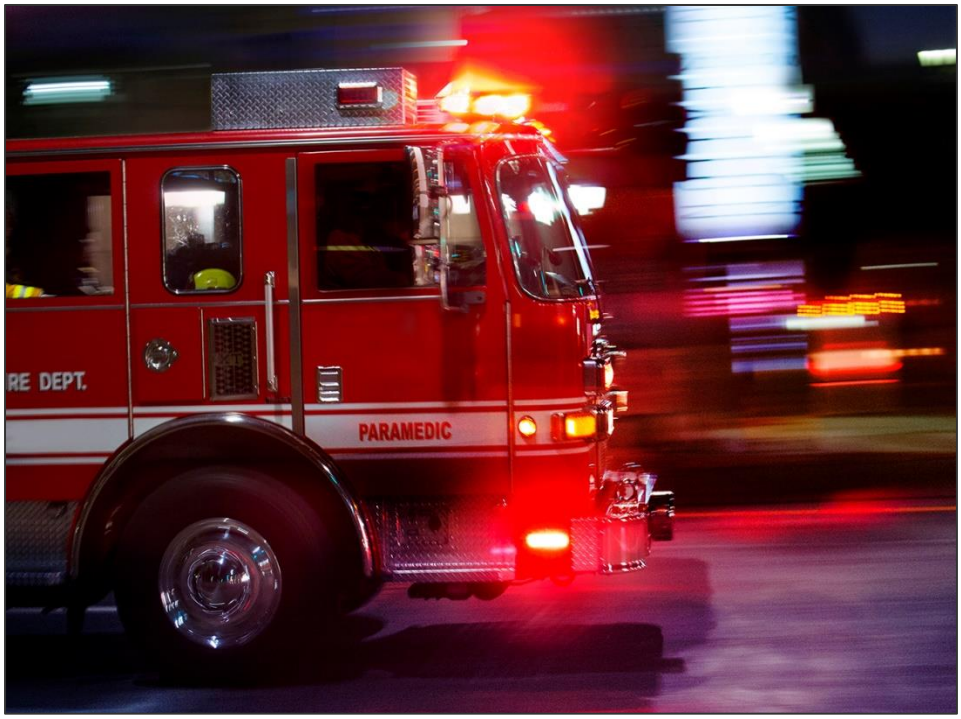
CENTER FOR PUBLIC SAFETY MANAGEMENT, LLC

FIRE OPERATIONAL & ADMINISTRATIVE ANALYSIS REPORT

Pikeville, Kentucky

Final Report: Updated August 29, 2021



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ICMA

Exclusive Provider of Public Safety Technical Services for
International City/County Management Association

THE ASSOCIATION & THE COMPANY

The International City/County Management Association is a 103-year-old, nonprofit professional association of local government administrators and managers, with approximately 13,000 members located in 32 countries.

Since its inception in 1914, ICMA has been dedicated to assisting local governments and their managers in providing services to its citizens in an efficient and effective manner. ICMA advances the knowledge of local government best practices with its website (www.icma.org), publications, research, professional development, and membership. The ICMA Center for Public Safety Management (ICMA/CPSM) was launched by ICMA to provide support to local governments in the areas of police, fire, and emergency medical services.

ICMA also represents local governments at the federal level and has been involved in numerous projects with the Department of Justice and the Department of Homeland Security.

In 2014, as part of a restructuring at ICMA, the Center for Public Safety Management (CPSM) was spun out as a separate company. It 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, PERF, IACP, IFCA, IPMA-HR, DOJ, BJA, COPS, NFPA, and others.

The Center for Public Safety Management, LLC, maintains the same team of individuals performing the same level of service as when it was a component of 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 align department operations with industry best practices. We have conducted over 341 such studies in 42 states and provinces and 246 communities ranging in population from 8,000 (Boone, Iowa) to 800,000 (Indianapolis, Ind.).

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

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SECTION 1. EXECUTIVE SUMMARY

The Center for Public Safety Management LLC (CPSM) was contracted by the City of Pikeville, Kentucky, to complete an analysis of the city's fire and EMS department.

The Pikeville Fire Department (PFD) currently operates out of three stations. One of these stations (Station 2) is scheduled to move over the next 12 to 18 months into another facility in order to provide closer coverage to the southern areas of the city. The PFD has 24 personnel assigned to fire and EMS shift operations. Staffing is spread across three platoons. Fire and EMS units are staffed on a 24-hour basis, with deployment consisting of seven front-line fire staff and one battalion chief. The PFD utilizes staff call-back and automatic and mutual aid to augment assembling an effective response force to mitigate various incidents to which it responds.

The PFD provides fire response from engine, heavy rescue, and ladder apparatus, as well as EMS ambulance ground transportation. Staffing this diverse apparatus cache is accomplished through a cross-staffing model, whereby a single crew in a single station staffs all apparatus in the station and responds with the most appropriate apparatus. The PFD provides a variety of non-operational activities and programs including fire prevention and inspection activities aimed at ensuring life safety, maintenance of fire protection systems, and compliance with the fire prevention code. The department also delivers as public education performed by on-duty fire personnel and which includes community CPR/AED training; business evacuation and fire extinguisher training; child car seat installation; and school and senior programs that have a focus on life safety.

The service demands of this community are numerous for the department and include EMS, fire, technical rescue, hazardous materials, transportation emergencies to include extensive rail traffic, and other non-emergency responses. The structural risks unique to a city with a core downtown and light suburban and even rural components are present in Pikeville. Risks include single-family homes; manufactured homes; townhouses and duplexes; apartment buildings; taxpayer (public) buildings; commercial/Industrial structures; strip malls; and hotel/dormitory structures. The age of many structures, the inclusion of basements, setbacks from the road, change of occupancy use, and renovations potentially increase fire risk.

The response time and staffing components discussion of this report are designed to examine the current level of service provided by the PFD compared to national best practices. As well, these components provide incident data and relevant information to be utilized for future planning and self-review of service levels for continued improvement designed to meet community expectations and mitigate emergencies effectively and efficiently.

A forensic data analysis was prepared as a key component of this study. The data analysis examined all calls for service involving the PFD between November 1, 2018, and October 31, 2019. During the year covered by this study, PFD operated out of three stations, utilizing four ambulances, three engines, two boats, two EMS carts, two fire carts, two towers, one rescue vehicle, one shift supervisor vehicle, and one support vehicle.

During the study period, the Pikeville Fire Department responded to 3,036 calls, of which 56 percent were EMS calls. These calls included 365 car seat installations and nonemergency service calls, as well as another 105 calls to which only administrative units responded. The total combined workload (deployed time) for all PFD units excluding the removed calls was 2,490.1 hours. The average dispatch time for the first arriving unit was 1.6 minutes and the average

response time of the first arriving PFD unit was 5.7 minutes. The 90th percentile dispatch time was 3.7 minutes and the 90th percentile response time was 8.9 minutes.

A significant component of this report is the completion of an All-Hazard Risk Assessment of the Community. The All-Hazard Risk Assessment of the Community contemplates many factors that cause, create, facilitate, extend, and enhance risk in and to a community. The risk analysis conducted by CPSM for Pikeville considers the impact of each risk or factor utilizing a three-axis approach. The three-axis approach to evaluating risk includes the ***probability*** of the event, ***consequences*** to the community, and ***impact*** on the organization, in this case the PFD. Factors that are discussed are:

- Population and demographics.
- Climate and the environment.
- Buildings located in the city (the built upon environment).
- Transportation.
- Targeted building/occupancy hazard.
- Fire- and EMS-related risks.
- Incident demand.

CPSM measured and reported on these risks individually and as a whole.

Other significant components of this report are an analysis of the current deployment of resources and the performance of these resources in terms of response times and the three PFD fire management zones; current staffing levels and patterns; department resiliency (ability to handle more than one incident); critical tasking elements for specific incident responses; and assembling an effective response force. CPSM analyzed these items and is providing recommendations where applicable to improve service delivery and for future planning purposes.

In summation, a comprehensive risk assessment and review of deployable assets are critical aspects of a fire department's operation. First, these reviews will assist the PFD in quantifying the risks that it faces. Second, the PFD will be better equipped to determine if the current response resources are sufficiently staffed, equipped, trained, and positioned. The factors that drive the service needs are examined and then link directly to discussions regarding the assembling of an effective response force and when contemplating the response capabilities needed to adequately address the existing risks, which encompasses the component of critical tasking.

Although it can reasonably be anticipated that the PFD's call volume will continue to gradually increase each year as the city continues its growth and development, at the present time the department appears able to handle its normal call volume. With the resources the department currently deploys, the department can handle most of the single unit requests for service that it receives without the need for outside assistance.

However, the PFD relies heavily on its on-duty staffing and call-back staffing of off-duty personnel when additional resources are needed to mitigate working fires that grow to second alarm or greater. It also relies on automatic and mutual aid that responds from moderate to long distances and are primarily volunteer staffed, to assemble an effective response force for building fires. To be effective and reduce safety concerns, fire (and some EMS) critical tasks are deigned to be performed simultaneously and not consecutively. Thus, it is important to assemble

an effective response force in a timely manner. This report addresses this critical component of staffing and deployment of resources.

This report also contains a series of observations and recommendations provided by CPSM that are intended to help the PFD deliver services more efficiently and effectively.[1]

Recommendations and considerations for continuous improvement of services are presented here. CPSM recognizes there may be recommendations and considerations offered that first must be budgeted for, or for which processes must be developed prior to implementation.

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[1] Draft report submitted to City of Pikeville November 2020. Updated report submitted to City August, 29, 2021.

RECOMMENDATIONS

1. CPSM recommends the City of Pikeville participate in the enhanced Medicaid payment program for EMS ground transport and required service provider assessment. (See p. 12.)
2. CPSM recommends the City and PFD conduct further fire facility analysis to include factors such as space needs for administrative, crew living, and in-station training; gender separate bunking and bathroom; and crew and equipment decontamination areas (clean rooms). CPSM further recommends once the facility analysis is completed, the city and the PFD develop a facility capital improvement plan and make improvements as funding allows with a priority on gender separation and crew/equipment decontamination. (See p. 16.)
3. CPSM recommends the PFD maintain proper vehicle maintenance schedules in accordance with motor and manufacturer specifications and recommendations, as well as a formal replacement schedule. (See p. 19.)
4. CPSM recommends the PFD consider, budget permitting, a change to a 15-year replacement schedule for heavy fire apparatus, as apparatus of more than 15 years of age might include only a few of the safety upgrades required by the most recent editions of NFPA 1901[2] (NFPA 1901 is generally updated every five years). (See p. 19.)
   Update 8/29/2021: The PFD ordered two (2) new engine apparatus and one (1) new aerial apparatus (tower ladder), Summer 2021.
5. CPSM further recommends a six- to eight-year replacement program, based on use, mileage, and maintenance records, for front-line EMS transport vehicles. (See p. 19.)
   Update8/29/2021: The PFD ordered a new EMS transport vehicle, Summer 2021.
6. CPSM recommends the PFD consider, for the purpose of enhancing water supply for firefighting operations, and funding permitting, the purchase of a water tender apparatus for response to those areas of the city where built upon areas are more than 1,000 feet from municipal fire hydrants. (See p. 22.)
7. CPSM recommends the PFD begin to record property loss and fire-related injury/fatality information in the fire reporting information system so that a community analysis can be completed at the end of each reporting year, for the purpose of identifying trends and issues, and developing solutions and programs targeted to reduce any fire or casualty problem. (See p. 23.)
8. CPSM recommends the PFD collaborate with the Pikeville Public Safety Department to identify and correct those elements that hinder call processing times for fire and EMS incidents. CPSM further recommends that the PFD identify and correct those elements that hinder turn-out of personnel responding to fire and EMS. Collectively, these two components of the total response time of the PFD are adding up to 7.4 minutes aggregately at the 90th percentile for fire and EMS incidents. (See p. 58.)
9. CPSM recommends, funding available, that the city develop a five-year strategic funding plan to increase the levels of staffing and deployment of resources as follows and in the priority order listed below. To accomplish this, CPSM further recommends the city apply for an Assistance to Firefighters, Staffing for Adequate Fire and Emergency Response (SAFER) grant to assist in the funding of these new positions. The SAFER grant was developed to provide communities across the country funding to increase the number of trained firefighters to enhance a fire department's ability to align with staffing, response, and operational standards established with NFPA 1710. For federal fiscal year 2020, $355 million

2. NFPA 1901, 2016 Edition, Quincy, MA.

was set aside for SAFER grant funding, which was an increase of $5 million from FY 2019. SAFER grants provide funding over a three-year period at 75 percent for years one and two, and 35 percent for year three. (See p. 85.)

10. Eliminate the cross-staffing model of fire and EMS apparatus at Station 1. Add one additional firefighter position on each shift. Once this is accomplished, a response of fire or EMS apparatus should always be a crew of two and never a crew of one ***(year 1)***. Minimum staffing would allow the ambulance to be staffed with two and the engine, tower, or heavy rescue to be staffed with two on a continual basis. This staffing model reduces the impact of simultaneous calls at Station 1 and enhances the ability to collect an Effective Response Force more quickly, which enhances the ability of on-scene crews to perform critical tasks simultaneously rather than consecutively. (See p. 85.)
11. Upgrade one firefighter position on each shift at Stations 1 and 2 to a lieutenant position so that the span of control for the on-duty battalion chief is reduced, and responsibility and accountability of individual company and station operations can be established consistently at all stations. This will also enhance the management and supervision capabilities on fire and EMS incidents ***(year 2)***. (See p. 85.)
12. Eliminate the cross-staffing model of fire and EMS apparatus at Station 3. Add two additional firefighter positions on each shift. Once this is accomplished, a response of fire or EMS apparatus should always be a crew of two and never a crew of one ***(add one per shift year 4 and one per shift year 5)***. Minimum staffing would allow the ambulance to be staffed with two and the engine to be staffed with two on a continual basis. This staffing model enhances the ability to collect an Effective Response Force more quickly, which enhances the ability of on-scene crews to perform critical tasks simultaneously rather than consecutively. (See p. 86.)
13. CPSM recommends the immediate dispatch of multiple mutual aid companies on the initial alarm for structural fire and other fire multi-unit responses to enhance the ability of the PFD to collect an Effective Response Force more quickly, which will enhance the ability of on-scene crews to perform critical tasks simultaneously rather than consecutively. CPSM further recommends when these mutual aid companies respond that they do so, as a matter of response policy, with a minimum staffing of two. CPSM also recommends frequent multi-unit training with these mutual aid companies to ensure incident scene critical tasking can be effectively accomplished and to the expectations of the PFD. (See p. 86.)
14. CPSM recommends, for crew safety reasons, that the PFD eliminate the dispatch of a single fire or EMS apparatus with a single firefighter unless a second unit from another station is dispatched in unison with the single-staffed apparatus. The purpose of the second unit dispatch is to act as the crew for the single-staffed apparatus. (See p. 86.)
15. CPSM recommends, for crew safety reasons, that when Stations 2 and 3 are down one firefighter position due to scheduled or unscheduled leave, and the leave position cannot be filled, the station be browned out for the period there is not at least two firefighters available to staff the station. (See p. 86.)

END SECTION 1

SECTION 2. AGENCY CHARACTERISTICS

DEPARTMENT OVERVIEW

The Pikeville Fire Department (PFD) is responsible for providing services that include fire suppression; first response emergency medical services; emergency medical services ground transportation; fire prevention and education; technical rescue to include vehicle extrication and high-angle rope rescue; response to and mitigation of hazardous materials incidents; and response to disasters both natural and man-made. Emergency medical service (EMS) is delivered at the basic life support level. All department members are trained to the emergency medical technician (EMT) level.

The PFD is led by a fire chief who reports to the public safety commissioner who reports to the city manager. The organizational structure includes senior- and middle-manager level positions who are responsible for programmatic and station-level operations. The largest contingent of personnel in the organization are company level firefighters. There are no station level first-line supervisors. Figure 2-1 illustrates the PFD organizational chart.

The PFD provides the aforementioned emergency services from three stations located throughout the city. Response is made through three engine apparatus, two aerial-ladder apparatus, one rescue/squad apparatus, one technical rescue unit, four ambulances, and various other operational support vehicles. Not all of these units are staffed 24/7. Appropriate units respond with available on-duty staff, depending on the type of call. This is commonly referred to cross-staffing of apparatus. The PFD does respond available resources outside of the city boundaries when needed through mutual aid agreements.

The PFD also performs fire prevention and inspection activities aimed at ensuring life safety, the maintenance of fire protection systems, and compliance with the fire prevention code. The senior battalion chief serves as the fire marshal and oversees this program. The PFD has a robust public education program performed by on-duty fire personnel and which includes community CPR/AED training; business evacuation and fire extinguisher training; child car seat installation; and school and senior programs that have a focus on life safety.

Program oversight for PFD training is assigned to a Lieutenant/Training Officer. New employee on-boarding, training, and progression through the new employee's probationary period is included in this oversight. The training regimen for all employees includes necessary and required recertification training for state fire certifications and the National Registry EMT certification each member has attained. PFD members complete this training in station while on duty or at the fire training center located next to Station 1.

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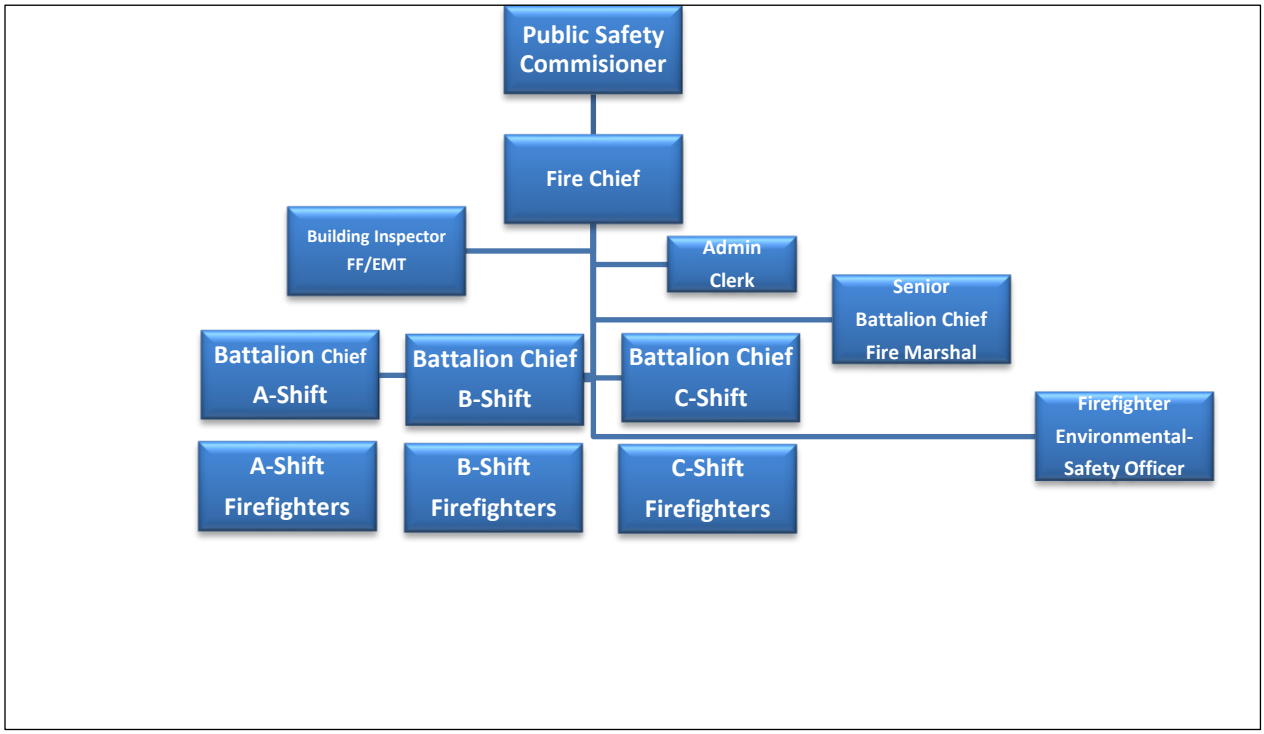
FIGURE 2-1: PFD Organizational Chart



GOVERNANCE AND ADMINSTRATION

The City of Pikeville operates under the city manager form of government. Under this form of government, citizens elect Commissioners (four total) and a Mayor who set the policy for the city, and who appoint a city manager. The manager carries out the policy set by elected officials and manages the city's day-to-day operations. In Pikeville, all legislative and executive authority of the city is vested in the Board of Commissioners (Mayor and four Commissioners).[3] The city operates as a Kentucky home rule class city, which under KRS 82.082 means a city may *exercise any power or perform any function that is within the boundaries of the city, in furtherance of public purpose, and not in conflict with a government provision or statute.*[4]

Article 33.25(A) of the Pikeville Code of Ordinances establishes a fire department. Article 33.25(B) of the Pikeville Code of Ordinances establishes the office of the fire chief who by city ordinance *shall be responsible for the organization and operation of the fire department and shall supervise, direct, and control the equipment of the fire department and the firefighters in their response to fires and the extinguishment thereof and the plans, preparations, procedures, practice, and training in regard thereto, and may, as chief of the fire department, perform or cause to be performed all other actions authorized by law, ordinance, or regulation.*[5]

3. https://codelibrary.amlegal.com/codes/pikeville/latest/pikeville_ky/0-0-0-1441#JD_Chapter38
4. Kentucky League of Cities, What is Home Rule, February 2019.
5. https://codelibrary.amlegal.com/codes/pikeville/latest/pikeville_ky/0-0-0-845#JD_33.25

SERVICE AREA

The PFD provides fire, EMS, and protective services within the municipal boundaries of the city. This includes an area of 15.4 square miles. Secondarily, the PFD responds to fire and EMS emergencies outside of the city boundaries through mutual and automatic aid agreements. Within the city limits is a private, general aviation airport. The PFD provides fire and EMS services to the airport. Additional EMS transport service area includes Coal Run Village. Pikeville is located in the Appalachian Mountains of Pike County; geographically it is in the central-eastern portion of Kentucky. Pike County is contiguous with Virginia and West Virginia. The following figure illustrates the Pikeville municipal boundaries, while the subsequent figure illustrates Pikeville's location in the state.

FIGURE 2-2: PFD Municipal Service Area

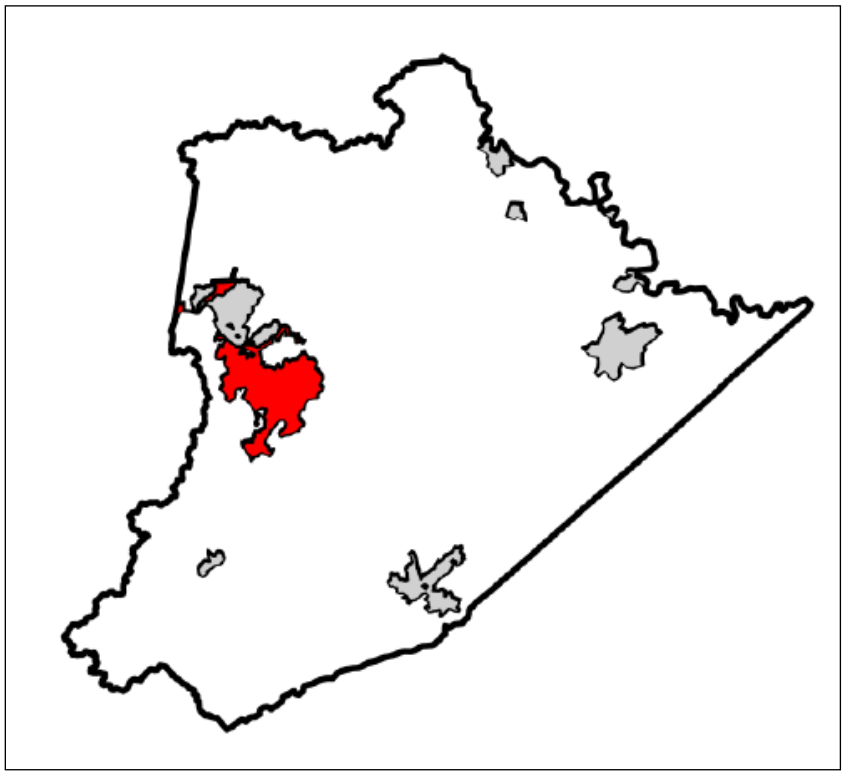


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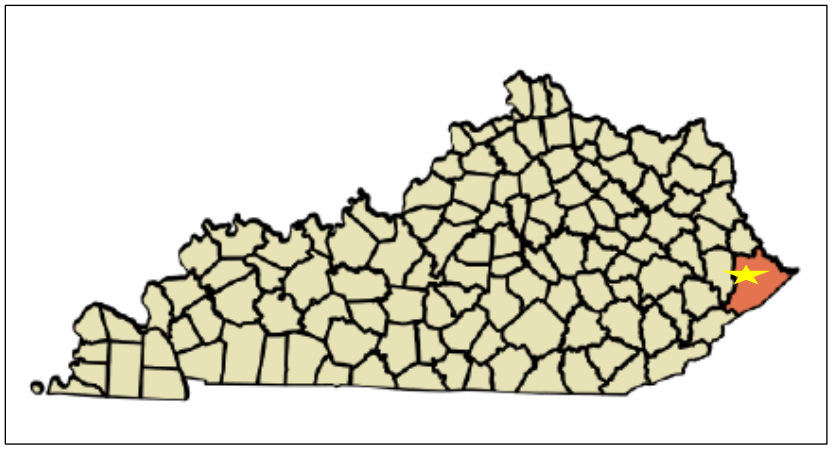
FIGURE 2-3: Pike County and Pikeville



END SECTION 2

SECTION 3. AGENCY PROGRAMS AND SERVICES

RESOURCE DESCRIPTIONS

Budget

The City of Pikeville operates on a fiscal year budget from July 1 to June 30. The fire department budget is divided into three operational categories: fire operations, ambulance, and lake. Each category includes operational, administrative, and other organizational expenses typical to a fire and EMS department. The fire operations segment is the largest category expenditure and includes all of the full-time employee wage and benefit costs, as well as fire apparatus operations and maintenance costs. The ambulance expenditure category includes the cost for ambulance billing and operational costs for the EMS vehicles and operation. The lake budget category includes operations and maintenance costs for maintaining the U.S. Army Corps of Engineers Levee Project. The PFD budget also includes a coal severance revenue appropriation. The appropriation is awarded to the city from the state and to be used among other things to address equipment needs in public safety.

The following table depicts the total (the three budget categories combined) appropriated PFD budgets for the last five-year period.

TABLE 3-1: PFD Five-year Budget Appropriation History

FY 2014-2015	FY 2015-2016	FY 2016-2017	FY 2017-2018	FY 2019-2020
$2,882,898.00	$2,696,934.00	$2,772,415.00	$3,235,735.00	$3,793,404.00

EMS Transport Billing

Like most cities and counties across the country that provide EMS ground transport through career staffed agencies, the PFD bills for transport. Revenue generated from the ground transport billing is deposited into the city's general fund and provides an overall indirect offset to operational costs to provide this municipal service. Nationally, EMS transport billing is either performed as an internal local government service, or through a contracted third-party billing agency. The PFD performs billing services through a third-party billing agency.

Actual cash revenues collected compared to overall gross billing charges vary by region of the country, and more importantly, by locality being served by the ground transport agency. This is driven largely by mandated adjustments in the gross billing. These include ceiling limits on reimbursement amounts legislated through U.S Code of Federal Regulations for Medicare, Medicaid, and other federally funded medical reimbursement programs, which also have a high use rate. In Pikeville, this also includes adjustments for inmates transported from the correctional facility that is located in the city. ***In CY 2019, the department saw $1,664,889.24 in mandated adjustments.***

Medicare and Medicaid reimbursements are based largely on a locality's demographics and can be better understood through analysis of the EMS services' payer mix. For instance, in a locality that has a large population of residents who utilize Medicare and Medicaid, the payer

mix shifts to a larger percentage of government-funded (federal and state) Medicare and Medicaid health care, which does not pay the full EMS transport fee. In each of these cases, the billable amount is not fully recovered, and the service can only bill the patient for the co-pay. In Pikeville this represents 68 percent of the payer mix. Even private insurance may not pay the full amount of the charge. In these cases, the co-pay and the remaining balance can be billed to the patient.

The following table depicts the current EMS ground transport fees in Pikeville.

TABLE 3-2: Pikeville EMS Ground Transport Fee Schedule

Description	Billing Description	Unit Price Amount
ALS LEVEL 2	ALS LEVEL 2	$1,500.00
BLS EMERGENCY	BLS EMERGENCY	$1,500.00
BLS NON-EMERGENCY	BLS NON-EMERGENCY	$600.00
BLS LOADED MILEAGE	BLS LOADED MILEAGE	$14.00
OXYGEN - MEDICARE ONLY	OXYGEN	$45.00
WAITING TIME PER HR AFTER 1 HR	WAITING TIME PER HR AFTER 1 HR	$100.00
TRAUMA SUPPLIES	TRAUMA SUPPLIES	$250.00
BLS LOADED MILEAGE > 50 MILES	BLS LOADED MILEAGE > 50 MILES	$12.00
OXYGEN - NON-MEDICARE	OXYGEN	$45.00
BLS NON EMRGENCY RETURN TRIP	BLS NON EMRGENCY RETURN TRIP	$600.00
MILEAGE, BLS NE / RETURN	MILEAGE, BLS NON-URGENT	$14.00
ALS EMERGENT	ALS EMERGENT	$1,700.00
ALS MILEAGE	ALS MILEAGE	$12.00
BLS DISPOSABLE	BLS DISPOSABLE	$150.00
EXTRICATION EQUIPMENT	EXTRICATION EQUIPMENT	$600.00

The next table shows the EMS ground transport charges, adjustments, and revenues for the past five years.

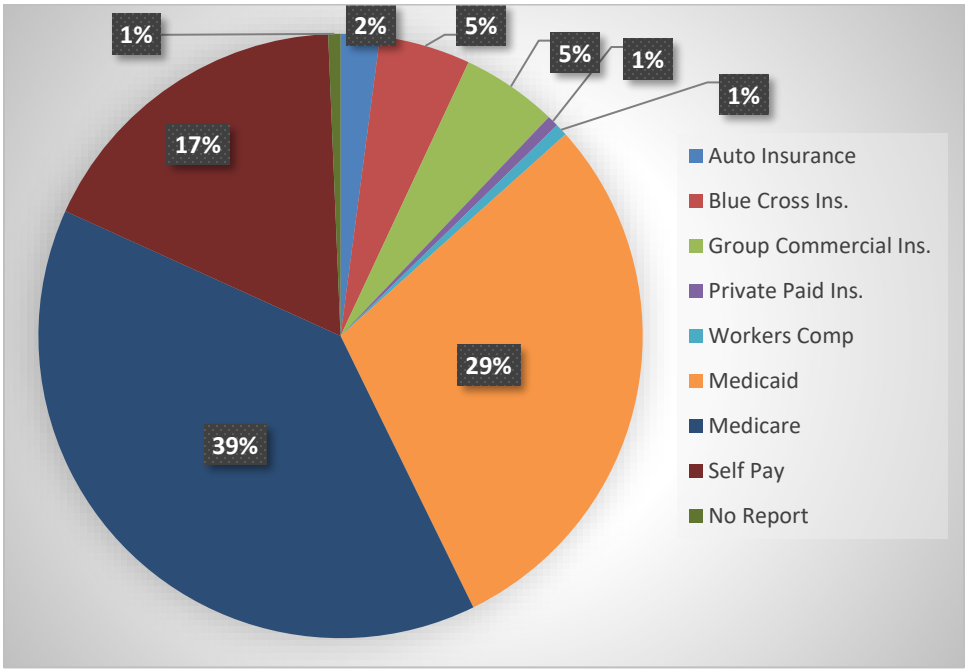
TABLE 3-3: Pikeville EMS Ground Transport Charges/Revenues, 2015–2019

Fiscal Year	CY 2015	CY 2016	CY 2017	CY 2018	CY 2019
Gross Charges	$1,853,007.00	$1,738,891.60	$1,902,028.60	$1,991,981.60	$2,356,562.00
Cash Revenues*	$331,979.65 18% paid on gross charges 57% collected on net charges	$315,010.00 18% paid on gross charges 52% collected on net charges	$340,114.76 18% paid on gross charges 46% collected on net charges	$391,432.09 20% paid on gross charges 68% collected on net charges	$416,260.52 18% paid on gross charges 50% collected on net charges

As discussed above, payer mix is the percentage of claims that result from EMS transport incidents when billed to the various main insurance payer groups. The following figure illustrates

the payer mix for PFD EMS ground transport. Typically, the major components in a payer mix are Medicare, Medicaid, commercial insurance, patient/self-pay, and in some cases, facility transport contract. Pikeville is no different. It should be noted that raising EMS transport fees will not counter a collection issue in all payer-mix categories, as federal law prohibits the billing of the remaining amount of the EMS transport bill for certain protected rates, such as Medicare and Medicaid other than the co-pay.

FIGURE 3-1: Pikeville EMS Ground Transport EMS Billing Payer Mix (CY 2019)



There is some relief for EMS ground transportation in terms of revenue that comes from the 2020 commonwealth legislative session through House Bill 8. House Bill 8, signed by the governor on April 24, 2020, allows an enhanced Medicaid payment to participating entities that choose to participate in the program. Federal Medicaid comes into the commonwealth through matching dollars; on average, this is two dollars to every one dollar invested in services. Through this enhanced payment program, EMS ground transport providers can invest dollars (an assessment fee based on a specific formula) into a proposed commonwealth trust fund, and in return receive enhanced reimbursement on the number of Medicaid transports made. This program is a certified public expenditure approved by the Centers for Medicare and Medicaid Services. According to the city's EMS billing provider, Pikeville's anticipated assessment, based on the number of transports would be $20,000. The gross return payments are estimated to be $53,000 for an estimated net receipt of $33,000 in enhanced Medicaid payments to the city.

Recommendation:

- CPSM recommends the City of Pikeville participate in the enhanced Medicaid payment program for EMS ground transport and required service provider assessment. (Recommendation No. 1.)

Facilities

Fire facilities must be designed and constructed to accommodate current and forecasted future trends in fire service vehicle type and manufactured dimensions. A facility must have sufficiently sized bay doors, circulation space between garaged vehicles, departure and return aprons of adequate length and turn geometry to ensure safe response, and floor drains and oil separators to satisfy environmental concerns. Station vehicle bay areas should also consider future tactical vehicles that may need to be added to the fleet to address forecasted response challenges, even if this consideration merely incorporates civil design that ensures adequate parcel space for additional bays to be constructed in the future.

Personnel-oriented needs in fire facilities must permit performance of daily duties in support of response operations. For personnel, fire facilities must have provisions for vehicle maintenance and repair; storage areas for essential equipment and supplies; space and amenities for administrative work, training, physical fitness, laundering, meal preparation, and personal hygiene/comfort, and—where a fire department is committed to minimize "turnout time"—bunking facilities.

A fire department facility may serve as a de facto "safe haven" during local community emergencies, and also serve as likely command center for large-scale, protracted, campaign emergency incidents. Therefore, design details and construction materials and methods should embrace a goal of building a facility that can perform in an uninterrupted manner despite prevailing climatic conditions and/or disruption of utilities. Programmatic details, such as the provision of an emergency generator connected to automatic transfer switching, even going as far as providing tertiary redundancy of power supply via a "piggyback" roll-up generator with manual transfer (should the primary generator fail), provide effective safeguards that permit the fire department to function fully during local emergencies when response activity predictably peaks.

Personnel/occupant safety is a key element of effective station design. This begins with small details such as the quality of finish on bay floors and nonslip treads on stairwell steps to decrease tripping/fall hazards or use of hands-free plumbing fixtures and easily disinfected surfaces/countertops to promote infection control. It continues with installation of specialized equipment such as an exhaust recovery system to capture and remove cancer-causing byproducts of diesel fuel exhaust emissions. A design should thoughtfully incorporate best practices for achieving a safe and hygienic work environment.

Ergonomic layout and corresponding space adjacencies in a fire station should seek to limit the travel distances between occupied crew areas to the apparatus bays. Likewise, design should carefully consider complementary adjacencies, like lavatories/showers in proximity of bunk rooms, and desired segregations, like break rooms or fitness areas that are remote from sleeping quarters. Furnishings, fixtures, and equipment selections should provide thoughtful consideration of the around-the-clock occupancy inherent to fire facilities. Durability is essential, given the accelerated wear and life cycle of systems and goods in facilities that are constantly occupied and operational.

Sound community fire-rescue protection requires the strategic distribution of fire station facilities to ensure that effective service area coverage is achieved, that predicted response travel times satisfy prevailing community goals and national best practices, and that the facilities are capable of supporting mission-critical personnel and vehicle-oriented requirements and needs. Additionally, depending on a fire-rescue department's scope of services, size, and complexity, other facilities may be necessary to support emergency communications, personnel training, fleet and essential equipment maintenance and repair, and supply storage and distribution.

National standards such as the National Fire Protection Association's (NFPA) 1500, *Standard on Fire Department Occupational Safety, Health, and Wellness Program*, outlines standards that transfer to facilities such as infection control, personnel and equipment decontamination, cancer prevention, storage of protective clothing, and employee fitness. NFPA 1851, *Standard on Selection, Care, and Maintenance of Protective Ensembles for Structural Firefighting and Proximity Fire Fighting*, further delineates laundering standards for protective clothing and station wear. Laundry areas in fire facilities continue to evolve and are being separated from living areas to reduce contamination. Factors such as wastewater removal and air flow need to be considered in a facility design.

The PFD operates out of three operational facilities. Adjacent to Station 1 is the training center, where much of the career and volunteer fire and EMS training occurs. Other training occurs on specific sites appropriate for the training or in-house at each fire station. The training center includes a drill tower and other applicable fire and EMS props to enhance classroom training with hands-on practical training.

Station 1 operates as the headquarters station for the department. Station 1 was built in 1988. Located at this station are the administrative offices for the department as well as operational assets to include fire suppression and EMS equipment and staffing. Station 1 also houses an aerial ladder apparatus and heavy rescue apparatus. An additional facility at Station 1 houses wildland fire and water rescue equipment. Station 1 also has a firefighting gear washer to clean and decontaminate these protective clothing ensembles.

Station 2 is the oldest of the three facilities. Station 2 was built in 1978. This facility houses fire and EMS operational equipment and staffing. PFD apparatus and equipment maintenance is performed at this station as well.

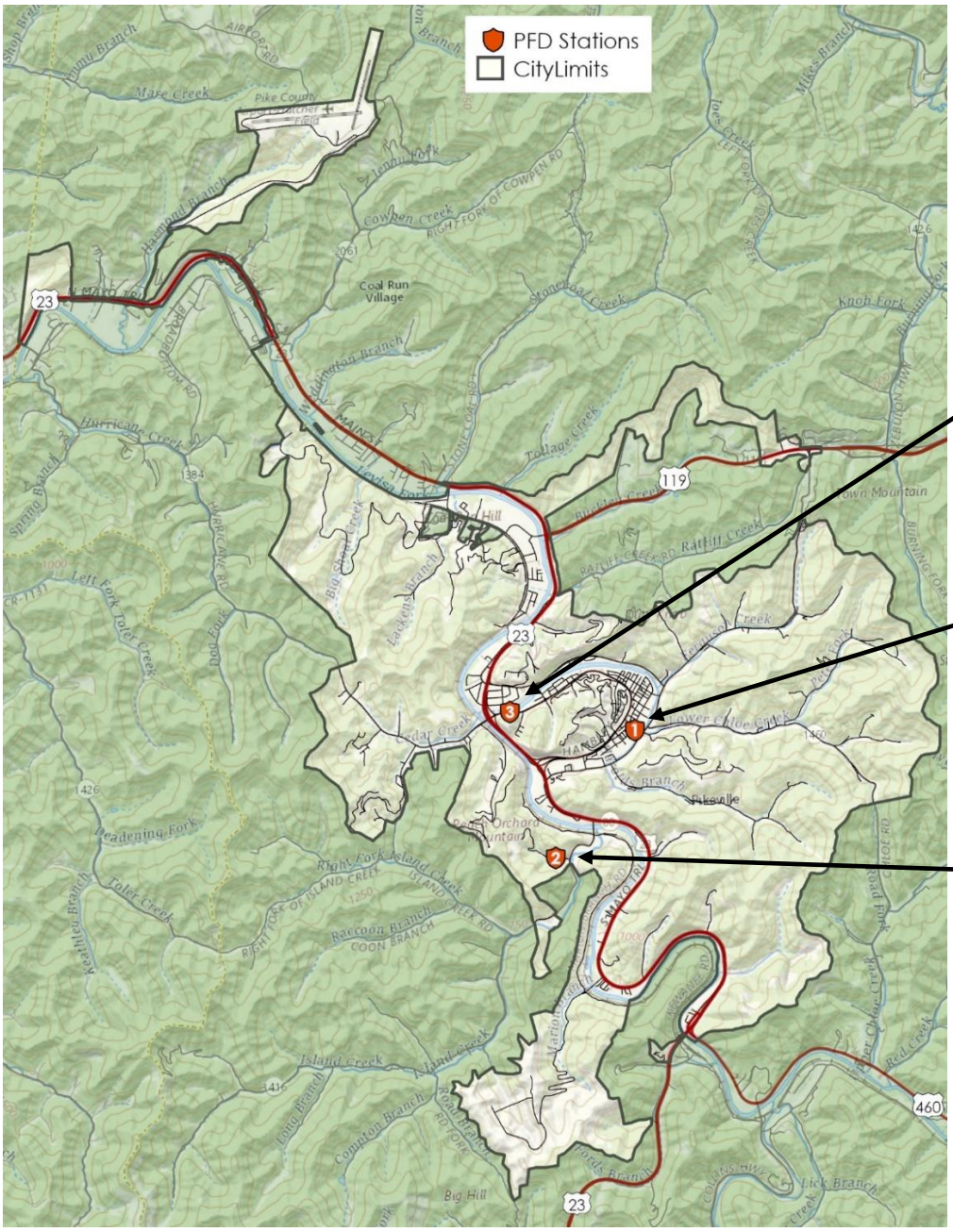
Station 3 is the newest of the three PFD stations. Station 3 was built in 2015 and houses fire and EMS equipment and staffing assets as well as several specialty pieces of apparatus to include an air boat, a mobile air unit, a mobile technical rescue unit, and a command unit.

