Operational and Administrative Analysis
Tulsa Fire Department
Tulsa, Oklahoma

Draft Report – June 2016

C E N T E R F O R P U B L I C S A F E T Y M A N A G E M E N T

CPSM

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Exclusive Provider of Public Safety Technical Assistance for the
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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 200 such studies in 36 states and 155 communities ranging in size from 8,000 population (Boone, Iowa) to 800,000 population (Indianapolis, Ind.).

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Section 1. Executive Summary

The Center for Public Safety Management, LLC (CPSM) was retained by the city of Tulsa to conduct a comprehensive analysis of its fire department operations, including the department's 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, financial efficiencies, and alternative modes of operation.

During the study, CPSM analyzed performance data provided by the Tulsa Fire Department (TFD) 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 the city 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 also used in conjunction with observations and information collected during on-site visits to assess the existing performance of the department and to compare that performance to national benchmarks. These benchmarks have been developed by organizations such as the National Fire Protection Association (NFPA), Center for Public Safety Excellence, Inc. (CPSE), and the ICMA Center for Performance Measurement.

Project staff conducted a site visit on January 10–12, and again on February 1-3, 2016, for the purpose of observing fire department and agency-connected support operations, 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, and the TFD so that CPSM staff could affirm the project scope, as well as elicit further discussion regarding this operational analysis.

TFD is a highly skilled and progressive organization that is a recognized leader nationally in its delivery of fire and EMS services. The city personnel with whom CPSM interacted are truly interested in serving the city to the best of their abilities. One outstanding issue facing TFD is the Vision Tax Plan, which was approved by Tulsa voters on April 5, 2016 and which will provide upwards of $70 million over the next 15 years to supplement TFD funding. A key aspect of CPSM's analysis is to provide a series of recommended options regarding the possible expenditures that can be funded with these revenues. In addition, the city of Tulsa has an ongoing partnership between TFD and the Emergency Medical Services Authority (EMSA) for the delivery of emergency medical services to Tulsa residents. This service agreement is to be renewed in 2018 and CPSM was asked to provide an evaluation of the current service model and its effectiveness. As service demands increase and TFD faces increased response activities, the need for strong collaborations and seamless service delivery will also continue to expand. This workload and the potential for expanding call volume is not, however, insurmountable. CPSM will provide a series of observations and recommendations that we believe will enable TFD to become ***more efficient*** and ***smarter*** in the management of its emergency and nonemergency responsibilities.

Recommendations

The TFD 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 Tulsa has maintained its relationship with EMSA since 1977. The working relationship observed between the city and EMSA is impressive and enables one of the highest levels of prehospital emergency medical care available in the nation.

Forty recommendations are listed below and in the applicable sections within this report. The recommendations are based on best practices derived from the studies, experiences, and judgements of 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. EMSA Medical Control should evaluate the difference in patient care and patient outcomes (if any) between TFD ALS first responders vs. TFD BLS first responders.
2. EMSA and its Medical Control should work closely with area hospitals to establish and monitor maximum patient off-loading times at emergency departments.
3. The department should develop and implement an internal risk management plan that follows NFPA 1500, *Standard for a Fire Department Occupational Safety and Health Program*.
4. Upon final installation of the Tritek Inform Mobile System, TFD should conduct a full community risk assessment and enter this information into the onboard mobile data terminals of each responding unit.
5. TFD should develop an overall integrated risk management plan that focuses on structure fires in the community.
6. TFD should consider the deployment of additional water-carrying apparatus (pumpers and tankers) to stations servicing the areas within the city limits that lack a readily available water supply.
7. TFD should pursue reaccreditation under the CPSE/CFAI fire accreditation process.
8. The city should adopt and implement the proposed TFD station plan. CPSM believes this plan is efficient in terms of adding minimal staffing and maximizing existing resources.
9. TFD should consider a reduction to three engines, one ladder, and one command vehicle in its initial assignment of resources to a reported structure fire in a single-family residential occupancy.
10. TFD should eliminate the minipumper and water tank on future squad units and move toward lightweight EMS first response units.

11. TFD should adjust its minimum staffing policy so that apparatus with four-person staffing are reduced to three-person staffing; this will help avoid the callback of off-duty personnel on overtime.
12. TFD should consider cross-staffing the Air & Light units (Air-4 and Air-27) with two other constantly staffed apparatus in the city so as to reduce the daily minimum staffing by two personnel.
13. Tulsa should revise its interpretation for "hours worked" when considering overtime eligibility for 52-hour fire personnel and exclude from the calculation of overtime eligibility any leave time utilized by an employee during the FLSA 27-day cycle.
14. TFD should consider the deployment of additional two-person EMS first response squads to better manage its workloads for the busiest fire response apparatus.
15. TFD should deploy additional two-person EMS first response squads assigned to a 40-hour schedule and operational only during peak periods of operation (a span of approximately 11 hours daily).
16. TFD should incorporate guidance from Medical Control in the placement of EMS first response units and ALS fire apparatus.
17. CPSM recommends the TFD fully participate in the FUSS capital vehicle replacement program for fire apparatus.
18. TFD should include Equipment Management Division staff in the design and specification process of all future fire apparatus.
19. TFD should utilize Medical Control guidelines and adjust its mode of response to a nonemergency, cold response for EMS Priority 2 incidents.
20. TFD should work with EMSA in the development of a Community Integrated Health Care program for the Tulsa service area.
21. TFD should work with the Tulsa 911 Dispatch Center to monitor and report on the full dispatch handling times including call taking, call screening, and dispatch times.
22. TFD should consider an expansion of its key performance indicators and institute monitoring systems for the periodic review of these outcomes. The process of developing these measures should involve input from TFD members, the community, the mayor and city council, and city administration.
23. The city should expedite the process of reinstating the Fire Marshal position within the Tulsa Fire Department.
24. TFD should consider the reclassification of the Fire Marshal position to a civilian managerial employee who is appointed by the Fire Chief.
25. TFD should consider the use of civilian fire inspectors to fill the various roles in the Safety Services section.

26. TFD should consider the implementation of an in-service fire company inspection program for those applicable properties that require periodic fire inspections.
27. TFD should pursue funding options for a cost-share program for installing automatic fire sprinklers in those remaining residential high-rise structures that are nonsprinklered.
28. The TFD fire investigations unit should publish an annual fire report that details the fire occurrences in Tulsa, where they are occurring, how these fires are caused, and the fire loss associated with these events.
29. TFD should reevaluate the level of effort devoted to making arrests by its fire investigation unit and instead shift this emphasis to reducing the numbers of fires.
30. TFD should adopt an integrated risk management plan aimed at reducing the number of fires by using analysis from fire investigations regarding fire patterns backed by a corresponding mitigation strategy.
31. TFD should consider increased funding for its public education staffing and reinstitute those critical life-safety education programs.
32. TFD should evaluate the purchase of a suitable fire training simulator for command, tactical, vehicle operator, and promotional applications.
33. TFD should consider the reclassification of the District Chief of Health and Safety to an occupational health and safety professional.
34. TFD should evaluate all injuries in the context of a failure to not follow the necessary safety practices and should evaluate the actions of its supervisory staff in allowing this situation to occur.
35. TFD should continue its efforts to institute an effective communication model that ensures multiple conduits for clear and productive communication among all levels of the organization.
36. TAEMA should develop a series of critical action checklists for departments and agencies involved in the EOP.
37. TAEMA should facilitate the development of a COOP planning process for every city and county department.
38. The Tulsa 911Center should monitor and record the time at which all calls are received at the Tulsa answering point and track the call processing duration until calls are received by the appropriate emergency dispatching unit.
39. The Tulsa 911 Center should synchronize its time clocks between the CAD system and TFD records management system.
40. TFD should consider the consolidation of its dispatch operations so that fire and EMS call processing is carried out without multiple transfers.

Section 2. Scope of Project

This project is intended as an independent review of the Tulsa Fire Department (TFD) which will provide the Mayor and city officials, including officials of the Tulsa Fire Department, with an external perspective of the city's fire and EMS delivery system. This study offers a comprehensive analysis of the Tulsa Fire

partment, including its anizational structure, rkload, staffing, loyment, training, fire vention, emergency nmunications (911), and nning and public ication efforts. City cials often attempt to lerstand if their fire partment is effectively l efficiently meeting the vice demands of the nmunity, and co dustry best practices. In our analysis, CPSM provides recommendations where appropriate, and offers input on a strategic direction for the future.

Key areas evaluated during this study were:

- Fire department response times (using data from the city's computer-aided dispatch system and the city's records management system).
- Deployment and staffing.
- Organizational structure and managerial oversight.
- Fire and EMS unit workloads.
- TFD support functions (training, fire prevention/code enforcement/911 dispatch).
- Essential TFD facilities, equipment, and resources.
- The working relationship with EMSA.
- Future personnel additions and capital investment options that may be funded through the Vision Tax Plan.

Section 3. Organization and Management

Governance and Administration

The city of Tulsa operates under council-mayor form of government. The council-mayor form replaced a commission form of government in 1989; the commission form had been in place since the city's original 1908 charter. As described in Article III of the city charter, the Mayor acts as chief administrator, hires the city manager, prepares the initial draft of the operating budget, and leads all administrative departments, including the Fire Department.[1] The Tulsa City Council functions as the legislative branch: it passes local laws and reviews and approves the annual budget. As described in Article II of the city charter, there are nine Councilors elected by districts. City Councilors are elected to two-year terms. The council staff is led by a Council Administrator.

Article XI of the city charter establishes the Tulsa Fire Department and specifies that the "Chief of the Fire Department shall be appointed by the Mayor" and "shall have had at least ten (10) years of experience as a firefighter in the city."[2] Section 3 of Article XI outlines the appointment authority of the Fire Chief and Mayor: "The sworn members of the Fire Department shall, upon the approval and recommendation of the Fire Chief, be appointed by the Mayor."[3]

Title 13 of Tulsa's Code of Ordinances outlines the organization and responsibilities of the Tulsa Fire Department; Section 100 declares, "The Fire Department shall be under the control and supervision of the Chief of the Fire Department."[4] According to Section 104, the Chief has "the superintending control of all members of the Department and of all fire apparatus and buildings belonging to the City; he shall have the police powers of a member of the Police Department." This section also specifies that the Fire Chief reports to the Mayor on issues regarding the fire department and "shall annually make to the Mayor a full and complete report in writing of the condition of the Department."[5] Section 105 requires that the department also create a Deputy Chief position that "shall perform such duties and exercise such authority as shall be assigned to him by the Chief."[6]

Figure 3-1 illustrates the organizational structure of the city of Tulsa.

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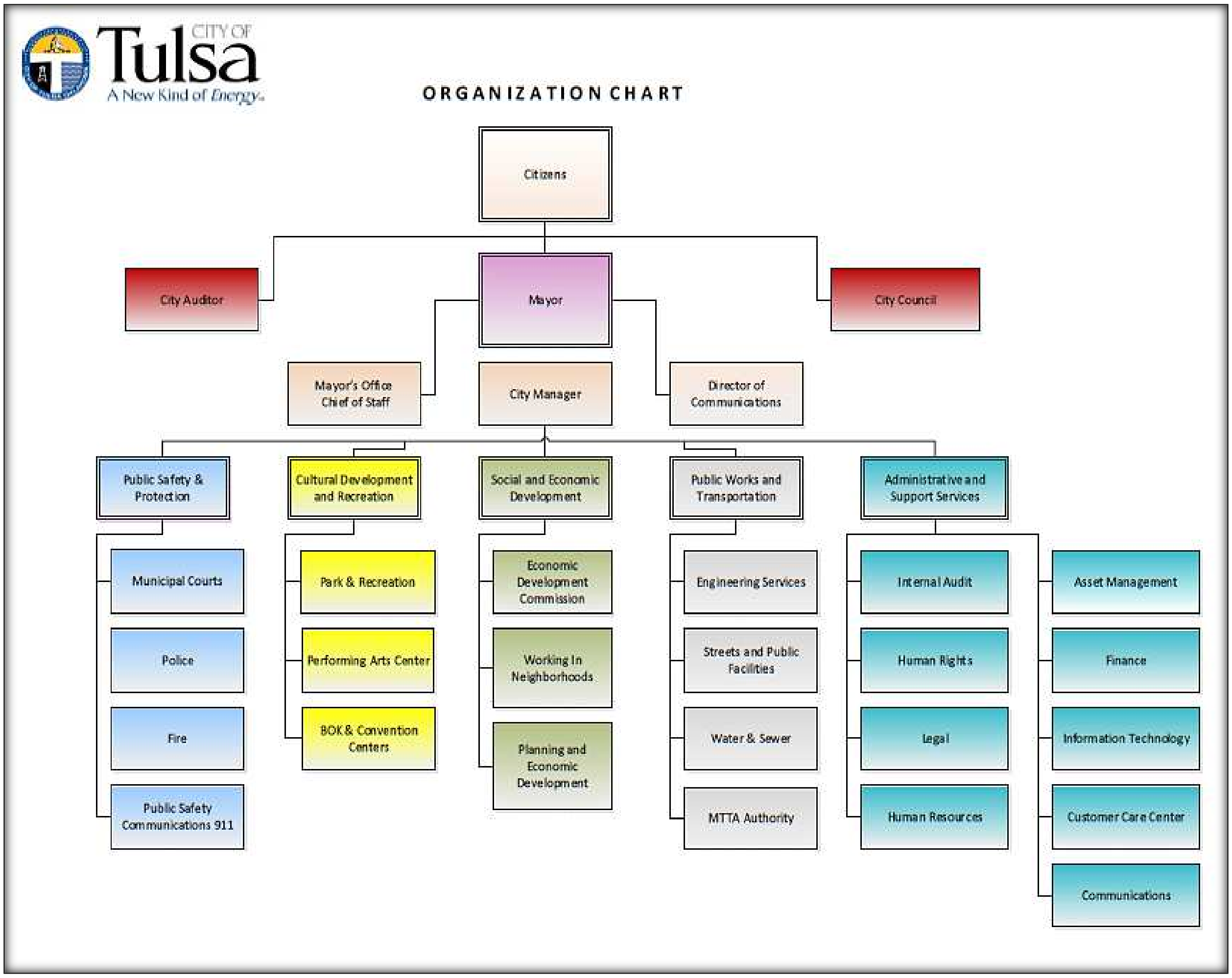
[1] 1989 Amended Charter, Tulsa, Oklahoma, https://www.municode.com/library/ok/tulsa/.
[2] 1989 Amended Charter, Tulsa, Oklahoma, Article XI, Section 2, https://www.municode.com/library/ok/tulsa/.
[3] 1989 Amended Charter, Tulsa, Oklahoma, Article XI, Section 3, https://www.municode.com/library/ok/tulsa/.
[4] Title 13 – Fire Department, Code of Ordinances, Section 100.
[5] Title 13 – Fire Department, Code of Ordinances, Section 104.
[6] Title 13 – Fire Department, Code of Ordinances, Section 105.

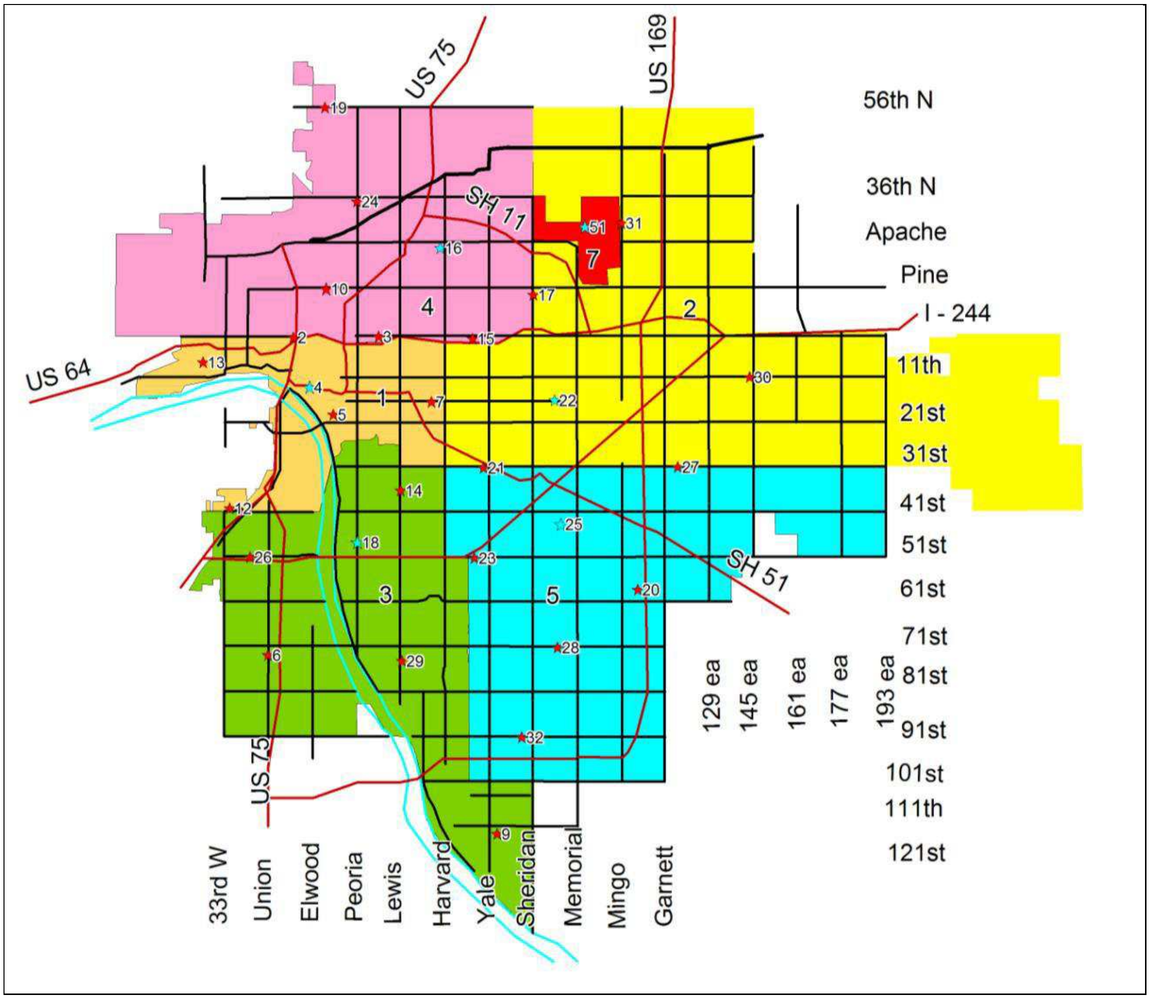
FIGURE 3-1: City of Tulsa Organizational Chart



TFD Organizational Structure

The Tulsa Fire Department's response area is approximately 200 square miles in size, with a residential population estimated at approximately 400,000 citizens. The department has an authorized strength of 676 members. There are 30 fire stations located in five geographical districts. Each of the five districts is commanded by a District Chief who is assisted by a Captain Intern. There is one additional district, number7, that services the Tulsa International Airport (TIA). Firefighters work 24 hours on duty and 48 hours off. The annual operational budget of the department is $66.9 million. The department currently responds to just under 57,000 incidents annually, of which approximately 36,000 or 63 percent are EMS-related calls.

FIGURE: 3-2: Fire Districts and Stations

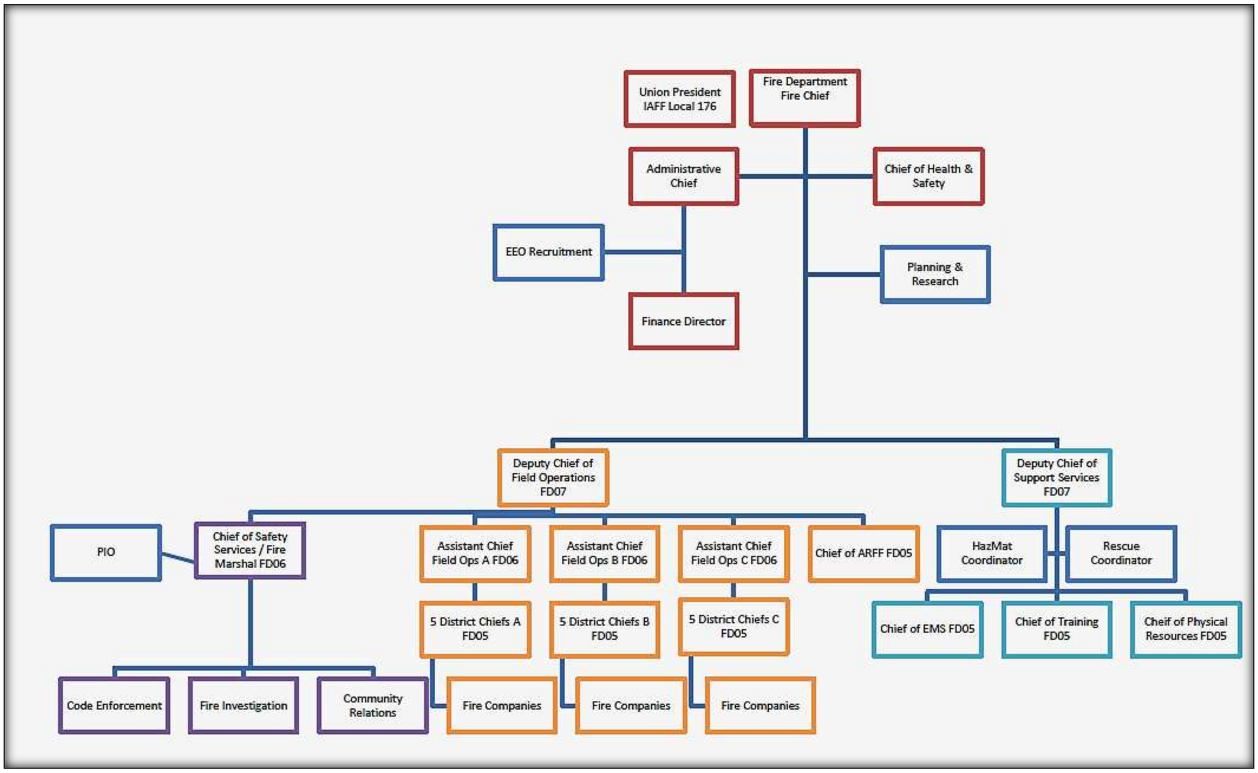


Personnel Management/Rank Structure

Under the direction of the Fire Chief the department's principal operations are organized into two main sections each managed by a Deputy Fire Chief reporting directly to the Fire Chief. The Deputy Chief of field operations manages three Assistant Field Chiefs (platoons A, B, and C), the Chief of the TIA, and the Assistant Chief (currently vacant) of Safety Services (Fire Marshall). The Deputy Chief of Support Services manages the Chief of EMS, the Chief of Training, the Chief of Physical Resources, the Hazardous Materials Coordinator, and the Rescue Coordinator. Each one the five fire districts is managed per shift by a District Chief who reports to the platoon Assistant Chief. Fire Chief Ray Driskell was appointed as the chief of the department on July 1, 2012. He has been a member of the Tulsa Fire Department since 1985 and has held various ranks, including district chief, chief of finance, assistant fire chief in field operations, deputy fire chief, and fire marshal.

Figure 3-3 shows the organization of the Tulsa Fire Department.

FIGURE 3-3: Tulsa Fire Department Organizational Chart



The fire department recruits and hires sworn officers in accordance with the union collective bargaining agreement and city charter. Title 13 specifies that all officers and members of the department must be citizens of the United States and residents of the city of Tulsa at the time they are appointed. Fire academy cadets, nonsworn or civilian fire department employees, the Fire Chief and the chief's designated administrative assistant are governed by civil service and city personnel policies

As defined by the city charter, a personnel committee is responsible for personnel decisions, including "standards of tests, examinations and ratings as will in an impartial manner determine the merit, efficiency and fitness of all applicants for promotion in the Department."[7] All promotions are made by the Mayor upon the written recommendation of the personnel committee.

The personnel committee is composed of seven members: the chief of the fire department; one chief officer selected by the Mayor; the chief officer in charge of training; one chief officer selected by the Fire Chief; one fire captain elected by the fire captains; one fire equipment officer elected by the fire equipment operations; and one firefighter elected by the firefighters below the rank of fire equipment operator. Committee terms are one year; elected positions are elected by secret ballot each February. In situations in which an elected member of the personnel committee is an applicant for promotion, a substitute is elected to serve during the time needed for the elected member to take an examination.

[7] Title 13 – Fire Department, Code of Ordinances, Section 108.

New recruits must complete a 20-week Tulsa Fire Department cadet academy course. Sworn members of the department, upon the approval and recommendation of the Fire Chief, are appointed by the Mayor. Selection criteria include performance on a written exam, physical agility test, structured oral assessment, and background interview. The interview team is comprised of members of the fire department and/or the city human resources department. Candidates are required to have a high school diploma or GED certificate, as well as National and State of Oklahoma Emergency Medical Technician (EMT) certification.

In accordance with the collective bargaining agreement between the city of Tulsa and IAFF Local No. 176, new hires are on probation for 12 months following their date of hire, during which time the fire department's personnel committee "may terminate the appointment . . . if upon observation, investigation, or consideration of the performance of duty they deem him [or her] unsatisfactory or unfit for the service."[8] The CBA also stipulates that seniority "shall be given the utmost consideration"[9] in the case of a personnel reduction, so that employees with the least seniority would be laid off first. In addition, no new employees can be hired until those employee(s) laid off and the union have been notified that an opening exists.

Service Relationship with EMSA

EMSA, the Emergency Medical Services Authority, is a public trust set up through a cooperative arrangement between the cities of Tulsa and Oklahoma City. EMSA provides ambulance service and oversight to the EMS delivery system in these two metropolitan areas as well as a number of adjacent communities. EMSA is often referred to as a ***Public Utility Model***; it was established in 1977. The concept of this model is to utilize a quasi-governmental entity to coordinate the delivery of ambulance services throughout the community. As a government-supported agency, EMSA does not provide service directly; rather, it contracts with a private ambulance provider, currently AMR, which provides pre-hospital emergency medical care, transport services, EMS dispatching, and related community outreach.

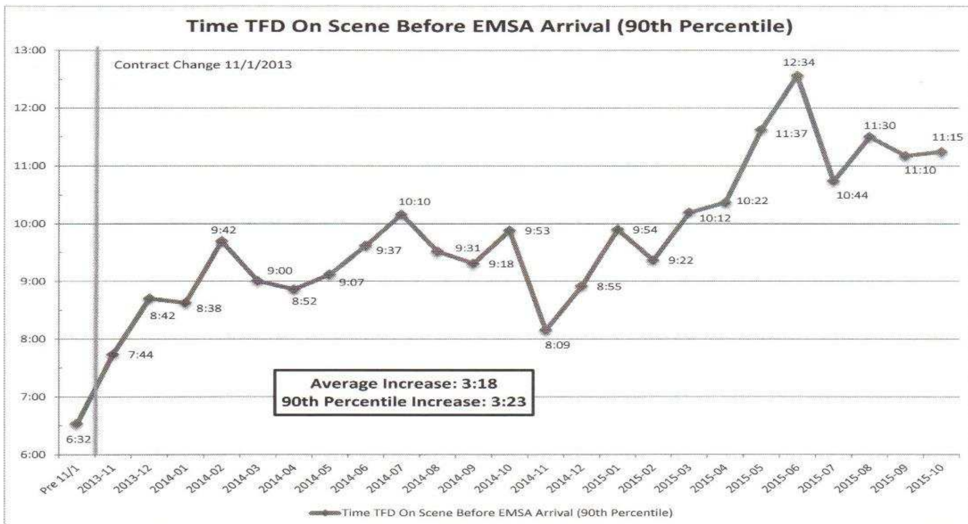
The EMSA service area has two Divisions, Eastern and Western. The Eastern Division includes the cities of Tulsa, Jenks, Bixby, and Sand Springs. The Western Division includes Oklahoma City and several of its neighboring municipalities. The current contractual agreement with AMR has a five-year term, running from Nov. 1, 2013 through Oct. 31, 2018. EMSA provides nearly 170,000 EMS transports annually, with this call volume split almost equally between the two divisions. There is slightly more activity in the Western Division. In the current arrangement with AMR, EMSA provides all ambulance vehicles, medical control, on-board equipment, and dispatching space and associated equipment. AMR provides all personnel to staff the ambulance fleet, supervisors, trainers, and the EMS dispatchers who operate within the Tulsa 911 Communications Center. AMR also provides medical supplies, disposable equipment, vehicle maintenance, training, and follows

[8] 1989 Amended Charter and Amendments, Article XI, Section 3, https://www.cityoftulsa.org/media/87556/citycharter4-15-10.pdf.
[9] "Agreement between the City of Tulsa and Local No. 176 of the International Association of Firefighters," July 1, 2015–June 30, 2016, Article 26, Section 1.

established reporting requirements. EMSA provides the billing for ambulance transports and receives all revenue for the associated emergency and nonemergency transports. AMR receives a flat rate payment for each transport completed. It is estimated that AMR will receive approximately $22.2 million for its Easter Division Services in FY2016. The EMSA budget for FY2016 is $29.4 million.

The Tulsa Fire Department provides EMS first response to 911 emergency calls within city limits. TFD provides its first response service at both the ALS (Advanced Life Support – Paramedic) and BLS (Basic Life Support – EMT) levels. The TFD supports 100 paramedics, and distributes paramedic staffing strategically throughout the city on the basis of call volume and in areas where EMSA response times are extended. Sixteen of the city's 42 first response units are continually staffed and equipped to provide ALS. TFD and EMSA operate in what is often termed a two-tiered response system. In this arrangement, the fire department is the immediate responding agency and typically arrives at the scene first and begins patient assessment and stabilization. The ambulance unit responds concurrently, but because of the distribution of ambulance resources and workload, typically arrives after the TFD unit. CPSM's evaluation indicates that since November 2013, the arrival time of EMSA units to the emergency scene has been increasing. Figure 3-4 is a monthly reflection over four years of the 90th percentile average time that TFD units arrive on-scene prior to EMSA units.

FIGURE 3-4: 90th Percentile Average Time TFD Units are On Scene before EMSA



In our analysis of arrival times by TFD and EMSA in 2015, we found that TFD arrives on life threatening calls (Priority 1) ahead of EMSA units on average 3.6 minutes faster. On non-life threatening calls (Priority 2), TFD arrives on average, 7 minutes sooner than EMSA units. It should also be noted that in a number of instances (25.6 percent of Priority 1 calls and 15.6 percent of Priority 2 calls), an EMSA unit arrives on scene prior to a TFD unit. Table 3-1 compares the on-scene arrival times between TFD and EMSA units during the CPSM study year.

TABLE 3-1: Comparison of On-Scene Arrival Times – TFD vs. EMSA

Priority	First Arriving Agency	Time Between First and Second Arriving Agency		Number of Calls
		Average	90th Percentile	
Life Threatening Emergency	EMSA	1.7	3.6	4,477
	TFD	3.6	6.9	13,010
	Total	**3.1**	**6.3**	**17,487**
Non-Life Threatening Emergency	EMSA	3.8	10.4	2,326
	TFD	7.0	14.6	12,381
	Total	**6.5**	**14.1**	**14,707**
Overall	EMSA	2.4	5.0	6,803
	TFD	5.3	11.2	25,391
	Total	**4.7**	**10.4**	**32,194**

TFD and EMSA units work effectively to manage patient care. In the main, once care is initiated by TFD personnel, the oversight of patient care is transferred to EMSA personnel upon their arrival. Because of the consistency in the levels of training for both EMSA and TFD personnel and the consistency in medical control, equipment, medications, etc., the patient care transfer process is usually achieved in a seamless fashion. This level of consistency and cooperative patient care is considered by CPSM to be a B*est Practice*. For those TFD units that are staffed with ALS personnel and equipment, neither TFD nor EMSA Medical Control have completed any analysis regarding patient outcomes with the differing levels of TFD first response (ALS vs. BLS).

> ***Recommendation: EMSA Medical Control should evaluate the difference in patient care and patient outcomes (if any) between TFD ALS first responders vs. TFD BLS first responders.***

Many agencies struggle with the decision regarding the impacts of delivering EMS first response at the ALS or BLS levels. There have been a number studies that have attempted to evaluate these differences.[10] TFD and EMSA Medical Control are in an ideal situation to evaluate these differences, given the ability to compare outcomes in a similar environment in which ALS and BLS first responders operate. The costs to maintain ALS delivery are significantly higher than those costs associated with BLS delivery.

Once the patient is stabilized and packaged, the EMSA unit transports the patient to the emergency department. EMSA units are staffed with two personnel; one paramedic and one EMT. TFD units are staffed with 2, 3, or 4 personnel, and as mentioned previously, are equipped to provide either ALS

[10] See "EFFECTIVENESS OF FIRST RESPONSE PARAMEDICS" By Thomas M. Dunn, Ph.D., NREMT-B, I William W. Dunn, BA, NREMT-P,23 Michael Krowka, BS, NREMT-P I Benjamin Dengerink, BS, NREMT-P I and Micah Ownbey, BS, NREMT-P I University of Northern Colorado, Greeley; 2 Denver Health Paramedic Division; 3 Eagle County (CO) Ambulance District Corresponding Author: thomas.dunn@unco.edu. ALSO; "Fewer Paramedics Means More Lives Saved" by Robert Davis, USA Today, May 21, 2006.

or BLS care, depending upon the location of the incident and the unit assigned. Once the EMSA unit transports the patient, the TFD unit returns to its station and becomes available for the next call. TFD has established a six-minute initial response time standard from receipt of the call on 90 percent of all responses. TFD is currently reporting response times that achieve this measure 81 percent of the time. However, CPSM's analysis indicates that the full dispatch processing time (911 call taking and EMSA call screening) is not being calculated in this reporting. We will discuss this issue in greater detail in our analysis of response times.

EMSA units utilize a ***system status management*** process for deployment; EMSA strives to achieve an 11-minute initial response to Priority 1 (most critical) calls and a 25-minute response to those less critical occurrences (Priority 2). EMSA utilizes a posting process in which ambulance units are assigned to geographic regions of the city and are reassigned on the basis of ongoing call activity. The response times of the EMSA units are vigorously monitored and in those occurrences when the response threshold are not met, EMSA will impose fines against AMR and these amounts are deducted from its monthly payment.

The Tulsa EMS system is being impacted by extended patient off-loading times at area hospitals. On average, units are waiting approximately 40 minutes to off-load patients at area hospitals and this delay has the effect of nearly doubling the average call duration. In many instances it is not uncommon to observe an EMSA ambulance waiting for upwards of two hours before its patient is received in the hospital emergency department. In one case during CPSM's study period (2015), we observed a unit waiting nearly ***five hours to off-load its patient***. This delay in off-loading patients limits the availability of EMSA units and delays overall response times. One hospital in particular (St. Francis) has been the most problematic in its ability to rapidly receive a patient and release EMSA ambulances. Table 3-2 is an analysis of patient off-loading times at the most frequently used hospital receiving facilities in the Tulsa area.

TABLE 3-2: Patient off-Loading Times at Tulsa Area Hospitals

Priority	Transport Destination	Average Offload Time	90th Percentile Offload Time	Average Call Duration	90th Percentile Call Duration	Number of Transports
Life Threatening Emergency	Hillcrest Medical Center	40.5	61.6	86.2	113.8	4,043
	Hillcrest South Hospital	36.7	56.1	84.6	110.4	437
	OSU Medical Center	34.5	52.0	78.7	103.7	1,812
	St. Francis Hospital	46.2	70.7	93.3	121.9	6,439
	St. Francis Hospital South	33.9	52.4	84.3	106.8	279
	St. John Medical Center	41.7	64.3	88.5	115.9	5,487
	Priority 1 Total	**42.0**	**65.5**	**88.6**	**116.7**	**18,497**
Non-Life Threatening Emergency	Hillcrest Medical Center	36.9	56.1	85.3	113.6	7,920
	Hillcrest South Hospital	32.9	49.6	84.3	110.8	958
	OSU Medical Center	31.5	47.8	77.0	102.5	4,274
	St. Francis Hospital	42.5	65.3	94.5	124.0	11,399
	St. Francis Hospital South	32.7	52.1	85.6	114.1	737
	St. John Medical Center	37.2	56.2	88.4	116.0	9,784
	Priority 2 Total	**37.9**	**58.4**	**88.1**	**117.2**	**35,072**
Total		**39.4**	**60.9**	**88.3**	**117.1**	**53,569**

Recommendation: EMSA and its Medical Control should work closely with area hospitals to establish and monitor maximum patient off-loading times at emergency departments.

Many urban area hospitals often encounter delays due to capacity issues and patient surges at their emergency departments. During these periods ambulances may divert to other hospitals in the area to expedite the patient off-loading process. It is important that EMSA address this issue in order to ensure availability of units.

Section 4. Population Growth and Demographics

The city of Tulsa is the county seat of Tulsa County and the second largest city in the state of Oklahoma. The city's population as of the 2010 U.S. Census was 391,922, with a 2014 estimated population of 399,682 residents.[11] Tulsa is the primary city in the Tulsa Metropolitan Area, an area in Oklahoma that includes seven counties and several cities and towns included in two rings of suburbs connected by suburban sprawl.[12] Table 4-1 offers the basic population/community statistics for Tulsa.

TABLE 4-1: Tulsa Population/Community Statistics

2010 Population	2014 Estimated Population	Sq. Miles-Land	Residents Per Square Mile, 2014 Estimated Population
391,922	399,682	196.75	2,031.4

Understanding the demographics and socioeconomics of the community to be served by fire and emergency medical services is critical to not only determining station location, but also staffing levels of apparatus and the types and numbers of apparatus to be deployed. According to a 2010 report by the National Fire Protection Association (NFPA),[13] "*The risk of fire death and injury varies by age group, race, region, and community size. Children under five and adults 65 or older face the highest risk of fire death, although they do not account for the majority of fire fatalities.*" The 2010 NFPA report also tells us that "*higher fire death rates occur in states with larger percentages of people who possess one or more of the following characteristics: are black, poor, smoke, have less formal education, or who live in rural areas. In more affluent areas, race played less of a role.*" In addition, this report found that the South and Midwest had the highest fire death rates per million population during the period 2004-2008.

An NFPA overview report published in 2013 on the U.S. fire problem remained consistent with the 2010 report. The 2013 report found that *"states with the highest fire death rates tend to have higher percentages of adults who did not finish high school, black or Native American residents, smokers, households living in poverty, and people living in rural areas."*[14] The report also found that adults over the age of 50 have a greater risk of a home fire death than the general population.[15] As conditions and demographics can vary so widely, CPSM does not consider number of firefighters per 1,000 population as a benchmark for staffing of resources, but rather recommends that communities focus on the overall demographic risk of the community, which generally corresponds directly to demand on services.

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[11] http://quickfacts.census.gov/qfd/states/40/4075000.html
[12] https://en.wikipedia.org/wiki/Tulsa_metropolitan_area
[13] NFPA, Demographic and Other Characteristics Related to Fire Deaths or Injuries. March 2010.
[14] John R. Hall Jr., *U.S. Unintentional Fire Death Rates by State,* NFPA, Quincy, MA, October 2012.
[15] Marty Ahrens, *Home Structure Fires,* NFPA, Quincy, MA, April 2013.

Tables 4-2, 4-3, and 4-4 depict certain demographic and socioeconomic information relevant to the Tulsa population.

TABLE 4-2: Tulsa Population Statistics: Race

2010 Population	% White	% African American	% American Indian and Alaska Native	% Asian	% Native Hawaiian and Other Pacific Islander	% Hispanic or Latino	% Two or More Races
391,922	62.6%	15.9%	5.3%	2.3%	0.1%	14.1%	5.9%

TABLE 4-3: Tulsa Age Demographics: Under age 5, Over Age 65

2010 Population	Persons Under 5	Persons over 65	% Female
391,922	7.5%	12.5%	51.3%

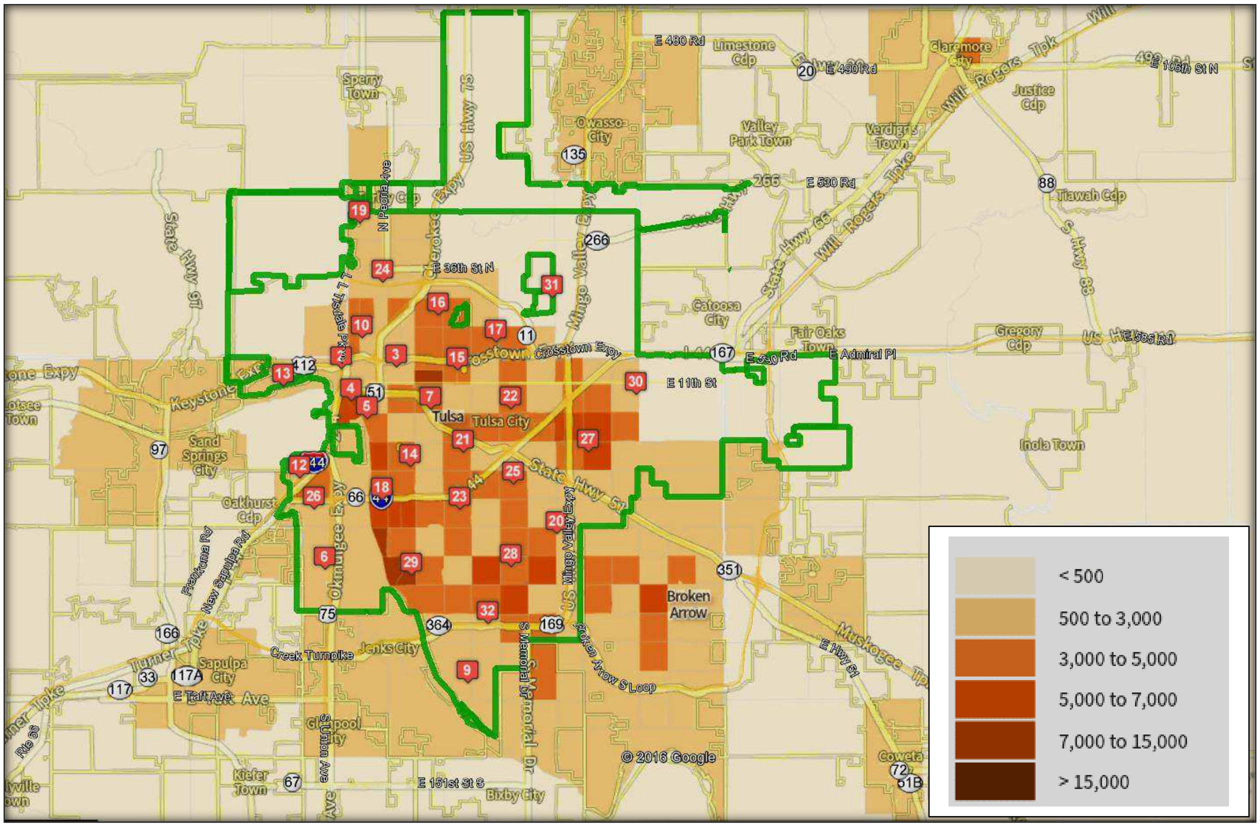
TABLE 4-4: Housing Units and Socioeconomics

Housing Units	Housing units in multi-unit structures	Persons per household, 2009-2013	Median household income, 2009-2013	Persons below poverty level, 2009-2013
185,127	32.2%	2.36	$41,241	20.1%

The city's population grew by 7 percent between the 1990 U.S. Census (367,302) and the 2000 U.S. Census population (393,049), and decreased by 0.3 percent between the 2000 U.S. Census and the 2010 U.S. Census (391,922). According to a report prepared for the city by Buxton Identifying Customers, the 2015 population for Tulsa is 406,482, which represents a 3.7 percent increase from the 2010 population. Buxton also projects a 2020 population for Tulsa of 408,575, which represents a 4.25 percent increase from the 2010 population, and an 11.25 percent increase from the 1990 population. The average ten-year population growth (1990-2020) is 3.65 percent per decennial census period.

Figure 4-1 illustrates the city's population density in 2010 and current fire station locations. In this figure the darker the shade of brown, the more densely populated the area. Each block represents one square mile. From the figure, one can observe the city is most densely populated in the central core, bounded by Interstate 244 to the north, U.S. Route 169 to the east, U.S. Route 364 to the south, and the Arkansas River to the west. There are currently sixteen fire stations within these described boundaries. Additional density occurs east of U.S. Route 169, where two fire stations are located (27 and 30), and in the northern portion of the city where three fire stations are located (10, 16, and 17). Another somewhat densely populated portion of the city is west of the Arkansas River. Two stations are located in this area (12 and 26).

FIGURE 4-1: City of Tulsa Population Density 2010, with Fire Station Locations



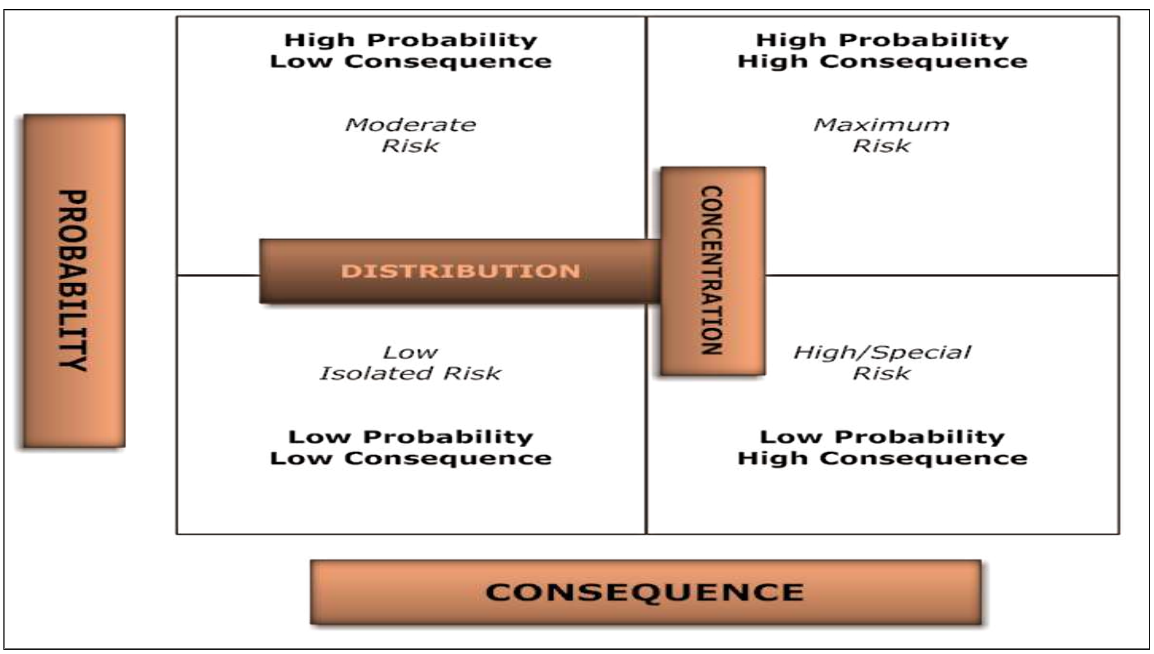
Section 5. Community Risk Assessment, Fire Department Risk Management, and Integrated Risk Management Plan

The cost of providing fire protection and EMS to a community has escalated steadily over the past 25 years. Therefore, it is of paramount importance that an agency have effective planning processes in place to support service delivery. Each jurisdiction decides what degree of risk is acceptable in that jurisdiction; the determination is based on criteria that are developed to define the levels of risk (e.g., of fire) within all sections of the community.[16] To this end, a comprehensive planning approach that includes a community risk assessment, hazard analysis, an internal fire department risk management plan, and finally an integrated risk management plan are today considered essential in determining local needs and in appropriately allocating resources and minimizing the cost of expansion.

Community Risk Assessment

A community risk and vulnerability assessment evaluates the community's various risks as a whole. Figure 5-1 presents the two main considerations of a risk assessment: the probability of an event occurring and the consequence of that event occurring. The matrix in the figure divides the risk assessment into four quadrants. Each quadrant of the chart creates different requirements in the community for commitment of resources.

FIGURE 5-1: Probability and Consequence Matrix

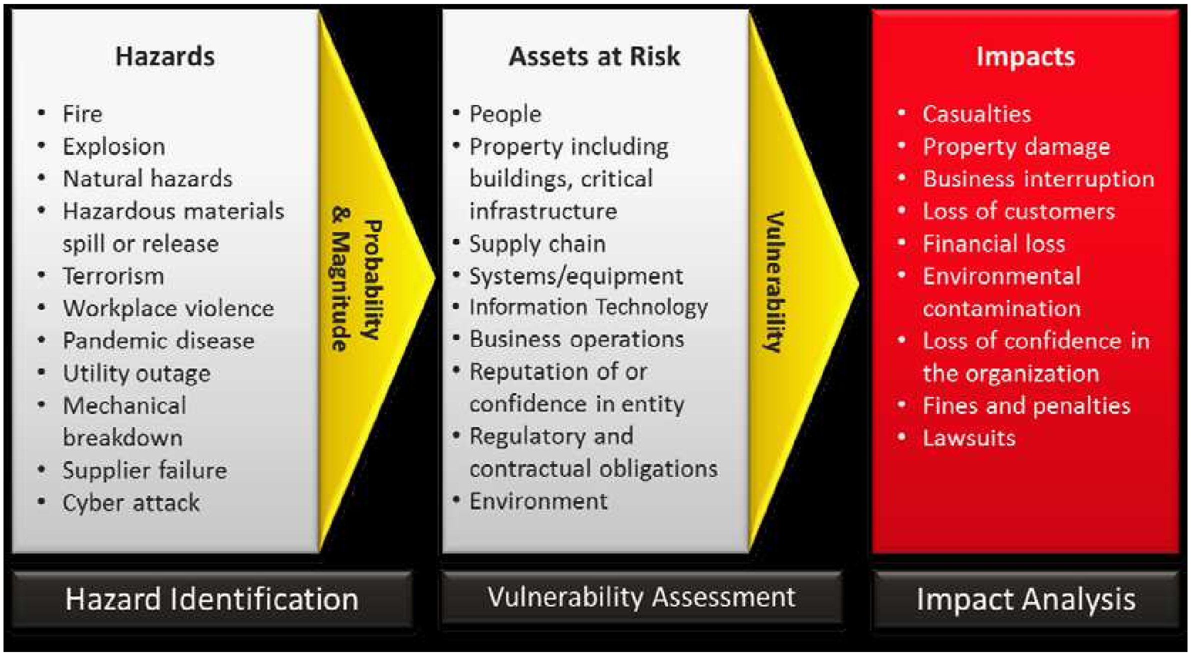


[16] Compton and Granito, Managing Fire and Rescue Services, 39.

