 p.m., and 4:00 p.m. to 6:00 p.m.).
- Average turnout time by hour ranged from 1.1 minutes (10:00 a.m. to 6:00 p.m.) to 2.3 minutes (3:00 a.m. to 5:00 a.m.).
- Average travel time by hour ranged from 4.1 minutes (11:00 a.m. to 1:00 p.m. and 9:00 p.m. to 10:00 p.m.) to 5.0 minutes (3:00 a.m. to 4:00 a.m.).
- Average total response time by hour ranged from 6.1 minutes (11:00 a.m. to noon) to 8 minutes (3:00 a.m. to 4:00 a.m.).
- 90th percentile total response time by hour ranged from 8.5 minutes (9:00 p.m. to 10:00 p.m.) to 11 minutes (3:00 a.m. to 4:00 a.m.).

Response Time Distribution

A more detailed look at how response times are distributed is presented here. Figure 10-9 shows the cumulative distribution of total response time for the first arriving unit to EMS calls, and Table 10-15 gives the same information. Figure 10-10 and Table 10-16 show the cumulative distribution of total response time for the first and second arriving units to structure and outside fires combined.

FIGURE 10-9: Cumulative Distribution of Response Time – First Arriving Unit – EMS

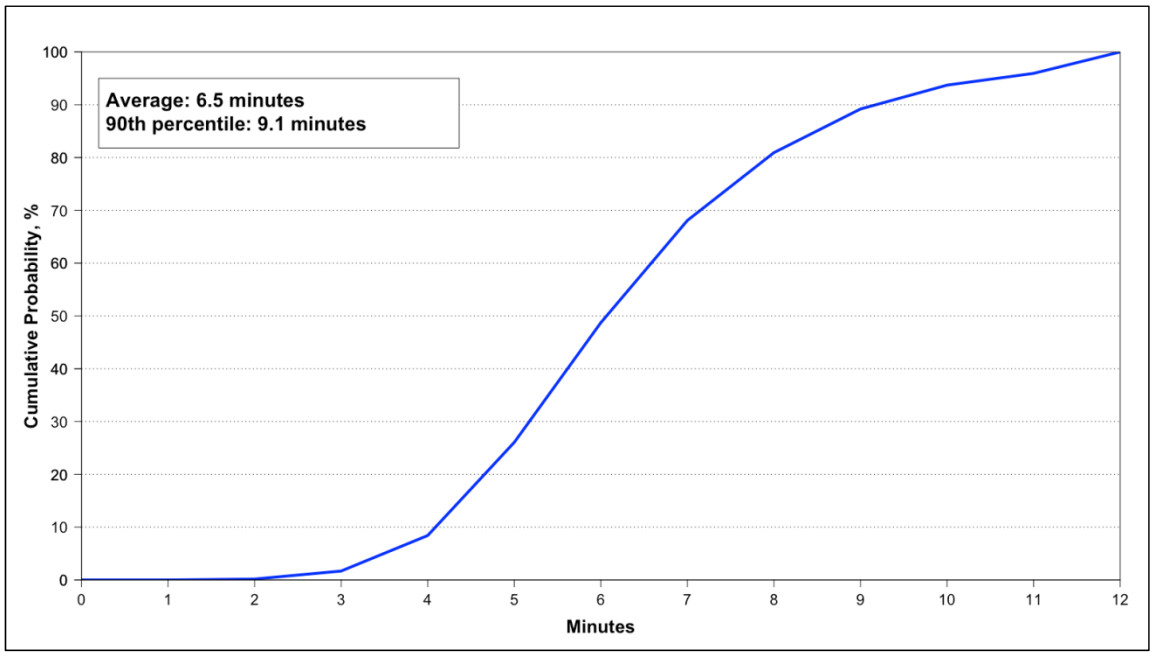


TABLE 10-15: Cumulative Distribution of Response Time – First Arriving Unit – EMS