Observations on PFD's fixed facilities include:

- All stations have back-up generators for emergency power.
- All stations have a washer/dryer for uniform cleaning and decontamination.
- Station 1 needs additional footprint to expand administrative offices and crew living and storage space. Station 1 currently utilizes a bunk-bed configuration, which exposes crew members to potential climbing and dismounting injuries. Station 1 is also in need of an upgraded air ventilation system (HVAC).
- Station 1 and Station 2 lack gender separation for bunking and bathroom facilities. ***This should be included in the new station 2.***
- The current stations do not include clean areas for decontaminating crew members, gear, and equipment. Structural PPE is not allowed in living areas.
- The current stations do not include training areas. Training is completed at the training center. This does, however, displace crews and apparatus from their primary response districts.
- Stations 1 and 3 include vehicle exhaust systems designed to externally evacuate apparatus exhaust gases (carcinogens). ***This should be included in the new Station 2.***

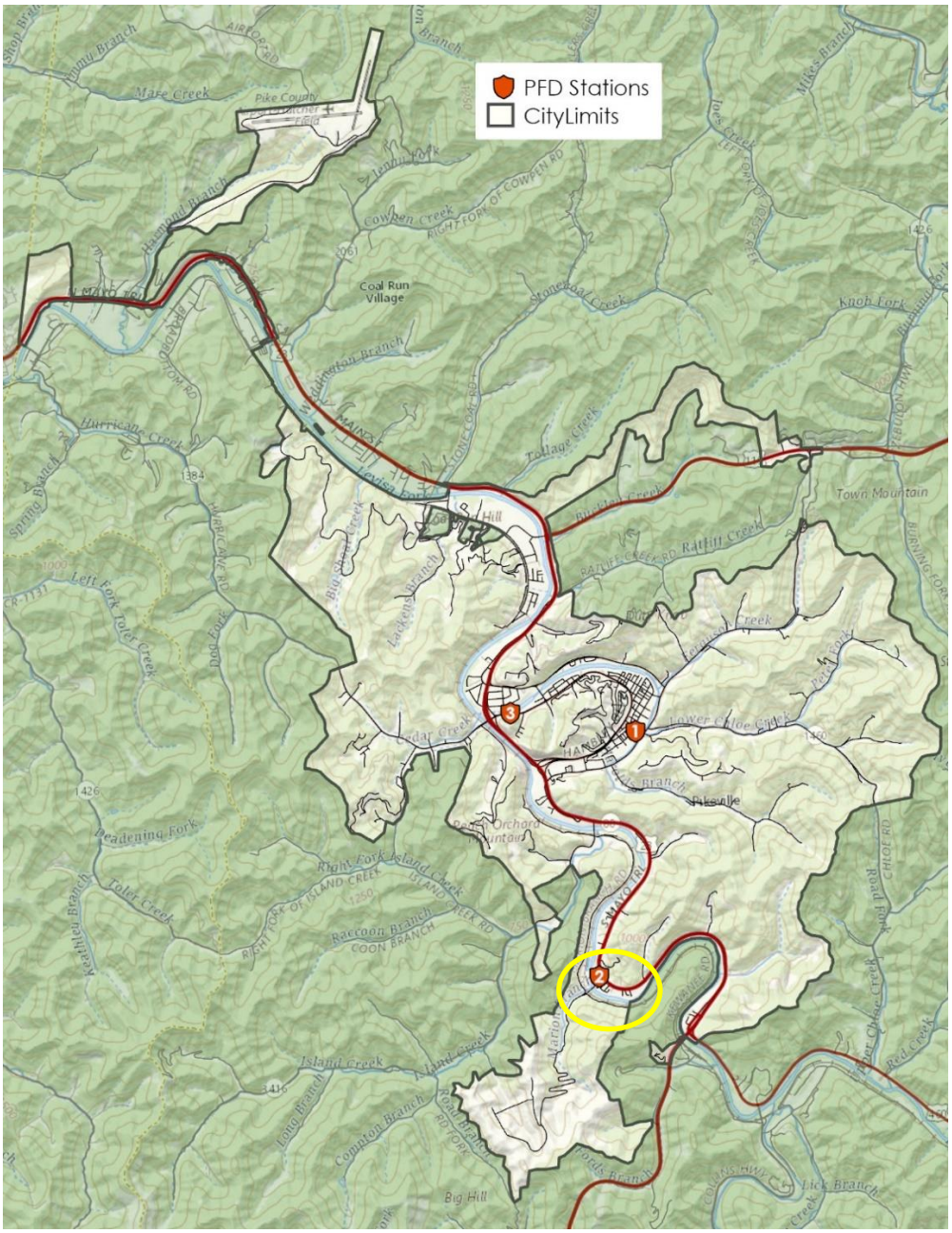
The following figure illustrates the location of current PFD fire stations within the city.

FIGURE 3-2: Current PFD Fire Station Locations and Apparatus Assignment



The 2013 Pikeville Comprehensive Plan update discusses the completion of moving the Thompson Road Fire Station (Station 3), relocating the station to Cedar Creek. This was accomplished in 2015. The 2013 Comprehensive Plan update also recommends relocation of Station 2. The city plans to relocate Station 2 to the former Fastenal building located at 1296 S. Mayo Trail in the southeast portion of the city. This relocation is expected to be completed in the summer of 2021. This facility will include three apparatus bays and will have a total of 4,900 square feet of which 1,460 square feet will be living space. The new Station 2 will provide fire and EMS transport. The next figure illustrates the location of PFD fire stations once the relocation of Station 2 occurs. The PFD plans to maintain the current Station 2 as the department fleet/equipment maintenance facility. Station 2 will then become Station 4.

FIGURE 3-3: PFD Fire Station Locations with Relocation of Station 2



Recommendation:

- CPSM recommends the City and PFD conduct further fire facility analysis to include factors such as space needs for administrative, crew living, and in-station training; gender separate bunking and bathroom; and crew and equipment decontamination areas (clean rooms). CPSM further recommends once the facility analysis is completed, the city and the PFD develop a facility capital improvement plan and make improvements as funding allows with a priority on gender separation and crew/equipment decontamination. (Recommendation No. 2.)

Fleet and Equipment

The provision of an operationally ready and strategically located fleet of mission-essential fire-rescue vehicles is fundamental to the ability of a fire-rescue department to deliver reliable and efficient public safety within a community.

The PFD currently operates a fleet of fire and EMS apparatus that includes:

- Three engine apparatus.
  - 2006, 1250 GPM, with 750-gallon water tank.
  - 2005, 1250 GPM, with 1000-gallon water tank.
  - 1995, 1250 GPM, with 1000-gallon water tank.
- Two ladder apparatus.
  - 1999, Quint (aerial ladder, fire pump, water tank, attack, and supply hose), 1250 GPM, with 750-gallon water tank, 70-foot aerial platform
  - 1981, Quint (aerial ladder, fire pump, water tank, attack, and supply hose), 1250 GPM, with 750-gallon water tank, 100-foot aerial platform
- One squad apparatus.
  - 2016, with 60-gallon water tank with Compressed Air Foam system, heavy/tactical rescue equipment.
- Four ambulance apparatus.
  - 2017, F550 Type I.
  - 2012, F550 4X4 Type I.
  - 2012, F550 4X4 Type I.
  - 2008, S35, Type III
- One forestry/brush apparatus.
  - 2006, F350, (designed for off-road fire attack), skid tank with 250-gallon tank and a Class A foam cell.
- One air boat
  - 2010 American Airboat/Coastline.

The PFD also has an assortment of command and service vehicles to include all terrain, golf cart, trailer, and small watercraft.

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

Replacement of fire-rescue response vehicles is a necessary, albeit expensive, element of fire department budgeting that should reflect 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*, 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. The committee membership is made up of representatives from the fire service, manufacturers, consultants, and special interest groups. The committee monitors various issues and problems that occur with fire apparatus and attempts to develop standards that address those issues. A primary interest of the committee over the past years has been improving firefighter safety and reducing fire apparatus crashes.

The Annex Material in NFPA 1901 (2016) 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 that have been properly maintained and that are still in serviceable condition be placed in reserve status and upgraded in accordance with NFPA 1912, Standard for Fire Apparatus Refurbishing (2016), 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."*

The impetus for these recommended service life thresholds is continual advances in occupant safety. Despite good stewardship and maintenance of emergency vehicles in sound operating condition, 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 as reflected 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.

Given that NFPA 1901 targets specifications for only fire suppression vehicles, NFPA 1917, Standard for Automotive Ambulances, was published in 2013 (updated in 2019) to provide similar recommendations governing the design and construction of ambulances. The U.S. General Services Administration also promulgates ambulance standards under KKK-A-1822. Additionally, the Commission on Accreditation of Ambulance Services (CAAS) has established a Ground Vehicle Standard (2016). While NFPA 1917, KKK, and CAAS standards do not include recommended service-life replacement standards for EMS vehicles, common industry practice suggests typical replacement intervals of four to eight years. This schedule depends on several variables, most notably vehicle mileage, escalation of annualized repair expenses, and frequency with which the subject vehicle is out of service. After replacement, serviceable vehicles may be retained in ready-reserve status for an additional two to four years. Considering the inherently shorter service life of ambulances, owing to a higher frequency of emergency responses handled than corresponding suppression vehicles, there are fewer legitimate concerns regarding "missing" essential improvements in occupant/operator safety standards.

The PFD does not have a replacement plan for front-line fire and EMS apparatus. The city is considering a lease program, which potentially will establish a more focused front-line apparatus replacement and reserve apparatus program.

Recommendations:

- CPSM recommends the PFD maintain proper vehicle maintenance schedules in accordance with motor and manufacturer specifications and recommendations, as well as a formal replacement schedule. (Recommendation No. 3.)
- CPSM recommends the PFD consider, budget permitting, a change to a 15-year replacement schedule for heavy fire apparatus, as apparatus of more than 15 years of age might include only a few of the safety upgrades required by the most recent editions of NFPA 1901[6] (NFPA 1901 is generally updated every five years). (Recommendation No. 4.)
- CPSM further recommends a six- to eight-year replacement program, based on use, mileage, and maintenance records, for front-line EMS transport vehicles. (Recommendation No. 5.)

SUPPORTIVE PROGRAMS AND SERVICES

Training Programs

Education and training are necessary at all levels of operation for tasks to be safely and effectively completed. The level of training or education required given a set of tasks varies with the jobs to be performed. Because so much depends upon the ability of the emergency responder to effectively deal with an emergency situation, education and training must have a prominent position within an emergency responder's schedule of activities when on duty.

The PFD has a robust training program for fire and EMS that includes both on-site and off-site training opportunities as follows:

- Kentucky Emergency Medical Technician (EMT) certification training.
- Kentucky 150-hour Fire Training Program (FFI).
- Kentucky 400-hour Fire Training Program (FFII).
- International Fire Service Congress (IFSAC) Certification Program (FF I and II) of which 75 percent of the PFD has completed (not a requirement).
- Hazardous Material Operations (100 percent of the PFD certified).
- Trench Rescue and Confined Space Rescue Certification.
- Rope Rescue Technician Certification.
- Building Collapse Operations.
- Swift Water Rescue.
- Dive Rescue.

The PFD also has an in-station training program that is required to be completed each shift by crew members. Additionally, the PFD conducts annual training programs at the department's training center to include live fire and flashover training utilizing the state fire training simulator.

The PFD, through medical direction of the EMS Operational Medical Director, has enhanced skills delivered through contemporary medical protocols that require initial and on-going training and

6. NFPA 1901, 2016 Edition, Quincy, MA.

skill assessment. This includes advanced airway care utilizing a Combi-Tube; administration of albuterol through nebulizer treatment for respiratory medical emergencies; 1-1000 epinephrine administration for allergic reactions; and 12-lead cardiac monitoring telemetry. ***These are small- to mid-size community best practices in pre-hospital emergency care.***

Fire Prevention Programs

Fire prevention is one of the most important missions in a modern-day fire department. A comprehensive fire prevention program should include, at a minimum, the key functions of fire prevention, code enforcement, inspections, and public education. Preventing fires before they occur, and limiting the impact of those that do occur, should be a priority of every fire department. Fire investigation is a mission-important function of fire departments, as this function serves to determine how a fire started and why the fire behaved the way it did, information that plays a significant role in fire prevention efforts. Educating the public about fire safety and teaching them appropriate behaviors on how to react should they be confronted with a fire is also an important life-safety responsibility of the fire department.

Fire suppression and response, although necessary to protect property, have little impact on preventing fire deaths. Rather, it is public fire education, fire prevention, and built-in fire protection systems that are essential elements in protecting citizens from death and injury due to fire, smoke inhalation, and carbon monoxide poisoning. The fire prevention mission is of utmost importance, as it is the only area of service delivery that dedicates 100 percent of its effort to the reduction of the incidence of fire before it starts.

The PFD has a fire marshal, who is responsible for public fire education, fire prevention inspections, and enforcement through adopted state and local laws, which includes national life safety codes. The fire marshal also works with the Pikeville Police Department (PPD) when the investigation of fire origin and cause requires this level of attention. When arson is suspected, the fire marshal and PPD work with the state fire marshal, utilizing available resources for a final determination and if needed, apprehension and prosecution of the arsonist.

Public fire education includes public cardiopulmonary resuscitation (CPR) and public automatic defibrillator training; building evacuation planning and training; public fire extinguisher training; and school- and senior-specific safety training. ***These are all best practice programs.***

ISO RATING

The ISO is a national, not-for-profit organization that collects and evaluates information from communities across the United States regarding their capabilities to combat building fires. The data collected from a community is analyzed and applied to ISO's Fire Suppression Rating Schedule (FSRS) from which a Public Protection Classification (PPC™) grade is assigned to a community (1 to 10). A Class 1 represents an exemplary fire suppression program that includes all of the components outlined below. A Class 10 indicates that the community's fire suppression program does not meet ISO's minimum criteria. It is important to understand the PPC is not just a fire department classification, but rather a compilation of community services that include the fire department, the emergency communications center, and the community's potable water supply system operator.[7]

7. PFD ISO PPC report; November 2019

A community's PPC grade depends on:

- **Needed Fire Flows** (building locations used to determine the theoretical amount of water necessary for fire suppression purposes).
- **Emergency Communications** (10 percent of the evaluation).
- **Fire Department** (50 percent of the evaluation).
- **Water Supply** (40 percent of the evaluation).

The City of Pikeville maintains an ISO rating of ***Class 02/2X,*** which was achieved in November 2019.

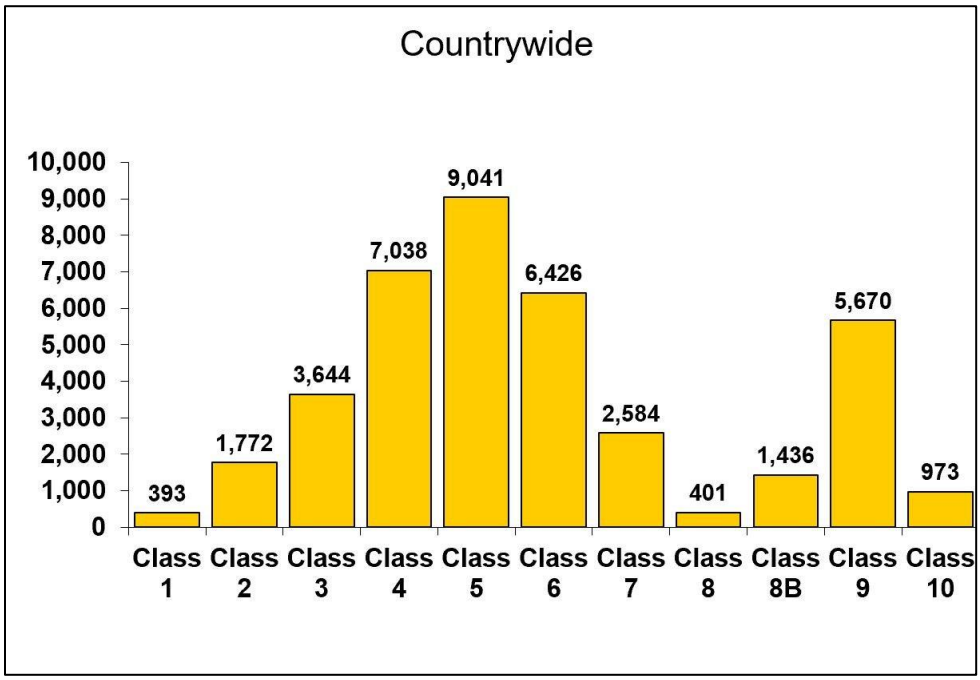
Some communities such as Pikeville have a split classification. The first number (2) represents the class that applies to properties within five road miles of the responding fire station and within 1,000 feet of a creditable water supply, such as a fire hydrant, suction point, or dry hydrant. The second number (2X) is the class that applies to properties within five road miles of a fire station but more than 1,000 feet away from of a creditable water supply (fire hydrant).

Although the city has a very good rating, a review of the 2019 report revealed the following deficiencies:

- Reserve pumper: **0.00**/0.50 credit points for reserve pumper apparatus. The PFD does not have reserve pumper apparatus. The PPC rating system outlines one reserve engine for every eight (8) front-line pumpers. Although the PFD ladder apparatus include fire pumps, water tanks, and hose, and can be utilized as pumper apparatus, they do not qualify as reserve pumper apparatus.
- Deployment analysis: **7.52**/10.00 credit points. This element analyzes the number of pumper and ladder apparatus to cover built-upon areas of the city. The analysis includes the distribution of engine and ladder companies in the city and is measured in one of two ways. One alternative is to measure the percentage of built-upon areas within 1.5 miles of each engine company, and within 2.5 miles of each ladder company. The second alternative is to utilize computer-aided dispatch (CAD) response time (travel time) data benchmarked against NFPA 1710 response time criterion. ***This element is discussed later in this report and will include structured recommendations for improvement.***
- Company personnel: **7.71**/15.00 credit points. This element analyzes the on-duty strength of personnel including company officers available to respond to first alarm structure fires. ***This element is discussed later in this report and will include structured recommendations for improvement.***

The following figure illustrates the dispersion of PPC ratings across the United States.

FIGURE 3-4: PPC Ratings: United States[8]



Recommendation:

- CPSM recommends the PFD consider, for the purpose of enhancing water supply for firefighting operations, and funding permitting, the purchase of a water tender apparatus for response to those areas of the city where built upon areas are more than 1,000 feet from municipal fire hydrants. (Recommendation No. 6.)

COMMUNITY LOSS AND SAVE INFORMATION

Fire loss is an estimation of the total loss from a fire to the structure and contents in terms of replacement. Fire loss includes contents damaged by fire, smoke, water, and overhaul. Fire loss does not include indirect loss, such as business interruption.

In a 2019 report published by the National Fire Protection Association on trends and patterns of U.S. fire losses, it was determined that home fires still cause the majority of all civilian fire deaths, civilian injuries, and property loss due to fire. Key findings from this report include:[9]

- Public fire departments responded to 1,318,500 fires in 2018, virtually the same as the previous year.

8. https://www.isomitigation.com/ppc/program-works/facts-and-figures-about-ppc-codes-around-the-country/
9. https://www.nfpa.org/News-and-Research/Data-research-and-tools/US-Fire-Problem/Fire-loss-in-the-United-States

- Every 24 seconds, a fire department in the United States responds to a fire somewhere in the nation. A fire occurs in a structure at the rate of one every 63 seconds, and a home fire occurs every 87 seconds.
- Seventy-four percent of all fire deaths occurred in the home.
- Home fires were responsible for 11,200 civilian injuries, or 74 percent of all civilian injuries, in 2018.
- An estimated $25.6 billion in property damage occurred as a result of fire in 2018; that is a large increase, as this number includes a $12 billion loss in wildfires in Northern California.
- An estimated 25,500 structure fires were intentionally set in 2018, an increase of 13 percent over the year before.

For the five-year period of 2015–2019, the PFD did not report any loss (in terms of dollars) as a result of fire-related calls for service. Additionally, the PFD did not report any fire or non-fire related injuries or fatalities during this same five-year period. That said, the PFD did respond to 1,929 fire/service/hazardous type calls for service (this does not include EMS or fire/false alarms). Typically fire departments across the nation record community loss in terms of property loss dollars of some type for these types of incidents, specifically for structural, vehicle, and outside fires. Additionally, over a five-year period there typically is some level of property/community save information as well.

Recommendation:

- CPSM recommends the PFD begin to record property loss and fire-related injury/fatality information in the fire reporting information system so that a community analysis can be completed at the end of each reporting year, for the purpose of identifying trends and issues, and developing solutions and programs targeted to reduce any fire or casualty problem. (Recommendation No. 7.)

END SECTION 3

SECTION 4. ALL-HAZARD RISK ASSESSMENT OF THE COMMUNITY

POPULATION AND DEMOGRAPHICS

The U.S. Census Bureau estimated the 2019 City of Pikeville population to be 6,551. This is a 5.2 percent decrease from the 2010 decennial population of 6,903. As the city is about 21 square miles in area, the population density based on the Census Bureau population data is 328/square mile; some areas of the city are denser than others.[10]

The age and socio-economic factors of the population can also have an impact on requests for fire and EMS service. Evaluation of the number of seniors and children by fire management zones can provide insight into trends in service delivery and quantitate the probability of future service requests. In a 2018 National Fire Protection Association (NFPA) report on residential fires, the following key findings were identified for the period 2011–2015:[11]

- Males were more likely to be killed or injured in home fires than females and accounted for a larger percentages of the victims (57 percent of the deaths and 54 percent of the injuries).
- The largest number of deaths (19 percent) in a single age group was among people ages 55 to 64.
- Half (50 percent) of the victims of fatal home fires were between the ages of 25 and 64, as were three of every five (62 percent) of the non-fatally injured.
- One-third (33 percent) of the fatalities were age 65 or older; only 15 percent of the non-fatal injured were in that age group.
- Children under the age of 15 accounted for 12 percent of the home fire fatalities and 10 percent of the injuries. Children under the age of 5 accounted for 6 percent of the deaths and 4 percent of the injuries.
- Adults of all ages had higher rates of non-fatal fire injuries than children.
- While smoking materials were the leading cause of home fire deaths overall, this was true only for people in the 45 to 84 age group.
- For adults 85 and older, fire from cooking was the leading cause of fire death.

In Pikeville the following age and socioeconomic factors should be considered when determining risk for fire and EMS preparedness and response:

- Children under the age of five represent 5.3 percent of the population.
- Persons under the age of 18 represent 19.1 percent of the population.
- Persons over the age of 65 represent 13.9 percent of the population.
- Female persons represent 50.8 percent of the population.
- There are 2.18 persons per household in Pikeville.

.10 https://www.census.gov/quickfacts/fact/table/pikevillecitykentucky/PST045219
11. M. Ahrens, "Home Fire Victims by Age and Gender", Quincy, MA: NFPA, 2018.

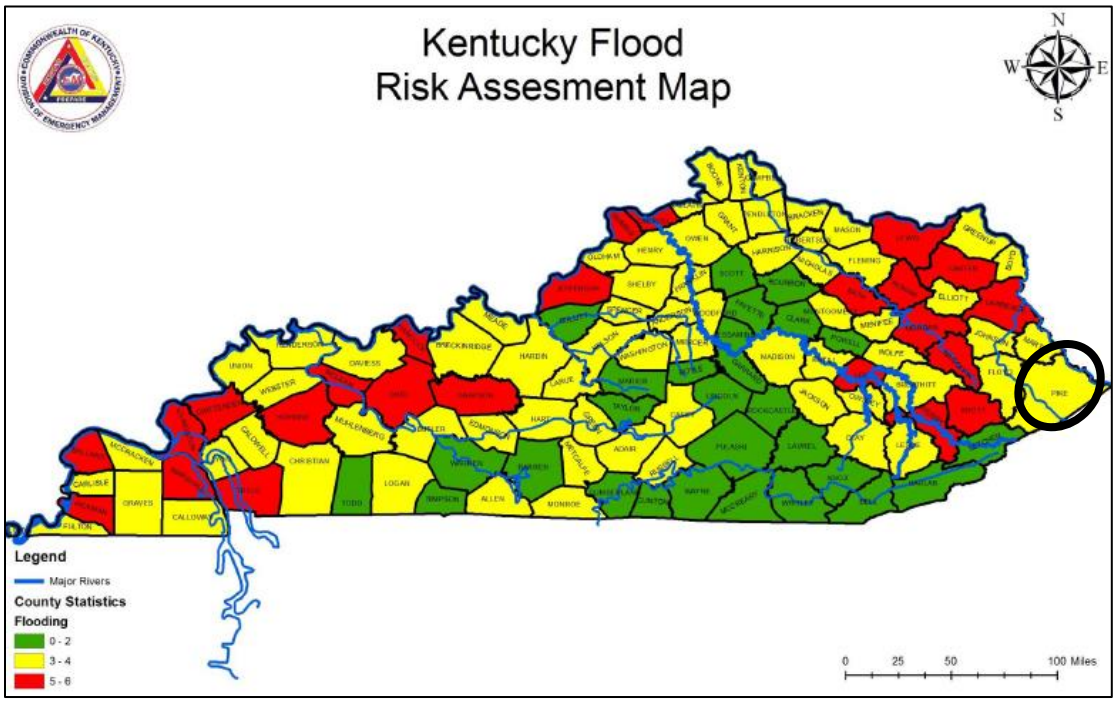
- The median household income in 2018 dollars is $34,718.
- Persons in poverty amount to 28.8 percent of the population.
- White alone represents the highest percentage of race in Pikeville at 92.5 percent. The remaining population profile by race is: Black or African-American at 3.6 percent, American Indian or Alaska Native alone at 1 percent, Asian alone at 1.2 percent, two or more races at 1.7 percent, and Hispanic or Latino at 1.8 percent.

ENVIRONMENTAL FACTORS

The City of Pikeville, because of its location in the mountains of eastern Kentucky, is prone to certain environmental factors that present the city with the following environmental risks:[12]

Flooding: Flooding is the predominant environmental risk for the city. The flooding risk is due to the city's close proximity to the Levisa Fork of the Big Sandy River. Flooding may result from heavy rainfall either in and around the city or region. Rivers in Kentucky flow from north to south with some flowing from south to north such as the Tug, Levisa, and Licking rivers. Flooding can be predicted from heavy rainfall or significant weather events such as the remnants of tropical systems, or flash flooding of tributaries that feed the Levisa Fork from sudden heavy rainfall. Flash floods have caused roadways to be covered in water, rendering the roads impassable for extended periods of time, destroying property both public and privately owned, and creating dangerous scenarios such as swift water. Figure 4-1 illustrates the flooding risk assessment map for the state. Figure 4-2 illustrates the Levisa Fork in Pikeville.

FIGURE 4-1: Kentucky Flood Risk Assessment Map



12. Commonwealth of Kentucky Emergency Operations Plan, 2014.

FIGURE 4-2: Levisa Fork

Landslides: Landslides present another environmental risk. Landslides in Pikeville have occurred both in sparsely populated areas and inside the populated city limits, moving people from their homes, affecting travel on roadways, and impacting daily life of citizens of Pikeville.

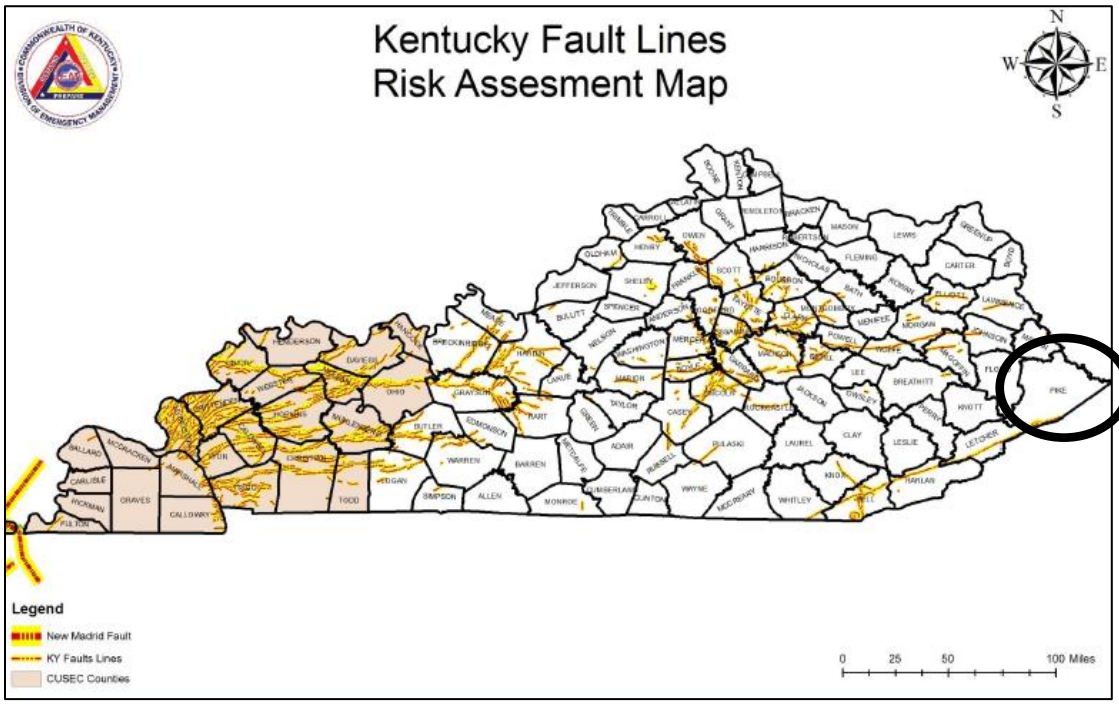
Severe Storms: The state of Kentucky, Pike County, and Pikeville are at risk for severe weather such as heavy rain, tornadoes, and ice storms.

Public Health Emergencies: The state of Kentucky, Pike County, and Pikeville are at risk for public health emergencies such as the 2020 pandemic known as COVID-19 or Coronavirus.

Natural Hazards: The state of Kentucky, Pike County, and Pikeville are at risk for natural hazards such as wildland fires.

Earthquake: The state of Kentucky, Pike County, and Pikeville are at risk for earthquakes. There are several fault lines that run through the state, including one in southeast Pike County. The following figure illustrates fault lines in Kentucky.

FIGURE 4-3: Fault Lines in Kentucky



BUILDING AND TARGET HAZARD FACTORS

A community risk and vulnerability exercise evaluates the community as a whole, and regarding buildings, measures all buildings and the risk associated with each property and then segregates the property as either a high-, medium-, or low-hazard depending on factors such as the life and building content hazard, and the potential fire flow and staffing required to mitigate an emergency in the specific property. According to the NFPA *Fire Protection Handbook*, these hazards are defined as:

High-hazard occupancies: Schools, hospitals, nursing homes, explosives plants, refineries, high-rise buildings, and other high life-hazard (vulnerable population) 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.[13]

The construction type for residential structures in Pikeville is predominantly wood frame with brick veneer. Basements are typical in residential structures. There are also manufactured or factory-built homes of light meta/wood construction with various exterior coverings. Pikeville does have single-family homes in excess of 3,500 square feet not including basement area. The majority of

13. Cote, Grant, Hall & Solomon, eds., *Fire Protection Handbook* (Quincy, MA: National Fire Protection Association, 2008), 12.

the commercial/industrial structure building inventory is ordinary (block/brick) construction with some metal (butler type).

Pikeville has the following building types:

- Single-family homes.
- Manufactured homes.
  - Single-family/manufactured homes used as rental.
- Townhouses, duplexes, triplexes, quads.
- Apartment buildings (5-unit, 6-unit, 8-unit, 10-unit, 16-unit, 18-unit, 24-unit).
- Attached apartments to commercial or residential.
- Commercial/industrial/professional business/educational structures.
- Strip malls.
- Hotel structures.
- Rooming/lodging structures.
- Educational dormitories.
- Assisted living/long term care structures.
- Housing/commercial/professional business structures over 75 feet (high rise).
- Public education structures.
- Correctional institution.
- Pikeville Medical Center.

In terms of identifying target hazards, consideration must be given to the activities that take place (manufacturing, processing, etc.), the number and types of occupants (elderly, youth, handicapped, imprisoned, etc.), and other specific aspects relating to the construction features of the building.

Pikeville has a variety of target hazards that include:

- Hotel/Dormitory Target Hazards (life safety).
- Correctional Instituion Target Hazard (life safety/access).
- Educational/School/Public Assembly Target Hazard (life safety).
- Mercantile/Business/Industrial (life safety, hazardous storage and or processes).
- Long Term Care Target Hazard (life safety, vulnerable population).
- Government Infrastructure Target Hazard (hazardous storage/processes and continuity of operations).
- Government Business Target Hazards (life safety, continuity of operations).
- Private Business Target Hazards (life safety).
- Hospital/Medical Center Target Hazards (life safety, hazardous materials storage and use).

The city has a slightly predominant low-hazard building risk (53.5 percent single-family dwellings according to the 2013 Comprehensive Plan). Medium- and high-hazard building risks are noted

in this section as well. There is a moderate number of housing units managed by the Housing Authority of Pikeville designated for the elderly, near elderly, or disabled. High life safety hazards include these structures, as well as hotels, rooming/lodging structures, public assembly structures, the Pikeville Medical Center, and certain University of Pikeville structures.

TRANSPORTATION FACTORS

The road network in Pikeville is typical of cities across the country and includes arterial streets, which carry high volumes of traffic; collector streets, which provide connection to arterial roads and local street networks as well as residential and commercial land uses; and local streets, which provide a direct road network to property and move traffic through neighborhoods and business communities.

Pikeville is served by four highways. These are: US Route 23 (north-south), US Route 119 (north-south), US Route 460 (east-west) and Kentucky Route 80 (east-west). According to the 2013 Pikeville Comprehensive Plan, these roads handle more than 30,000 vehicles each day.

The road network described herein poses a vehicular accident and vehicular-versus-pedestrian risk in Pikeville. There are additional transportation risks since tractor-trailer and other commercial vehicles traverse the roadways of Pikeville to deliver mixed commodities to businesses and residential locations. Fires involving these products can produce smoke and other products of combustion risks that may be hazardous to health.

The CSX Transportation, Big Sandy Subdivision main line, passes through Pikeville. There are some at-grade crossings on connector and local roads, and this creates transportation risks. Otherwise, arterial streets and highways do not intersect directly with rail traffic, thus neutralizing rail/vehicular traffic accidents. Primary commodities handled by CSX in Kentucky include coal, light trucks, containerized consumer goods, semi-finished steel, and iron ore. Consist can also include chemicals, lumber, sand, and gravel. While not all of these commodities may not be considered hazardous materials, fires involving these commodities can produce smoke and other products of combustion risks that may be hazardous to health. Hazardous materials themselves present hazards to health risks. Figure 4-4 illustrates the CSX main line that travels through Pikeville. Figure 4-5 illustrates major road transportation components in Pikeville.

FIGURE 4-4: CSX Big Sandy Subdivision Mainline through Pikeville

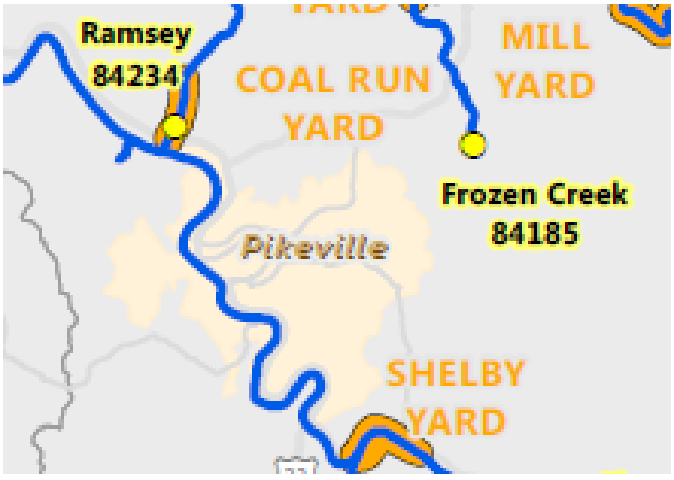
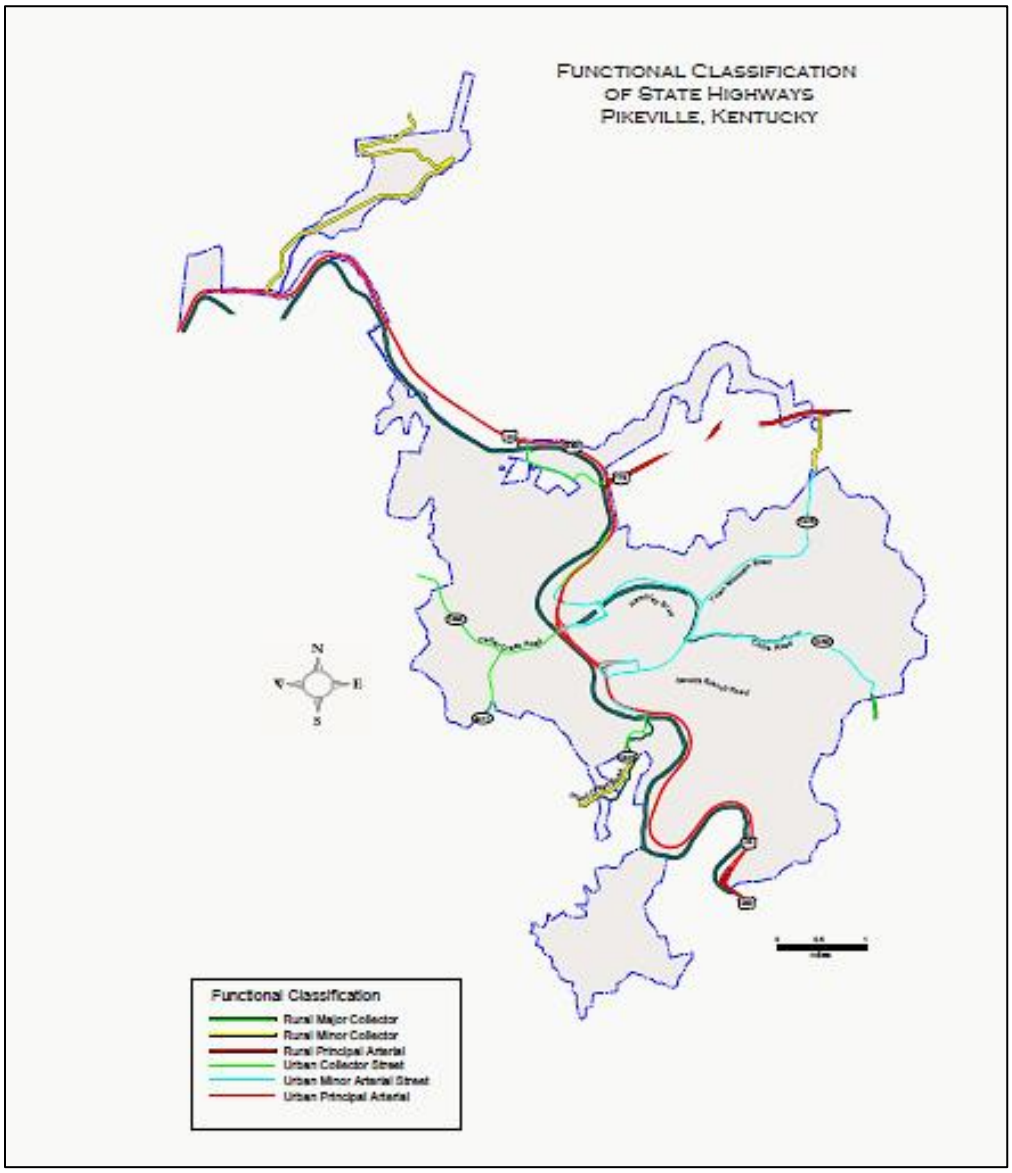


FIGURE 4-5: Pikeville Major Road Network and Classification



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FIRE AND FIRE-RELATED INCIDENT RISK

An indication of the community's fire risk is the type and number of fire-related incidents the fire department responds to. During the CPSM data analysis study period of November 1, 2018, to October 31, 2019, the PFD responded to 888 fire-related calls for service. The following table details the call types and call type totals for these types of fire-related risks.