The TFD completed a community hazard analysis in 2009 as part of its fire department accreditation process. TFD used the United States Fire Administration's community risk assessment method, "Leading Community Risk Reduction,"[17] which similarly identifies hazards and their probability value.

Figure 5-2 illustrates the components of a risk assessment model that focuses on the identification of hazards and the potential reduction of the impacts of these hazards through mitigation.

FIGURE 5-2: Risk Assessment Model



Source: FEMA Risk Assessment Model, http://www.ready.gov/risk-assessment

Community risk and vulnerability assessment are essential elements in a fire department's planning process. According to a National Fire Protection Association (NFPA) paper on assessing community vulnerability, fire department operational performance is a function of three considerations: resource availability/reliability, department capability, and operational effectiveness.[18] These elements can be further defined as:

- **Resource availability/reliability**: The degree to which the resources are ready and available to respond.
- **Department capability**: The ability of the resources deployed to manage an incident.

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[17] USFA, *Leading Community Risk Reduction*, http://www.usfa.dhs.gov/training/nfa.
[18] "Fire Service Deployment, Assessing Community Vulnerability," http://www.nfpa.org/assets/files/pdf/urbanfirevulnerability.pdf.

- **Operational effectiveness**: The product of availability and capability. It is the outcome achieved by the deployed resources or a measure of the ability to match resources deployed to the risk level to which they are responding.[19]

Linking a fire department's operational performance functionality to the community risk and vulnerability assessment further assists fire personnel in the planning process by increasing their understandings of the community risk with regard to property and life-hazard potential. By plotting the rated properties on a map, management can better understand how current and future resource capabilities relate to specific risks and vulnerabilities, as well as identify potential gaps in service delivery. The community risk assessment may also include determining and defining the differences in risk between a detached single-family dwelling, a multifamily dwelling, an industrial building, and a high-rise building by placing each in a separate category.

What's involved in a fire risk analysis? A fire department collects and organizes risk evaluation information about individual properties and on the basis of the rated factors can derive a "fire risk score" for each property. The score is then used to categorize the property as one of low, moderate, or high/maximum risk. To assist in this endeavor, there are retail products currently available that rate the property based on information inputs. As the rated properties are plotted on a map, fire station locations and staffing patterns can be considered to provide a higher concentration of resources for worst-case scenarios or, conversely, a lower concentration of resources based on the risk.[20]

According to the NFPA *Fire Protection Handbook*, these property hazard categories are defined as:

- **High-hazard occupancies**: Schools, hospitals, nursing homes, explosives 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.[21]

As part of it 2009 CPSE/CFAI Fire Accreditation process, TFD conducted a fire risk assessment. In this process a number of these occupancies were identified as sensitive sites. A sensitive site is an occupancy deemed to present high risk and greater than normal manpower requirements. Sensitive sites includes high life-risk occupancies, high-rise occupancies, and those occupancies where hazardous materials are produced or stored in amounts that require high levels of response resources (people and equipment) to mitigate the emergency. The TFD maps these sensitive sites

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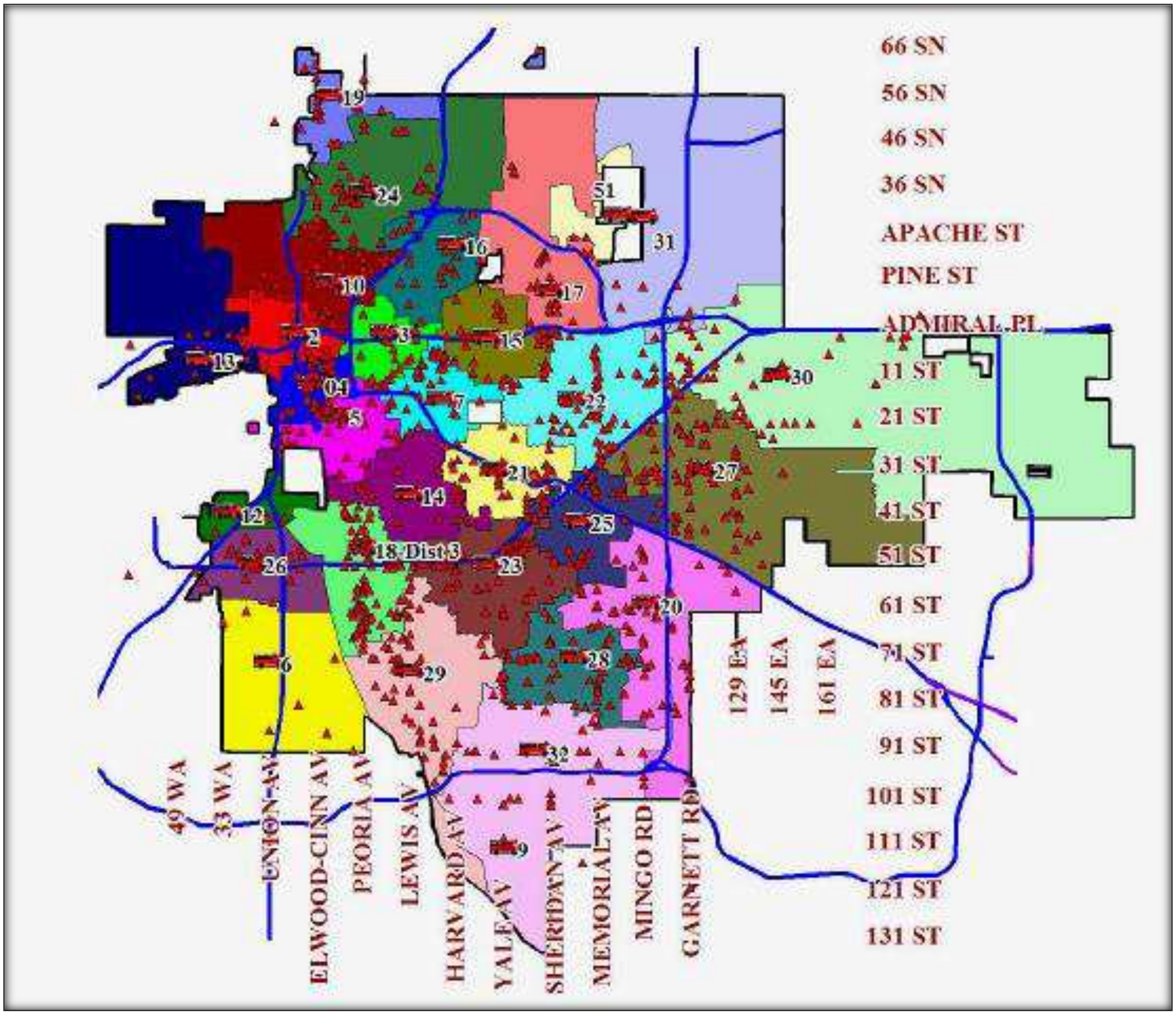
[19] National Fire Service Data Summit Proceedings, U.S. Department of Commerce, NIST Tech Note 1698, May 2011.
[20] *Fire and Emergency Service Self-Assessment Manual, 8th edition*, (Center for Public Safety Excellence, 2009), 49.
[21] Cote, Grant, Hall & Solomon, eds., *Fire Protection Handbook* (Quincy, MA: National Fire Protection Association, 2008), 12.

aggregately and separately (high risk and hazardous materials) so that responding companies and command officers are aware of the potential life safety or building hazard.

Figure 5-3 illustrates the aggregate mapping of sensitive sites performed in 2009. In this mapping, each red pyramid represents a sensitive site as defined above.

FIGURE 5-3: City of Tulsa Sensitive Site Mapping-2009



Fire Department Risk Management Plan

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, including personnel, resources, and property. 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) requires the development of a separate risk management plan for fire departments; that is, separate from those incorporated in the local government plan. The Tulsa Fire Department does not have a written internal risk management plan in place at this time.

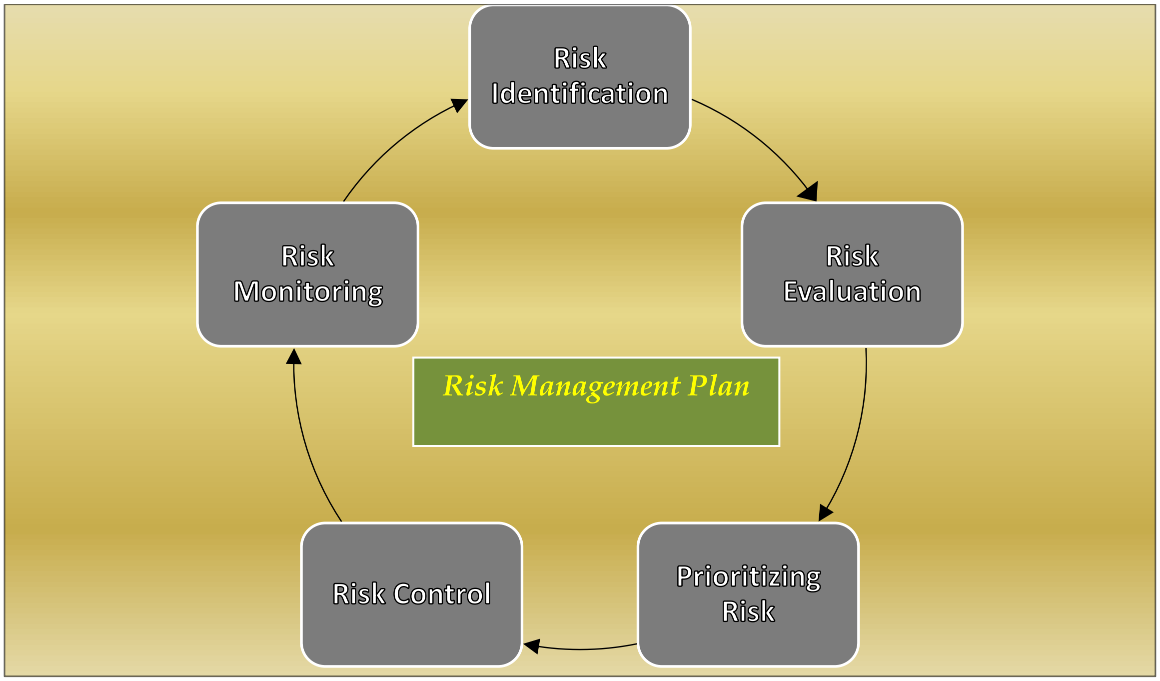
> ***Recommendation: The department should develop and implement an internal risk management plan that follows the standards of NFPA 1500,* Standard for a Fire Department Occupational Safety and Health Program*.***

A fire department risk management plan is developed and implemented to comply with the requirements of NFPA 1500. In order for this process to be effective, the following components must be included (see Figure 5-4):

- **Risk identification**: Actual or potential hazards.
- **Risk evaluation**: The potential of occurrence of a given hazard and the severity of its consequences.
- **Prioritizing risk**: The degree of a hazard based upon the frequency and severity of occurrence.
- **Risk control**: Solutions for elimination or reduction of real or potential hazards by implementing an effective control measure.
- **Risk monitoring**: Evaluation of effectiveness of risk control measures.[22]

[22] NFPA 1500, *Standard for a Fire Department Occupational Safety and Health Program (2007 ed.), Annex D*.

FIGURE 5-4: Components of a Risk Management Plan



The risk management plan establishes a standard of safety for the daily operations of the department. This standard of safety establishes the parameters by which the department conducts activities during emergency and nonemergency operations. The intent is for all members to operate within this standard or plan of safety and not deviate from this process.

Prefire Planning

An important part of risk management in the fire service is to conduct prefire planning inspections by fire companies of large and complex buildings in each fire station's response area. Conducting prefire planning by fire companies can have significant impact on both potentially reducing structural fire loss and on reducing firefighter injuries. By improving firefighters' understanding of complex building layouts, stand pipe locations, etc., as well as by identifying any structural changes and possible code violations, suppression ground activities can be improved and potential firefighter injuries avoided.

The TFD regularly conducts prefire planning surveys of commercial, industrial, institutional, and other similar types of buildings. Each fire company must complete two prefire planning surveys per month. The benefits of these prefire planning surveys are limited, however, only to the company doing the inspection because the information gathered is still recorded in a paper filing system. In its most recent (2012) ISO evaluation the TFD received zero credits out of possible 15 credits available for prefire inspections.

The TFD has recently purchased and is currently in the process of upgrading its records management system with the Tritek Inform Mobile System platform (including AVL). As part of this effort mobile data terminals (MDTs) will be placed in each piece of apparatus. This will provide access to prefire planning survey information. Completed prefire surveys, as well as all other building and planning documents, will then be immediately accessible to all fire companies. The installation of the system hardware and software is expected to be completed in July 2016.

> ***Recommendation: Upon final installation of the Tritek Inform Mobile System, TFD should conduct a full community risk assessment and enter this information into the onboard mobile data terminals of each responding unit.***

Integrated Risk Management

The term *integrated risk management*, first developed in the United Kingdom, refers to a planning methodology that recognizes that citizen safety, plus the protection of property and the environment from fire and related causes, must include provisions for the reasonable safety of emergency responders. This means assessing the risk faced, taking preventive action, and deploying the proper resources in the right place at the right time.[23]

An integrated risk management model uses incident and planning (structural, population density, demographics, etc.) data 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. It 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, resource allocation, and performance measurement into one unified, cohesive whole. The end product of this effort is the reduction of fire incidents.

Many of the basic elements required to develop an integrated risk management plan have been previously completed by the TFD, particularly as part of the TFD's standards of coverage documentation during the 2009 accreditation process. The TFD does not, however, currently have an integrated risk management plan.

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

Figure 5-5 is a graphic representation of the locations of fires in 2015 which each saw more than $20,000 in damage. This information can be a base from which to initiate an integrated risk management plan with an objective of reducing the number of more critical fires in the community.

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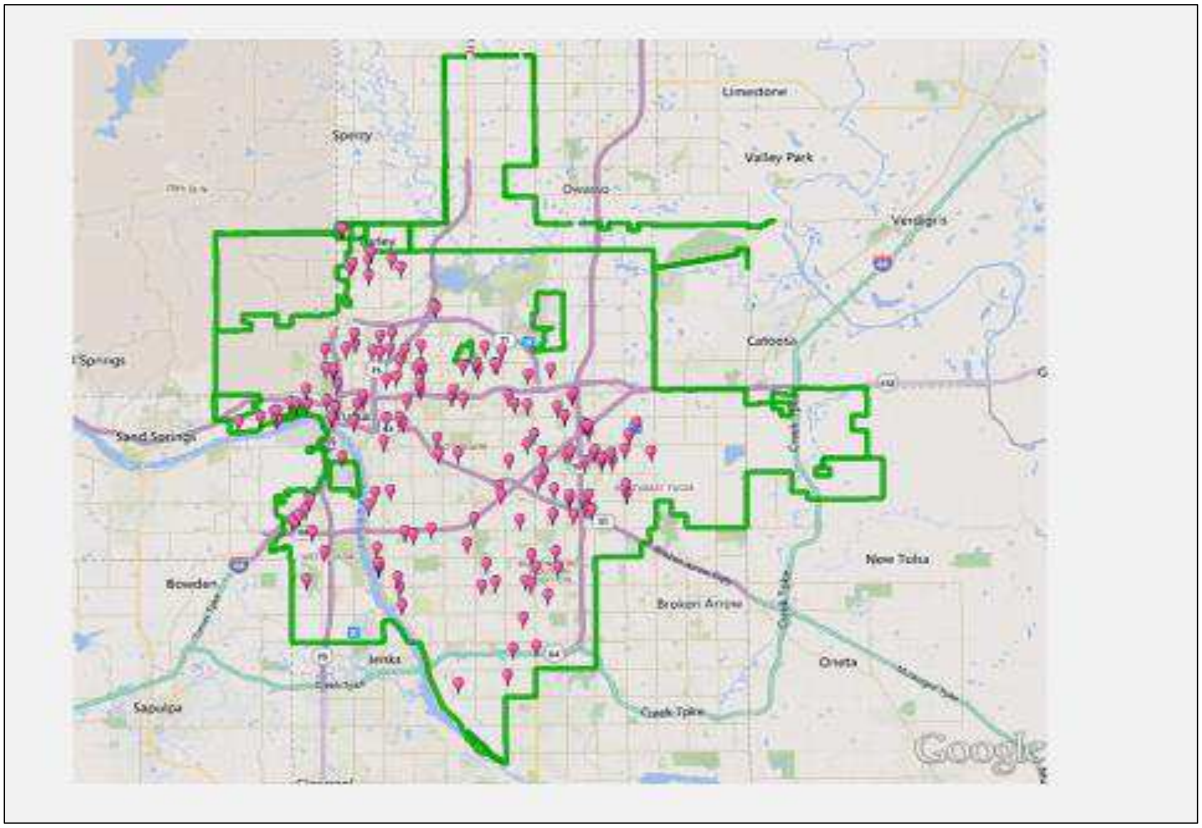
[23] National Fire Protection Association, *Fire Protection Handbook* (2008 Edition), 12-3.

FIGURE 5-5: 2015 Fires with Reported Damage of More Than $20,000



ISO Community Grading Schedule.

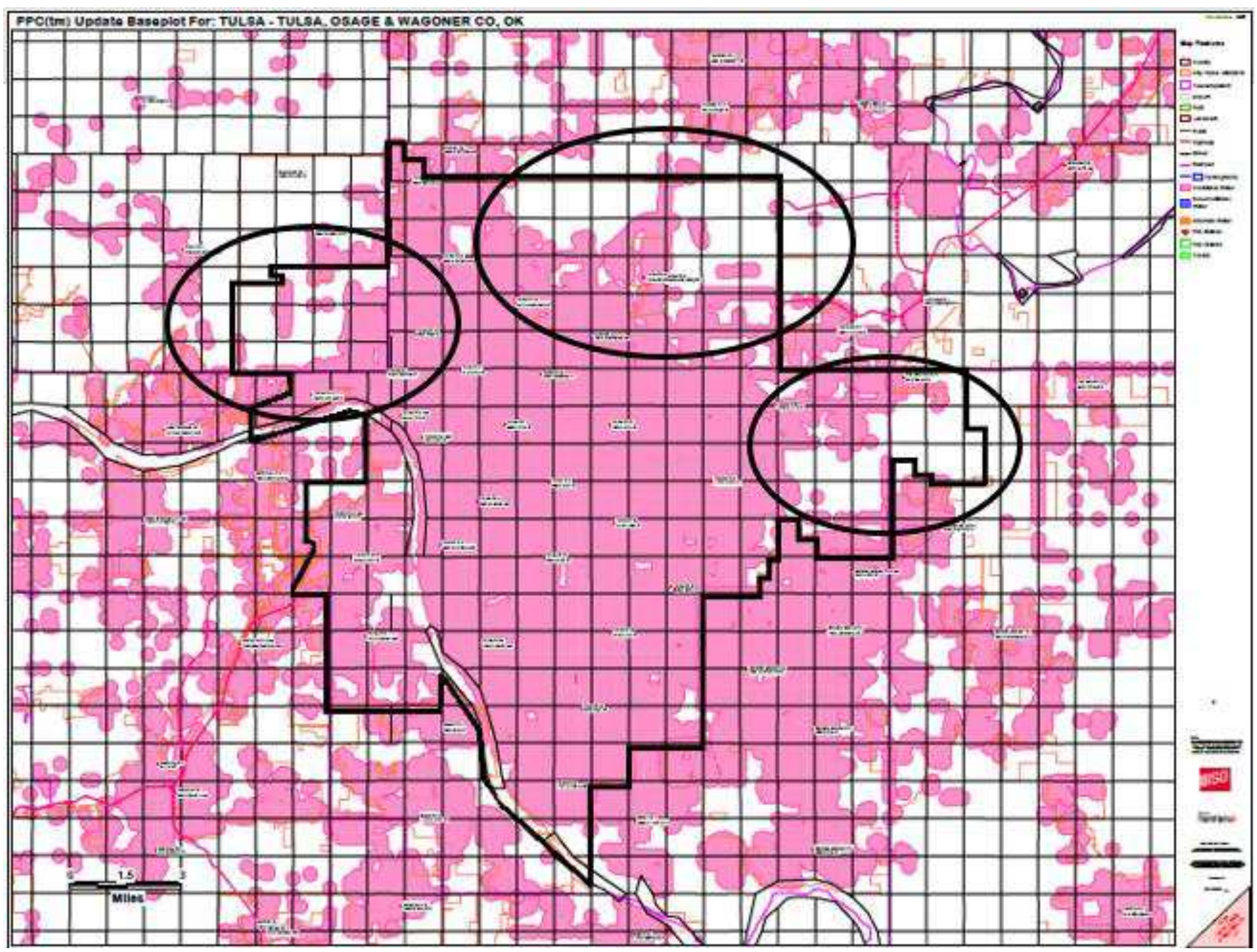
The ISO Community Grading / Fire Suppression Rating Schedule (FSRS) measures the principal elements of a community's fire suppression system. These elements are: emergency communications, fire department resources, and water supply. The schedule is performance based, and assigns credit points for each of the three main areas of a community's fire suppression system for a total score from 0 to 105.5 (new 2013 edition). The fire department resources section of the schedule provides a maximum 50 points of the overall score. Water supply provides a maximum of 40 points and emergency communications consists of a maximum of 10 points. The 5.5 points above 100 recognizes additional community efforts to reduce losses through fire prevention, fire safety public education, an integrated risk management plan, and fire investigations.

The city of Tulsa was last evaluated by the ISO in February 2012 under an older edition of the grading schedule that did not include the extra credit available for community loss reduction programs. The numerical grade (1-10, best to worst) or Public Protection Classification (PPC), for the city of Tulsa in its last ISO evaluation was determined to be a 3/9.

The first number of the classification (3) applies to properties (most of the city) that are within five road miles of a fire station and within 1,000 feet of a fire hydrant or alternative water supply. Larger properties that require more than 3,500 GPM are evaluated separately and are assigned an individual classification. The second number of the classification (9) applies to properties beyond 1,000 feet of a fire hydrant but within five road miles of a fire station.[24] In general, property insurance rates are based on a community's ISO classification, with a major determining factor being the access to water for fire suppression. An ISO rating above a 6 can make a difference to property insurance rates; however, there is little change in residential property insurance premiums when the overall ISO classification is 5 or lower.

The map of Tulsa and the surrounding regional area in Figure 5-6 shows areas in red where properties are within 1,000 feet of a fire hydrant or an alternative and reliable water supply. The areas in white are where properties are located that do not have a ready access to water supply. The large circled areas are those areas within the city limits that lack ready access to water supply. These areas are classified with an ISO PPC of 9.

FIGURE 5-6: ISO Map of Tulsa Indicating Areas (red) that are within 1,000 ft. of a Fire Hydrant



[24] Public Protection Classification Summary Report. Tulsa, Oklahoma. Prepared by Insurance Services Office, Inc. February 14, 2012. p.5.

Recommendation: TFD should consider the deployment of additional water-carrying apparatus (pumpers and tankers) to stations servicing the areas within the city limits that lack a readily available water supply.

Strategic Planning

Strategic planning is a disciplined effort with a goal of producing fundamental decisions and actions that shape and guide what an organization is, what it does, and why it does it.[25] This process helps to ensure that an adequate level of resources, including staffing and equipment, are allocated as efficiently as possible to meet the community's needs for the services delivered by the fire department.

Defining clear goals and objectives for any organization through a formal strategic planning process enables a visible method in defining the direction the organization is heading as well as how the organization is planning to get there. Ultimately, the strategic plan defines the systems thinking the organization is conducting to serve its core mission.

In a strategic plan, it is essential that clear and achievable goals and objectives for each program area are developed. Each program area must then (1) define its goals, (2) translate the goals into measurable indicators of goal achievement, (3) collect data on the indicators for those who have utilized the program, and (4) compare the data on program participants and controls in terms of goal criteria.[26] Objectives should be SMART: **s**pecific, **m**easurable, **a**mbitious/attainable, **r**ealistic, and **t**ime-bound.

The TFD has been developing and using strategic plans as part of its long-range management and annual business plan process since the late 1990s. CPSM recognizes TFD's strategic planning efforts as a ***Best Practice***. The last strategic plan was completed in January 2007. Management initiated a new strategic planning process in 2012. That strategic planning process is ongoing.

TFD has two working committees addressing strategic issues. First, the Strategic Planning Committee led by the Fire Chief is focused on internal processes and efficiencies. The committee has been meeting biweekly since July 2015. The committee adopted the strategic planning process found in the text *Strategic Planning for Public and Nonprofit Organizations: A Guide to Strengthening and Sustaining Organizational Achievement.*[27] Once the guide's recommended planning actions are complete, the committee will begin implementation efforts followed by operational planning.

The second committee, the Deployment Committee led by two deputy chiefs, is looking at resource allocation efficiencies and needs for capital assets. The committee has been meeting since August 2015. The purpose of this committee is to evaluate the number and placement of the department's response resources, including the deployment of first-in response units, deployment of companies

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[25] John M. Bryson, *Creating and Implementing Your Strategic Plan: A Workbook for Public and Nonprofit Organizations, 2nd edition* (Jossey-Bass, 2004), 3
[26] Grover Starling, *Managing the Public Sector*, *8th edition* (New York: Thomson/Wadsworth, 2008), 287.
[27] John M. Bryson, *Strategic Planning for Public and Nonprofit Organizations: A Guide to Strengthening and Sustaining Organizational Achievement, 4th edition* (John Wiley & Sons, 2011).

for fire and EMS response, deployment of district chiefs, hazardous materials response capabilities, and rescue response capabilities. Both committees have broad representation from the department with members from each rank and division (Administrative, Field Operations, and Support Services).

The planning process is expected to be completed by June 2016. Operational planning and implementation will follow with a complete execution of the plan to be completed by June 2017. Thereafter, it is anticipated the strategic plan will be updated on an annual basis. The TFD committee work regarding its organization and deployment, along with its inclusive efforts, are truly commendable and indicative of the organizational commitment to long-range planning.

Accreditation and Standard of Cover

Standard of Cover

Perhaps the most comprehensive and effective assessment process available to fire departments today is the accreditation program managed by the Center for Public Safety Excellence (CPSE). This program offers an analytical self-assessment process used to evaluate ten categories of the agency's performance. During this process, the department examines more than 240 separate performance indicators, 98 of which are considered core or required competencies. The accreditation process provides a department the benefit of a critical self-analysis of its performance at varying levels to ensure continuous self-improvement. It is an extremely comprehensive review that is conducted over a certain time period and it also requires reaccreditation, which helps to ensure that the standards are being maintained.

Included within the ten accreditation categories is an expectation for the fire department to analyze itself by planning zones, to identify the hazards posed within each planning zone, to rank hazards by potential severity, and to ensure that the appropriate resources are available to manage the hazards.[28] The accreditation program is a continuous process that requires an agency to constantly strive for excellence, even after accreditation is achieved. This is achieved through the reaccreditation process every five years. The TFD was accredited in 2001 and reaccredited in 2006. However, the TFD has allowed its accreditation status to expire due to cost and a lack of internal resources to maintain this credential.

The CPSE fire accreditation process provides a well-defined, internationally recognized benchmark system to measure the quality of fire and emergency services.[29] As a best practice, the accreditation process enables local governments to justify their expenditures by demonstrating a direct link to improved services.

According to the Center for Public Safety Excellence,[30] a Standard of Cover document represents those written procedures that determine the distribution and concentration of the fixed and mobile resources of a fire and EMS organization. A systems approach to deployment, rather than a one-

[28] CPSE, *CFAI Accreditation Process* (2012) http://www.publicsafetyexcellence.org/agency-accreditation/the-process.aspx (accessed on October 31, 2012).
[29] CPSE, *About CPSE* (2012), http://www.publicsafetyexcellence.org (accessed on October 31, 2012).
[30] Center for Public Safety Excellence, Commission on Fire Accreditation International, Chantilly, VA.

size-fits-all prescriptive formula, enables local determination of the level of deployment to meet the risks presented in each community. In this comprehensive approach, each agency can match local need (risks and expectations) with the costs of various levels of service.

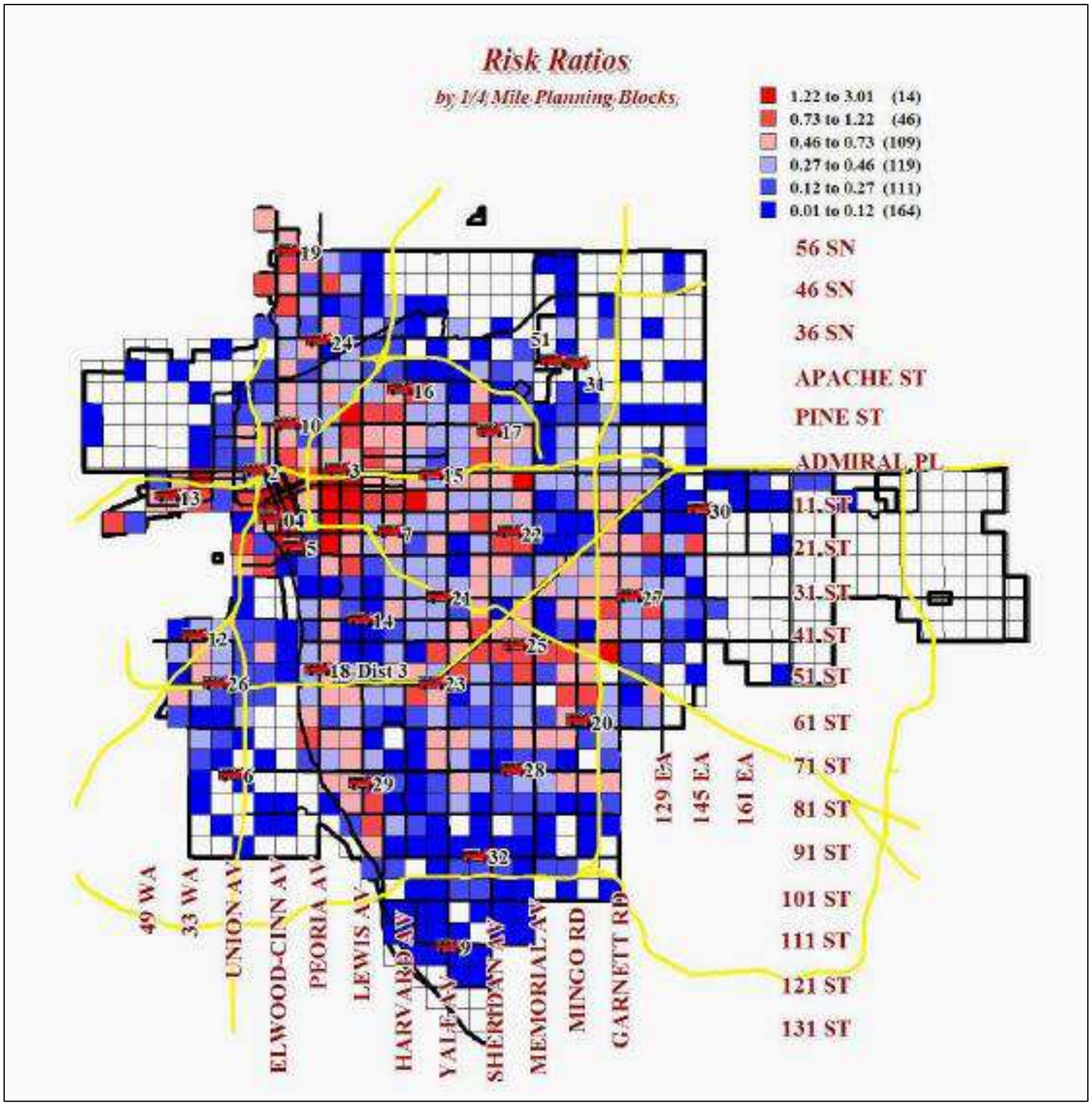
An additional and unique risk assessment included in the TFD Standard of Cover is an effort to measure risk by planning zone. In this exercise, the Standard of Cover divides the entire city into separate one-quarter square mile planning zones. Risk data are incorporated and evaluated for each zone and then compared to a benchmark value for each risk factor. The six key factors for determining risk are:

- Residential fires.
- Apartment fires.
- Commercial fires.
- High-rise fires.
- Nonsprinklered commercial square feet.
- Nonsprinklered high-rise square feet.

The TFD collected data for each of the six factors listed above within each one-quarter square mile planning block of the city; the information included occupancy type and actual fires in the block. Those blocks with the highest number of fires for each risk factor were rated higher, or received a higher risk ratio than those with a lower number of fires as measured against the same occupancy type. As such, the block with the highest number of fires was given a ratio of 1.00, while all the other blocks had a lower score.

Figure 5-7 illustrates how risk is identified by the one-quarter square mile planning blocks in the 2009 Standard of Cover document.

FIGURE 5-7: Risk Ratios by One-quarter Square Mile Planning Zones, 2009



The effort displayed in this analysis is significant; however, TFD stopped short of using this information to developing programs to prevent future fires. This is the essence of the Integrated Risk Management Plan, which will be discussed in greater detail in the *Essential Resources* section of this report.

A body of research that has been developed over the past four years has direct implications on fire department staffing and tactics. For the first time, quantitative evidence is being produced regarding the impact of crew size on accomplishing critical tasks. Additionally, continual research from Underwriters Laboratories (UL) has provided tactical insights that shed further light on the needs related to crew size and firefighter safety. This body of research includes:

- The April 2010 report on *Residential Fire Ground Field Experiments* from the National Institute of Standards and Technology (NIST).
- The April 2013 report on *High-Rise Fire Ground Field Experiments* from the National Institute of Standards and Technology (NIST-HR).
- The December 2010 report on the *Impact of Ventilation on Fire Behavior in Legacy and Contemporary Residential Construction* (UL).

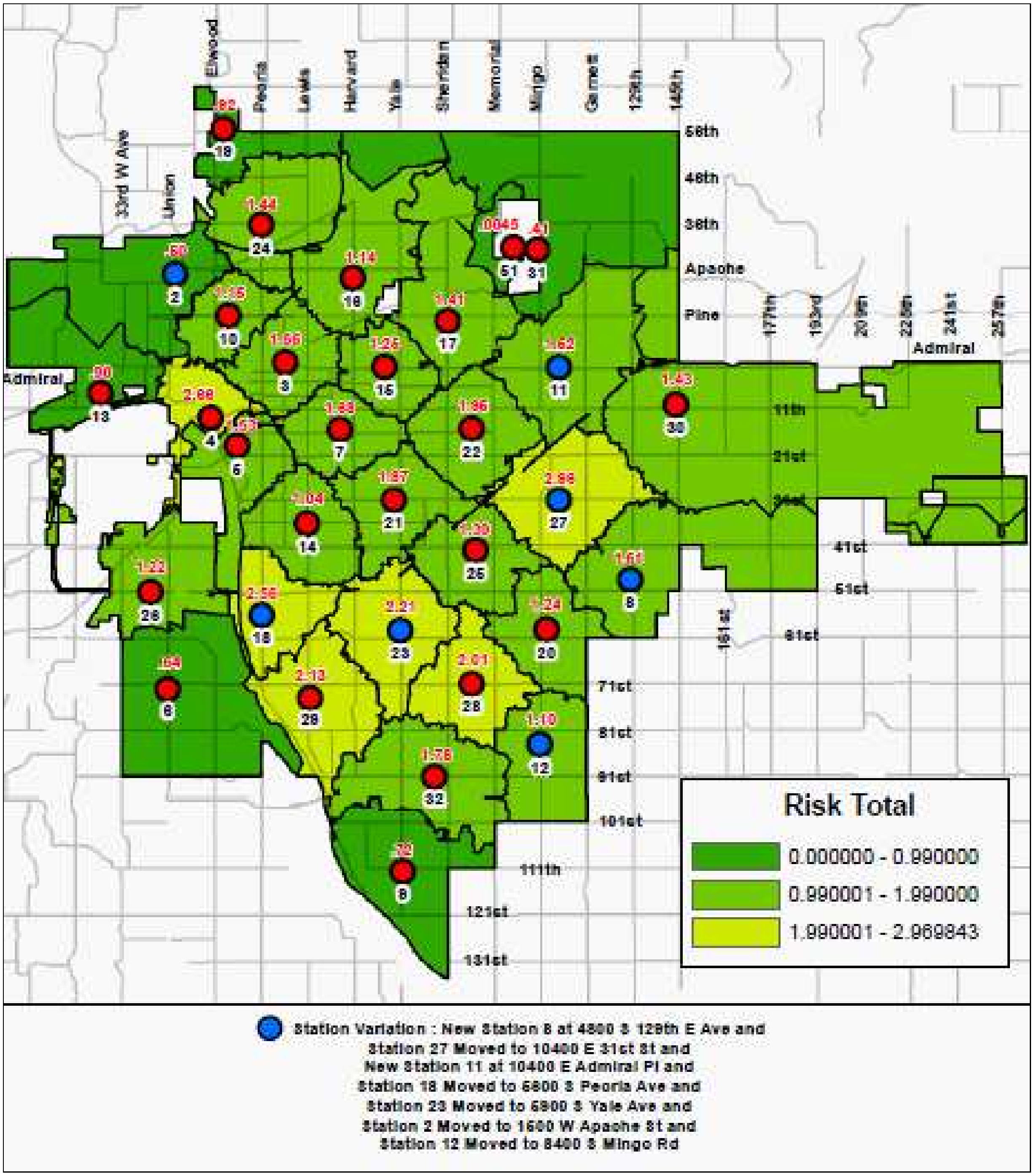
As stated, some of these studies' findings have a direct impact on the exercise of critical tasking. For example, as UL studied the impact of ventilation on fire behavior, it was able to obtain empirical data about the effect of water application on fire spread and occupant tenability. The research clearly indicates that the external application of a fire stream, especially a straight stream, does not "push fire" or decrease tenability in any adjacent rooms.[31] Therefore, during the deployment of resources for the critical task of fire attack, consideration must be given to the option of applying water to the fire from the exterior when able. This approach allows for a fire attack to begin prior to the establishment of an initial rapid intervention team (IRIT) and it decreases the time to get water on the fire, which has the greatest impact on occupant survivability.

The NIST studies examined the impact of crew size and stagger on the timing of fire ground task initiation, duration, and completion. Although each study showed crew size having an impact on time-to-task, consideration must be given to what tasks were affected and to what extent. For example, four-person crews operating at a low-hazard structure fire completed all fire ground tasks (on average) 5.1 minutes or 25 percent faster than three-person crews. However, considering the two tasks most influential in occupant survivability, the difference was minimal. For time to "water on the fire," the four-person crew completed the task only 6 percent faster than the three-person crew, which represents a difference of 34 seconds. For time to "primary search," the four-person crew completed the task only 6 percent faster than the three-person crew, which represents a difference of 23 seconds. The "rescue time" difference from a four-person to a three-person crew shows to be only 7 seconds.[32]

Over the last three years, the TFD has implemented new methodology to identify and map fire risks, which CPSM finds to be very effective and on the cutting edge of operations. TFD found that it can purchase data from the U.S. Postal Service (which is updated weekly), which is geocoded to rooftops, and which identifies single family dwellings (houses and duplexes) and multifamily residences (apartments). The TFD finds these data to be more accurate and efficient in terms of identifying and maintaining current fire building risk data. The risk is identified by color and assigned numerical value (see map insert for key). Figure 5-8 illustrates this new fire risk methodology and how it is applied to the distribution of stations.

[31] Kerber. *Impact of Ventilation on Fire Behavior in Legacy and Contemporary Residential Construction*.
[32] National Institute of Standards and Technology. (2010). *Report on Residential Fireground Field Experiments.* NIST.

FIGURE 5-8: Planning Map Based on Risk and First-In Boundaries

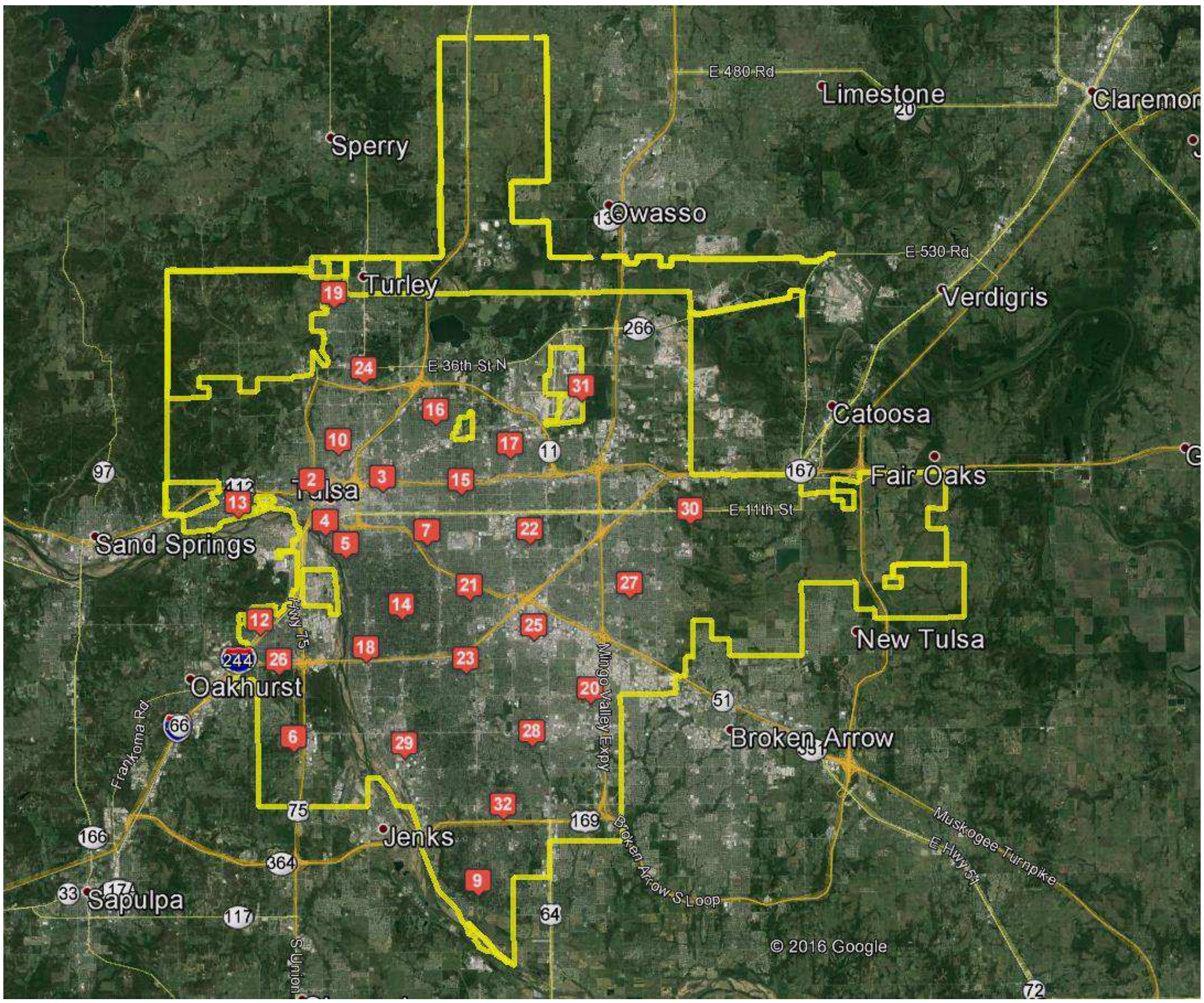


Recommendation: TFD should pursue reaccreditation under the CPSE/CFAI fire accreditation process.

Distribution of Stations

The geographic distribution of fire stations/resources is a key element in delivering fire services. Fire station location is driven primarily by two goals. The first goal is to provide a spatial distribution of resources in order to facilitate a desired response time outcome. The second goal is to allocate or balance workload throughout the jurisdiction and its available resources. Station location is also a key component in the Standard of Coverage process included in fire accreditation. Figure 5-9 illustrates existing fire station locations in the city of Tulsa.

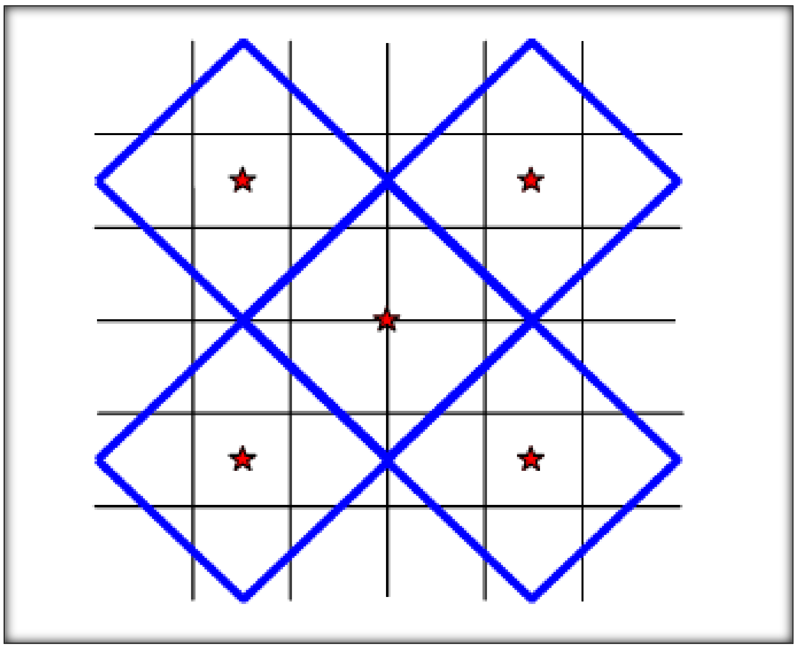
FIGURE 5-9: Existing Fire Stations



TFD utilizes a methodology for the distribution of stations that is based on 1.5-mile and 2.5-mile diamonds centered over each fire station. Each 1.5-mile diamond (3 miles wide) represents a four-minute travel time from each station utilizing the existing road network and with apparatus traveling at 30 miles per hour. Each 2.5-mile diamond (5 miles wide) represents a six-minute travel time from each station utilizing the same criteria. The TFD benchmarks a four-minute travel time for first due service against the potential for flashover[33] in a structural fire, and the potential of sudden cardiac arrest[34] in emergency medical services incidents.

The diamond grid methodology provides an immediate illustration of station/response gaps. When overlaid onto risks and demand layers, the planning is enhanced, as response gaps can then be benchmarked against identified risks and demand for service. This planning methodology is considered by CPSM to be a ***Best Practice***. A goal of the diamond grid system is to have contiguous diamond boarders with little to no overlapping. Figure 5-10 illustrates how this methodology is applied.

FIGURE 5-10: Diamond Grid Station Distribution Methodology

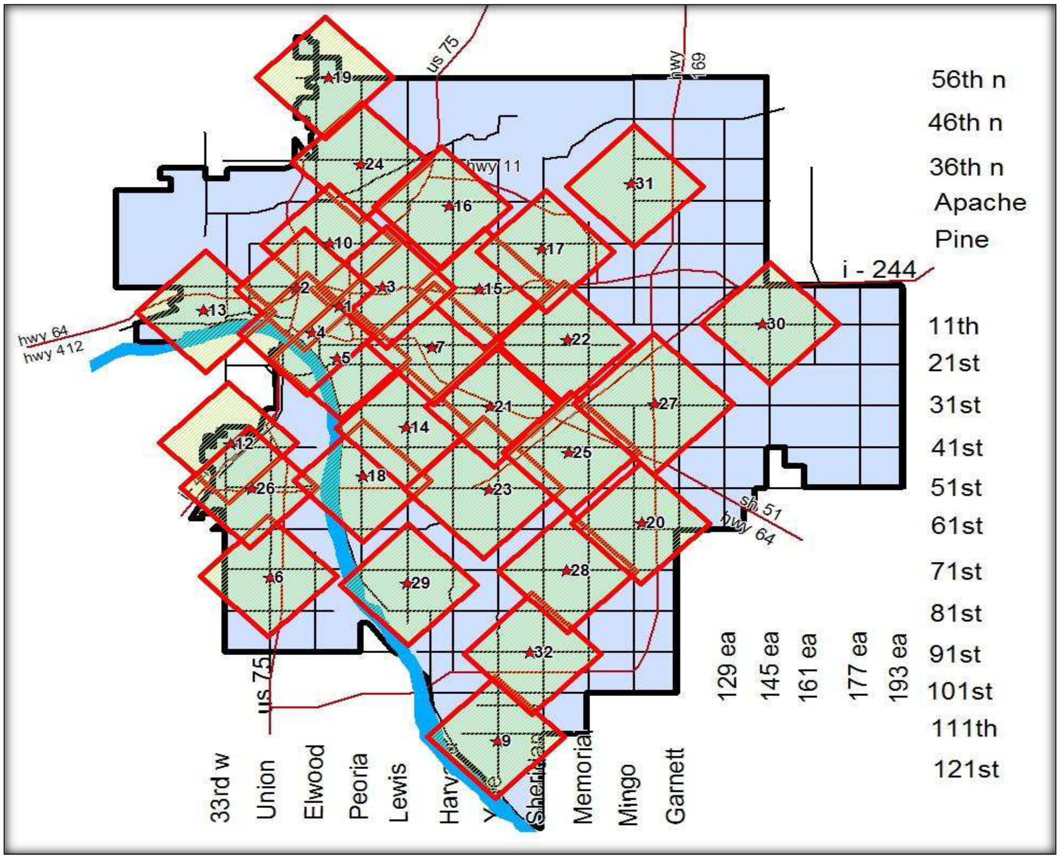


The actual application of the diamond grid methodology in the Tulsa system is shown in Figure 5-11.

[33] At approximately the 10-minute mark of fire progression, the fire flashes over (due to superheating of room contents and other combustibles) and extends beyond the room of origin, thus increasing proportionately the destruction to property and potential endangerment of life. The ability to quickly deploy adequate fire staff before flashover thus limits the fire's extension beyond the room or area of origin.