Response Time (minute)	Frequency	Cumulative Percentage
0 - 1	0	0.0
1 - 2	8	0.2
2 - 3	72	1.7
3 - 4	320	8.4
4 - 5	839	26.1
5 - 6	1,078	48.7
6 - 7	921	68.1
7 - 8	611	80.9
8 - 9	393	89.2
9 - 10	215	93.7
10 - 11	106	95.9
11+	193	100.0

FIGURE 10-10: Cumulative Distribution of Response Time – First and Second Arriving Units – Structure and Outside Fires

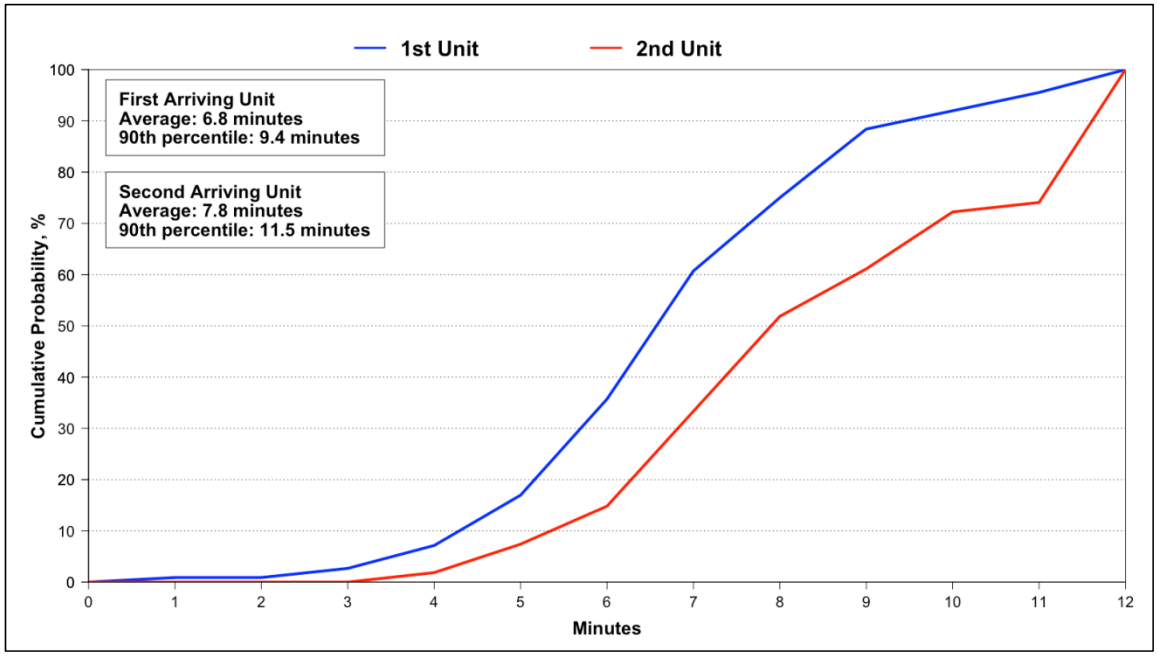


TABLE 10-16: Cumulative Distribution of Response Time – First and Second Arriving Units – Structure and Outside Fires

Response Time (minute)	1st Unit		2nd Unit	
	Frequency	Cumulative Percent	Frequency	Cumulative Percent
0 - 1	1	0.9	0	0
1 - 2	0	0.9	0	0.0
2 - 3	2	2.7	0	0.0
3 - 4	5	7.1	1	1.9
4 - 5	11	17.0	3	7.4
5 - 6	21	35.7	4	14.8
6 - 7	28	60.7	10	33.3
7 - 8	16	75.0	10	51.9
8 - 9	15	88.4	5	61.1
9 - 10	4	92.0	6	72.2
10 - 11	4	95.5	1	74.1
11+	5	100.0	14	100.0

Observations:

- For 81 percent of EMS calls, the response time of the first arriving unit was less than 8 minutes.
- For 36 percent of structure and outside fire calls, the response time of the first arriving unit was less than 6 minutes.
- For structure and outside fire calls, the average response time of the second arriving unit was 7.8 minutes.
- For structure and outside fire calls, the 90th percentile response time of the second arriving unit was 11.5 minutes.