TABLE 4-1: Fire Call Types

Call Type	Number of Calls	Calls per Day	Call Percentage (All Calls)
False alarm	325	0.9	10.7
Good intent	28	0.1	0.9
Hazard	68	0.2	2.2
Outside fire	20	0.1	0.7
Public service	443	1.2	14.6
Structure fire	4	0.0	0.1
Fire Total	**888**	**2.4**	**29.2**

Key takeaways from this data set are:

- Fire calls for the study period totaled 888 (29 percent of all calls), an average of 2.4 fire calls per day.
- Public service calls were the highest category of fire type calls at 14.6 percent of all calls and averaged 1.2 calls per day. Public service calls are those responses by the PFD to incidents such as lock outs, smoke odor with no fire, water evacuation, non-electrical line down from a pole, animal rescue, public service assist to include assist to police, and steam mistaken for smoke.
- False alarm calls were the second highest category of fire calls and made-up 10.7 percent of all calls and averaged of 0.9 calls per day. False alarms typically include fire alarms activated with no fire or smoke present (largest percent) and fire alarm/sprinkler system malfunction.
- Structure and outside fire calls combined made up 2.3 percent of fire calls and 0.8 percent of all calls and represent an average of less than 0.1 call per day or less than one per week. Outside fires include vegetation, brush, wild land, vehicle, dumpster, trash pile, and other actual fires not in or exposing a structure where the structure is also involved in fire.

Note that the call percentge shown in the table is the pecentage of all calls, including fire-related, EMS, car seat intallation, mutual aid, canceled enroute, and non-emergency calls. ***As can be seen in these data, the occurrence of actual fire calls (outside and structural) is minimal.***

EMS RISK

As with fire risks, an indication of the community's pre-hospital emergency medical risk is the type and number of EMS calls to which the fire department responds. During the CPSM data analysis study period pf November 1, 2018, through October 31, 2019, the PFD responded to 1,709 EMS-related calls for service. The following table outlines the call types and call type totals for these types of EMS risks.

TABLE 4-2: EMS Call Types

Call Type	Number of Calls	Calls per Day	Call Percentage (All Calls)
Breathing difficulty	153	0.4	5.0
Cardiac and stroke	35	0.1	1.2
Fall and injury	228	0.6	7.5
Illness and other	846	2.3	27.9
MVA	183	0.5	6.0
Overdose and psychiatric	99	0.3	3.3
Seizure and unconsciousness	165	0.5	5.4
EMS Total	**1,709**	**4.7**	**56.3**

Key takeaways from this data set are:

- Illness and other calls, by far, made up the largest category of EMS calls at 27.9 percent of all calls, an average of 2.3 calls per day.
- Fall and injury calls made up the second largest EMS call category at 7.5 percent of all calls, an average of 0.6 calls per day.
- Cardiac, stroke, and breathing difficulty calls made up 6.2 percent of all calls, an average of 0.5 calls per day.

Again, the call percentage shown in the table is the pecentage of all calls including fire-related, EMS, and other calls such as car seat intallation, mutual aid, canceled enroute, and non-emergency calls. ***As can be seen in these data, the occurrence of EMS-related calls represents the largest number of calls overall responded to by the PFD (56.3 percent).***

FIRE INCIDENT DEMAND AND EMS INCIDENT DEMAND

The fire and EMS risk in terms of numbers and types of incidents is important when analyzing a community's risk, as outlined above. Analyzing where the fire and EMS incidents occur, and the demand density of fire and EMS incidents, determines adequate fire management zone resource assignment and deployment. The following figures illustrate fire and EMS demand in the PFD fire management zones. Figure 4-6 illustrates fire incidents (structural and outside fires, alarm activations etc.); Figure 4-7 illustrates other types of fire-related incidents such as good intent and public service calls, which are calls for service such as smoke scares (no fire), wires down, lock outs, water leaks, etc.; Figure 4-8 illustrates the call density of false alarms; and Figure 4-9 illustrates EMS incident demand.

The following four demand maps from current fire station locations tell us that fire-related responses and EMS incident demand is highest in the core/central portion of the city. Actual fire incidents (outside and structural) are spread out in the central, eastern, and northern areas of the city.

FIGURE 4-6: Fire Incident Demand Density (Structural and Outside Fires)

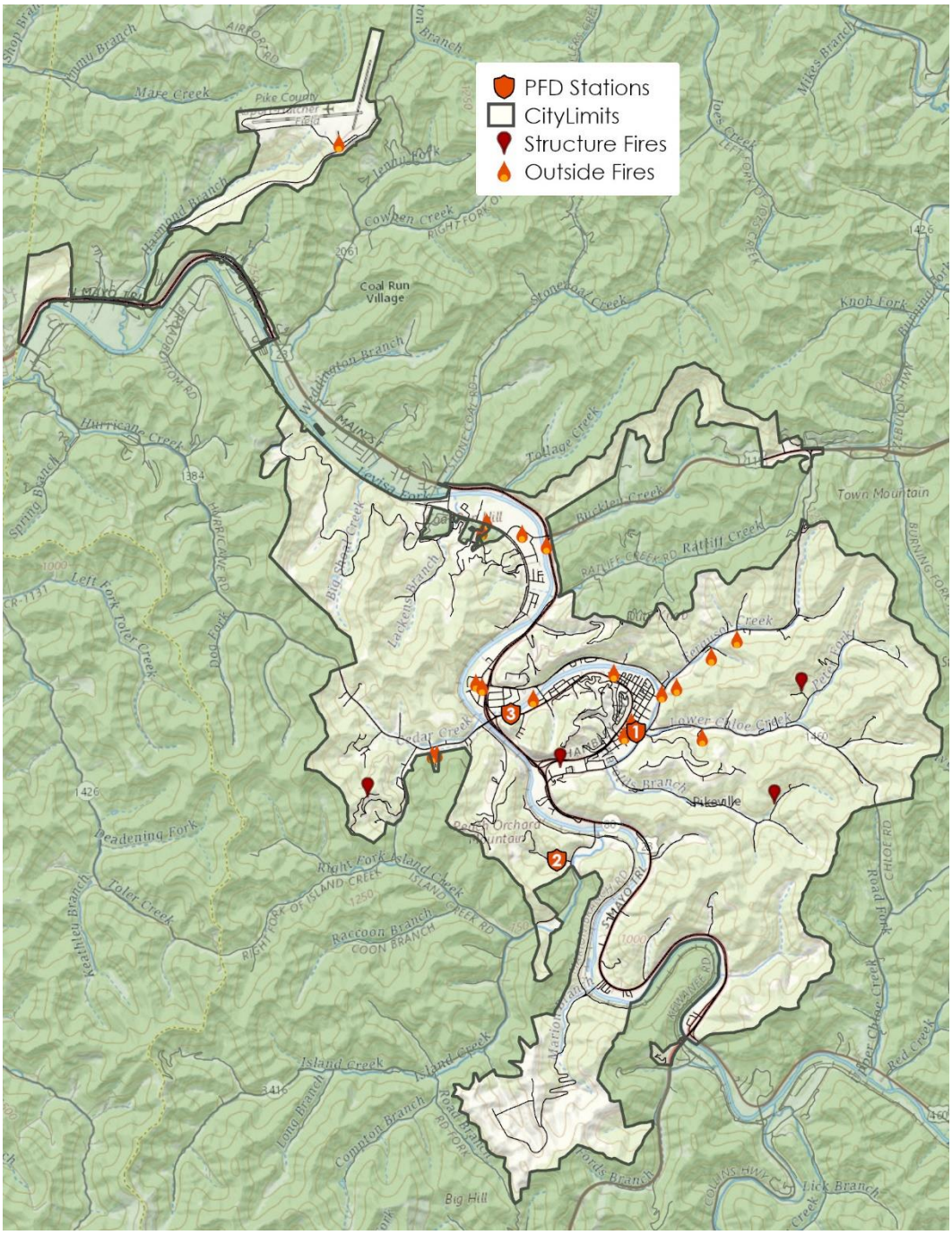


FIGURE 4-7: Fire Incident Demand Density (Other Fire-related Incidents)

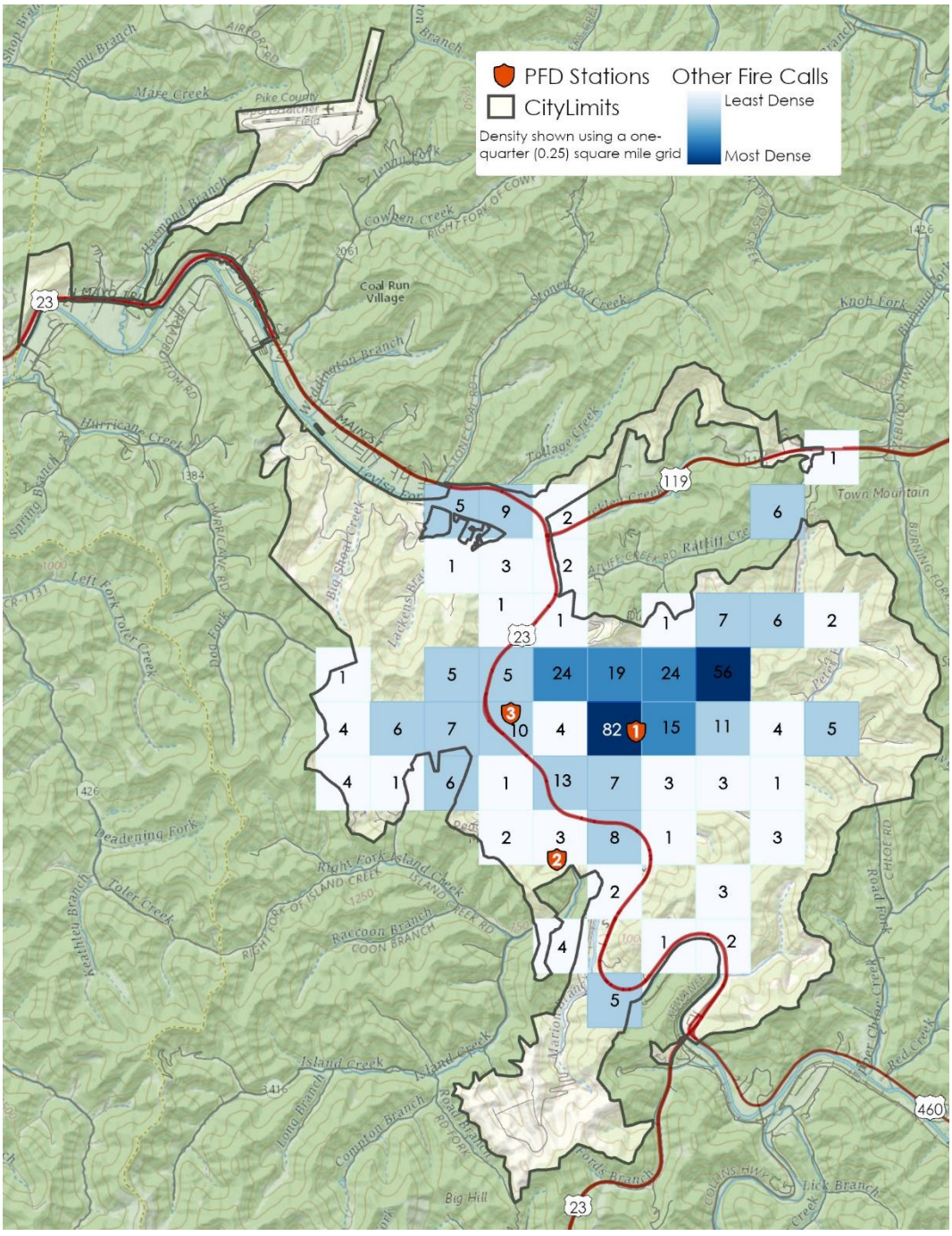


FIGURE 4-8: False Alarm Incident Demand Density

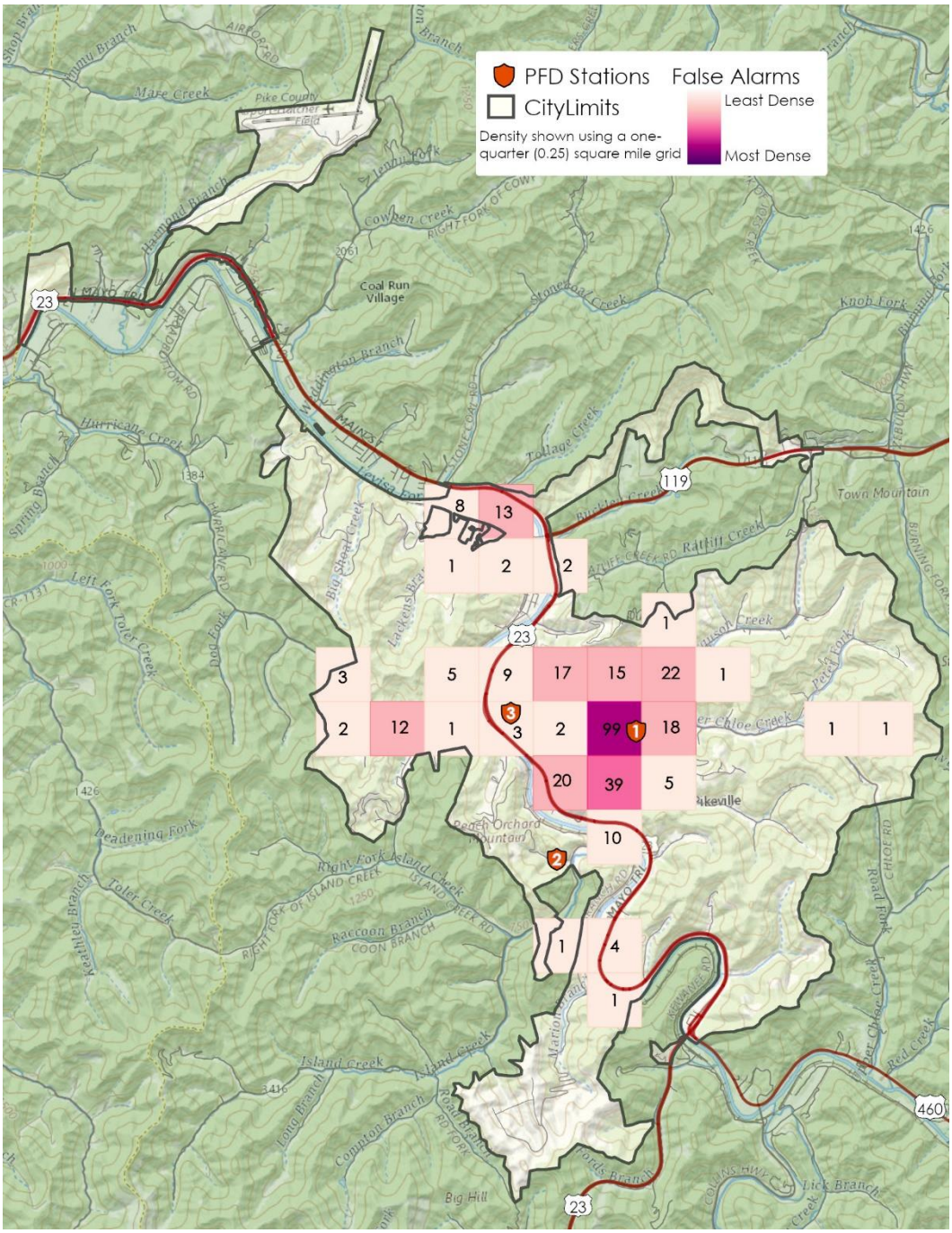
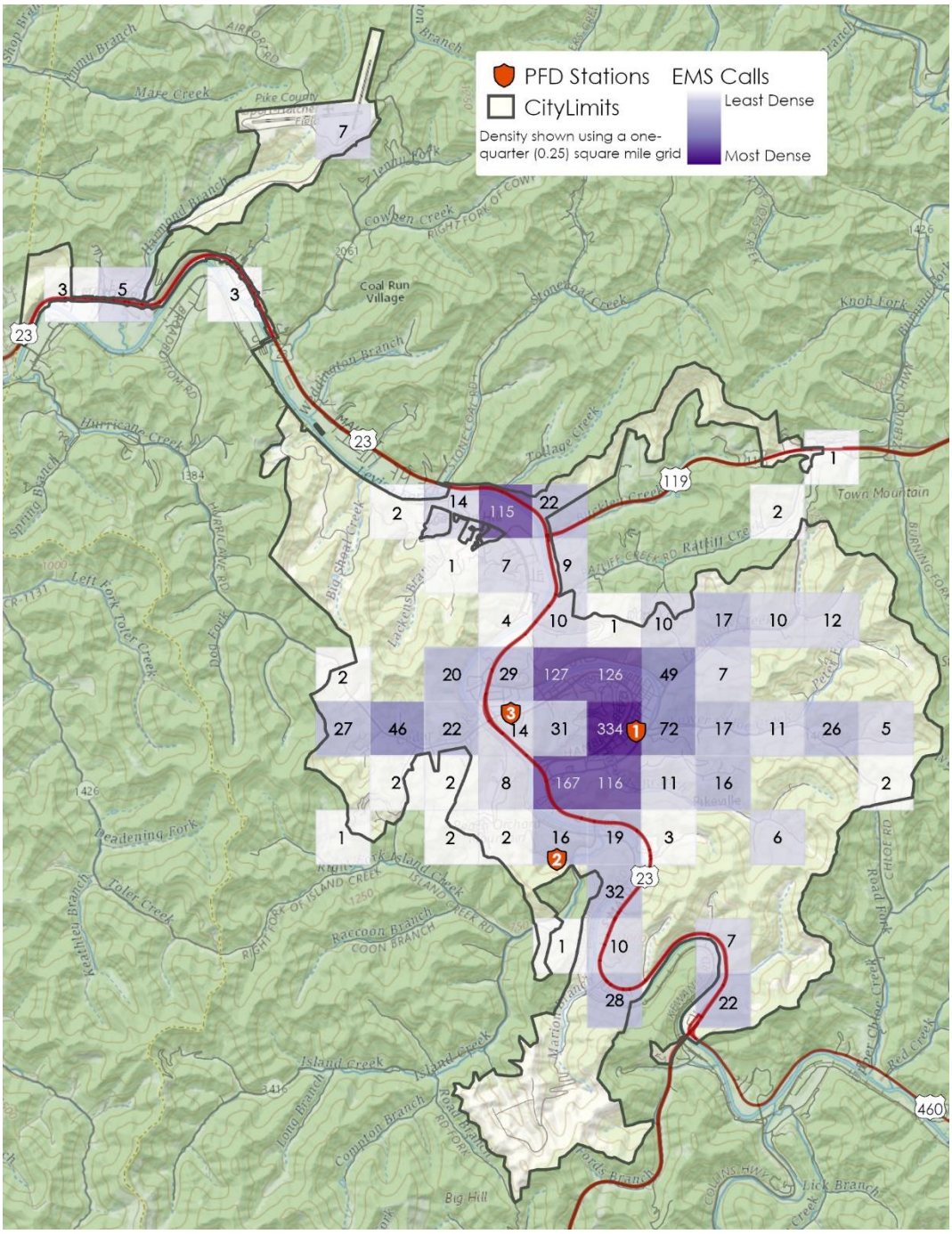


FIGURE 4-9: EMS Incident Demand Density



RESILIENCY

Resiliency as defined by the Center for Public Safety Excellence (CPSE) in the *Fire and Emergency Services Self-Assessment Manual* (FESSAM) 9th edition: "an organization's ability to quickly recover from an incident or events, or to adjust easily to changing needs or requirements." Greater resiliency can be achieved by constant review and analysis of the response system and should focus on three key components:

- Resistance: The ability to deploy only resources necessary to safely and effectively control an incident and bring it to termination, which is achieved through the development and implementation of critical tasking and its application to the establishment of an effective response force for all types of incidents.
- Absorption: The ability of the agency to quickly add or duplicate resources necessary to maintain service levels during heavy call volume or incidents of high resource demand.
- Restoration: The agency's ability to quickly return to a state of normalcy.

Resistance is controlled by the PFD through planned staffing and response protocol, and with PFD resources dependent on the level of staffing and units available at the time of the alarm. As discussed in the next section, the current PFD staffing model may not, for certain incident types, be able to assemble an Effective Response Force necessary to perform the critical tasks necessary in a simultaneous fashion to safely control an incident.

Absorption is accomplished through initial responding units available to respond by the PFD and through mutual and automatic aid agreements. As discussed above, the PFD largely receives mutual and automatic aid from volunteer companies, but which are not regularly staffed. This delays response and does not guarantee a specific number of firefighters responding.

Restoration is managed by PFD unit availability as simultaneous calls occur, recall of staff-to-staff fire units during campaign events when warranted, efficient work on incidents for a quick return to service, and mutual aid agreements.

Regarding restoration, the following three tables analyze the station availability to respond to calls, and the frequency by number of hours that units are dedicated to a single or multiple incidents.

The PFD cross-staffs its units in each station. This means the on-duty crew at the station responds to the call by type (fire, EMS, technical rescue) with the most appropriate unit (ambulance, aerial ladder, engine, rescue).

The first table looks at the overall workload of the PFD, which links to restoration.

TABLE 4-3: Annual Runs and Deployed Time by Run Type

Call Type	Avg. Deployed Min. per Run	Total Annual Hours	Percent of Total Hours	Avg. Deployed Min. per Day	Total Annual Runs	Avg. Runs per Day
Breathing difficulty	50.9	139.3	5.6	22.9	164	0.4
Cardiac and stroke	56.9	42.7	1.7	7.0	45	0.1
Fall and injury	55.2	239.1	9.6	39.3	260	0.7
Illness and other	48.3	768.3	30.9	126.3	955	2.6
MVA	62.7	425.6	17.1	70.0	407	1.1
Overdose and psychiatric	61.0	111.9	4.5	18.4	110	0.3
Seizure and unconsciousness	51.8	172.6	6.9	28.4	200	0.5
EMS Total	**53.2**	**1,899.5**	**76.3**	**312.2**	**2,141**	**5.9**
False alarm	19.1	174.3	7.0	28.7	547	1.5
Good intent	20.8	13.9	0.6	2.3	40	0.1
Hazard	39.5	61.9	2.5	10.2	94	0.3
Outside fire	41.7	29.9	1.2	4.9	43	0.1
Public service	25.2	190.9	7.7	31.4	455	1.2
Structure fire	114.8	36.4	1.5	6.0	19	0.1
Fire Total	**25.4**	**507.2**	**20.4**	**83.4**	**1,198**	**3.3**
Canceled	27.4	5.5	0.2	0.9	12	0.0
Mutual aid	66.8	77.9	3.1	12.8	70	0.2
Other Total	**61.0**	**83.4**	**3.3**	**13.7**	**82**	**0.2**
Total	**43.7**	**2,490.1**	**100.0**	**409.3**	**3,421**	**9.4**

The next table looks at station availability to respond to calls in the first due fire management zone, which links to restoration.

TABLE 4-4: Station Availability to Respond to Calls

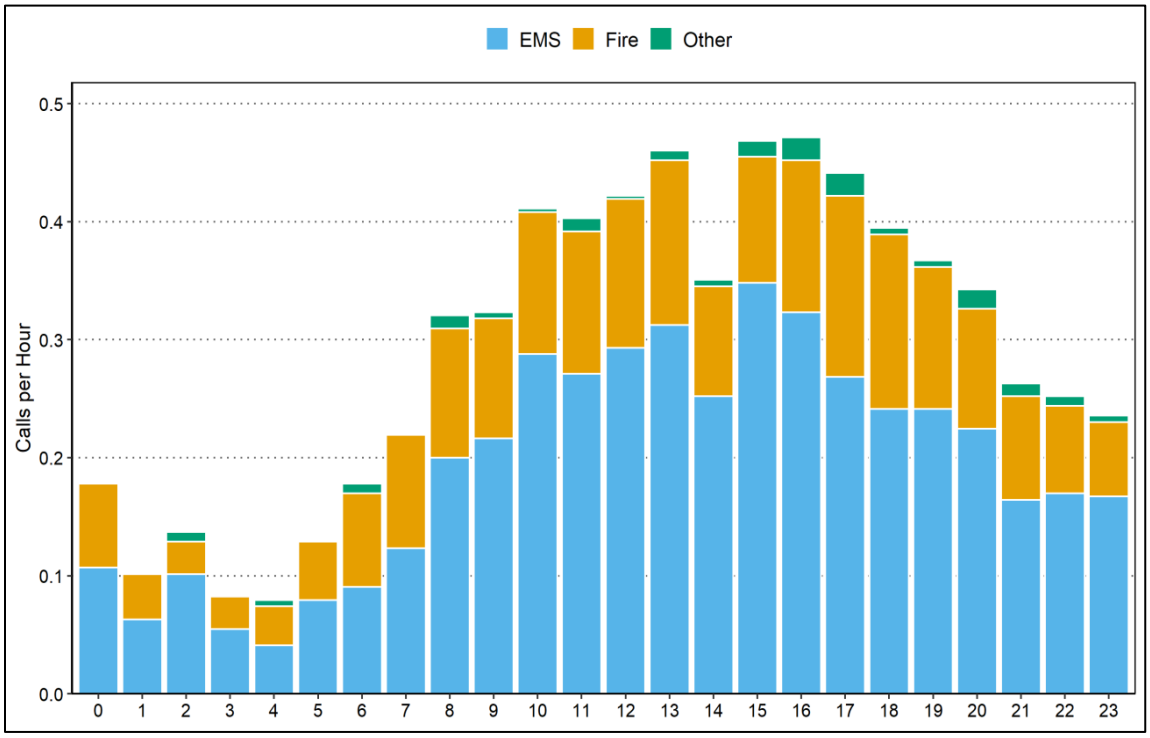
Station	Calls in Area	First Due Responded	First Due Arrived	First Due First	Percent Responded	Percent Arrived	Percent First
1	1,477	1,301	1,294	1,265	88.1	87.6	85.6
2	367	218	214	192	59.4	58.3	52.3
3	524	397	384	353	75.8	73.3	67.4
Total	**2,368**	**1,916**	**1,892**	**1,810**	**80.9**	**79.9**	**76.4**

The next table looks at the frequency of calls in a given hour, followed by an illustration of the number of calls occurring during each hour of the day.

TABLE 4-5: Frequency Distribution of the Number of Calls

Calls in an Hour	Frequency	Percentage
0	6,635	75.7
1	1,761	20.1
2	306	3.5
3+	58	0.7
Total	**8,760**	**100.0**

FIGURE 4-10: Calls by Hour of Day



The next figure illustrates the number of PFD units, and the frequency of this number, that respond to fire calls, which links to resistance.

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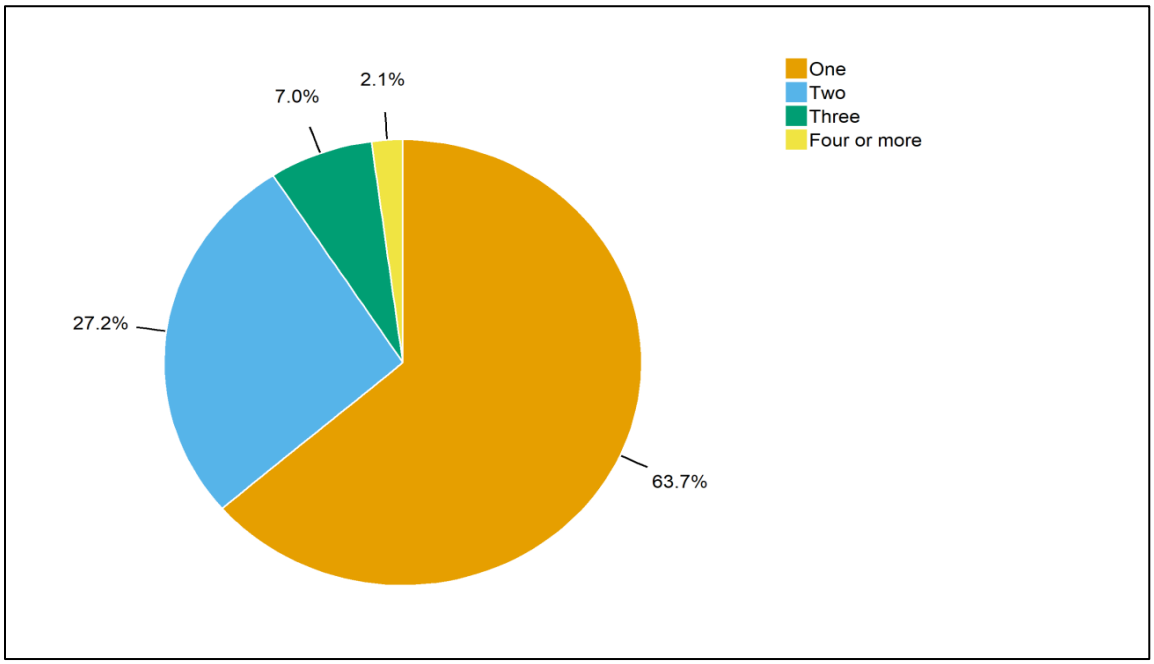
FIGURE 4-11: Calls by Number of Units Dispatched – Fire



The final table examines the frequency of overlapping calls per station, which links to absorption.

TABLE 4-6: Frequency of Overlapping Calls

Station	Scenario	Number of Calls	Percent of All Calls	Total Hours
1	No overlapped call	1,386	88.2	909.4
	Overlapped with one call	157	10.0	55.9
	Overlapped with two calls	25	1.6	2.8
	Overlapped with three calls	3	0.2	1.2
	Overlapped with four calls	1	0.1	0.0
2	No overlapped call	365	95.3	286.3
	Overlapped with one call	18	4.7	7.3
3	No overlapped call	510	92.6	423.2
	Overlapped with one call	40	7.3	17.6
	Overlapped with two calls	1	0.2	0.4

Regarding the PFD's resiliency to respond to calls, analysis of these tables and figures tells us:

- On average the PFD responded to 9.4 calls per day.
- On average, all calls averaged 43.7 minutes per run.
- Overall, 92 percent of the time there was a single call (no call overlap).
- Overall, 8 percent of the time a call was overlapped with another call.
- Station 1 had call overlap 12 percent of the time.
- Station 2 had call overlap 5 percent of the time.

- Station 3 had call overlap 8 percent of the time.
- 81 percent of the time the first due unit responded to calls in its first due area.
- 76 percent of the time the first due unit arrived first in its first due area.
- 64 percent of the time, the PFD responds one unit to a fire or EMS incident.
- Hourly deployed time was highest during the day from 8:00 am to 8:00 pm.
- The deployed time peaked between 1:00 p.m. and 5:00 p.m.

Overall, this discussion shows that the PFD does not have a resiliency issue, since, on average, about 92 percent of the time the PFD has a unit or units available to respond to an incident, albeit not always from the first-due station. Singularly, Station 1 has an overlapped call 12 percent of the time and Station 3 has an overlapped call 8 percent of the time. This, combined with each station's availability to respond to calls in their first due area as detailed above (81 percent overall), does raise some concern regarding unit and crew availability to respond in each fire management zone.

As outlined in the next section, the PFD staffs each unit with a cross-staffing model. In this model a single crew is assigned to station with multiple pieces of apparatus. The single crew responds the appropriate piece of apparatus to an incident based on call type. Station 1 does have three personnel assigned and may respond a single firefighter on a single piece of apparatus, which, depending on the type of incident, presents service delivery and crew safety issues, since many fire and EMS incidents require more than a crew of one to mitigate.

RISK CATEGORIZATION

A comprehensive risk assessment is a critical aspect of creating standards of cover and can assist the PFD in quantifying the risks that it faces in the city. Once it knows these risks, the department is better equipped to determine if the current response resources are sufficiently staffed, equipped, trained, and positioned. In this component, the factors that drive the service needs are examined and then link directly to discussions regarding the assembly of an effective response force (EFR) and when contemplating the response capabilities needed to adequately address the existing risks, which encompasses the component of critical tasking.

The risks that the department faces can be natural or man-made and may be affected by the changing demographics of the community served. With the information available from the CPSM data analysis, the PFD, the city, and public research, CPSM and the PFD can begin an analysis of the city's risks and can begin working towards recommendations and strategies to mitigate and minimize their effects. This section contains an analysis of the various risks considered within the PFD's service area.

Effects on the community are often categorized in three ways: the consequence of the event on the community, the probability the event will occur in the community, and the impact on the fire department. The following three tables look at the probability of the event occurring (Table 4-7), which ranges from unlikely to frequent; consequence to the community (Table 4-8), which is categorized ranging from insignificant to catastrophic; and the impact to the organization (Table 4-9), which ranges from insignificant to catastrophic. For each risk categorization (Low, Moderate, High, Special), a risk score from each table (Probability, Consequence, Impact) is applied to a formula (Heron's Formula), and a three-axis risk calculation is created. This concept is illustrated in Figures 4-12 through 4-16.

TABLE 4-7: Event Probability

Probability	Chance of Occurrence	Description	Risk Score
Unlikely	2%-25%	Event may occur only in exceptional circumstances.	**2**
Possible	26%-50%	Event could occur at some time and/or no recorded incidents. Little opportunity, reason, or means to occur.	**4**
Probable	51%-75%	Event should occur at some time and/or few, infrequent, random recorded incidents or little anecdotal evidence. Some opportunity, reason, or means to occur; may occur.	**6**
Highly Probable	76%-90%	Event will probably occur and/or regular recorded incidents and strong anecdotal evidence. Considerable opportunity, means, reason to occur.	**8**
Frequent	90%-100%	Event is expected to occur. High level of recorded incidents and/or very strong anecdotal evidence.	**10**

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TABLE 4-8: Consequence to Community Matrix

Impact	Impact Categories	Description	Risk Score
Insignificant	Life Safety	▪ 1 or 2 people affected, minor injuries, minor property damage, and no environmental impact.	**2**
Minor	Life Safety Economic and Infrastructure Environmental	▪ Small number of people affected, no fatalities, and small number of minor injuries with first aid treatment. Minor displacement of people for <6 hours and minor personal support required. ▪ Minor localized disruption to community services or infrastructure for <6 hours. Minor impact on environment with no lasting effects.	**4**
Moderate	Life Safety Economic and Infrastructure Environmental	▪ Limited number of people affected (11 to 25), no fatalities, but some hospitalization and medical treatment required. Localized displacement of small number of people for 6 to 24 hours. Personal support satisfied through local arrangements. Localized damage is rectified by routine arrangements. ▪ Normal community functioning with some inconvenience. ▪ Some impact on environment with short-term effects or small impact on environment with long-term effects.	**6**
Significant	Life Safety Economic and Infrastructure Environmental	▪ Significant number of people (>25) in affected area impacted with multiple fatalities, multiple serious or extensive injuries, and significant hospitalization. ▪ Large number of people displaced for 6 to 24 hours or possibly beyond. External resources required for personal support. Significant damage that requires external resources. Community only partially functioning, some services unavailable. ▪ Significant impact on environment with medium- to long-term effects.	**8**
Catastrophic	Life Safety Economic and Infrastructure Environmental	▪ Very large number of people in affected area(s) impacted with significant numbers of fatalities, large number of people requiring hospitalization with serious injuries with long-term effects. General and widespread displacement for prolonged duration and extensive personal support required. Extensive damage to properties in affected area requiring major demolition. ▪ Serious damage to infrastructure causing significant disruption to, or loss of, key services for prolonged period. ▪ Community unable to function without significant support. ▪ Significant long-term impact on environment and/or permanent damage.	**10**

TABLE 4-9: Impact on PFD

Impact	Impact Categories	Description	Risk Score
Insignificant	Personnel and Resources	One apparatus out of service for period not to exceed one hour.	**2**
Minor	Personnel and Resources	More than one but not more than two apparatus out of service for a period not to exceed one hour.	**4**
Moderate	Personnel and Resources	More than 50% of available resources committed to incident for over 30 minutes.	**6**
Significant	Personnel and Resources	More than 75% of available resources committed to an incident for over 30 minutes.	**8**
Catastrophic	Personnel, Resources, and Facilities	More than 90% of available resources committed to incident for more than two hours or event which limits the ability of resources to respond.	**10**

This section also contains an analysis of the various risks considered in the city. In this analysis, information presented and reviewed in this section (All-Hazards Risk Assessment of the Community) have been considered. Risk is categorized as Low, Moderate, High, or Special.

Prior risk analysis has only attempted to evaluate two factors of risk: probability and consequence. Contemporary risk analysis considers the impact of each risk to the organization, thus creating a three-axis approach to evaluating risk as depicted in the following figure. A contemporary risk analysis now includes probability, consequences to the community, and impact on the organization, which in this case is the PFD.

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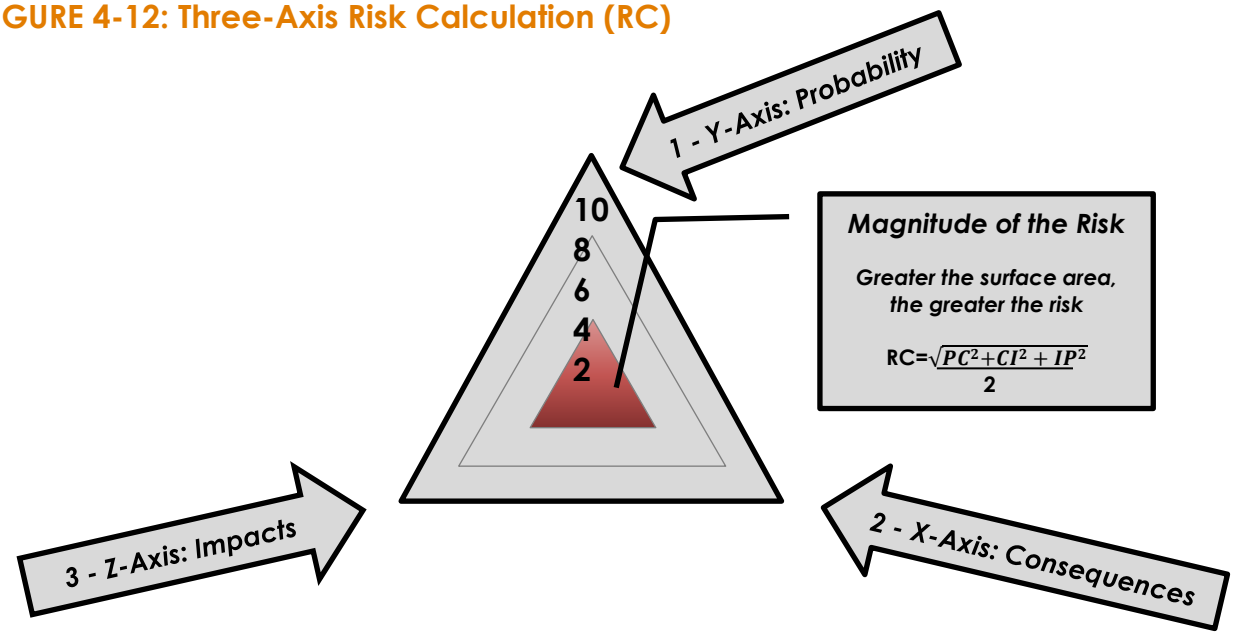
FIGURE 4-12: Three-Axis Risk Calculation (RC)



The following factors/hazards were identified and considered:

- **Demographic factors** such as age, socio-economic, vulnerability.
- **Natural hazards** such as flooding, snow and ice events, wind events, wild land fires.
- **Man-made hazards** such as rail lines, roads and intersections, target hazards.
- **Structural/building risks**.
- **Fire and EMS incident numbers and density**.