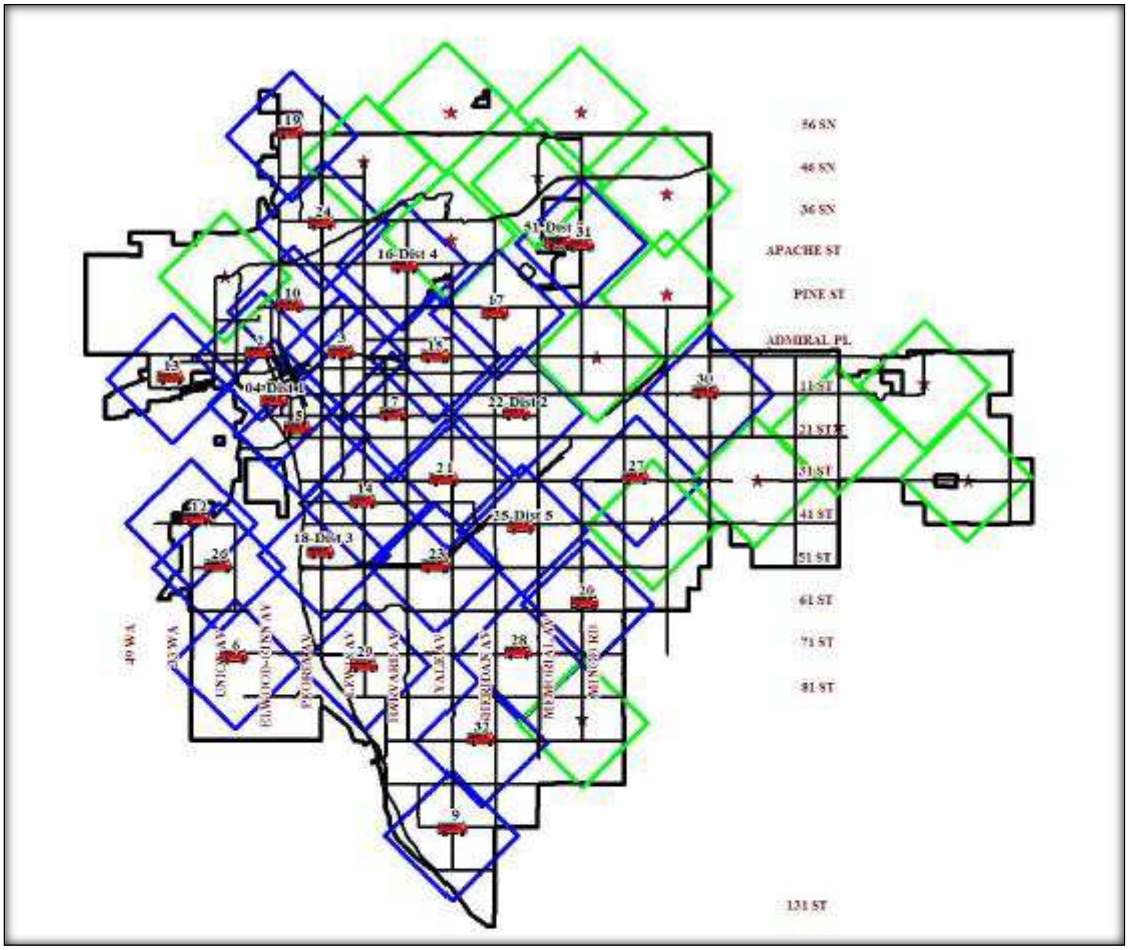
[34] The brain may sustain damage after blood flow has been stopped for about four minutes and suffers irreversible damage after about seven minutes.

FIGURE 5-11: TFD Station Locations (2016) Showing 1.5-Mile Polygons



Following this analysis , Figure 5-12 illustrates the existing fire station configuration (blue diamonds) and the proposed fire station locations that would be needed to fill the current voids in fire station distribution (green diamonds) utilizing the 1.5-mile diamond gird as the only benchmark.

FIGURE 5-12: TFD Station Locations (2009) 1.5-Mile Diamond Grid, with Potential Future Stations Indicated with Green 1.5-Mile Diamonds



It is well documented by the National Fire Protection Association, the ISO, and the Commission on Fire Accreditation International that the strategic location of fire stations and a smoothly operating pattern of response to alarms make a significant difference in the service delivery of fire and emergency medical services. Initial capital outlay or construction costs for a fire station may prove to be relatively insignificant when compared with the upkeep of an around-the-clock facility, crew, and fleet year after year.

Therefore, savings are realized over a period of time if the total number of fire stations is kept to only those that are needed or those with which the community will grow and from which service demand is effectively managed. One properly located fire station can provide more protection than several poorly located stations. Through the use of a comprehensive plan for fire station location, dollars can be maximized and efficiencies gained through the incremental growth of these facilities. The TFD has accomplished this planning, as discussed in the Standard of Cover review herein, utilizing the 1.5 mile diamond gird station siting methodology along with a number of benchmarks that guide the decision making as well. These benchmarks include:

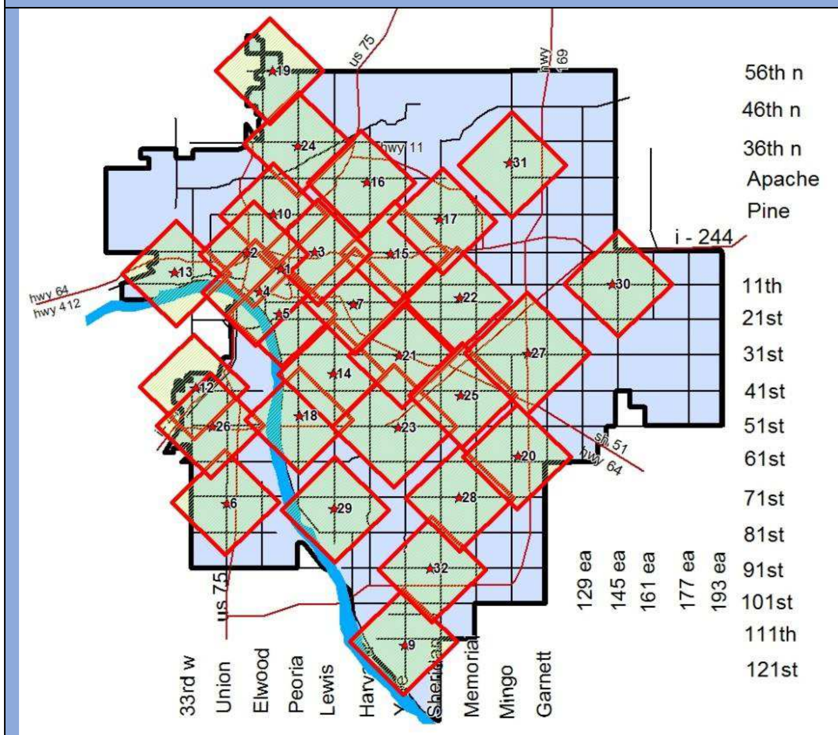
- Life Safety - Fire and EMS coverage:
    - Engine Company Coverage.
    - Ladder Company Coverage.
    - Advanced Life Support Coverage.
    - Basic Life Support Coverage.
- NFPA 1710 - *Standard for the Organization and Deployment of Fire Suppression Operations, Emergency Medical Operations, and Special Operations to the Public by Career Fire Departments*.
- Medical Director – ROSC.
- Medical literature – time until irreversible brain damage/time until application of a defibrillator.
- Number of previous incidents.
- Location of other fire stations in area.
- Location of other EMS in area.
- Growth trends and/or future growth trends.
- Land ownership/intention.
- Population density.
- Target hazards.
- Travel speed of apparatus.
- Expressway coverage.
- Expressways – availability for response.
- Insurance rating – most direct cost savings for citizens.

The goal of the diamond gird station siting methodology is to minimize overlap, and establish contiguous borders of defined diamond polygons (in the TFD's case, 1.5-mile polygons that represent four-minute travel times). In densely populated areas where call demand is high and risk is increased, overlapping polygons may justifiably occur. In the short term, this is an excellent planning tool for current station siting analysis and revision, as well as the foundation for long-term future station siting based on the benchmarks listed above.

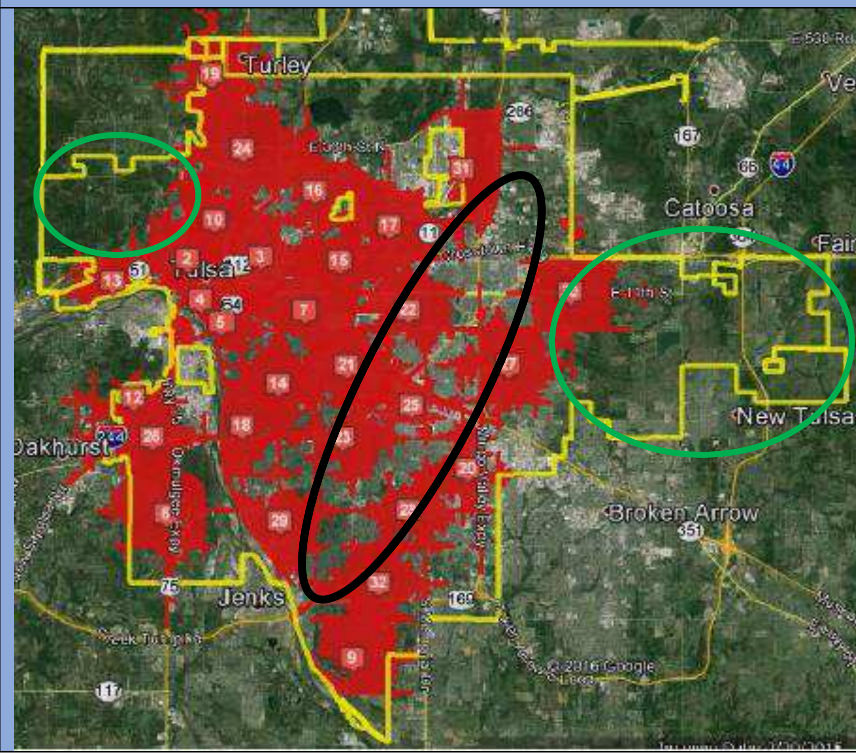
Figure 5-13 provides a side-by-side look at the current 1.5-mile polygons and a response map that CPSM created. This map shows, from each station, travel time computed utilizing ArcGIS network data, which has average road speeds built in. In this figure, CPSM utilized a four-minute travel time. Figures 5-14 and 5-15 illustrate, respectively, six- and eight-minute travel time maps side by side with the 1.5-mile polygons. Six minutes was utilized as this represents the TFD's 2009 Standard of Cover response goals of a first-due engine to EMS and structure fire incidents 90 percent of the time. Eight minutes was utilized as this is the NFPA 1710 benchmark for a first alarm assignment arrival to a single family dwelling fire.

FIGURE 5-13: 1.5-Mile Station Polygons and Four-Minute Bleeds

TFD 1.5-Mile Polygons (4-minute travel times)



CPSM 4-Minute Travel Time Bleeds



Observations from the maps in Figure 5-13 show that when the 1.5-mile polygons are not contiguous, as is the goal of the TFD, gaps occur in a continuous four-minute travel time using existing road networks between fire stations. The areas of concern are the more populated southeast and northeast areas of the city, and those with higher risks, as indicated by the black circle. The eastern and northwestern areas of the city (green circles) are not as densely populated and do not present with the risk comparable to the center core of the city.

FIGURE 5-14: 1.5-Mile Station Polygons and Six-Minute Bleeds

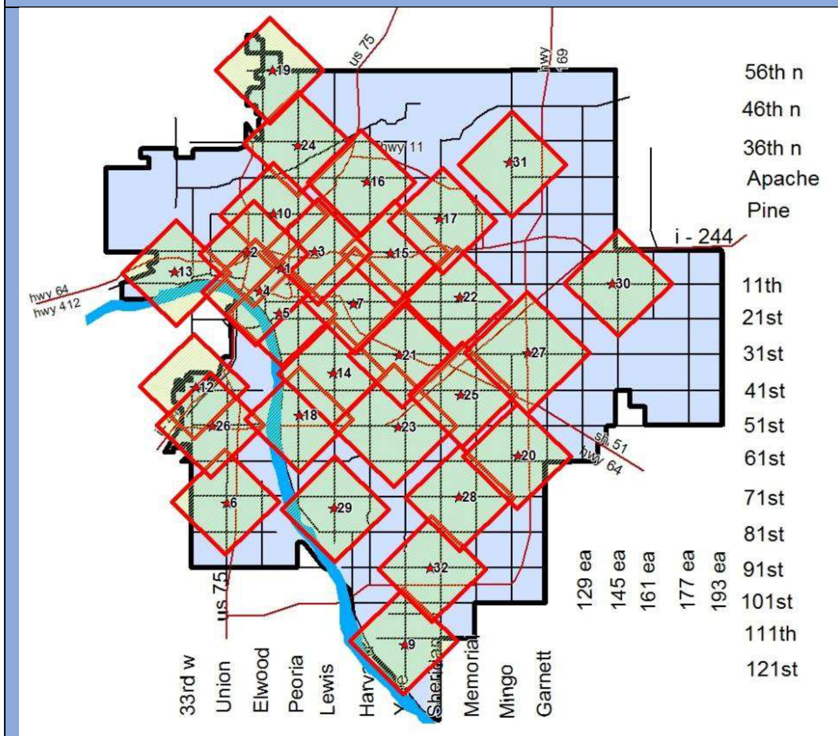
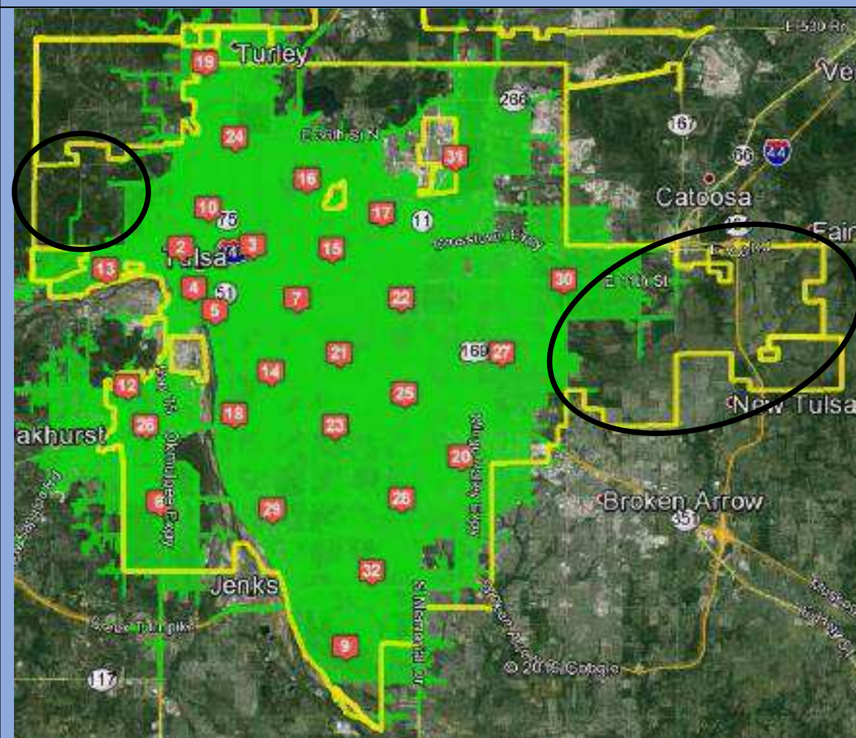
TFD 1.5-Mile Polygons (4-minute travel times)	CPSM 6-Minute Travel Time Bleeds
	

Figure 5-14, which shows six-minute travel times, indicates the gaps of concern in the four-minute travel time map are closed in the southwest area of the city, as well as in the northeast area of the city. There still remains areas of concern in the eastern and northwestern areas of the city (black circles). However, as discussed above, these areas are less densely populated and do not have the risks the central core of the city has.

FIGURE 5-15: 1.5-Mile Station Polygons and Eight-Minute Bleeds

TFD 1.5-Mile Polygons (4-minute travel times)	CPSM 8-Minute Travel Time Bleeds

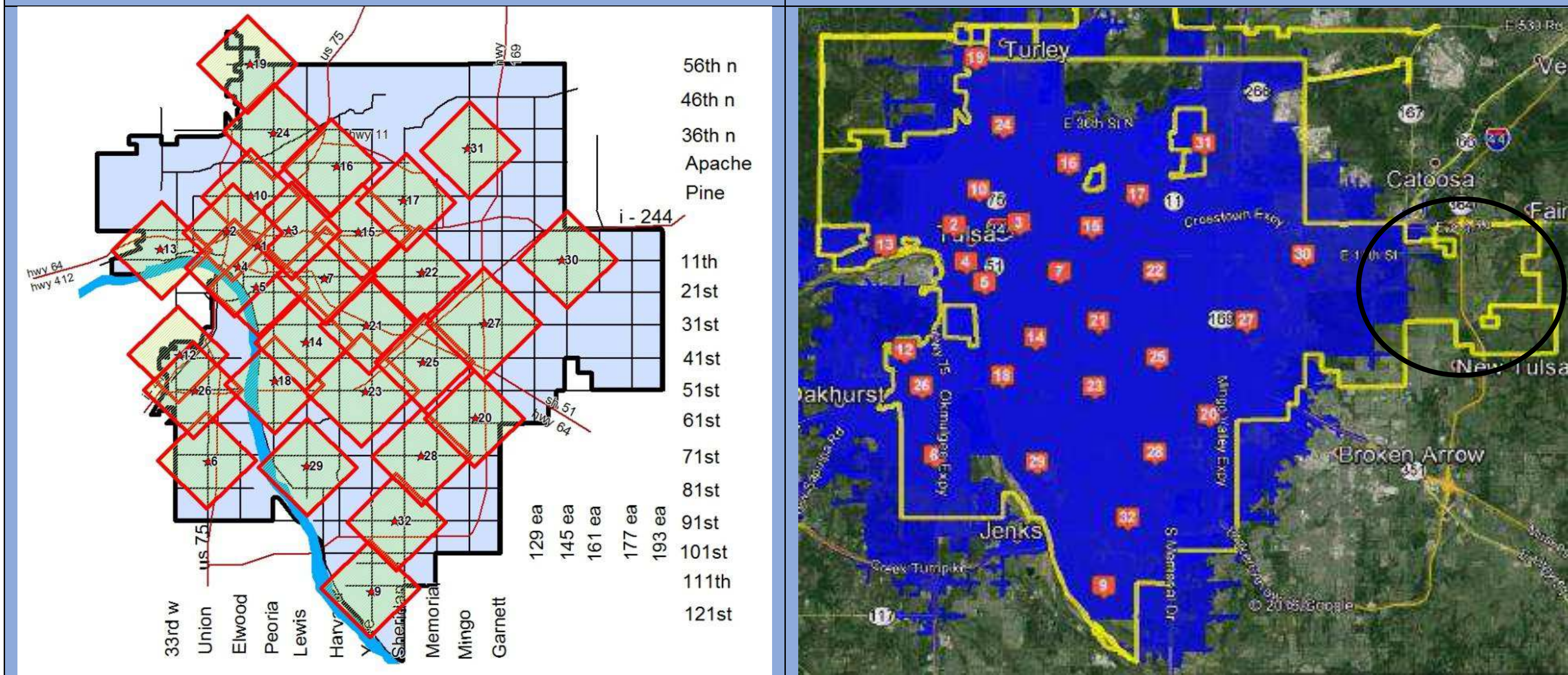


Figure 5-15 shows that the TFD can meet the NFPA 1710 benchmark for a first alarm assignment arrival to a single family dwelling fire within eight minutes in the central core of the city, where the highest density in population and risk is. There remains a response gap in the eastern area of the city (see circle) even at the eight-minute travel time benchmark.

From the data analysis CPSM conducted, we found the aggregate average travel time by station area is 3.7 minutes (3-minutes 42 seconds). The data analysis also tells us the aggregate 90th percentile travel time by station area is 5.6 minutes. When reviewing the average travel time by station area, only four stations (9, 30, 31, and 32) are above the four-minute travel time mark. This increases dramatically when reviewing the 90th percentile travel times, as all but one station area (4) are above the four-minute travel time mark. The data analysis further tells us that overall, first due units are first to arrive on the scene of an incident in their first-due response area 78 percent of the time. The units most likely to arrive in their first-due response area the greatest percentage of the time are units from station 31 (91.2 percent). The units least likely to arrive in their first-due response area the greatest percentage of the time are units from station 5 (63.9 percent).

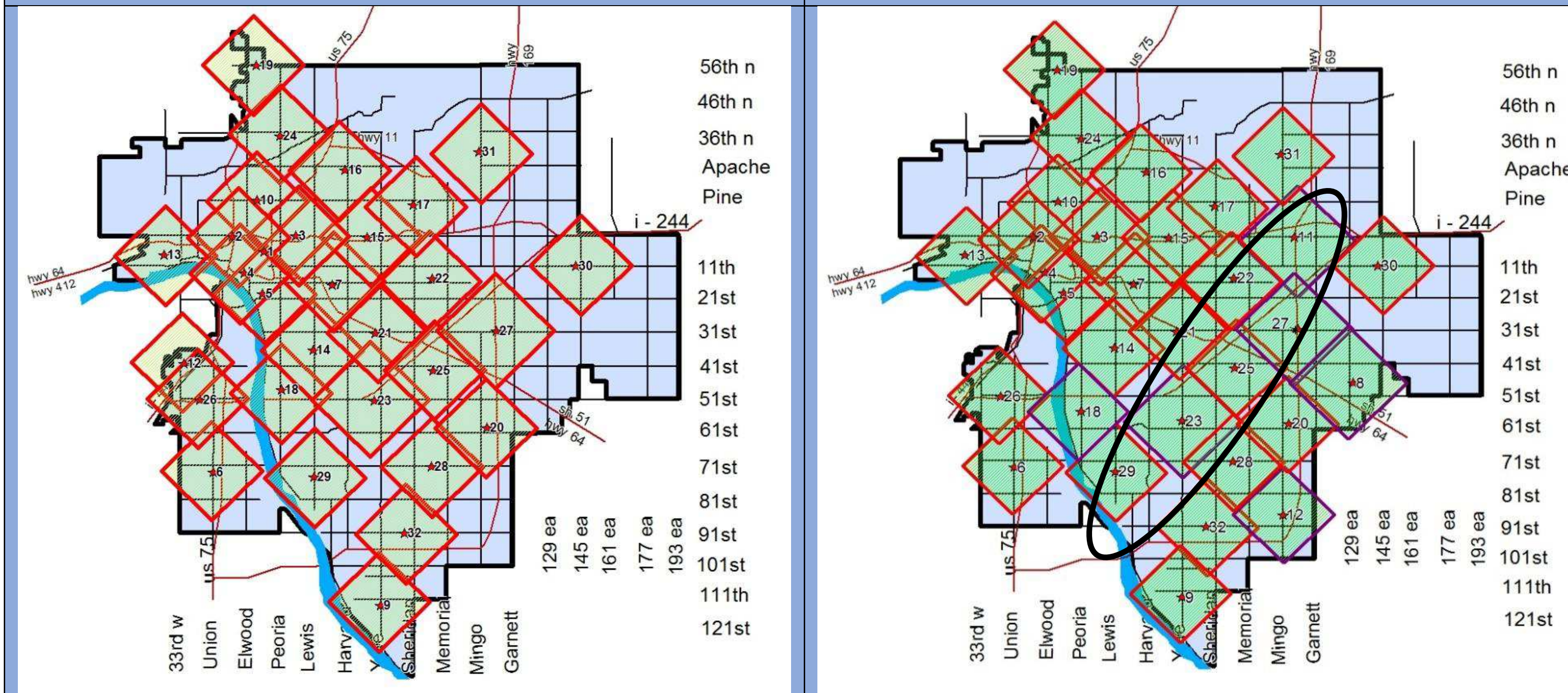
To minimize gaps in current four-minute first-in travel times, and to close gaps in areas of the city where a four-minute travel time from stations exists, the TFD has proposed the realignment of some stations and the construction of two new stations. Table 5-1 offers the proposed station plan, and Figure 5-16 illustrates a side-by-side comparison of the current station model with the proposed station model. In the figure, the purple 1.5-mile polygons represent the new or relocated fire stations.

TABLE 5-1: TFD Proposed Station Plan

Station #	Priority	Current Location	New Location	Staffing
New #8	High	N/A	8 @ 4800 S 129th E. Ave.	New Staffing, must be done in conjunction with Fire Station 27 move.
New #11	High	N/A	11 @ 10400 E. Admiral Pl.	Move 1 Existing Company From 31
Relocate #27	High	11707 E. 31st	27 @ 10400 E. 31st St.	Move 2 Existing Companies
Relocate #12	High	3123 W. 40th	12 @ 8400 S. Mingo Rd.	Move 1 Existing Company
Relocate #18	Medium	4802 S. Peoria	18 @ 5600 S. Peoria Ave.	Move 1 Existing Company
Relocate #23	Medium	4348 E. 51st	23 @ 5800-6100 S. Yale Ave. or 4700-4900 E. 61st St.	Move 2 Existing Companies

FIGURE 5-16: Current 1.5-Mile Station Polygons and Proposed 1.5-Mile Station Polygons

TFD 1.5-Mile Polygons (4-minute travel times)	TFD Proposed Station Realignment



Observations from these maps tell us that the TFD's proposed new station 11 and the relocation of stations 23 and 27 realign the polygons to close the four-minute travel time gap along a line in the southeast and northeast areas of the city as indicated by a black circle in Figure 5-13 (above) and in Figure 5-16 here. The relocation of station 18 closes a four-minute travel time gap in the southwest area of the city. Likewise, the relocation of station 12 from the western edge of the city to the southeast corner of the city closes this travel time gap. Adding a new station (8) to the eastern area of the city closes a four-minute travel time gap here, where the population and risk is greater than the eastern most area of the city where travel times in excess of eight minutes are likely in some cases.

Workload and demand are indicators as well for station realignment and also when considering new stations. The CPSM data analysis tells us that units in District 5 are the busiest (stations 20, 21, 23, 25, 28, 32) with 18,429 runs. District 3 units (stations 6, 9, 14, 18, 26, 29) were the least busy in terms of runs with 13,459. Station 27 had the most runs (5,690), and station 9 had the least number of runs (634). Table 5-2 shows the workload of each station by district.

TABLE 5-2: Call Workload by Station

District &	Station	Avg. Deployed Min. per Run	Avg. Deployed Min. per Day	Total Annual Runs	Avg. Runs per Day	Number of Units
1	2	18.1	192.7	3,892	10.7	3
	4	19.9	208.3	3,820	10.5	6
	5	17.0	84.3	1,810	5.0	1
	7	17.8	149.1	3,064	8.4	2
	12	22.2	44.3	728	2.0	1
	13	20.4	71.9	1,284	3.5	1
	Total	**18.8**	**750.7**	**14,598**	**40.0**	**14**
2	22	19.1	230.5	4,401	12.1	3
	27	**21.0**	**327.6**	**5,690**	**15.6**	**3**
	30	22.0	163.5	2,713	7.4	4
	31	22.2	89.3	1,468	4.0	3
	Total	**20.7**	**810.9**	**14,272**	**39.1**	**13**
3	6	33.5	185.8	2,024	5.5	4
	9	**19.1**	**33.2**	**634**	**1.7**	**2**
	14	17.6	68.7	1,426	3.9	1
	18	19.7	161.1	2,984	8.2	1
	26	21.7	117.5	1,980	5.4	4
	29	22.8	275.3	4,411	12.1	4
	Total	**22.8**	**841.7**	**13,459**	**36.9**	**16**
4	3	17.1	133.6	2,844	7.8	1
	10	19.7	115.6	2,143	5.9	2
	15	18.6	112.3	2,201	6.0	1
	16	19.9	102.7	1,888	5.2	1
	17	18.7	127.7	2,493	6.8	1
	19	20.8	85.7	1,505	4.1	1
	24	21.5	203.0	3,448	9.4	4
	Total	**19.5**	**880.6**	**16,522**	**45.3**	**11**
5	20	19.5	213.3	3,999	11.0	2
	21	18.2	138.0	2,766	7.6	2
	23	19.6	206.6	3,849	10.5	3
	25	17.7	115.8	2,391	6.6	1
	28	20.6	151.0	2,675	7.3	1
	32	21.2	159.8	2,749	7.5	3
	Total	**19.5**	**984.5**	**18,429**	**50.5**	**12**

Figures 5-17 and 5-18 illustrate fire and EMS demand concentration in one square mile-block cells in a side-by-side comparison with a map of population density in 2010. Figure 5-19 illustrates fire demand with structural risk.

FIGURE 5-17: Fire Call Demand (1 square mile-block cells) and Population Density

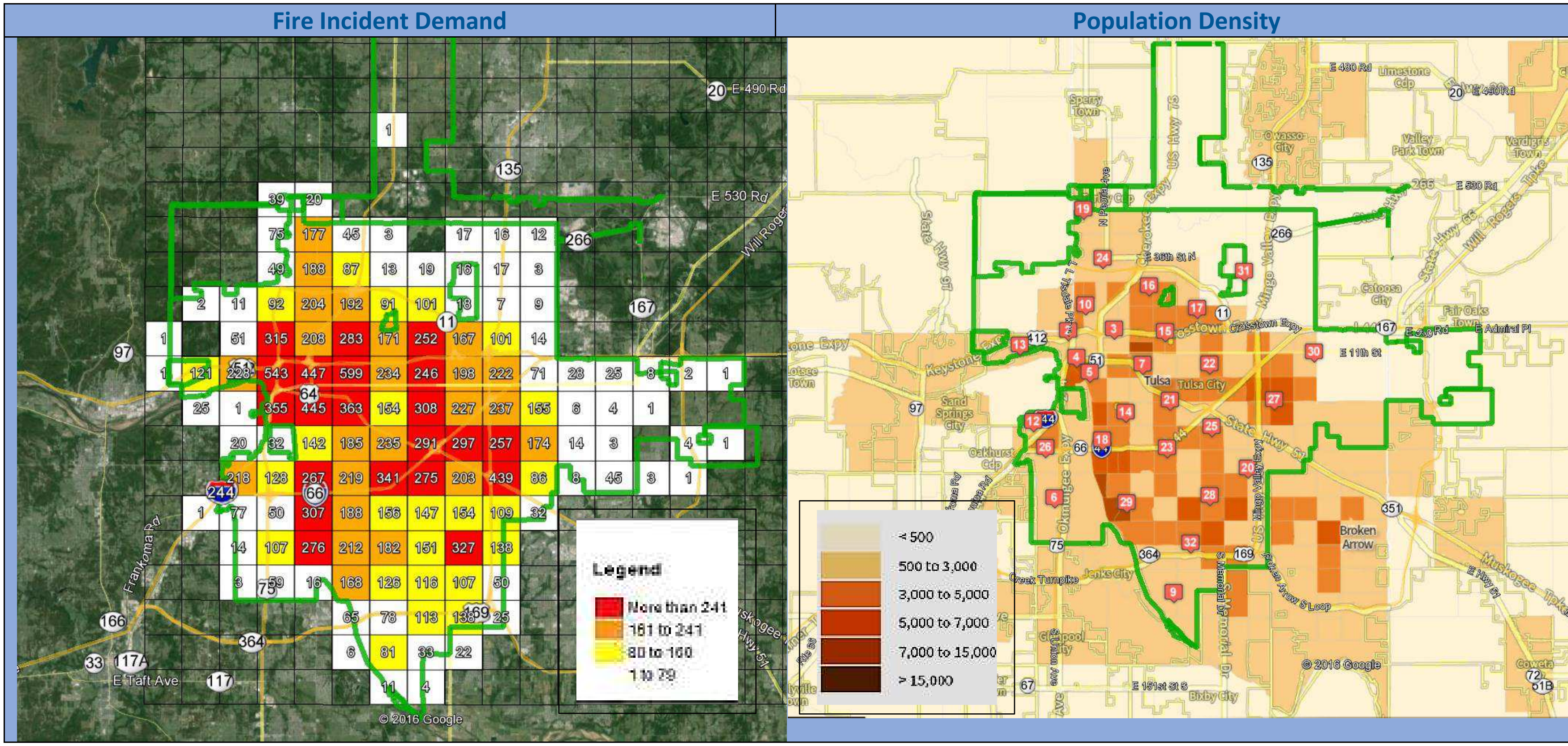


Figure 5-17 shows that fire demand is concentrated in the central core of the city, and that this call concentration matches population concentration.

FIGURE 5-18: EMS Call Demand (1 square mile-block cells) and Population Density

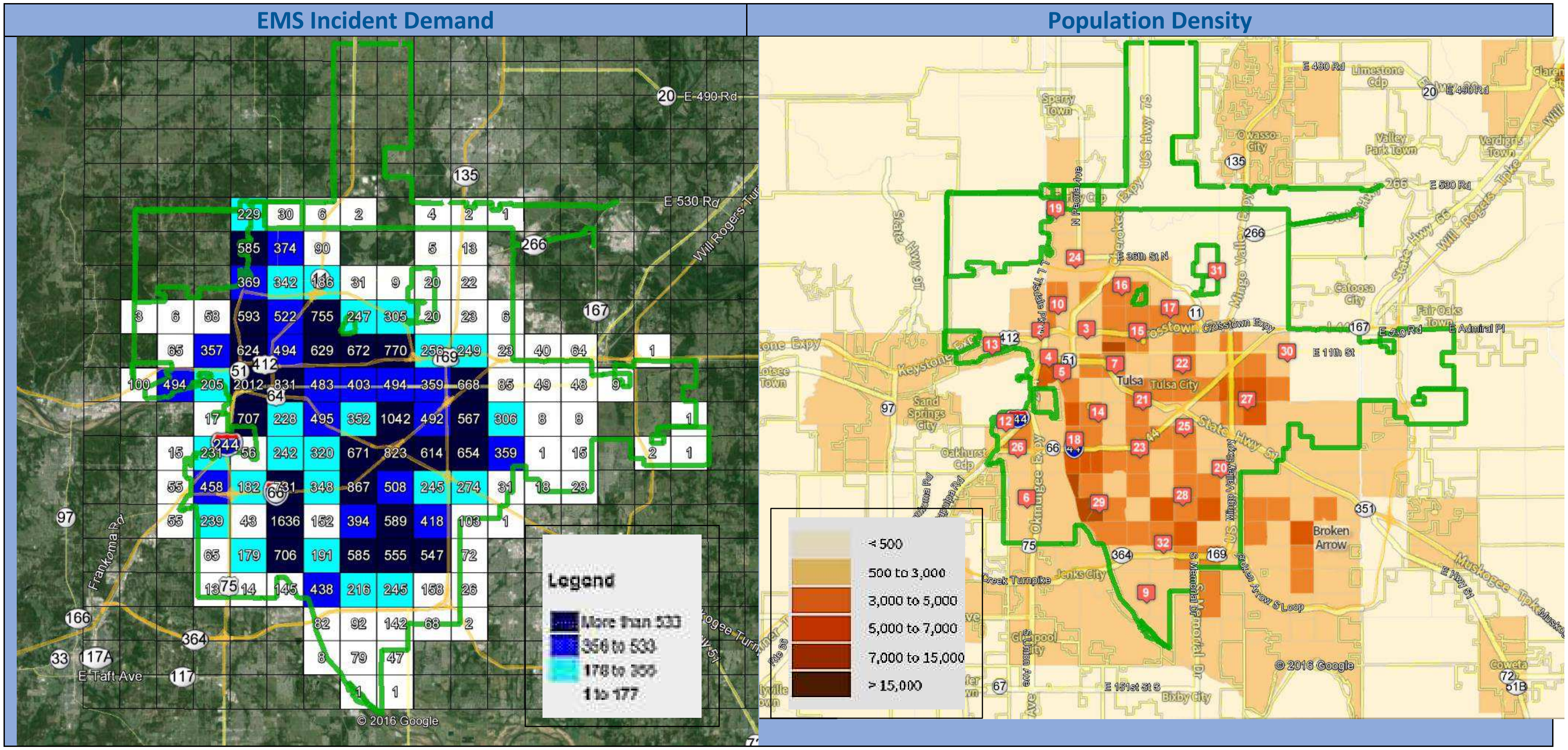
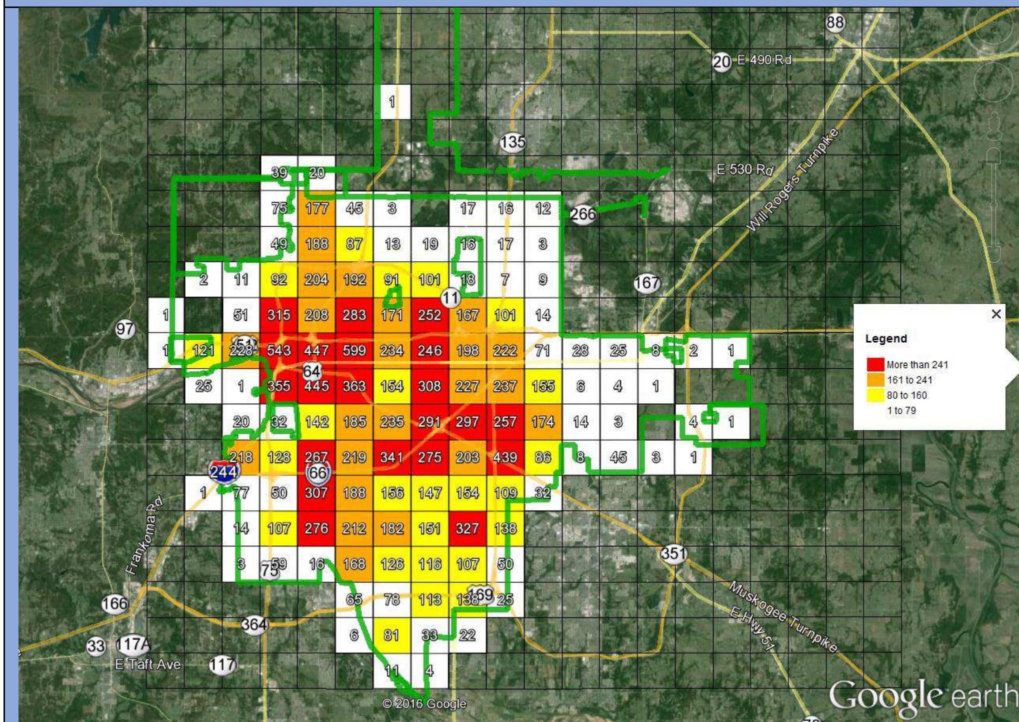


Figure 5-18 shows that EMS demand is concentrated in the central core of the city much like fire demand, and that EMS call concentration also matches population concentration.

FIGURE 5-19: Fire Call Demand (1 square mile-block cells) and Structural Risk

Fire Incident Demand



Structural Risk

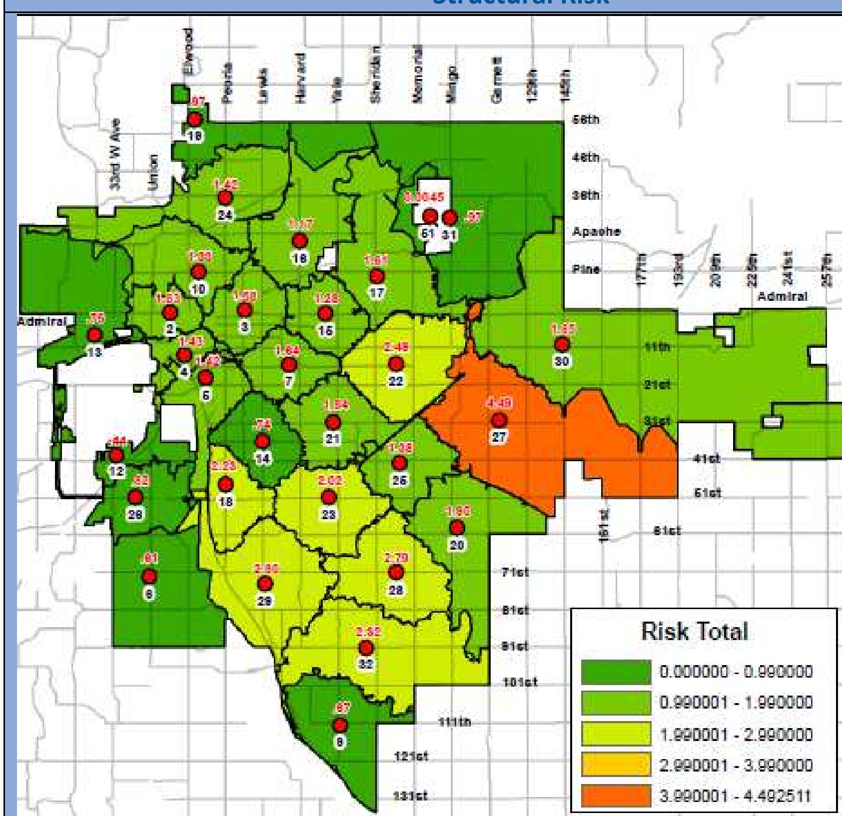


Figure 5-19 shows that increased fire demand generally follows the increase in structural risk. In areas with lesser structural risk, fire demand is generally lower, such as illustrated in the eastern portion of the city (station 30's district), and generally increased with greater structural risk such as in station 27's and 22's districts, as well as the southern portion of the city.

> ***Recommendation: The city should adopt and implement the proposed TFD station plan. CPSM believes this plan is efficient in terms of adding minimal staffing and maximizes existing resources.***

The proposed plan will improve overall coverage by closing travel time gaps in areas of the city where call demand, structural risk, and population is most concentrated. This assessment is based on a review of four-minute response travel time gaps as indicated above, overall travel time gaps in the eastern portion of the city, population concentration, and fire and EMS call demand.

Section 6. Operational Response Approaches

Overview

Tulsa utilizes a very traditional deployment process in its response protocols for the myriad of calls it encounters. The Tulsa system is extremely busy, responding to approximately 56,600 calls annually. The majority of calls are EMS, more than 63% of all calls, which TFD responds jointly with an EMSA unit. TFD responds to approximately 1,600 fire-related incidents each year, which equates to approximately 2.9 percent of all responses. Approximately 1.3 percent of TFD responses involve structure fires. Nearly 70 percent of all fire responses (more than 11,000) are typically nonemergency events, primarily service calls involving false alarms, good intent, and public service requests. TFD deploys 56 first response units distributed among 30 fire stations throughout the city. In its daily deployment, TFD utilizes the apparatus and minimum staffing shown in Table 6-1.

TABLE 6-1: Minimum Daily Staffing and First Response Vehicles

Number	Unit Type	Minimum Daily Staffing
1	Assistant Chief-Command	1
5	District Chief w/Intern-Command	10
25	Engines	76
13	Ladder & Quint Trucks	40
5	Squad Units	10
2	Air & Light Units	2
2	Hazardous Material Units	4
3	ARFF Units (Airport)	4
56		147

TFD has a pre-identified response matrix that assigns units to emergency calls on the basis of the type of occupancy and the determination at the dispatch center as to the magnitude of the event. TFD will deploy a single unit on most EMS responses and this unit will respond in tandem with an EMSA ambulance unit. On those more critical EMS events (cardiac arrest, automobile accidents with extrication, entrapment, and multiple patient incidents, etc.) additional units may be assigned. For reported structural fires in single family residential structures, the initial response assignment includes four engines, one ladder, and one chief/command vehicle. On commercial occupancy and high-rise assignments, the complement of equipment is increased to five engines, two ladders, and a chief/command vehicle.

TABLE 6-2: TFD Response Assignments

Type of Incident	Units Assigned	Minimum Staffing
EMS	1 EMSA, 1 TFD	4
EMS (Special)	1 EMSA, 2 TFD	7
SFR Structure Fire	4 Engines, 1 Ladder, 1 Command	17
Commercial Occupancy	5 Engines, 2 Ladders, 1 Command	23
High Rise Structure	5 Engines, 2 Ladders, 1 Command	23

The deployment of resources is ultimately designed to provide sufficient personnel and equipment to perform the necessary tasks that would be required in the event of a true emergency. The traditional mind-set is to have more resources than are typically needed so that when a more complex incident occurs, those resources are en route or available. (NFPA) 1710, *Organization and Deployment of Fire Suppression Operations, Emergency Medical Operations, and Special Operations to the Public by Career Fire Departments (2016 Edition)*, provides guidance regarding staffing levels recommended in the management of less complex incidents, particularly fires in single-family residential structures. In this pamphlet the recommended assignment of personnel when an aerial device is not utilized is 14 personnel. These personnel are assigned as follows:

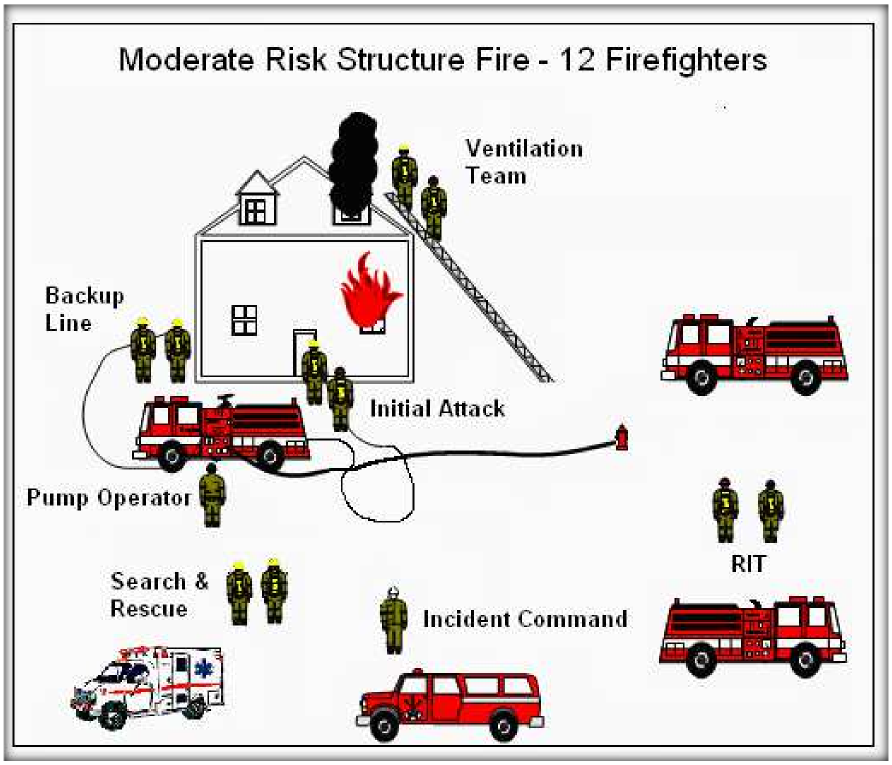
NFPA 1710, Recommended Initial full alarm assignment (when an aerial device is not utilized):

- Incident Commander 1
- Water Supply 1
- Two Fire Attach Lines 4
- Support for Attack Lines 2
- Search & Rescue Team 2
- Ventilation Team 2
- Rapid Intervention Crew 2

Total **14**

It is, however, not uncommon to see smaller organizations that utilize an initial assignment of 12 personnel for single family residential structures (less than 2,000 sq. ft.). Figure 6-1 is a depiction of the assignment of personnel when fewer firefighters are deployed.

FIGURE 6-1: Moderate Risk Response–Interior Fire Attack with 12 Firefighters



The utilization of fewer personnel, combined with the reduction in the number of responding units can have two positive impacts. The number of incident runs (for individual units) can be reduced significantly. This would increase the availability of these units and reduce their overall workload. In addition, if fewer units respond can reduce the possibility of vehicle accidents. 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.[35] It is estimated that more than 30,000 fire apparatus are involved in accidents when responding to emergencies each year in the U.S.[36] Responding fewer units and having these units respond in a nonemergency mode makes sense in terms of safety and efficiency.

The counterpoint to responding fewer units and assembling fewer personnel at the scene is the added workload placed on those personnel responding. CPSM's evaluation of fire incidents in Tulsa and throughout the U.S. is that on many, if not most incidents, the fires are minor, typically involving cooking materials, appliances, or heating units and usually involving a limited portion of the occupancy. From this perspective, the need for responding larger numbers of personnel and equipment is limited. In addition, in those events that are larger in scale and have grown to a magnitude that requires additional resources, these events are readily apparent either at the time the call is received at dispatch or by the multiple callers who observe a larger or growing incident.

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

In these cases, added resources can be added to the assignment and would assemble at the scene with minimal delay. Based on this perspective, CPSM believes that the TFD should consider a reduction in its initial assignment of equipment to a reported single family residential structure fire.

> ***Recommendation: TFD should consider a reduction to three engines, one ladder, and one command vehicle in its initial assignment of resources to a reported structure fire in a single-family residential occupancy.***

This assignment will provide 14 personnel, which CPSM believes is sufficient to carry out the necessary rescue and extinguishment tasks in most reported incidents. In the event that the incident is larger or more complex than originally reported, added resources can be dispatch to the scene as needed. CPSM does not recommend any change in the initial assignments for commercial or high-rise assignments.

Staffing, Deployment, and Overtime

TFD typically staffs its primary response units (engines and ladders) with three personnel. In addition, there are five squad units that are each staffed with two-personnel. However, in those stations that operate squad-units the adjoining apparatus (either an engine or ladder) are staffed with four personnel. TFD also operates five District Chief/Command units and these units are staffed with two personnel (one District Chief and a Captain/Intern). There are two Air & Light Units, which operate with one-person on each unit, and two Hazardous Materials Units, which each operate with two personnel. The total daily minimum staffing for all first response units is 143 personnel. The airport station utilizes a daily complement of four personnel to operate its three ARFF response units. When the airport personnel are added, the combined daily minimum staffing for all first response units is 147 personnel. In the event that the personnel levels drop below 147, additional people are called back on overtime status to maintain the staffing at 147.

Individual unit staffing and minimum daily staffing levels are perhaps the most contentious aspect in managing fire operations. There are a number of factors that have fueled the staffing debate. Aside from FAA requirements for minimum staffing levels at commercial airports, ***there are no state or federal requirements for staffing 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 TFD. 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.[37] 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 they are attempting to rescue a person or persons in the structure before the entire team is assembled.[38]

A second factor that contributes to the staffing debate is 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., 5.2.1.), 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 Tulsa) are not required to adhere to it. 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 level 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.*"[39] 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 and given the two-tiered response mode that combines TFD and EMSA units on most EMS calls, the majority of incidents can be handled with a single company of either two or three fire personnel.

TFD initiated the "squad" concept in an attempt to deal with the higher call volume associated with EMS. As mentioned above, squad units are staffed with two personnel and CPSM recognizes this as a ***Best Practice*** that should be maintained. 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. Currently most squad units are operated as minipumpers and are equipped with both a fire pump and a small water supply. These added features are very costly and recently these squad units have seen a capital cost in excess of $300,000 per unit. CPSM believes that the concept of using a minipumper for the squad units is unnecessary and their pumping capabilities are seldom used. We would recommend that all future squad units be designed as EMS first response units and the practice of adding a fire pump and water supply on these units be discontinued.