TRANSPORT CALL ANALYSIS

This section analyzes the EMS calls that involved transporting patients, the variations by hour of day, and the average time for each stage of transport service. We identified transport calls by requiring that at least one SLF-EMS responding ambulance had recorded both beginning to transport time and arriving at the hospital time. One structure fire call that resulted in a transport is not included in this analysis.

Transport Calls by Type

Table 10-17 shows the number of EMS calls by call type broken out by transport and non-transport calls.

TABLE 10-17: Transport Calls by Call Type

Call Type	Number of Calls			Transport Rate
	Non-Transport	Transport	Total	
Breathing difficulty	162	328	490	66.9
Cardiac and stroke	159	368	527	69.8
Fall and injury	352	544	896	60.7
Illness and other	1,529	778	2,307	33.7
MVA	255	203	458	44.3
Overdose and psychiatric	40	51	91	56.0
Seizure and unconsciousness	279	383	662	57.9
Total	**2,776**	**2,655**	**5,431**	**48.9**

Observations:

- Overall, 49 percent of EMS calls to which SLF-EMS responded involved transporting one or more patients.
- On average, SLF-EMS responded to 14.8 EMS calls per day, and 7.3 involved transporting one or more patients.
- Cardiac and stroke calls had the highest transport rate, averaging 70 percent.

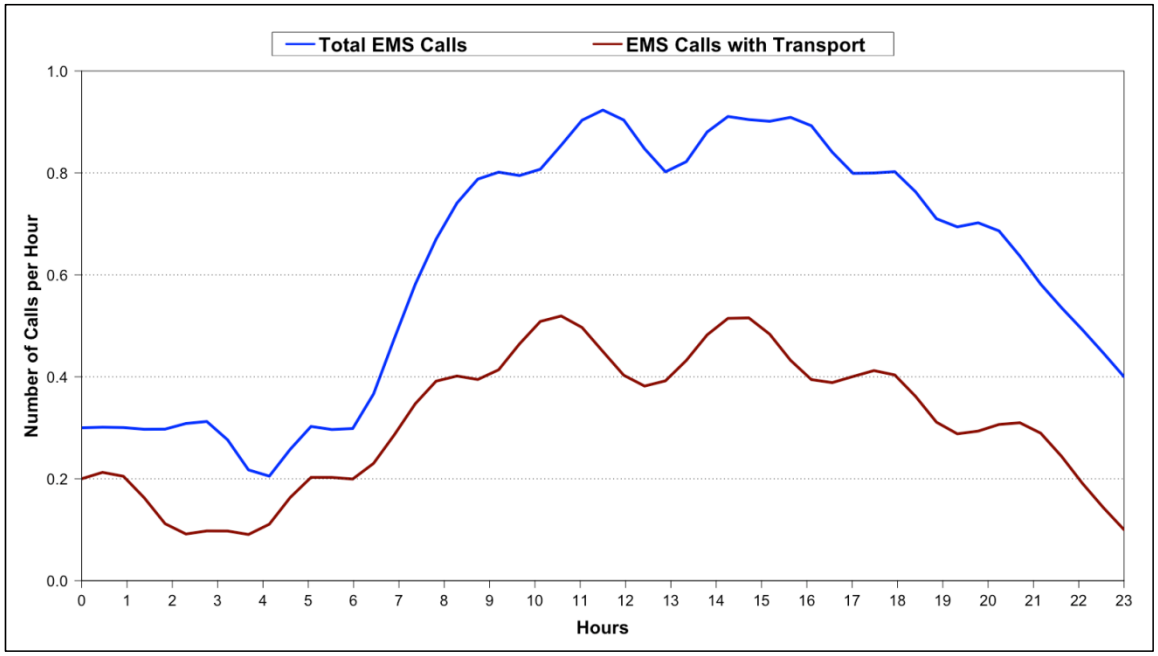
Average Transport Calls per Hour

Table 10-18 and Figure 10-11 show the average number of EMS calls received each hour of the day over the course of the year and the average number of transport calls.