The assessment of each factor and hazard as listed below took into consideration the likelihood of the event, the impact on the city itself, and the impact on PFD's ability to deliver emergency services, which includes automatic aid capabilities as well. The list is not all inclusive but includes categories most common or that may present to the city and the PFD.

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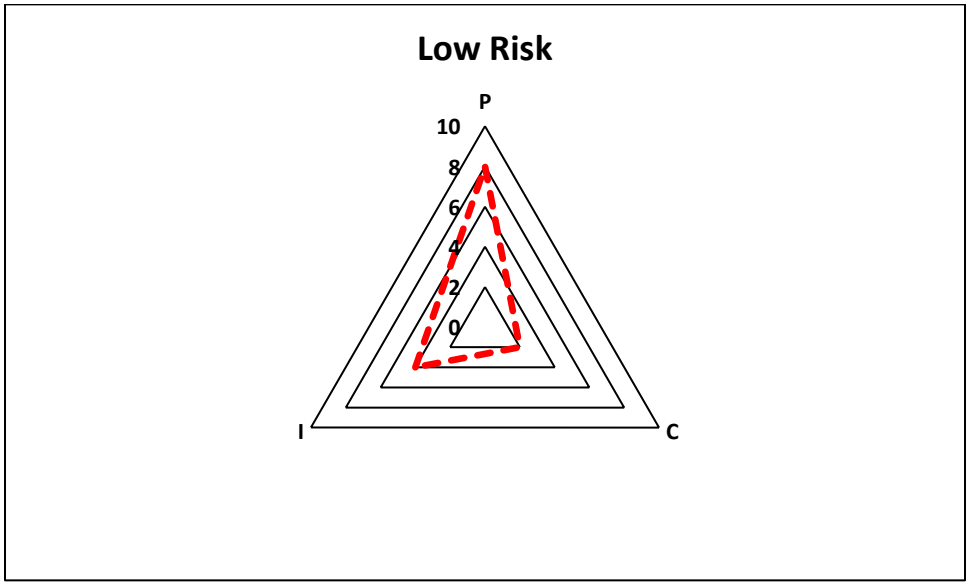
Low Risk

- Automatic fire/false alarms.
- BLS EMS Incidents.
- Minor flooding with thunderstorms.
- Good intent/hazard/public service fire incidents with no life safety exposure.
- Outside fires such as grass, rubbish, dumpster, vehicle with no structural/life safety exposure.

FIGURE 4-13: Low Risk Diagram



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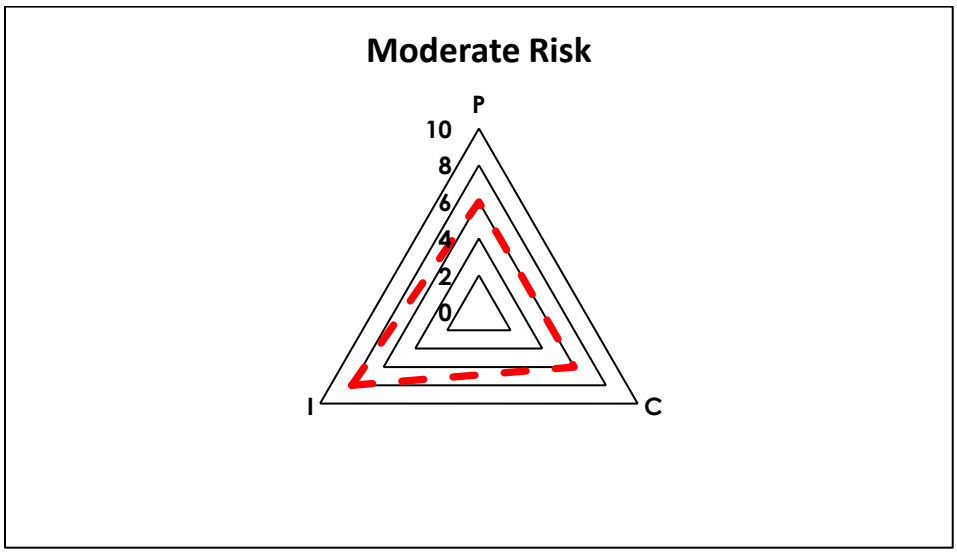
Moderate Risk

- Fire incident in a single-family dwelling where fire and smoke or smoke is visible, indicating a working fire.
- Suspicious substance investigation involving multiple fire companies and law enforcement agencies.
- ALS EMS incident.
- Motor vehicle accident (MVA).
- MVA with entrapment of passengers.
- Grass/brush fire with structural endangerment/exposure.
- Low angle rescue involving ropes and rope rescue equipment and resources.
- Surface water rescue.
- Good intent/hazard/public service fire incidents with life safety exposure.

FIGURE 4-14: Moderate Risk Diagram



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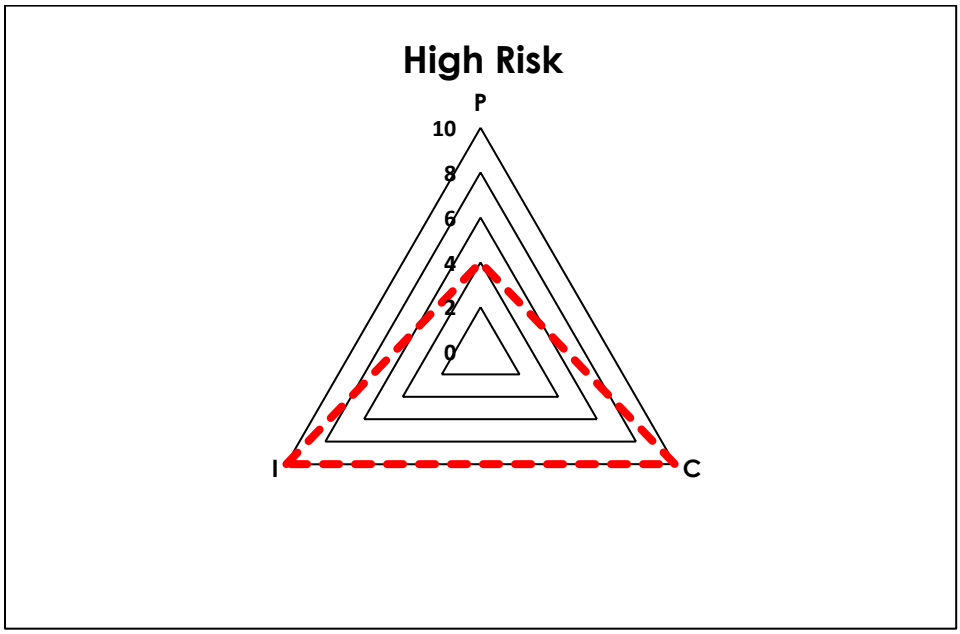
High Risk

- Working fire in a target hazard.
- Cardiac arrest.
- Mass casualty incident of more than 10 patients but fewer than 25 patients.
- Confined space rescue.
- Structural collapse involving life safety exposure.
- High angle rescue involving ropes and rope rescue equipment.
- Trench rescue.
- Suspicious substance incident with injuries.
- Industrial leak of hazardous materials that causes exposure to persons or threatens life safety.
- Weather event that creates widespread flooding, landslides, building damage, and/or life safety exposure.

FIGURE 4-15: High Risk Diagram



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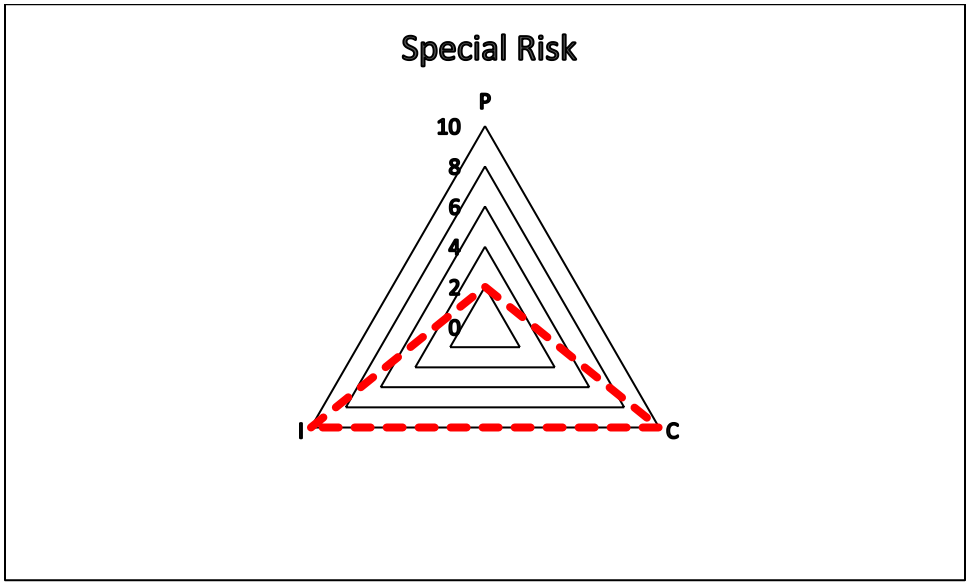
Special Risk

- Working fire in a structure of more than three floors.
- Fire at an industrial building or complex with hazardous materials.
- Fire in an occupied targeted hazard with special life safety risks such as age, medical condition, or other identified vulnerabilities.
- Mass casualty incident of more than 25 patients.
- Rail or transportation incident that causes life safety exposure or threatens life safety through the release of hazardous smoke or materials.
- Explosion in a building that causes exposure to persons or threatens life safety or outside of a building that creates exposure to occupied buildings or threatens life safety.
- Massive river flooding, earthquake, pandemic, multiple landslides.

FIGURE 4-16: Special Risk Diagram



END SECTION 4

SECTION 5. RESPONSE TIME ANALYSIS

MEASURING RESPONSE TIMES

Response times are typically the primary measurement for evaluating fire and EMS services. Response times can be used as a benchmark to determine how well a fire department is currently performing, to help identify response trends, and to predict future operational needs. Achieving the quickest and safest response times possible should be a fundamental goal of every fire department.

However, the actual impact of a speedy response time is limited to very few incidents. For example, in a full cardiac arrest, analysis shows that successful outcomes are rarely achieved if basic life support (CPR) is not initiated within four to six minutes of the onset. However, cardiac arrests occur very infrequently; on average they are 1 percent to 1.5 percent of all EMS incidents.[14] There are also other EMS incidents that are truly life-threatening, and the time of response can clearly impact the outcome. These involve cardiac and respiratory emergencies, full drownings, obstetrical emergencies, allergic reactions, electrocutions, and severe trauma (often caused by gunshot wounds, stabbings, and severe motor vehicle accidents, etc.). Again, the frequencies of these types of calls are limited.

There is no "right" amount of fire protection and EMS delivery. It is a constantly changing level based on such things as the expressed needs of the community, community risk, and population growth. Thus, in looking at response times it is prudent to design a deployment strategy around the actual circumstances that exist in the community and the fire problem that is identified to exist. The strategic and tactical challenges presented by the widely varied hazards that the department protects against need to be identified and planned for through a community risk analysis planning and management process as identified in this report.

It is ultimately the responsibility of elected officials to determine the level of risk that is acceptable to their respective community. It would be imprudent, and probably very costly, to build a deployment strategy that is based solely upon response times.

Response times for fire incidents is generally based on the concept of "flashover." A **flashover** is the near-simultaneous ignition of most of the directly exposed combustible material in an enclosed area. When certain organic materials are heated, they undergo thermal decomposition and release flammable gases. Flashover occurs when the majority of the exposed surfaces in a space are heated to their auto ignition temperature and emit flammable gases. "Flashover is the transition phase in the development of a contained fire in which surfaces exposed to thermal radiation, from fire gases in excess of 600 degrees Celsius, reach ignition temperature more or less simultaneously and fire spreads rapidly throughput the space."[15]

Flashover is not time dependent. Some flashovers can occur within three minutes from ignition; others may take considerably longer. Flashover times are more dependent on the size of the compartment, the fuel load within the compartment, and the construction of the compartment.

14. Myers, Slovis, Eckstein, Goodloe et al. (2007). "Evidence-based Performance Measures for Emergency Medical Services System: A Model for Expanded EMS Benchmarking." *Pre-hospital Emergency Care*.
15. National Institute of Standards and Technology, Definition of Flashover.

Again, these variables cannot be seen from outside the structure, so the interior firefighters and officers must be constantly aware of them.[16]

When the fire does reach this extremely hazardous state, initial firefighting forces are often overwhelmed, a larger and more destructive fire occurs, the fire escapes the room and possibly even the building of origin, and significantly more resources are required to affect fire control and extinguishment.

Flashover occurs more quickly and more frequently today and is caused at least in part by the introduction of significant quantities of plastic- and foam-based products into homes and businesses (e.g., furnishings, mattresses, bedding, plumbing and electrical components, home and business electronics, decorative materials, insulation, and structural components). These materials ignite and burn quickly and produce extreme heat and toxic smoke.

As a benchmark, for an urban community and as described in the staffing analysis section above, NFPA 1710, *Standard for the Organization and Deployment of Fire Suppression Operations, Emergency Medical Operations, and Special Operations to the Public by Career Departments*, 2020 Edition, recommends the entire initial effective response force of between 16 and 43 personnel, depending on occupancy type, be on scene within eight minutes of dispatch (other than high rise, which is 610 seconds, or just over ten minutes). It is also important to keep in mind that once units arrive on scene there is a time lag before water reaches the fire as crews and companies have several tasks to complete in the initiating action period immediately after arrival at the scene.

The ability to quickly deploy adequate fire staff prior to flashover thus limits the fire's extension beyond the room or area of origin. Regarding the risk of flashover, the authors of an IAFF report conclude: Clearly, an early aggressive and offensive initial interior attack on a working structural fire results in greatly reduced loss of life and property damage. Consequently, given that the progression of a structural fire to the point of "flashover" (the very rapid spreading of the fire due to super-heating of room contents and other combustibles) generally occurs in less than ten minutes, two of the most important elements in limiting fire spread are the quick arrival of sufficient numbers of personnel and equipment to attack and extinguish the fire as close to the point of its origin as possible.[17]

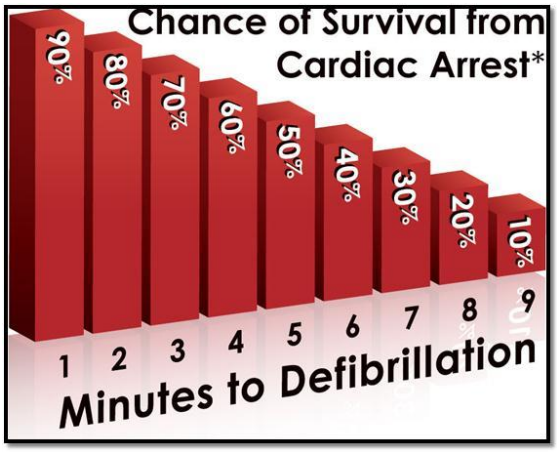
EMS response times are measured differently than fire service response times. Where the fire service uses NFPA 1710 and 1720 as response time benchmarking documents, EMS' focus is and should be directed to the evidence-based research relationship between clinical outcomes and response times. Much of the current research suggests response times have little impact on clinical outcomes outside of a small segment of call types. These include cerebrovascular accidents (stroke), injury or illness compromising the respiratory system, injury or illness compromising the cardiovascular system to include S-T segment elevation emergencies, and certain obstetrical emergencies. Each require rapid response times, rapid on-scene treatment and packaging for transport, and rapid transport to the hospital.

Paragraph 4.1.2.1(7) of NFPA 1710 recommends that for EMS incidents a fire unit with first responder or higher-level trained personnel and equipped with an AED should arrive on scene within four minutes of travel time (time after call is processed, dispatched, and the unit turns out). An advanced life support (ALS) unit should arrive on scene within eight minutes travel time, provided the fire department responded first with a first responder or higher-level trained

16. *Fire Engineering*, June 2010, "Understanding Flashover."
17. *Safe Fire Fighter Staffing: Critical Considerations*, 2nd ed. (Washington, DC: International Association of Fire Fighters, 1995), 5.

personnel and equipped with an AED. According the NFPA 1710, "This requirement is based on experience, expert consensus, and science. Many studies note the role of time and the delivery of early defibrillation in patient survival due to heart attacks and cardiac arrest, which are the most time-critical, resource-intensive medical emergency events to which fire departments respond." The next figure illustrates the chance of survival for a victim in cardiac arrest who does not have access to critical emergency defibrillation.

FIGURE 5-1: Cardiac Arrest Survival Probability by Minute



Typically, a low percentage of 9-1-1 patients have time-sensitive and advanced life support (ALS) needs. But, for those patients that do, time can be a critical issue of morbidity and mortality. For the remainder of those calling 9-1-1 for a medical emergency, though they may not have a medical necessity, they still expect rapid customer service. Response times for patients and their families are often the most important measurement of the EMS department. Regardless of the service delivery model, appropriate response times are more than a clinical issue; they are also a customer service issue and should not be ignored.

In addition, a true emergency is when an illness or injury places a person's health or life in serious jeopardy and treatment cannot be delayed. Examples include severe trauma with cardiovascular system compromise, difficulty breathing, chest pain with S-T Segment Elevation (STEMI), a head injury, or ingestion of a toxic substance.[18]

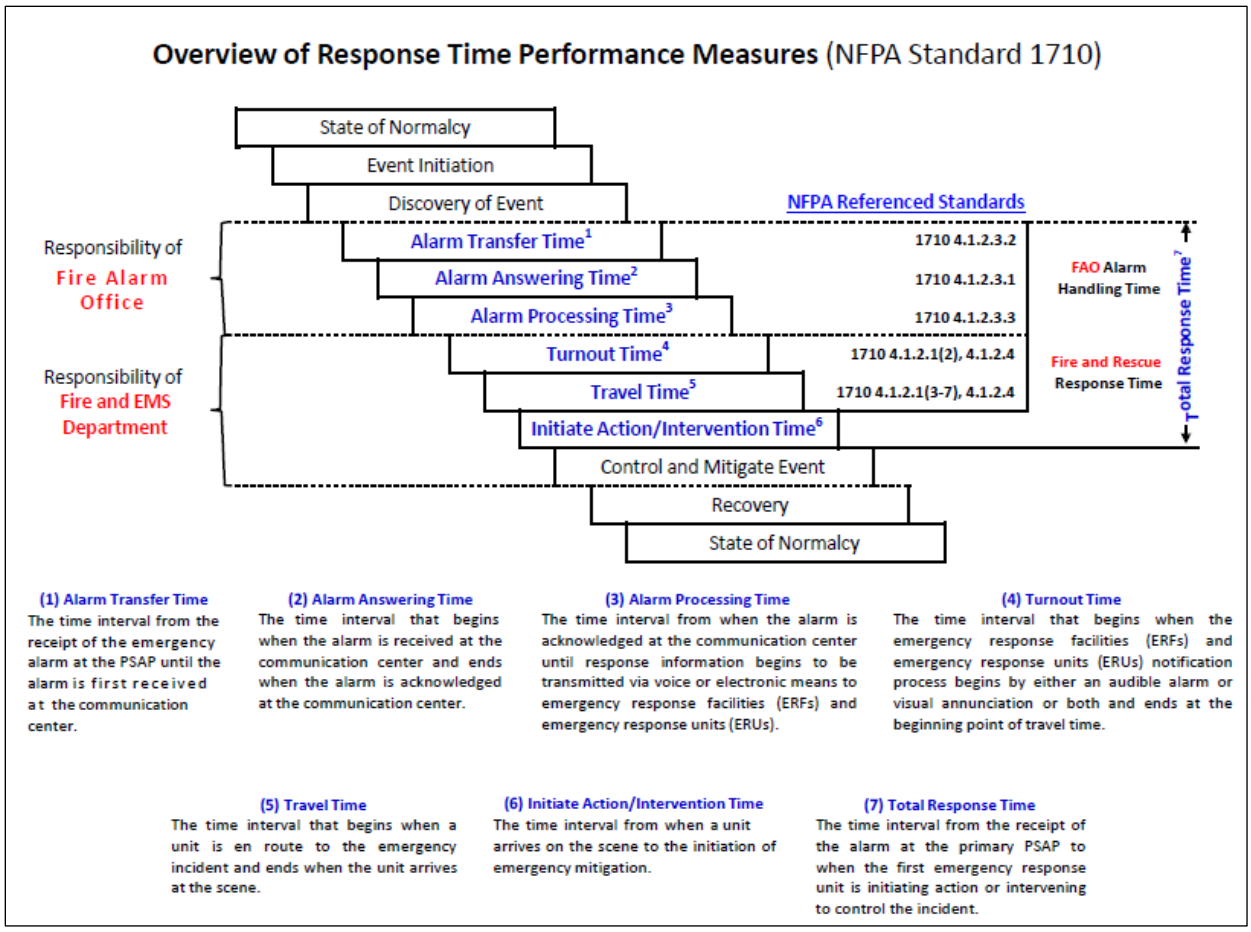
If a person is experiencing severe pain, that is also an indicator of an emergency. Again, the frequencies of these types of calls are infrequent as compared to the routine, low-priority EMS incident responses. In some cases, these emergencies often make up no more than 5 percent of all EMS calls.[19]

Another important factor in the whole response time question is what we term "**detection time**." This is the time it takes to detect a fire or a medical situation and notify 911 to initiate the response. In many instances, particularly at night or when automatic detection systems (fire sprinklers and smoke detectors) are not present or inoperable, the detection process can be extended. Fires that go undetected and are allowed to expand in size become more destructive and are difficult to extinguish. The following figure illustrates the overview of response

18. Mills-Peninsula Health Blog, Bruce Wapen, MD.
19. www.firehouse.com/apparatus/article/10545016/operations-back-to-basics-true-emergency-and-due-regard

time performance and identifies responsibility of the key components of the emergency communications center and the fire and rescue department.

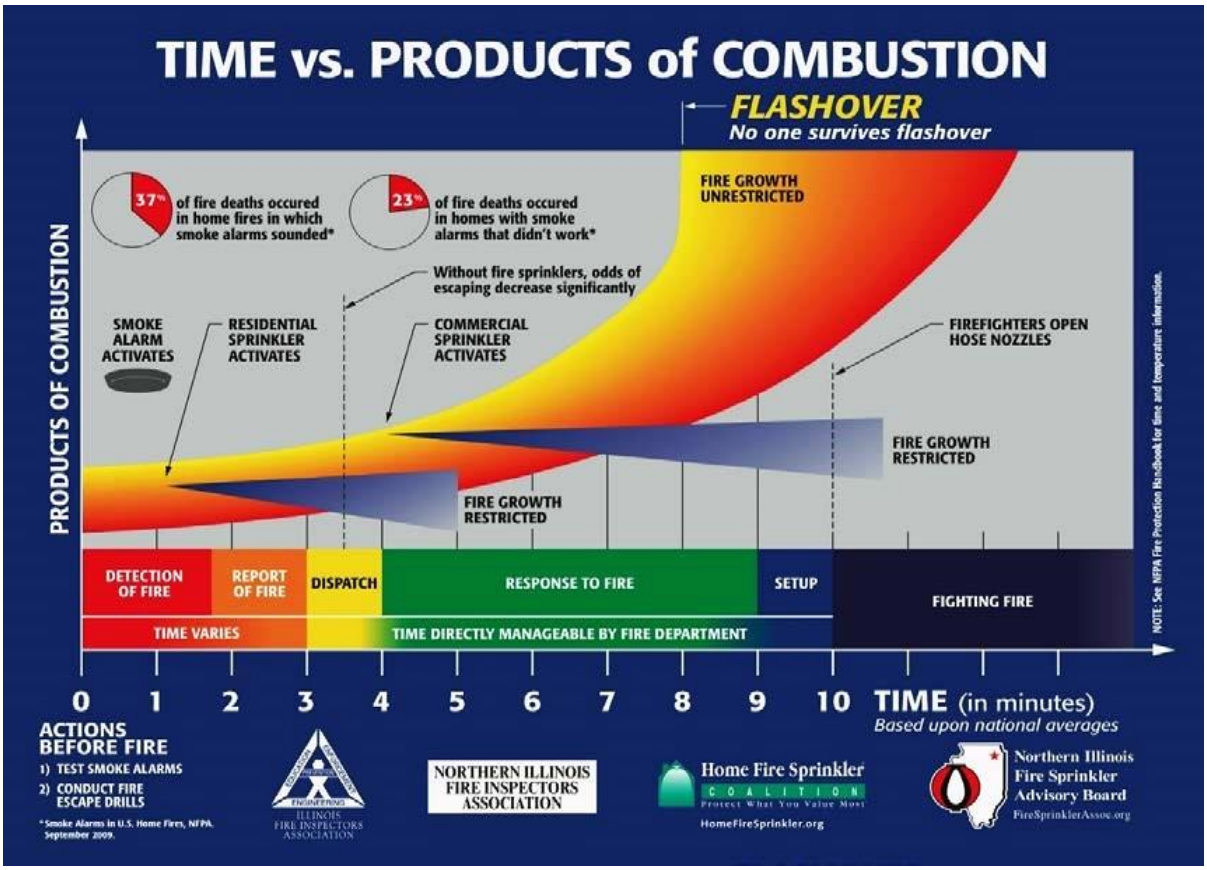
FIGURE 5-2: Response Time Performance Measures



The next three figures illustrate the importance of understanding the concepts of response time as discussed above.

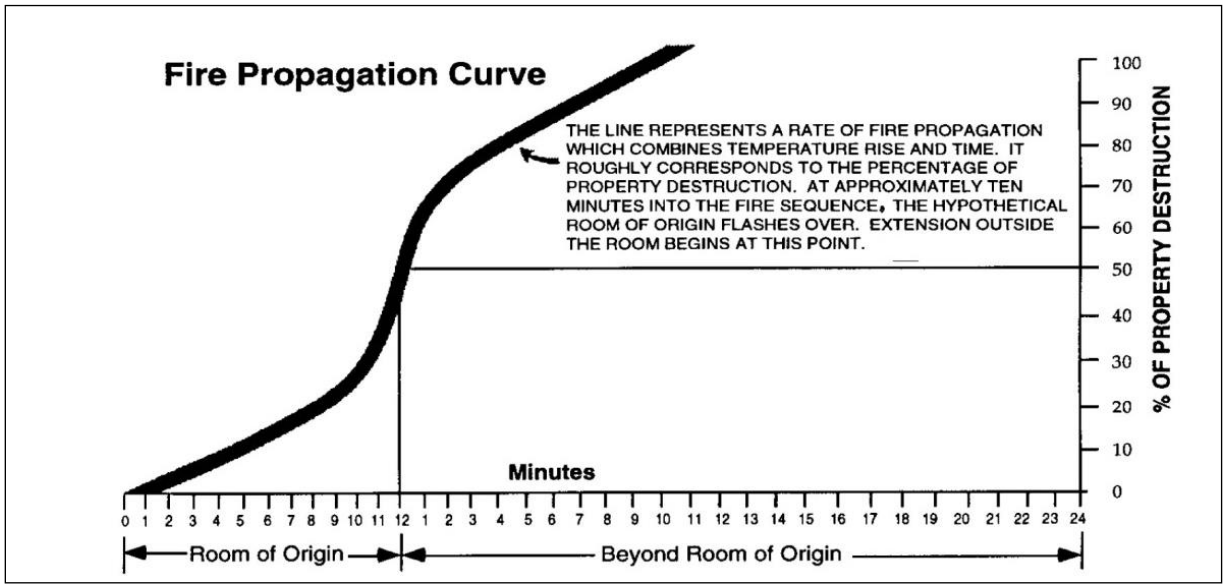
Figure 5-3 illustrates the time progression of a fire from inception (event initiation) through flashover. The time-versus-products of combustion curve shows activation times and effectiveness of residential sprinklers (approximately one minute), commercial sprinklers (four minutes), flashover (eight to ten minutes), and firefighters applying first water to the fire after notification, dispatch, response, and set-up (ten minutes). It also illustrates that the fire department's response time to the fire is one of the only aspects of the timeline that the fire department can exert direct control over. Figure 5-4 shows the fire propagation curve relative to fire being confined to the room of origin or spreading beyond it and the percentage of destruction of property by the fire.

FIGURE 5-3: Fire Growth from Inception to Flashover



Source: From Northern Illinois Fire Sprinkler Advisory Board.

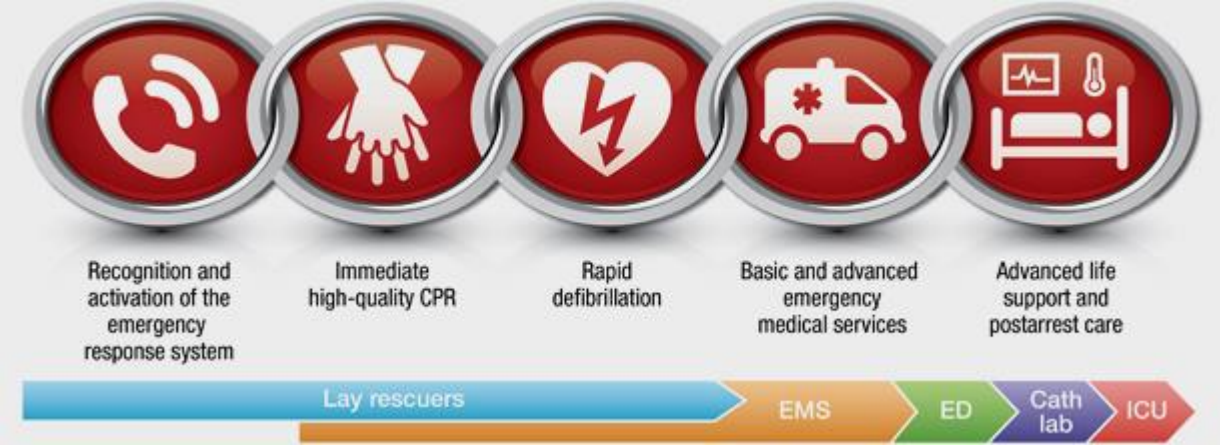
FIGURE 5-4: Fire Propagation Curve



Cardiac arrest is one emergency EMS response times were initially built around. The science tells us that the brain begins to die without oxygenated blood flow at the 4-6 minute mark. Without immediate cardiopulmonary resuscitation (CPR) and rapid defibrillation, the chances of survival diminish rapidly at the cessation of breathing and heart pumping activity. For every minute without CPR and/or defibrillation, chances of survival decrease 7-10 percent. Further, only 10 percent of victims who suffer cardiac arrest outside of the hospital survive[20].

The following figure illustrates the out of hospital chain of survival, which is a series of actions that, when put in motion, reduce the mortality of sudden cardiac arrest. Adequate EMS response times coupled with community and public access defibrillator programs potentially can impact the survival rate of sudden cardiac arrest victims by deploying early CPR, early defibrillation, and early advanced life support care provided in the prehospital setting.

FIGURE 5-5: Sudden Cardiac Arrest Chain of Survival



From: "Out of Hospital Chain of Survival," http://cpr.heart.org/AHAECC/CPRAndECC/AboutCPRFirstAid/CPRFactsAndStats/UCM_475731_Out-of-hospital-Chain-of-Survival.jsp

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

Dispatch time (alarm processing 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 when the emergency response units are notified of the incident and ends when travel time begins. **Travel Time** is the difference between the time the unit is en route and arrival on scene. ***Response time*** is the total time elapsed between receiving a call to arriving on scene.

For this study, and unless otherwise indicated, response times and travel times measure the first arriving unit only. The primary focus of this section is the dispatch and response time of the first arriving units for calls responded to with lights and sirens (Code 3).

According to NFPA 1710, the alarm processing time or dispatch time should be less than or equal to 64 seconds 95 percent of the time. NFPA 1710 also states that turnout time should be less than or equal to 80 seconds (1.33 minutes) for fire and special operations 90 percent of the time and 60 seconds (1.0 minute) for EMS. As noted above, turnout time is the segment of total response

[20] American Heart Association. *A Race Against the Clock, Out of Hospital Cardiac Arrest*. 2014

time that the fire department has the most ability to control. Travel time shall be less than or equal to 240 seconds for the first arriving engine company 90 percent of the time and for the second due engine 360 seconds 90 percent of the time. The standard further states the initial first alarm assignment should be assembled on scene in 480 seconds, 90 percent of the time for low/medium hazards, and 610 seconds for high-rise or high hazards. Note that NFPA 1710 response time criterion is a benchmark for service delivery and not a CPSM recommendation.

Table 5-1 provides an analysis of PFD average response times and Table 5-2 provides analysis of 90th percentile response times, which is the strictest measurement of fire and rescue response times. A 90th percentile time means that 90 percent of calls had response times at or below that number. For example, Table 5-2 shows a 90th percentile response time for EMS calls of 8.9 minutes, which means that 90 percent of the time an EMS call had a response time of no more than 8.9 minutes.

TABLE 5-1: Average Response Time of First Arriving Unit, by Call Type

Call Type	Time in Minutes				Number of Calls
	Dispatch	Turnout	Travel	Total	
Breathing difficulty	1.4	1.1	2.6	5.1	137
Cardiac and stroke	1.0	1.6	3.1	5.7	32
Fall and injury	1.6	1.1	3.1	5.7	178
Illness and other	1.6	1.1	2.9	5.7	649
MVA	1.7	1.1	3.0	5.8	91
Overdose and psychiatric	3.1	1.1	2.8	7.0	60
Seizure and unconsciousness	1.6	1.1	3.3	6.0	142
EMS Total	**1.6**	**1.1**	**3.0**	**5.7**	**1,289**
False alarm	1.6	1.3	2.3	5.2	266
Good intent	1.4	1.8	3.3	6.5	15
Hazard	1.0	2.1	5.5	8.6	15
Outside fire	1.4	0.9	3.0	5.2	15
Public service	1.6	1.0	3.4	6.0	67
Structure fire	0.9	1.8	3.6	6.3	2
Fire Total	**1.6**	**1.3**	**2.7**	**5.6**	**380**
Total	**1.6**	**1.2**	**2.9**	**5.7**	**1,669**

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TABLE 5-2: 90th Percentile Response Time of First Arriving Unit, by Call Type

Call Type	Time in Minutes				Number of Calls
	Dispatch	Turnout	Travel	Total	
Breathing difficulty	3.4	3.8	4.6	8.0	137
Cardiac and stroke	2.3	4.0	6.1	8.2	32
Fall and injury	3.3	3.7	5.3	9.1	178
Illness and other	3.7	3.4	5.4	8.9	649
MVA	3.2	2.7	5.0	10.6	91
Overdose and psychiatric	5.9	3.5	4.1	10.6	60
Seizure and unconsciousness	3.3	3.2	5.6	8.7	142
EMS Total	**3.6**	**3.5**	**5.3**	**8.9**	**1,289**
False alarm	4.1	4.2	4.9	8.5	266
Good intent	4.0	5.5	5.3	9.8	15
Hazard	3.8	4.1	8.6	12.7	15
Outside fire	3.9	3.1	7.3	10.1	15
Public service	4.9	2.6	6.5	9.4	67
Structure fire	1.5	2.1	4.3	7.9	2
Fire Total	**4.0**	**4.1**	**5.5**	**8.9**	**380**
Total	**3.7**	**3.7**	**5.3**	**8.9**	**1,669**

The conclusions we can reach from these two tables are:

- The average dispatch time was 1.6 minutes.
  - The 90th percentile dispatch time was 3.7 minutes. ***In terms of meeting the benchmark time, PFD is not NFPA 1710 compliant.***
- The average fire turnout time was 1.3 minutes.
  - The 90th percentile fire turnout time was 4.1 minutes. ***In terms of meeting the benchmark time, PFD is not NFPA 1710 compliant (NFPA 1710 compliance time is 80 seconds).***
- The average fire travel time was 2.7 minutes.
  - The 90th percentile fire travel time was 5.5 minutes. ***In terms of meeting the benchmark time, PFD is not NFPA 1710 compliant.***
- The average EMS turnout time was 1.1 minutes.
  - The 90th percentile EMS turnout time was 3.5 minutes. ***In terms of meeting the benchmark time, PFD is not NFPA 1710 compliant (NFPA compliance time is 60 seconds).***
- The average EMS travel time was 3.0 minutes.
  - The 90th percentile EMS travel time was 5.3 minutes***. In terms of meeting the benchmark time, PFD is not NFPA 1710 compliant.***

Recommendation:

- CPSM recommends the PFD collaborate with the Pikeville Public Safety Department to identify and correct those elements that hinder call processing times for fire and EMS incidents. CPSM further recommends that the PFD identify and correct those elements that hinder turn-out of personnel responding to fire and EMS. Collectively, these two components of the total response time of the PFD are adding up to 7.4 minutes aggregately at the 90th percentile for fire and EMS incidents. (Recommendation No. 8.)

ASSESSMENT OF FIRE MANAGEMENT ZONES

Travel time is key to understanding how fire and EMS station location influences a community's aggregate response time performance. Travel time can be mapped when existing and proposed station locations are known. The location of responding units is one important factor in response time; reducing response times, which is typically a key performance measure in determining the efficiency of department operations, often depends on this factor. The goal of placement of a single fire station or creating a network of responding fire stations in a single community is to optimize coverage with short travel distances when possible, while giving special attention to natural and manmade barriers, and response routes that can create response-time problems.[21] This goal is generally budget-driven and based on demand intensity of fire and EMS incidents, which for this report were mapped earlier.

As already discussed, the PFD responds from three stations. As discussed above, NFPA 1710 outlines national consensus travel time benchmarks of less than or equal to 240 seconds for the first arriving engine company 90 percent of the time and the arrival of the second due engine in 360 seconds, 90 percent of the time. NFPA further outlines that the initial first alarm assignment should be assembled on scene in 480 seconds, 90 percent of the time for low/medium hazards and 610 seconds for high-rise or high hazards. Hazards are outlined above as well in the community risk analysis section.

This section expands on the travel times outlined above, depicting how travel times of 240, 360, and 480 seconds look when mapped from the current fire station locations. This mapping includes travel time utilizing existing city streets. The GIS data for streets includes speed limits for each street segment and allows for "U-turns" for dead-end streets and intersections. This analysis is not all inclusive as it does not contemplate traffic, weather, and such things as road obstructions caused by construction, public transportation movement, and the like.

It is, however, important to note that while GIS-drawn, theoretical travel times do reflect favorably on the adequacy of station facilities and their corresponding locations within the city to support efficient fire and EMS response. Keep in mind, the benefits of favorable travel time findings are only meaningfully realized when apparatus can be predictably staffed for response and have aggressive turn out times.

Figure 5-6 illustrates the 240-seconds travel time response bleed from each PFD fire station.

Figure 5-7 illustrates the 360-seconds travel time response bleed from each PFD fire station.

Figure 5-8 illustrates the 480-seconds travel time response bleed from each PFD fire station.

21. 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, 122.

As one can see, the 240-seconds travel time response bleed is concentrated in the central portion of the city with extension north and south along South Mayo Trail and east along the primary road network that feeds the central city district. This is also where the demand intensity is highest for fire and EMS incidents. At 480 seconds, the city is covered except for the extreme northwest (airport) and southern portions of the city.