> ***Recommendation: TFD should eliminate the minipumper and water tank on future squad units and move to lightweight EMS first response units.***

A number of communities are reexamining the deployment of ladders and fire trucks and opting for a more efficient, less costly vehicle type to handle EMS and nonemergency workloads. (See, for example, "CARS" Program, Tualatin Valley Fire Rescue, Ore., and "SPRINT" Program, Shreveport

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[37] OSHA-Respiratory Protection Standard, 29CFR-1910.134(g)(4).
[38] Ibid, Note 2 to paragraph (g).
[39] (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*.)

Fire Department, La.). Given the two-tiered system of EMS delivery in the Tulsa area, a smaller lightweight vehicle (utility vehicle or SUV) staffed with two personnel and equipped with EMS equipment is sufficient to handle the majority of EMS first response activities. It is also of note that an analysis by an agency of repair costs for fire apparatus compared to lighter weight SUVs/utility vehicles was extremely revealing. The cost estimates in Table 6-3 were utilized by the Shreveport (La.) Fire Department in justifying its SPRINT program.

TABLE 6-3: Fire Apparatus vs. EMS First Response Vehicle Cost Comparison

Service	Fire Apparatus (Engine)	SUV/Utility 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 to 5 MPG	15 to 20 MPG

In addition to being more cost efficient to operate, the use of smaller, lightweight EMS first response vehicles reduces the wear and tear on engines and ladders and this will extend the work cycle of these more expensive apparatus. Smaller, lightweight vehicle are also more maneuverable in heavy traffic and response times are often faster.

Fire Department Overtime

Overtime in the Tulsa Fire Department has been very costly, adding in excess of $2.1 million annually to the fire department's operating budget. The primary factor affecting the amount overtime paid is the maintenance of the department's minimum daily staffing policy. This policy requires off-duty personnel to be utilized on an overtime basis whenever the on-duty staffing level drops below 147 personnel. CPSM estimates that the annual overtime costs associated with the minimum staffing policy is approximately $1.5 million. This results in nearly 39,000 hours of overtime annually or 106 hours of overtime every day. The minimum staffing policy is not a contractual provision included in the Tulsa Fire Fighters Union collective bargaining agreement. Any change, however, in this staffing policy is likely to require a negotiated settlement because of impacts it has on a ***pre-existing working condition***.

As mentioned earlier, most engine and ladder companies are staffed each with three personnel. There are, however, five units staffed with four personnel. These units are:

- Engine 2.
- Ladder 22.
- Ladder 23.
- Ladder 26.
- Ladder 32.

Each of these units is housed in a station that also houses the two person squad units. It is not clear why only these five units are staffed with four personnel. TFD has not been able to demonstrate any measurable benefit or working efficiency that results from this additional staffing. CPSM believes that significant overtime savings can be realized if these units utilize a floating staffing model and when there is a need to bring in additional personnel because of a daily staffing shortage that these units be reduced to three person staffing. By reducing these five units to three person staffing, the daily minimum staffing level will be reduced from 147 personnel to 142 personnel. CPSM estimates that $1 million in annual overtime savings can be realized just through this action.

> ***Recommendation: TFD should adjust its minimum staffing policy so that apparatus with four-person staffing are reduced to three-person staffing; this will help avoid the callback of off-duty personnel on overtime.***

TFD also operates two Air & Light units staffed continuously by one person on each unit. These units are typically deployed to larger fire incidents to provide scene lighting when needed and to recharge air bottles (SCBAs). These units are deployed from Station 4 and Station 27. Air & Light units are perhaps the most underutilized, constantly staffed apparatus in the system. In 2015 Air & Light unit Air 4 responded a total of 131 times, while Air-27 responded a total of 57 times. It would seem appropriate to consider the cross-staffing of the Air & Light units with two other apparatus in the system. Squads 2, 26, and 32 are the least busy squad units in the city, thus it may be more appropriate to cross staff two of these units with the Air & Light units and reduce the minimum staffing threshold by two personnel.

> ***Recommendation: TFD should consider cross-staffing the Air and Light units (Air-4 and Air-27) with two other constantly staffed apparatus in the city so as to reduce the daily minimum staffing by two personnel.***

TFD has a number of options with which to cross-staff the two Air & Light units to ensure their availability when needed, maintain their geographic distribution, and reduce the daily minimum staffing requirements.

In addition to the overtime expended for maintaining the minimum staffing levels, CPSM estimates that an additional $650,000 in overtimes is spent annually by the city of Tulsa for what is often termed ***FLSA Overtime.*** The Fair Labor Standards Act (FLSA) is federal legislation, enforced by the U.S. Department of Labor, and which requires that overtime be paid to hourly employees for those hours worked in excess of the normal workweek (typically 40-hours). FLSA specifies that overtime hours be paid at a rate that is 1.5 times the regular hourly rate ("time and one-half"). FLSA has also adopted the ***7(k) Exemption***, which is applicable to municipal firefighters. Because of the 24-hour scheduled worked by most firefighters, the maximum hours worked prior to being eligible for overtime is 53 hours rather than 40 hours. TFD employees work an average 52-hour workweek. This workweek is achieved through the issuance of an "***hours reduction day***" (Kelly-Day), which is one 24-hour shift day off for every fourteen 24-hour shifts worked. The hours reduction day system reduces annual work hours from 2,912 to 2,704. However, because of the cycling of the shift days, there are certain pay cycles in which the actual hours worked is in excess of the 53 hours specified by FLSA guidelines. During these work cycles, overtime is paid (FLSA overtime) for the excess hours. FLSA only requires overtime pay when the ***actual hours worked*** are in excess of the designated workweek. FLSA does not require that this calculation include time not worked, such as vacation time, sick leave, or holidays (federal or otherwise).[40] In the current collective bargaining agreement, the city has agreed to consider that hours worked include sick leave, vacation, bereavement, disability, etc. This provision excludes from hours worked that time not worked when compensatory leave time is utilized (Article 10, Sect. 10.2A). If this contract language is modified to exclude all lost time when calculating FLSA overtime, CPSM believes that the savings will be considerable.

> ***Recommendation: Tulsa should revise its interpretation for "hours worked" when considering overtime eligibility for 52-hour fire personnel and exclude from the calculation of overtime eligibility any leave time utilized by an employee during the FLSA 27-day cycle.***

It is difficult to estimate the actual savings that would be realized if Tulsa were to modify its interpretation of "hours worked" in determining overtime eligibility. If adopted, CPSM believes that there would be a significant reduction in FLSA overtime earnings. Under this interpretation, employees who work extra hours during the 27-day cycle, but have taken leave time, will still receive extra pay for these hours. However, these hours can be paid at the straight-time rate rather than the time-and-one-half premium rate. In addition, employees who do not work the required hours in the applicable 27-day cycle (192 hours or 212 hours) would not be eligible for FLSA overtime.

As previously discussed, many TFD units are exceptionally busy. CPSM identified eight units that each respond to more than 2,500 runs annually, with the majority of these runs being EMS-related. Table 6-4 is a listing of the busiest fire units in the TFD system.

[40] U.S. Department of Labor., Wage and Hour Division, Overtime Pay: General Guidance.

TABLE 6-4: TFD Busiest Emergency Response Units

Unit ID	Total Runs	EMS Runs	Availability	Daily Deployment (in minutes)
E-27	3,642	2,294	88.4%	200.1
E-29	3,050	2,096	87.2%	187.7
E-18	2,984	1,738	80.7%	161.0
E-20	2,844	1,452	81.4%	148.8
E-3	2,844	1,275	73.3%	133.6
E-21	2,765	1,622	73.2%	137.9
E-28	2,675	1,782	81.8%	187.7
E-17	2,493	1,614	84.2%	132.6
E-4	2,473	1,332	83.3%	114.9
E-24	2,363	1,555	82.3%	130.1
SQ-22	2,593	1,992	77.0%	131.4

These eleven units respond on nearly 50 percent of all the responses made throughout the TFD system. In many instances these units are unavailable to handle calls because they have been previously assigned to an earlier call. In these instances the response must be handled by another apparatus, either a ladder company from within district or another unit from a neighboring station. In either case, the workload causes delays in response and excessive wear and tear on the fire apparatus. Of the 28,213 calls handled by these apparatus, more than 60 percent were EMS calls. In addition, it is often necessary for ladder companies to respond to EMS incidents. In the 12-month period evaluated by CPSM, ladders responded to 5,431 EMS calls. This level of response results in excessive wear and tear on these costly apparatus and accelerates their replacement schedule. CPSM believes that TFD should deploy additional two-person EMS first response squads to more efficiently handle the EMS workload.

> ***Recommendation: TFD should consider the deployment of additional two-person EMS first response squads to better manage workloads for the busiest fire response apparatus.***

CPSM believes that TFD would benefit greatly by the addition of ten EMS first response units that would be deployed in the city's busies response areas. This would improve the availability of the fire response units for fire incidents and would also reduce the vehicle maintenance and replacement schedule for fire engines and ladders. CPSM believes that the deployment of additional two-person EMS Squads will be operationally more effective and significantly more cost effective than moving to four-person staffing. Given the distribution of the call load, CPSM further recommends that the additional EMS first response units be staffed with one EMT and one paramedic and these units be deployed ***only*** during the peak demand periods of the day, that is, 9:00 a.m. to 8:00 p.m.

Recommendation: TFD should deploy additional two-person EMS first response squads assigned to a 40-hour schedule and operational only during peak periods of operation (a span of approximately 11 hours daily).

The ability to deploy additional EMS first response squads that are only staffed during peak hours and work a 40-hour schedule and not the traditional 24-hour shift is likely to face opposition from the Fire Fighters Union. However, the 40-hour workweek is currently being utilized by a number of uniformed, bargaining unit personnel at TFD. In addition, the financial savings for operating these units on a 40-hour schedule is very significant, approximately 62 percent of the cost when compared to operating on a 24-hour schedule. During those nonpeak hours that the additional squad units are not operational, calls would revert back to being handled by 24-hour personnel.

To staff ten, two-person EMS first response squads during the peak-demand period will require a two-shift rotation, each consisting of 24 personnel (20 assigned personnel and 4 for coverage). If the same ten units were to be operated on a 24-hour schedule, CPSM estimates that this would require a three-shift rotation, each consisting of 26-personnel, or a total for 78 personnel.

TABLE 6-5: Staffing Requirements for 10 (two-person, 40-hour) EMS First Response Squads

Hourly Work Schedule	# of Shifts	Personnel per Shift	Coverage per Shift	Total Personnel
40 (Peak)	2	20	4	48
52 (24-hour)	3	20	6	78

There are many iterations of work schedules that can be utilized for staffing these units on a four-day, 40-hour schedule. CPSM believes that an eight-day cycle in which two shifts work 11-hour tours is the most viable. In this rotation, each crew would work four consecutive 11-hour tours, followed by four days off. The weekly average hours worked would be 38.6 hours, or 2,008 hours annually. This schedule will revolve each week so that the duty days would rotate throughout the year. Table 6-6 is an example of the eight day cycle that may be utilized within a 24-day FLSA work cycle.

TABLE 6-6: Eight Day-Peak Period Work Schedule (24-Day FLSA Cycle)

Sunday	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday
A-11 Hrs.	A-11 Hrs.	A-11 Hrs.	A-11 Hrs.	B- 11 Hrs.	B- 11 Hrs.	B- 11 Hrs.
B- 11 Hrs.	A-11 Hrs.	A-11 Hrs.	A-11 Hrs.	A-11 Hrs.	B- 11 Hrs.	B- 11 Hrs.
B- 11 Hrs.	B- 11 Hrs.	A-11 Hrs.	A-11 Hrs.	A-11 Hrs.	A-11 Hrs.	B- 11 Hrs.
B- 11 Hrs.	B- 11 Hrs.	B- 11 Hrs.				

Alternative work schedules have been found to be appealing to certain segments of the employee workforce for a number of reasons. Single parents who choose to be home every night often prefer a non-24-hour work schedule. In addition, employees who do not prefer to work the 24-hour schedule because of the fatigue factor or who simply do not want to respond to calls throughout the night prefer the shorter work assignment. In addition, new employees can be placed on the 11-hour schedule initially and then as 24-hour assignments open up, they may be reassigned upon request. Typically, 40-hour assignments are paid the same annual base salary as those assignments on the 52-hour assignment; however, these positions would not qualify for the 53-hour FLSA overtime payment nor would they receive the hours reduction relief day. In this case employees may find the schedule appealing because it is the same rate of pay for fewer hours being worked and when overtime is required it would be at a higher hourly rate.

The geographic placement of additional EMS first response squads will be critical in improving overall response coverage. The key to the placement of these units is to align these resources with both the service demands and availability of both TFD fire units and EMSA units. Medical Control has access to extensive analysis of the call patterns and the deployment of EMSA units. It is realistic that these insights be incorporated in the ultimate placement of all TFD squad units and ALS fire apparatus.

> ***Recommendation: TFD should incorporate guidance from Medical Control in the placement of EMS first response units and ALS fire apparatus.***

The ultimate decision on how and where to deploy TFD units is the responsibility of TFD leadership. As with the placement of ALS fire apparatus, this is clearly a fire department responsibility. It is critical, however, that the fire department incorporate the suggestions and analysis of Medical Control in effectively executing this decision making.

Apparatus and Fleet Maintenance

The ability to maintain an operationally ready and strategically located fleet of mission-essential fire apparatus is critical in the delivery of reliable and efficient public safety within a community.

The procurement, maintenance, and eventual replacement of aging response vehicles is one of the largest expenses incurred in sustaining a community's fire-rescue department. While it is the personnel of the TFD who provide emergency services within the community, the department's fleet of response vehicles is essential to their operational success. Reliable vehicles are needed to deliver responders and the equipment/materials they employ to the scene of dispatched emergencies within the city.

TFD Fleet

The TFD currently maintains and operates a fleet of 117 emergency support assets that range from sophisticated aerial devices, to pumper apparatus, to quick EMS response units, to tractor-trailer prime movers. This count includes both front-line and reserve assets. The TFD also operates a broad mix of light fleet sedans and SUVs and other administrative/staff vehicles (55 total).

FIGURE 6-2: TFD Ladder Apparatus

The department operates daily with 47 active frontline suppression vehicles (frontline vehicles are constantly staffed). Of the 47 fire apparatus, 25 are classified as engines, 13 are aerial ladder apparatus, and five are EMS squad vehicles. The TFD also deploys as active frontline emergency apparatus two air and light vehicles,[41] and two hazardous material vehicles. Generally, the location of numbered frontline fire and support apparatus aligns with the numbering of the fire station to which a vehicle is assigned (e.g., Engine 29 assigned to Station 29).

The TFD also cross-staffs certain vehicles, meaning staffing from one unit (frontline) in a station will staff another unit (active special duty) if needed. Once the active special duty unit is staffed and responds to an incident, the frontline unit is out of service. There are efficiencies in this staffing model, as generally specialty units are needed for specific responses, which generally are low in volume and would not be efficient to staff 24-hours/day. Therefore, CPSM believes the deployment model of cross-staffing specialty units should continue and recognizes this as a ***Best Practice.*** Apparatus included in the cross-staffing deployment model for the TFD include brush units[42] (five), a technical rescue unit,[43] and a tractor (prime mover).[44]

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[41] Air and Light units carry a supply of breathing air and oxygen cylinders, heat/cold rehabilitation equipment, specialty tools such as smoldering insulation vacuums, and other light equipment. These units have a large scene light mast for night operations.

[42] A brush unit responds to wildland fires and wildland urban interface fires. The TFD unit is a single cab F450 unit with all-wheel drive and a small tank and pump.

[43] The technical rescue unit has equipment for trench rescue, confined space rescue, and high-angle rescue. It also carries some water rescue equipment to supplement the boats we have stationed around town.

[44] The TFD operates three prime movers; these units are for pulling USAR trailers and the mobile radio tower (ECHO-1).

The TFD also operates and deploys six command units that are staffed on a 24-hours basis. These include five district chiefs (fire suppression command units) and one emergency medical services officer (EMS-related field operations). TFD also utilizes a 24-hour Assistant Chief who is also deployed in a command unit.

The remaining emergency support vehicle count includes reserve engine and ladder apparatus, and an array of active special duty units that includes supply and fuel trucks, a backhoe, urban search and rescue assets, and other special response vehicles.

EMS Squad Units

TFD squad units are staffed with two members — one paramedic and one emergency medical technician. These units are utilized primarily as TFD quick response deployable assets to medical calls, and secondarily as an engine company resource on structure fire incidents. If a squad responds to a structure fire, it replaces an engine on the response assignment. As the squad is not equipped functionally as a traditional engine, the squad typically is positioned out of the way of the larger apparatus and the two-person crew is assigned a functional task (primarily fire suppression related) by the incident commander.

FIGURE 6-3: TFD Squad Apparatus

Since its inception, the squad program apparatus model has changed a number of times, which is normal when implementing a model such as this. The pilot program utilized a sport utility vehicle. Again, the primary use was as a quick response vehicle to EMS incidents. As the program transitioned to the implementation phase, two squads were purchased utilizing Ford F550s with a utility box (Squad 22 and Squad 23). As the program further evolved, the units were equipped with a small fire pump, water tank, and hose, and were similar to a minipumper. The TFD operates three of these unit types (Squad 2, Squad 26, and Squad 32).

The Squad program is further transitioning again to units that do not have hose, water, and a fire pump. The next generation TFD squad will utilize a Ford F250, crew cab pickup, will be fitted with a bed cap/cover to protect supplies and equipment, and will be equipped with basic and advanced life support EMS equipment. CPSM agrees with this transition of vehicle type for the squad program and how it will be equipped.

Because three of the current squad units and future apparatus of this type are not configured as fire engines it is logical that these units not replace an engine company on structure fire responses. Instead, a squad unit can be included on the response assignment to provide staffing to be utilized as needed by the incident commander.

Fleet Maintenance

An effective fleet maintenance program is essential in prolonging the life of fire department apparatus and ensuring safe operations. Effective daily, weekly, and monthly inspections of apparatus and support vehicles by fire department personnel discovers and/or recognizes when repairs should be performed by qualified service technicians, which ensures continued service delivery to citizens and visitors of the city of Tulsa.

The city's Equipment Management Division, a division in the Asset Management Department, handles fleet maintenance and repair of fire apparatus and support vehicles. In 2015, the Equipment Management Division was ranked among the top 15 best fleets in North America by the *Top 100 Fleets in North America*.

The *Fire Garage* at 1790 Newblock Park Dr. handles most of the fire apparatus and heavy equipment. The *Main Garage*, at 1720 Newblock Park Dr. handles most of the staff and light vehicles. Small equipment such as saws, jaws, fans, generators, and lawn equipment are handled through the *Fire Garage*. Apparatus and support vehicles are scheduled for routine repair and maintenance at these facilities.

TFD Administrative Operating Procedure Section #304 addresses procedures for apparatus and equipment repairs, and Administrative Operating Procedure Section #306 addresses procedures for the daily and weekly inspection of apparatus, apparatus mechanical components, apparatus equipment, and support vehicles. Reserve apparatus are included in the daily inspection procedures to ensure their readiness, which CPSM considers a ***Best Practice.***

The FY14/15 fleet maintenance budget was $1,601,629 (which did not include fuel). Expenditures amounted to $1,647,079, with the overage attributable to parts replacement and the negative collection of insurance dollars for collision repairs.

Fleet Replacement

Replacement of fire-rescue response vehicles is a necessary, albeit expensive, element of fire department budgeting that should be backed with careful planning. A well-planned and documented emergency vehicle replacement plan ensures ongoing preservation of a safe, reliable, and operationally capable response fleet. A plan must also schedule future capital outlay in a manner that is affordable to the community.

NFPA 1901, *Standard for Automotive Fire Apparatus*, *2016 edition*, serves as a guide to the manufacturers that build fire apparatus and the fire departments that purchase them. The document is updated every five years using input from the public/stakeholders through a formal review process. 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 recent 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 purchasing. With respect to recommended vehicle service life, the following excerpt is noteworthy:

"It is recommended that apparatus greater than 15 years old and which 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."[45]

"Apparatus that were not manufactured to the applicable apparatus standards or that are over 25 years old should be replaced."[46]

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.[47] The results are shown in Table 6-7.

TABLE 6-7: 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 Manufacturer's Association, August 2004.

The impetus for service life thresholds is in part driven by the continual advances in occupant safety. Despite good stewardship and the proper maintenance of emergency vehicles, there are many advances in occupant safety such as fully enclosed cabs, enhanced rollover protection and air bags, three–point restraints, antilock brakes, higher visibility, cab noise abatement/hearing protection, and a host of other improvements that have been added over time and included in each revision of NFPA 1901. These improvements provide safer response vehicles for those providing emergency services within the community as well those "sharing the road" with these responders.

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

The city of Tulsa uses a contemporary approach to the replacement of capital vehicles. To ensure funding for capital projects (to include capital vehicles), in 2014, the citizens of Tulsa voted to approve a temporary 1.1% Capital Sales Tax Extension to fund various capital needs across the city. The total appropriation amount to be received for each project is stated in the Capital Program Ordinance. Annual appropriations are determined and approved by the City Council as part of the annual budget process. Fire capital projects (apparatus) are included in this appropriation.

Currently the TFD utilizes an apparatus replacement plan that specifies replacement for engine and ladder apparatus based on years of service. Squads are included in this and considered engines. Engines in the fire department plan are generally replaced at the ten year mark, with ladders generally planned for replacement at the fifteen year mark. Support vehicles such as brush units and haz-mat units are generally planned for replacing at the twelve year mark.

The city of Tulsa has implemented a capital vehicle replacement plan developed by the Equipment Management Division. This plan is termed FUSS, which is an acronym for Fleet Utilization Scoring System. FUSS is designed to help develop city-wide capital fleet replacement priorities, and ensure the most deserving city of Tulsa vehicles are replaced with the level of available funding.[48] The FUSS replacement methodology utilizes a scoring process that is based on seven vehicle related categories:

1. Age.
2. Life-to-date (LTD) mileage or LTD hours.
3. Reliability (LTD number of work orders).
4. LTD maintenance and repair costs.
5. LTD downtime.
6. LTD fuel usage (gallons).
7. LTD miles per gallon.[49]

FUSS Replacement methodology is based on an aggregate scoring of the above criteria with replacement considered on a vehicles score as follows:

- Vehicles that receive a cumulative score of 17 or under are rated in excellent shape.
- Vehicles that receive a score of 18-22 are rated in good shape.
- Vehicles that receive a score of 23-27 are rated in fair shape.
- Vehicles that receive a score of 28-35 are rated as “Needs Immediate Consideration for Replacement.”[50]

[48] City of Tulsa FUSS budget presentation for FY 2016-2017.
[49] City of Tulsa FUSS budget presentation for FY 2016-2017.
[50] City of Tulsa FUSS budget presentation for FY 2016-2017.

In CPSM's review of the FUSS methodology, we found that it is objective and considers those critical factors relevant to vehicle sustainability. Although the fire department has an in-house vehicle replacement methodology that is based largely on years of service, reuse as a reserve, and other factors, the FUSS methodology is state of the art, consistently applied to all city vehicles, and efficient in terms of what vehicles should be replaced based on objective scoring.

> ***Recommendation: CPSM recommends the TFD fully participate in the FUSS capital vehicle replacement program for fire apparatus.***

The design and specification of fire apparatus is a critical aspect in the effective utilization of this equipment; proper design also contributes to more efficient maintenance and upkeep of this wide range of equipment. The ability to achieve prompt and timely repairs of fire apparatus is oftentimes related to the familiarity of the mechanical staff with the equipment, staff's capabilities to make repairs, and the availability of parts. It is therefore essential that in the design process of fire apparatus there be consideration given to the maintenance and repairs of this equipment. CPSM was advised that the fleet maintenance group is not regularly involved in the design and specification of new fire apparatus. This task is handled entirely by fire department staff.

> ***Recommendation: TFD should include Equipment Management Division staff in the design and specification process of all future fire apparatus.***

Though TFD is the ultimate user of fire apparatus there should be some guidance provided by the city's mechanical staff when considering the design and maintenance of these apparatus. Certain considerations regarding the repairs, maintenance special tools, and fit devices, along with the needed parts inventories, should be considered in this process.

Water Tender Apparatus

The city of Tulsa has fire service areas that have buildings that are greater than 1,000 feet from the closest fire hydrant, but still are within five miles of the closest fire station. This was discussed previously. As these areas of the city do contain buildings, this presents an issue in terms of delivering and sustaining the needed fire flow to mitigate an active fire incident.

FIGURE 6-5: Water Tender Apparatus

Currently the TFD does not have water tender apparatus. These apparatus (Figure 6-5) are designed to carry large volumes of water (2,000 to 3,500 gallons) to supplement attack engine tank water, and when used in a relay operation of tankers, sustain the needed fire flow to mitigate a larger fire.

An alternative to this traditional model is to combine two units into one where possible, while maintaining effective fire services with existing crews. An available water tender/engine alternative is combined into one unit.

FIGURE 6-6: Engine-Tender Apparatus

In TFD station areas that have buildings that are greater than 1,000 feet from the closest fire hydrant, the water tender alternative may provide additional benefit. Figure 6-6 illustrates this concept in a locality where the engine/tanker apparatus concept is deployed and the overall fleet has been maximized. Although this apparatus resembles that of a normal engine apparatus, it carries 1,750 gallons of water and pumping capacity. These vehicles may also be equipped with a compressed air foam system (CAFS) and a portable water tank; the vehicle has the normal array of tools, hose, and equipment. The goal of this deployment would be the delivery of 4,500 net gallons of water on initial alarm assignments through the combination of engine tank water and water tender apparatus response.

Fire Response

The Tulsa system is built around its capacity to provide an immediate and concentrated fire response. TFD deploys 38 fire apparatus (25 engines and 13 ladders) from its 30 fire facilities. On average, each fire station has a coverage area of 6.7 square miles. The size of a service area will vary depending on location; core or downtown areas that have the greatest concentration of people and structures have smaller geographic service areas while the more periphery locations in which populations are more dispersed have larger coverage areas. Most fire stations operate with multiple fire companies; 18 out of the 30 facilities house two or more primary response units. Only 12 of the 30 fire stations operate with a single response unit. Fire stations are strategically located and these locations are determined on the basis of workload and geographic distribution.

In a *Data Report* published in 2012, ICMA reported survey information from 38 municipalities with populations exceeding 100,000 people. In this grouping the average fire station service area was 13.11 square miles.[51] The median service area for this grouping of communities was 7.86 square miles per fire station.[52]

The NFPA and ISO have also 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.[53] 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.[54] 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.[55] A polygon based on a 1.97 mile travel distance results in a service area that on average is 7.3 square miles.[56]

From these comparisons, it can be seen that the average 6.7 square-mile service area per station in Tulsa is slightly smaller than the noted references. TFD has a number of planning efforts that provide an on-going evaluation of its resource allocation, fire station locations, the projection of future fire stations, and the relocation of existing facilities and resources to improve overall coverage and response. TFD is very proficient in its deployment strategies and planning efforts in this regard and this is considered a ***Best Practice*** by CPSM.

The Tulsa service demand for fire-related calls is significant. On average, TFD responds to more than 16,000 fire calls annually or approximately 44 fire incidents each day. Fire calls account for approximately 28 percent of all responses. In the 12-month period analyzed by CPSM there were a total of 713 structure fires handled by TFD units.

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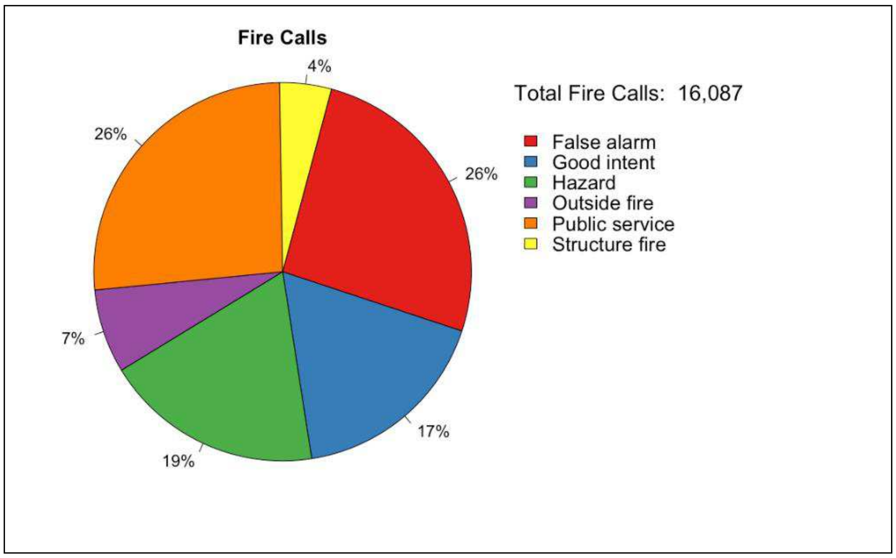
[51] "Comparative Performance Measurement, FY 2011 Data Report - Fire and EMS," ICMA Center for Performance Measurement, August 2012.
[52] Ibid.
[53] Insurance Services Office. (2003) Fire Protection Rating Schedule (edition 02-02). Jersey City, NJ: Insurance Services Office (ISO).
[54] National Fire 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.
[55] University of Tennessee Municipal Technical Advisory Service, Clinton Fire Location Station Study, Knoxville, TN, November 2012. p. 8.
[56] Ibid., p. 9.

TABLE 6-8: Fire Call Types

Call Type	Number of Calls	Calls per Day	Call Percentage
False alarm	4,168	11.4	7.4
Good intent	2,809	7.7	5.0
Hazard	3,017	8.3	5.3
Outside fire	1,153	3.2	2.0
Public service	4,227	11.6	7.5
Structure fire	713	2.0	1.3
Fire Total	**16,087**	**44.1**	**28.5**

FIGURE 6-7: Fire Calls by Type



Observations:

- Fire calls for the year totaled 16,087 (28 percent of all calls), an average of 44.1 per day.
- Structure and outside fires combined for a total of 1,866 calls during the year, an average of 5.1 calls per day.
- A total of 713 structure fire calls accounted for 4 percent of fire calls.
- A total of 1,153 outside fire calls accounted for 7 percent of fire calls.
- Public service calls were the largest category of fire call and made up 26 percent of fire calls.
- False alarm calls were 26 percent of fire calls.

TFD is extremely proficient in its handling of the high volume of call activity and the management of its resources in responding to the cross-section of incidents occurring. 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, it is found that no emergency exists. 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 the combined effort between the 911 dispatch center and the fire department that recognizes these occurrences and scales its response on the basis of the information at hand and the development predetermined response procedures that reflect the different nature of the calls. Two key factors impact response activities and workload when responding to the range of citizen requests. The first is the number of units that respond to the various incident types and the second is the mode of response. TFD had done well in adjusting the number of units responding on the basis of call type, but CPSM believes that further improvements can be made in the mode of response to the array of call types.

Table 6-9 is the summary of the average number of units responding to the various calls handled in 2015. As noted in this chart, more than 81 percent of all responses are handled by one TFD unit. It is important to note however, on most EMS responses, there is a corresponding response from an EMSA unit. It is also important to note, particularly when looking at the fire responses, the frequency in which one unit is responding to those calls that are typically nonemergency (good intent-79 percent and public service-86 percent). Compare this with structure fire calls, in which only 9 percent of the calls are handled with one unit. These outcomes are extremely commendable as they indicate proper screening at the dispatch level and a modified response by fire. CPSM considers this a ***Best Practice*** that improves overall efficiency and responder safety.

FIGURE 6-8: Number of TFD Units Dispatched to Fire Calls

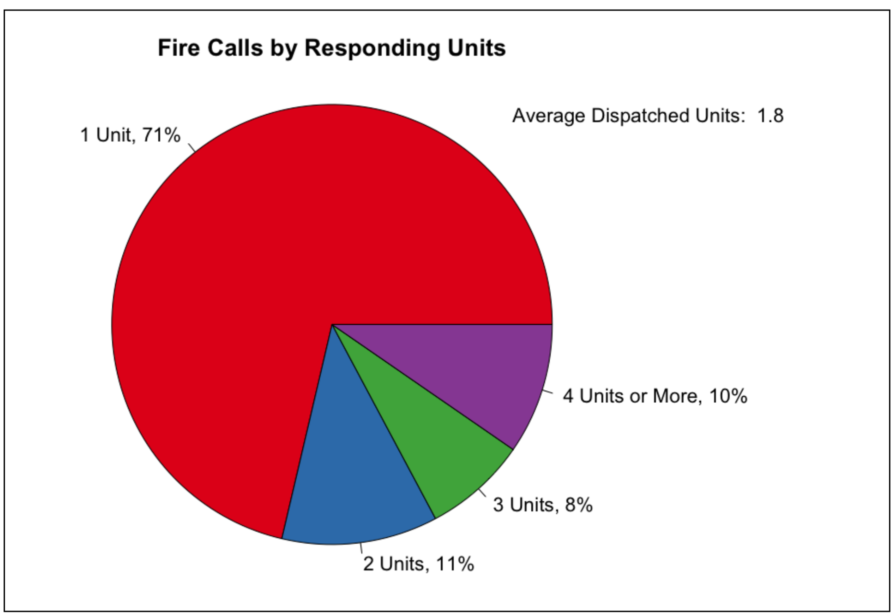


TABLE 6-9: Number of Units Dispatched to Calls by Call Type

Call Type	Number of Units						Total
	One	Two	Three	Four	Five	Six or More	
False alarm	3,101	199	543	25	8	292	4,168
Good intent	2,206	294	132	14	8	155	2,809
Hazard	1,676	665	377	73	23	203	3,017
Outside fire	803	196	65	14	9	66	1,153
Public service	3,626	467	73	11	6	44	4,227
Structure fire	64	22	30	2	14	581	713
Fire Total	**11,476**	**1,843**	**1,220**	**139**	**68**	**1,341**	**16,087**
Percentage	71.3	11.5	7.6	0.9	0.4	8.3	100

Observations:

- On average, 1.8 units were dispatched per fire call.
- For fire calls, one unit was dispatched 71 percent of the time; two units were dispatched 11 percent of the time; three units were dispatched 8 percent of the time; four or five units were dispatched 1 percent of the time; and six or more units were dispatched 8 percent of the time.
- For structure fire calls, three units were dispatched 4 percent of the time; four or five units were dispatched 2 percent of the time; and six or more units were dispatched 81 percent of the time:
  - Six units were dispatched 18 percent of the time.
  - Seven units were dispatched 31 percent of the time.
  - Eight units were dispatched 17 percent of the time.
  - Nine units were dispatched 9 percent of the time.
  - Ten or more units were dispatched 6 percent of the time.
- For outside fire calls, three units were dispatched 6 percent of the time, and four or more units were dispatched 8 percent of the time.

Our analysis regarding the mode of response shows that for fire-related calls the level of screening that is taking place results in nearly 22 percent of all fire responses being in "***cold***" mode. 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. A "***hot***" response is when a unit responds with lights and sirens; in this mode it may pass red lights, stop signs and utilize other response patterns that expedites its rate of travel

Fire Loss

TFD responds to approximately 700 structure fires annually. The number of structure fires has seen some reduction in recent years; however, the number and severity of fires in the Tulsa system continues to constitute a significant workload. Of the 713 structure fires in 2015, a total of 687 of these incidents resulted in some type of property damage or damage to the contents in the occupancy. In 2015 there was $11,109,031 of combined damage (building and contents) from these events. This equates to an average fire loss of approximately $16,152 per structure fire. It is helpful to look at fire loss comparisons nationwide for structure fires. NFPA estimates that in 2012 the average fire loss for a structure fire was $20,345.[57] Though the average fire loss for structure fires in Tulsa is lower than the national average, CPSM observes that the frequency of structure fire occurrences in Tulsa is significant and warrants a directed intervention.

TABLE 6-10: Content and Property Loss – Structure and Outside Fires in 2015

Call Type	Property Loss		Content Loss	
	Loss Value	Number of Calls	Loss Value	Number of Calls
Outside fire	$1,664,279	526	$188,874	350
Structure fire	$8,355,317	687	$2,741,308	538
Total	**$10,019,596**	**1,213**	**$2,930,182**	**888**

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

Observations:

- Out of 1,153 outside fires, 526 had recorded property loss, with a combined $1,664,279 in loss.
- 350 outside fires also had content loss, with a combined $188,874 in loss.
- Out of 713 structure fires, 687 had recorded property loss, with a combined $8,355,317 in loss.
- 538 structure fires also had content loss, with a combined $2,741,308 in loss.
- The average total loss for a structure fire was $16,152.29.

In evaluating the magnitude of the fires occurring in the TFD system another useful measure is the amount of time spent on each particular incident. Table 6-11 is a summary of the time spent on the various incident types. It is important to note that on 308 (43 percent) of the total structure fires, crews were engaged for more than one hour. Though not definitive, CPSM believes this is a further indication of the frequency of the more complex fire events.

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

TABLE 6-11: Fire Calls by Type and Duration

Call Type	Less than One-half Hour	One-half to One Hour	One to Two Hours	Greater than Two Hours	Total
False alarm	3,959	176	27	6	4,168
Good intent	2,652	135	15	7	2,809
Hazard	1,919	777	273	48	3,017
Outside fire	855	217	67	14	1,153
Public service	3,653	452	91	31	4,227
Structure fire	225	180	180	128	713
Fire Total	**13,263**	**1,937**	**653**	**234**	**16,087**

- A total of 15,200 fire category calls (94 percent) lasted less than one hour, 653 fire category calls (4 percent) lasted between one and two hours, and 234 fire category calls (1 percent) lasted more than two hours. On average, there were 2.4 fire category calls per day that lasted more than one hour.
- A total of 405 structure fires (57 percent) lasted less than one hour, 180 structure fires (25 percent) lasted between one and two hours, and 128 structure fires (18 percent) lasted more than two hours.
- A total of 1,072 outside fires (93 percent) lasted less than one hour, 67 outside fires (6 percent) lasted between one and two hours, and 14 outside fires (1 percent) lasted more than two hours.
- A total of 4,135 false alarms (99 percent) lasted less than one hour, and 33 false alarms (1 percent) lasted more than an hour.

CPSM also looked at the frequency in which fire loss exceeded the national average. Table 6-12 is a representation of the number of fires in which the loss exceeded $20,000. It is interesting to note that on 162 of the 713 structure fires (22.7 percent), fire loss exceeded $20,000.

TABLE 6-11: Incidents with Total Fire Loss Either Above or Below $20,000

Call Type	No Loss	Under $20,000	$20,000+
Outside fire	622	510	21
Structure fire	26	525	162
Total	**648**	**1,035**	**183**

Observations:

- 622 outside fires and 26 structure fires had no recorded loss.
- 118 outside fires and 75 structure fires had $2 or less in total recorded loss — $1 in property loss and $1 in content loss. This may be a reporting issue.

- 21 outside fires and 162 structure fires had $20,000 or more in loss.
- The highest total loss for an outside fire was $101,000.
- The highest total loss for a structure fire was $580,000.

In CPSM's experience, $20,000 in fire loss is not an exceptionally large amount of damage. In reality, a single room and contents or a kitchen fire will typically generate this amount of loss. Our intent in providing this perspective is to indicate a measurement that can provide a point of reference with regard to severity. CPSM believes that the $20,000 threshold provides a realistic demarcation of an actual fire event in which extinguishment by the fire department is warranted. It is also important to note that the ability to limit a fire to $20,000 in fire loss is very positive and also indicative of effective firefighting tactics and speedy response.

In looking at the fire incident workload it is also important to understand the amount of time units spend on the various fire calls. Table 6-13 provides the annual deployed time by all TFD units for fire-related incidents. The average time spent on all fire related calls combined was 21.6 minutes. This call duration includes both travel time to and from the scene, along with turnout time at the station. Subsequently, a call lasting 20 to 30 minutes is indicative of an on-scene time that is typically less than 15 minutes. Generally this would be a nonfire event. The times, however, observed in Tulsa are very consistent with the amount of time CPSM sees spent on fire related calls in other communities. In our experience, fire calls of longer duration are typically the more complex incidents, requiring more resources and resulting in more fire damage. Typically, fire call durations of less than one hour are indicative of either minor fires or no fire at all.

TABLE 6-13: Annual Deployed Time for Fire Related Calls

Call Type	Average Deployed Minutes per Run	Annual Hours	Percent of Total Hours	Deployed Hours per Day	Annual Number of Runs	Runs per Day
False alarm	10.5	1,289.9	4.9	3.5	7,397	20.3
Good intent	12.1	886.4	3.4	2.4	4,385	12.0
Hazard	26.2	2,616.2	10.0	7.2	5,991	16.4
Outside fire	22.6	740.2	2.8	2.0	1,963	5.4
Public service	19.0	1,631.0	6.3	4.5	5,161	14.1
Structure fire	44.6	3,470.8	13.3	9.5	4,673	12.8
Fire Total	**21.6**	**10,634.5**	**40.8**	**29.1**	**29,570**	**81.0**

It was also very interesting to observe the amount of fire loss allocated by fire station service areas throughout Tulsa. Table 6-14 is a summary of fire loss from structure fires by fire station service area. We broke out this comparison by the number of fires with any fire loss, the number of fires with losses over $20,000, and the total dollar loss in the respective service areas.

TABLE 6-14: Total Fire Loss by Station Area – Structure Fires

District	Station	Fires with Loss	Average Loss	Fires with Loss Over $20,000	Total Losses
1	2	22	$36,280.14	7	$798,163
	4	9	$13,893.56	3	$125,042
	5	21	$7,952.57	3	$167,004
	7	15	$11,221.73	3	$168,326
	12	13	$4,808.08	1	$62,505
	13	29	$12,915.28	10	$374,543
	Total	**109**	**$15,555.81**	**27**	**$1,695,583**
2	22	40	$17,914.75	10	$716,590
	27	65	$23,795.34	20	$1,546,697
	30	20	$30,322.50	7	$606,450
	31	8	$18,169.00	2	$145,352
	Not Recorded	1	$1,500.00	0	$1,500
	Total	**134**	**$22,511.86**	**39**	**$3,016,589**
3	6	7	$5,729.71	1	$40,108
	9	4	$19,287.75	2	$77,151
	14	8	$16,150.38	2	$129,203
	18	33	$17,133.45	7	$565,404
	26	18	$17,750.39	6	$319,507
	29	43	$16,786.60	3	$721,824
	Total	**113**	**$16,399.97**	**21**	**$1,853,197**
4	3	47	$11,089.06	9	$521,186
	10	34	$12,388.71	8	$421,216
	15	16	$12,532.56	5	$200,521
	16	32	$6,065.91	4	$194,109
	17	22	$15,739.32	7	$346,265
	19	34	$11,163.38	8	$379,555
	24	35	$10,880.91	5	$380,832
	Not Recorded	1	$15,000.00	0	$15,000
	Total	**221**	**$11,125.27**	**46**	**$2,458,684**
5	20	20	$31,906.55	7	$638,131
	21	12	$18,347.58	2	$220,171
	23	22	$11,600.05	5	$255,201
	25	20	$19,022.25	7	$380,445
	28	19	$21,566.74	6	$409,768
	32	16	$10,553.38	2	$168,854
	Total	**109**	**$19,014.40**	**29**	**$2,072,570**

Observations:

- District 2 had the highest total loss, and the two stations with the most structure fires with loss over $20,000: Station 27 with 20 fires and Station 22 with 10 fires (tied with Station 13 in District 1).
- District 4 had the most structure fires with loss and the most with loss over $20,000.
- Station 2, Station 20, and Station 30 had the highest average losses for structure fires, averaging over $30,000 each.

Fires in the Station 27 service area resulted in the highest total fire loss, more than $1.5 million in 2015. There were eight service areas in which the fire loss exceeded $500,000 in 2015. Also it is important to note that in these eight service areas combined, more than half of the total loss throughout the city occurred. As indicated in our section on fire prevention, these data can provide a good starting point in developing an ***integrated risk management plan***, which CPSM believes can ultimately reduce the numbers of fires and the associated injuries and fire loss associated with these occurrences.

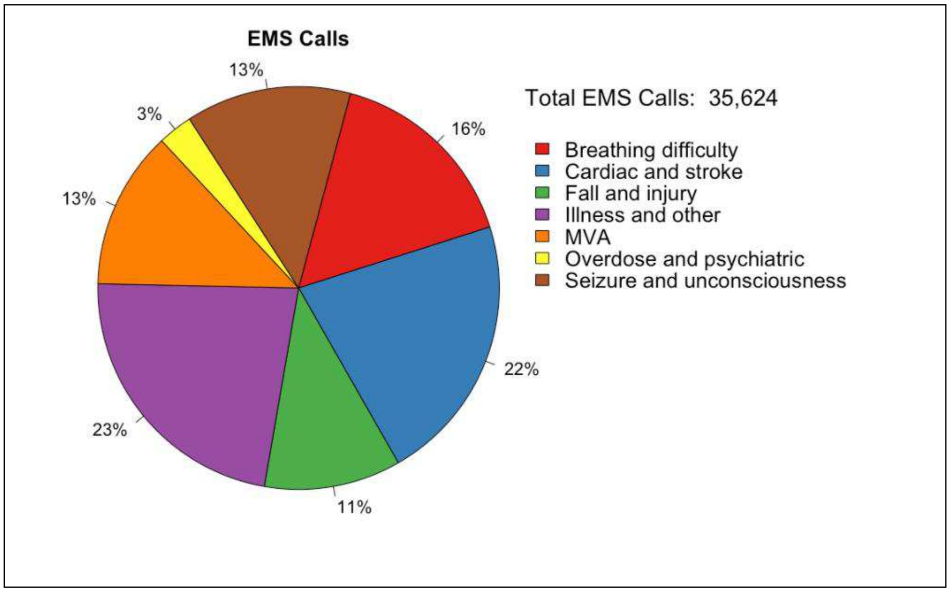
EMS Response

EMS response is the predominant workload in the TFD system. In the 12-month period evaluated, TFD units responded to a total of 35,624 EMS runs. This is approximately 63 percent of the entire call load, and accounted for an average of nearly 98 calls each day. Table 6-15 shows distribution of EMS call types.

TABLE 6-15: EMS Call Types

Call Type	Number of Calls	Calls per Day	Call Percentage
Breathing difficulty	5,676	15.6	10.1
Cardiac and stroke	7,704	21.1	13.6
Fall and injury	3,922	10.7	6.9
Illness and other	8,052	22.1	14.3
MVA	4,530	12.4	8.0
Overdose and psychiatric	993	2.7	1.8
Seizure and unconsciousness	4,747	13.0	8.4
EMS Total	**35,624**	**97.6**	**63.1**

FIGURE 6-9: EMS Calls by Type



The call duration for EMS calls is very consistent across the array of call categories. On average, the deployed time for each EMS call is 20.6 minutes. Again, the total call duration includes turnout, travel, and return to service time, so actual on-scene time is estimated to be in the 10 to 15 minute range. The amount of time spent on EMS calls in Tulsa is very consistent with the average call durations we have observed in other communities that operate in a two-tiered system utilizing both fire as a first response unit and a separate ambulance provider responsible for ALS care and transport. It is also important to note that given the concern that was raised regarding the slower response times of EMSA units on Priority 2 calls, the overall call durations for TFD units do not appear to be extended.

In addition, we received a number of comments from TFD personnel regarding the off-loading time of patients at the emergency departments by EMSA units. Indications are that at some facilities (particularly St. Francis Hospital), patient off-loading times regularly exceed two hours. In these situations, EMSA units are required to wait in queue at the ER facility until space becomes available to receive the patient. This delay increases overall transport times and can reduce the availability of EMSA units. Though off-loading times are extended, EMSA has managed this situation effectively and the extended off-loading times do not appear to be adversely impacting TFD unit call durations. Table 6-16 shows the annual deployed time of TFD units for EMS call types.

TABLE 6-16: Annual Runs and Deployed Time by EMS Call Type

Call Type	Average Deployed Minutes per Run	Annual Hours	Percent of Total Hours	Deployed Hours per Day	Annual Number of Runs	Runs per Day
Breathing difficulty	18.8	1,848.9	7.1	5.1	5,906	16.2
Cardiac and stroke	20.1	3,001.5	11.5	8.2	8,980	24.6
Fall and injury	19.7	1,581.3	6.1	4.3	4,807	13.2
Illness and other	19.7	2,841.3	10.9	7.8	8,637	23.7
MVA	24.8	3,006.1	11.5	8.2	7,287	20.0
Overdose and psychiatric	20.2	370.6	1.4	1.0	1,100	3.0
Seizure and unconsciousness	19.8	1,699.8	6.5	4.7	5,146	14.1
EMS Total	**20.6**	**14,349.6**	**55.0**	**39.3**	**41,863**	**114.7**

TABLE 6-17: EMS Calls by Type and Duration

Call Type	Less than One-half Hour	One-half to One Hour	One to Two Hours	Greater than Two Hours	Total
Breathing difficulty	5,145	457	63	11	5,676
Cardiac and stroke	6,743	768	176	17	7,704
Fall and injury	3,332	530	52	8	3,922
Illness and other	6,980	975	80	17	8,052
MVA	2,780	1,392	332	26	4,530
Overdose and psychiatric	833	145	13	2	993
Seizure and unconsciousness	4,150	519	72	6	4,747
EMS Total	**29,963**	**4,786**	**788**	**87**	**35,624**

Observations:

- A total of 34,749 EMS category calls (98 percent) lasted less than one hour, 788 EMS category calls (2 percent) lasted between one and two hours, and 87 EMS category calls (less than 1 percent) lasted more than two hours. On average, there were 2.4 EMS category calls per day that lasted more than one hour.
- A total of 7,511 cardiac and stroke calls (97 percent) lasted less than one hour, and 193 cardiac and stroke calls (3 percent) lasted more than an hour.
- A total of 4,172 motor vehicle accidents (92 percent) lasted less than one hour, and 358 motor vehicle accidents (8 percent) lasted more than an hour.

It is interesting that, in looking at both fire and EMS calls, the call durations are very similar. On average, fire calls lasted 21.6 minutes and EMS calls lasted 20.6 minutes. Not surprisingly, structure fire calls had the highest call durations and EMS calls involving motor vehicle accidents are among the highest, averaging just under 25 minutes.

When looking at the number of responding units, EMS calls are typically handled by a single unit. In 86 percent of all responses, a single unit is assigned. As noted earlier, on most EMS calls, both a TFD and EMSA unit responds, so there are two assigned units on most calls. Table 6-18 is a summary of the number of TFD units assigned to EMS call types.