TABLE 10-18: Transport Calls per Day, by Hour

Hour	Number of Transport Calls	Number of EMS Calls	Transport Calls per Day	EMS Calls per Day	Transport Rate
0	56	126	0.2	0.3	44.4
1	61	122	0.2	0.3	50.0
2	50	108	0.1	0.3	46.3
3	40	94	0.1	0.3	42.6
4	41	89	0.1	0.2	46.1
5	64	107	0.2	0.3	59.8
6	55	101	0.2	0.3	54.5
7	99	177	0.3	0.5	55.9
8	142	267	0.4	0.7	53.2
9	162	292	0.4	0.8	55.5
10	168	310	0.5	0.8	54.2
11	186	346	0.5	0.9	53.8
12	163	314	0.4	0.9	51.9
13	163	309	0.4	0.8	52.8
14	171	318	0.5	0.9	53.8
15	174	347	0.5	0.9	50.1
16	158	318	0.4	0.9	49.7
17	132	293	0.4	0.8	45.1
18	130	284	0.4	0.8	45.8
19	113	273	0.3	0.7	41.4
20	104	274	0.3	0.7	38.0
21	95	228	0.3	0.6	41.7
22	76	198	0.2	0.5	38.4
23	52	136	0.1	0.4	38.2

FIGURE 10-11: Average Transport Calls per Day, by Hour



Observations:

- Transport call rates were highest between 10:00 a.m. and noon and again between 2:00 p.m. and 4:00 p.m., averaging 0.5 calls per hour.
- Transport call rates were lowest between 2:00 a.m. and 5:00 a.m. as well as 11:00 p.m. and midnight, averaging 0.1 transports per hour.
- The percent of EMS calls resulting in a transport was highest between 5:00 a.m. and 6:00 a.m., averaging 60 percent.

Calls by Type and Duration

Table 10-19 shows the average duration of transport and non-transport EMS calls by call type.

TABLE 10-19: Transport Call Duration by Call Type

Call Type	Non-Transport		Transport	
	Average Duration	Number of Calls	Average Duration	Number of Calls
Breathing difficulty	43.4	162	59.7	328
Cardiac and stroke	46.6	159	59.8	368
Fall and injury	36.3	352	60.4	544
Illness and other	27.0	1,529	61.3	778
MVA	35.6	255	64.9	203
Overdose and psychiatric	39.3	40	59.6	51
Seizure and unconsciousness	40.3	279	61.5	383
Total	**32.6**	**2,776**	**61.0**	**2,655**

Note: Duration of a call is defined as the longest deployed time of any of the SLF-EMS units responding to the same call.

Observations:

- The average duration was 33 minutes for a non-transport EMS call.
- The average duration was 61 minutes for an EMS call where one or more patients were transported to a hospital.
- On average, a transport call lasted 1.9 times as long as a non-transport EMS call.

Transport Time Components

Table 10-20 gives the average deployed time for an ambulance on a transport call along with three major components of the deployed time: on-scene time, travel to hospital time, and at-hospital time.

The on-scene time is the interval from the unit arriving on-scene time through the time the unit departs the scene for the hospital. Travel to hospital time is the interval from the time the unit departs the scene to travel to the hospital through the time the unit arrives at the hospital. At-hospital time is the time it takes for patient turnover at the hospital.

The 2,655 transport calls resulted in 2,683 transports, since more than one transport may occur on a call. Runs for which the unit was missing a time for arrival on scene (109 runs) or was missing a clear time (2 runs) were excluded from this analysis, leaving 2,572 runs resulting from 2,548 calls.