FIGURE 5-6: 240-Seconds Travel Times from current PFD Stations

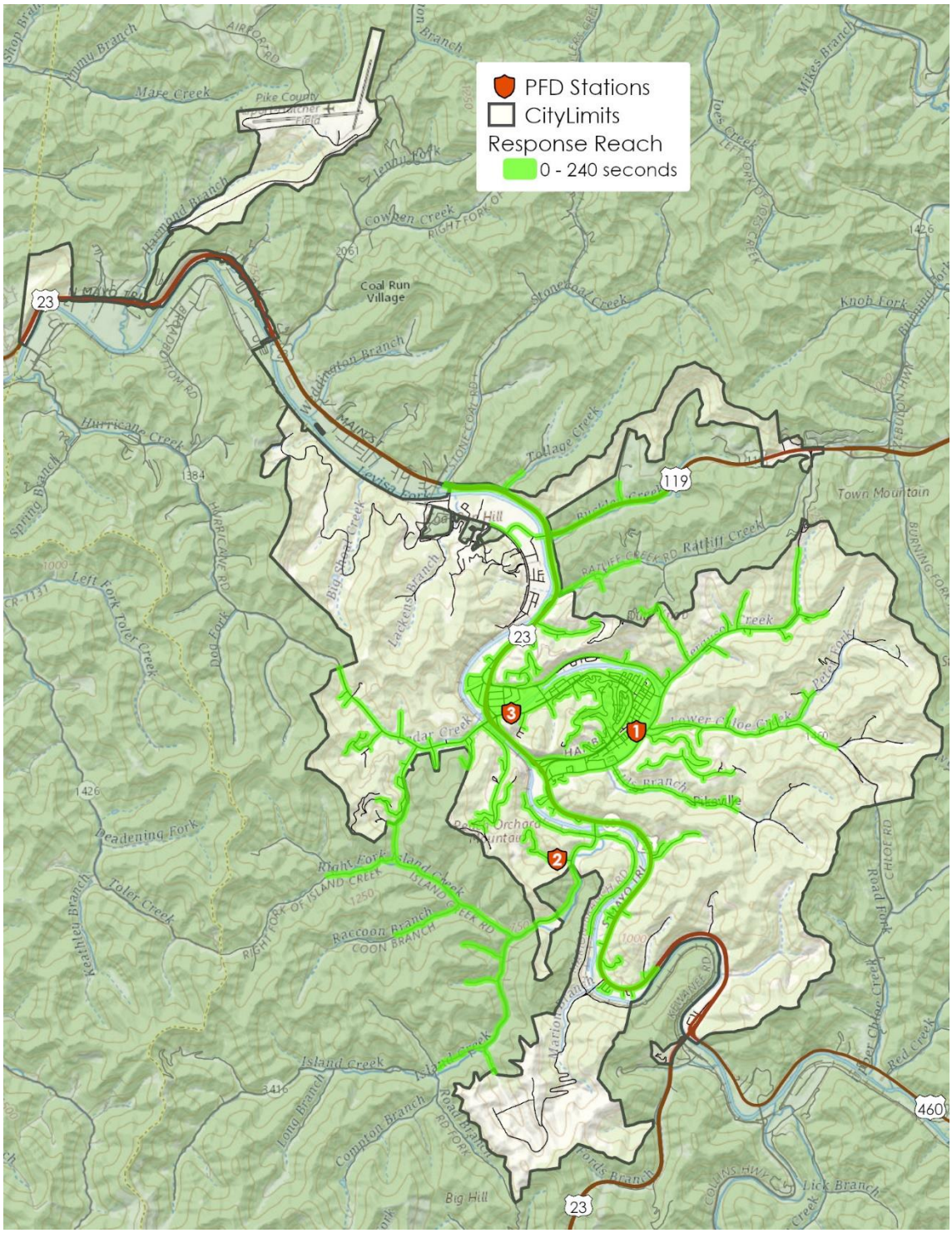


FIGURE 5-7: 360-Seconds Travel Time from current PFD Stations

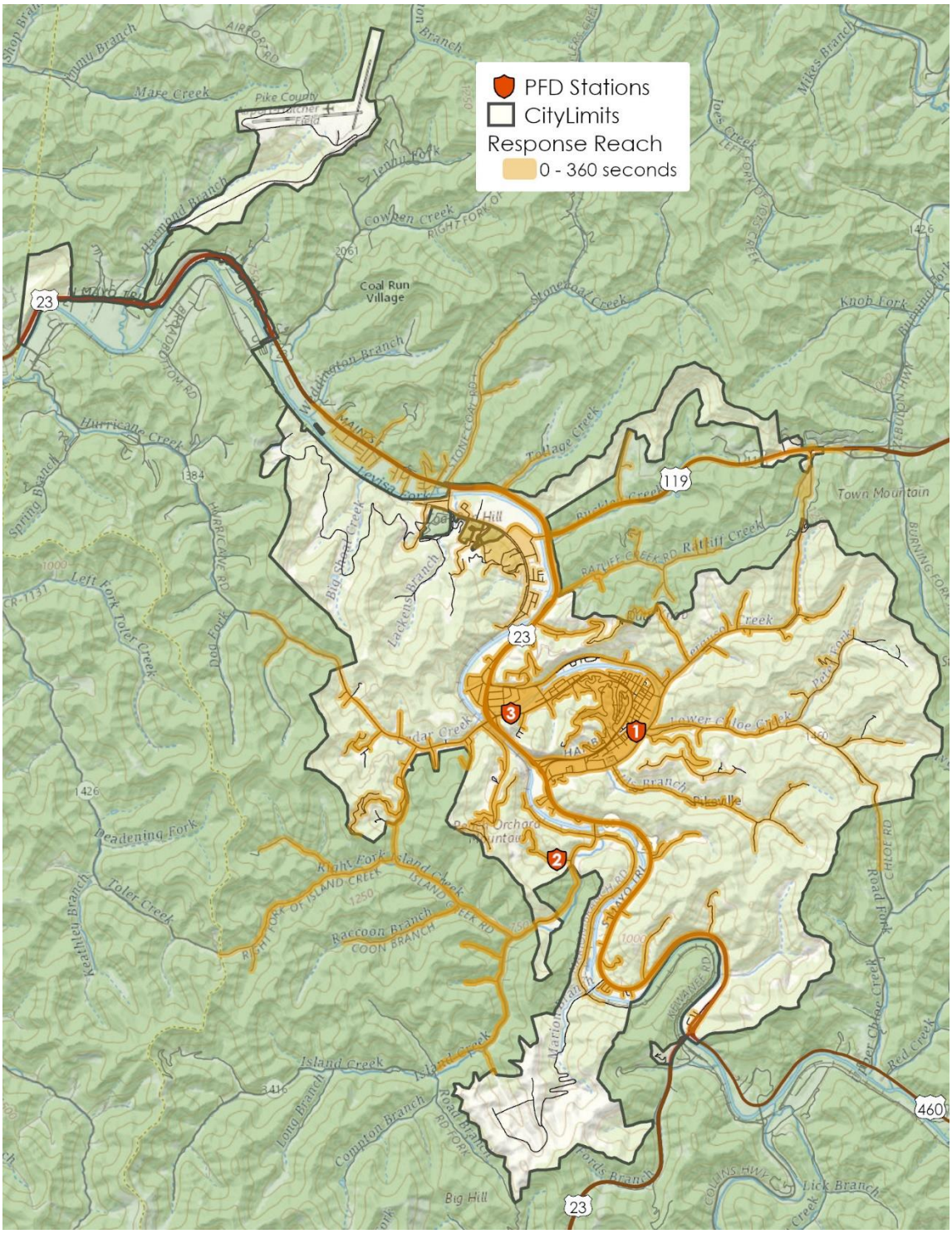
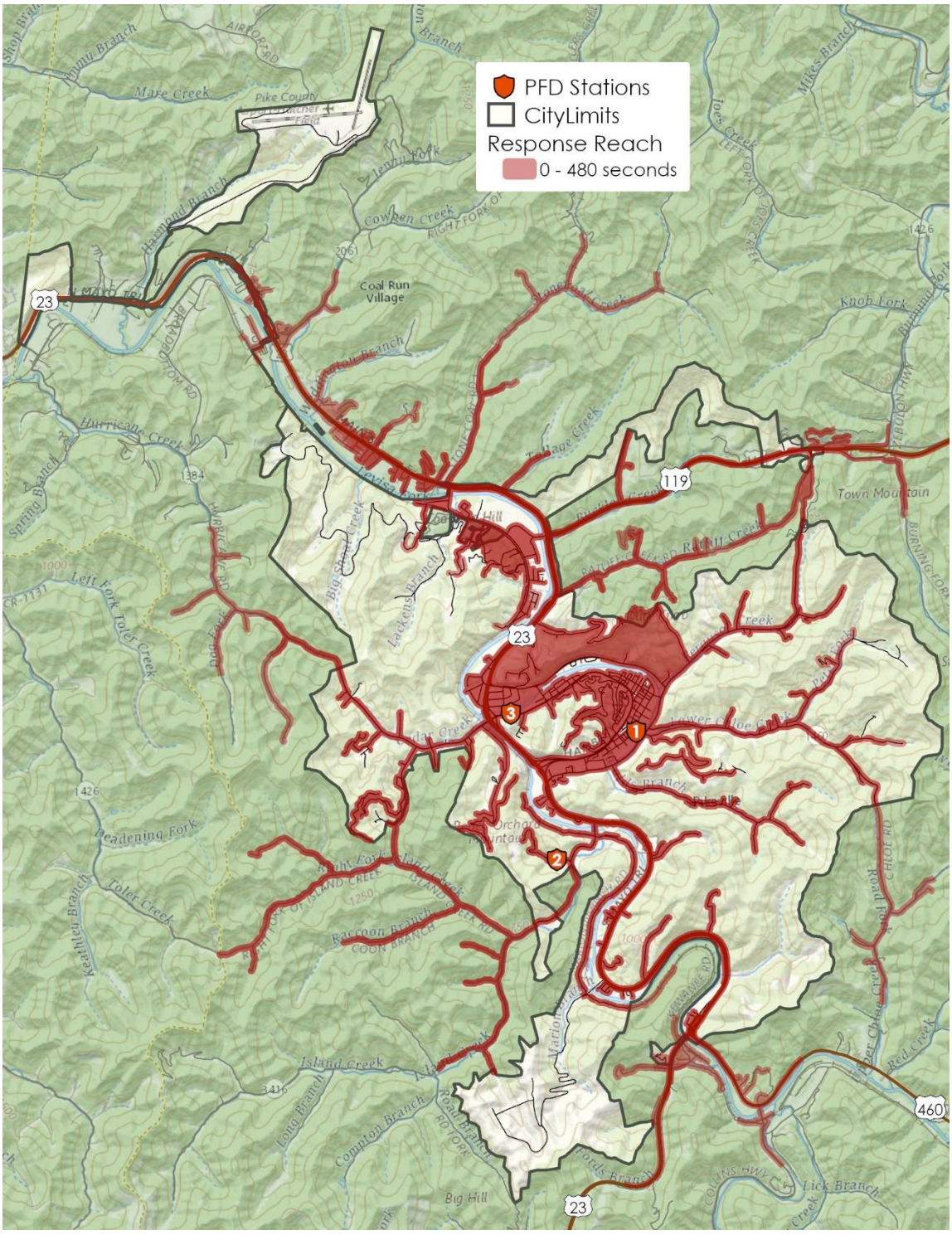
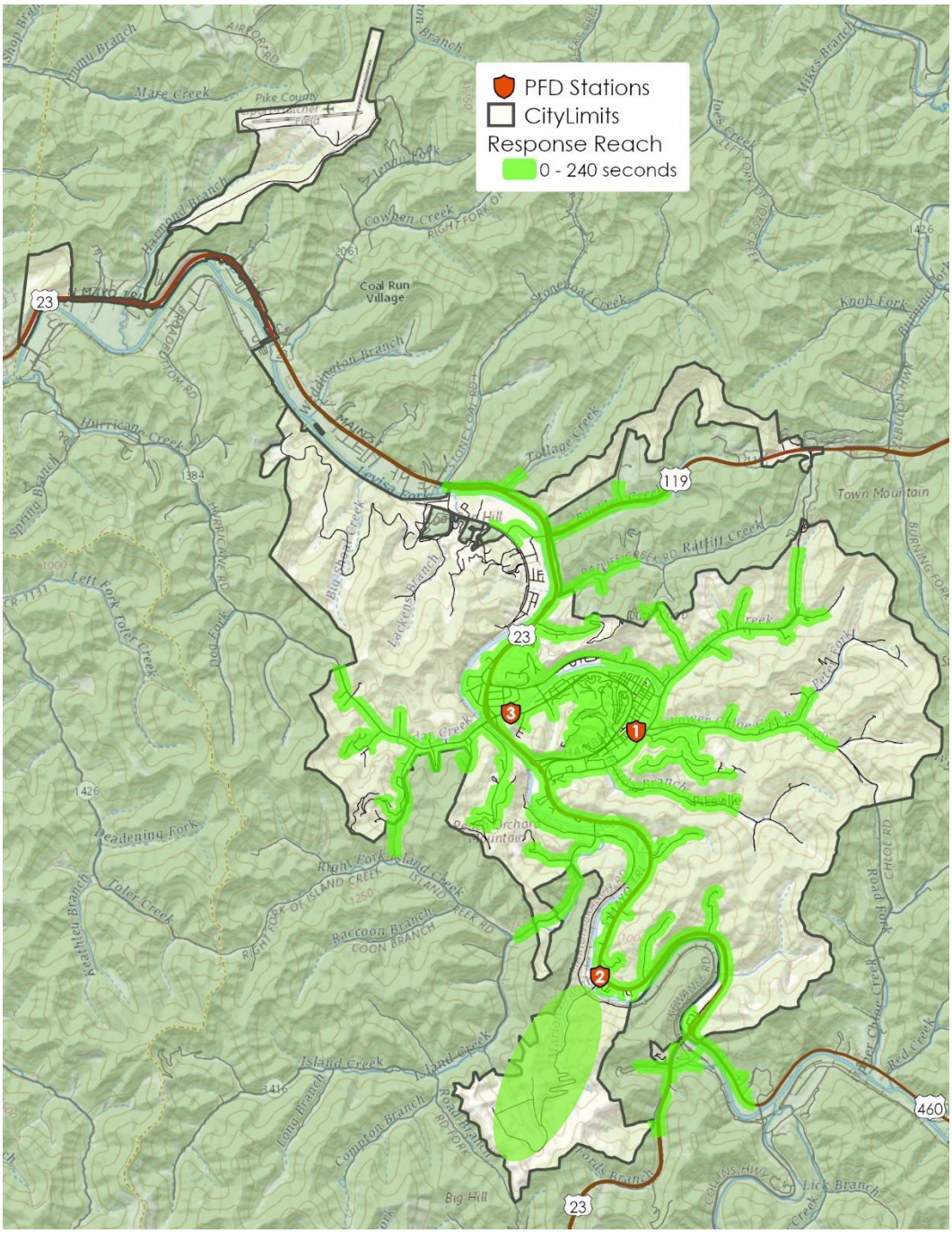


FIGURE 5-8: 480-Seconds Travel Time from current PFD Station



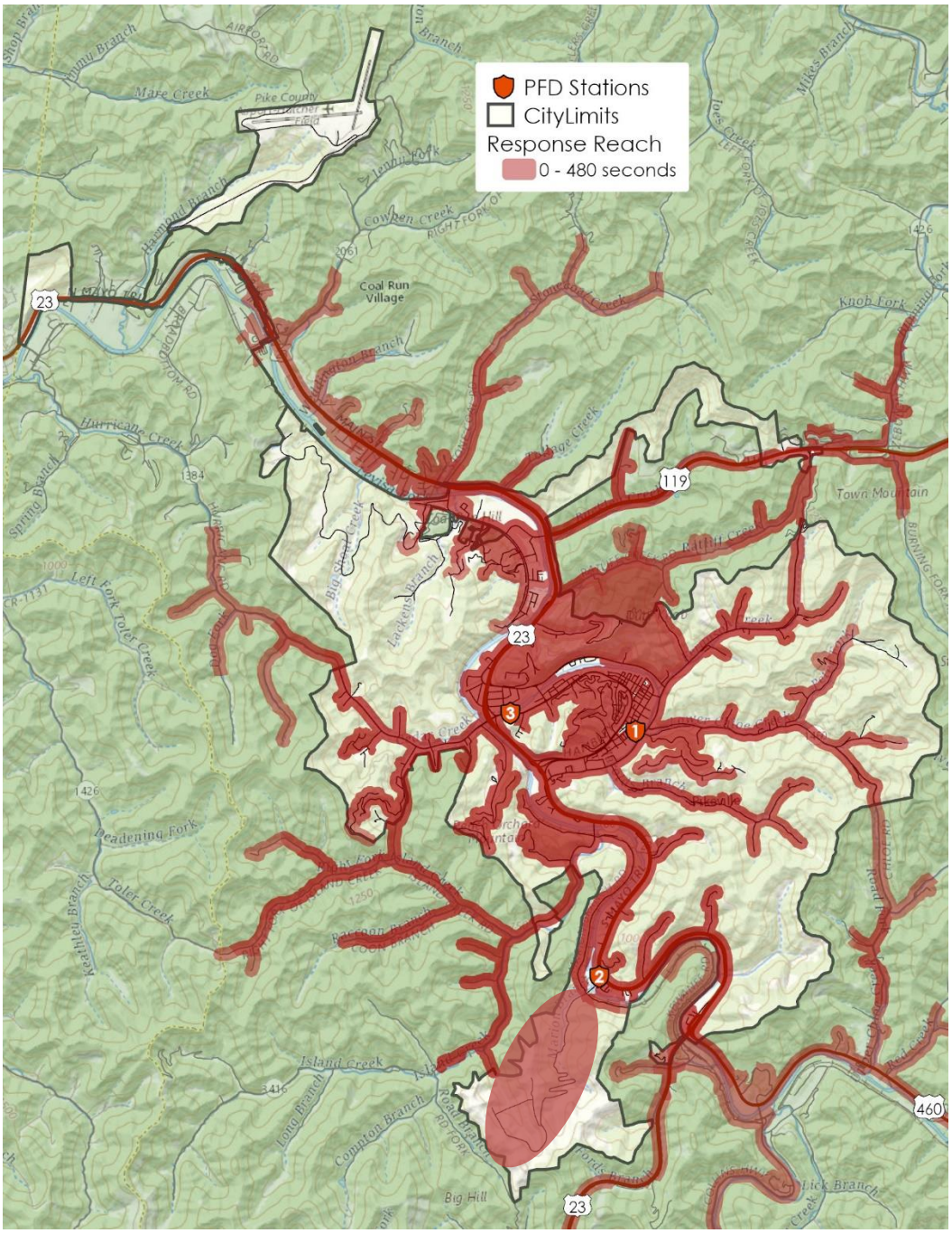
Figures 5-9 and 5-10 show what 240-seconds travel time and 480-seconds travel time will look like with the new station 2 at 1296 South Mayo Trail.

FIGURE 5-9: 240-Seconds Travel Time from Stations 1 and 3, and new Station 2



At 240 seconds and with the new location of Station 2, the southernmost section of the city has expanded coverage. There is no deficiency created in the former Station 2 fire management zone.

FIGURE 5-10: 480-Seconds Travel Time from Stations 1 and 3, and new Station 2



At 480 seconds and with the new location of Station 2, there is no deficiency created in the former Station 2 fire management zone.

AUTOMATIC AND MUTUAL AID

The PFD participates in automatic and mutual aid with contiguous and non-contiguous fire and EMS departments in the region. These include:

- Fire Mutual Aid
  - Betsy Lane VFD.
  - Coal Run Village VFD.
  - Elkhorn City VFD.
  - Hurricane Creek VFD.
  - Island Creek VFD.
  - Johns Creek VFD.
  - Millard VFD.
  - Paintsville FD.
  - Prestonsburg FD.
  - Shelby Valley VFD.
- EMS Mutual Aid
  - Appalachian First Response.
  - Lifeguard EMS.

Figure 5-11 illustrates travel time for fire mutual aid companies and Figure 5-12 illustrates travel time for EMS mutual aid station agencies.

The majority (8 of the 10) fire mutual aid companies are volunteer. The two career mutual aid companies are in excess of 45 minutes of travel time from Pikeville. Three of the eight fire mutual aid companies have travel times of less than 10 minutes into Pikeville, and four of the remaining five have less than 20 minutes of travel time into Pikeville.

A consideration when depending on volunteer companies for mutual aid assistance is they are not constantly staffed with a crew to respond, so there likely will be additional overall response time when these companies are called to assist with an incident in Pikeville. This should not be a deterrent to utilizing these resources, particularly when the PFD contemplates resources required when assembling an Effective Response Force for medium-, high-, and special-hazard responses.

The distances that EMS mutual aid agencies must travel should be a concern for the PFD, as both mutual aid EMS agencies are in excess of 25 minutes travel time into Pikeville. Although the PFD does not have a high incidence of overlapping EMS incidents, should these resources be needed, response coordination should be implemented quickly.

FIGURE 5-11: Fire Mutual Aid Response Time into Pikeville

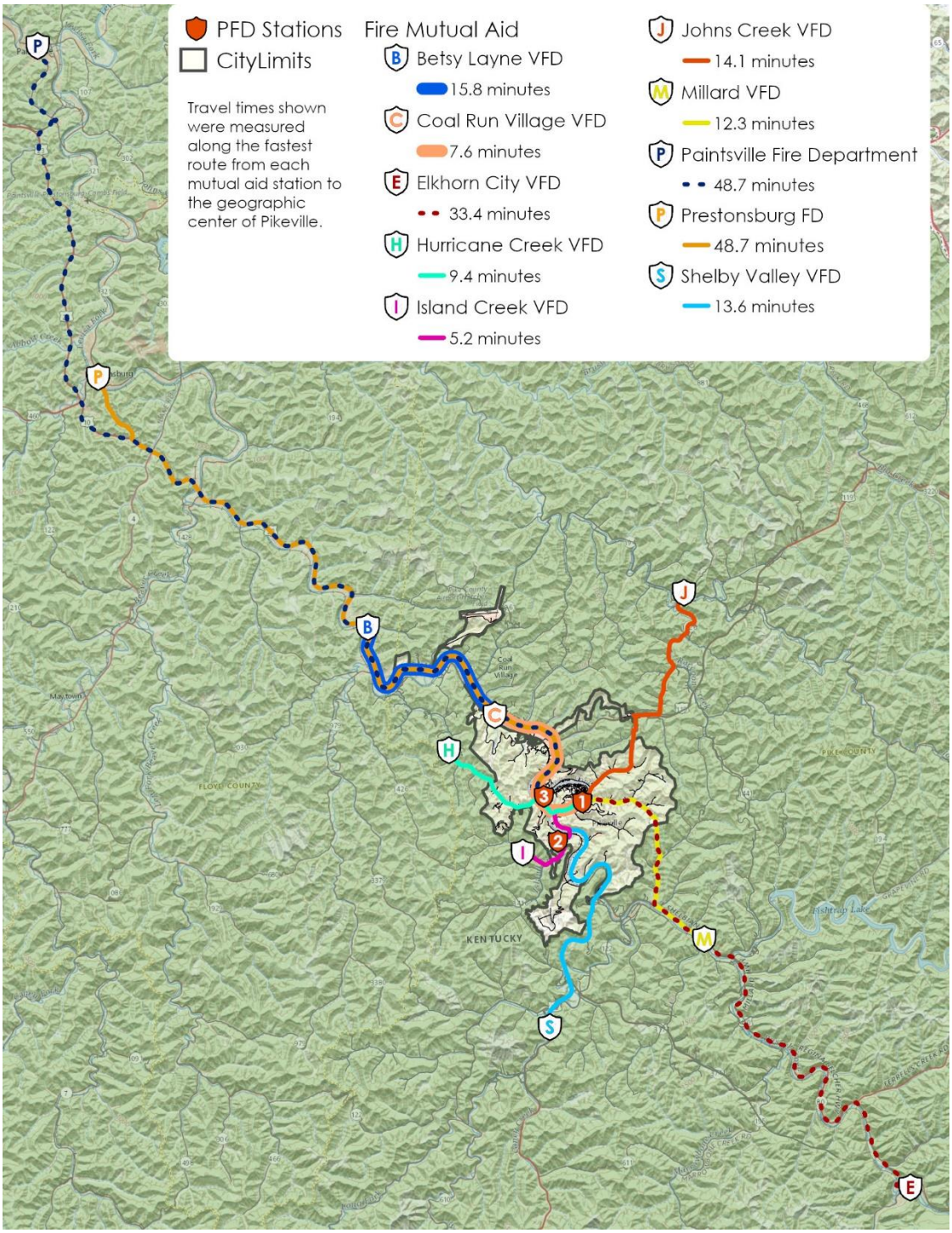
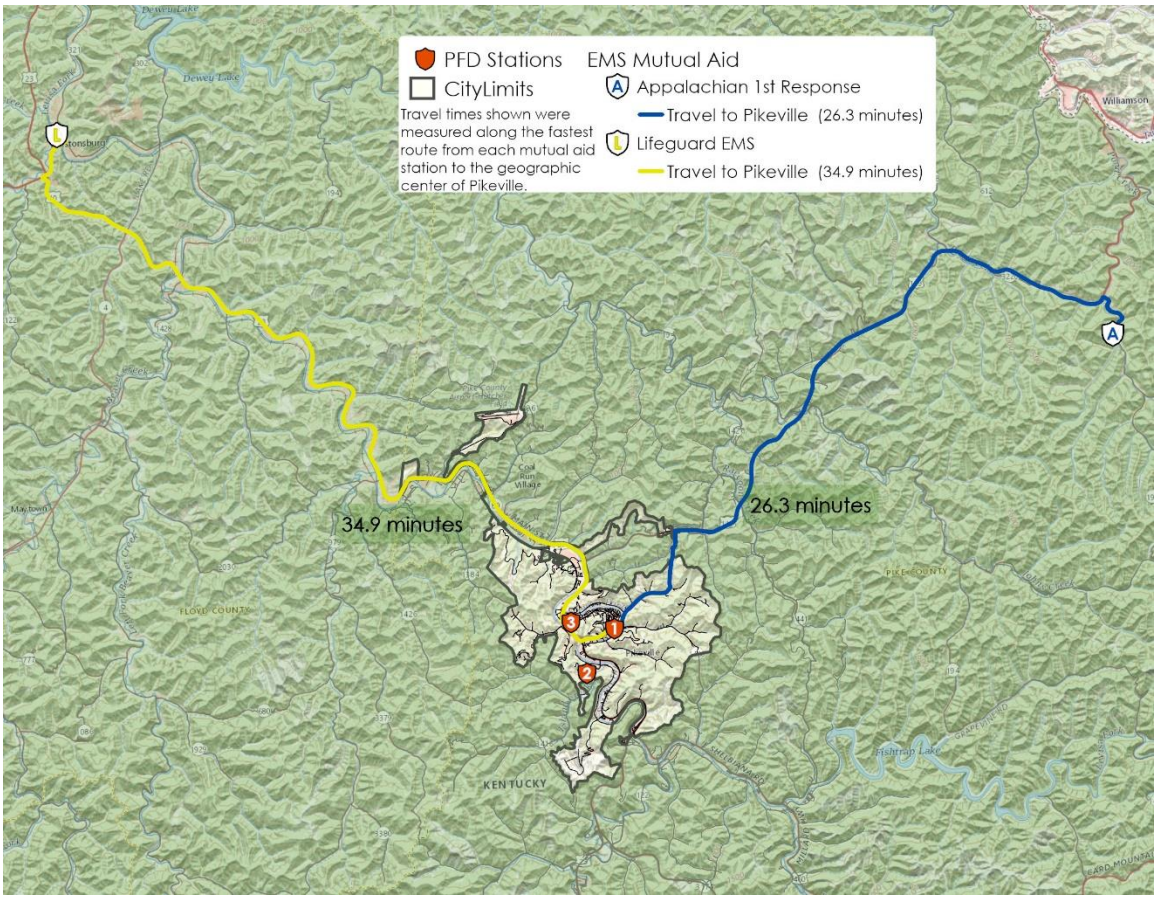


FIGURE 5-12: EMS Mutual Aid Response Time into Pikeville



END SECTION 5

SECTION 6. STAFFING AND DEPLOYMENT OF FIRE AND EMS RESOURCES

Staffing fire and EMS companies continues to remain a focus of attention among fire service and governmental leadership. While NFPA 1710 and OSHA provide guidelines and to some extent law (OSHA in OSHA states) as to the level of staffing and response of personnel, the adoption of these agency documents varies from state to state, and department to department. NFPA 1710 addresses the recommended staffing in terms of specific types of occupancies. The needed staffing to accomplish the critical tasks for each specific occupancy are determined to be the effective response force (ERF). The ERF for each of these occupancies in detailed in NFPA 1710 (2020 edition), section 5.2.4, Deployment.

One of the factors that has helped the fire service in terms of staffing is technology. The fire service continues to experience several technological advances that help firefighters extinguish fires more effectively. More advanced equipment in terms of nozzles, personal protective gear, thermal imaging systems, advancements in self-contained breathing apparatus, incident command strategies, and devices used to track personnel air supply are some of the advancements of technologies and techniques that help firefighters extinguish fires faster and manage the fireground more effectively and safely. While some of these technologies do not reduce the staffing or manpower required, they can have an impact on workload capacity, property loss, and crew fatigue.

Even with the many advances in technology and equipment, the fireground is an unforgiving and dynamic environment where critical tasks must be completed by firefighters. Lightweight wood construction, truss roofs, dwellings and buildings with basements, increased setbacks making accessibility to the building difficult, and estate homes are examples of the challenges that firefighting forces are met with when mitigating structural fires. Newly constructed homes are larger than many of the older homes in the community. These homes tend to incorporate open floor plans, with large spaces that contribute to rapid fire spread. The challenge of rapid fire spread is exacerbated using lightweight roof trusses, vinyl siding, and combustible sheathing. The result is that more personnel are required to safely and effectively mitigate the incidents in these structures. Providing adequate staffing (Effective Response Force) for these environments utilizes many factors.

Understanding that staffing and deployment of fire services is not an exact science, CPSM has developed metrics it follows and recommends that communities consider when making recommendations regarding staffing and deployment of fire resources. While there are many benchmarks that communities and management utilize in justifying certain staffing levels, there are certain considerations that are data driven and reached through national consensus that serve this purpose as well.

In addition to metrics, fire and EMS staffing is also linked to station location, what type of apparatus is responding, that is, the combination of engine, ladder, ambulance, or specialty piece. These combined factors help to determine what level of fire and EMS service is going to be delivered in terms of manpower, response time, and resources.

Linked to these components of staffing and deployment are 11 critical factors that drive various levels and models from which fire and EMS departments staff and deploy. These factors are:

All-Hazard Risk Assessment of the Community: A fire department collects and organizes risk evaluation information about community risk (population and demographics; environmental; transportation; fire and EMS call demand and call types), and individual property types. Based on the rated factors then derives a "fire risk score" and response strategy for each community risk and property type. The all-hazard community risk and community assessment is used to evaluate the community. Regarding individual property types, the assessment is used to measure all property and the risk associated with that property and then segregate the property as either a high-, medium-, or low-hazard/risk depending on factors such as the life and building content hazard and the potential fire flow and the staffing and apparatus types required to mitigate an emergency in the specific property. The factors such as fire protection systems are considered in each building evaluation. Included in this assessment should be both a structural and nonstructural (weather, wildland-urban interface, transportation routes, etc.) analysis. All factors are then analyzed and the probability of an event occurring, the impact on the fire department, and the consequences on the community are measured and scored.

Population, Demographics, and Socioeconomics of a Community: Population and population density drives calls for local government service, particularly public safety. The risk from fire is not the same for everyone, with studies telling us age, gender, race, socio-economic factors, and what region in the country one might live in contribute to the risk of death from fire. Studies also tell us these same factors affect demand for EMS, particularly population increase and the increased use of hospital emergency departments since many uninsured or underinsured patients rely on emergency services for their primary and emergent care, utilizing pre-hospital EMS transport systems as their entry point.

Call Demand: Demand is made up of the types of calls to which units are responding and the location of the calls. This drives workload and station staffing considerations. Higher population centers with increased demand require greater resources.

Workload of Units: The types of calls to which units are responding and the workload of each unit in the deployment model. This defines what resources are needed and where; it links to demand and station location, or in a dynamic deployed system, the area(s) in which to post units.

Travel Times from Fire Stations: Analyzes the ability to cover the fire management zone/response area in a reasonable and acceptable travel time when measured against national benchmarks. Links to demand and risk assessment.

NFPA Standards, ISO, OSHA, State OSH requirements (and other national benchmarking).

EMS Demand: Community demand; demand on available units and crews; demand on non-EMS units responding to calls for service (fire/police units); availability of crews in departments that utilize cross-trained EMS staff to perform fire suppression.

Critical Tasking: On-scene capabilities to control and mitigate emergencies is determined by staffing and deployment of certain resources for low-, medium-, and high-risk responses. Critical Tasking is the individual or team level task that is required to be performed by on-scene personnel based on the type of incident the firefighting and EMS force is responding to.

Effective Response Force: The ability of the jurisdiction to assemble the necessary personnel on the scene to perform the critical tasks necessary in rapid sequence to mitigate the emergency. The speed, efficiency, and safety of on-scene operations are dependent upon the number of

firefighters performing the tasks. If fewer firefighters are available to complete critical on-scene tasks, those tasks will require more time to complete.

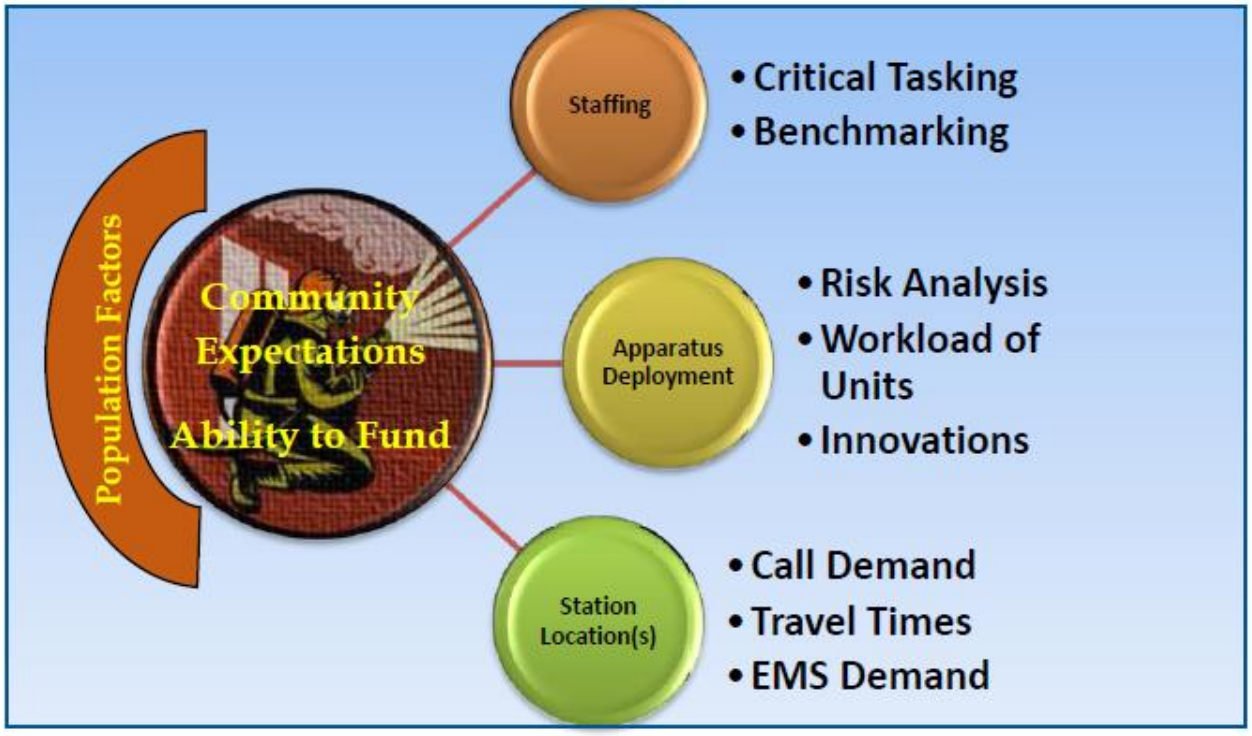
Innovations in Staffing and Deployable Apparatus: The fire department's ability and willingness to develop and deploy innovative apparatus (combining two apparatus functions into one to maximize available staffing, as an example). Deploying quick response vehicles (light vehicles equipped with medical equipment and some light fire suppression capabilities) on those calls (typically the largest percentage) that do not require heavy fire apparatus.

Community Expectations: The gathering of input and feedback from the community, then measuring, understanding, and developing goals and objectives to meet community expectations.

Ability to Fund: The community's understanding of, and its ability and willingness to fund fire and EMS services, while understanding how budgetary revenues are divided up to meet all community's expectations.

These factors are further illustrated in the following figure.

FIGURE 6-1: Fire Department Staffing Diagram



While each component presents its own metrics of data, consensus opinion, and/or discussion points, aggregately they form the foundation for informed decision making geared toward the implementation of sustainable, data- and theory-supported, effective fire and EMS staffing and deployment models that fit the community's profile, risk, and expectations.

FIRE AND EMS STAFFING AND RESPONSE METHODOLOGIES

When looking at response times it is prudent to design a deployment strategy around the actual circumstances that exist in the community and the fire problem that is identified to exist. The strategic and tactical challenges presented by the widely varied hazards that a department protects against need to be identified and planned for through a community risk analysis planning and management process as identified in this report. It is ultimately the responsibility of elected officials to determine the level of risk that is acceptable to their community. Once the acceptable level of risk has been determined, then operational service objectives can be established. Whether looking at acceptable risk, or level of service objectives, it would be imprudent, and probably very costly, to build a deployment strategy that is based solely upon response times.

Fire, rescue, and EMS incidents, and the fire department's ability to respond to, manage, and mitigate them effectively, efficiently, and safely, are mission-critical components of the emergency services delivery system. In fact, fire, rescue, and EMS operations provide the primary, and certainly most important, basis for the very existence of the fire department.

Nationwide, fire departments are responding to more EMS calls and fewer fire calls, particularly fire calls that result in active firefighting operations by responders. This is well documented in both national statistical data, as well as in CPSM fire studies. Pikeville's experience is consistent with these trends. Nationally, improved building construction, code enforcement, automatic sprinkler systems, and aggressive public education programs have contributed to a decrease in serious fires and, more importantly, fire deaths among civilians.

These trends and improvements in the overall fire protection system notwithstanding, fires still do occur, and the largest percentage of those occur in residential occupancies, where they place the civilian population at risk. Although they occur with less frequency than they did several decades ago, when they occur today, they grow much quicker and burn more intensely than they did in the past due to building construction features, more flammable interior finishes and furniture, and in the case of localities such as Pikeville with older buildings, multiple renovations that have led to hidden voids and spaces that act as channels for fire and smoke. As will be discussed later in this section, ***it is imperative that the fire department is able to assemble an effective response force (ERF) within a reasonable time period in order to successfully mitigate these incidents with the least amount of loss possible.***

Fire and rescue work are task-oriented and labor intensive, performed by personnel wearing heavy, bulky personal protective equipment (PPE). Many critical fireground tasks require the skillful operation and maneuvering of heavy equipment.

The speed, efficiency, and safety of fireground operations are dependent upon the number of firefighters performing the tasks. If fewer firefighters are available to complete critical fireground tasks, those tasks will require more time to complete. This increased time is associated with elevated risk to both firefighters and civilians who may still be trapped in a structure.

To ensure civilian and firefighter safety, fireground tasks must be coordinated and performed in rapid sequence. Assembling an Effective Response Force (ERF) is essential to accomplish on-scene goals and objectives safely and efficiently. Without adequate resources to control the fire, the structure and its contents continue to burn. This increases the likelihood of a sudden change in fire conditions, the potential for failure of structural components leading to collapse, and limits firefighters' ability to successfully perform a search and potential rescue of any occupants.

NFPA 1710

National Fire Protection Association (NFPA) standards are consensus standards and not the law. Many cites and countries strive to achieve these standards to the extent possible without an adverse financial impact to the community. Cities and communities must decide on the level of service they can deliver based on several factors as discussed herein and including budgetary considerations. Questions of legal responsibilities are often discussed in terms of compliance with NFPA Standards. Again, these are national consensus standards, representing best practices and applied science and research.

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*, 2020 edition (National Fire Protection Association, Quincy, Mass.) outlines organization and deployment of operations by career, and primarily career fire and rescue organizations.[22] It serves as a benchmark to measure staffing and deployment of resources to certain structures and emergencies.