TABLE 6-18: Number of Units Dispatched to EMS Calls by Call Type

Call Type	Number of Units						Total
	One	Two	Three	Four	Five	Six or More	
Breathing difficulty	5,467	193	13	1	2	0	5,676
Cardiac and stroke	6,638	881	164	19	1	1	7,704
Fall and injury	3,252	529	109	18	3	11	3,922
Illness and other	7,571	421	43	9	4	4	8,052
MVA	2,415	1,624	404	55	15	17	4,530
Overdose and psychiatric	904	74	13	1	1	0	993
Seizure and unconsciousness	4,393	312	39	3	0	0	4,747
EMS Total	**30,640**	**4,034**	**785**	**106**	**26**	**33**	**35,624**

Emergency/Nonemergency Response

Another interesting trend CPSM continues to evaluate is the frequency of true emergency calls vs. nonemergency or public assist calls. Our findings nationally (from CPSM fire data reports) indicate that in many jurisdictions more than 50 to 60 percent of all responses (fire, EMS, and other) are not true emergencies. This factor is critical when calculating response time data, determining staffing levels, identifying appropriate deployment strategies, and the addition of added resources in areas with excessive call volume.

For EMS responses, TFD units are responding hot on nearly 98 percent of all calls and only running cold for less than 3 percent of all responses. On fire response, units respond hot 78 percent of the time. Table 6-19 is the comparison of hot responses among fire and EMS calls by TFD units.

TABLE 6-19: Number of Hot Response as a Percentage of Total Responses

Type of Call	Number of Hot Responses	Total Response*	Percentage
Fire	11,100	14,611	78.2
EMS	32,047	32,889	97.6
Total	43,147	47,500	90.8

***Note:** Excludes calls without complete time stamps, mutual aid and cancelled calls.

CPSM believes that the mode of response utilized by TFD for EMS calls should be evaluated. EMS calls are categorized at the 911 dispatch center as being Priority 1 or Priority 2 calls. In the timeframe evaluated, ***Priority 1 calls accounted for 55 percent*** of the EMS calls and ***Priority 2 calls accounted for 45-percent*** of EMS calls. EMSA units respond in a nonemergency mode on most Priority 2 calls, yet TFD units respond hot. Medical Control has provided guidance for TFD units to respond cold on those minor EMS call categories. TFD, through an internal policy, has chosen instead to respond on nearly all EMS incidents with lights and sirens.

> ***Recommendation: TFD should utilize Medical Control guidelines and adjust its mode of response to a nonemergency cold response for EMS Priority 2 incidents.***

As mentioned earlier, the potential for accidents involving emergency vehicles responding with lights and sirens is significant. TFD has received directed guidance from Medical Control on the types of calls that merit a cold response and the dispatch center has the capability to distinguish these calls and dispatch them accordingly. CPSM believes that ***upwards of 35 to 40 percent*** of the current EMS responses can be reduced to a nonemergency response.

Many urban fire service agencies are attempting to address the high number of nonemergency EMS service calls by deploying ***alternative response vehicles*** [See; MedStar (Ft. Worth, Texas), CARS Program (Tualatin Valley, Ore.), SPRINT Program (Shreveport, La.), and CARES Program, (Colorado Springs, Col.)]. These alternative response programs are designed to shift or possibly reduce the non-emergent workloads by assisting frequent service utilizers in gaining access to social services and definitive care centers rather than using the 911 system. There has been a recent emphasis in what has been termed ***Community Integrated Health Care or Community Paramedicine***. Similarly, these programs focus on directing patients to the appropriate care options apart from the emergency service network. In fact a number of agencies involved in these innovative approaches have been able to develop a revenue stream in providing these services. This has been achieved through contractual agreements with health care providers who seek to avoid readmissions of nonemergency patients into emergency care facilities.

> ***Recommendation: TFD should work with EMSA in the development of a Community Integrated Health Care program for the Tulsa service area.***

The Tulsa system responds to thousands of nonemergency calls annually and in many cases these calls are generated by individuals who are in need of assistance, and have no other option, so rely on the 911-emergency response network and hospital emergency departments in addressing these needs. It would be of great benefit to the TFD, EMSA, and area hospitals if a support network can be established that proactively provides definitive care referrals to those chronic 911 users and removes this service demand from the emergency response network.

Section 7. Operational Response Time Analysis

The utilization of response times to measure service levels has been a long-held tenet of fire and emergency medical service delivery systems. For decades, the belief that "faster is better" has served as the guiding force behind fire-based system design. However, in the past decade new research and consensus standards have emerged that are beginning to influence fire and EMS system design beyond "faster is better."

Empirical research has found little clinical distinction between response times under eight minutes and those over eight minutes.[58] A study has indicated impacts on patient outcomes when the response times are very rapid, that is, less than four minutes. Similarly, other research has found that there are improved patient survival rates for a response time of less than five minutes, but no statistical distinction in patient survival rates for response times greater than five minutes, and up to 10:59, 90 percent of the time.[59]

Research into the response times for EMS' role in trauma supportive care revealed similar results. In one study, the efficacy of the eight-minute response standard was researched and it was found that exceeding the eight-minute recommendation did not have a statistically significant impact on patient survival after traumatic injury.[60] In other words, whether units responded in less than or greater than eight minutes, patient survivability due to trauma did not change. Similarly, a study examined EMS' role in the "golden hour" for traumatic care; the study looked at 146 EMS agencies transporting to 51 Level 1 and Level 2 trauma centers across North America. Results led to the conclusion that there was no association between EMS intervals and mortality among injured patients with physiologic abnormality in the field.[61]

Currently, there is no empirical evidence that supports an optimal response time for fire suppression efforts. In addition, there is no empirical evidence linking response times to specific outcomes. Scientifically, it is known that fire grows rapidly and thus, designers of fire department systems attempt to maintain a geographic distribution of fire stations that limits the travel distance between stations. This general design is still evaluated by agencies such as the ISO. For example, ISO recommends that there be a fire engine every 1.5 miles and a ladder truck every 2.5 miles.[62]

In general, fire suppression system design strategies have not changed in upwards of 100 years. However, recent research by UL's Fire Research Division has found that today's fires may grow very rapidly and reach untenable levels in as little as four minutes.[63] In home furnishings of the past, this

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[58] P.T. Pons, et. al. (2005). Paramedic response time: does it affect patient survival? *Academic Emergency Medicine,* 12(7), 594-600.
[59] T.H. Blackwell and J.S. Kaufman. (2002). Response time effectiveness: Comparison of response time and survival in an urban emergency medical services system. *Academic Emergency Medicine,* 9(4), 288-295.
[60] P.T. Pons and V. J. Markovchick. (2002). Eight minutes or less: Does the ambulance response time guideline impact trauma patient outcome? *Journal of Emergency Medicine,* 23(1), 43-48.
[61] C.D. Newgard, et. al. (2010). Emergency medical services intervals and survival in trauma: Assessment of the golden hour in a North American prospective cohort. *Annal of Emergency Medicine*, 55(3), 235-246.
[62] Insurance Services Office. (2012). *Fire suppression rating schedule.* Jersey City, NJ: ISO.
[63] S. Kerber. (2010). *Impact of ventilation on fire behavior in legacy and contemporary residential construction* (Chicago, IL: Underwriter's Laboratories).

time is reported to be upwards of twenty minutes. Few municipalities will be in a position to fund labor-intensive deployment models that will meet the demands of the modern fire ground or the recommendations of NFPA 1710. Therefore, CPSM recommends, as discussed herein, a risk-based Integrated Risk Management Plan (IRMP) that utilizes a system of efforts to reduce the community's risk; for example, the impact from fire. An IRMP provides a greater return on investment and improves long-term sustainability.

In summary, setting reasonable standards for ***response times should be a local policy decision*** that incorporates elements of risk, the community's willingness to pay for services, the community's acceptable level of risk it is willing to assume, and the community's expectations for service.

Measuring Response Times

Operational response time contains several elements: dispatch/call processing time, turnout time, and travel time.

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. ***The fire department has the greatest control over turnout time than any other element of the response time measure.***

Travel time is the difference between the times the first responder goes en route until its arrival on-scene. Response time is the total time elapsed between receiving a call to arriving on scene. ***Response time*** (or total response time) is the time interval that begins when the call is received by the primary dispatch center (Tulsa Public Safety Communications Center) and ends when the dispatched unit arrives on the scene to initiate action.

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, 2016 Edition*, where the primary public safety answering point is the communications center, the alarm processing time or dispatch time should be less than or equal to 64 seconds 90 percent of the time and not more than 106 seconds 95 percent of the time.[64] This standard also states that the turnout time should be 60 seconds for emergency medical services and 80 seconds for fire suppression and special operations. The standard further states that the travel time for a fire suppression incident is 240 seconds or less for the first arriving unit, and 480 seconds or less for the deployment of the initial full alarm assignment.[65] Regarding high rise incidents, the standard

[64] NFPA 1710, *Standard for the Organization and Deployment of Fire Suppression Operations, Emergency Medical Operations, and Special Operations to the Public by Career Departments,* 2010 Edition,

[65] This standard is benchmarked against a 2000 square foot, two-story single family dwelling without a basement and exposures. Greater fire load and/or life safety risks where additional response units are

assigns a time of 610 seconds or less travel time for the deployment of the initial full alarm assignment.

NFPA addresses fire service response to EMS incidents as well. The standard assigns a 240-second or less travel time for first responder units carrying an automatic external defibrillator (AED) or higher level of capability at an EMS incident. For advanced life support, the standard assigns a travel time of 480 seconds or less provided a unit arrived in 240 seconds or less with an AED or basic life support in 240 seconds or less travel time.

For all turnout and travel times included in the NFPA 1710 document and discussed herein, the standard assigns a performance objective of 90th percentile achievement.

NFPA 1710 response time criterion is utilized by CPSM as a benchmark for service delivery and in the overall staffing and deployment of a fire department. CPSM does not recommend the 1710 standard as a single criterion.

Lastly, when considering travel time, it is generally assumed that fire department apparatus drivers, in concert with their direct supervisors riding on the apparatus with them, are traveling at the most expeditious speed while maintaining a high degree of safety awareness, obeying state and local laws, and following department policy and standard operating procedure. Additionally, since traffic patterns, available street infrastructure, and fire department fixed facilities remain constant, a consistent travel experience is expected. From this perspective, most agencies have little room for improvement without comprising the safety of the fire department crews and the traveling public.

Tulsa Fire Department Response Times

For the purposes of this analysis, CPSM focused on Priority 1 and Priority 2 calls, which were responded to by TFD units with lights and sirens. CPSM 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. For most types of calls, the main focus is the dispatch and response time of the first arriving, non-administrative unit. For structure fire calls, the analysis included the response time of the second arriving unit.

The response time analysis includes a total of 43,147 calls for service. During the one-year analysis period (January 1, 2015-December 31, 2015), the TFD responded to a total of 56,469 calls for service. To ensure accuracy in the response time analysis, several thousand calls were excluded for the reasons as described below:

- 4,867 nonemergency calls and 27 calls with no priority assigned
- 4,758 mutual aid and cancelled calls.
- 1,900 calls were excluded due to issues with time stamps, including incomplete time stamps; time stamps that were the same for dispatch, en route, and arrival; and time stamps showing negative response times (e.g., arrival before en route).

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dispatched are benchmarked, and should be, by the authority having jurisdiction with respect to response travel times. The TFD has done this as outlined in its 2009 Standard of Cover document.

Table 7-1 shows the average response time of TFD units for the year-long study period. Analysis of the information in the table tells us:

- The overall average dispatch time was 0.6 minutes. This does not include EMSA call processing time and the time it takes for call takers to receive and transfer the call to EMSA dispatchers. The fire average dispatch time was 1.3 minutes. For fire calls, Call Taker processing time is not included and EMSA is not involved in the fire dispatching process.
- The average turnout time was 1.1 minutes.
- The average travel time for the first arriving unit was 3.3 minutes.

Further analysis shows the average total response time for the first arriving unit to EMS calls was 4.8 minutes, and the average total response time for the first arriving unit for fire category calls was 5.8 minutes.

For actual fire calls, the average travel time for the first arriving unit for structure fire calls was 2.6 minutes, and the average travel time for the first arriving unit for outside fire calls was 3.3 minutes. The average total response time for the second arriving unit to a structure fire was 6.2 minutes.

As noted above, the data compiled does *not* include call processing (call taker time) and transfer time from EMSA to the TFD. Without this data the actual call processing time in this report is skewed. While it is possible the call processing and transfer times are within industry standard as benchmarked against NFPA 1710, it is strongly recommended the TFD work with EMSA to receive regular reporting of call processing and transfer times.

> ***Recommendation: TFD should work with the Tulsa 911 Dispatch Center to monitor and report on the full dispatch handling times including call taking, call screening, and dispatch times.***

In CPSM's analysis we were unable to obtain the call taking time, as this is not monitored by the Tulsa 911 Center. We were able to obtain the EMSA call screening time and this was estimated to be 1.6 minutes for Priority 1 Calls and 2.4 minutes for Priority 2 Calls. On average, the call screening times for all calls was approximately 2.0 minutes. Table 7-1 also includes average dispatch, turnout, travel, and total response times of first arriving fire units for fire category calls.

TABLE 7-1: Average Dispatch, Turnout, Travel, and Response Times of First Arriving Unit, by Call Type

Call Type	Dispatch Time*	Turnout Time	Travel Time	Response Time	Sample Size
Breathing difficulty	0.3	1.2	3.4	4.9	5,289
Cardiac and stroke	0.3	1.1	3.3	4.7	7,206
Fall and injury	0.5	1.1	3.3	4.9	3,630
Illness and other	0.4	1.1	3.4	5.0	6,808
MVA	0.6	1.0	3.2	4.8	3,798
Overdose and psychiatric	0.4	1.1	3.3	4.8	915
Seizure and unconsciousness	0.3	1.1	3.2	4.6	4,401
EMS Total	**0.4**	**1.1**	**3.3**	**4.8**	**32,047**
False alarm	1.4	1.1	3.2	5.8	2,725
Good intent	1.1	1.1	3.5	5.8	2,389
Hazard	1.4	1.1	3.5	6.0	2,115
Outside fire	1.5	1.1	3.3	5.8	1,038
Public service	1.2	1.1	3.8	6.2	2,168
Structure fire	1.2	1.1	2.6	4.9	665
Fire Total	**1.3**	**1.1**	**3.4**	**5.8**	**11,100**
Total	**0.6**	**1.1**	**3.3**	**5.1**	**43,147**

*__Note:__ Dispatching time does not include call-taker processing time and for EMS calls does not include EMSA screening time.

A more conservative and descriptive measure of total response time is the 90th percentile measurement. Simply explained, for 90 percent of calls, the first unit arrived within a specified time, and if measured, the second and third unit. Also by utilizing a 90th percentile measurement, one has a more realistic evaluation of response time performance. Not every call will be within the prescribed guidelines; however, at the 90th percent level only a limited number of calls (10 percent) will fall outside this measure. Table 7-2 details the 90th percentile response time.

TABLE 7-2: 90th Percentile Dispatch, Turnout, Travel, and Response Times of First Arriving Unit, by Call Type

Call Type	Dispatch Time	Turnout Time	Travel Time	Response Time	Sample Size
Breathing difficulty	0.6	1.7	5.1	6.7	5,289
Cardiac and stroke	0.6	1.6	5.0	6.6	7,206
Fall and injury	1.0	1.7	5.1	7.0	3,630
Illness and other	0.9	1.7	5.4	7.1	6,808
MVA	1.4	1.5	5.3	7.3	3,798
Overdose and psychiatric	0.8	1.6	5.1	6.8	915
Seizure and unconsciousness	0.6	1.6	4.9	6.6	4,401
EMS Total	**0.8**	**1.6**	**5.1**	**6.9**	**32,047**
False alarm	2.3	1.7	5.3	8.3	2,725
Good intent	2.5	1.7	5.6	8.5	2,389
Hazard	2.6	1.6	5.6	8.7	2,115
Outside fire	2.4	1.6	5.4	8.5	1,038
Public service	2.7	1.7	6.0	9.3	2,168
Structure fire	2.0	1.6	4.1	6.9	665
Fire Total	**2.5**	**1.7**	**5.5**	**8.6**	**11,100**
Total	**1.5**	**1.7**	**5.3**	**7.4**	**43,147**

Note: Dispatch Time includes on TFD processing Time. EMSA call screening times are not included.

Observations taken from the table are:

- The overall 90th percentile dispatch time was 1.5 minutes. Again, this does not include the call taker processing time and EMSA screening time. Fire dispatch time is 2.5 minutes and is well above the NFPA benchmark for this category and again does not include call taker processing time.
- The 90th percentile turnout time was 1.7 minutes. Separately, fire turnout is above the NFPA benchmark at 102 seconds and EMS turnout is well above the NFPA benchmark at 96 seconds.
- The aggregate fire and EMS 90th percentile travel time was 5.3 minutes. Fire alone, at 5.5 minutes, is above the NFPA benchmark. EMS alone is 5.1 minutes and above the NFPA benchmark of a first arriving unit delivering basic life support, and below the NFPA benchmark for a first arriving unit delivering advanced life support capabilities.
- The 90th percentile total response time for the second arriving unit to a structure fire was 8.3 minutes.
- The 90th percentile total response time for EMS calls was 6.9 minutes, and the 90th percentile total response time for fire category calls was 8.6 minutes.

- The 90th percentile total response time for structure fire calls was 6.9 minutes.
- The 90th percentile total response time for outside fire calls was 8.5 minutes.

Regarding EMS response, EMSA utilizes a medical priority dispatch system. This system assists the EMS dispatcher to determine the type of call and then assigns the appropriate response units to the incident based on local protocol.[66] EMSA has 1,207 call determinants, which are further broken down into life threatening or Priority 1(hot or lights and siren) and non-life threatening Priority 2 (cold or no lights and siren).

As spelled out in the current ambulance provider contract, EMSA specifies up to a 25-minute response time to Priority 2, non-life threatening calls. This point was raised by a number of TFD officials as a problem that frequently resulted in extended on-scene time by TFD units. While the intent of cold responses is not to delay patient care or service delivery, it is designed to reduce response liability, and increase safety for first responders and civilian motorists. Our analysis has shown, however, that at the 90th percentile, TFD units arrive first on-scene on Priority 2 calls 85 percent of the time. On these incidents EMSA units arrive approximately 14.6 minutes after the TFD unit arrival. Based on evaluation of on-scene time and the overall call duration, the perceived problem of the 25-minute Priority 2 response of EMSA units is not significant in our estimation.

[66] https://www.emergencydispatch.org/articles/whatis.html

Section 8. Performance Measurement

Fire suppression, prevention programs, and EMS service delivery need to be planned and managed to 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. It 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 done.

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?[67]

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

[67] Starling, *Managing the Public Sector*, 396.

information on how these measures should be interpreted. An explanation of these types of performance measures are shown in Table 8-1.

TABLE 8-1: The Five GASB Performance Indicators[68]

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.*[69]

The TFD has established a list of eleven ***Key Performance Indicators*** that it is utilizing to measure system performance. In FY 15-16, nine of these measure were new measures for which previous outcomes were not available. Only two of the measures were in place for the previous year and measurements were available. Table 8-2 is a listing of the Key Performance Indications currently in use in the Tulsa Fire Department.

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

TABLE 8-2: FY 15-16 TFD Key Performance Indicators

Key Performance Indicators	FY 13-14 Actual	FY 14-15 Target	FY 14-15 Estimate	FY 15-16 Target
% of arrival on scene within 6 minutes from receipt of call	86.5%	90%	90%	90%
Total incidents responded to	New Measure	New Measure	New Measure	New Measure
# of fire fatalities/accidental	New Measure	New Measure	New Measure	New Measure
% of property value saved	New Measure	New Measure	New Measure	90%
% of reduction FF Injuries	32%	5%	5%	5%
# of building inspections completed	New Measure	New Measure	New Measure	New Measure
% of fire protection system plans review completed within 10 days of receipt	New Measure	New Measure	New Measure	90%
# public education events	New Measure	New Measure	New Measure	New Measure
# public safety education participants served	New Measure	New Measure	New Measure	New Measure
# of smoke alarms installed	New Measure	New Measure	New Measure	New Measure
% of arson cases cleared by arrest	New Measure	New Measure	New Measure	10%

Though TFD has formally established a series of measures, its efforts to build a process that is utilized and beneficial to the organization is untested. It will be critical that TFD develop a series of internal reporting processes that provides a direct link to department goals or specific target measures. Ongoing analysis and the monitoring of trends are most useful to justify program budgets and to measure service delivery levels.

None of the measures currently in place provide service-quality and customer-satisfaction measures. TFD should look at additional measures that provide this type of feedback. In developing any measure, staff throughout the organization should participate in their development. In addition to helping facilitate department wide buy-in, this could provide an opportunity for upper management to better understand what the line staff believes to be critical goals — and vice versa. For the same reason, the process of developing performance measures should include citizen input, specifically with regard to service level preferences. Translating this advice from the citizens into performance measures will link the citizens and business community to the department, and will articulate clearly if the public's expectations are being met.

> ***Recommendation: TFD should consider an expansion of its key performance indicators and institute monitoring systems for the periodic review of these outcomes. The process of developing these measures should involve input from TFD members, the community, the mayor and city council, and city administration.***

The following are a number of performance measures that may be considered:

Operations:

- Response times (fire and fractile/average/frequency of excessive times)
  - Alarm handling times.
  - Turnout times.
  - Travel times.
  - On-scene time.
  - Call duration.
  - Cancelled en route.
- Workload measures
  - Emergency vs. nonemergency responses.
  - EMS transports and accompaniments.
  - Response to automatic fire alarms/frequency and outcomes.
  - Company inspections/area occupancy familiarization.
  - Fire preplanning.
  - Public education: contact hours/numbers by age group.
- Outcome Measures
  - EMS/save rates/action taken.
  - Fire loss/limit of fire spread-point of origin, room of origin, etc.
  - On-duty injuries/workers' comp claims.
  - Lost time-sick/injury.
  - Vehicle accidents.
  - Equipment lost or broken.

Training:

- Fire and EMS hours.
- Officer development.
- Specialty training.
- Professional development/formal education/certifications.
- Fitness performance.

Prevention:

- Plans review (numbers/valuation amount/completion time).

- Inspections (new and existing).
    - Numbers.
    - Completion time.
    - Violations (found/corrected).
    - Quantification by type of violation and occupancy type.
- Fire investigations
    - Numbers and determinations.
    - Fire loss/structure and contents.
    - Arson arrests/convictions.
    - Fire deaths (demographics/occupancy type/cause and origin).

Miscellaneous:

- Customer service surveys (by engine/by shift).
    - Following emergency response.
    - Public assist.
    - Inspections (prevention and company).
    - Public education.
    - In-service training (employee assessments).
- Financial/Budgetary
    - Overtime expenditures and cause.
    - Apparatus repair costs and out-of-service time.

Section 9. Essential Resources

Fire Prevention, Fire Investigations, and Public Fire Safety Education

Although fire and EMS response are the more prominent activities in fire service delivery systems, these strategies have little impact on preventing deaths or injuries. Public fire education, built-in fire protection systems, and other fire and injury prevention programs have been proven to be far more effective strategies for protecting citizens.

Fire prevention activities also impact a city's ISO Public Protection Classification. The new 2012 edition of the ISO evaluation (released in July 2013) gives a potential 5.5 points additional credit for a department's fire prevention, public fire and life safety education, and code enforcement activities.

The Tulsa Fire Department Safety Services section has the responsibility for fire inspections, public fire and life safety education, and fire investigations for the city. The section is part of a "one-stop shop" where Tulsa citizens can apply, pay for, and receive required city building and fire permits. The section has a performance standard dictating a seven-day turnaround on permit issuance. This is an excellent practice that CPSM considers a ***Best Practice***. Safety Services inspection responsibilities include the following:

- Reviewing for fire code compliance.
- Inspecting buildings.
- Issuing special event licenses.
- Inspecting certificates of occupancy.
- Issuing permits for fire protection systems.
- Issuing violation notices and follow-up.
- Inspecting bars, night clubs, and other similar establishments.
- Conducting plan reviews for new construction and building renovations.
- Conducting license renewal inspections.
- Inspections for fire work displays.

The city currently uses the 2009 editions of both the International Fire Code (IFC) and the International Building Code (IBC). The state of Oklahoma has adopted 2015 editions of both these codes, and the Tulsa City Council is expected to adopt these new 2015 editions (with amendments Title 14 and 51) in 2016.

The TFD Safety Services section is managed by a captain who currently serves as the section's Chief Code Enforcement Officer and Plans Reviewer, as well as the Acting Fire Marshal. In 2009, the Safety Services section staffing was reduced by six staff members. This staff reduction included three Assistant Fire Chiefs who oversaw code enforcement, fire investigations, and public education, respectively. The section's 2015 organizational chart (Figure 9-1) includes these unassigned Assistant Fire Chief positions, but their duties are currently performed by the section's Captains. The Acting Fire Marshal currently manages 20 full-time personnel, including ten code enforcement officers (which includes the Acting Fire Marshal/Plan Reviewer), eight investigators, and two clerical staff. Recently, the public education section was reassigned to the Deputy Chief of Field Operations in an effort to reduce the supervisory duties of the Acting Fire Marshal.

As mentioned above, the TFD Safety Services section plays a critical role in managing the all-encompassing aspects of public protection and life safety for the city of Tulsa. CPSM believes that the extended period during which the Safety Services section has been staffed with an Interim Fire Marshal has been counterproductive, resulting in a disconnect in the overall section leadership and ineffective program coordination. Though the Acting Fire Marshal has done an admiral job in attempting to shore up the day-to-day duties of this section, the overall direction, planning, and managerial oversight in these areas have suffered.

> ***Recommendation: The city should expedite the process of reinstating the Fire Marshal position within the Tulsa Fire Department.***

The Fire Marshal is a uniformed position within the Tulsa Fire Department and is covered under the Firefighter's Collective Bargaining Agreement. The Fire Marshal holds a comparable rank to that of a Deputy Fire Chief and as such, any new appointment to this position must come from within the ranks of existing fire department employees who hold the rank of Assistant Fire Chief. This limitation is not conducive to the selection of an individual with the type of experience, education, and professional credentials that are required of this key position in the organization. Under existing guidelines, the Captain who has been acting Fire Marshal is ineligible. This is a very unfortunate situation and is extremely restrictive when considering qualified outside applicants to fill this position.

> ***Recommendation: TFD should consider the reclassification of the Fire Marshal position to civilian managerial employee who is appointed by the Fire Chief.***

The Fire Marshal is a critical position in the fire department organization, perhaps second in importance to only the Fire Chief. This position requires a unique set of professional skills, including formal education, technical skills, and the managerial experience in running a large metropolitan fire prevention and code enforcement operation. The successful candidate for this position must have a close affiliation with the building community including the city's Chief Building Official. The person must be well versed in code enforcement practices, fire plans review, the field inspection process, and building construction practices. Many larger metropolitan fire departments have recruited fire protection engineers into their Fire Marshal positions. The skills of a fire protection engineer are not often obtained from emergency response positions. The ability to open this position to outside employees improves the opportunity for a new and progressive approach to fire prevention and public education efforts and increases the opportunities for expanded diversity in a very key and visible public official.

In 2015 the Safety Services section conducted more than 9,000 inspections in the city of Tulsa. This was carried out by nine fire inspectors. Seven of these inspectors are assigned to the five fire districts. One inspector is designated as a floater, and is assigned to any of the districts, depending on workload or to cover for vacancies. One inspector is assigned exclusively to inspections at schools and hospitals. A District 3 fire inspector manages the city's juvenile fire-setter program. CPSM believes the current inspection workload carried out by the Safety Services section is considerable. Though there are no definitive standards regarding the number of inspectors, plans reviewers, or fire investigators for a given community, the size of this workforce is often a product of the workload. This is driven by the number of annual inspections required under the code and the volume of permit activity associated with new construction and renovations. According to the Texas Department of Insurance, a city with the population the size of Tulsa should have twice as many fire inspectors than are currently employed by the TFD.[70] In a 2012 ICMA publication, "Comparative Performance Management Report," it was reported that municipal agencies with service populations in excess of 100,000 (average 435,000) had a mean of 18 employees assigned to fire prevention activities.[71]

TFD utilizes only uniformed fire inspectors who are certified as firefighters to fill the assigned roles in the Safety Services section. Many jurisdictions have recognized the limitations in using only certified firefighters in fire prevention positions and have transitioned to the use of civilian employees to fill fire inspector, fire plans reviewer, and fire safety specialist roles. Though there have been very few studies that look at the benefits of civilian fire inspectors vs. fire inspectors who are certified firefighters, CPSM believes that the expertise needed in the code review process and enforcement activities, do not require firefighter skills, experience, and certification.

> ***Recommendation: TFD should consider the use of civilian fire inspectors to fill the various roles in the Safety Services section.***

The state of Oklahoma does not require that a firefighter certification for employees who function as fire inspectors. This is a decision that is delegated to the local jurisdiction, and TFD has chosen to use only certified firefighters to fill this role. In addition, TFD requires its inspectors to also hold certifications as EMTs and hazardous material first responders, along with specialized training in code enforcement and plans review. CPSM believes that TFD should reconsider these multiple certification requirements for its fire inspectors. The ability to use both certified firefighters and civilian fire inspectors broadens the applicant pool, provides for specialized training and expertise, and enhances the opportunity to expand diversity among the applicants.

The TFD does not use fire companies to assist with fire inspections. Many agencies utilize a practice known as a ***fire company inspection process*** in which in-service fire companies (engines and ladders) are utilized to do fire inspections in certain lower-risk occupancies (retail establishments) to relieve the inspection workload and to provide area familiarization for the fire companies within their fire station service areas. These inspections typically review such things as changes in occupancy usage, storage areas, egress, exit signage, and the availability of fully charged fire

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[70] Texas Addendum to the Fire Suppression Rating Schedule. Texas Department of Insurance (January 2004), 5–8.

[71] ICMA Center for Performance Measurement, *FY-2011 Data Report*, August 2012, p.150.

extinguishers. In restaurant establishments, fire company inspections will also review the service maintenance record of cooking hood systems. CPSM believes that this option is beneficial for both a distribution of workload and in providing direct interaction between the responding fire companies and occupants for the purpose of fire prevention and providing guidance in fire safety practices.

> ***Recommendation: TFD should consider the implementation of an in-service fire company inspection program for those applicable properties that require periodic fire inspections.***

An effective in-service company inspection process is one in which fire companies and fire inspectors work jointly in managing fire safety in their community. The city of Portland, Oregon, has developed an extensive model that should be looked at when this effort is considered in Tulsa.[72]

[72] See; City of Portland OR, FIR-1.07 - Company Fire Inspection Program-2007 http://www.portlandoregon.gov/citycode/article/160557?

FIGURE 9-1: TFD Safety Services Organizational Chart (2015)

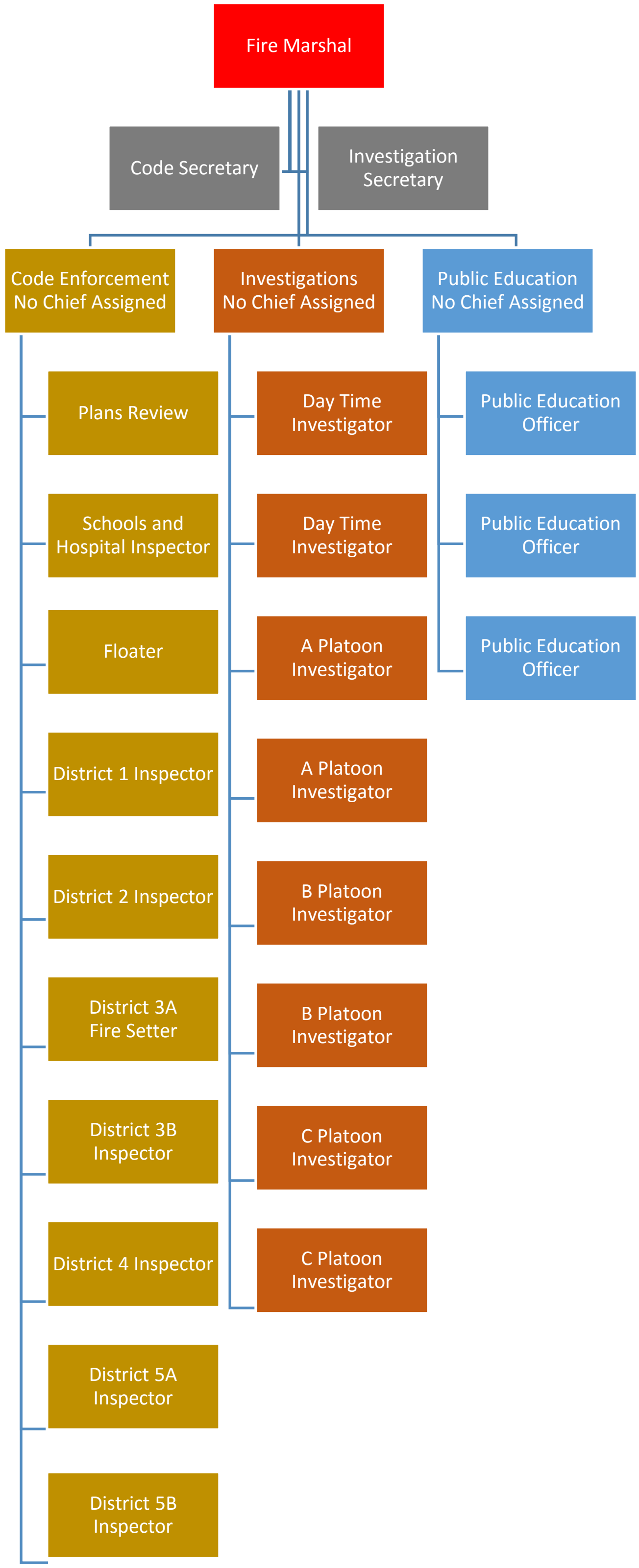
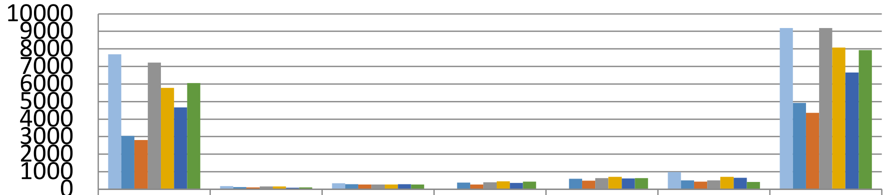


FIGURE 9-2: TFD Inspections 2009-2015

2009-2015 TFD Inspections



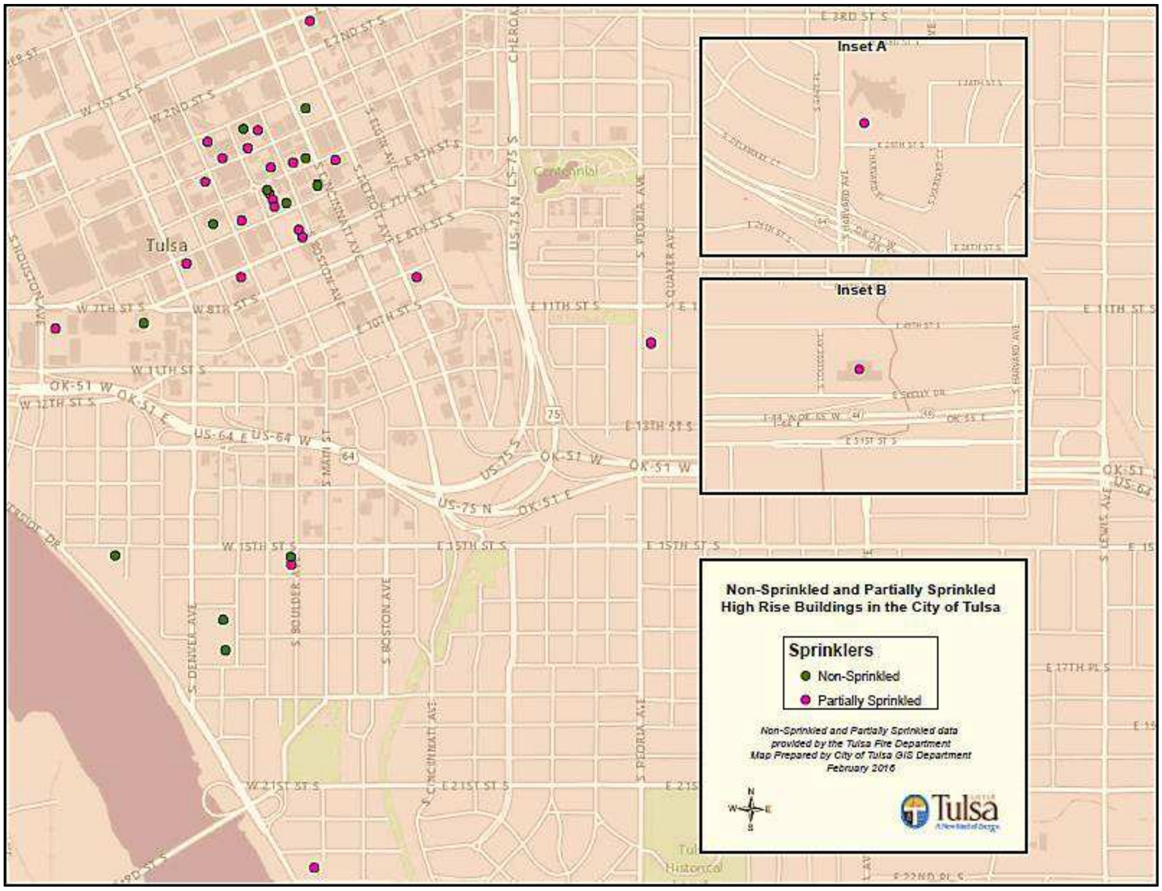
	Building Inspections	TFD Permitted	License	Fire Alarm	Fire Suppression	Cert. of Occ.	Total Inspections
2009	7703	171	336	0	0	975	9185
2010	3047	118	284	370	602	506	4927
2011	2813	107	264	266	480	433	4363
2012	7216	158	261	405	641	512	9193
2013	5779	160	268	453	708	714	8082
2014	4665	80	289	361	613	652	6660
2015	6056	110	277	439	629	419	7930

Residential sprinklers play an increasingly important role today in saving lives and limiting fire loss to the room of origin. Their importance is especially critical in residential high-rise buildings, where there is an increased risk for life loss and the extinguishment process is more difficult. Figure 9-3 details the high-rise buildings in Tulsa that are nonsprinklered or only partially sprinklered. Ninety percent of these buildings are residential. TFD Safety Services, under the current fire code, requires that all high-rise building owners whose buildings are undergoing renovation must sign a contract to retrofit their high rises with sprinklers.

The number of high-rise residential structures in the Tulsa area that are either partially sprinklered or nonsprinklered is fewer than 35 buildings. These occupancies are clearly some of the more significant life safety risks in the city. The cost to retrofit these buildings with automatic fire sprinklers is high. Though the city can adopt ordinances that require the modification of these building to install fire sprinklers, the cost may be prohibitive and can cause financial hardship on those affected. Many agencies with significant fire problems in their communities have utilized outside funding sources in developing *cost-share programs* that promote mitigation efforts by offsetting a portion of the cost required to improve or eliminate fire hazards. CPSM believes that TFD should evaluate options for instituting a cost-share program for the installation of fire sprinklers in the city's existing residential high rise buildings that are not sprinklered.

> ***Recommendation: TFD should pursue funding options for a cost-share program for installing automatic fire sprinklers in those remaining residential high-rise structures that are nonsprinklered.***

FIGURE 9-3: Nonsprinklered and Partially Sprinklered High-Rise Buildings in Tulsa



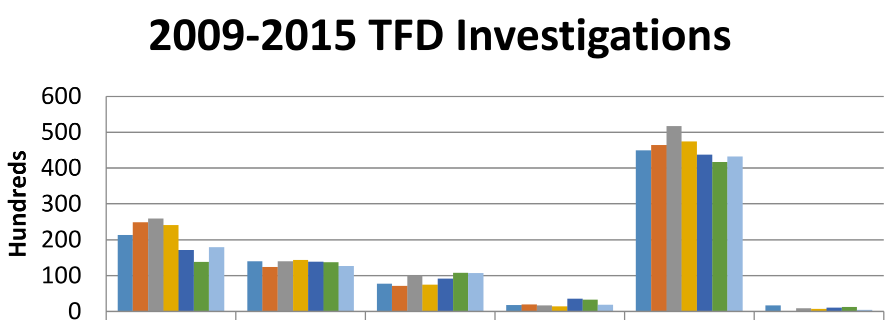
A cost-share program of this magnitude would require significant funding and would require an extended timeframe to carry out. This is not a project that can be orchestrated in a short timeframe. This would be a multiyear commitment that realistically should be looked at in a 5 to 10 year timeframe.

TFD Fire Investigations

TFD has eight fire investigators, all of whom serve as "peace officers" and who are certified to examine fire sites, collect and analyze evidence, determine probable cause, subpoena and interview witnesses, swear out warrants, arrest and process suspected arsonists, prepare case information, and provide expert court testimony. TFD fire investigators are highly trained and qualified. They must maintain state law enforcement certification (including annual firearms qualifications), maintain EMT certification, and comply with NFPA 1033, *Standard for Professional Qualifications for Fire Investigators*. Each fire investigator must also acquire and maintain the International Association of Arson Investigators-Certified Fire Investigator certification.

TFD fire investigators examine all fires except for small, inconsequential fires, such as grass or trash fires. TFD fire investigators conducted 432 fire investigations in 2015. Of these, 179 were determined to be incendiary.

FIGURE 9-4: TFD Fire Investigations 2009-2015



	Incendiary	Accidental	Undetermined	Other/Natural	Total Investigations	Fatalities
2009	213	140	78	18	449	17
2010	249	124	71	20	464	
2011	259	140	101	17	517	9
2012	241	144	75	14	474	7
2013	171	139	92	36	438	11
2014	138	137	108	33	416	13
2015	179	127	107	19	432	5

The investigation process carried out by TFD personnel is a major undertaking that appears to be carried out with professionalism and a high level of expertise. The financial commitment required to maintain the needed personnel and the associated logistical support (workspace, computers, telephones, vehicles, etc.) is significant. The volume of incendiary fires recorded in 2015 (179) appears very high when considering that there were a total of 162 structure fires in 2015 that had fire losses in excess of $20,000. Though TFD responded to more than 162 structure fires, one can question whether the level of effort required to maintain the investigative unit is providing a true cost-effective benefit to the community. One might also ask if a more selective investigative process would more cost-effective and have similar outcomes. It goes without saying that arson fires are criminal acts that require investigation and prosecution when warranted. However, we believe that a large percentage of those fires classified as incendiary in 2015 (179) were minor in nature and did not necessarily require a full-scale investigation.

Traditionally, larger fire departments maintain a fire investigations unit, but we frequently observe little effort in analyzing these investigative findings beyond the effort to build a case against arsonists. CPSM believes that the true benefit in ***the fire investigations process should focus on reducing the numbers of fires rather than making arrests***. The investigative unit in TFD does not produce an annual report regarding fires in Tulsa, there is no reporting regarding the types of structures in which fires are occurring, their cause, and the overall fire loss. These are fundamental reporting practices that are currently not being published by TFD.

> ***Recommendation: The TFD fire investigations unit should publish an annual fire report that details the fire occurrences in Tulsa, where they are occurring, the distribution on how these fires are caused, and the fire loss associated with these events.***

TFD has recently established as a new key performance indicator, for FY 2015-16, the percentage of arson cases that go to trial. In this indicator TFD has established that 10 percent of its arson cases should result in arrests. At this level an estimated 18 arrests should occur in a year. CPSM believes that successfully reaching this goal will have a negligible impact in reducing the overall fire problem in Tulsa.

> ***Recommendation: TFD should reevaluate the level of effort devoted toward making arrests by its fire investigation unit and instead shift this emphasis to reducing the number of fires.***

The investigation process is designed to determine the cause and origin of fires. Once this information is obtained the next logical step is to identify any patterns that are observed regarding how and where fires are occurring. Are they occurring in certain neighborhoods, or among certain segments of the population, or within a certain demographic? What are the patterns that are observed regarding the cause of these fires: faulty electrical systems, improper heating, or improper use of smoking materials? Through this type of analysis is there a strategy that can be developed that identifies methods to reduce the number of fire starts or reduce their impacts? This is the objective of an ***integrated risk management plan*** and this is an initiative the CPSM believes is greatly needed in the city of Tulsa.

> ***Recommendation: TFD should adopt an integrated risk management plan aimed at reducing the number of fires by using analysis from fire investigations regarding fire patterns, backed by a corresponding mitigation strategy.***

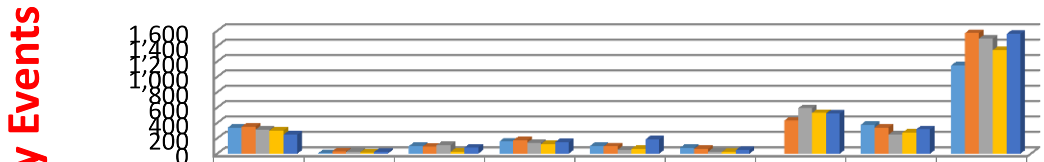
By understanding where and how fires are occurring agencies can structure a mitigation plan that utilizes code enforcement, public assistance, and life safety education that reduces the actual numbers of fires. A number of communities have been extremely successful in reducing fire starts through these efforts (See: Merseyside Fire & Rescue and Nanaimo Fire Rescue).

Public Fire and Life Safety Education

Asphyxiation is the leading cause of fire deaths. However, the widespread adoption of residential smoke alarms over the past four decades has been successful in saving countless lives by providing early warning of potentially life-threatening fires. Without properly installed and working smoke alarms, fire victims usually die of smoke inhalation before structural fires are reported to fire departments and first responders can arrive on the scene. As part of the TFD public fire and life safety program more than 500 smoke detectors are being installed annually in area residences. This is a commendable effort that CPSM recognizes as a ***Best Practice***.

FIGURE 9-5: TFD Public Education Events Held 2010-2014

2010-2014 Public Education Events



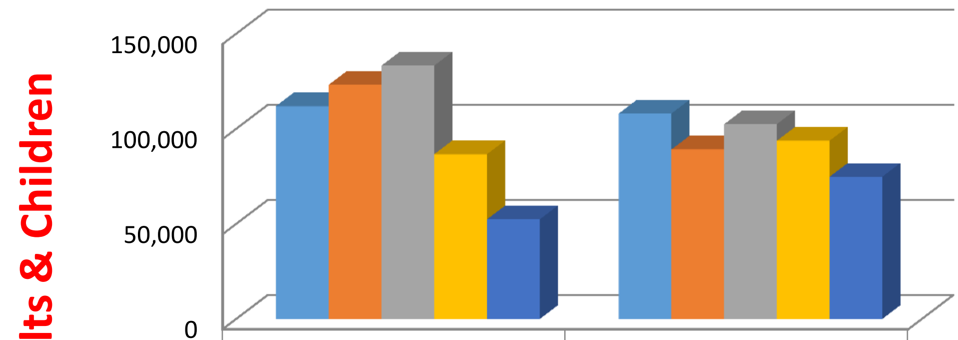
	Fire Truck Show & Tells	Pink Fire Truck Show & Tells	Station Tours	Presen tations	Special Duty	Meetin gs	Smoke Alarms Installe d	Car Seat Checks	Total
2010	338	6	97	156	98	77		375	1,147
2011	352	29	91	173	93	61	430	339	1,568
2012	313	21	109	140	50	23	592	247	1,495
2013	301	15	22	123	61	20	530	273	1,345
2014	246	20	79	147	184	45	520	317	1,558

Smoke detectors also reduce the number of fire suppression responses because occupants discover fires more quickly and are more often able to extinguish the fire on their own. Nevertheless, fire risks remain, and some new risks are increasing. For example, residents are outfitting their homes and apartments with modern furnishings that often are manufactured from petroleum-based synthetics, which burn hotter, more toxic and up to 800 percent faster than traditional materials, according to UL.[73] This makes properly working smoke detectors all the more essential in saving lives.

Children and the elderly are most prone to fire-related deaths. Senior citizens are most likely to forget to replace the batteries in their smoke detectors. Children who are at home alone after school are also vulnerable. Risks include young children playing with matches, clothes catching on fire as children use a gas range, and troubled juveniles who set fires for the thrill of it.

[73] "Comparison of Modern and Legacy Home Furnishings," UL Experiment, Nov. 2009. Web: 12 Oct. 2012. https://www.ul.com/room_fire/room_fire.html

FIGURE 9-6: Public Education of Adults and Children 2010–2014



	Number Adults	Number Children
2010	111,886	108,105
2011	123,109	89,192
2012	133,202	102,471
2013	86,637	93,744
2014	52,374	74,788

Public education is one of the most effective ways a fire department can reduce civilian injuries and death from fire and carbon monoxide. This effort is closely aligned with and a key component of an integrated risk management plan. Unfortunately, the number of public education and outreach programs for both adults and children have declined significantly in the past five years. As can be seen in Figure 9-6, TFD public education programs made over 111,000 contacts with adults and over 108,000 contacts with children in 2010. By 2014, this level of outreach was reduced by half for adults and by 25 percent to school-aged children. Budget cuts reduced the number of TFD public education staff from seven full-time personnel in 2009 to today's level of three in the current budget cycle.

Several important public education programs have been put on hold because of these staff reductions. These include the use of the Fire Safety Trailer, which was purchased with donated funds from the SAFE KIDS Coalition. The trailer had been used to teach second graders about fire safety, but it now sits in storage and needs to be refurbished. Another public education program that is on hold is Project Life. This smoke alarm installation program accessed historical statistics to identify target areas that had experienced high number of residential fires and fatalities. The program coordinated by Tulsa Volunteer organizations to work with firefighters to canvas these high-risk-prone areas and install smoke detectors in buildings where they were absent. Also on hold is the NFPA Risk Watch program, which teaches students in Grades K about preventable accidents using props donated by SAFE KIDS. Each of these programs are on hold and their re-instatement should be considered.

Recommendation: TFD should consider increased funding for its public education staffing and reinstitute those critical life-safety education programs.