TABLE 10-20: Time Component Analysis for Ambulance Transport Runs by Call Type (in Minutes)

Call Type	Avg. Deployed Time per Run	Avg. Time On-Scene	Avg. Travel to Hospital Time	Avg. Time at Hospital	Number of Runs
Breathing difficulty	59.2	17.0	9.1	27.3	309
Cardiac and stroke	59.1	17.9	8.7	27.0	357
Fall and injury	59.9	17.5	10.3	26.3	533
Illness and other	60.7	19.2	9.7	25.7	752
MVA	62.6	18.0	9.8	28.7	206
Overdose and psychiatric	59.6	16.6	9.7	25.7	50
Seizure and unconsciousness	60.5	18.1	9.0	27.5	365
Total	**60.2**	**18.1**	**9.5**	**26.7**	**2,572**

Note: Average unit deployed time per run is lower than average call duration because call duration is based on the longest deployed time of any of the SLF-EMS units responding to the same call, which may include an engine or ladder. Total deployed time is larger than the combination of on-scene, transport, and hospital wait times as it includes turnout and initial travel times.

Observations:

- On average, an SLF-EMS ambulance spent 18 minutes on scene, and then spent 9.5 minutes traveling from scene to hospital.
- The average time spent at the hospital, or other transport destination, was 27 minutes.

TABLE 10-21: Actions Taken Analysis for Structure and Outside Fire Calls

Action Taken	Number of Calls	
	Structure Fire	Outside Fire
Fire control or extinguishment, other	0	1
Extinguishment by fire service personnel	27	62
Salvage & overhaul	14	7
Search	1	1
Remove hazard	7	6
Ventilate	11	0
Forcible entry	1	0
Evacuate area	1	0
Operate apparatus or vehicle	0	1
Shut down system	1	0
Provide manpower	1	0
Provide equipment	1	0
Incident command	6	15
Investigate	30	45
Investigate fire out on arrival	4	1
Standby	0	3
Total	**105**	**142**

Note: Totals are higher than the total number of calls because some calls had more than one action taken.

Observations:

- A total of 62 outside fires were extinguished by fire service personnel, which accounted for 66 percent of outside fires.
- A total of 27 structure fires were extinguished by fire service personnel, which accounted for 49 percent of structure fires.

TABLE 10-22: Content and Property Loss – Structure and Outside Fires

Call Type	Property Loss		Content Loss	
	Loss Value	Number of Calls	Loss Value	Number of Calls
Outside fire	$296,350	20	$233,600	9
Structure fire	$367,900	15	$210,660	13
Total	**$664,250**	**35**	**$444,260**	**22**

Note: This analysis only includes calls with recorded loss greater than 0.

Observations:

- Out of 94 outside fires, 20 had recorded property loss, with a combined $296,350 in loss.
- Nine outside fires had content loss with a combined $233,600 in loss.
- Out of 55 structure fires, 15 had recorded property loss, with a combined $367,900 in loss.
- 13 structure fires had content loss with a combined $210,660 in loss.
- The average total loss for all structure fires was $10,519.
- The average total loss for structure fires with loss was $32,142.

TABLE 10-23: Total Fire Loss Above and Below $20,000

Call Type	No Loss	Under $20,000	$20,000 plus
Outside fire	74	18	2
Structure fire	37	14	4
Total	**111**	**32**	**6**

Observations:

- 74 outside fires and 37 structure fires had no recorded loss.
- Two outside fires and four structure fires had $20,000 or more in loss.
- The highest total loss for an outside fire was $300,000.
- The highest total loss for a structure fire was $400,000.

ATTACHMENT III

TABLE 10-21: Workload of Administrative Units

Unit ID	Annual Hours	Annual Runs
FD03	2.4	4
FD04	1.3	4
FD10	14.2	14
FD11	12.5	10
FD12	4.7	5
FD13	3.7	7
SLEMS1	29.3	76
SLF-EMS56	0.9	1

Note: Only administrative units that appeared in the data used for the analysis are included in this table.