NFPA 1710 was the first organized approach to defining levels of service, deployment capabilities, and staffing levels for substantially career departments. Research work and empirical studies in North America were used by NFPA committees for the basis for developing response times and resource capabilities for those services as identified by the fire department.[23]

According to NFPA 1710, fire departments should base their capabilities on a formal all-hazards community risk assessment, as discussed earlier in this report, and taking into consideration:[24]

- Life hazard to the population protected.
- Provisions for safe and effective firefighting performance conditions for the firefighters.
- Potential property loss.
- Nature, configuration, hazards, and internal protection of the properties involved.
- Types of fireground tactics and evolutions employed as standard procedure, type of apparatus used, and results expected to be obtained at the fire scene.

According to NFPA 1710, if a community follows this standard, engine companies shall be staffed with a minimum of four on-duty members[25] and ladder companies shall be staffed with *five* and six based on geographical isolation and tactical hazards.[26] This staffing configuration is designed to ensure a fire department can complete the critical tasking necessary on building fires and other emergency incidents simultaneously rather that consecutively, and efficiently assemble an effective response force. ***While CPSM does not recommend the City of Pikeville follow this standard as this is a jurisdictional decision, CPSM does support staffing and deployment of resources in support of assembling an adequate and Effective Response Force to control and mitigate the emergencies to which the PFD responds.***

22. NFPA 1710 is a nationally recognized standard, but it has not been adopted as a mandatory regulation by the federal government or the State of Kentucky. It is a valuable resource for establishing and measuring performance objectives for the City of Pikeville but should not be the only determining factor when making local decisions about the city's fire and EMS services.
23. NFPA, Origin and Development of the NFPA 1710, 1710-1
24. NFPA 1710, 5.2.1.1, 5.2.2.2
25. NFPA 1710, 5.2.3.1.1
26. NFPA 1710, 5.2.3.1.2, 5.2.3.1.2.1.,5.2.3.2.2.,5.3.2.3.2.2.1

Code of Federal Regulations, NFPA 1500, and Two-In/Two-Out

Another consideration, and one that links to critical tasking and assembling an Effective Response Force is that of two-in/two-out. Essentially, prior to initiating any fire attack in an immediately dangerous to life and health (IDLH) environment [with no confirmed rescue in progress], the initial two-person entry team shall ensure that there are sufficient resources on-scene to establish a two-person initial rapid intervention team (IRIT) located outside of the building.

This critical tasking model has its genesis with the Occupational Safety and Health Administration, specifically 29 CFR 1910.134(g)(4). The Kentucky State Occupational Safety and Health Plan applies to state and local government employers. Federal OSHA covers the issues not covered by the Kentucky State Plan, except for the enforcement of the field sanitation and temporary labor camp standards. The federal rule (29 CFR 1910.134(g)(4)) applies to the PFD.

The PFD responds to structural fires with seven on-duty firefighters and a command officer (battalion chief) if no units/staffing are already assigned to other incidents. Under this response model, the PFD provides the minimum number of firefighters on the initial response in order to comply with CFR 1910.134(g)(4), regarding two-in/two-out rules and initial rapid intervention team (IRIT).

CFR 1910.134: Procedures for interior structural firefighting. The employer shall ensure that:

(i) At least two employees enter the IDLH atmosphere and remain in visual or voice contact with one another at all times;

(ii) At least two employees are located outside the IDLH atmosphere; and

(iii) All employees engaged in interior structural firefighting use SCBAs.[27]

According to the standard, one of the two individuals located outside the IDLH atmosphere may be assigned to an additional role, such as incident commander in charge of the emergency or safety officer, so long as this individual is able to perform assistance or rescue activities without jeopardizing the safety or health of any firefighter working at the incident.

NFPA 1500 *Standard on Fire Department Occupational Health, Safety, and Wellness,* 2018 Edition has similar language as CFR 1910.134)g)(4) to address the issue of two-in/two-out by stating *the initial stages of the incident where only one crew is operating in the hazardous area of a working structural fire, a minimum of four individuals shall be required consisting of two members working as a crew in the hazardous area and two standby members present outside this hazard area available for assistance or rescue at emergency operations where entry into the danger area is required.*[28]

NFPA 1500 also speaks to the utilization of the two-out personnel in context of the health and safety of the firefighters working at the incident. *The assignment of any personnel including the incident commander, the safety officer, or operations of fire apparatus , shall not be permitted as standby personnel if by abandoning their critical task(s) to assist, or if necessary, perform rescue, the clearly jeopardize the safety and health of any firefighter working at the incident.*[29]

In order to meet CFR 1910.134(g)(4), and NFPA 1500, the PFD must utilize two personnel to commit to interior fire attack while two firefighters remain out of the hazardous area or

27. CFR 1910.134 (g) 4
28. NFPA 1500, 2018, 8.8.2.
29. NFPA 1500, 2018, 8.8.2.5.

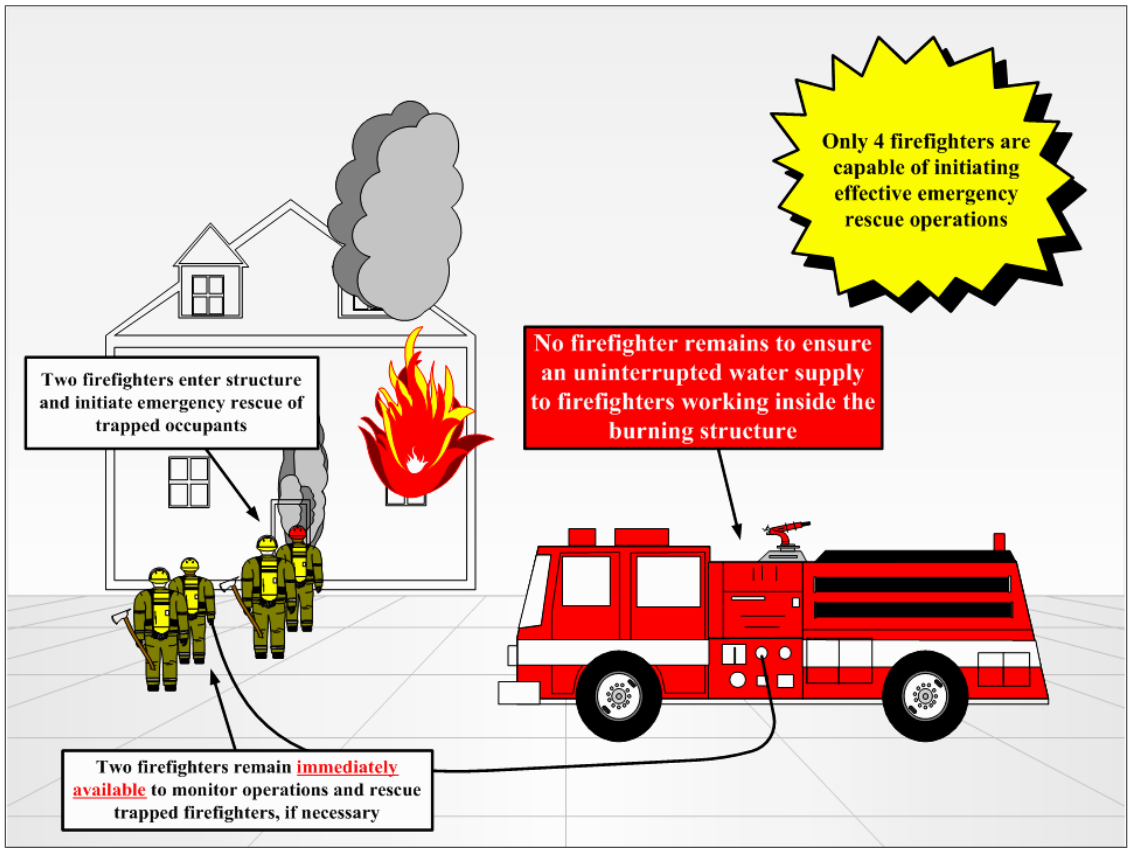
immediately dangerous to life and health (IDLH) area to form the IRIT, while attack lines are charged, and a continuous water supply is established.

However, NFPA 1500 allows for fewer than four personnel under specific circumstances. It states, *Initial attack operations shall be organized to ensure that if on arrival at the emergency scene, initial attack personnel find an imminent life-threatening situation where immediate action could prevent the loss of life or serious injury, such action shall be permitted with fewer than four personnel*.[30]

CFR 1910.134(g)(4) also states that nothing in section (g) is meant to preclude firefighters from performing emergency rescue activities before an entire team has assembled.[31]

It is also important to note that the OSHA standard (and NFPA 1710) specifically references "interior firefighting." Firefighting activities that are preformed from the exterior of the building are not regulated by this portion of the OSHA standard. However, in the end, the ability to assemble adequate personnel, along with appropriate apparatus to the scene of a structure fire, is critical to operational success and firefighter safety.

FIGURE 6-2: Two-In/Two-Out Interior Firefighting Model*



Note: *Four-person staffing, with single engine arrive at scene, or
Two 2-person staffed units (engine/engine; engine/ambulance) arrive at scene.

30. NFPA 1500, 2018 8.8.2.10.
31. CFR 190.134, (g).

The variables of how and where personnel and companies are located, and how quickly they can arrive on scene, play major roles in controlling and mitigating emergencies. ***The reality is that the PFD relies heavily on its own on-duty staffing and deployable resources and equipment because mutual aid companies are almost all volunteer staffed, are not all contiguous with the city, and not always immediately ready to respond.*** The PFD's isolated continuous career staffing model in relation to volunteer mutual aid companies will continue to impact assembling enough personnel and resources to the scene. Given this, interior vs. exterior fire attacks that do not involve life safety have to be considered by the PFD until responding companies arrive on the scene.

Fire Operations

As a fire grows and leaves the room and then floor of origin, or extends beyond the building of origin, it is most probable that additional personnel and equipment will be needed, as initial response personnel will be taxed beyond their available resources. From this perspective it is critical that the PFD and mutual/automatic aid units respond quickly and initiate extinguishment efforts as rapidly as possible after notification of an incident. It is, however, difficult to determine in every case the effectiveness of the initial response in limiting the fire spread and fire damage. Many variables will impact these outcomes, including:

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

Subsequently, in those situations in which there are extended delays in the extinguishment effort, or the fire has progressed sufficiently upon arrival of fire units, there is actually very little that can be done to limit the extent of damage to the entire structure and its contents. In these situations, suppression efforts may need to focus on the protection of nearby or adjacent structures (exterior exposures) with the goal being to limit the spread of the fire beyond the building of origin, and sometimes the exposed building. This is often termed ***protecting exposures***. When the scope of damage is extensive, and the building becomes unstable, firefighting tactics typically move to what is called a ***defensive attack***, or one in which hose lines and more importantly personnel are on the outside of the structure and their focus is to merely discharge large volumes of water until the fire goes out. In these situations, the ability to enter the building is very limited and if victims are trapped in the structure, there are very few safe options for making entry.

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

fires in larger structures, the defensive type, exterior attacks generally involve the use of master streams, typically from an elevated aerial device, and capable of delivering large volumes of water for an extended period of time.

Recent studies by UL have evaluated the effectiveness of interior vs. exterior attacks in certain simulated fire environments. These studies have found the exterior attack to be equally effective in these simulations.[32] This debate is deep-seated in the fire service and traditional tactical measures have always proposed an interior fire attack, specifically when there is a possibility that victims may be present in the burning structure. The long-held belief in opposition to an exterior attack is that this approach may actually push the fire into areas that are not burning or where victims may be located. The counterpoint supporting the exterior attack centers on firefighter safety. In the end, how an interior fire is attached is a jurisdictional choice and should be based on resources immediately available on the fireground to combat the fire, available water supply, and the situation faced initially by crews, and throughout the incident.

The exterior attack limits the firefighter from making entry into those super-heated structures that may be susceptible to collapse. From CPSM's perspective, there is an increased likelihood a PFD single response crew of two or three personnel will encounter a significant and rapidly developing fire situation. This situation can occur during times of multiple incident activity when an EMS unit may be committed on another emergency, or when there is a reliance on mutual/automatic aid companies responding to the incident that have long turnout and response times to arrive on the scene. ***It is prudent, therefore, that the PFD build at least a component of its training and operating procedures around the tactical concept of this occurring.***

PFD Staffing Matrix

The PFD has three operational shifts, A, B, and C. Each of the shifts is staffed with six firefighters, one lieutenant (company officer), and one battalion chief (shift commander), for an on-duty operational response force of eight personnel.

The following table details the positions and qualifications for each shift. Some on-duty staff are advanced EMTs, and as well some are trained to haz-mat operations level, and in technical rescue and water rescue as discussed above. All are trained in fire operations.

TABLE 6-1: PFD Shift Matrix

A Shift	B Shift	C Shift
Station 1: FF, FF, FF, battalion chief	**Station 1:** FF, FF, FF, battalion chief	**Station 1:** FF, FF, FF, battalion chief
Station 2: FF, FF	**Station 2:** FF, FF	**Station 2:** FF, FF
Station 3: LT, FF	**Station 3:** LT, FF	**Station 3:** LT, FF

The table above depicts minimum staffing levels for the department. The PFD does not have extra personnel to fill in for scheduled and unscheduled leave (overstaffing). The PFD, like many fire departments across the country staffs through the constant-staffing level model, meaning that on each shift there is minimum number of staffed positions to be filled. In the case of the PFD that number is eight each shift. When a position is vacated by scheduled or unscheduled leave, and because it represents minimum staffing, the position is backfilled by overtime staffing. If a position cannot be filled, the PFD will operate with a minimum of seven on duty across two or

32. "Innovating Fire Attack Tactics," U.L.COM/News Science, Summer 2013.

three stations. When this occurs, Station 1 remains at three personnel, and another station may operate at a staffing level of one. In some cases, the staffing may be combined at one station so that the minimum of two staff at that station remains in place. When this occurs the third station is unmanned for the shift.

As identified in the table above, the PFD does not have a company officer (lieutenant) at Stations 1 and 2. A fire lieutenant's position is a level above a regular firefighter and the position still has the responsibility for responding to fire and other emergencies. A lieutenant organizes and supervises the day-to-day tasks at the fire station, and also provides training on safety procedures and fire equipment to firefighters assigned. During an incident response, the lieutenant is responsible for utilizing the fire and rescue equipment, as well as providing emergency medical treatment to victims as necessary, while supervising firefighters assigned to his/her company/station and making incident decisions and supervising personnel on the incident scene. The position is an integral piece of a fire department organization, reduces span of control, and firmly seats responsibility and accountability of individual company and station operations. ***For these reasons, CPSM recommends the city review the current supervisory model in the PFD.***

The PFD utilizes a cross-staffing model for virtually every piece of apparatus. The department can staff three response apparatus, depending on the call type. All units cannot be staffed at one time. For a building fire response, generally two fire apparatus and an ambulance respond. Always the first due station responds a fire apparatus to fire incidents. For an EMS incident, typically one ambulance responds from the first-due station, or if that station is out on another incident, from the closest next station.

The following table details the combinations for cross-staffing that the PFD utilizes for fire responses. The subsequent table details the staffing matrix for EMS calls, a motor vehicle accident, and a single EMS call with a simultaneous fire call.

TABLE 6-2: Distribution of Personnel for: Fire Response

Fire Response: Building*		Fire Response: Outside Fire**		Fire Response: Technical Rescue***	
	3 Firefighters		3 Firefighters		3 Firefighters
	1 Lieutenant 1 Firefighter		2 Firefighters		2 Firefighters
	2 Firefighters				2 Firefighters
	1 Battalion Chief				1 Battalion Chief

Notes:

* If the first due station is either Station 1 or Station 2, the on-duty crew may elect to respond in the Tower Ladder assigned to those stations in place of the engine apparatus.
** For Stations 2 and 3, the response would be four (4) personnel (2 on the Engine from the first-due station and 2 on ambulance from the second-due station). This response model also includes a Lieutenant from station 3 as part of the two-person crew.
*** A Technical Rescue response may include 1 Heavy Rescue and two ambulance apparatus, or 1 Heavy Rescue, 1 Engine or Ladder, and 1 Ambulance apparatus. This is dependent in the type of call and incident details.

TABLE 6-3: Distribution of Personnel for: Simultaneous EMS Calls, Motor Vehicle Accident, and Single EMS with Simultaneous Fire Call

Ambulance Response		Ambulance Response		Ambulance Response	
First EMS Call Second EMS Call Third EMS Call*					
	2 Firefighters		2 Firefighters		1 Firefighter 1 Lieutenant
Motor Vehicle Accident**					
	2 Firefighters		1 Firefighter (Heavy Rescue)		1 Battalion Chief
First EMS Call and Simultaneous Fire Call***					
	2 Firefighters		2 Firefighters		3 Firefighters
			1 Battalion Chief	Or 	Or 

Notes:

* If three simultaneous EMS calls are transmitted, or a single or two calls require all three ambulances, there will be one FF left at Station 1 to respond a fire unit if needed.
** The first due station responds with the ambulance. The heavy squad from Station 1 responds with one FF.
*** The initial EMS call dispatches the first-due station ambulance and crew of two. If a subsequent fire call is transmitted, the first due station responds with an engine apparatus. If the first due station is either Station 1 or Station 2, the on-duty crew may elect to respond in the tower ladder assigned to those stations in place of the engine apparatus. Dependent on the type of fire incident, the second-due station may respond in the ambulance.

While the PFD has done a good job with cross-staffing over the years, this system will be difficult to sustain when regularly tested through the increase growth and development (increased population and risk), which typically drives up demand.

Off-duty personnel are requested to respond to the scene of an incident, or to their assigned station in circumstances where a second alarm is transmitted. Available off-duty PFD members who may be available respond, but there is no guarantee. A third alarm brings into the scene available mutual aid companies. Second and third alarms are transmitted when additional resources, typically additional on-scene firefighters, are needed to control and mitigate the emergency.

In the long term, the PFD will need to move away from the cross-staffing model as the number of incidents increase, and/or as the number of simultaneous calls increases, both of which decreases available staffing to initially respond to structural fires. In a 2018 article fire service journal article, Steven Knight, Ph.D., stated that, "There are limitations on cross-staffing units. Once the call volume becomes too frequent or the rate of simultaneous calls rises, then each respective unit needs to be separately staffed."[33] Knight goes on to say that each agency can establish its own benchmarks for cross-staffing effectiveness; however, he suggests a good

33. Alternate Deployment Models for the Fire Service, *Fire Rescue1*, Jun 2018, Steven Knight PhD.

benchmark to evaluate the effectiveness of cross-staffing is no more than five calls per day and a call concurrency rate of no more than 15 percent.

Currently the PFD averages 8.3 calls a day (fire and EMS). Station 1 averages 5.1 calls per day and is the busiest. Station 3 averages just under two calls per day, and Station 2 just over one call per day. Station 1 has an overlapped call on average 12 percent of the time. Station 3 has an overlapped call on average 7.5 percent of the time, and Station 2 on average just under 5 percent of the time. ***At a minimum, and based on Dr. Knight's methodology and research, the city should consider a different staffing model for Stations 1 (now) and 3 (in the next five years) wherein fire and EMS units are not cross-staffed.***

Critical Tasks, and Effective Response Force

Critical tasks are those activities that must be conducted in a timely manner by responders at emergency incidents to control the situation and stop loss. Critical tasking for fire operations is the minimum number of personnel needed to perform the tasks required to effectively control and mitigate a fire or other emergency. To be effective, critical tasking must assign enough personnel so that all identified functions can be performed simultaneously. However, it is important to note that secondary support functions may be handled by initial response personnel once they have completed their primary assignment. Thus, while an incident may end up requiring a greater commitment of resources or a specialized response, a properly executed critical tasking assignment will provide adequate resources to immediately begin bringing the incident under control.

The specific number of people required to perform all the critical tasks associated with an identified risk or incident type is referred to as an Effective Response Force (ERF). The goal is to deliver an ERF within a prescribed time frame. NFPA 1710 provides a benchmark for effective response forces.

The following will outline how critical tasking and assembling an effective response force is first measured in NFPA 1710, and how the PFD is benchmarked against this standard. This includes single-family dwelling buildings, open-air strip mall buildings, apartment buildings, and high-rise buildings. As mentioned already in this report, the PFD cannot rely on mutual or automatic aid to support its efforts in assembling an Effective Response Force, as these responding companies are volunteer and are not reliable 24/7 to respond with adequate staffing.

Single-Family Dwelling: NFPA 1710, 5.2.4.1

The initial full alarm assignment to a structural fire in a typical 2,000 square-foot, two-story, single-family dwelling without a basement and with no exposures must provide for a minimum of 16 members (17 if an aerial device is used). The following figure illustrates this, and the subsequent table outlines the critical task matrix.

§ § §

FIGURE 6-3: Effective Response Force for Single-Family Dwelling Fire

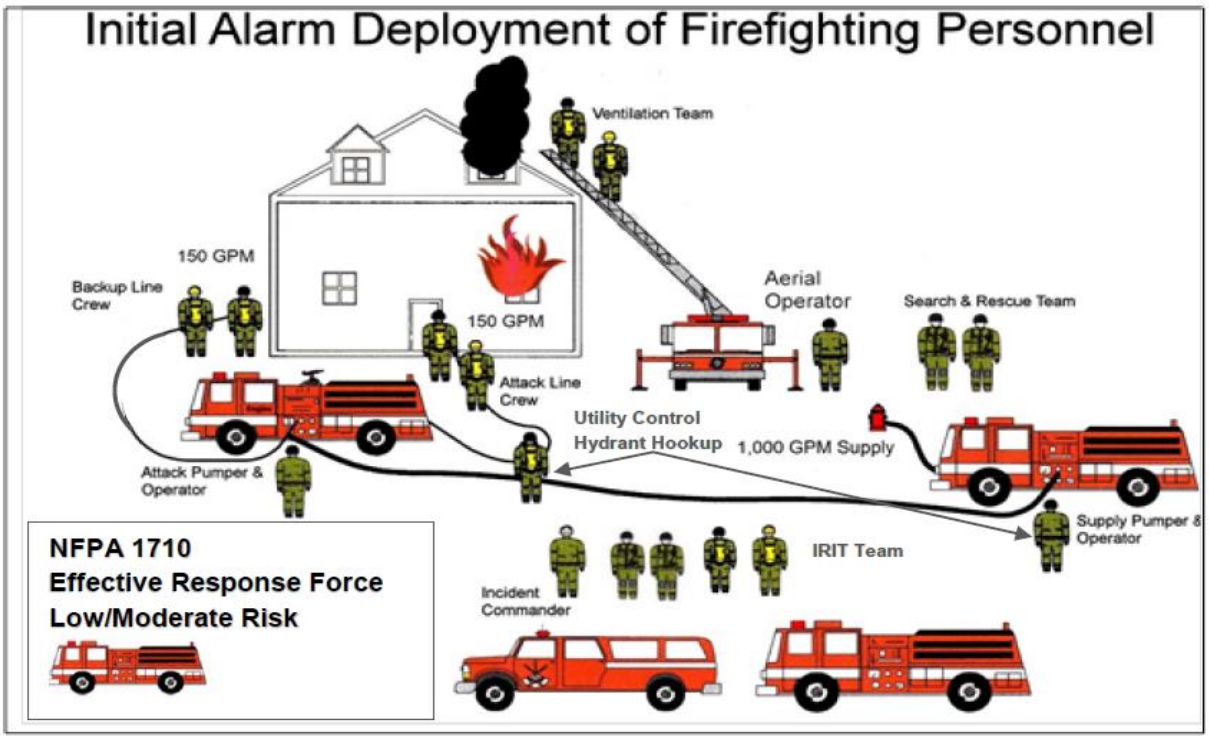


TABLE 6-4: Effective Response Force for Single-Family Dwelling Fire

Critical Tasks	Personnel
Incident Command	1
Continuous Water Supply	1
Fire Attack via Two Handlines	4
Hydrant Hook Up - Forcible Entry - Utilities	2
Primary Search and Rescue	2
Ground Ladders and Ventilation	2
Aerial Operator if Aerial is Used	1
Establishment of IRIC (Initial Rapid Intervention Crew)	4
Total Effective Response Force	**16** (17 If aerial is used)

The following table outlines the how the PFD is able to assemble an effective response force for a single-family dwelling fire.

§ § §

TABLE 6-5: PFD Effective Response Force for Single-Family Dwelling Fire

Apparatus	Personnel
PFD Battalion Chief	1
PFD Engine	3
PFD Engine/Ladder	2
PFD Ambulance	2
Total ERF	**8**

Open-Air Strip Mall, NFPA 5.4.2

The initial full alarm assignment to a structural fire in a typical open-air strip center ranging from 13,000 square feet to 196,000 square feet in size must provide for a minimum of 27 members (28 if an aerial device is used). The following table outlines the critical tasking matrix for this type of fire.

TABLE 6-6: Effective Response Force for Open-Air Strip Mall Fire

Critical Tasks	Personnel
Incident Command	2
Continuous Water Supply	2
Fire Attack via Two Handlines	6
Hydrant Hook Up - Forcible Entry - Utilities	3
Primary Search and Rescue	4
Ground Ladders and Ventilation	4
Aerial Operator if Aerial is Used	1
Establishment of IRIC (Initial Rapid Intervention Crew)	4
Medical Care Team	2
Total Effective Response Force	**27** (28 If aerial is used)

The following table outlines the how the PFD is able to assemble an effective response force for an open-air strip mall fire.

TABLE 6-7: PFD Effective Response Force for Open-Air Strip Mall Fire

Apparatus	Personnel
PFD Battalion Chief	1
PFD Engine	3
PFD Engine/Ladder	2
PFD Ambulance	2
Total ERF	**8**

Apartment Building

The initial full alarm assignment to a structural fire in a typical 1,200 square-foot apartment within a three-story, garden-style apartment building must provide for a minimum of 27 members (28 if an aerial device is used). The following table outlines the critical tasking matrix for this type of building fire.

TABLE 6-8: Effective Response Force for Apartment Building Fire

Critical Tasks	Personnel
Incident Command	2
Continuous Water Supply	2
Fire Attack via Two Handlines	6
Hydrant Hook Up - Forcible Entry - Utilities	3
Primary Search and Rescue	4
Ground Ladders and Ventilation	4
Aerial Operator if Aerial is Used	1
Establishment of IRIC (Initial Rapid Intervention Crew	4
Medical Care Team	2
Total Effective Response Force	**27** (28 If aerial is used)

The following table outlines the how the PFD is able to assemble an effective response force for an apartment building fire.

TABLE 6-9: PFD Effective Response Force for Apartment Building Fire

Apparatus	Personnel
PFD Battalion Chief	1
PFD Engine	3
PFD Engine/Ladder	2
PFD Ambulance	2
Total ERF	**8**

High-Rise, NFPA 1710 5.2.4.4

The initial full alarm assignment to a fire in a building where the highest floor is greater than 75 feet above the lowest level of fire department vehicle access must provide for a minimum of 42 members (43 if the building is equipped with a fire pump). The following table outlines the critical tasking matrix for this type of building fire.

§ § §

TABLE 6-10: Effective Response Force for High-Rise Fire Matrix

Critical Tasks	Personnel
Incident Command	2
Continuous Water Supply	1 FF for continuous water; if fire pump exists, 1 additional FF required.
Fire Attack via Two Handlines	4
One handline above the Fire Floor	2
Establishment of IRIC (Initial Rapid Intervention Crew)	4
Primary Search and Rescue Teams	4
Entry Level Officer with Aide near entry point of Fire Floor	2
Entry Level Officer with Aide near the entry point above the Fire Floor	2
Two Evacuation Teams	4
Elevation Operations	1
Safety Officer	1
FF two floors below fire to coordinate staging	1
Rehabilitation Management	2
Officer and FFs to manage vertical ventilation	4
Lobby Operations	1
Transportation of Equipment below Fire Floor	2
Officer to Management Base Operations	1
Two ALS Medical Care Teams	4
Total Effective Response Force	**42** (43) If building is Equipped with Pump

The following table outlines how the PFD is able to assemble an Effective Response Force for a high-rise building fire.

TABLE 6-11: PFD Effective Response Force for High-Rise Building

Apparatus	Personnel
PFD Battalion Chief	1
PFD Engine	3
PFD Engine/Ladder	2
PFD Ambulance	2
Total ERF	**8**

EMS Operations

Emergency medical service (EMS) operations are an important component of the comprehensive emergency services delivery system in any community. Together with the delivery of police and fire services, EMS forms the backbone of the community's overall public safety net. As is noted in several sections of this report, the PFD, like many, if not most, fire departments, respond to significantly more emergency medical incidents and low acuity incidents than actual fires or other types of emergency incidents.

The EMS component of the emergency services delivery system is more heavily regulated than the fire side. In addition to National Fire Protection Association (NFPA) Standard 1710, *Organization and Deployment of Fire Suppression Operations, Emergency Medical Operations, and Special Operations to the Public by Career Fire Departments* (2020 Edition), NFPA 450 *Guidelines for Emergency Medical Services (EMS) and Systems*, (2017 edition), provides a template for local stakeholders to evaluate EMS operations and to make improvements based on that evaluation. The Commission on Accreditation of Ambulance Services (CAAS)[34] also promulgates EMS benchmarking that are applicable to its accreditation process for ambulance services. In addition, the Kentucky Board of Emergency Medical Services (KBEMS) regulates EMS personnel and agencies operating in the Commonwealth.

As a percentage of overall incidents responded to by the emergency agencies in most communities, it could be argued that EMS incidents constitute the greatest number of "true" emergencies, where intervention by trained personnel does truly make a difference, sometimes literally between life and death.

Heart attack and stroke victims require rapid intervention, care, and transport to a medical facility. The longer the time duration without care, the less likely the patient is to fully recover. Numerous studies have shown that irreversible brain damage can occur if the brain is deprived of oxygen for more than four minutes. In addition, the potential for successful resuscitation during cardiac arrest decreases exponentially with each passing minute that cardiopulmonary resuscitation (CPR), or cardiac defibrillation, is delayed. On average, for every minute that elapses, successful resuscitation decreases 7 to 10 percent for each minute.

PFD is responsible for Basic Life Support (BLS) responses in the City of Pikeville, as well as EMS ground transportation. As noted, the PFD staffs three ambulances around the clock. Pikeville Medical Center (PMC) is the main receiving hospital for PFD ground transportation. PMC provides the Medical Director and is in close contact with PFD regarding medical direction, protocol development and implementation, and other EMS policies and guidelines. As already noted above, the PFD through medical direction of the EMS Operational Medical Director has enhanced skills delivered through contemporary medical protocols that require initial and on-going training and skill assessment. This includes advanced airway care utilizing a Combi-Tube; administration of albuterol through nebulizer treatment for respiratory medical emergencies; 1-1000 epinephrine administration for allergic reactions; and 12-lead cardiac monitoring telemetry.

The following table depicts PFD EMS ground transport by call type and Table 6-13 depicts the various time components for EMS ground transportation by the PFD.

34. The Commission on Accreditation of Ambulance Services (CAAS) is an independent commission that established a comprehensive series of standards for the ambulance service industry.

TABLE 6-12: Transport Calls by Call Type

Call Type	Number of Calls			Conversion Rate
	Non-transport	Transport	Total	
Breathing difficulty	13	140	153	91.5
Cardiac and stroke	6	29	35	82.9
Fall and injury	32	194	226	85.8
Illness and other	167	675	842	80.2
MVA	78	97	175	55.4
Overdose and psychiatric	8	90	98	91.8
Seizure and unconsciousness	30	135	165	81.8
EMS Total	**334**	**1,360**	**1,694**	**80.3**
Fire & Other Total	**826**	**46**	**872**	**5.3**
Total	**1,160**	**1,406**	**2,566**	**54.8**

Note: 80 percent of PFD EMS incidents are transported to the hospital.
** On average, four calls/day required transport.

TABLE 6-13: Time Analysis for Ambulance Transport Runs by Call Type

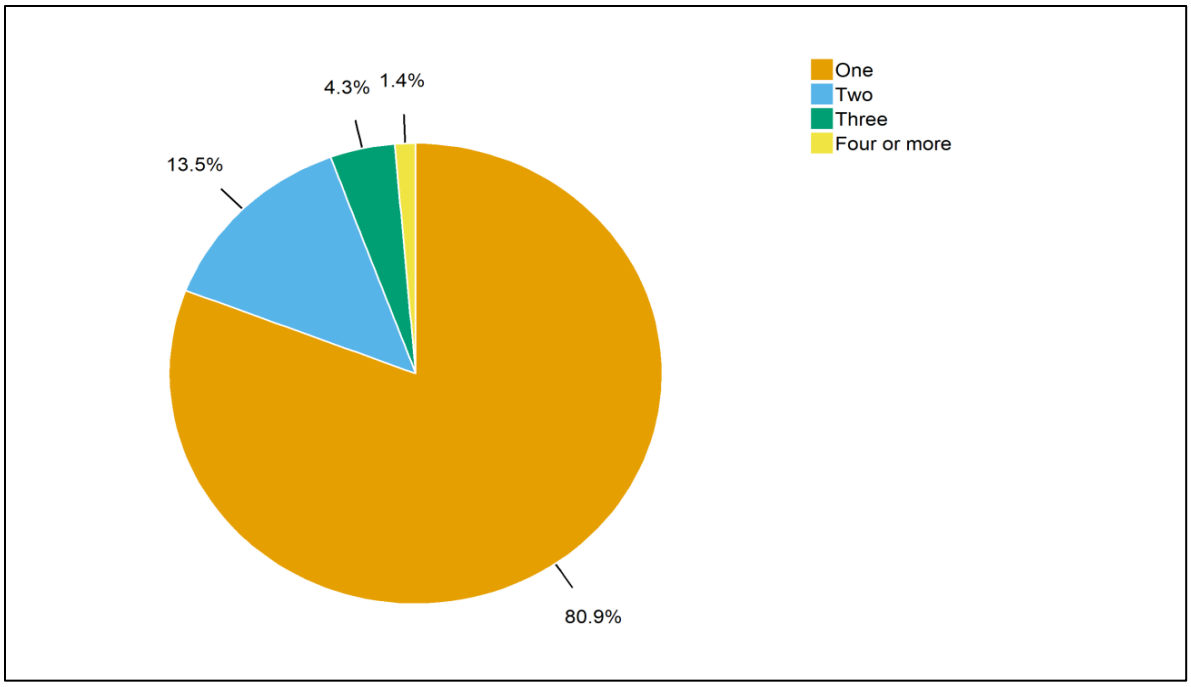
Call Type	Average Time Spent per Run, Minutes				Number of Runs
	On Scene	Traveling to Hospital	At Hospital	Deployed	
Breathing difficulty	12.3	3.2	32.3	51.5	134
Cardiac and stroke	12.4	3.1	29.6	48.8	28
Fall and injury	13.9	4.1	37.4	59.7	191
Illness and other	11.5	4.1	32.6	52.0	644
MVA	13.1	4.0	49.1	71.7	117
Overdose and psychiatric	11.1	3.6	39.0	57.6	87
Seizure and unconsciousness	12.2	4.5	33.2	53.8	134
EMS Total	**12.1**	**4.0**	**35.1**	**55.3**	**1,335**
Fire & Other Total	**14.6**	**10.9**	**37.1**	**71.1**	**41**
Total	**12.2**	**4.2**	**35.2**	**55.7**	**1,376**

This table tells us that: the average time spent on-scene for a transport call was 12.1 minutes (exceptional efficiency); the average travel time from the scene of the call to the hospital was 4.0 minutes; the average deployed time spent on transport calls was 55.3 minutes; the average deployed time at the hospital was 35.1 minutes. The deployed time at hospital should be routinely reviewed by PFD senior staff. According to PFD senior officials however, once an ambulance has been returned to serviceable condition, it is available for call while finishing required patient care reporting.

PFD responds two personnel on an ambulance to an EMS incident. The heavy squad apparatus will be added in the case of a vehicle accident. If additional manpower is required, an additional EMS unit will be dispatched. In some cases, an engine company and the battalion chief will be added to the incident. The next figure illustrates the average number of units per EMS call to which the PFD responded during the data analysis period, which as discussed in this

report influences available staffing to respond fire or EMS apparatus when simultaneous fire/EMS calls occur.

FIGURE 6-4: Calls by Number of Units Arriving – EMS



The above figure tells us that for EMS calls, one unit was dispatched nearly 81 percent of the time, two units were dispatched just under 14 percent of the time, and three or more units were dispatched almost 6 percent of the time.

Staffing and Deployment Recommendations:

- CPSM recommends, funding available, that the city develop a five-year strategic funding plan to increase the levels of staffing and deployment of resources as follows and in the priority order listed below. To accomplish this, CPSM further recommends the city apply for an Assistance to Firefighters, Staffing for Adequate Fire and Emergency Response (SAFER) grant to assist in the funding of these new positions. The SAFER grant was developed to provide communities across the country funding to increase the number of trained firefighters to enhance a fire department's ability to align with staffing, response, and operational standards established with NFPA 1710. For federal fiscal year 2020, $355 million was set aside for SAFER grant funding, which was an increase of $5 million from FY 2019. SAFER grants provide funding over a three-year period at 75 percent for years one and two, and 35 percent for year three. (Recommendation No. 9.)
- Eliminate the cross-staffing model of fire and EMS apparatus at Station 1. Add one additional firefighter position on each shift. Once this is accomplished, a response of fire or EMS apparatus should always be a crew of two and never a crew of one ***(year 1)***. Minimum staffing would allow the ambulance to be staffed with two and the engine, tower, or heavy rescue to be staffed with two on a continual basis. This staffing model reduces the impact of simultaneous calls at Station 1 and enhances the ability to collect an Effective Response Force more quickly, which enhances the ability of on-scene crews to perform critical tasks simultaneously rather than consecutively. (Recommendation No. 10.)

- Upgrade one firefighter position on each shift at Stations 1 and 2 to a lieutenant position so that the span of control for the on-duty battalion chief is reduced, and responsibility and accountability of individual company and station operations can be established consistently at all stations. This will also enhance the management and supervision capabilities on fire and EMS incidents ***(year 2)***. (Recommendation No. 11.)
- Eliminate the cross-staffing model of fire and EMS apparatus at Station 3. Add two additional firefighter positions on each shift. Once this is accomplished, a response of fire or EMS apparatus should always be a crew of two and never a crew of one ***(add one per shift year 4 and one per shift year 5)***. Minimum staffing would allow the ambulance to be staffed with two and the engine to be staffed with two on a continual basis. This staffing model enhances the ability to collect an Effective Response Force more quickly, which enhances the ability of on-scene crews to perform critical tasks simultaneously rather than consecutively. Recommendation No. 12.)
- CPSM recommends the immediate dispatch of multiple mutual aid companies on the initial alarm for structural fire and other fire multi-unit responses to enhance the ability of the PFD to collect an Effective Response Force more quickly, which will enhance the ability of on-scene crews to perform critical tasks simultaneously rather than consecutively. CPSM further recommends when these mutual aid companies respond that they do so, as a matter of response policy, with a minimum staffing of two. CPSM also recommends frequent multi-unit training with these mutual aid companies to ensure incident scene critical tasking can be effectively accomplished and to the expectations of the PFD. (Recommendation No. 13.)
- CPSM recommends, for crew safety reasons, that the PFD eliminate the dispatch of a single fire or EMS apparatus with a single firefighter unless a second unit from another station is dispatched in unison with the single-staffed apparatus. The purpose of the second unit dispatch is to act as the crew for the single-staffed apparatus. (Recommendation No. 14.)
- CPSM recommends, for crew safety reasons, that when Stations 2 and 3 are down one firefighter position due to scheduled or unscheduled leave, and the leave position cannot be filled, the station be browned out for the period there is not at least two firefighters available to staff the station. (Recommendation No. 15.)

END SECTION 6

SECTION 7. DATA ANALYSIS

The data analysis examines all calls for service between November 1, 2018, and October 31, 2019, as recorded in the City of Pikeville 911 Public Safety's computer-aided dispatch (CAD) system and the PFD's National Fire Incident Reporting System (NFIRS). Additional EMS data came from PFD's Patient Care Reporting system.

This analysis is made up of five parts. The first part focuses on call types and dispatches. The second part explores time spent and the workload of individual units. The third part presents an analysis of the busiest hours in the year studied. The fourth part provides a response time analysis of PFD units. The fifth and final part is an analysis of unit transports.

During the year covered by this study, PFD operated out of three stations, utilizing four ambulances, three engines, two boats, two EMS carts, two fire carts, two towers, one rescue vehicle, one shift supervisor vehicle, and one support vehicle. Administrative staff for the department included the fire chief, the housing chief, the fire marshal/senior battalion chief, three battalion chiefs, and the safety officer / environmental officer.