Education and Training Programs

Education and training programs 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. The prioritization of training also fosters professionalism and teamwork and instills pride in the organization. TFD places a significant emphasis on the training of its personnel. There are 11 personnel permanently assigned in the Training Division. In addition, there are three personnel assigned in the EMS division who coordinate EMS training and continuing education recordkeeping. TFD also maintains a training officer dedicated to ARFF training and FAA certification. The efforts of the Training Chief and the cadre of training instructors are truly commendable in terms of the enthusiasm we observed and the degree of commitment that is devoted to maintaining the critical skill levels within the organization.

TFD is responsible for administering the training program for its members and maintaining and generally following the guidelines for fire training as prescribed by ISO guidelines. EMS training is specified by EMSA Medical Control and this coordination is done by the EMS Chief and the EMS personnel. ARFF training (Aircraft Rescue Fire Fighting) is coordinated separately by the ARFF training officer at the airport.

All fire personnel at TFD receive a minimum of 192 hours of fire training annually. Training is conducted primarily while personnel are on duty, with topics identified in a monthly training calendar that is published by the Training Division. At any given time, upwards of 10 units (2 per district) may be removed from service and assigned to a training activity. The training staff is responsible for developing the various training regimens that meet the categorical and hourly requirements specified by ISO guidelines as well as in response to any safety needs or new objectives developed by the department. The state of Oklahoma does not have any regulatory oversight of existing firefighter training for TFD.

Training records for the TFD are meticulous, kept by the training staff on the TargetSolution training reporting system. All training hours and the topics involved are logged for each employee. Training records are critical in documenting the required certifications for EMT and paramedics, ARFF, and firefighting requirements as specified by ISO. These records are input into the system by the company officers and reviewed by the training staff.

In 2012, TFD was reviewed by ISO as part of its Public Protection Class Rating. In the ISO Fire Suppression Rating Schedule, fire training is included as part of the overall fire department rating. Approximately eighteen percent (18%) of the fire department rating is attributable to its training activities. TFD received approximately 76% of the possible training points in this most recent review. Overall, the training activities of TFD were exceptional. However, TFD had points deducted for its inability to conduct ***Prefire Planning Inspections*** and the required annual ***Night Fire Drills***. CPSM officials were advised during our site visit that these issues have been corrected and TFD is now conducting the required night fire drills and has assigned prefire planning inspections to all its companies.

Fire training simulators are assuming larger roles in command and tactical training scenarios for police, fire, EMS, and emergency management disciplines. Training simulators have been utilized in military and aviation industries and this technology has been applied in recent years for local public safety officials. These applications provide true-to-life, high fidelity graphics and virtual environments that fully immerse the trainee in unscripted and open-ended scenarios that elicit real-life emotion and field-like responses. Display solutions are presented in 3D-LED panoramic theater settings and are well suited for in-service training and promotional testing.

Fire training simulators range in price from $10,000 to upwards of $75,000 to $80,000 for the top-of-the-line systems. These training tools are viable in all climatic conditions and provide a reliable scheduling option for training and promotional exercises. TFD does not have access to fire training simulators; however, with recent advances in this technology, cost options are now within reach of most local agencies.

> ***Recommendation: TFD should evaluate the purchase of a suitable fire training simulator for command, tactical, vehicle operator, and promotional applications.***

The training facilities maintained by TFD are modern, include a number of safety features, and are state-of-the-art in terms of their design and practical application. TFD's facility is available for mutual aid partners and other law enforcement and public safety professionals in the area. The location of the facility is ideal and a very solid example of good planning and a sound commitment to emergency services training that will benefit the personnel of the Tulsa Fire department and the community for many years to come.

Employee Health and Safety

Closely aligned with the TFD Education and Training program is the department's Health and Safety program. TFD has a District Chief position in charge of employee health and safety and who works closely with the city's risk management office in an effort to reduce the number of injuries sustained by fire personnel. Typically, injuries within the fire department are among the highest of any department in a city. The cost associated with OSHA-recordable injuries in terms of medical costs, lost time, and workers' compensation insurance costs are very significant. In 2015 it was estimated that the workers' compensation payout for fire department injuries was $3.9 million. There were a total of 425 injuries reported, of which 53 percent (226) resulted in some amount of lost time. The effort displayed by TFD in developing its Health and Safety program is commendable and considered by CPSM to be a ***Best Practice***. Since 2012 alone, the number of reported injuries has been reduced by more than 42 percent (from 737 to 425). TFD and the city's risk management office has done excellent work in documenting the numbers of injuries and the mechanism of injury. The overall intent of this process is to use statistical analysis to isolate the highest frequencies of injuries and build into the training regimens and the equipment utilized, those methodologies to reduce injuries.

Though the Health and Safety program has demonstrated considerable success in the past few years, there are still significant additional benefits that can be obtained through this process. One area for obtaining improved results is in the establishment of professional qualifications and relative experience for the individual chosen to lead this effort. As mentioned above, Health and

Safety is led by an assigned District Chief. In most instances this position is filled by a newly promoted District Chief who has little or no formal training in occupational safety or program management. The current appointee at the time of our interviews had held the position for approximately eight months and was leaving in order to take a field assignment. Prior to that the previous District Chief held the position for only fourteen months before an opening in operations occurred and the incumbent requested to be transferred. The Health and Safety position is not a preferred assignment among field personnel. In most cases individuals accept this promotion to District Chief (from Captain) and only hold the Health and Safety role until a field District Chief position opens. There are not any special requirements for this assignment and the individual selected does not have any formal training in occupational safety, risk management, or a related field. This assignment appears to be caught in a revolving-door process which is not conducive to program continuity, long-range planning, or program follow-through.

Recommendation: TFD should consider the reclassification of the District Chief of Health and Safety to an occupational health and safety professional.

TFD has been very progressive in its effort to address firefighter injuries and the lost time and costs associated with these occurrences. However, the structured environment created by the collective bargaining agreement and the promotional processes limits the opportunity to realize the full potential of this program. CPSM believes that the Chief of Health and Safety does not require firefighting experience but instead would be more effective in this role if this individual had a background in occupational health and safety, risk management, or a related field. This individual needs to be familiar with the analysis of statistical data regarding injuries, when and how they are occurring, and then being able to recognize patterns that lead to a comprehensive program intended to mitigate these outcomes. The continuity of this effort is critical and the current practice of placing short-tenured District Chiefs in this role appears counterproductive.

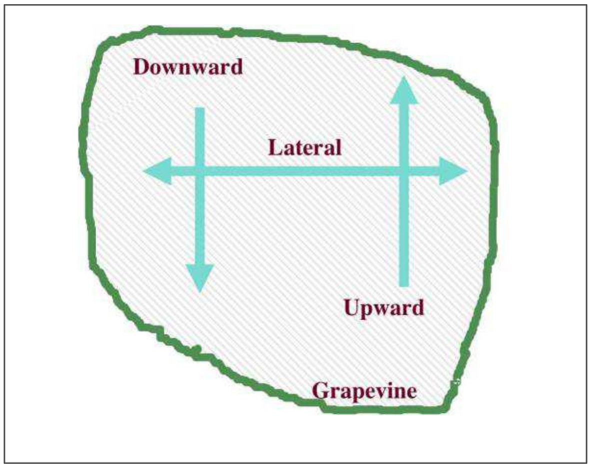
Injury prevention is an organizational objective. From this perspective, it is critical that supervisory personnel, specifically Captains and District Chiefs, must have a more active role in the efforts to reduce injuries. Though injuries in the fire service are avoided at all costs, there is a very strong sentiment that when a firefighter is injured in the line of duty, it is viewed with praise, as a sense of bravery or heroism. In reality, most fire ground injuries are the result of some failure to follow a prescribed safety procedure or a lapse in judgment. From this perspective, it is critical that every injury be evaluated on the basis of why it occurred and more importantly, how it could have been avoided. The supervisor is critical to this process and in our estimation their actions, or more importantly inactions, should be evaluated in determining the cause of the injury. If TFD is intent on reducing firefighter injuries, it must begin to scrutinize the actions of its supervisory personnel whenever injuries occur.

Recommendation: TFD should evaluate all injuries in the context of a failure to follow the necessary safety practices and should evaluate the actions of its supervisory staff in allowing this situation to occur.

The ratio of supervisors to subordinates in the fire service is very high, usually one supervisor for every two to three subordinates. Though firefighters operate in dangerous environments it is critical that the supervisory oversight be evaluated when an accident occurs. CPSM believes that if someone is held accountable for not following the applicable safety guidelines (either the officer or the employee), there will be greater vigilance that will result in a reduction in the number of injuries.

Internal Communication

In any organization, effective communication is critical to success. However, despite the tremendous advances in communication and information technology, communications among people in organizations still leaves much to be desired.[74] Some experts argue that the advent of new communication strategies has actually undermined information sharing. When we are inundated with information, it can be hard to determine what we need to pay attention to.



Communication within an organization occurs both vertically and laterally, as shown in the adjacent figure. Communication also takes place through the "grapevine," in which employees get their information from informal — and often uninformed — sources. When formal communication channels are ineffective, this grapevine becomes more powerful. Sometimes higher-ups are unaware of the information that is communicated via these informal networks, which become fodder for the rumor mill.

Communication is particularly challenging in fire departments. A work schedule with rotating 24-hour shifts complicates effective communication, as does the decentralized work environment in which people report to different locations. In addition, the strong presence of a labor-management divide which often fosters separation and sometimes distrust, further impairs effective communications.

Communication can occur verbally and in writing. Fire departments typically have written policies and procedures, and changes are usually made in writing. The challenge can be getting people to read written communication. In addition, written documents are one-way communication strategies that do not allow people to ask questions or respond. In many organizations, important information is communicated verbally in organization or department-wide meetings, but such meetings are less viable in organizations in which people work on different shifts and at different locations. These challenges make it imperative for fire departments to have a clear and consistent approach to communication. The strategy should make clear which information is most critical and provide redundancy so that people receive the same, consistent messages in more than one way. It

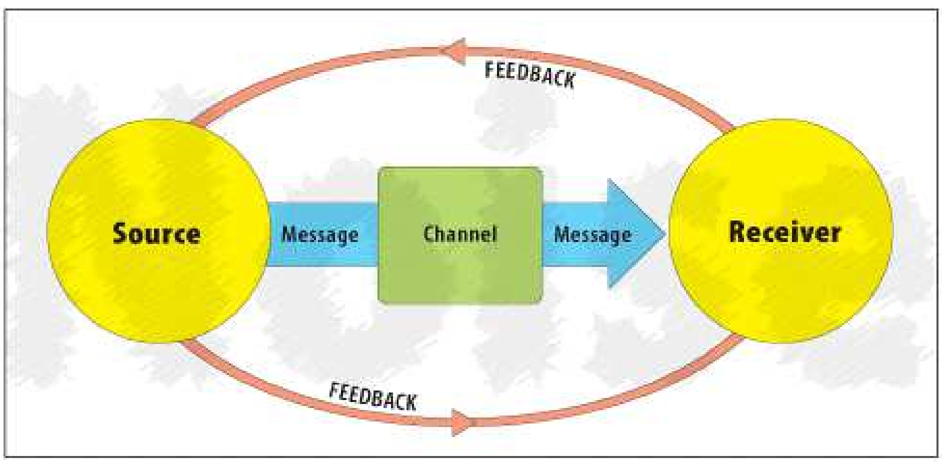
74 See James L. Gibson, John M. Ivancevich, James H. Donnelly, and Robert Konopaske, *Organizations: Behavior, Structure, Processes,* Eighth Edition (New York: Irwin/McGraw-Hill, 2002).

is also important that fire organizations check to ensure that messages are reaching their intended audience(s).

The importance of effective communication, established communication processes, and ongoing follow-up cannot be overstated. The development of a communication model that provides a consistent means for communication within and among various levels of the organization and encourages feedback that can be integrated into continuous improvement supports a healthy organizational culture.

Figure 9-7 represents a basic communication model that, if followed, enhances communication across any organization. Having a "channel" by which information flows is key to ensuring effective ongoing communication, written and oral. The vertical flow of information between the Fire Chief, top management, midlevel managers, and frontline staff impacts the lateral communication that takes place. A lack of communication and direction, or disconnect at the channeling stage, creates morale issues, promotes inconsistencies, and fuels grapevine communication and informal leadership.

FIGURE 9-7: Effective Communication Model



From: Communication Model, Sanctioning Agent Communication Consultancy, http://www.sanctioningagent.com/about/what.htm.

Interviews with fire department personnel suggest that the TFD faces many of the same communication challenges as other fire departments and reveals that communication gaps exist vertically between senior management and midlevel managers and between managers and frontline staff, as well as laterally between shifts. ***TFD senior staff have recognized this problem and have made improving internal communication a key objective in the current strategic planning process.*** TFD staff is looking at a number of internal communication improvements and options including a monthly video update from Chief Driskell distributed via social media or as a TargetSolutions assignment with an attached feedback mechanism to get questions answered.

Currently, the principal means of communication used by the TFD is the chain of command. The TFD has formal written internal communication procedures published in its Administrative Operative Procedures (AOP). TFD uses TargetSolutions assignments to track its chain of command directives. Interviews with key personnel suggest that the chain of command within the TFD is effective (although prone to error): if the Chief or other leaders asks for something to be done through the chain of command, it is accomplished. However, the chain of command has some inherent weaknesses. As in the game of telephone — in which one person repeats the same message to another, that person tells the next person, and so on — inevitably a message can be inadvertently changed between how it is received and how it is sent. By the time the message gets to the firefighter, it may be obliterated. Or it may be amplified, so that it becomes the only thing that everyone focuses on. In Figure 9-7, this demonstrates a weakness in both the "channel" and "message" part of the model.

An alternative recommended internal communication model is shown in Figure 9-8. As shown in this model, the message is as important as the channel. TFD—like other organizations—needs to ensure that the message is clear, concise, and consistent. This means that anyone involved in making a decision or setting a policy should approve a message before it is sent to a wider audience. As much as possible, the organization should have and use consistent language and terminology. Although this will never eliminate the inherent weaknesses in chain-of-command communication, it will help reduce the risk of error.

In the proposed model, continuous communication occurs between each platoon. While the model illustrates the Platoon Assistant Chief as the primary communicator (appropriate for this position), it remains the responsibility of each District Chief to communicate, particularly as one shift is coming on duty and another is going off duty.

FIGURE 9-8: Proposed Communications Model

The model also depicts the flow of communication from senior leadership to each Platoon Assistant Chief, through a communications channel. It is critical that this communication occurs on an ongoing basis. Senior leadership must also provide a means for two-way communication, seeking feedback to ensure the message has been properly received and the organization is moving in a positive direction.

In addition, like any other organizational strategy, effective communication requires monitoring to see what is working and what is not. In the end, effective communication is closely linked to effective management and supervision. Supervising personnel must seek to understand the people they manage, provide and encourage feedback, and follow up on the communication that takes place.

> ***Recommendation: TFD should continue its efforts to carry out an effective communication model that ensures multiple conduits for clear and productive communication among all levels of the organization.***

Finally, as in many organizations, TFD employees have defaulted to e-mail as the main means of communication. But e-mail has inherent limitations, including the fact that it is almost impossible to know whether anyone has read a message. Important messages can be tagged as "high importance." In addition, messages can be tagged for "delivery receipt" and/or "read receipt." Similarly, people may be asked to respond to a question within the e-mail itself, so that those sending the message know that it has been received. Such strategies still require the person sending the message to keep track of whether the e-mails have reached their intended targets.

The underlying problem with e-mail is that it is often overused. It is also often viewed as an informal means of communication. If people receive e-mails all day long, it can be difficult to weed out those that are truly important. Some organizations have resolved such issues by having a routinely scheduled e-mail that captures all important information. The e-mail is sent from the chief or other senior staff member and is sent at the same time each week with the same subject line. Classifying other types of e-mails can further assist e-mail in becoming a useful communication channel. In the current strategic planning process TFD staff are considering including the following e-mail classifications to help delineate the intent and importance of the message:

1. **Worthy of Procedure**: Published in Administrative Operative Procedures (AOP) or Emergency Operating Guidelines. Sent out as an assignment via TargetSolutions for tracking.

2. **Highly important but not procedural**: Published as an administrative message via email and so designated (in accordance with the AOP Procedure on Administrative Messages), logged, and compilation posted on the TFD Doc Library for later reference. Employees will be accountable for this information, which would also be sent out as an assignment via Target Solutions for tracking.

3. **FYI**: Regular e-mail with information that is helpful.

While organizations rarely want to suppress any communication among employees, it can be helpful to remind personnel of when an e-mail is and is not appropriate, how to flag an e-mail whose main intent is an "FYI," and when to narrow the pool of recipients so that all messages are not sent to everyone on an e-mail list, whether or not it is useful to them.

Emergency Management

Emergency management is the discipline and profession of applying science, technology, planning, and management 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.[75]

Oklahoma has had 173 Federal Disaster Declarations, the third highest among the 50 states, with only Texas and California having more federally declared disasters. Adjusted for population, Oklahoma has the highest incidence of federally declared disasters per capita in the United States. The Tulsa metropolitan area is vulnerable to a wide array of extreme natural events such as tornadoes, floods, winter storms, wild fires, drought, earthquakes, etc., as well as man-made events such as accidental hazardous material spills, releases and explosions, airplane crashes, pandemics, and terrorism. In 2008, the State Hazard Mitigation Planning Committee prepared the State of Oklahoma Multi-Hazard Mitigation Plan in which it identified the natural and man-made hazards to which the state is most vulnerable. Table 9-1 illustrates the natural hazard, the probability, severity,

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

warning time, duration, and priority of risk of each hazard to which the Tulsa regional area is prone.[76]

TABLE 9-1: Tulsa Region Critical Risk Index

Natural Hazard	Category of Risk				Critical Priority Risk Index (CPRI)
	Probability x 0.45	Magnitude/ Severity x 0.30	Warning Time x 0.15	Duration x 0.10	
Tornado	Highly Likely 4	Critical 3	Less 6 Hours 4	Less than 6 hours 1	
	4 x 0.45	3 x 0.30	4 x 0.15	1 x 0.10	= 3.4
Winter Storms/Ice/Freezing Rain	Highly Likely 4	Critical 3	12-24 Hours 2	Less than 1 week 3	
	4 x 0.45	3 x 0.30	2 x 0.15	3 x 0.10	= 3.3
Flooding	Highly Likely 4	Limited 2	12-24 Hours 2	Less than 1 week 3	
	4 x 0.45	3 x 0.30	2 x 0.15	3 x 0.10	= 3.0
Severe Thunderstorm/Hail/Lightning	Highly Likely 4	Limited 2	12-24 Hours 2	Less than 6 hours 1	
	4 x 0.45	2 x 0.30	2 x 0.15	1 x 0.10	= 2.8
High Winds	Highly Likely 4	Limited 2	12-24 Hours 2	Less than 6 hours 1	
	4 x 0.45	2 x 0.30	2 x 0.15	1 x 0.10	= 2.8
Wildfires	Likely 3	Limited 2	Less 6 Hours 4	Less than 1 day 2	
	3 x 0.45	2 x 0.30	4 x 0.15	2 x 0.10	= 2.75
Extreme Heat	Likely 3	Limited 2	24+ Hours 1	Less than 1 week 3	
	3 x 0.45	2 x 0.30	1 x 0.15	3 x 0.10	= 2.4
Earthquake	Possible 2	Negligible 1	Less 6 Hours 4	Less than 6 hours 1	
	2 x 0.45	1 x 0.30	4 x 0.15	1 x 0.10	= 1.9
Dam Failure	Unlikely 1	Critical 3	24+ Hours 1	More than 1 week 4	
	1 x 0.45	3 x 0.30	1 x 0.15	4 x 0.10	= 1.9

Disaster Risk Assessment Summary	
High Risk, ≥ 3.0	Tornado Winter Storms/Ice/Freezing Rain Flooding
Moderate Risk, 2.0-2.9	Severe Thunderstorm/Hail/Lightning High Winds Wildfires Extreme Heat
Low Risk, <2.0	Earthquake Dam Failure

The Tulsa Area Emergency Management Agency (TAEMA) is a joint agency of the city of Tulsa and Tulsa County. CPSM views this level of cooperation and collaboration as a ***Best Practice*** that should be continued. TAEMA leads the coordination, collaboration, and cooperation of all organizations

[76] Tulsa Standard of Cover, Section 2-Risk Assessment, 2009. P.5-6.

involved in the prevention, preparedness, response, and recovery to disasters and emergencies in the city and the county. The Director of TEAMA reports directly to the city's Mayor and to the Chair of the Tulsa County Commission. The Director is supported by a two-person staff consisting of a Deputy Director and a Finance and Grants Coordinator.

Oklahoma municipalities are responsible for managing the first response to a large emergency event. When an extreme event exceeds the capabilities of a municipal or regional response or if life and property loss is extensive, the Oklahoma Department of Emergency Management can provide additional state assistance by request of the city of Tulsa Mayor or the Chair of the Tulsa County Commission. Further, the Governor of the State of Oklahoma can declare a state disaster to help coordinate the resources available from the state, i.e., the National Guard and request from the Federal Emergency Management Agency (FEMA) for assistance through a presidential disaster declaration.

Risk and vulnerability analysis, mitigation, planning and training are the backbone of TAEMA's emergency management program. In the mid1970s and early 1980s the Tulsa metropolitan area experienced a series of catastrophic floods. The extent of the damage provided the impetus to initiate a large flood mitigation program that included buying out buildings in the floodplain, strengthening building codes to prevent construction in identified floodplains, improving channel flow, and improving flood and water detention. Subsequently, the city was recognized for its mitigation efforts by becoming a part of ***FEMA's National Project Impact Program***, which provided federal grants and promoted the positive effects of mitigating natural disasters. These mitigation efforts have resulted in Tulsa not experiencing a major flood since 1986.

Since the April 1995 terror bombing attack on the Murrah Federal building in Oklahoma City, TAEMA has had a vigorous program focused on domestic preparedness. TAEMA works closely with its many local, regional, state, and federal stakeholders as part of the National Incident Management System (NIMS). In 2009 and 2010, Tulsa County was designated as an ***Urban Area Security Initiative (UASI)*** by the Department of Homeland Security (DHS). The UASI has provided $3.4 million to strengthen both the county and city's abilities to prevent and respond to potential terrorist attacks and natural disasters.

The City of Tulsa/Tulsa County Emergency Operations Center is located in the basement of the Police-Municipal Courts Building. The building is equipped with back-up generators, as well as water storage tanks. The EOC includes space for designated functional areas to organize support for emergency and disaster events including room for a policy group, operations group, and coordination group. The EOC provides space for the Joint Information Center to support the Tulsa City/County public information function to provide for one coordinated message to the community about preparedness, mitigation, recovery assistance, and other disaster-related information. The EOC has a designated area to serve as a place, with the needed equipment and electrical power, to conduct media briefings. The EOC is capable of operating continually over long-term, multiday events with a multipurpose room for staff breaks and meals. Finally, the EOC serves as the Regional Emergency Operations Center per written agreement between the city of Tulsa and the Oklahoma Department of Emergency Management.

The single most important aspect of effective emergency management is making sure before a disaster occurs that in a disaster the responsibility, authority, and channels of communications are clearly delineated.[77] Emergency management planning is an essential element of that process. As a part of preparedness, it is the least costly of the four phases of emergency management: mitigation, preparedness, response, and recovery. It also has a large impact on the ability of a community to recover quickly from a disaster.

The TAEMA emergency management plan (EOP) is a useable and thorough document that was last updated and distributed in September 2015. The EOP was developed by a planning committee whose members represent the major organizations involved in the plan. The city departments represented included police, fire, parks, finance, engineering, and tec. Several key regional governmental agencies participated, including EMSA, transit, health, and the international airport. Essential nonprofit organizations such as the Red Cross and Salvation Army participated, as well as a number of key county departments, including the sheriff's office, the levee districts, and a host of social services agencies. The state had representation from emergency management and state police. This level of involvement and the extent of agency participation in the emergency planning process is considered by CPSM to be a ***Best Practice***.

The EOP establishes a comprehensive (multi-use), integrated framework for city and county departments, government agencies, state and regional governments, and public-private organizations to coordinate a response to a major emergency or disaster in the Tulsa regional area. The TAEMA is currently in the process of revising the EOP from an Annex format to an Emergency Support Functions (ESFs)-based format. This format incorporates a functional approach (National Response Framework) to facilitate the provision of federal assistance under twelve Emergency Support Functions (ESFs). Each ESF is led by a primary agency with unique capabilities in the functional area.

The existing TAEMA EOP uses the National Incident Management System and includes clearly defined responsibilities for policy, coordination, and operational groups as well as detailed tasks and responsibilities for the individual departments and agencies involved. The EOP, due to its comprehensiveness, is lengthy yet usable. The EOP could be improved with more individual department and agency critical action checklists.

> ***Recommendation: TAEMA should develop a series of critical action checklists for departments and agencies involved in the EOP.***

Although each city and county department is responsible for developing and maintaining its own standard operating guidelines for emergencies, not every department has completed this task. In addition, it is vital that an EOP provide details on the continuity of operations (COOP), the succession of leadership, and the preservation of records.

> ***Recommendation: TAEMA should facilitate the development of a COOP planning process for every city and county department.***

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[77] Drabek, Hoetmer, p. xx.

COOP plans detail how a particular agency will continue to operate under adverse conditions including under circumstances where its primary operating locations are no longer functional or the normal staffing levels have been reduced so that an altered service model is required. FEMA provides a very functional guide in developing agency-specific COOP planning documents (See: http://www.fema.gov/pdf/about/org/ncp/coop/continuity_plan_federal_d_a.pdf).

EOPs are of little value without preparedness and exercising. The three-person TAEMA staff is experienced and exceptionally well trained to lead the Tulsa regional emergency management program. The TAEMA program is visible and robust in coordinating its training and planning responsibilities. In the last two years TAEMA has participated in or conducted 22 exercises, of which five were full-scale exercises. This effort is truly commendable and considered by CPSM to be a ***Best Practice.***

Finally, an integral and crucial part of emergency management is damage assessment. Without a systematic damage assessment process an event that causes extensive damage can lead to lengthy delays in a community's recovery (e.g., Hurricane Sandy[78]). In the past, TAEMA staff and the city of Tulsa building inspectors used a cumbersome paper process to assess damage. Recently the Oklahoma Department of Emergency Management provided the "Orion" software program to digitize damage assessment information. TAEMA staff, using their programmed I-Pads, are currently in the process of training city building inspectors to use this program on their smart phones. The TAEMA has also partnered with the Tulsa County Assessor's Office to merge their information with the program. Upon completion, this digitized damage assessment program will provide instant monetary estimates of property losses and will expedite the recovery process.

Emergency Communications Center (ECC)

The Tulsa Police Department operates the city's 911 Center, which is the primary Public Safety Answering Point (PSAP) for the city of Tulsa. This Center is managed by the city's 911 Director, and is housed at a secure and dedicated 911 facility located at 801 E. Oklahoma St. The Center is extremely proficient and in the recent ISO review (February 2012), it received the maximum allotted points in the emergency communication portion of the review. The Center provides dispatching services for the Tulsa Police Department, Tulsa Fire, EMSA, Tulsa County, and a number of smaller neighboring communities (Berryhill, Catoosa, Oak Grove, and Sperry). The Center operates with separate dispatching units for those key agencies (TPD, TFD, EMSA, and Tulsa County). The Center handles in excess of one million 911 calls annually and is operational on a 24/7 basis. Dispatching duties for TFD are shared between EMSA dispatchers and TFD dispatchers. When a fire call is received at the Center's answering point it is then transferred to the Fire Dispatchers who will send the alert to the responding units and manage the radio transmissions for the incident. When an EMS call is received it is first transferred to the EMSA dispatch consoles where it is screened to determine its prioritization and a determination if a TFD unit is needed. If a TFD unit is needed then the call is transferred to the TFD dispatchers for processing.

[78] *FEMA to Review All Damage Claims from Hurricane Sandy*, New York Times, March 12, 2015.

The center utilizes the TriTech™ computer-aided dispatch (CAD) software. For EMS calls, EMSA utilizes ProQA, a nationally recognized emergency medical dispatching (EMD) system to provide callers with critical pre-arrival instructions as well as establishing dispatching parameters for response recommendations. EMSA dispatchers are trained to provide Emergency Medical Dispatching (EMD), and this activity is reviewed by a staff member who is QA/QI certified. All critical ECC equipment is on an uninterrupted power supply (UPS). The police headquarters building serves as the backup for the Tulsa 911 Center in the event that the primary Center goes down or must be relocated. The process for transferring Center operations to the back-up center is exercised on a regular basis.

Tulsa's 911 communications link is managed by AT&T; however, when calls are first received at the Center's answering point and it is determined what the call type is (police, fire, EMS), the call is then transferred to the appropriate dispatching point. However, due to a transfer processing glitch, the call transfer process may take upwards of 30 to 45 seconds due to a routing problem on the AT&T end of the system. Tulsa's 911 officials are very aware of these delays in the call transferring process and are working with Verizon to rectify the situation. The initial call screening process and the ultimate transfer of the caller to the appropriate dispatcher (EMSA or TFD) is not monitored and the actual time segment involved in this action is not recorded. Typically, the initial screening by the Call Taker is a relatively quick process that should take less than 10 seconds; however, with the delays being experienced in transferring the call, CPSM believes that Tulsa 911 officials should be monitoring the receipt of all calls at the 911 answering point (call takers) to receipt by the appropriate dispatch unit.

> ***Recommendation: The Tulsa 911Center should monitor and record the time at which all calls are received at the Tulsa answering point and track the call processing duration until calls are received by the appropriate emergency dispatching unit.***

It was also determined that the time clocks of the CAD system and the TFD records management system are not synchronized. Because of this, there is often a different timestamp for the same activities on a call.

> ***Recommendation: The Tulsa 911 Center should synchronize its time clocks between the CAD system and TFD records management system.***

The personnel who fill the various roles at the center are employed by different agencies (TFD, TPD, EMSA, Tulsa County), and each of these operations are established as different work areas. This arrangement causes multiple transfers, especially during an EMS response when both TFD and EMSA units are utilized. This process results in unneeded redundancy and some delay in processing.

> ***Recommendation: TFD should consider the consolidation of its dispatch operations so that fire and EMS call processing is carried out without multiple transfers.***

CPSM recognizes that there are distinct differences in the management of fire, EMS, and police dispatching activities. It is acceptable to separate the police and EMS/fire dispatching duties, however, we believe that there is an ability to streamline this process and utilize cross-trained personnel to do each of these functions. Many agencies that participate in a centralized dispatch operation often choose to utilize their own employees for their particular aspect of the service. This outcome often results in unneeded redundancies and delays in call processing time.

Section 10. Vision Proposal 2016

On April 5, 2016, Tulsa residents were asked to vote on the "2017 Limited Purpose Public Safety Permanent Sales Tax Fund." This tax levy specifically earmarked public safety funding for the Tulsa Police Department, Tulsa Fire Department, and the city's 911 Call Center. The levy is to be in effect for 15 years and during this time an estimated $70 million dollars is expected to be generated for specific fire department activities. Tulsa City Ordinance # 23423, specifies the types of expenditures authorized under this funding to include:

> *"Tulsa Fire Department: additional firefighters, and equipment for said firefighters; new or additional firefighting and rescue equipment; and construction of fire stations and/or renovation of existing fire stations."*

As part of this Operational and Administrative Analysis, CPSM was asked to provide a summary of the most critical needs of the Tulsa Fire Department that may be considered for funding through the public safety sales tax funding. The following is a listing of those expenditures and their estimated cost in 2016 dollars for each of these recommendations. These recommendations are not provided in any prioritized or recommended order. In addition, the implementation of all of these projects combined is anticipated to be carried out over a multiyear period and the order in which these programs are instituted would be a decision of the Mayor and the Tulsa City Council.

Recommended Expenditures

Increase Staffing for Ten Peak-Period EMS First Response Squads

CPSM estimates that a total of 48 personnel who are certified as firefighter/EMT-Paramedics would be required to staff ten additional EMS squads that will operate within those city areas with the busiest call volume. Units should be staffed with two personnel (one EMT & one Paramedic) and be operational seven days a week between the hours of 9:00 a.m. and 8:00 p.m.
Estimated Cost: $3 Million (Recurring Cost)

Add Ten Peak-Period EMS First Response Vehicles

CPSM recommends the purchase of 10 utility type light duty trucks with exterior compartmentation and lighting and equipped to function as nontransport ALS units.
Estimated Cost: $1.25 Million (One-Time Cost)

Replace Ten Fire Pumpers

CPSM estimates that ten existing fire pumpers currently exceed the recommend replacement schedule (FUSS) as identified by the city's Asset Management Department.
Estimated Cost: $4.75 Million (One-Time Cost)

Establish a Mobile Integrated Health Care Program

In cooperation with EMSA, CPSM recommends that a Mobile Integrated Health Care Program be established to extend health and social services access to the population which frequently utilizes the 911 emergency response network to access these services. Initially utilize three response units staffed with three personnel each working 40-hour schedules.

Estimated Cost: $425,000 w/$190,000 Recurring Cost

Institute an Integrated Risk Management Plan

Utilizing a targeted risk reduction effort that focuses on the highest fire-prone neighborhoods in Tulsa, institute a multipronged effort to reduce fire occurrences and associated injuries. Efforts can include the installation of hard-wired smoke detectors, improvements to heating systems, upgrades to electrical service, and fire prevention and life-safety outreach efforts ($100,000 annually). Hire three fire safety specialist to institute this program under the TFD Fire Marshal.

Estimated Cost: $300,000 (Recurring Cost)

Retrofit Existing High-Rise Residential Structures with Fire Sprinklers

Utilizing a cost-share program and working with the current property owners, provide partial city grant funding in a prioritized, competitive process to install automatic fire sprinklers and annunciator/alarm systems. Earmark $750,000 annually, under the direction of the Fire Marshal, to reduce and ultimately retrofit all of the estimated 35 residential high-rise structures that are either partially sprinklered or nonsprinklered.

Estimated Cost: $750,000 Annually (Recurring Cost)

Purchase Three Water Tender/Tanker Apparatus

Purchase three water tender/tanker apparatus to be located in the three main areas of the city that do not have sufficiently dispersed fire hydrants. These apparatus should be cross-staffed and can respond to fire-related incidents when hydrant water is unavailable.

Estimated Cost: $1,050,000 (One-Time Cost)

Fire and EMS Training Simulation Equipment

Purchase simulation hardware and software to facilitate training in firefighting tactics, safety, and command along with ARFF simulation and driver training modules.

Estimated Cost: $25,000 to 80,000 (One-Time Cost)

Consolidate the Tulsa 911 Call Center

Provide design, renovation CAD software, and dispatch consoles needed to consolidate the Tulsa 911 Call Center including TFD, EMSA, Tulsa County, and the 911 call taker positions.

Estimated Cost: $2,500,000 (One-Time Cost)

Section 11. Data Analysis

Introduction

This data analysis was prepared as a key component of the study of the Tulsa Fire Department (TFD), which was conducted by the Center for Public Safety Management, LLC. This analysis examines all calls for service between January 1, 2015, and December 31, 2015, as recorded in the 911 Public Safety Communications computer-aided dispatch (CAD) system and the National Fire Incident Reporting System (NFIRS).

This analysis contains four 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 analysis of the busiest hours in the year studied; and the fourth section provides a response time analysis of TFD units.

During the period covered by this study, TFD operated out of 30 stations in six districts utilizing 25 engines, 12 ladders, 5 squads, 6 grass rigs, 5 boats, 2 hazmat units, 2 air and light units, 1 rescue, 1 truck, 1 ATV, 5 district chief vehicles, 1 on-duty EMS officer unit, and 1 on-duty assistant chief vehicle.

During the study period, the Tulsa Fire Department responded to 56,469 calls, of which 63 percent were EMS calls. The total combined yearly workload (deployed time) for all TFD units was 26,067 hours. The average dispatch time for the first arriving TFD unit was 0.6 minutes and the average response time of the first arriving TFD unit was 5.1 minutes. The 90th percentile dispatch time was 1.5 minutes and the 90th percentile response time was 7.4 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 Tulsa Fire Department as well as CAD data for the Emergency Medical Services Authority (EMSA). We first matched the TFD CAD and NFIRS data and the TFD CAD and EMSA CAD data. We then assigned calls to standard call types.

Cancelled calls were identified based on NFIRS incident type and CAD problem description and priority. Mutual aid calls were identified based on location; calls outside the city limits were categorized as mutual aid. EMS calls were assigned detailed categories based first on EMSA problem description and then, when necessary, NFIRS incident type, and finally CAD problem description. Remaining calls were categorized based on NFIRS incident type, where possible, and on CAD problem description when no matching NFIRS call was found. Finally, we removed calls to which no TFD unit responded.

A total of 114 incidents to which administrative units (command vehicles) 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, cancelled and mutual aid calls are included in all analyses except 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, TFD responded to 56,469 calls. Of these, 713 were structure fire calls and 1,153 were outside fire calls within TFD'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

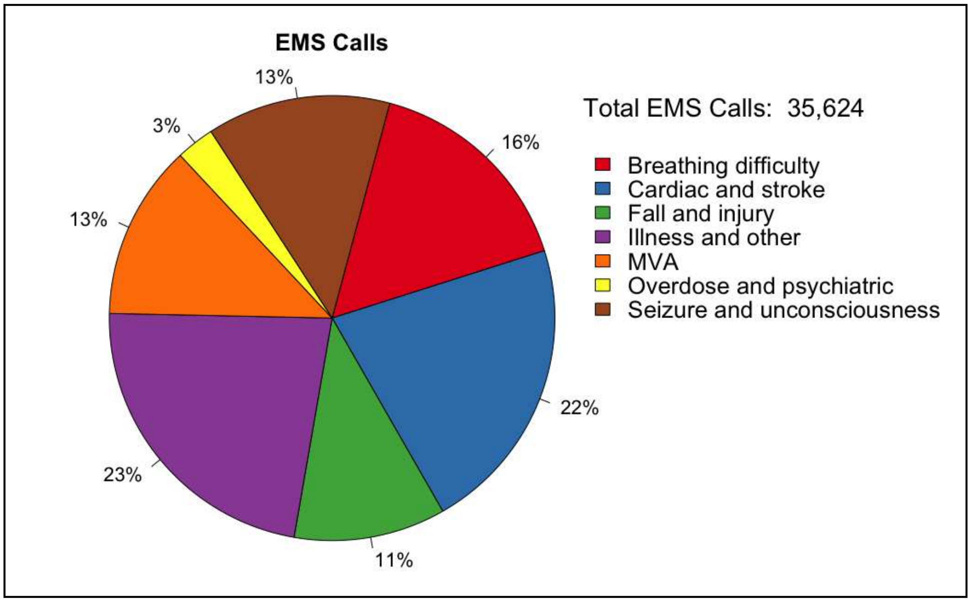
Table 11-1 and Figure 11-1 show the number of calls by call type, average calls per day, and the percentage of calls that fall into each call type category.

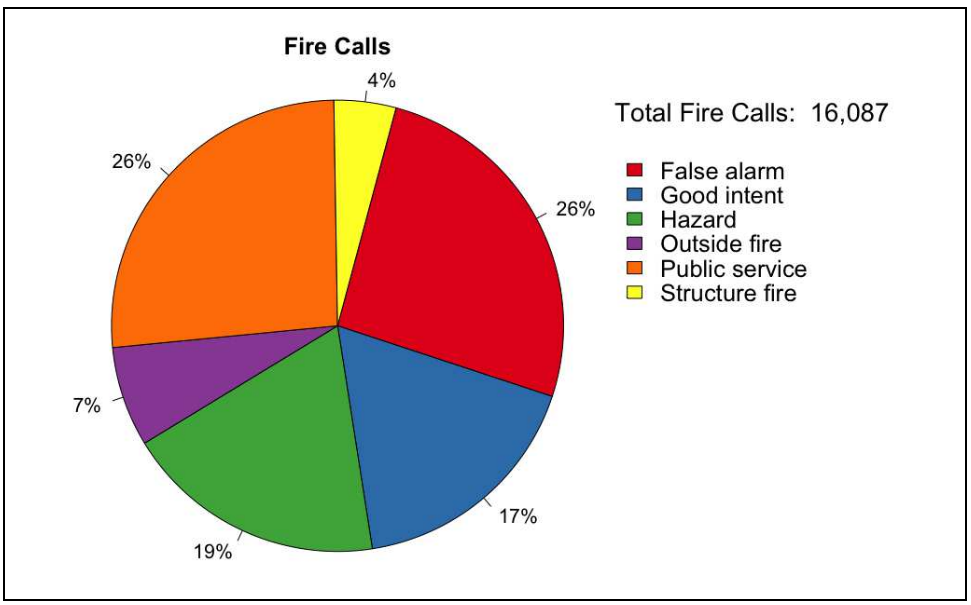
TABLE 11-2: Call Types

Call Type	Number of Calls	Calls per Day	Call Percentage
Breathing difficulty	5,676	15.6	10.1
Cardiac and stroke	7,704	21.1	13.6
Fall and injury	3,922	10.7	6.9
Illness and other	8,052	22.1	14.3
MVA	4,530	12.4	8.0
Overdose and psychiatric	993	2.7	1.8
Seizure and unconsciousness	4,747	13.0	8.4
EMS Total	**35,624**	**97.6**	**63.1**
False alarm	4,168	11.4	7.4
Good intent	2,809	7.7	5.0
Hazard	3,017	8.3	5.3
Outside fire	1,153	3.2	2.0
Public service	4,227	11.6	7.5
Structure fire	713	2.0	1.3
Fire Total	**16,087**	**44.1**	**28.5**
Cancelled	4,237	11.6	7.5
Mutual aid	521	1.4	0.9
Total	**56,469**	**154.7**	**100.0**

Note: Structure fires are defined in accordance with NFIRS standards and include incident type codes 111 through 123.

FIGURE 11-1: EMS and Fire Calls by Type





Observations

Overall

- The department received an average of 154.7 calls, including 1.4 mutual aid calls, per day.
- EMS calls for the year totaled 35,624 (63 percent of all calls), averaging 97.6 per day.
- Fire calls for the year totaled 16,087 (28 percent of all calls), averaging 44.1 per day.

EMS

- Illness and other calls were the largest category of EMS calls at 23 percent of EMS calls.
- Cardiac or stroke calls made up 22 percent of the EMS calls.

- Motor vehicle accidents made up 13 percent of the EMS calls.

Structure and Outside Fires

- Structure and outside fires combined for a total of 1,866 calls during the year, an average of 5.1 calls per day.
- A total of 713 structure fire calls accounted for 4 percent of the fire calls.
- A total of 1,153 outside fire calls accounted for 7 percent of the fire calls.
- Public service calls were the largest fire call category, with 26 percent of the fire calls.
- False alarm calls were 26 percent of the fire calls.

Calls by Type and Duration

Table 11-2 shows the duration of calls by type using four duration categories: less than 30 minutes, 30 minutes to one hour, one to two hours, more than two hours.

TABLE 11-3: Calls by Type and Duration

Call Type	Less than One-half Hour	One-half Hour to One Hour	One to Two Hours	More than Two Hours	Total
Breathing difficulty	5,145	457	63	11	5,676
Cardiac and stroke	6,743	768	176	17	7,704
Fall and injury	3,332	530	52	8	3,922
Illness and other	6,980	975	80	17	8,052
MVA	2,780	1,392	332	26	4,530
Overdose and psychiatric	833	145	13	2	993
Seizure and unconsciousness	4,150	519	72	6	4,747
EMS Total	**29,963**	**4,786**	**788**	**87**	**35,624**
False alarm	3,959	176	27	6	4,168
Good intent	2,652	135	15	7	2,809
Hazard	1,919	777	273	48	3,017
Outside fire	855	217	67	14	1,153
Public service	3,653	452	91	31	4,227
Structure fire	225	180	180	128	713
Fire Total	**13,263**	**1,937**	**653**	**234**	**16,087**
Cancelled	4,162	47	20	8	4,237
Mutual aid	421	61	25	14	521
Total	**47,809**	**6,831**	**1,486**	**343**	**56,469**

Observations

EMS

- A total of 34,749 EMS category calls (98 percent) lasted less than one hour, 788 EMS category calls (2 percent) lasted between one and two hours, and 87 EMS category calls (less than 1 percent) lasted more than two hours.
- On average, there were 2.4 EMS category calls per day that lasted more than one hour.
- A total of 7,511 cardiac and stroke calls (97 percent) lasted less than one hour, and 193 cardiac and stroke calls (3 percent) lasted more than an hour.
- A total of 4,172 motor vehicle accidents (92 percent) lasted less than one hour, and 358 motor vehicle accidents (8 percent) lasted more than an hour.

Fire

- A total of 15,200 fire category calls (94 percent) lasted less than one hour, 653 fire category calls (4 percent) lasted between one and two hours, and 234 fire category calls (1 percent) lasted more than two hours.
- On average, there were 2.4 fire category calls per day that lasted more than one hour.
- A total of 405 structure fires (57 percent) lasted less than one hour, 180 structure fires (25 percent) lasted between one and two hours, and 128 structure fires (18 percent) lasted more than two hours.
- A total of 1,072 outside fires (93 percent) lasted less than one hour, 67 outside fires (6 percent) lasted between one and two hours, and 14 outside fires (1 percent) lasted more than two hours.
- A total of 4,135 false alarms (99 percent) lasted less than one hour, and 33 false alarms (1 percent) lasted more than an hour.

Average Calls per Day and per Hour

Figure 11-2 shows the monthly variation in the average daily number of calls handled by TFD during the year studied. Similarly, Figure 11-3 illustrates the average number of calls received each hour of the day.

FIGURE 11-2: Average Calls per Day, by Month

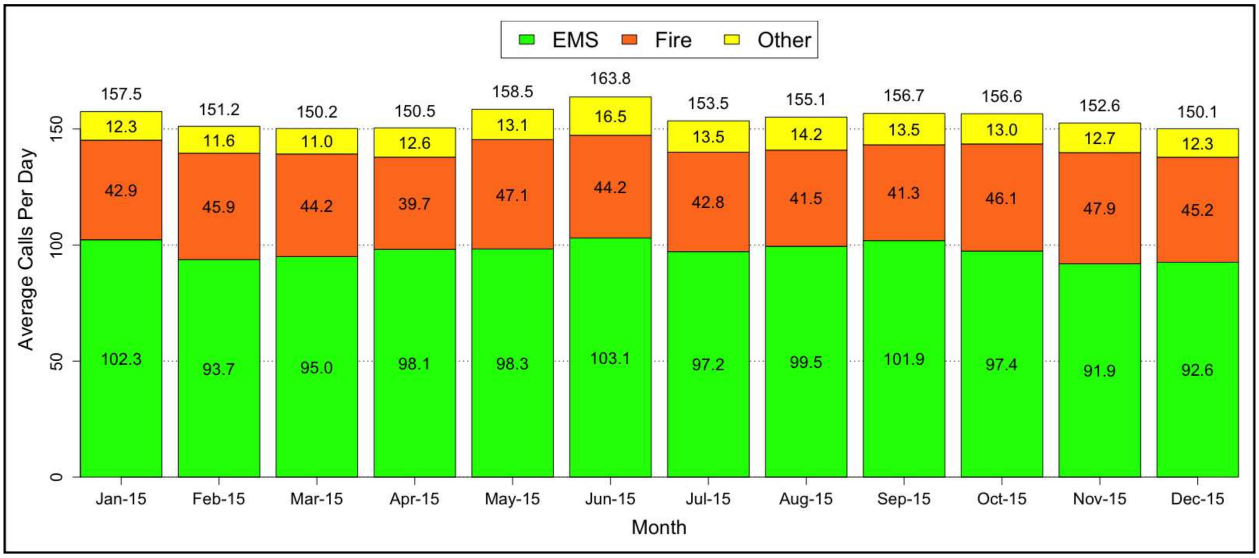
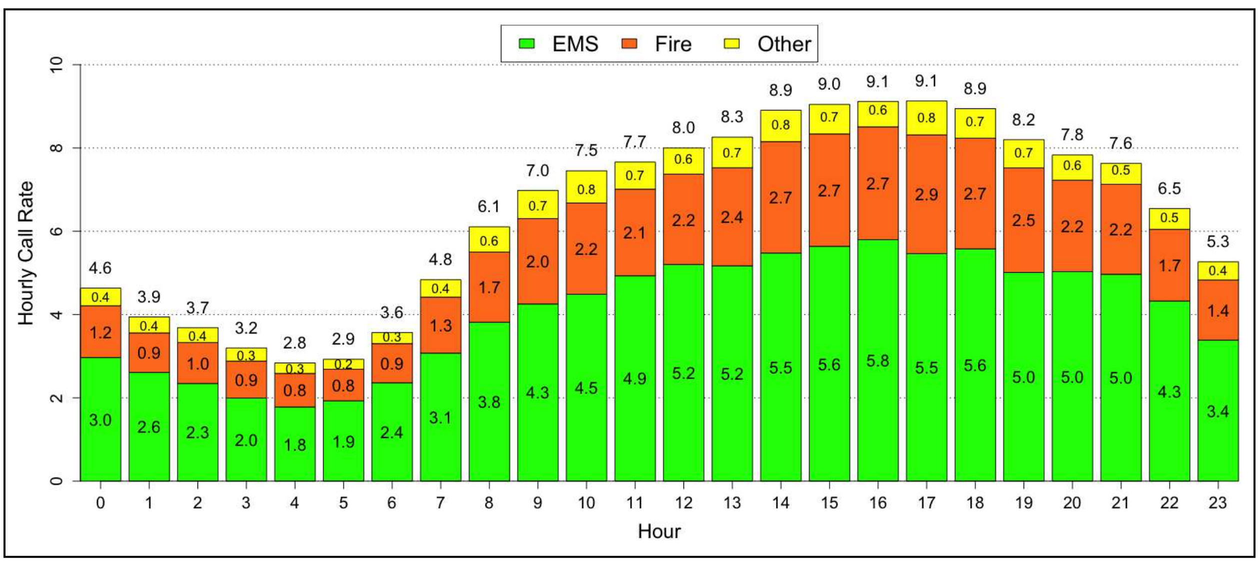


FIGURE 11-3: Calls by Hour of Day



Observations

Average Calls per Day

- Average calls per day ranged from a low of 150.1 calls per day in December 2015 to a high of 163.8 calls per day in June 2015. The highest monthly average was 9 percent greater than the lowest monthly average.
- Average EMS calls per day ranged from a low of 91.9 calls per day in November 2015 to a high of 103.1 calls per day in June 2015.
- Average fire calls per day ranged from a low of 39.7 calls per day in April 2015 to a high of 47.9 calls per day in November 2015.
- Average other calls per day ranged from a low of 11.0 calls per day in March 2015 to a high of 16.5 calls per day in June 2015.
- The highest number of calls received in a single day was 215, which occurred on June 5, 2015, and the second highest total calls in a day was 210, which occurred on October 20, 2015.