During the study period, the Pikeville Fire Department responded to 3,036 calls, of which 56 percent were EMS calls. These calls included 365 car seat installations and nonemergency service calls, as well as another 105 calls to which only administrative units responded. The total combined workload (deployed time) for all PFD units excluding the removed calls was 2,490.1 hours. The average dispatch time for the first arriving unit was 1.6 minutes and the average response time of the first arriving PFD unit was 5.7 minutes. The 90th percentile dispatch time was 3.7 minutes and the 90th percentile response time was 8.9 minutes.

METHODOLOGY

In this data analysis, CPSM analyzed calls and runs. A call is an emergency service request or incident. A run is a dispatch of a unit (i.e., a unit responding to a call). Thus, a call may include multiple runs.

We received CAD, NFIRS, and EMS data for the Pikeville Fire Department. We first matched the information in different data sets based on the incident numbers provided. Then, we classified the calls in a series of steps. We first used the NFIRS incident type, when available, to identify canceled calls and to assign EMS, motor vehicle accident (MVA), and fire category call types. When the NFIRS incident type was not available, we instead used the call description as recorded in the CAD data. EMS calls were then assigned detailed categories based on the description of the call in the EMS data. Mutual aid calls were identified by geocoding each call to determine if it occurred in PFD's jurisdiction.

The CAD data records 3,037 calls occurring during the study period. Two units with no corresponding call were removed, as were two units with no clear timestamps, resulting in one call being excluded. Table 7-1 breaks down the remaining 3,036 calls by call type.

At this point, we removed several types of calls and runs from all other analyses in the first five sections of the report. The 365 car seat installations and non-emergency service calls, and the 470 runs associated with these calls, were removed here. These calls and runs are further examined in Attachment II. Next, we removed 341 remaining administrative units, as well as 105 associated calls for which the only responding units were administrative units. The workload of all

administrative units in the original 3,036 calls is documented in Attachment III. Due to these exclusions, after an initial analysis of calls by type, the remainder of the first five sections of the report focuses on the remaining 2,566 calls.

In this report, canceled and mutual aid calls are included in all analyses other than the response time analyses.

CAD DATA PROBLEMS

The key unit-level timestamps we utilize in this study are *dispatch*, *en route*, *arrive*, and *clear*, as well as *begin transport* and *end transport* for transport runs. We observed several issues in how these timestamps are recorded.

Over the course of this study, we often observed that not all of these timestamps are being recorded in the unit history log. For example, on a particular run, the dispatch and arrive timestamps would be recorded, but the en route timestamp would be missing. Sometimes, units will later radio in these missing timestamps to dispatch. Dispatchers may attempt to include these timestamps by adding a note, albeit usually without recording the seconds component of the timestamps. These missing timestamps hamper our ability to accurately calculate each component of a unit's response time, as well as our ability to accurately calculate the workload associated with each component of a transport run.

We noticed a further issue with the dispatch timestamps. When the dispatch center begins to determine who should be dispatched, the computer system will sometimes recommend dispatching a particular station. A dispatch time for that station will usually be recorded. When an individual unit is later dispatched, that unit's dispatch time will often *not* be recorded. As a result, we had over a thousand runs missing individual dispatch times. When a call with a unit missing a dispatch timestamp also recorded a station with a dispatch timestamp, we were able to fill in the unit's missing timestamp with the corresponding station's timestamp. Even after doing this, we were left with more than 300 runs that were missing dispatch timestamps. As a result, the workload of these runs is underestimated, since we are unable to determine when these runs began.

Furthermore, for car seat installation and non-emergency service calls, the clear timestamp often did not accurately reflect the time the call ended. As such, we were unable to calculate the workload for these calls.

In addition, sometimes more than one clear timestamp was recorded for an individual unit on a specific call. By default, we decided to use the last clear timestamp as the unit's final clear time. Due to this decision, the workload of these runs may be overestimated.

Finally, we observed that sometimes instead of recording which individual units responded to a call, the dispatch center only recorded the responding station, and occasionally, only the responding agency. When this occurred, we were not able to determine how many units actually responded to the call, and thus could not accurately calculate that call's workload. In this situation, we assumed that one unidentified unit was dispatched.

AGGREGATE CALL TOTALS AND RUNS

During the year studied, PFD responded to 3,036 calls. Of these, 4 were structure fire calls and 20 were outside fire calls within PFD's jurisdiction.

Calls by Type

The following table and two figures show the number of calls by call type, average calls per day, and the percentage of calls that fall into each call type category for the 12-month period studied.

TABLE 7-1: Call Types

Call Type	Number of Calls	Calls per Day	Call Percentage
Breathing difficulty	153	0.4	5.0
Cardiac and stroke	35	0.1	1.2
Fall and injury	228	0.6	7.5
Illness and other	846	2.3	27.9
MVA	183	0.5	6.0
Overdose and psychiatric	99	0.3	3.3
Seizure and unconsciousness	165	0.5	5.4
EMS Total	**1,709**	**4.7**	**56.3**
False alarm	325	0.9	10.7
Good intent	28	0.1	0.9
Hazard	68	0.2	2.2
Outside fire	20	0.1	0.7
Public service	443	1.2	14.6
Structure fire	4	0.0	0.1
Fire Total	**888**	**2.4**	**29.2**
Canceled	13	0.0	0.4
Car seat installation	121	0.3	4.0
Mutual aid	61	0.2	2.0
Nonemergency service	244	0.7	8.1
Other Total	**439**	**1.2**	**14.5**
Total	**3,036**	**8.3**	**100.0**

FIGURE 7-1: EMS Calls by Type

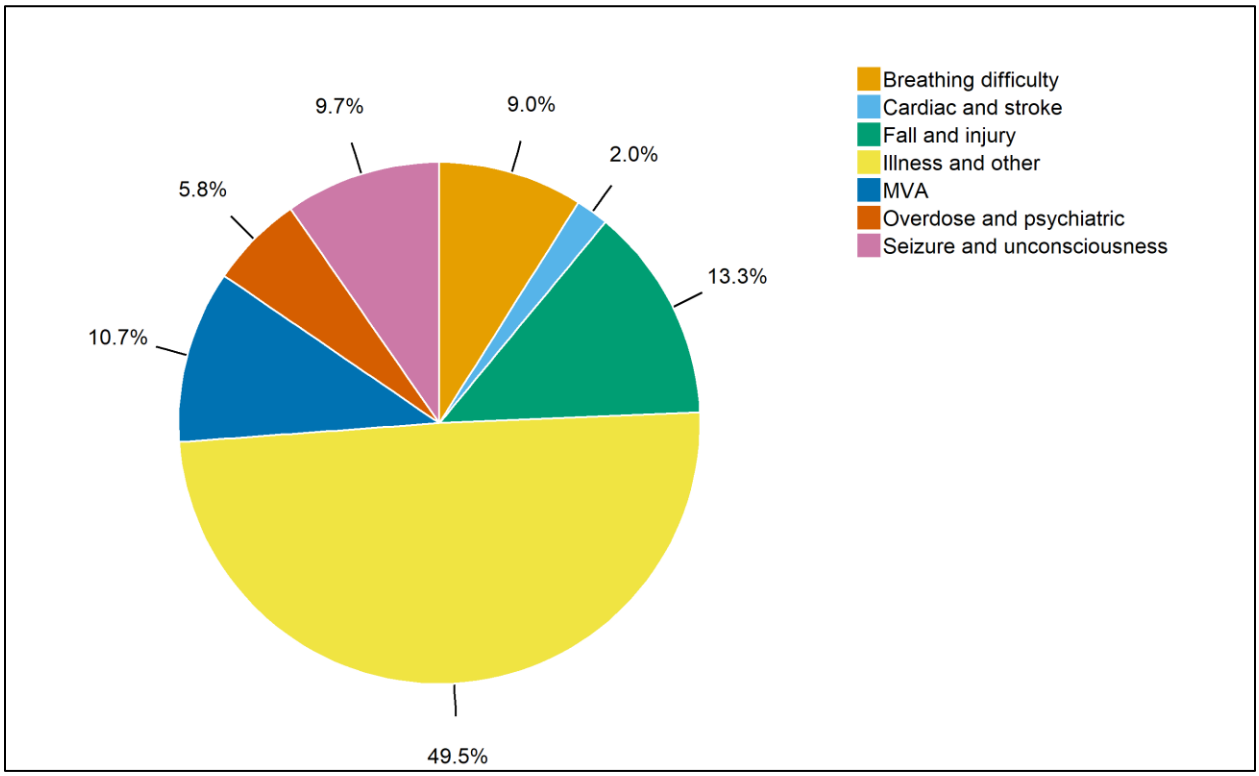
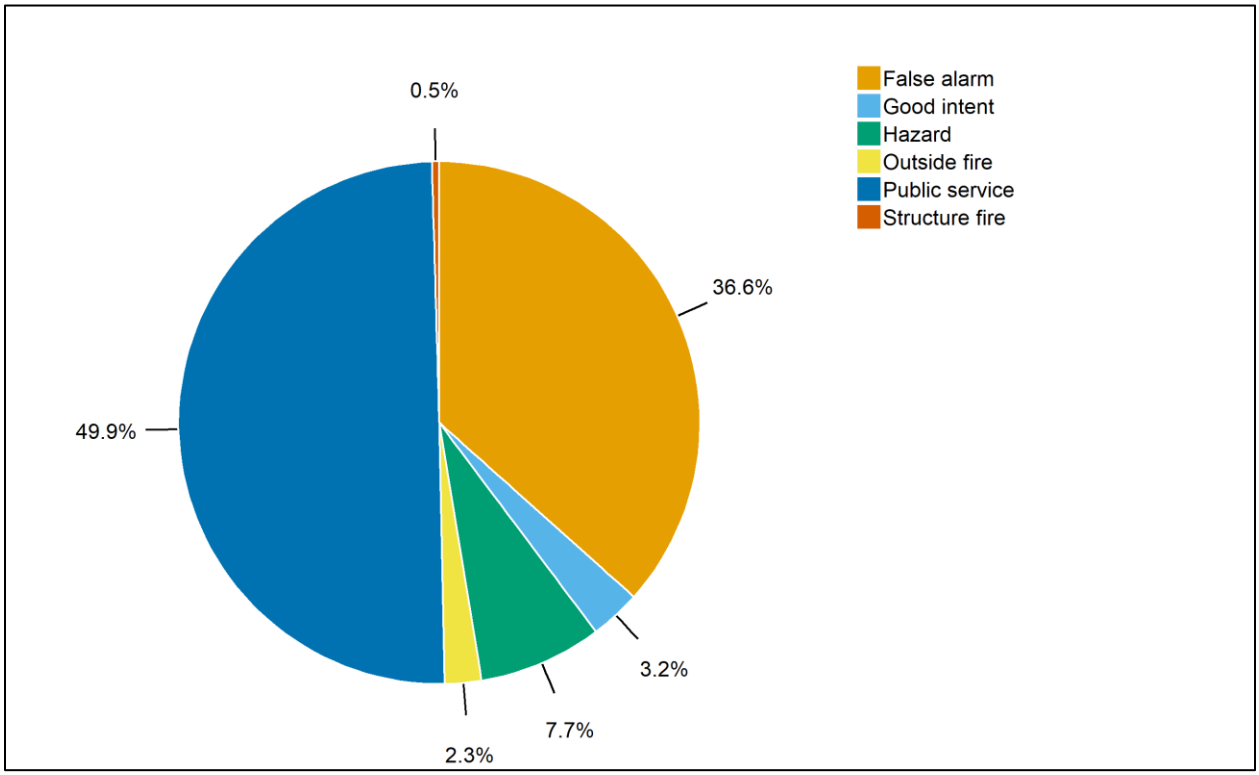


FIGURE 7-2: Fire Calls by Type



Observations:

Overall

- The department handled an average of 8.3 calls per day.
- EMS calls for the year totaled 1,709 (56 percent of all calls), an average of 4.7 per day.
- Fire calls for the year totaled 888 (29 percent of all calls), an average of 2.4 per day.

EMS

- Illness and other calls were the largest category of EMS calls at 50 percent of EMS calls, an average of 2.3 calls per day.
- Cardiac and stroke calls made up 2 percent of EMS calls, an average of 0.1 calls per day.
- Motor vehicle accidents made up 11 percent of EMS calls, an average of 0.5 calls per day.

Fire

- Public service calls were the largest category of fire calls at 50 percent of fire calls, an average of 1.2 calls per day.
- False alarm calls made up 37 percent of fire calls, an average of 0.9 calls per day.
- Structure and outside fire calls combined made up 3 percent of fire calls, an average of fewer than 0.1 calls per day, or one call every 15 days.

Calls by Type and Duration

From this point forward, we exclude several types of calls, as described in the methodology section. We exclude 365 car seat installation and nonemergency service calls. In addition, 105 calls were excluded as their only responding units were administrative. As a result, 2,566 calls remain.

The following table shows the duration of calls by type using four duration categories: less than 30 minutes, 30 minutes to one hour, one to two hours, and more than an hour.

TABLE 7-2: Calls by Type and Duration

Call Type	Less than 30 Minutes	30 Minutes to One Hour	One to Two Hours	More Than Two Hours	Total
Breathing difficulty	28	90	32	3	153
Cardiac and stroke	11	14	9	1	35
Fall and injury	34	117	64	11	226
Illness and other	223	436	156	27	842
MVA	33	64	65	13	175
Overdose and psychiatric	19	54	20	5	98
Seizure and unconsciousness	27	87	49	2	165
EMS Total	**375**	**862**	**395**	**62**	**1,694**
False alarm	276	33	8	2	319
Good intent	20	3	1	0	24
Hazard	37	14	12	2	65
Outside fire	11	5	1	2	19
Public service	306	44	21	7	378
Structure fire	0	1	1	2	4
Fire Total	**648**	**100**	**44**	**15**	**807**
Canceled	8	1	1	0	10
Mutual aid	10	16	22	5	53
Total	**1,043**	**979**	**462**	**82**	**2,566**

Observations:

EMS

- A total of 1,237 EMS calls (73 percent) lasted less than one hour, 395 EMS calls (23 percent) lasted one to two hours, and 62 EMS calls (4 percent) lasted two or more hours.
- On average, there were 1.3 EMS calls per day that lasted more than one hour.
- A total of 25 cardiac and stroke calls (71 percent) lasted less than one hour, 9 cardiac and stroke calls (26 percent) lasted one to two hours, and 1 cardiac and stroke calls (3 percent) lasted two or more hours.
- A total of 97 motor vehicle accidents (55 percent) lasted less than one hour, 65 motor vehicle accidents (37 percent) lasted one to two hours, and 13 motor vehicle accidents (7 percent) lasted two or more hours.

Fire

- A total of 750 fire calls (93 percent) lasted less than one hour, 44 fire calls (5 percent) lasted one to two hours, and 15 fire calls (2 percent) lasted two or more hours.
- An average, there were 0.2 fire calls per day that lasted more than one hour.
- A total of 1 structure fire call (25 percent) lasted less than one hour, 1 structure fire call (25 percent) lasted one to two hours, and 2 structure fire calls (50 percent) lasted two or more hours.
- A total of 16 outside fire calls (84 percent) lasted less than one hour, 1 outside fire calls (5 percent) lasted one to two hours, and 2 outside fire calls (11 percent) lasted two or more hours.
- A total of 309 false alarm calls (97 percent) lasted less than one hour, 8 false alarm calls (3 percent) lasted one to two hours, and 2 false alarm calls (less than 1 percent) lasted two or more hours.

Average Calls per Day and per Hour

Figure 7-3 shows the monthly variation in the average daily number of calls handled by the PFD during the year studied. Similarly, Figure 7-4 illustrates the average number of calls received each hour of the day over the course of the year.

FIGURE 7-3: Average Calls per Day, by Month

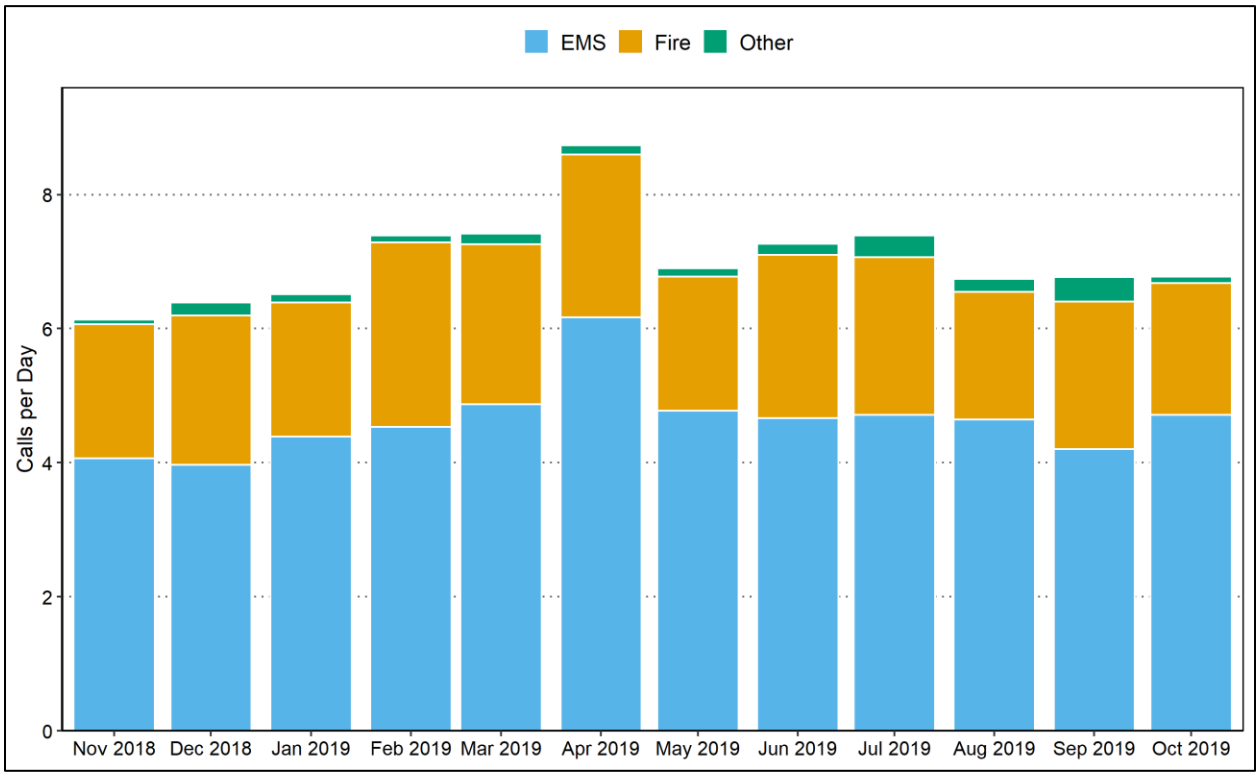
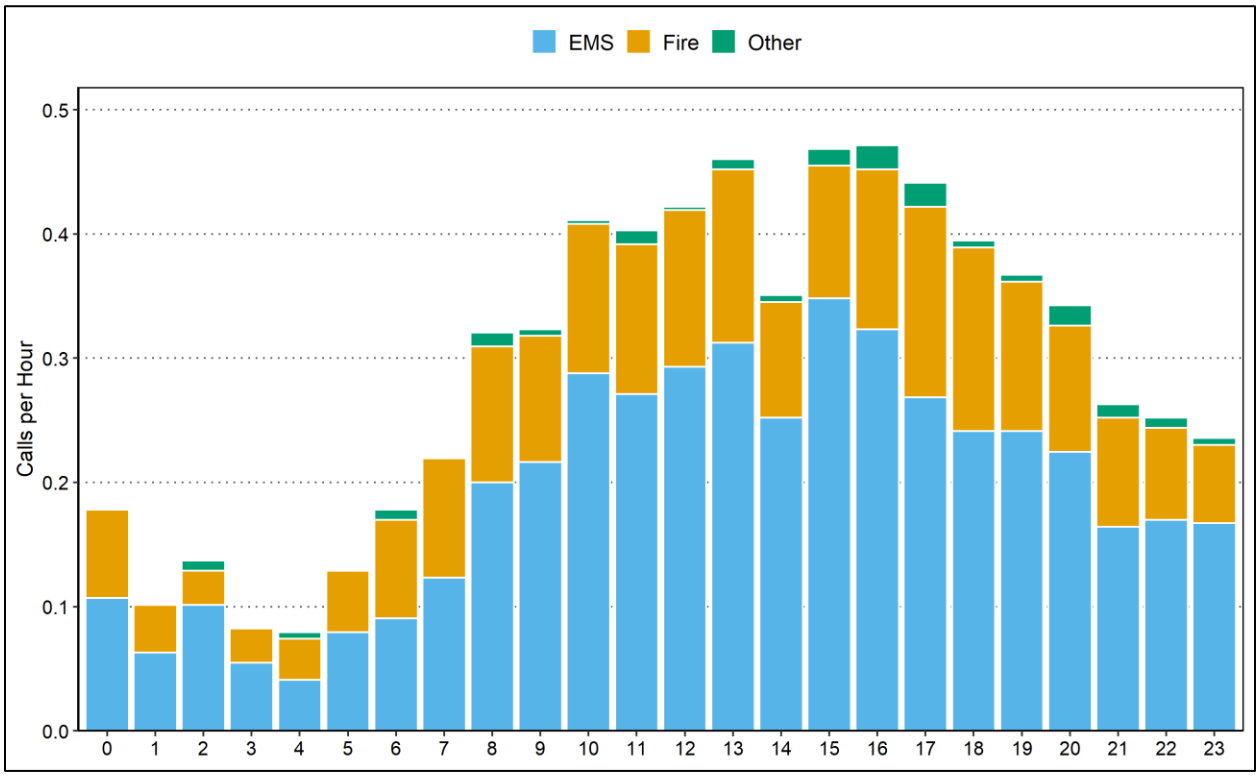


FIGURE 7-4: Calls by Hour of Day



Observations:

Average Calls per Month

- Average EMS calls per day ranged from 4.0 in December 2018 to 6.2 in April 2019.
- Average fire calls per day ranged from 1.9 in August 2019 to 2.8 in February 2019.
- Average other calls per day ranged from 0.1 in November 2019 to 0.4 in September 2019.
- Average calls per day overall ranged from 6.1 in November 2018 to 8.7 in April 2019.
- The high number of calls per day in April 2019 is due to a three-day festival from April 11 through April 13. PFD responded to a total of 68 calls during that time.

Average Calls per Hour

- Average EMS calls per hour ranged from 0.04 between 4:00 a.m. and 5:00 a.m. to 0.35 between 3:00 p.m. and 4:00 p.m.
- Average fire calls per hour ranged from 0.03 between 2:00 a.m. and 4:00 a.m. to 0.15 between 5:00 p.m. and 6:00 p.m.
- Average other calls per hour stayed at or below 0.02 throughout the day.
- Average calls per hour overall ranged from 0.08 between 4:00 a.m. and 5:00 a.m. to 0.47 between 4:00 p.m. and 5:00 p.m.

Units Dispatched to Calls

The following table and two figures detail the number of PFD calls with one, two, three or four or more units dispatched overall and broken down by call type.

TABLE 7-3: Calls by Call Type and Number of Units Dispatched

Call Type	Number of Units				Total Calls
	One	Two	Three	Four or More	
Breathing difficulty	143	9	1	0	153
Cardiac and stroke	26	8	1	0	35
Fall and injury	197	24	5	0	226
Illness and other	742	90	7	3	842
MVA	42	59	54	20	175
Overdose and psychiatric	87	10	1	0	98
Seizure and unconsciousness	133	29	3	0	165
EMS Total	**1,370**	**229**	**72**	**23**	**1,694**
False alarm	143	131	39	6	319
Good intent	12	9	2	1	24
Hazard	41	19	5	0	65
Outside fire	4	9	3	3	19
Public service	315	52	8	3	378
Structure fire	0	0	0	4	4
Fire Total	**515**	**220**	**57**	**17**	**809**
Canceled	8	2	0	0	10
Mutual aid	41	9	1	2	53
Total	**1,934**	**460**	**130**	**42**	**2,566**
Percentage	**75.4**	**17.9**	**5.1**	**1.6**	**100.0**

FIGURE 7-5: Calls by Number of Units Dispatched – EMS

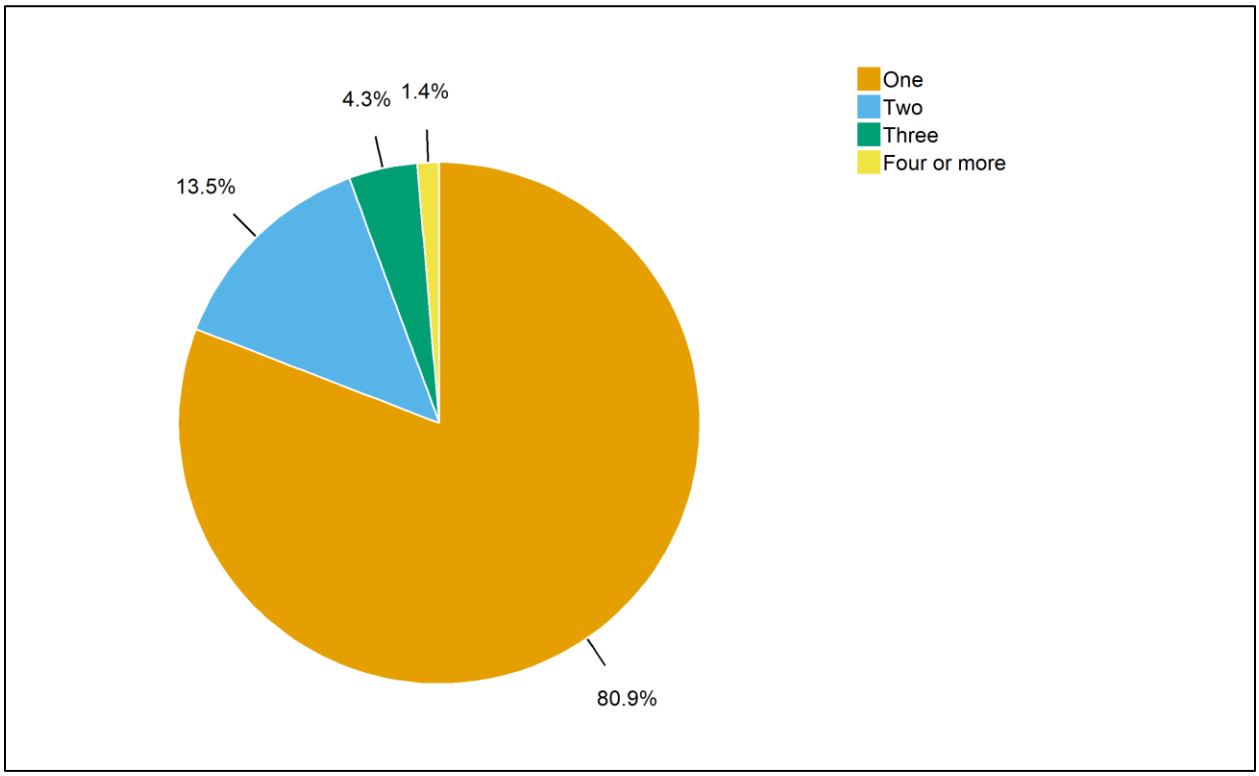
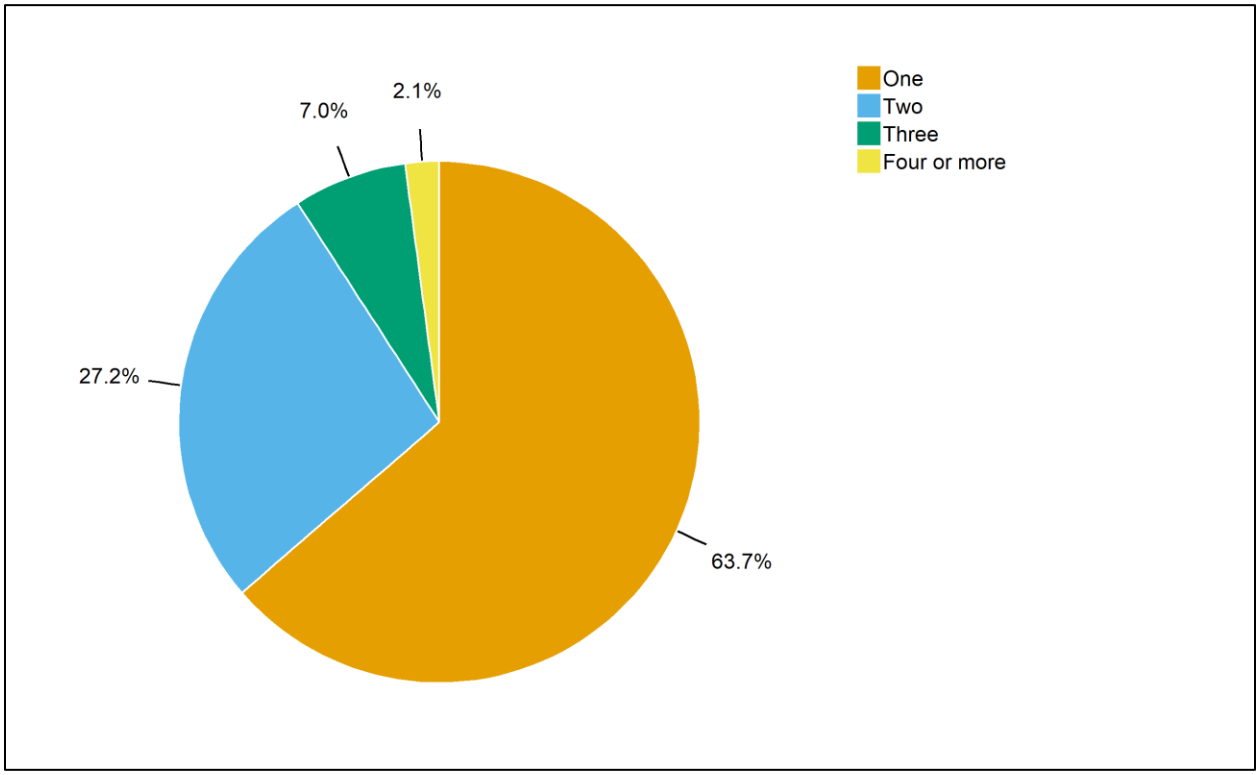


FIGURE 7-6: Calls by Number of Units Dispatched – Fire



Observations:

Overall

- On average, 1.3 units were dispatched to all calls; for 75 percent of calls only one unit was dispatched.
- Overall, four or more units were dispatched to 2 percent of calls.

EMS

- For EMS calls, one unit was dispatched 81 percent of the time, two units were dispatched 14 percent of the time, three units were dispatched 4 percent of the time, and 4 or more units were dispatched 1 percent of the time.
- On average, 1.3 units were dispatched per EMS call.

Fire

- For fire calls, one unit was dispatched 64 percent of the time, two units were dispatched 27 percent of the time, three units were dispatched 7 percent of the time, and four or more units were dispatched 2 percent of the time.
- On average 1.5 units were dispatched per fire call.
- For outside fire calls, three or more units were dispatched 32 percent of the time.
- For structure fire calls, three or more units were dispatched 100 percent of the time.

WORKLOAD: RUNS AND TOTAL TIME SPENT

The workload of each unit is measured in two ways: runs and deployed time. The deployed time of a run is measured from the time a unit is dispatched through the time the unit is cleared. Because multiple units respond to some calls, there are more runs than calls and the average deployed time per run varies from the total duration of calls.

Runs and Deployed Time – All Units

Deployed time, also referred to as deployed hours, is the total deployment time of all units deployed on all runs. The following table shows the total deployed time, both overall and broken down by type of run, for PFD units during the year studied.

TABLE 7-4: Annual Runs and Deployed Time by Run Type

Call Type	Avg. Deployed Min. per Run	Total Annual Hours	Percent of Total Hours	Avg. Deployed Min. per Day	Total Annual Runs	Avg. Runs per Day
Breathing difficulty	50.9	139.3	5.6	22.9	164	0.4
Cardiac and stroke	56.9	42.7	1.7	7.0	45	0.1
Fall and injury	55.2	239.1	9.6	39.3	260	0.7
Illness and other	48.3	768.3	30.9	126.3	955	2.6
MVA	62.7	425.6	17.1	70.0	407	1.1
Overdose and psychiatric	61.0	111.9	4.5	18.4	110	0.3
Seizure and unconsciousness	51.8	172.6	6.9	28.4	200	0.5
EMS Total	**53.2**	**1,899.5**	**76.3**	**312.2**	**2,141**	**5.9**
False alarm	19.1	174.3	7.0	28.7	547	1.5
Good intent	20.8	13.9	0.6	2.3	40	0.1
Hazard	39.5	61.9	2.5	10.2	94	0.3
Outside fire	41.7	29.9	1.2	4.9	43	0.1
Public service	25.2	190.9	7.7	31.4	455	1.2
Structure fire	114.8	36.4	1.5	6.0	19	0.1
Fire Total	**25.4**	**507.2**	**20.4**	**83.4**	**1,198**	**3.3**
Canceled	27.4	5.5	0.2	0.9	12	0.0
Mutual aid	66.8	77.9	3.1	12.8	70	0.2
Other Total	**61.0**	**83.4**	**3.3**	**13.7**	**82**	**0.2**
Total	**43.7**	**2,490.1**	**100.0**	**409.3**	**3,421**	**9.4**

Observations:

Overall

- The total deployed time for the year was 2,490.1 hours. The daily average was 6.8 hours for all units combined.
- There were 3,421 runs, including 12 runs dispatched for canceled call and 70 runs dispatched for mutual aid calls. The daily average was 9.4 runs.

EMS

- EMS runs accounted for 76 percent of the total workload.
- The average deployed time for EMS runs was 53.2 minutes. The deployed time for all EMS runs averaged 5.2 hours per day.

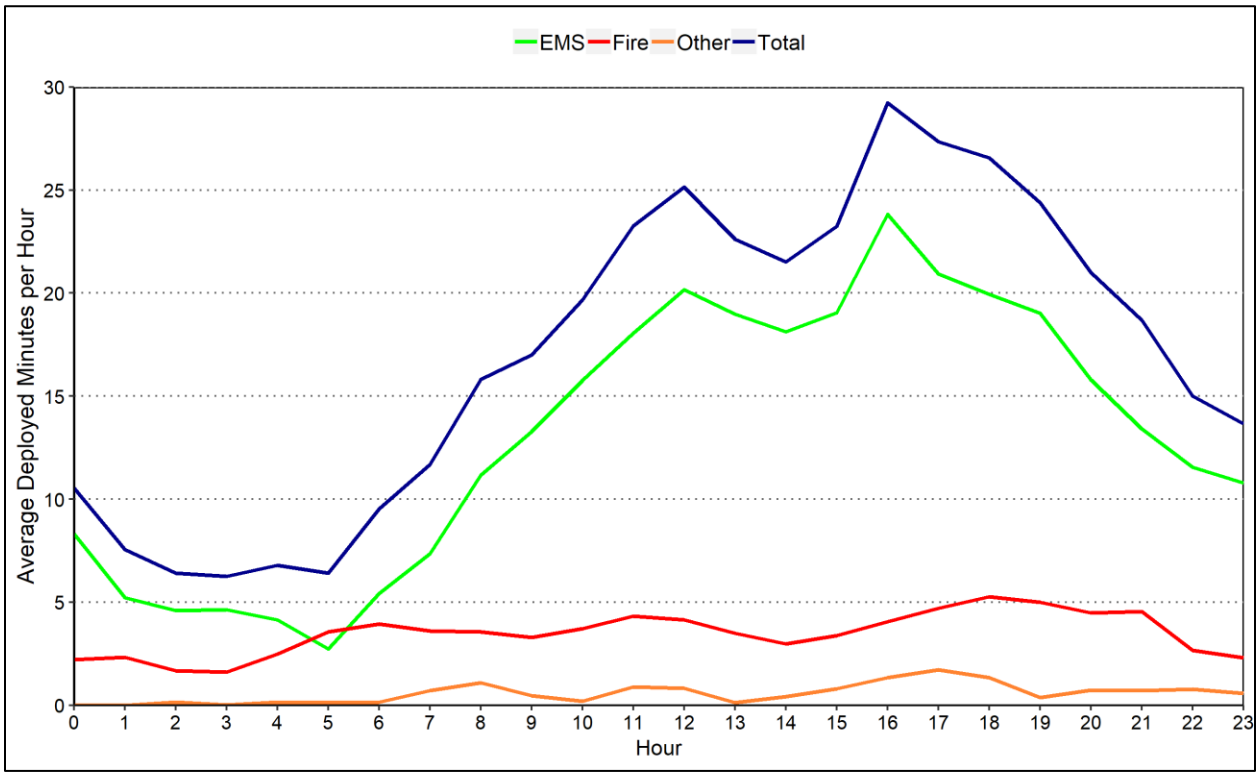
Fire

- Fire runs accounted for 20 percent of the total workload.
- The average deployed time for fire runs was 25.4 minutes. The deployed time for all fire runs averaged 1.4 hours per day.
- There were 62 runs for structure and outside fire calls combined, with a total workload of 66.3 hours. This accounted for 3 percent of the total workload.
- The average deployed time for outside fire runs was 41.7 minutes per run, and the average deployed time for structure fire runs was 114.8 minutes per run.

TABLE 7-5: Average Deployed Minutes by Hour of Day

Hour	EMS	Fire	Other	Total
0	8.3	2.2	0.0	10.5
1	5.2	2.3	0.0	7.6
2	4.6	1.7	0.2	6.4
3	4.6	1.6	0.0	6.3
4	4.2	2.5	0.2	6.8
5	2.7	3.6	0.1	6.4
6	5.4	3.9	0.1	9.5
7	7.4	3.6	0.7	11.7
8	11.2	3.6	1.1	15.8
9	13.3	3.3	0.5	17.0
10	15.8	3.7	0.2	19.7
11	18.0	4.3	0.9	23.3
12	20.2	4.1	0.8	25.1
13	19.0	3.5	0.1	22.6
14	18.1	3.0	0.4	21.5
15	19.0	3.4	0.8	23.2
16	23.8	4.1	1.3	29.2
17	20.9	4.7	1.7	27.3
18	19.9	5.3	1.4	26.6
19	19.0	5.0	0.4	24.4
20	15.8	4.5	0.7	21.0
21	13.4	4.5	0.7	18.7
22	11.5	2.7	0.8	15.0
23	10.8	2.3	0.6	13.7
Total	**312.2**	**83.4**	**13.7**	**409.3**

FIGURE 7-7: Average Deployed Minutes by Hour of Day



Observations:

- Hourly deployed time was highest during the day from 11:00 a.m. to 9:00 p.m., averaging between 21 and 29 minutes.
- Average deployed time peaked between 4:00 p.m. and 5:00 p.m., averaging 29 minutes.
- Average deployed time was lowest between 3:00 a.m. and 4:00 a.m., averaging 6 minutes.

Workload by Unit

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

TABLE 7-6: Call Workload by Unit

Station	Unit ID	Unit Type	Avg. Deployed Min. per Run	Total Annual Hours	Avg. Deployed Min. per Day	Total Annual Runs	Avg. Runs per Day
None	EMS*	EMS	38.9	1.3	0.2	2	0.9
	PFD*	Fire department	19.5	4.9	0.8	15	0.0
	Total		**21.8**	**6.2**	**1.0**	**17**	**0.0**
1	B1	Shift supervisor vehicle	41.1	264.6	43.5	386	1.1
	E1	Engine	31.0	195.0	32.1	378	1.0
	EMS1	Ambulance	46.7	857.1	140.9	1,101	3.0
	EMS4	Ambulance	50.9	42.4	7.0	50	0.1
	EMS5	EMS cart	34.9	9.9	1.6	17	0.0
	FC1	Fire cart	31.5	3.1	0.5	6	0.0
	FC2	Fire cart	15.5	1.6	0.3	6	0.0
	R1	Rescue	51.8	203.8	33.5	236	0.6
	STA1*	Station	20.0	10.7	1.8	32	0.1
	T1	Tower	22.8	11.0	1.8	29	0.1
	Total		**42.8**	**1,599.2**	**262.9**	**2,241**	**6.1**
2	E2	Engine	30.9	28.3	4.6	55	0.2
	EMS2	Ambulance	46.7	323.2	53.1	415	1.1
	STA2*	Station	4.6	0.3	0.1	4	0.0
	T2	Tower	19.5	3.3	0.5	10	0.0
	Total		**44.0**	**355.0**	**58.4**	**484**	**1.3**
3	E3	Engine	30.3	32.8	5.4	65	0.2
	EMS3	Ambulance	49.7	484.9	79.7	585	1.6
	EMS6	EMS cart	27.8	8.8	1.4	19	0.1
	STA3*	Station	18.8	3.1	0.5	10	0.0
	Total		**46.8**	**529.7**	**87.1**	**679**	**1.9**
Total			**43.7**	**2,490.1**	**409.3**	**3,421**	**9.4**

Note for Tables 7-6 through 7-8: For some calls, no unit-level information was recorded. Instead, only the station, agency or general unit type involved in these calls was documented. Most such calls are nonemergency service calls or car seat installation calls, which are further examined in Attachment II. The remaining such calls are analyzed in this section. Non-specific units are identified with asterisks.