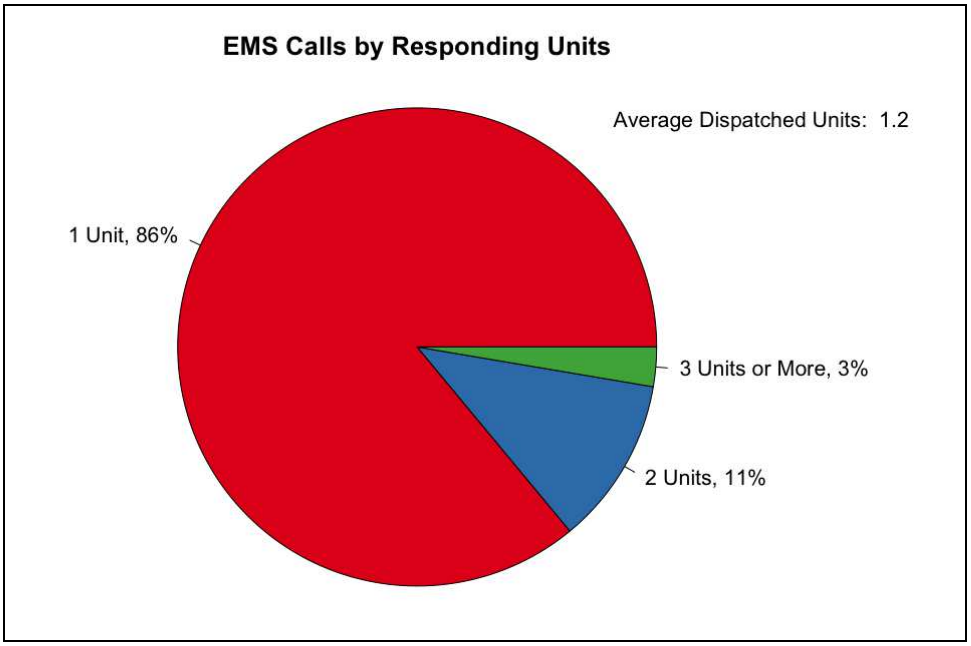
Average Calls per Hour

- Average hourly call rates ranged from 2.8 to 9.1 calls per hour.
- Call rates were highest between 2:00 p.m. and 7:00 p.m., averaging 9 calls per hour.
- Call rates were lowest between 4:00 a.m. and 6:00 a.m. averaging fewer than 3 calls per hour.

Units Dispatched to Calls

Figure 11-4 and Table 11-3 detail the number of TFD units dispatched to calls overall and broken down by call type.

FIGURE 11-4: Number of TFD Units Dispatched to Calls



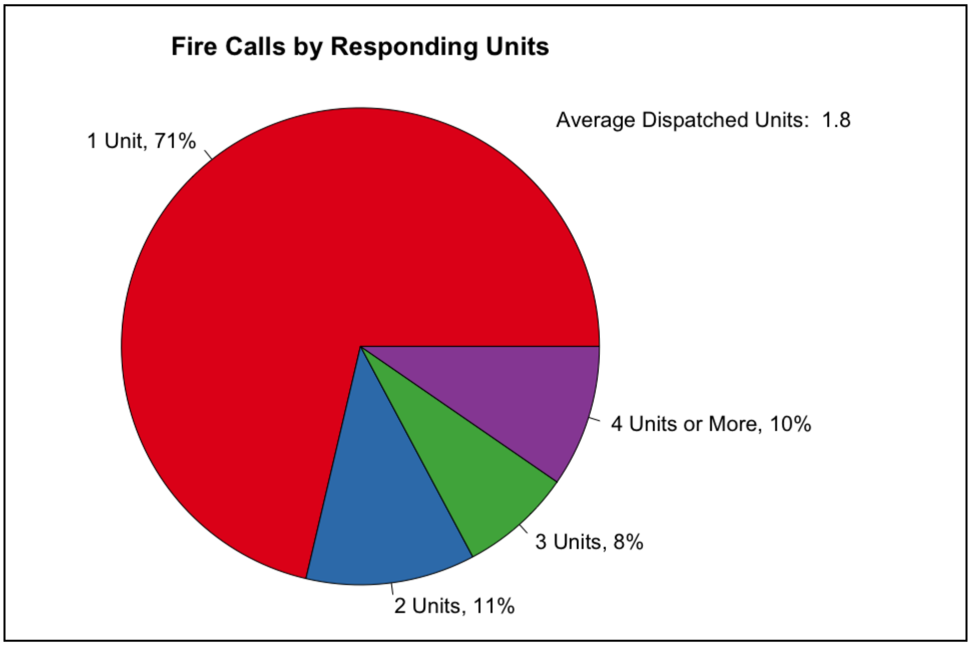


TABLE 11-4: Number of Units Dispatched to Calls by Call Type

Call Type	Number of Units						Total
	One	Two	Three	Four	Five	Six or More	
Breathing difficulty	5,467	193	13	1	2	0	5,676
Cardiac and stroke	6,638	881	164	19	1	1	7,704
Fall and injury	3,252	529	109	18	3	11	3,922
Illness and other	7,571	421	43	9	4	4	8,052
MVA	2,415	1,624	404	55	15	17	4,530
Overdose and psychiatric	904	74	13	1	1	0	993
Seizure and unconsciousness	4,393	312	39	3	0	0	4,747
EMS Total	**30,640**	**4,034**	**785**	**106**	**26**	**33**	**35,624**
False alarm	3,101	199	543	25	8	292	4,168
Good intent	2,206	294	132	14	8	155	2,809
Hazard	1,676	665	377	73	23	203	3,017
Outside fire	803	196	65	14	9	66	1,153
Public service	3,626	467	73	11	6	44	4,227
Structure fire	64	22	30	2	14	581	713
Fire Total	**11,476**	**1,843**	**1,220**	**139**	**68**	**1,341**	**16,087**
Cancelled	3,545	474	158	14	5	41	4,237
Mutual aid	409	66	20	1	2	23	521
Total	**46,070**	**6,417**	**2,183**	**260**	**101**	**1,438**	**56,469**
Percentage	**81.6**	**11.4**	**3.9**	**0.5**	**0.2**	**2.5**	**100.0**

Observations

- On average 1.4 units were dispatched to all calls, and on 82 percent of all calls only one unit was dispatched.
- Overall, three or more units were dispatched to 7 percent of calls; four or more units were dispatched to 3 percent of calls; and six or more units were dispatched to 2 percent of calls.

EMS

- On average, 1.2 units were dispatched per EMS call.
- For EMS calls, one unit was dispatched 86 percent of the time; two units were dispatched 11 percent of the time; and three or more units were dispatched 3 percent of the time.

Fire

- On average, 1.8 units were dispatched per fire call.
- For fire calls, one unit was dispatched 71 percent of the time; two units were dispatched 11 percent of the time; three units were dispatched 8 percent of the time; four or five units

were dispatched 1 percent of the time; and six or more units were dispatched 8 percent of the time.

- For structure fire calls, three units were dispatched 4 percent of the time; four or five units were dispatched 2 percent of the time; and six or more units were dispatched 81 percent of the time.
  - Six units were dispatched 18 percent of the time.
  - Seven units were dispatched 31 percent of the time.
  - Eight units were dispatched 17 percent of the time.
  - Nine units were dispatched 9 percent of the time.
  - Ten or more units were dispatched 6 percent of the time.
- For outside fire calls, three units were dispatched 6 percent of the time, and four or more units were dispatched 8 percent of the time.

Workload by Station—Calls and Total Time Spent

In this section, the workload of units by type and the workload of each station 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 a unit is cleared.

Workload by individual unit is provided in Attachment IV.

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 11-4 shows the total deployed time, both overall and broken down by type of call, for TFD units during the year studied.

TABLE 11-5: Annual Runs and Deployed Time by Call Type

Call Type	Avg. Deployed Min. per Run	Total Annual Hours	Percent of Total Hours	Avg. Deployed Hours per Day	Total Annual Runs	Avg. Runs per Day
Breathing difficulty	18.8	1,848.9	7.1	5.1	5,906	16.2
Cardiac and stroke	20.1	3,001.5	11.5	8.2	8,980	24.6
Fall and injury	19.7	1,581.3	6.1	4.3	4,807	13.2
Illness and other	19.7	2,841.3	10.9	7.8	8,637	23.7
MVA	24.8	3,006.1	11.5	8.2	7,287	20.0
Overdose and psychiatric	20.2	370.6	1.4	1.0	1,100	3.0
Seizure and unconsciousness	19.8	1,699.8	6.5	4.7	5,146	14.1
EMS Total	**20.6**	**14,349.6**	**55.0**	**39.3**	**41,863**	**114.7**
False alarm	10.5	1,289.9	4.9	3.5	7,397	20.3
Good intent	12.1	886.4	3.4	2.4	4,385	12.0
Hazard	26.2	2,616.2	10.0	7.2	5,991	16.4
Outside fire	22.6	740.2	2.8	2.0	1,963	5.4
Public service	19.0	1,631.0	6.3	4.5	5,161	14.1
Structure fire	44.6	3,470.8	13.3	9.5	4,673	12.8
Fire Total	**21.6**	**10,634.5**	**40.8**	**29.1**	**29,570**	**81.0**
Cancelled	7.2	640.6	2.5	1.8	5,328	14.6
Mutual aid	33.4	442.7	1.7	1.2	795	2.2
Total	**20.2**	**26,067.4**	**100.0**	**71.4**	**77,556**	**212.5**

Observations:

- Total deployed time for the year was 26,067 hours. The daily average was 71.4 hours for all units combined.
- There were 77,556 runs, including 795 runs dispatched for mutual aid calls. The daily average was 213 runs.
- Fire calls accounted for 40.8 percent of the total workload.
- There were 6,636 runs for structure and outside fire calls, with a total workload of 4,211 hours. This accounted for 16.2 percent of the total workload. The average deployed time for structure fire calls was 44.6 minutes, and the average deployed time for outside fire calls was 22.6 minutes.
- EMS calls accounted for 55 percent of the total workload. The average deployed time for EMS calls was 20.6 minutes. The deployed hours for all units dispatched to EMS calls averaged 39.3 hours per day.

FIGURE 11-5: Average Deployed Minutes by Hour of Day

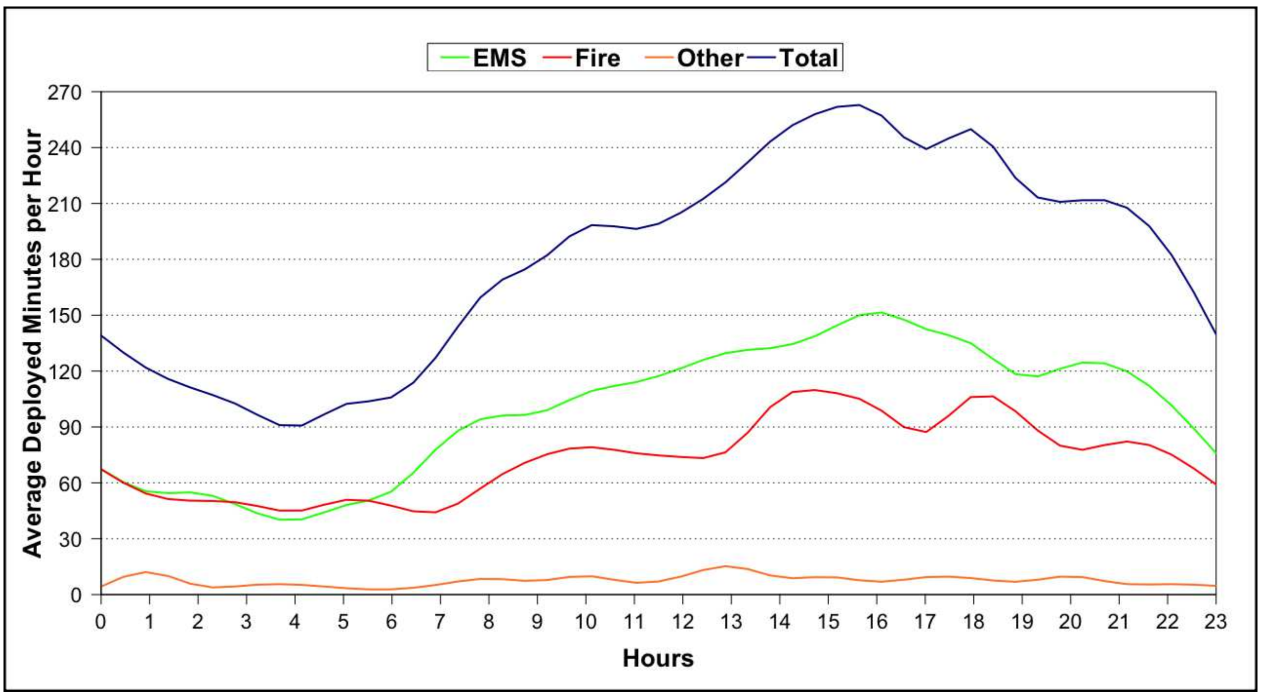


TABLE 11-6: Average Deployed Minutes by Hour of Day

Hour	EMS	Fire	Other	Total
0	67.4	67.3	4.3	139.1
1	55.0	53.6	12.1	120.7
2	54.6	50.4	4.8	109.8
3	46.0	48.8	4.9	99.7
4	39.9	44.7	5.4	90.0
5	47.7	50.7	3.5	101.9
6	55.6	47.6	2.8	106.1
7	80.3	44.7	5.6	130.6
8	95.4	60.2	8.6	164.1
9	97.4	73.5	7.4	178.3
10	108.3	79.2	10.0	197.6
11	113.9	76.0	6.4	196.3
12	121.9	73.8	10.0	205.7
13	130.3	78.4	15.2	224.0
14	133.0	105.2	9.3	247.4
15	142.1	108.9	9.5	260.5
16	151.7	100.5	6.9	259.1
17	142.7	87.1	9.4	239.2
18	134.1	106.8	8.7	249.6
19	117.1	95.3	7.0	219.4
20	123.3	78.0	9.9	211.2
21	121.8	81.9	6.0	209.7
22	103.6	76.3	5.6	185.4
23	75.9	59.1	4.7	139.7

Observations

- Hourly deployed time was highest during the day between 10:00 a.m. and 11:00 p.m., averaging between 185 minutes (3 hours and 5 minutes) and 261 minutes (4 hours and 21 minutes).
- Average deployed time peaked between 3:00 p.m. and 5:00 p.m., averaging about 260 minutes.
- Hourly deployed time was the lowest between 3:00 a.m. and 5:00 a.m., averaging between 90 and 100 minutes.

Workload Unit Type and by Station

Table 11-6 provides a summary of workload for units by unit type and Table 11-7 provides a summary of workload for all units in each station. Again, a detailed breakdown of workload by individual unit is provided in Attachment IV.

TABLE 11-7: Call Workload by Unit Type

Unit Type	Avg. Deployed Min. per Run	Total Annual Hours	Avg. Deployed Min. per Day	Total Annual Runs	Avg. Runs per Day	Number of Units
Air & Light	57.6	180.4	29.7	188	0.5	2
ARFF	22.0	101.1	16.6	276	0.8	4
ATV	1.4	0.0	0.0	1	0.0	1
Boat	54.4	26.3	4.3	29	0.1	5
Engine	19.3	16,917.7	2,781.0	52,668	144.3	27
Grass Rig	60.3	88.5	14.5	88	0.2	6
HazMat	40.6	784.9	129.0	1,161	3.2	3
Ladder	21.1	5,117.3	841.2	14,527	39.8	13
Rescue	34.3	65.1	10.7	114	0.3	1
Squad	19.6	2,778.2	456.7	8,499	23.3	6
Truck	94.2	7.9	1.3	5	0.0	1

Note: The number of engines includes two reserve engines that are occasionally used when a ladder is undergoing maintenance. The number of squads includes a 6th squad that is part of a pilot program.

Observations:

- Engines accounted for 52,668 runs during the year, an average of 144 runs per day or 6 runs per hour, with an average deployed time of 19 minutes per run.
- Engines averaged 1,951 runs each. Engines averaged 2,107 runs each when excluding the two reserve engines.
- Ladders accounted for 14,527 runs, an average of 40 runs per day, with an average deployed time of 21 minutes per run.
- Ladders averaged 1,177 runs each.
- Squads accounted for 8,499 runs, but averaged 1,417 runs each.

TABLE 11-8: Call Workload by Station

District &	Station	Avg. Deployed Min. per Run	Total Annual Hours	Avg. Deployed Min. per Day	Total Annual Runs	Avg. Runs per Day	Number of Units
1	2	18.1	1,172.5	192.7	3,892	10.7	3
	4	19.9	1,267.1	208.3	3,820	10.5	6
	5	17.0	512.9	84.3	1,810	5.0	1
	7	17.8	907.3	149.1	3,064	8.4	2
	12	22.2	269.5	44.3	728	2.0	1
	13	20.4	437.6	71.9	1,284	3.5	1
	Total	**18.8**	**4,566.9**	**750.7**	**14,598**	**40.0**	**14**
2	22	19.1	1,402.5	230.5	4,401	12.1	3
	27	21.0	1,992.9	327.6	5,690	15.6	3
	30	22.0	994.4	163.5	2,713	7.4	4
	31	22.2	543.4	89.3	1,468	4.0	3
	Total	**20.7**	**4,933.2**	**810.9**	**14,272**	**39.1**	**13**
3	6	33.5	1,130.3	185.8	2,024	5.5	4
	9	19.1	202.0	33.2	634	1.7	2
	14	17.6	418.0	68.7	1,426	3.9	1
	18	19.7	980.1	161.1	2,984	8.2	1
	26	21.7	714.6	117.5	1,980	5.4	4
	29	22.8	1,675.0	275.3	4,411	12.1	4
	Total	**22.8**	**5,120.1**	**841.7**	**13,459**	**36.9**	**16**
4	3	17.1	812.9	133.6	2,844	7.8	1
	10	19.7	703.3	115.6	2,143	5.9	2
	15	18.6	683.1	112.3	2,201	6.0	1
	16	19.9	624.9	102.7	1,888	5.2	1
	17	18.7	776.7	127.7	2,493	6.8	1
	19	20.8	521.3	85.7	1,505	4.1	1
	24	21.5	1,234.8	203.0	3,448	9.4	4
	Total	**19.5**	**5,357.0**	**880.6**	**16,522**	**45.3**	**11**
5	20	19.5	1,297.6	213.3	3,999	11.0	2
	21	18.2	839.3	138.0	2,766	7.6	1
	23	19.6	1,257.0	206.6	3,849	10.5	3
	25	17.7	704.2	115.8	2,391	6.6	1
	28	20.6	918.7	151.0	2,675	7.3	1
	32	21.2	972.3	159.8	2,749	7.5	3
	Total	**19.5**	**5,989.1**	**984.5**	**18,429**	**50.5**	**11**
7	51	22.0	101.1	16.6	276	0.8	4
	Total	**22.0**	**101.1**	**16.6**	**276**	**0.8**	**4**

TABLE 11-9: Total Annual Runs by Call Type and Station

District & Station		EMS	False Alarm	Good Intent	Hazard	Outside Fire	Public Service	Structure Fire	Cancelled	Mutual Aid	Total	Runs Per Day
1	2	2,186	398	220	193	67	198	344	249	37	3,892	10.7
	4	1,669	616	176	361	69	175	426	294	34	3,820	10.5
	5	838	346	103	136	36	82	78	183	8	1,810	5.0
	7	1,249	376	244	346	72	205	259	312	1	3,064	8.4
	12	383	54	37	61	29	73	47	28	16	728	2.0
	13	802	37	89	55	46	85	46	57	67	1,284	3.5
	Total	**7,127**	**1,827**	**869**	**1,152**	**319**	**818**	**1,200**	**1,123**	**163**	**14,598**	**40.0**
2	22	2,736	275	290	223	98	304	258	211	6	4,401	12.1
	27	3,280	582	421	311	135	343	284	310	24	5,690	15.6
	30	1,547	116	121	131	112	163	136	220	167	2,713	7.4
	31	524	121	84	158	71	211	90	111	98	1,468	4.0
	Total	**8,087**	**1,094**	**916**	**823**	**416**	**1,021**	**768**	**852**	**295**	**14,272**	**39.1**
3	6	546	143	163	806	38	145	89	53	41	2,024	5.5
	9	263	106	35	48	14	64	32	69	3	634	1.7
	14	595	208	88	129	21	126	89	168	2	1,426	3.9
	18	1,738	293	222	139	59	224	119	185	5	2,984	8.2
	26	1,119	167	107	117	74	145	142	74	35	1,980	5.4
	29	2,712	498	220	190	66	294	202	219	10	4,411	12.1
	Total	**6,973**	**1,415**	**835**	**1,429**	**272**	**998**	**673**	**768**	**96**	**13,459**	**36.9**
4	3	1,275	204	149	179	97	275	202	457	6	2,844	7.8
	10	1,212	184	99	127	82	141	192	94	12	2,143	5.9
	15	1,198	157	157	128	59	190	140	170	2	2,201	6.0
	16	1,158	112	113	97	75	100	149	73	11	1,888	5.2
	17	1,614	153	116	125	74	126	96	174	15	2,493	6.8
	19	984	70	65	56	46	72	65	75	72	1,505	4.1
	24	1,985	190	149	158	132	229	282	228	95	3,448	9.4
	Total	**9,426**	**1,070**	**848**	**870**	**565**	**1,133**	**1,126**	**1,271**	**213**	**16,522**	**45.3**
5	20	1,835	546	179	454	112	224	214	421	14	3,999	11.0

District & Station		EMS	False Alarm	Good Intent	Hazard	Outside Fire	Public Service	Structure Fire	Cancelled	Mutual Aid	Total	Runs Per Day
	21	1,623	246	126	196	56	223	128	165	3	2,766	7.6
	23	2,238	366	267	250	66	271	226	162	3	3,849	10.5
	25	1,226	278	145	290	56	120	138	135	3	2,391	6.6
	28	1,782	285	90	154	43	132	83	103	3	2,675	7.3
	32	1,397	252	100	324	58	188	114	314	2	2,749	7.5
	Total	**10,101**	**1,973**	**907**	**1,668**	**391**	**1,158**	**903**	**1,300**	**28**	**18,429**	**50.5**
7	51	149	18	10	49	0	33	3	14	0	276	0.8
	Total	**149**	**18**	**10**	**49**	**0**	**33**	**3**	**14**	**0**	**276**	**0.8**

TABLE 11-10: Daily Average Deployed Minutes by Call Type and Station

District & Station		EMS	False Alarm	Good Intent	Hazard	Outside Fire	Public Service	Structure Fire	Cancelled	Mutual Aid	Total
1	2	105.2	10.6	6.3	11.2	3.7	12.5	38.0	3.9	1.3	192.7
	4	81.4	18.4	5.0	25.0	3.7	10.9	50.5	6.0	7.4	208.3
	5	43.0	9.5	3.3	9.4	2.1	4.2	8.9	2.4	1.5	84.3
	7	62.2	10.5	6.9	24.4	4.2	11.0	24.9	5.0	0.0	149.1
	12	22.9	1.6	1.2	3.9	1.1	4.1	7.6	0.5	1.4	44.3
	13	41.7	1.2	2.7	4.4	2.8	4.9	9.4	1.2	3.6	71.9
	Total	**356.5**	**51.7**	**25.3**	**78.4**	**17.8**	**47.5**	**139.3**	**19.0**	**15.2**	**750.7**
2	22	143.4	9.2	10.4	12.3	6.9	14.2	28.9	5.1	0.2	230.5
	27	195.6	16.8	15.5	17.1	6.6	18.1	47.8	8.2	2.0	327.6
	30	96.0	4.0	4.2	8.6	8.2	9.5	18.7	6.1	8.2	163.5
	31	29.6	4.3	2.7	12.3	5.6	12.5	11.2	2.3	8.9	89.3
	Total	**464.6**	**34.2**	**32.8**	**50.3**	**27.3**	**54.3**	**106.5**	**21.6**	**19.4**	**810.9**
3	6	43.3	4.8	6.2	100.7	2.9	9.4	9.7	1.3	7.6	185.8
	9	17.2	3.2	1.5	3.5	0.7	3.2	2.9	0.8	0.2	33.2
	14	33.7	5.9	3.0	8.0	1.0	6.4	7.9	2.7	0.1	68.7
	18	106.8	7.9	7.8	8.1	2.5	10.2	13.2	3.8	1.0	161.1
	26	66.8	3.8	2.7	6.5	4.3	8.3	19.4	1.5	4.2	117.5
	29	180.4	15.0	9.4	13.5	5.3	18.4	26.1	4.1	3.0	275.3
	Total	**448.1**	**40.6**	**30.6**	**140.3**	**16.7**	**56.0**	**79.1**	**14.2**	**16.1**	**841.7**
4	3	61.2	5.7	4.0	11.5	6.0	12.3	24.1	8.2	0.6	133.6
	10	59.8	5.3	3.1	7.9	6.8	5.7	23.5	1.5	2.0	115.6
	15	61.0	4.1	5.4	8.1	3.9	8.9	18.3	2.6	0.1	112.3
	16	59.8	2.8	3.4	6.9	5.2	4.7	16.8	1.5	1.6	102.7
	17	87.0	4.1	3.7	8.3	4.1	4.2	10.7	4.4	1.1	127.7
	19	56.0	1.8	2.1	3.7	2.1	2.5	9.2	2.0	6.3	85.7
	24	105.9	5.3	5.2	9.8	9.9	8.6	44.8	4.7	8.8	203.0
	Total	**490.7**	**29.0**	**26.9**	**56.3**	**38.0**	**46.9**	**147.5**	**24.9**	**20.5**	**880.6**

District & Station		EMS	False Alarm	Good Intent	Hazard	Outside Fire	Public Service	Structure Fire	Cancelled	Mutual Aid	Total
5	20	108.4	15.9	5.9	27.9	6.3	12.5	26.5	8.6	1.1	213.3
	21	88.7	6.5	3.5	10.5	2.6	10.9	12.3	2.8	0.1	138.0
	23	133.1	10.5	9.7	13.7	3.2	14.1	19.3	3.0	0.0	206.6
	25	59.5	7.0	4.1	17.6	2.9	6.3	16.0	2.2	0.2	115.8
	28	108.5	8.1	2.9	10.1	2.3	6.7	10.9	1.4	0.1	151.0
	32	91.2	7.7	3.7	22.0	4.5	10.8	12.9	6.9	0.1	159.8
	Total	**589.4**	**55.7**	**29.8**	**101.8**	**21.9**	**61.3**	**98.0**	**24.9**	**1.7**	**984.5**
7	51	9.6	0.8	0.3	2.9	0.0	2.1	0.1	0.8	0.0	16.6
	Total	**9.6**	**0.8**	**0.3**	**2.9**	**0.0**	**2.1**	**0.1**	**0.8**	**0.0**	**16.6**

Observations:

- District 5 was the busiest district, with 18,429 runs and 5,989 hours of deployed time for the year. EMS calls accounted for 55 percent of these runs and 60 percent of the deployed time.
- District 7, which covers just the airport, was by far the least busy district when measured either by total runs or deployed time.
- District 3 had the second fewest runs with 13,459 runs and 5,120 hours of deployed time for the year. EMS calls accounted for 52 percent of these runs and 53 percent of the total deployed time.
- District 1 was the second least busy district in terms of deployed time with 4,567 hours of deployed time for the year and 14,598 runs.
- Station 27, with 3 units, had the most runs (5,690) and the most total deployed time (1,993 hours). Station 27 accounted for 40 percent of District 2's workload.
- Station 29 (4 units) and Station 22 (3 units) had the second and third most runs (4,411 and 4,401, respectively). Station 29 had considerably more total deployed time (1,675 hours) than Station 22 (1,403 hours).
- While the airport had the least runs and deployed time, the next stations that were least busy were Station 9 (2 units) and Station 12 (1 unit). Station 9 had 634 runs and 202 hours of deployed time, while Station 12 had 728 runs and 270 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 8,760 hours in the year. Table 11-10 shows the number of hours in the year where there were zero to 16 or more calls during the hour.

Table 11-11 shows the 10 one-hour intervals during the year with the most calls. When looking at the 10 hours with the most calls, calls with extremely short durations were excluded. This is because leaving those calls in resulted in one hour with 25 calls but less than one hour of deployed time for all units deployed to those calls.

TABLE 11-11: Frequency Distribution of the Number of Calls

Calls in an Hour	Frequency	Percentage
0	119	1.36
1	374	4.27
2	637	7.27
3	821	9.37
4	918	10.48
5	972	11.10
6	936	10.68
7	884	10.09
8	784	8.95
9	644	7.35
10	511	5.83
11	375	4.28
12	270	3.08
13	173	1.97
14	148	1.69
15	82	0.94
16+	112	1.28

TABLE 11-12: Top 10 Hours with the Most Calls Received

Hour	Number of Calls	Number of Runs	Total Deployed Hours
5/16/2015 – 11 p.m. to 12 a.m.	32	36	12.3
5/23/2015 – 9 p.m. to 10 p.m.	31	51	15.8
2/16/2015 – 6 p.m. to 7 p.m.	31	41	14.9
6/19/2015 – 3 p.m. to 4 p.m.	26	32	11.3
1/17/2015 – 3 p.m. to 4 p.m.	25	30	10.5
11/5/2015 – 3 p.m. to 4 p.m.	24	34	13.8
6/18/2015 – 5 p.m. to 6 p.m.	22	31	8.2
7/30/2015 – 1 p.m. to 2 p.m.	22	28	12.3
7/9/2015 – 10 a.m. to 11 a.m.	21	38	16.7
3/25/2015 – 5 p.m. to 6 p.m.	21	36	7.1

Note: The 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. Number of runs only includes dispatches of TFD units.

Observations

- During 785 hours (9 percent of all hours), 12 or more calls occurred. That is, the TFD responded to an average of two calls per district in an hour, including the airport, roughly twice a day.
- During 112 hours (1.3 percent of all hours), 16 or more calls occurred; in other words, the TFD responded to 16 or more calls in an hour roughly once every three days.
- The highest number of calls to occur in an hour was 32, which happened once.
- The hour with the most calls was 11:00 p.m. to midnight on May 16, 2015. The 32 calls involved 36 individual dispatches resulting in 12.3 hours of deployed time. These 32 calls included 8 EMS calls, 2 of which were MVAs, 3 cancelled calls, 6 false alarms, 7 hazards, 7 public service calls, and 1 good intent call. The longest call lasted 49 minutes, and it was an illness and other type EMS call.
- The hour with the second most calls received was the hour with the most runs and which occurred between 9:00 p.m. and 10:00 p.m. on May 23, 2015, with 31 calls and 51 individual dispatches resulting in 15.8 hours of deployed time. The 31 calls included 6 EMS calls, 1 cancelled call, 5 false alarms, 2 hazards, 13 public service calls, and 4 good intent calls. The longest call lasted 2 hours and 14 minutes and was a public service call.
    - The area experienced record rainfall in May 2015 and experienced severe flash flooding on May 23.
- February 16, 2015, between 6 p.m. and 7 p.m. also saw 31 calls. Those 31 calls resulted in 41 dispatches and 14.9 total deployed hours. On that day, Tulsa received over 2.5 inches of snow and freezing rain.

Response Time

This section presents response time statistics for different call types and units.

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 focused on priority 1 and priority 2 calls, which were responded to by TFD units with lights and sirens. We focused on units that had complete timestamps, that is, units with all components recorded so as to be able to calculate each segment of response time. For most types of calls, the main focus is the dispatch and response time of the first arriving, non-administrative unit. However, for structure fire calls, we also analyze the response time of the second arriving unit.

Based on the methodology above, 4,867 nonemergency calls and 27 calls with no priority assigned were excluded as were the 4,758 mutual aid and cancelled calls. An additional 1,900 calls were excluded due to issues with time stamps, including incomplete time stamps, time stamps that were the same for dispatch, en route, and arrival, and time stamps showing negative response times (e.g., arrival before en route). As a result, in this section, a total of 43,147 calls were used in the analysis.

Response Times by Type of Call

Table 11-12 provides average dispatch, turnout, travel, and total response times for the first arriving units, broken out by call type. Figures 11-6 and 11-7 illustrate the same information. Table 11-13 gives the 90th percentile time broken out in the same manner. A 90th percentile time means that 90 percent of calls had dispatch, turnout, travel, or total response times at or below that number.

TABLE 11-13: Average Response Times of First Arriving Unit, by Call Type (Minutes)

Call Type	Dispatch Time	Turnout Time	Travel Time	Response Time	Sample Size
Breathing difficulty	0.3	1.2	3.4	4.9	5,289
Cardiac and stroke	0.3	1.1	3.3	4.7	7,206
Fall and injury	0.5	1.1	3.3	4.9	3,630
Illness and other	0.4	1.1	3.4	5.0	6,808
MVA	0.6	1.0	3.2	4.8	3,798
Overdose and psychiatric	0.4	1.1	3.3	4.8	915
Seizure and unconsciousness	0.3	1.1	3.2	4.6	4,401
EMS Total	**0.4**	**1.1**	**3.3**	**4.8**	**32,047**
False alarm	1.4	1.1	3.2	5.8	2,725
Good intent	1.1	1.1	3.5	5.8	2,389
Hazard	1.4	1.1	3.5	6.0	2,115
Outside fire	1.5	1.1	3.3	5.8	1,038
Public service	1.2	1.1	3.8	6.2	2,168
Structure fire	1.2	1.1	2.6	4.9	665
Fire Total	**1.3**	**1.1**	**3.4**	**5.8**	**11,100**
Total	**0.6**	**1.1**	**3.3**	**5.1**	**43,147**

Note: EMS dispatch times here appear to be very low because this includes only the TFD dispatch time. It does not include call processing time or EMSA call screening time.

FIGURE 11-6: Average Response Times of First Arriving Unit, by Call Type – EMS Calls

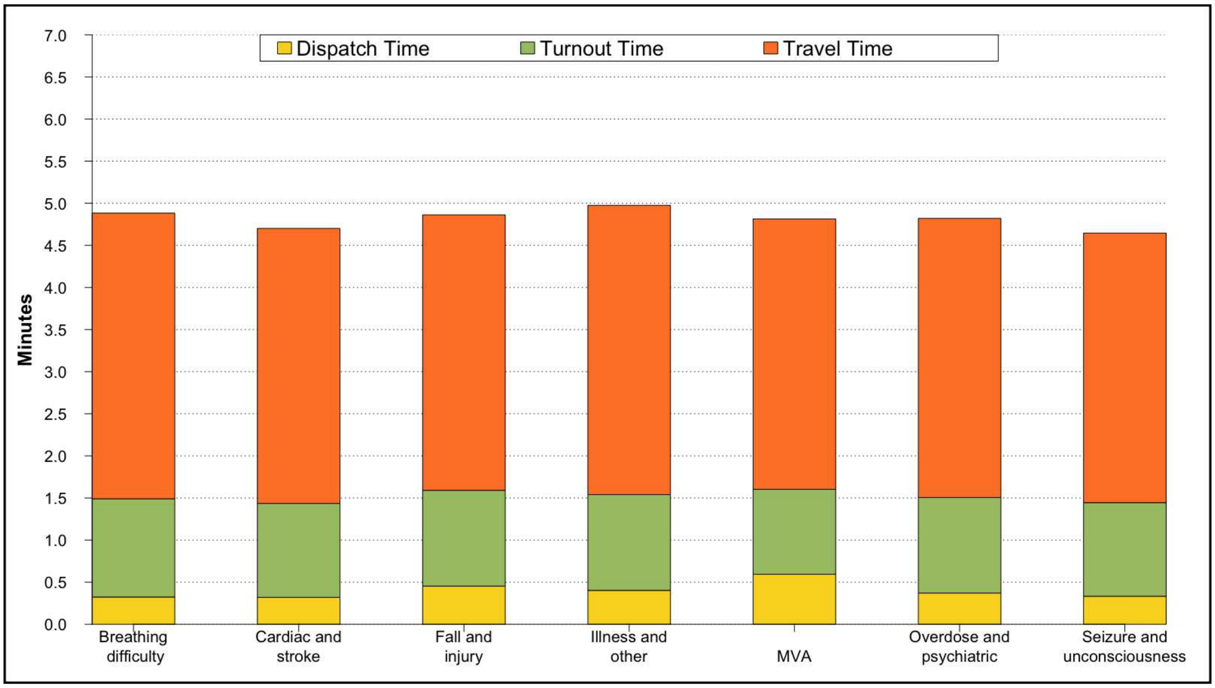


FIGURE 11-7: Average Response Times of First Arriving Unit, by Call Type – Fire Calls

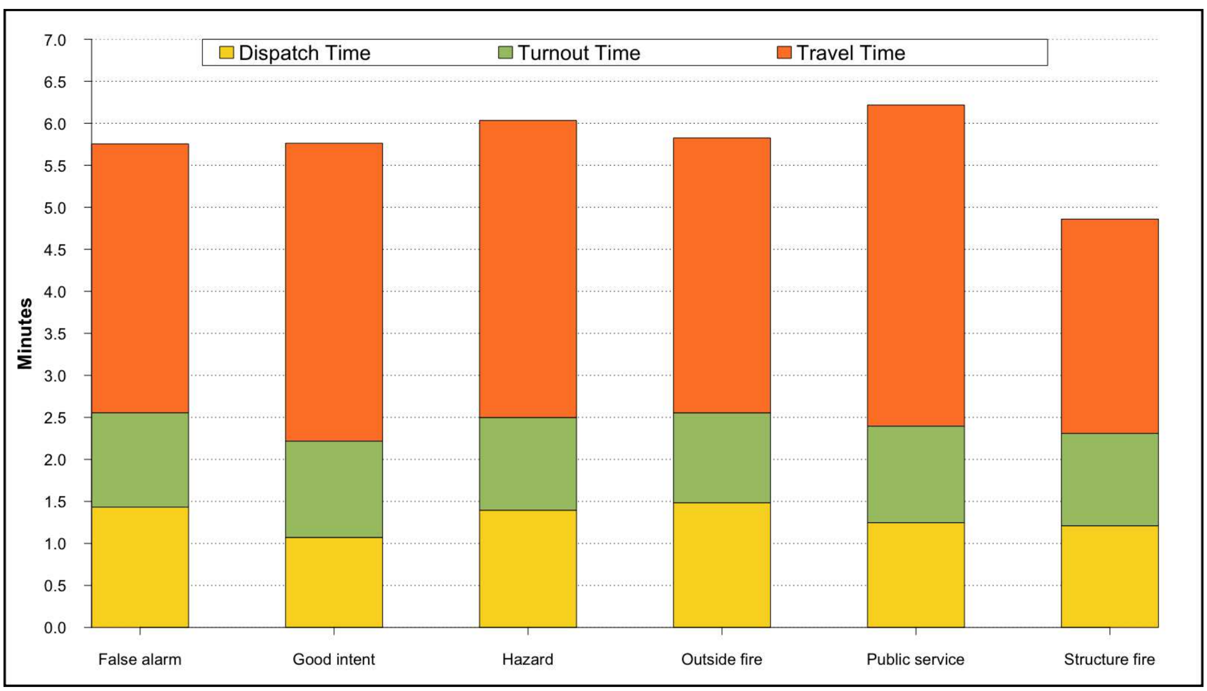


TABLE 11-14: 90th Percentile Response Times of First Arriving Unit, by Call Type (Minutes)

Call Type	Dispatch Time	Turnout Time	Travel Time	Response Time	Sample Size
Breathing difficulty	0.6	1.7	5.1	6.7	5,289
Cardiac and stroke	0.6	1.6	5.0	6.6	7,206
Fall and injury	1.0	1.7	5.1	7.0	3,630
Illness and other	0.9	1.7	5.4	7.1	6,808
MVA	1.4	1.5	5.3	7.3	3,798
Overdose and psychiatric	0.8	1.6	5.1	6.8	915
Seizure and unconsciousness	0.6	1.6	4.9	6.6	4,401
EMS Total	**0.8**	**1.6**	**5.1**	**6.9**	**32,047**
False alarm	2.3	1.7	5.3	8.3	2,725
Good intent	2.5	1.7	5.6	8.5	2,389
Hazard	2.6	1.6	5.6	8.7	2,115
Outside fire	2.4	1.6	5.4	8.5	1,038
Public service	2.7	1.7	6.0	9.3	2,168
Structure fire	2.0	1.6	4.1	6.9	665
Fire Total	**2.5**	**1.7**	**5.5**	**8.6**	**11,100**
Total	**1.5**	**1.7**	**5.3**	**7.4**	**43,147**

Observations

- The average dispatch time was 0.6 minutes.
- The average turnout time was 1.1 minutes.
- The average travel time was 3.3 minutes.
- The average response time was 4.8 minutes for EMS calls and 5.8 minutes for fire calls.
- The average response time for structure fire calls was 4.9 minutes, and outside fire calls was 5.8 minutes.
- The 90th percentile dispatch time was 1.5 minutes.
- The 90th percentile turnout time was 1.7 minutes.
- The 90th percentile travel time was 5.3 minutes.
- The 90th percentile response time was 6.9 minutes for EMS calls and 8.6 minutes for fire calls.
- The 90th percentile response time for structure fire calls was 6.9 minutes, and for outside fire calls was 8.5 minutes.

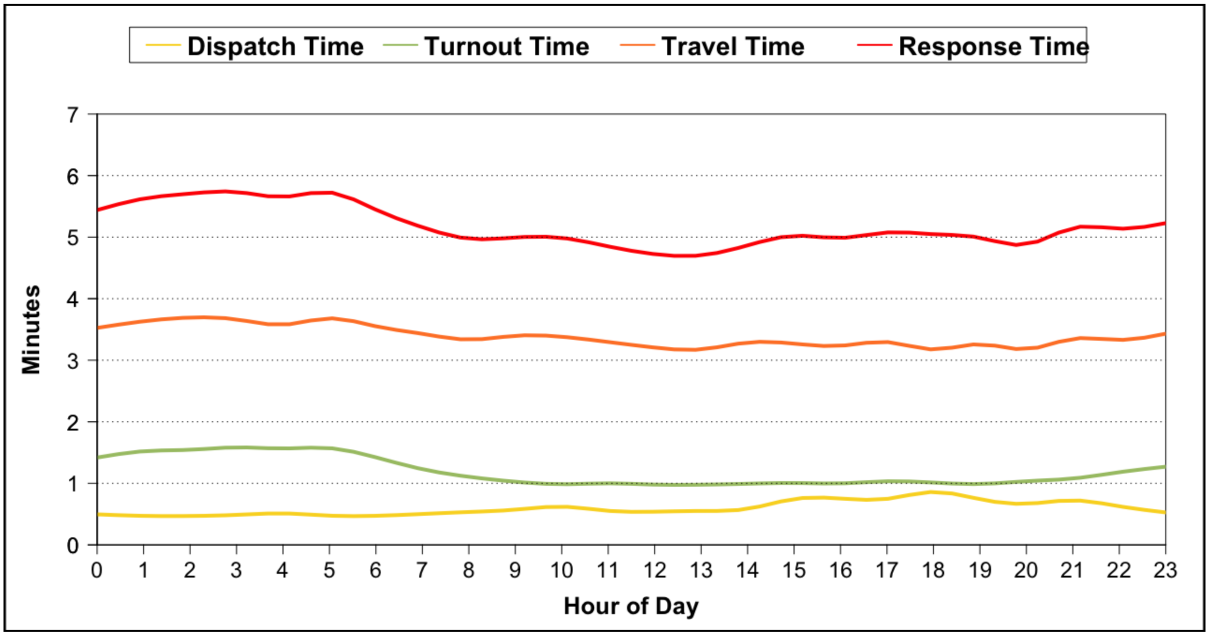
Response Times by Hour

Average dispatch, turnout, travel, and total response times by hour are shown in Table 11-14 and Figure 11-8. The table also shows 90th percentile times.

TABLE 11-15: Average and 90th Percentile Response Times of First Arriving Unit, by Hour of Day

Hour	Dispatch Time	Turnout Time	Travel Time	Response Time	90th Percentile Response Time	Sample Size
0	0.5	1.4	3.5	5.4	7.5	1,323
1	0.5	1.5	3.7	5.7	7.9	1,158
2	0.5	1.5	3.7	5.7	7.9	1,061
3	0.5	1.6	3.7	5.7	8.0	898
4	0.5	1.6	3.6	5.7	7.9	815
5	0.5	1.6	3.7	5.7	7.8	854
6	0.5	1.4	3.5	5.4	7.6	1,043
7	0.5	1.2	3.4	5.2	7.4	1,358
8	0.5	1.1	3.3	5.0	7.1	1,651
9	0.6	1.0	3.4	5.0	7.2	1,839
10	0.6	1.0	3.4	5.0	7.1	1,964
11	0.6	1.0	3.3	4.8	7.0	2,076
12	0.5	1.0	3.2	4.7	6.9	2,250
13	0.6	1.0	3.2	4.7	7.0	2,263
14	0.6	1.0	3.3	4.9	7.0	2,444
15	0.7	1.0	3.3	5.0	7.5	2,466
16	0.8	1.0	3.2	5.0	7.5	2,530
17	0.7	1.0	3.3	5.1	7.7	2,438
18	0.9	1.0	3.2	5.0	7.3	2,468
19	0.7	1.0	3.3	5.0	7.3	2,253
20	0.7	1.0	3.2	4.9	7.0	2,270
21	0.7	1.1	3.3	5.2	7.5	2,284
22	0.6	1.2	3.3	5.1	7.5	1,885
23	0.5	1.3	3.4	5.2	7.5	1,556

FIGURE 11-8: Average Response Time of First Arriving Unit, by Hour of Day



Observations

- Average dispatch time was between 0.5 minute (11:00 p.m. to 9:00 a.m.) and 0.9 minute (6:00 p.m. and 7:00 p.m.).
- Average turnout time was between 1.0 minute (9:00 a.m. to 9:00 p.m.) and 1.6 minutes (3:00 a.m. to 6:00 a.m.).
- Average travel time was between 3.2 and 3.7 minutes, with peak times occurring between 2:00 a.m. and 6:00 a.m.
- Average response time was between 4.7 minutes (Noon to 2:00 p.m.) and 5.7 minutes (1:00 a.m. to 6:00 a.m.).

Response Time Distribution

A more detailed look at how response times are distributed among call types is presented here. Further breakdown of response times by station area is included in Attachment VI.

Figure 11-9 and Table 11-15 show the cumulative distribution of response time for the first arriving unit to EMS calls. Figure 11-10 shows response times for first arriving TFD unit to EMS calls as a frequency distribution in whole minute increments.

The same cumulative and frequency distribution information is presented for structure fires in Figure 11-11, Table 11-16, and Figure 11-12, and for outside fires in Figure 11-13, Table 11-17, and Figure 11-14. Structure fire response time distributions show both the first and second arriving units.

FIGURE 11-9: Cumulative Distribution of Response Time – First Arriving Unit – EMS

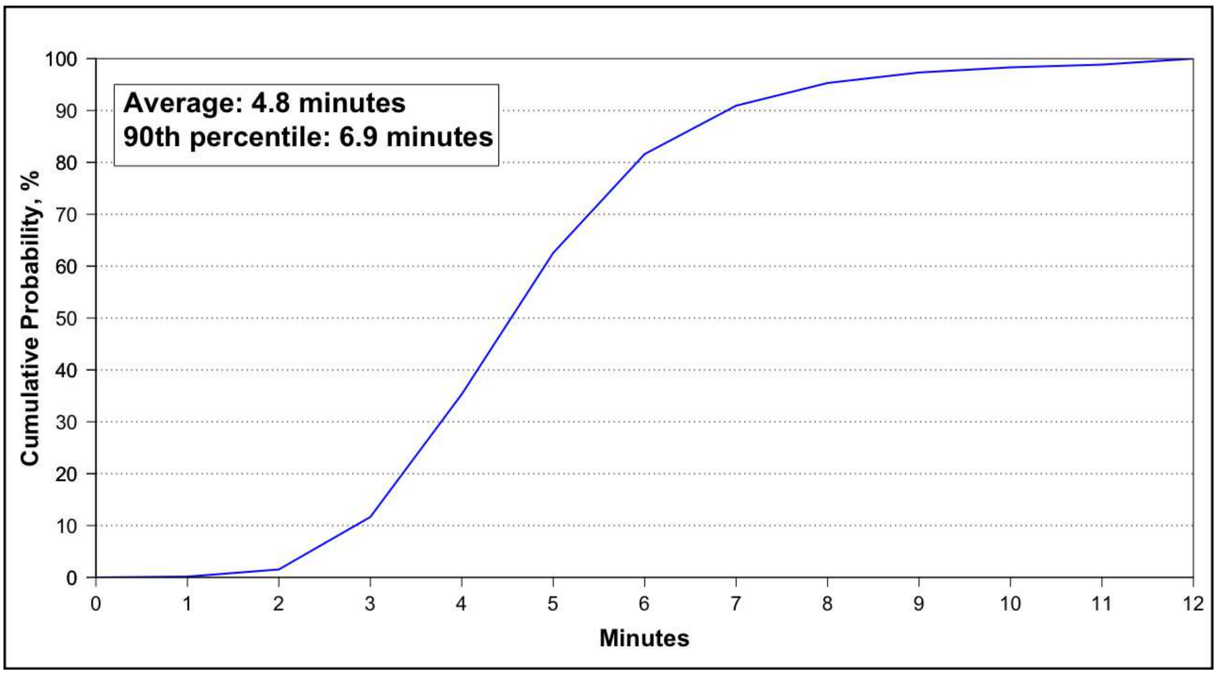
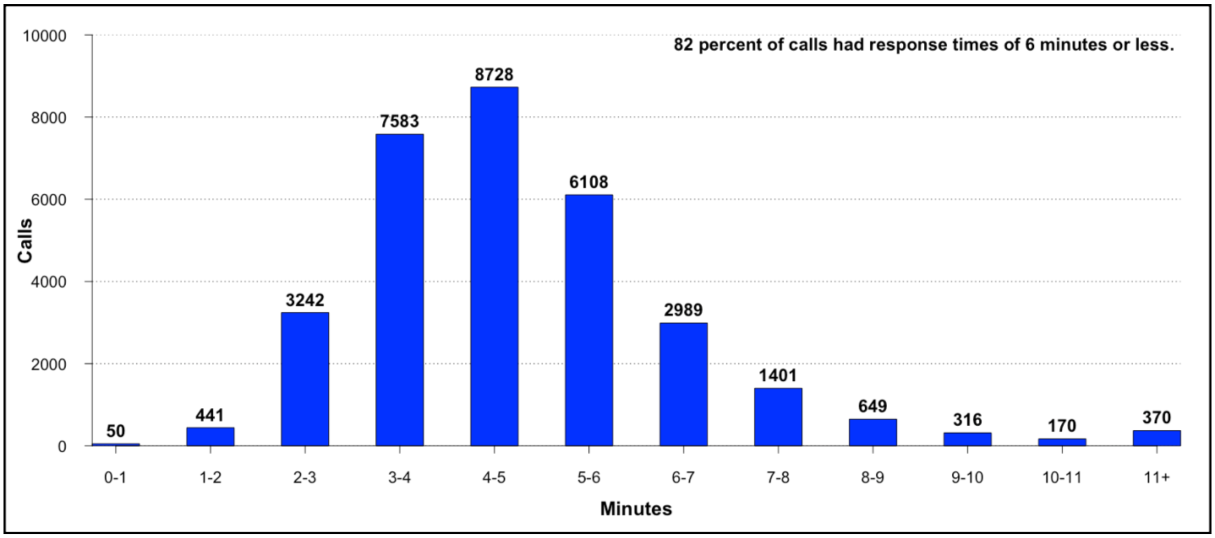


TABLE 11-16: Cumulative Distribution of Response Time – First Arriving Unit – EMS Calls

Response Time (minute)	Frequency	Cumulative Percentage
0 - 1	50	0.2
1 - 2	441	1.5
2 - 3	3,242	11.6
3 - 4	7,583	35.3
4 - 5	8,728	62.5
5 - 6	6,108	81.6
6 - 7	2,989	90.9
7 - 8	1,401	95.3
8 - 9	649	97.3
9 - 10	316	98.3
10 - 11	170	98.8
11+	370	100.0

FIGURE 11-10: Frequency Distribution of Response Time – First Arriving Unit – EMS Calls



Observations

- The average response time of first arriving TFD unit to EMS calls was 4.8 minutes.
- For 82 percent of EMS calls, the response time of the first arriving unit 6 minutes or less.
- For 90 percent of EMS calls, the response time of the first arriving was less than 7 minutes.

FIGURE 11-11: Cumulative Distribution of Response Time – First and Second Arriving Unit – Structure Fire Calls

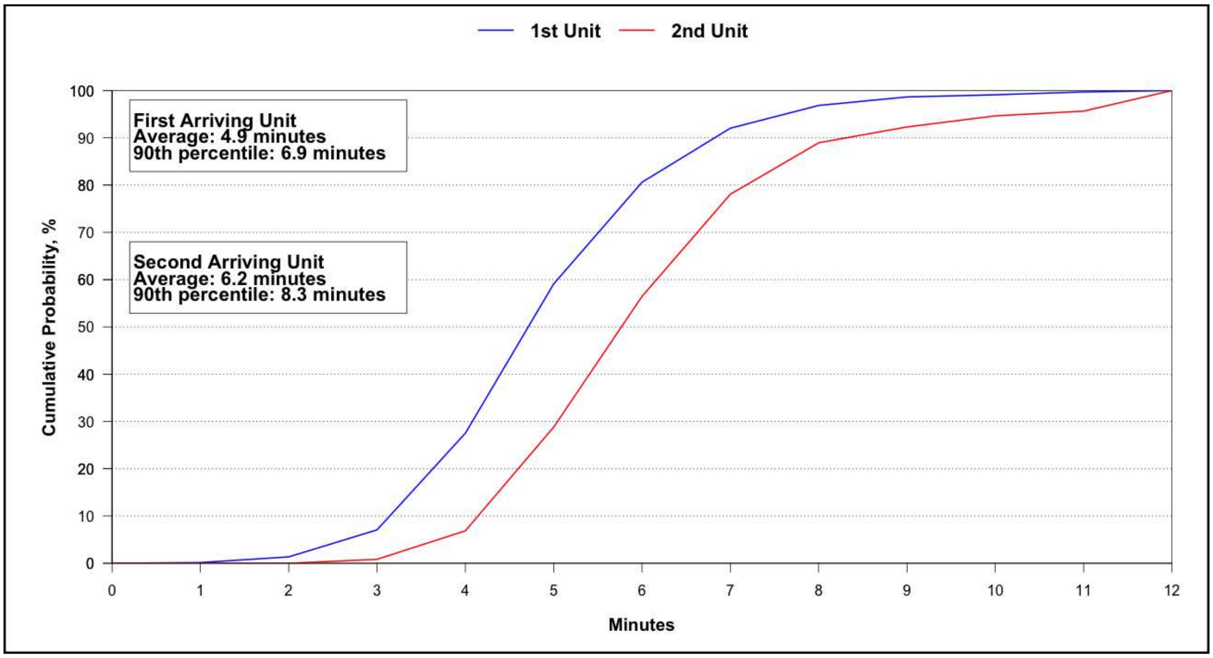
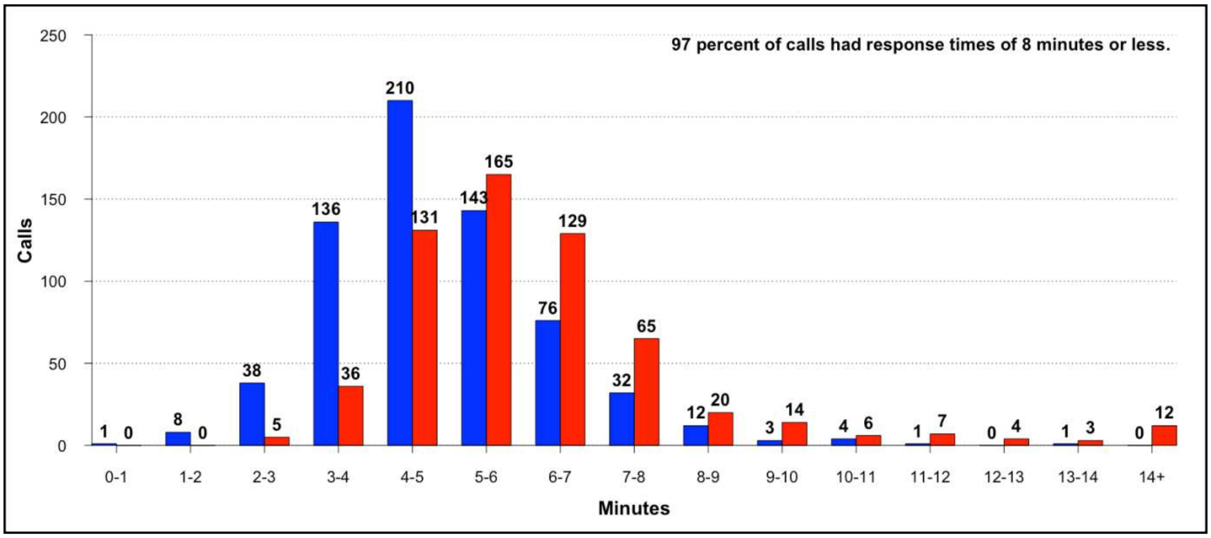


TABLE 11-17: Cumulative Distribution of Response Time – First and Second Arriving Unit – Structure Fire Calls

Response Time (minute)	1st Unit		2nd Unit	
	Frequency	Cumulative Percent	Frequency	Cumulative Percent
0 - 1	1	0.2	0	0.0
1 - 2	8	1.4	0	0.0
2 - 3	38	7.1	5	0.8
3 - 4	136	27.5	36	6.9
4 - 5	210	59.1	131	28.8
5 - 6	143	80.6	165	56.4
6 - 7	76	92.0	129	78.1
7 - 8	32	96.8	65	88.9
8 - 9	12	98.6	20	92.3
9 - 10	3	99.1	14	94.6
10 - 11	4	99.7	6	95.6
11+	2	100.0	26	100.0

FIGURE 11-12: Frequency Distribution of Response Time – First and Second Arriving Unit – Structure Fire Calls



Observations

- The average response time of the first arriving unit for structure fire calls was 4.9 minutes.
- 97 percent of the time, the first arriving unit's response time was less than 8 minutes for structure fire calls.
- For structure fire calls, the average response time of the second arriving unit was 6.2 minutes.
- For structure fire calls, the 90th percentile response time of the second arriving unit was 8.3 minutes.

FIGURE 11-13: Cumulative Distribution of Response Time – First Arriving Unit – Outside Fire Calls

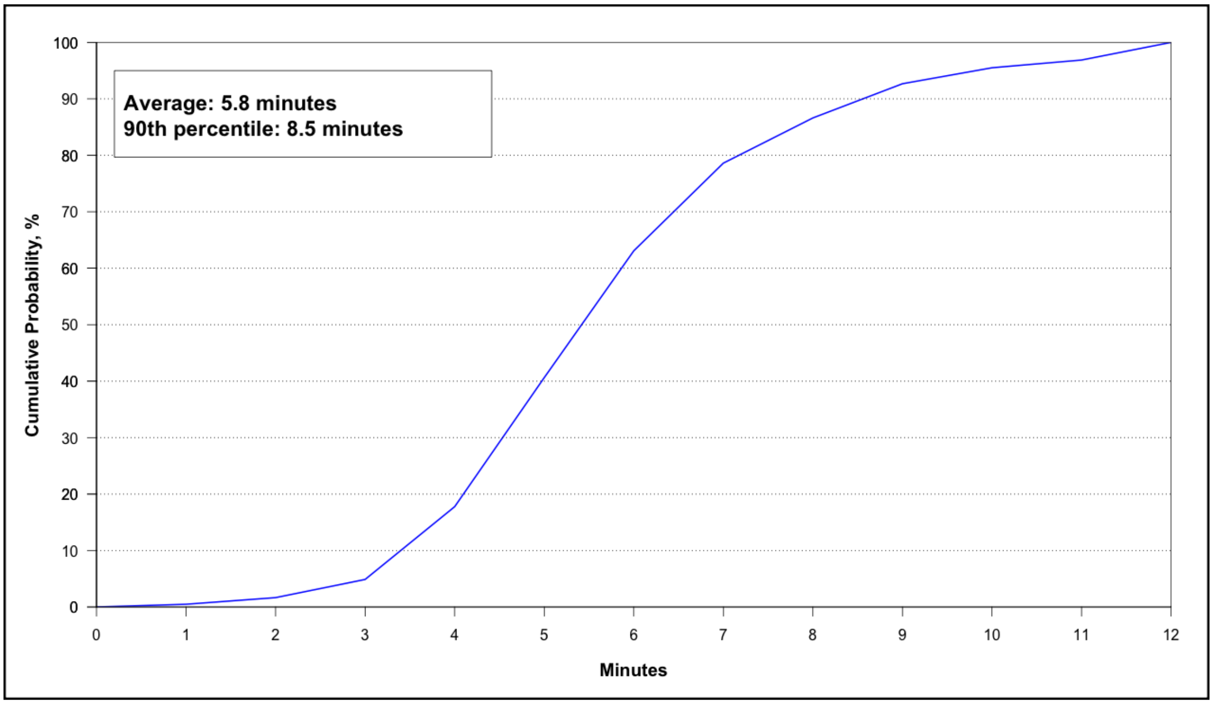
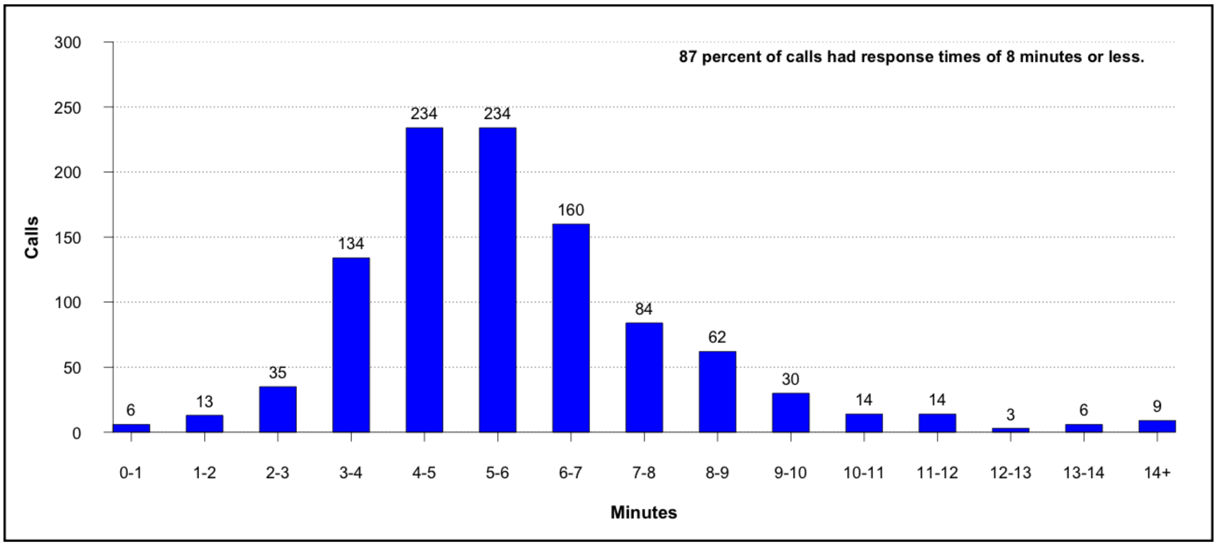


TABLE 11-18: Cumulative Distribution of Response Time – First Arriving Unit – Outside Fire Calls

Response Time (minute)	Frequency	Cumulative Percentage
0 - 1	6	0.6
1 - 2	13	1.8
2 - 3	35	5.2
3 - 4	134	18.1
4 - 5	234	40.7
5 - 6	234	63.2
6 - 7	160	78.6
7 - 8	84	86.7
8 - 9	62	92.7
9 - 10	30	95.6
10 - 11	14	96.9
11+	32	100.0

FIGURE 11-14: Frequency Distribution of Response Time – First Arriving Unit – Outside Fire Calls



Observations

- The average response time of first arriving unit for outside fire calls was 5.8 minutes.
- 87 percent of the time, the first arriving unit's response time was less than 8 minutes for outside fire calls.
- For outside fire calls, the 90th percentile response time of the first arriving unit was 8.5 minutes.

Attachment I

TABLE 11-19: Actions Taken for Structure and Outside Fire Calls

Action Taken	Number of Calls	
	Structure fire	Outside fire
Fire control or extinguishment, other	115	189
Extinguishment by fire service personnel	407	732
Salvage & overhaul	97	11
Establish fire lines, Contain, Confine, or Control fire (wildfire)	0	15
Search	34	0
Ventilate	47	1
Information, investigation & enforcement, other	3	17
Incident command	18	22
Investigate	194	156
Investigate fire out on arrival	34	39
All Other Actions	62	55
Total	**1,011**	**1,237**

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

Observations

- A total of 407 structure fire calls were extinguished by fire service personnel, which accounted for 57 percent of structure fire calls in TFD's jurisdiction.
- A total of 732 outside fire calls were extinguished by fire service personnel, which accounted for 63 percent of outside fire calls in TFD's jurisdiction.

Attachment II

TABLE 11-20: 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	$1,664,279	526	$188,874	350
Structure fire	$8,355,317	687	$2,741,308	538
Total	**$10,019,596**	**1,213**	**$2,930,182**	**888**

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

Observations

- Out of 1,153 outside fires, 526 had recorded property loss, with a combined $1,664,279 in loss.
- 350 outside fires also had content loss, with a combined $188,874 in loss.
- Out of 713 structure fires, 687 had recorded property loss, with a combined $8,355,317 in loss.
- 538 structure fires also had content loss with a combined $2,741,308 in loss.
- The average total loss for structure fires was $16,152.29.

TABLE 11-21: Total Fire Loss Above and Below $20,000

Call Type	No Loss	Under $20,000	$20,000 plus
Outside fire	622	510	21
Structure fire	26	525	162
Total	**648**	**1,035**	**183**

Observations

- 622 outside fires and 26 structure fires had no recorded loss.
- 118 outside fires and 75 structure fires had $2 or less in total recorded loss - $1 in property loss and $1 in content loss. This may be a reporting issue.
- 21 outside fires and 162 structure fires had $20,000 or more in loss.
- The highest total loss for an outside fire was $101,000.
- The highest total loss for a structure fire was $580,000.

TABLE 11-22: Total Fire Loss by Station Area – Structure Fires

District &Station		Fires with Loss	Average Loss	$20,000+ Loss Fires	Total Losses
1	2	22	$36,280.14	7	$798,163
	4	9	$13,893.56	3	$125,042
	5	21	$7,952.57	3	$167,004
	7	15	$11,221.73	3	$168,326
	12	13	$4,808.08	1	$62,505
	13	29	$12,915.28	10	$374,543
	Total	**109**	**$15,555.81**	**27**	**$1,695,583**
2	22	40	$17,914.75	10	$716,590
	27	65	$23,795.34	20	$1,546,697
	30	20	$30,322.50	7	$606,450
	31	8	$18,169.00	2	$145,352
	Not Recorded	1	$1,500.00	0	$1,500
	Total	**134**	**$22,511.86**	**39**	**$3,016,589**
3	6	7	$5,729.71	1	$40,108
	9	4	$19,287.75	2	$77,151
	14	8	$16,150.38	2	$129,203
	18	33	$17,133.45	7	$565,404
	26	18	$17,750.39	6	$319,507
	29	43	$16,786.60	3	$721,824
	Total	**113**	**$16,399.97**	**21**	**$1,853,197**
4	3	47	$11,089.06	9	$521,186
	10	34	$12,388.71	8	$421,216
	15	16	$12,532.56	5	$200,521
	16	32	$6,065.91	4	$194,109
	17	22	$15,739.32	7	$346,265
	19	34	$11,163.38	8	$379,555
	24	35	$10,880.91	5	$380,832
	Not Recorded	1	$15,000.00	0	$15,000
	Total	**221**	**$11,125.27**	**46**	**$2,458,684**
5	20	20	$31,906.55	7	$638,131
	21	12	$18,347.58	2	$220,171
	23	22	$11,600.05	5	$255,201
	25	20	$19,022.25	7	$380,445
	28	19	$21,566.74	6	$409,768
	32	16	$10,553.38	2	$168,854
	Total	**109**	**$19,014.40**	**29**	**$2,072,570**
7	51	1	$2.00	0	$2
	Total	**1**	**$2.00**	**0**	**$2**

Observations

- District 2 had the highest total loss, and the two stations with the most structure fires with loss over $20,000: Station 27 with 20 fires and Station 22 (tied with Station 13) with 10 fires.
- District 4 had the most structure fires with loss and the most with loss over $20,000.
- Station 2, Station 20, and Station 30 had the highest average losses for structure fires, averaging over $30,000 each.

Attachment III

TABLE 11-23: Workload of Administrative Units (Command Vehicles)

Description	Annual Hours	Annual Number of Runs
District Chief 1	150.3	409
District Chief 2	115.4	275
District Chief 3	101.2	311
District Chief 4	120.2	306
District Chief 5	110.8	396
On-duty Assistant Chief	15.3	8
On-duty EMS Officer	186.7	282
Staff Vehicle	1,235.0	913

Attachment IV

TABLE 11-24: Call Workload by Unit

District & Station		Unit Type	Unit ID	Avg. Deployed Min. per Run	Total Annual Hours	Avg. Deployed Min. per Day	Total Annual Runs	Avg. Runs per Day
1	2	Engine	E-2	17.2	632.0	103.9	2,203	6.0
		Ladder	L-2	22.2	188.8	31.0	511	1.4
		Squad	SQ-02	17.9	351.7	57.8	1,178	3.2
	4	Air & Light	AIR 4	49.4	107.8	17.7	131	0.4
		Boat	BOAT 4	75.0	16.3	2.7	13	0.0
		Engine	E-4	17.0	699.1	114.9	2,473	6.8
		Ladder	L-4	20.5	370.9	61.0	1,084	3.0
		Rescue	RESCUE 4	34.3	65.1	10.7	114	0.3
		Truck	TRUCK 4	94.2	7.9	1.3	5	0.0
	5	Engine	E-5	17.0	512.9	84.3	1,810	5.0
	7	Engine	E-7	16.8	568.1	93.4	2,033	5.6
		Ladder	L-7	19.7	339.2	55.8	1,031	2.8
	12	Engine	E-12	22.2	269.5	44.3	728	2.0
	13	Engine	E-13	20.4	437.6	71.9	1,284	3.5
	Total			**18.8**	**4,566.9**	**750.7**	**14,598**	**40.0**
2	22	Engine	E-22	9.6	2.6	0.4	16	0.0
		Ladder	L-22	20.1	600.6	98.7	1,792	4.9
		Squad	SQ-22	18.5	799.3	131.4	2,593	7.1
	27	Air & Light	AIR 27	76.4	72.6	11.9	57	0.2
		Engine	E-27	20.1	1,217.4	200.1	3,642	10.0
		Ladder	L-27	21.2	702.9	115.5	1,991	5.5
	30	Boat	BOAT 30	43.3	1.4	0.2	2	0.0
		Engine	E-30	21.3	726.4	119.4	2,046	5.6
		Grass Rig	GR-30	60.1	26.0	4.3	26	0.1
		Ladder	L-30	22.6	240.6	39.5	639	1.8
	31	Engine	E-31	21.6	392.7	64.6	1,093	3.0

District & Station		Unit Type	Unit ID	Avg. Deployed Min. per Run	Total Annual Hours	Avg. Deployed Min. per Day	Total Annual Runs	Avg. Runs per Day
		Grass Rig	GR-31	46.2	9.2	1.5	12	0.0
		Ladder	L-31	23.4	141.5	23.3	363	1.0
	Total			**20.7**	**4,933.2**	**810.9**	**14,272**	**39.1**
3	6	ATV	ATV 1	1.4	0.0	0.0	1	0.0
		Engine	E-6	24.1	348.1	57.2	867	2.4
		HazMat	HM-1	39.2	435.7	71.6	667	1.8
		HazMat	HM-2	42.5	346.6	57.0	489	1.3
	9	Engine	E-9	19.0	199.4	32.8	629	1.7
		HazMat	HM-4	31.6	2.6	0.4	5	0.0
	14	Engine	E-14	17.6	418.0	68.7	1,426	3.9
	18	Engine	E-18	19.7	980.1	161.1	2,984	8.2
	26	Boat	BOAT 26	20.0	2.7	0.4	8	0.0
		Grass Rig	GR-26	43.3	7.9	1.3	11	0.0
		Ladder	L-26	21.5	329.5	54.2	921	2.5
		Squad	SQ-26	21.6	374.5	61.6	1,040	2.8
	29	Boat	BOAT 29	63.6	5.3	0.9	5	0.0
		Engine	E-29	22.5	1,142.8	187.9	3,050	8.4
		Ladder	L-29	23.1	480.1	78.9	1,245	3.4
		Squad	SQ-29	25.3	46.8	7.7	111	0.3
	Total			**22.8**	**5,120.1**	**841.7**	**13,459**	**36.9**
4	3	Engine	E-3	17.1	812.9	133.6	2,844	7.8

District &	Station	Unit Type	Unit ID	Avg. Deployed Min. per Run	Total Annual Hours	Avg. Deployed Min. per Day	Total Annual Runs	Avg. Runs per Day
	10	Engine	E-10	19.3	686.2	112.8	2,132	5.8
		Grass Rig	GR-10	93.5	17.1	2.8	11	0.0
	15	Engine	E-15	18.6	683.1	112.3	2,201	6.0
	16	Engine	E-16	19.9	624.9	102.7	1,888	5.2
	17	Engine	E-17	18.7	776.7	127.7	2,493	6.8
	19	Engine	E-19	20.8	521.3	85.7	1,505	4.1
	24	Boat	BOAT 24	37.4	0.6	0.1	1	0.0
		Engine	E-24	20.1	791.3	130.1	2,363	6.5
		Grass Rig	GR-24	59.1	19.7	3.2	20	0.1
		Ladder	L-24	23.9	423.1	69.5	1,064	2.9
	Total			**19.5**	**5,357.0**	**880.6**	**16,522**	**45.3**
5	20	Engine	E-20	19.1	905.0	148.8	2,844	7.8
		Ladder	L-20	20.4	392.6	64.5	1,155	3.2
	21	Engine	E-21	18.2	839.3	138.0	2,765	7.6
	23	Engine	E-23	22.8	107.3	17.6	282	0.8
		Ladder	L-23	19.5	455.7	74.9	1,404	3.8
		Squad	SQ-23	19.3	694.0	114.1	2,163	5.9
	25	Engine	E-25	17.7	704.2	115.8	2,391	6.6
	28	Engine	E-28	20.6	918.7	151.0	2,675	7.3
	32	Grass Rig	GR-32	63.0	8.4	1.4	8	0.0
		Ladder	L-32	20.4	451.9	74.3	1,327	3.6
		Squad	SQ-32	21.7	511.9	84.2	1,414	3.9
	Total			**19.5**	**5,989.1**	**984.5**	**18,429**	**50.5**
7	51	ARFF	UNIT-50	21.2	51.0	8.4	144	0.4
		ARFF	UNIT-51	29.4	20.6	3.4	42	0.1
		ARFF	UNIT-52	19.7	28.5	4.7	87	0.2
		ARFF	UNIT-54	18.8	0.9	0.2	3	0.0
	Total			**22.0**	**101.1**	**16.6**	**276**	**0.8**

TABLE 11-25: Total Annual Runs by Call Type and Individual Unit

District & Station		Unit Type	Unit ID	EMS	False Alarm	Good Intent	Hazard	Outside Fire	Public Service	Structure Fire	Cancelled	Mutual Aid	Total	Runs per Day
1	2	Engine	E-2	1,152	291	137	119	45	117	173	147	22	2,203	6.0
		Ladder	L-2	140	80	39	41	11	53	112	28	7	511	1.4
		Squad	SQ-02	894	27	44	33	11	28	59	74	8	1,178	3.2
	4	Air & Light	AIR 4	10	6	2	6	3	3	94	1	6	131	0.4
		Boat	BOAT 4	4	2	1	0	0	2	0	1	3	13	0.0
		Engine	E-4	1,332	352	96	195	48	77	148	216	9	2,473	6.8
		Ladder	L-4	269	252	73	139	18	85	170	67	11	1,084	3.0
		Rescue	RESCUE 4	52	4	4	21	0	7	14	8	4	114	0.3
		Truck	TRUCK 4	2	0	0	0	0	1	0	1	1	5	0.0
	5	Engine	E-5	838	346	103	136	36	82	78	183	8	1,810	5.0
	7	Engine	E-7	989	228	156	177	49	100	115	219	0	2,033	5.6
		Ladder	L-7	260	148	88	169	23	105	144	93	1	1,031	2.8
	12	Engine	E-12	383	54	37	61	29	73	47	28	16	728	2.0
	13	Engine	E-13	802	37	89	55	46	85	46	57	67	1,284	3.5
	Total			**7,127**	**1,827**	**869**	**1,152**	**319**	**818**	**1,200**	**1,123**	**163**	**14,598**	**40.0**
2	22	Engine	E-22	6	1	2	4	0	1	0	2	0	16	0.0
		Ladder	L-22	738	214	141	143	78	220	149	107	2	1,792	4.9
		Squad	SQ-22	1,992	60	147	76	20	83	109	102	4	2,593	7.1
	27	Air & Light	AIR 27	2	2	0	3	2	3	42	1	2	57	0.2
		Engine	E-27	2,294	325	296	149	91	137	121	215	14	3,642	10.0
		Ladder	L-27	984	255	125	159	42	203	121	94	8	1,991	5.5
	30	Boat	BOAT 30	0	0	1	0	0	1	0	0	0	2	0.0
		Engine	E-30	1,271	72	81	72	63	91	68	185	143	2,046	5.6
		Grass Rig	GR-30	1	0	0	0	16	1	7	1	0	26	0.1
		Ladder	L-30	275	44	39	59	33	70	61	34	24	639	1.8
	31	Engine	E-31	439	92	50	97	52	158	47	86	72	1,093	3.0

District & Station		Unit Type	Unit ID	EMS	False Alarm	Good Intent	Hazard	Outside Fire	Public Service	Structure Fire	Cancelled	Mutual Aid	Total	Runs per Day
		Grass Rig	GR-31	0	0	0	1	5	0	1	1	4	12	0.0
		Ladder	L-31	85	29	34	60	14	53	42	24	22	363	1.0
	Total			**8,087**	**1,094**	**916**	**823**	**416**	**1,021**	**768**	**852**	**295**	**14,272**	**39.1**
3	6	ATV	ATV 1	0	0	0	0	0	0	0	0	1	1	0.0
		Engine	E-6	416	105	56	65	28	85	67	36	9	867	2.4
		HazMat	HM-1	82	26	59	418	6	37	12	10	17	667	1.8
		HazMat	HM-2	48	12	48	323	4	23	10	7	14	489	1.3
	9	Engine	E-9	262	106	35	45	14	64	31	69	3	629	1.7
		HazMat	HM-4	1	0	0	3	0	0	1	0	0	5	0.0
	14	Engine	E-14	595	208	88	129	21	126	89	168	2	1,426	3.9
	18	Engine	E-18	1,738	293	222	139	59	224	119	185	5	2,984	8.2
	26	Boat	BOAT 26	2	3	0	0	0	1	0	0	2	8	0.0
		Grass Rig	GR-26	1	0	0	0	8	1	0	0	1	11	0.0
		Ladder	L-26	337	124	70	82	49	110	90	41	18	921	2.5
		Squad	SQ-26	779	40	37	35	17	33	52	33	14	1,040	2.8
	29	Boat	BOAT 29	1	1	2	0	0	0	0	0	1	5	0.0
		Engine	E-29	2,096	285	148	93	46	120	104	154	4	3,050	8.4
		Ladder	L-29	529	206	69	95	20	162	97	64	3	1,245	3.4
		Squad	SQ-29	86	6	1	2	0	12	1	1	2	111	0.3
	Total			**6,973**	**1,415**	**835**	**1,429**	**272**	**998**	**673**	**768**	**96**	**13,459**	**36.9**
4	3	Engine	E-3	1,275	204	149	179	97	275	202	457	6	2,844	7.8
	10	Engine	E-10	1,212	184	99	126	75	139	192	94	11	2,132	5.8
		Grass Rig	GR-10	0	0	0	1	7	2	0	0	1	11	0.0
	15	Engine	E-15	1,198	157	157	128	59	190	140	170	2	2,201	6.0
	16	Engine	E-16	1,158	112	113	97	75	100	149	73	11	1,888	5.2
	17	Engine	E-17	1,614	153	116	125	74	126	96	174	15	2,493	6.8
	19	Engine	E-19	984	70	65	56	46	72	65	75	72	1,505	4.1

District & Station		Unit Type	Unit ID	EMS	False Alarm	Good Intent	Hazard	Outside Fire	Public Service	Structure Fire	Cancelled	Mutual Aid	Total	Runs per Day
	24	Boat	BOAT 24	0	0	1	0	0	0	0	0	0	1	0.0
		Engine	E-24	1,555	97	83	81	79	91	137	174	66	2,363	6.5
		Grass Rig	GR-24	0	0	0	0	14	0	2	1	3	20	0.1
		Ladder	L-24	430	93	65	77	39	138	143	53	26	1,064	2.9
	Total			**9,426**	**1,070**	**848**	**870**	**565**	**1,133**	**1,126**	**1,271**	**213**	**16,522**	**45.3**
5	20	Engine	E-20	1,452	377	125	273	77	114	112	304	10	2,844	7.8
		Ladder	L-20	383	169	54	181	35	110	102	117	4	1,155	3.2
	21	Engine	E-21	1,623	246	126	196	56	223	128	165	3	2,765	7.6
	23	Engine	E-23	105	42	26	29	8	33	27	12	0	282	0.8
		Ladder	L-23	533	232	108	146	46	162	122	53	2	1,404	3.8
		Squad	SQ-23	1,600	92	133	75	12	76	77	97	1	2,163	5.9
	25	Engine	E-25	1,226	278	145	290	56	120	138	135	3	2,391	6.6
	28	Engine	E-28	1,782	285	90	154	43	132	83	103	3	2,675	7.3
	32	Grass Rig	GR-32	0	1	0	0	6	0	0	0	1	8	0.0
		Ladder	L-32	468	197	56	202	35	136	69	163	1	1,327	3.6
		Squad	SQ-32	929	54	44	122	17	52	45	151	0	1,414	3.9
	Total			**10,101**	**1,973**	**907**	**1,668**	**391**	**1,158**	**903**	**1,300**	**28**	**18,429**	**50.5**
7	51	ARFF	UNIT-50	91	8	4	17	0	14	1	9	0	144	0.4
		ARFF	UNIT-51	10	4	3	15	0	8	1	1	0	42	0.1
		ARFF	UNIT-52	46	6	3	17	0	10	1	4	0	87	0.2
		ARFF	UNIT-54	2	0	0	0	0	1	0	0	0	3	0.0
	Total			**149**	**18**	**10**	**49**	**0**	**33**	**3**	**14**	**0**	**276**	**0.8**

TABLE 11-26: Total Annual Deployed Minutes by Call Type and Individual Unit

District &	Station	Unit Type	Unit ID	EMS	False Alarm	Good Intent	Hazard	Outside Fire	Public Service	Structure Fire	Cancelled	Mutual Aid	Total
1	2	Engine	E-2	54.7	7.6	4.1	6.7	2.7	7.0	18.5	1.9	0.7	103.9
		Ladder	L-2	6.9	2.5	0.9	3.0	0.4	3.8	12.9	0.5	0.2	31.0
		Squad	SQ-02	43.7	0.4	1.4	1.5	0.6	1.7	6.6	1.5	0.4	57.8
	4	Air & Light	AIR 4	0.6	0.1	0.0	0.8	0.8	0.1	14.3	0.0	1.0	17.7
		Boat	BOAT 4	0.5	0.0	0.0	0.0	0.0	0.4	0.0	0.3	1.4	2.7
		Engine	E-4	62.3	10.4	2.7	12.2	2.3	4.0	15.9	3.4	1.6	114.9
		Ladder	L-4	14.9	7.7	2.0	9.1	0.6	5.1	18.6	1.6	1.4	61.0
		Rescue	RESCUE 4	3.0	0.1	0.2	3.0	0.0	1.2	1.7	0.4	1.2	10.7
		Truck	TRUCK 4	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.3	0.8	1.3
	5	Engine	E-5	43.0	9.5	3.3	9.4	2.1	4.2	8.9	2.4	1.5	84.3
	7	Engine	E-7	49.4	6.3	4.1	11.8	2.6	5.5	10.0	3.7	0.0	93.4
		Ladder	L-7	12.8	4.2	2.7	12.6	1.6	5.5	14.9	1.3	0.0	55.8
	12	Engine	E-12	22.9	1.6	1.2	3.9	1.1	4.1	7.6	0.5	1.4	44.3
	13	Engine	E-13	41.7	1.2	2.7	4.4	2.8	4.9	9.4	1.2	3.6	71.9
	Total			**356.5**	**51.7**	**25.3**	**78.4**	**17.8**	**47.5**	**139.3**	**19.0**	**15.2**	**750.7**
2	22	Engine	E-22	0.2	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.4
		Ladder	L-22	40.5	7.6	5.0	9.1	5.5	10.9	18.2	1.8	0.1	98.7
		Squad	SQ-22	102.7	1.5	5.4	3.1	1.4	3.2	10.7	3.3	0.1	131.4
	27	Air & Light	AIR 27	1.0	0.0	0.0	0.1	0.1	0.3	9.7	0.2	0.5	11.9
		Engine	E-27	134.9	10.1	11.1	7.4	4.6	7.3	19.0	5.3	0.6	200.1
		Ladder	L-27	59.6	6.6	4.4	9.6	2.0	10.5	19.2	2.6	1.0	115.5
	30	Boat	BOAT 30	0.0	0.0	0.0	0.0	0.0	0.2	0.0	0.0	0.0	0.2
		Engine	E-30	79.3	2.4	2.8	4.7	4.5	5.6	8.6	5.2	6.3	119.4
		Grass Rig	GR-30	0.1	0.0	0.0	0.0	1.7	0.5	1.9	0.1	0.0	4.3
		Ladder	L-30	16.6	1.6	1.4	3.9	2.0	3.2	8.1	0.7	1.9	39.5
	31	Engine	E-31	25.0	3.4	1.5	7.9	3.8	9.0	5.9	1.6	6.4	64.6

District & Station		Unit Type	Unit ID	EMS	False Alarm	Good Intent	Hazard	Outside Fire	Public Service	Structure Fire	Cancelled	Mutual Aid	Total
		Grass Rig	GR-31	0.0	0.0	0.0	0.0	0.5	0.0	0.3	0.1	0.6	1.5
		Ladder	L-31	4.6	0.9	1.2	4.4	1.3	3.4	4.9	0.6	2.0	23.3
	Total			**464.6**	**34.2**	**32.8**	**50.3**	**27.3**	**54.3**	**106.5**	**21.6**	**19.4**	**810.9**
3	6	ATV	ATV 1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
		Engine	E-6	30.6	2.8	2.0	5.8	1.6	5.3	6.8	0.9	1.4	57.2
		HazMat	HM-1	7.3	1.3	2.1	52.6	0.8	2.4	1.7	0.2	3.2	71.6
		HazMat	HM-2	5.3	0.7	2.1	42.4	0.5	1.7	1.2	0.2	3.0	57.0
	9	Engine	E-9	17.1	3.2	1.5	3.1	0.7	3.2	2.9	0.8	0.2	32.8
		HazMat	HM-4	0.1	0.0	0.0	0.4	0.0	0.0	0.0	0.0	0.0	0.4
	14	Engine	E-14	33.7	5.9	3.0	8.0	1.0	6.4	7.9	2.7	0.1	68.7
	18	Engine	E-18	106.8	7.9	7.8	8.1	2.5	10.2	13.2	3.8	1.0	161.1
	26	Boat	BOAT 26	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.4
		Grass Rig	GR-26	0.4	0.0	0.0	0.0	0.9	0.0	0.0	0.0	0.0	1.3
		Ladder	L-26	20.0	2.9	1.7	5.0	2.5	6.6	12.1	0.7	2.6	54.2
		Squad	SQ-26	46.3	0.9	1.0	1.5	0.9	1.7	7.3	0.8	1.4	61.6
	29	Boat	BOAT 29	0.1	0.0	0.2	0.0	0.0	0.0	0.0	0.0	0.6	0.9
		Engine	E-29	140.1	8.5	6.0	7.0	3.8	6.5	13.1	2.7	0.3	187.9
		Ladder	L-29	34.5	6.5	3.1	6.4	1.5	11.4	13.0	1.3	1.3	78.9
		Squad	SQ-29	5.8	0.1	0.1	0.1	0.0	0.6	0.1	0.0	0.8	7.7
	Total			**448.1**	**40.6**	**30.6**	**140.3**	**16.7**	**56.0**	**79.1**	**14.2**	**16.1**	**841.7**
4	3	Engine	E-3	61.2	5.7	4.0	11.5	6.0	12.3	24.1	8.2	0.6	133.6
	10	Engine	E-10	59.8	5.3	3.1	7.9	4.8	5.6	23.5	1.5	1.3	112.8
		Grass Rig	GR-10	0.0	0.0	0.0	0.0	2.0	0.1	0.0	0.0	0.7	2.8
	15	Engine	E-15	61.0	4.1	5.4	8.1	3.9	8.9	18.3	2.6	0.1	112.3
	16	Engine	E-16	59.8	2.8	3.4	6.9	5.2	4.7	16.8	1.5	1.6	102.7
	17	Engine	E-17	87.0	4.1	3.7	8.3	4.1	4.2	10.7	4.4	1.1	127.7
	19	Engine	E-19	56.0	1.8	2.1	3.7	2.1	2.5	9.2	2.0	6.3	85.7
	24	Boat	BOAT 24	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.1

District & Station		Unit Type	Unit ID	EMS	False Alarm	Good Intent	Hazard	Outside Fire	Public Service	Structure Fire	Cancelled	Mutual Aid	Total
		Engine	E-24	83.8	2.3	2.6	3.8	5.2	3.2	20.9	3.7	4.6	130.1
		Grass Rig	GR-24	0.0	0.0	0.0	0.0	2.1	0.0	0.2	0.0	0.9	3.2
		Ladder	L-24	22.2	3.0	2.5	5.9	2.5	5.4	23.7	1.0	3.3	69.5
	Total			**490.7**	**29.0**	**26.9**	**56.3**	**38.0**	**46.9**	**147.5**	**24.9**	**20.5**	**880.6**
5	20	Engine	E-20	85.1	11.0	4.0	17.0	4.3	6.6	14.5	5.6	0.6	148.8
		Ladder	L-20	23.3	4.9	1.9	10.9	2.0	5.9	12.0	3.0	0.5	64.5
	21	Engine	E-21	88.7	6.5	3.5	10.5	2.6	10.9	12.3	2.8	0.1	138.0
	23	Engine	E-23	7.4	1.6	1.3	1.7	0.4	2.3	2.7	0.2	0.0	17.6
		Ladder	L-23	33.5	6.5	3.6	8.9	2.3	8.4	10.9	0.7	0.0	74.9
		Squad	SQ-23	92.2	2.3	4.7	3.1	0.4	3.4	5.8	2.1	0.0	114.1
	25	Engine	E-25	59.5	7.0	4.1	17.6	2.9	6.3	16.0	2.2	0.2	115.8
	28	Engine	E-28	108.5	8.1	2.9	10.1	2.3	6.7	10.9	1.4	0.1	151.0
	32	Grass Rig	GR-32	0.0	0.1	0.0	0.0	1.3	0.0	0.0	0.0	0.0	1.4
		Ladder	L-32	31.7	6.1	1.9	13.9	2.2	8.2	7.7	2.6	0.1	74.3
		Squad	SQ-32	59.5	1.5	1.8	8.2	1.0	2.6	5.2	4.3	0.0	84.2
	Total			**589.4**	**55.7**	**29.8**	**101.8**	**21.9**	**61.3**	**98.0**	**24.9**	**1.7**	**984.5**
7	51	ARFF	UNIT-50	5.4	0.5	0.1	1.0	0.0	0.7	0.0	0.7	0.0	8.4
		ARFF	UNIT-51	1.4	0.1	0.2	0.8	0.0	0.8	0.0	0.0	0.0	3.4
		ARFF	UNIT-52	2.7	0.2	0.0	1.1	0.0	0.5	0.0	0.1	0.0	4.7
		ARFF	UNIT-54	0.1	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.2
	Total			**9.6**	**0.8**	**0.3**	**2.9**	**0.0**	**2.1**	**0.1**	**0.8**	**0.0**	**16.6**

Attachment V

First Due Availability

Table 11-26 shows the number of priority 1 and 2 calls in each station's first due area where at least one unit arrived on scene and how often a unit from that station was the first to arrive on scene. This analysis looks only at whether a unit from the first-due station arrived first or did not arrive at all before the call ended. Whether a unit from the first due station was dispatched or not was not a factor.

TABLE 11-27: Frequency of First Due Unit Arriving First

District & Station		Calls	Number of Calls First Arriving Unit from First Due Station	Percent of Calls First Arriving Unit from First Due Station	Percent of Calls Second or Later Arriving Unit from First Due Station
1	2	1,852	1,581	85.4	86.9
	4	1,612	1,342	83.3	85.4
	5	1,641	1,048	63.9	66.2
	7	1,160	1,019	87.8	90.7
	12	385	342	88.8	91.7
	13	1,078	913	84.7	86.8
	Total	**7,728**	**6,245**	**80.8**	**83.0**
2	22	3,098	2,385	77.0	78.9
	27	3,520	3,112	88.4	89.5
	30	1,589	1,353	85.1	87.4
	31	521	475	91.2	93.5
	Total	**8,728**	**7,325**	**83.9**	**85.6**
3	6	589	502	85.2	86.2
	9	314	247	78.7	80.9
	14	599	387	64.6	68.8
	18	1,948	1,572	80.7	82.6
	26	983	801	81.5	88.2
	29	2,961	2,581	87.2	88.4
	Total	**7,394**	**6,090**	**82.4**	**84.8**
4	3	1,759	1,290	73.3	76.1
	10	1,448	1,139	78.7	80.9
	15	1,411	976	69.2	71.2
	16	1,293	1,078	83.4	86.3
	17	1,312	1,105	84.2	86.2
	19	1,138	1,006	88.4	90.4

District & Station		Calls	Number of Calls First Arriving Unit from First Due Station	Percent of Calls First Arriving Unit from First Due Station	Percent of Calls Second or Later Arriving Unit from First Due Station
	24	1,995	1,641	82.3	85.1
	Total	**10,356**	**8,235**	**79.5**	**82.0**
5	20	2,163	1,760	81.4	84.1
	21	1,894	1,386	73.2	75.7
	23	2,396	1,881	78.5	80.1
	25	1,591	1,097	69.0	72.0
	28	1,926	1,576	81.8	83.2
	32	1,043	906	86.9	88.8
	Total	**11,013**	**8,606**	**78.1**	**80.3**
7	51	193	106	54.9	65.8
	Total	**193**	**106**	**54.9**	**65.8**

Note: The total number of calls here is lower than the total number of calls overall because cancelled calls and mutual aid calls are not included. In addition, a station area could not be determined for all calls.

Observations

- Overall, first due units are the first to arrive about 81 percent of the time.
- On average, a unit from the first due station does not arrive to a call before the call ends 17 percent of the time.
- Units from Station 31 were most likely to arrive first to a call in their first due area, arriving first 91 percent of the time. Units from Station 31 did not arrive to a call in their first due area only 6.5 percent of the time.

Attachment VI

Response Times by Station Area

Tables 11-27 and 11-28 show the average and 90th percentile response times by station area. The station area is the area in which the call occurred, not the station from which a unit responded.

TABLE 11-28: Average Response Times by Station Area

District	Station	Dispatch Time	Turnout Time	Travel Time	Response Time	Sample Size
1	2	0.5	1.2	2.7	4.4	1,752
	4	0.7	1.1	2.3	4.1	1,526
	5	0.7	1.0	2.7	4.5	1,582
	7	0.7	1.1	2.7	4.5	1,095
	12	0.6	1.2	3.0	4.8	366
	13	0.6	1.2	3.0	4.8	1,028
	Total	**0.6**	**1.1**	**2.7**	**4.4**	**7,349**
2	22	0.6	1.1	3.3	5.0	2,952
	27	0.6	1.1	3.7	5.4	3,200
	30	0.6	1.1	4.5	6.3	1,511
	31	0.9	1.1	4.3	6.3	491
	Total	**0.6**	**1.1**	**3.7**	**5.5**	**8,154**
3	6	0.8	1.2	3.3	5.3	569
	9	0.8	1.2	4.7	6.7	302
	14	0.6	1.1	3.3	5.0	573
	18	0.6	1.1	3.5	5.1	1,870
	26	0.7	1.2	3.2	5.1	937
	29	0.6	1.1	3.6	5.2	2,760
	Total	**0.6**	**1.1**	**3.5**	**5.2**	**7,011**
4	3	0.7	1.0	3.0	4.7	1,691
	10	0.6	1.0	3.1	4.7	1,385
	15	0.6	1.1	3.2	4.9	1,366
	16	0.7	1.2	3.0	4.9	1,246
	17	0.6	1.1	2.9	4.6	1,272
	19	0.6	1.1	2.9	4.6	1,096
	24	0.5	1.2	3.2	4.9	1,882
	Total	**0.6**	**1.1**	**3.1**	**4.8**	**9,938**
5	20	0.7	1.2	4.0	5.8	2,027
	21	0.6	1.1	3.1	4.9	1,822
	23	0.6	1.2	3.6	5.4	2,306
	25	0.6	1.2	3.7	5.5	1,519
	28	0.6	1.1	3.6	5.3	1,854

District	Station	Dispatch Time	Turnout Time	Travel Time	Response Time	Sample Size
	32	0.6	1.2	4.1	5.9	992
	Total	**0.6**	**1.2**	**3.7**	**5.4**	**10,520**
7	51	1.0	1.1	2.4	4.4	151
	Total	**1.0**	**1.1**	**2.4**	**4.4**	**151**

TABLE 11-29: 90th Percentile Response Times by Station Area

District	Station	Dispatch Time	Turnout Time	Travel Time	Response Time	Sample Size
1	2	1.3	1.7	4.1	6.1	1,752
	4	1.5	1.6	3.6	5.9	1,526
	5	1.6	1.5	4.3	6.5	1,582
	7	1.4	1.6	4.1	6.3	1,095
	12	1.6	1.6	5.0	7.3	366
	13	1.6	1.7	4.6	7.1	1,028
	Total	**1.5**	**1.6**	**4.2**	**6.4**	**7,349**
2	22	1.4	1.6	5.0	7.1	2,952
	27	1.5	1.7	5.6	7.8	3,200
	30	1.5	1.7	6.5	8.7	1,511
	31	2.1	1.7	6.0	8.8	491
	Total	**1.5**	**1.7**	**5.7**	**7.9**	**8,154**
3	6	1.8	1.7	5.3	7.9	569
	9	1.9	1.7	7.2	9.7	302
	14	1.5	1.6	4.8	7.0	573
	18	1.4	1.5	5.2	7.2	1,870
	26	1.8	1.8	4.9	7.4	937
	29	1.4	1.6	5.5	7.6	2,760
	Total	**1.5**	**1.6**	**5.4**	**7.6**	**7,011**
4	3	1.6	1.5	4.5	6.9	1,691
	10	1.4	1.6	4.8	6.8	1,385
	15	1.4	1.6	5.1	7.2	1,366
	16	1.4	1.7	4.9	7.2	1,246
	17	1.5	1.5	4.7	6.7	1,272
	19	1.2	1.6	4.4	6.2	1,096
	24	1.3	1.8	4.8	6.7	1,882
	Total	**1.4**	**1.6**	**4.8**	**6.9**	**9,938**
5	20	1.6	1.7	5.9	8.1	2,027
	21	1.6	1.7	4.9	7.1	1,822
	23	1.5	1.7	5.6	7.7	2,306
	25	1.4	1.8	5.5	7.8	1,519
	28	1.4	1.6	5.4	7.4	1,854
	32	1.5	1.7	6.4	8.7	992
	Total	**1.5**	**1.7**	**5.6**	**7.8**	**10,520**
7	51	1.7	1.8	4.7	6.8	151
	Total	**1.7**	**1.8**	**4.7**	**6.8**	**151**