TABLE 7-7: Total Annual Runs by Run Type and Unit

Station	Unit ID	Unit Type	EMS	False Alarm	Good Intent	Hazard	Outside Fire	Public Service	Structure Fire	Canceled	Mutual Aid	Total
None	EMS	EMS	2	0	0	0	0	0	0	0	0	2
	PFD	Fire department	0	1	0	1	0	13	0	0	0	15
	Total		**2**	**1**	**0**	**1**	**0**	**13**	**0**	**0**	**0**	**17**
1	B1	Shift supervisor vehicle	118	116	16	27	11	90	3	1	4	386
	E1	Engine	84	190	9	30	7	51	4	1	2	378
	EMS1	Ambulance	924	36	2	6	4	114	1	3	11	1,101
	EMS4	Ambulance	35	2	0	0	0	10	0	0	3	50
	EMS5	EMS cart	15	0	0	0	0	2	0	0	0	17
	FC1	Fire cart	2	0	0	1	0	3	0	0	0	6
	FC2	Fire cart	4	0	0	0	0	2	0	0	0	6
	R1	Rescue	135	42	2	14	4	30	2	1	6	236
	STA1	Station	9	4	0	0	1	14	0	3	1	32
	T1	Tower	0	26	1	0	0	2	0	0	0	29
	Total		**1,326**	**416**	**30**	**78**	**27**	**318**	**10**	**9**	**27**	**2,241**
2	E2	Engine	9	26	4	4	2	8	1	0	1	55
	EMS2	Ambulance	323	31	1	2	4	40	1	1	12	415
	STA2	Station	3	0	0	0	0	0	0	1	0	4
	T2	Tower	0	9	0	0	0	0	1	0	0	10
	Total		**335**	**66**	**5**	**6**	**6**	**48**	**3**	**2**	**13**	**484**
3	E3	Engine	3	38	3	3	7	7	3	0	1	65
	EMS3	Ambulance	453	24	2	6	3	64	3	1	29	585
	EMS6	EMS cart	17	0	0	0	0	2	0	0	0	19
	STA3	Station	5	2	0	0	0	3	0	0	0	10
	Total		**478**	**64**	**5**	**9**	**10**	**76**	**6**	**1**	**30**	**679**
Total			**2,141**	**547**	**40**	**94**	**43**	**455**	**19**	**12**	**70**	**3,421**

TABLE 7-8: Daily Average Deployed Minutes by Run Type and Unit

Station	Unit ID	Unit Type	EMS	False Alarm	Good Intent	Hazard	Outside Fire	Public Service	Structure Fire	Canceled	Mutual Aid	Total
None	EMS	EMS	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.2
	PFD	Fire department	0.0	0.0	0.0	0.5	0.0	0.3	0.0	0.0	0.0	0.8
	Total		**0.2**	**0.0**	**0.0**	**0.5**	**0.0**	**0.3**	**0.0**	**0.0**	**0.0**	**1.0**
1	B1	Shift supervisor vehicle	23.0	5.6	0.8	2.5	1.6	7.9	0.9	0.2	1.0	43.5
	E1	Engine	10.6	9.5	0.6	3.6	0.5	5.4	1.3	0.2	0.4	32.1
	EMS1	Ambulance	129.3	1.8	0.2	0.6	0.3	6.6	0.4	0.0	1.8	140.9
	EMS4	Ambulance	4.9	0.1	0.0	0.0	0.0	0.7	0.0	0.0	1.3	7.0
	EMS5	EMS cart	1.6	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0	1.6
	FC1	Fire cart	0.0	0.0	0.0	0.3	0.0	0.2	0.0	0.0	0.0	0.5
	FC2	Fire cart	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.3
	R1	Rescue	23.4	3.3	0.1	1.2	0.5	3.2	0.5	0.2	1.1	33.5
	STA1	Station	0.2	0.0	0.0	0.0	0.8	0.6	0.0	0.1	0.2	1.8
	T1	Tower	0.0	1.6	0.1	0.0	0.0	0.1	0.0	0.0	0.0	1.8
	Total		**193.2**	**22.0**	**1.8**	**8.1**	**3.6**	**24.8**	**3.1**	**0.6**	**5.7**	**262.9**
2	E2	Engine	1.6	1.1	0.1	0.4	0.1	0.5	0.6	0.0	0.3	4.6
	EMS2	Ambulance	46.4	1.3	0.1	0.3	0.4	1.9	0.4	0.1	2.3	53.1
	STA2	Station	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1
	T2	Tower	0.0	0.4	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.5
	Total		**48.1**	**2.8**	**0.3**	**0.7**	**0.5**	**2.3**	**1.1**	**0.1**	**2.6**	**58.4**
3	E3	Engine	0.4	2.0	0.1	0.3	0.6	0.7	1.1	0.0	0.2	5.4
	EMS3	Ambulance	68.5	1.8	0.1	0.6	0.3	3.2	0.7	0.2	4.3	79.7
	EMS6	EMS cart	1.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.4
	STA3	Station	0.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.5
	Total		**70.7**	**3.8**	**0.2**	**0.9**	**0.9**	**3.9**	**1.8**	**0.2**	**4.5**	**87.1**
Total			**312.2**	**28.7**	**2.3**	**10.2**	**4.9**	**31.4**	**6.0**	**0.9**	**12.8**	**409.3**

Observations:

- On a station level, Station 1 made the most runs (2,241, or an average of 6.1 runs per day) and had the highest total annual deployed time (1,599.2 hours, or an average of 4.4 hours per day).
  - EMS calls accounted for 59 percent of runs and 74 percent of total deployed time.
  - Structure and outside fire calls accounted for 2 percent of runs and 3 percent of total deployed time.
- On a station level, Station 3 made the second-most runs (679, or an average of 1.9 runs per day), and had the second-highest total annual deployed time (529.7 hours, or an average of 1.5 hours per day).
  - EMS calls accounted for 70 percent of runs and 81 percent of total deployed time.
  - Structure and outside fire calls accounted for 2 percent of runs and 3 percent of total deployed time.
- On an overall unit level, EMS1 made the most runs (1,101, or an average of 3.0 runs per day) and had the highest total annual deployed time (857.1 hours, or an average of 2.3 hours per day).
  - EMS calls accounted for 84 percent of runs and 92 percent of total deployed time.
- On an overall unit level, EMS3 made the second-most runs (585, or an average of 1.6 runs per day) and had the second-highest total annual deployed time (484.9 hours, or an average of 1.3 hours per day).
  - EMS calls accounted for 77 percent of runs and 86 percent of total deployed time.
- Of the engines, E1 made the most runs (378, or an average of 1.0 per day) and had the highest total annual deployed time (195.0 hours, or an average of 0.5 hours per day).
  - EMS calls accounted for 22 percent of runs and 33 percent of total deployed time.
  - Structure and outside fire calls accounted for 3 percent of runs and 6 percent of total 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 7-9 shows the number of hours in the year in which there were zero to four or more calls during the hour. Table 7-10 examines the number of times a call within a station's first due area overlapped with another call within the same area. Table 7-11 examines the availability of a unit at a station to respond to calls within its first due area. Table 7-12 shows the 10 one-hour intervals which had the most calls during the year.

TABLE 7-9: Frequency Distribution of the Number of Calls

Calls in an Hour	Frequency	Percentage
0	6,635	75.7
1	1,761	20.1
2	306	3.5
3+	58	0.7
Total	**8,760**	**100.0**

TABLE 7-10: Frequency of Overlapping Calls

Station	Scenario	Number of Calls	Percent of All Calls	Total Hours
1	No overlapped call	1,386	88.2	909.4
	Overlapped with one call	157	10.0	55.9
	Overlapped with two calls	25	1.6	2.8
	Overlapped with three calls	3	0.2	1.2
	Overlapped with four calls	1	0.1	0.0
2	No overlapped call	365	95.3	286.3
	Overlapped with one call	18	4.7	7.3
3	No overlapped call	510	92.6	423.2
	Overlapped with one call	40	7.3	17.6
	Overlapped with two calls	1	0.2	0.4

TABLE 7-11: Station Availability to Respond to Calls

Station	Calls in Area	First Due Responded	First Due Arrived	First Due First	Percent Responded	Percent Arrived	Percent First
1	1,477	1,301	1,294	1,265	88.1	87.6	85.6
2	367	218	214	192	59.4	58.3	52.3
3	524	397	384	353	75.8	73.3	67.4
Total	**2,368**	**1,916**	**1,892**	**1,810**	**80.9**	**79.9**	**76.4**

Note: For each station, we count the number of calls occurring within its first due area. Then, we count the number of calls to where at least one PFD unit arrived. Next, we focus on units from the first due station to see if any units responded, arrived, or arrived first.

TABLE 7-12: Top 10 Hours with the Most Calls Received

Hour	Number of Calls	Number of Runs	Total Deployed Hours
4/11/2019, 4:00 p.m. to 5:00 p.m.	7	10	1.9
4/12/2019, 5:00 p.m. to 6:00 p.m.	7	8	8.9
2/24/2019, 7:00 a.m. to 8:00 a.m.	6	8	4.4
4/11/2019, 2:00 p.m. to 3:00 p.m.	5	8	1.5
8/7/2019, 10:00 a.m. to 11:00 a.m.	4	9	1.0
8/5/2019, 2:00 p.m. to 3:00 p.m.	4	5	3.1
4/13/2019, 4:00 p.m. to 5:00 p.m.	4	5	2.8
10/4/2019, 5:00 p.m. to 6:00 p.m.	4	5	1.7
4/24/2019, 3:00 p.m. to 4:00 p.m.	4	4	6.5
7/18/2019, 1:00 p.m. to 2:00 p.m.	4	4	1.1

Note: Total deployed hours is a measure of the total time spent responding to calls received in the hour, and which may extend into the next hour or hours. The number of runs and deployed hours only includes PFD units.

Observations:

- For 58 hours, (0.7 percent of all hours), three or more calls occurred; in other words, the department responded to three or more calls in an hour roughly once every 6 days.
  - The highest number of calls to occur in an hour was 7, which happened twice.
- Four of the top ten hours with the most calls occurred between April 11, 2019, and April 13, 2019, when Pikeville hosted the 2019 Hillbilly Days festival.
- One of the two hours with the most calls were 4:00 p.m. to 5:00 p.m. on April 11, 2019.
  - The hour's 7 calls involved 10 individual dispatches resulting in 1.9 hours of deployed time. These 7 calls included five illness and other calls, one fall and injury call, and one public service call.
- The other hour with the most calls was 5:00 p.m. to 6:00 p.m. on April 12, 2019.
  - The hour's 7 calls involved 8 individual dispatches resulting in 8.9 hours of deployed time. These 7 calls included 3 hazard calls, two illness and other calls, and two public service calls.

Response Time

In this part of the analysis we present response time statistics for different call types. We separate response time into its identifiable components. *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 to a call's location. *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 analysis, we included all 2,566 calls to which at least one non-administrative PFD unit responded, while excluding canceled and mutual aid calls. In addition, non-emergency calls and calls with a total response time of more than 30 minutes were excluded. Finally, we focused on units that had complete time stamps, that is, units with all components recorded, so that we could calculate each segment of response time.

Based on the methodology above, we excluded 63 canceled and mutual aid calls, 135 calls where no units recorded a valid on-scene time, 62 calls where the first arriving unit response was greater than 30 minutes, 443 nonemergency calls, and 194 calls where one or more segments of first arriving unit's response time could not be calculated due to missing data. As a result, in this section, a total of 1,669 calls are included in the analysis.

Response Time by Type of Call

Table 7-13 provides average dispatch, turnout, travel, and total response time for the first arriving unit to each call in the city, broken out by call type. Figures 7-8 and 7-9 illustrate the same information. Table 7-14 gives the 90th percentile time broken out in the same manner. A 90th percentile time means that 90 percent of calls had response times at or below that number. For example, Table 7-14 shows a 90th percentile response time of 8.9 minutes which means that 90 percent of the time a call had a response time of no more than 8.9 minutes.

TABLE 7-13: Average Response Time in Minutes of First Arriving Unit, by Call Type

Call Type	Dispatch	Turnout	Travel	Total	Number of Calls
Breathing difficulty	1.4	1.1	2.6	5.1	137
Cardiac and stroke	1.0	1.6	3.1	5.7	32
Fall and injury	1.6	1.1	3.1	5.7	178
Illness and other	1.6	1.1	2.9	5.7	649
MVA	1.7	1.1	3.0	5.8	91
Overdose and psychiatric	3.1	1.1	2.8	7.0	60
Seizure and unconsciousness	1.6	1.1	3.3	6.0	142
EMS Total	**1.6**	**1.1**	**3.0**	**5.7**	**1,289**
False alarm	1.6	1.3	2.3	5.2	266
Good intent	1.4	1.8	3.3	6.5	15
Hazard	1.0	2.1	5.5	8.6	15
Outside fire	1.4	0.9	3.0	5.2	15
Public service	1.6	1.0	3.4	6.0	67
Structure fire	0.9	1.8	3.6	6.3	2
Fire Total	**1.6**	**1.3**	**2.7**	**5.6**	**380**
Total	**1.6**	**1.2**	**2.9**	**5.7**	**1,669**

FIGURE 7-8: Average Response Time of First Arriving Unit, by Call Type – EMS

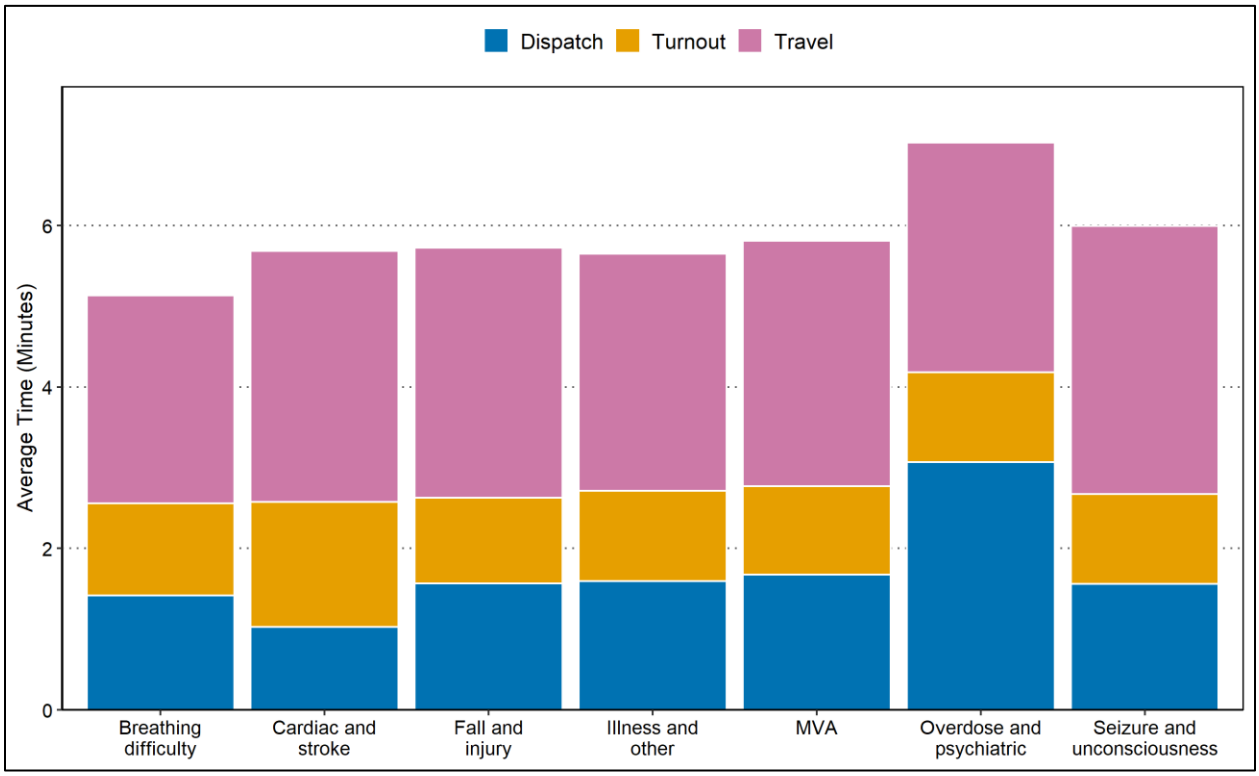


FIGURE 7-9: Average Response Time of First Arriving Unit, by Call Type – Fire

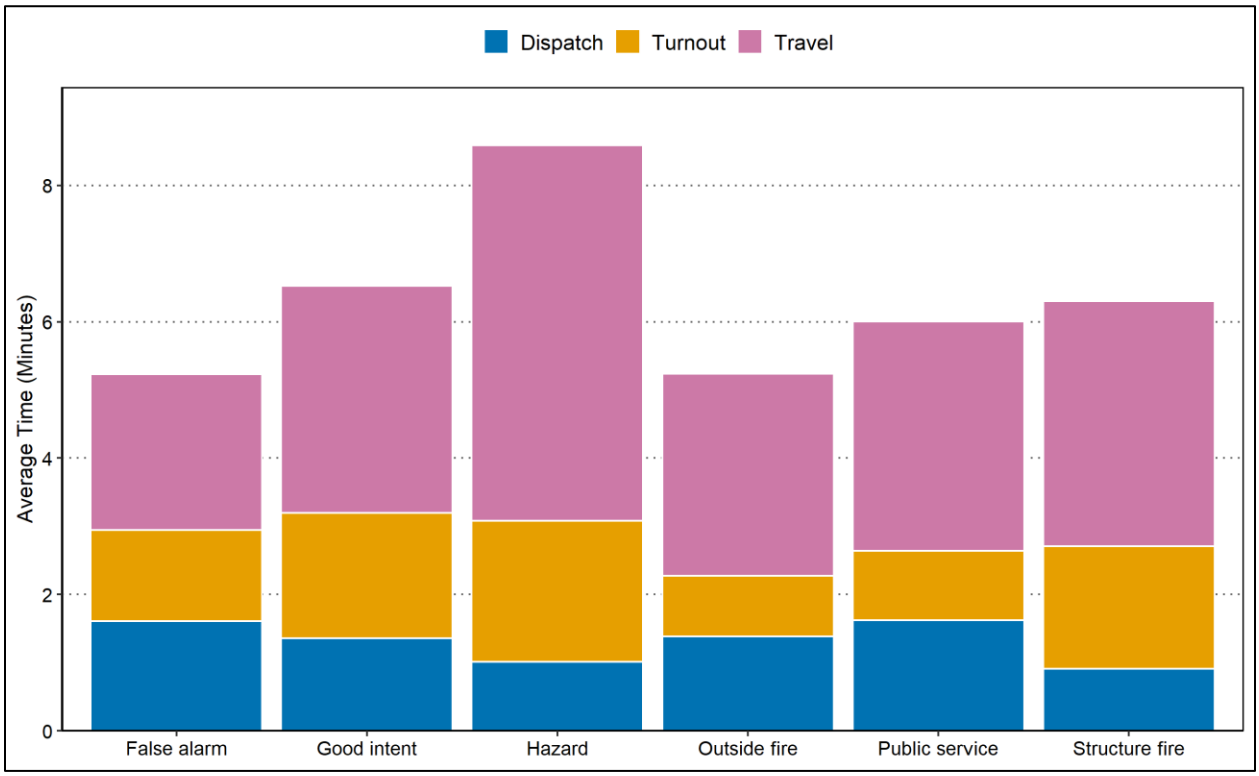


TABLE 7-14: 90th Percentile Response Time in Minutes of First Arriving Unit, by Call Type

Call Type	Dispatch	Turnout	Travel	Total	Number of Calls
Breathing difficulty	3.4	3.8	4.6	8.0	137
Cardiac and stroke	2.3	4.0	6.1	8.2	32
Fall and injury	3.3	3.7	5.3	9.1	178
Illness and other	3.7	3.4	5.4	8.9	649
MVA	3.2	2.7	5.0	10.6	91
Overdose and psychiatric	5.9	3.5	4.1	10.6	60
Seizure and unconsciousness	3.3	3.2	5.6	8.7	142
EMS Total	**3.6**	**3.5**	**5.3**	**8.9**	**1,289**
False alarm	4.1	4.2	4.9	8.5	266
Good intent	4.0	5.5	5.3	9.8	15
Hazard	3.8	4.1	8.6	12.7	15
Outside fire	3.9	3.1	7.3	10.1	15
Public service	4.9	2.6	6.5	9.4	67
Structure fire	1.5	2.1	4.3	7.9	2
Fire Total	**4.0**	**4.1**	**5.5**	**8.9**	**380**
Total	**3.7**	**3.7**	**5.3**	**8.9**	**1,669**

Observations:

- The average dispatch time was 1.6 minutes.
- The average turnout was 1.2 minutes.
- The average travel time was 2.9 minutes.
- The average total response time was 5.7 minutes.
- The average response time was 5.7 minutes for EMS calls and 5.6 minutes for fire calls.
- The average response time was 5.2 minutes for outside fires and 6.3 minutes for structure fires.
- The 90th percentile dispatch time was 3.7 minutes.
- The 90th percentile turnout time was 3.7 minutes.
- The 90th percentile travel time was 5.3 minutes.
- The 90th percentile total response time was 8.9 minutes.
- The 90th percentile response time was 8.9 minutes for EMS calls and 8.9 minutes for fire calls.
- The 90th percentile response time was 10.1 minutes for outside fires and 7.9 minutes for structure fires.

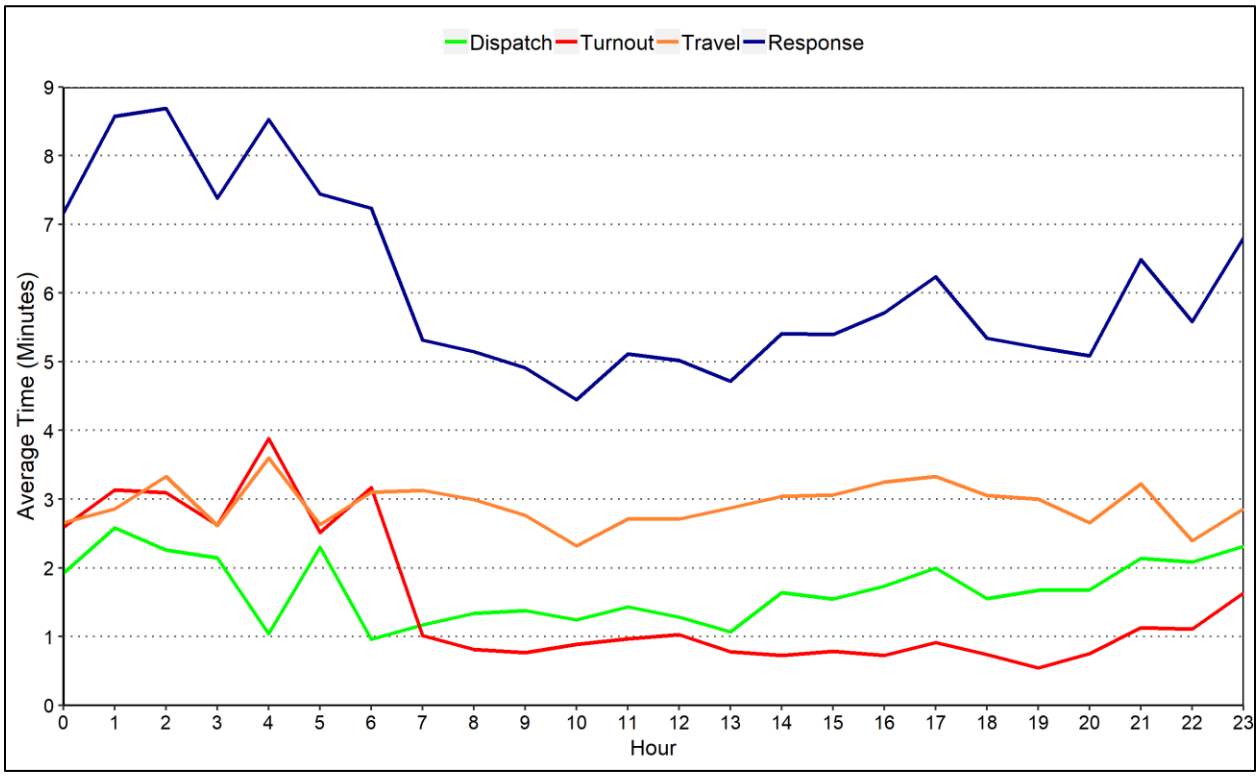
Response Time by Hour

Average dispatch, turnout, travel, and total response time by hour for calls are shown in Table 7-15 and Figure 7-8. The table also shows 90th percentile response times.

TABLE 7-15: Average and 90th Percentile Response Time of First Arriving Unit, by Hour of Day

Hour	Time in Minutes					Number of Calls
	Dispatch	Turnout	Travel	Response Time	90th Percentile Response Time	
0	1.9	2.6	2.7	7.2	9.8	50
1	2.6	3.1	2.9	8.6	12.2	28
2	2.3	3.1	3.3	8.7	12.7	34
3	2.1	2.6	2.6	7.4	9.4	24
4	1.0	3.9	3.6	8.5	11.9	18
5	2.3	2.5	2.6	7.4	10.5	35
6	1.0	3.2	3.1	7.2	10.6	45
7	1.2	1.0	3.1	5.3	8.6	45
8	1.3	0.8	3.0	5.1	8.6	75
9	1.4	0.8	2.8	4.9	8.4	83
10	1.2	0.9	2.3	4.5	6.5	96
11	1.4	1.0	2.7	5.1	8.8	99
12	1.3	1.0	2.7	5.0	7.3	107
13	1.1	0.8	2.9	4.7	7.9	112
14	1.6	0.7	3.0	5.4	8.0	77
15	1.5	0.8	3.1	5.4	8.7	112
16	1.7	0.7	3.2	5.7	8.9	106
17	2.0	0.9	3.3	6.2	9.4	91
18	1.6	0.7	3.1	5.3	8.0	88
19	1.7	0.5	3.0	5.2	8.8	82
20	1.7	0.8	2.7	5.1	7.5	75
21	2.1	1.1	3.2	6.5	11.9	66
22	2.1	1.1	2.4	5.6	8.6	65
23	2.3	1.6	2.9	6.8	10.6	56
Total	**1.6**	**1.2**	**2.9**	**5.7**	**8.9**	**1,669**

FIGURE 7-10: Average Response Time of First Arriving Unit, by Hour of Day



Observations:

- Average dispatch time was between 1.0 minutes (6:00 a.m. to 7:00 a.m.) and 2.6 minutes (1:00 a.m. to 2:00 a.m.).
- Average turnout time was between 0.5 minutes (7:00 p.m. to 8:00 p.m.) and 3.9 minutes (4:00 a.m. to 5:00 a.m.).
- Average travel time was between 2.3 minutes (10:00 a.m. to 11:00 a.m.) and 3.6 minutes (4:00 a.m. to 5:00 a.m.).
- Average response time was between 4.5 minutes (10:00 a.m. to 11:00 a.m.) and 8.7 minutes (2:00 a.m. to 3:00 a.m.).
- The 90th percentile response time was between 6.5 minutes (10:00 a.m. to 11:00 a.m.) and 12.7 minutes (2:00 a.m. to 3:00 a.m.).

Response Time Distribution

Here, we present a more detailed look at how response times to calls are distributed. The cumulative distribution of total response time for the first arriving unit to EMS calls is shown in Figure 7-11 and Table 7-16. Figure 7-11 shows response times for the first arriving PFD unit to EMS calls as a frequency distribution in whole-minute increments, and Figure 7-12 shows the same for the first arriving unit to outside and structure fire calls.

The cumulative percentages here are read in the same way as a percentile. In Figure 7-11, the 90th percentile of 8.9 minutes means that 90 percent of EMS calls had a response time of 8.9 minutes or less. In Table 7-16, the cumulative percentage of 85.2, for example, means that 85.2 percent of EMS calls had a response time under 8 minutes.

FIGURE 7-11: Cumulative Distribution of Response Time – First Arriving Unit – EMS

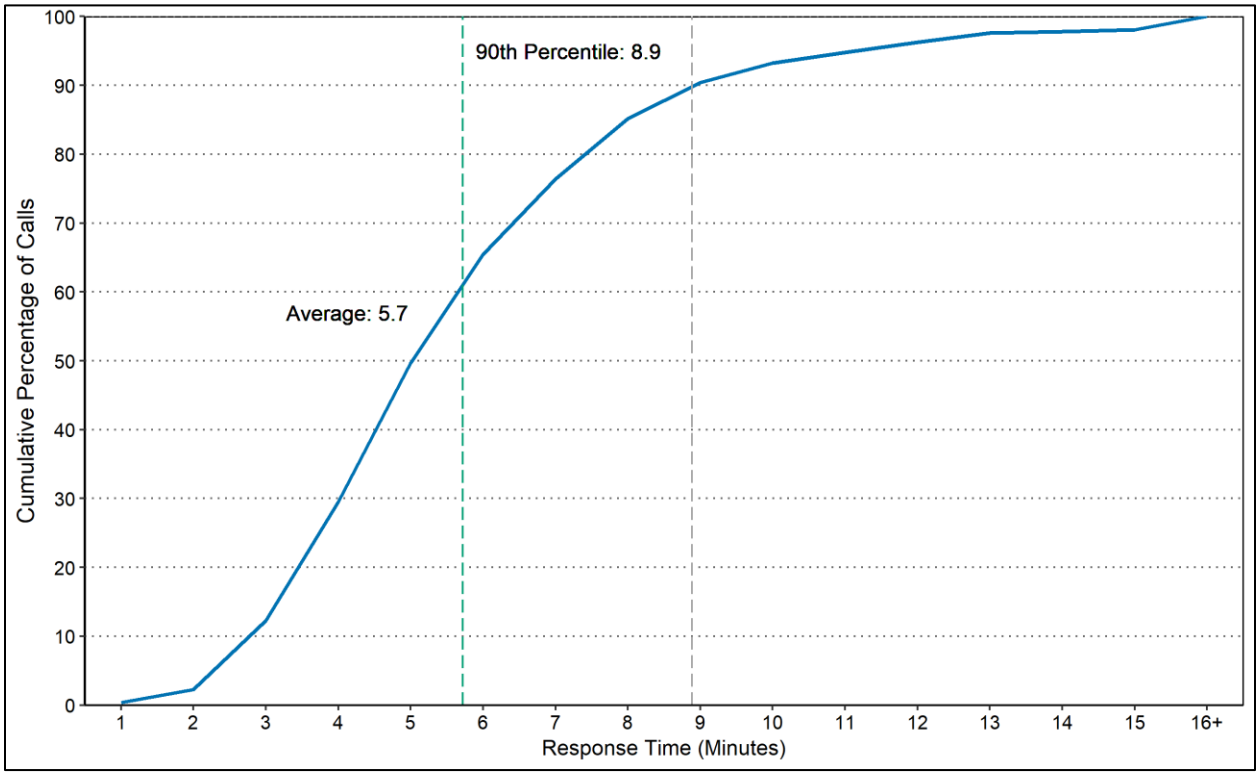


FIGURE 7-12: Cumulative Distribution of Response Time – First Arriving Unit – Outside and Structure Fires

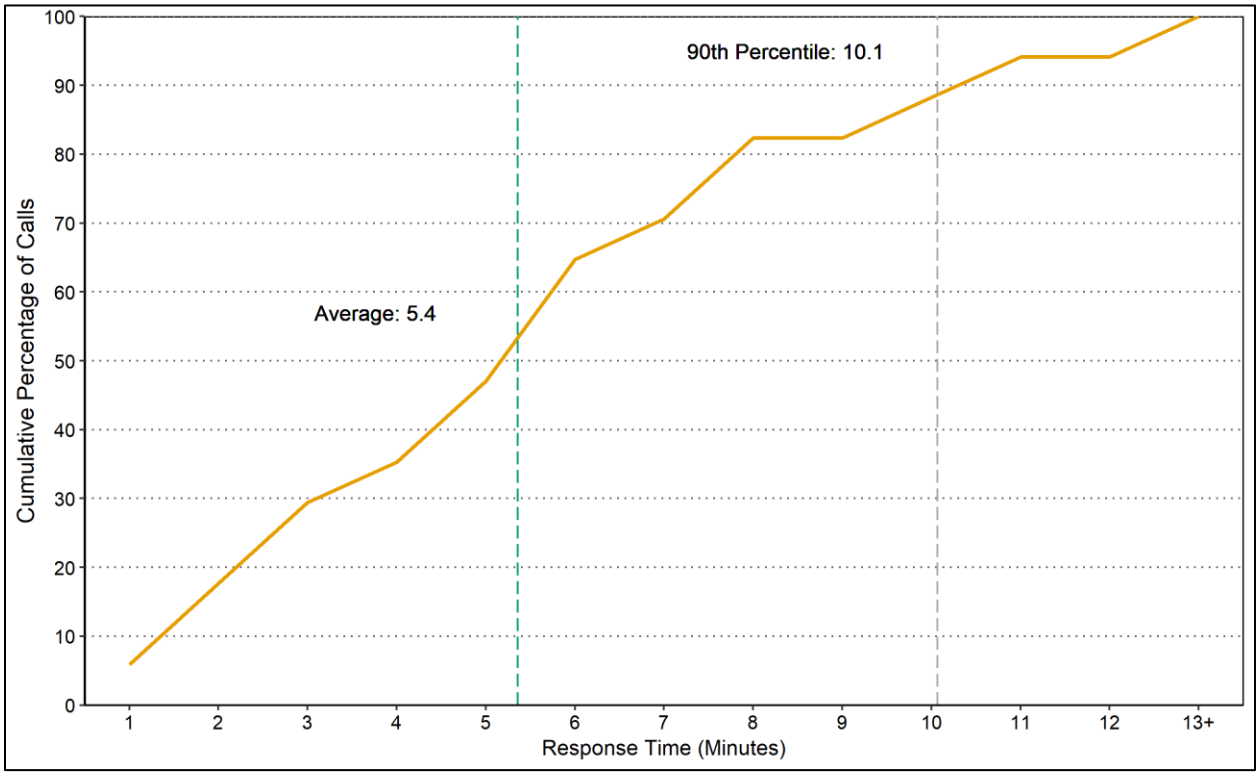


TABLE 7-16: Cumulative Distribution of Response Time – First Arriving Unit – EMS

Response Time (minute)	Frequency	Cumulative Percentage
1	5	0.4
2	24	2.2
3	129	12.3
4	223	29.6
5	259	49.7
6	204	65.5
7	141	76.4
8	113	85.2
9	67	90.4
10	37	93.3
11	20	94.8
12	19	96.3
13	17	97.6
14	3	97.8
15	3	98.1
16+	25	100.0

TABLE 7-17: Cumulative Distribution of Response Time – First Arriving Unit – Outside and Structure Fires

Response Time (minute)	Frequency	Cumulative Percentage
1	1	5.9
2	2	17.6
3	2	29.4
4	1	35.3
5	2	47.1
6	3	64.7
7	1	70.6
8	2	82.4
9	0	82.4
10	1	88.2
11	1	94.1
12	0	94.1
13+	1	100.0

Observations:

- For 85.2 percent of EMS calls, the response time of the first arriving unit was less than 8 minutes.
- For 82.4 percent of outside and structure fire calls, the response time of the first arriving unit was less than 8 minutes.

TRANSPORT CALL ANALYSIS

In this section we present an analysis of PFD unit activity that involved transporting patients, the variations by hour of day, and the average time for each stage of transport service. We identified transport calls by requiring that at least one responding medic or aid unit had recorded either "beginning to transport" time or "arriving at the hospital" time. Based on these criteria, note that 46 non-EMS calls that resulted in transports are included in this analysis.

Transport Calls by Type

Table 7-18 shows the number of calls by call type broken out by transport and non-transport calls.

TABLE 7-18: Transport Calls by Call Type

Call Type	Number of Calls			Conversion Rate
	Non-transport	Transport	Total	
Breathing difficulty	13	140	153	91.5
Cardiac and stroke	6	29	35	82.9
Fall and injury	32	194	226	85.8
Illness and other	167	675	842	80.2
MVA	78	97	175	55.4
Overdose and psychiatric	8	90	98	91.8
Seizure and unconsciousness	30	135	165	81.8
EMS Total	**334**	**1,360**	**1,694**	**80.3**
Fire & Other Total	**826**	**46**	**872**	**5.3**
Total	**1,160**	**1,406**	**2,566**	**54.8**

Observations:

- Overall, 80 percent of EMS calls involved transporting one or more patients.
- On average, there were approximately 4 calls per day that involved transporting one or more patients.

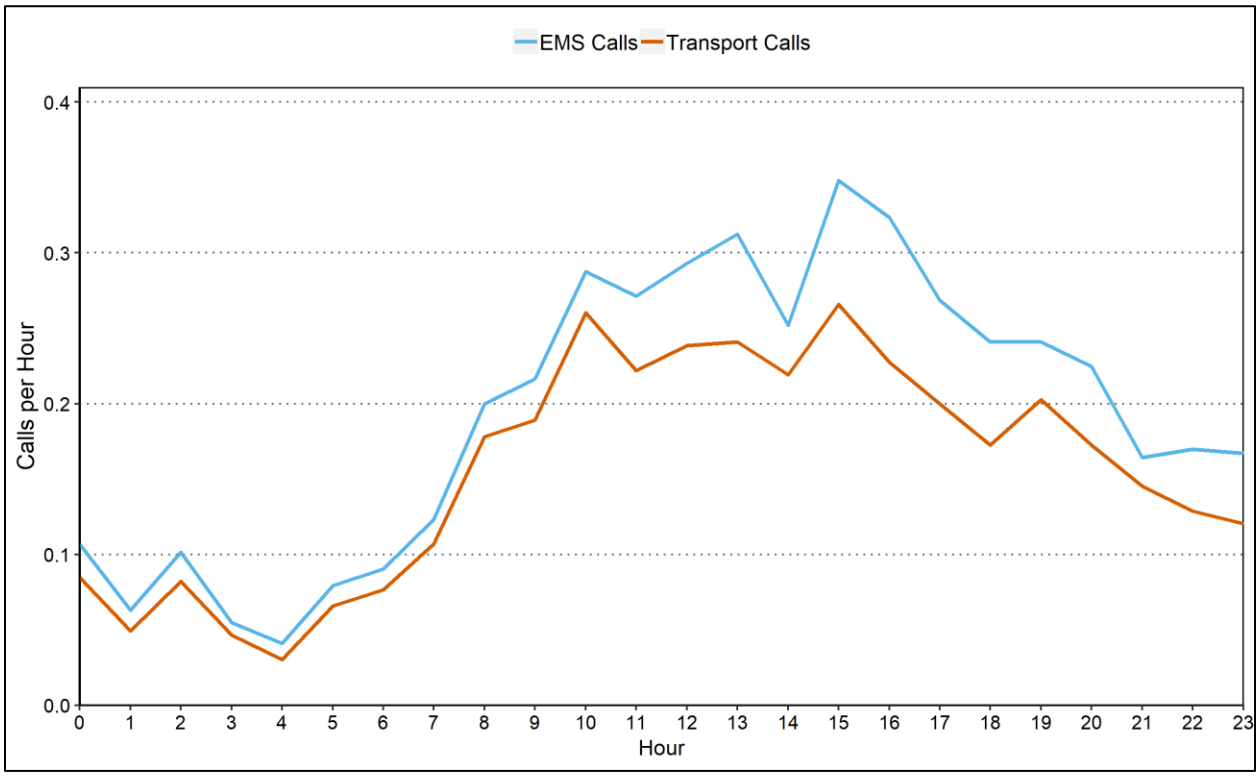
Average Transport Calls per Hour

Table 7-19 and Figure 7-13 show the average number of EMS calls received each hour of the day over the course of the year and the average number of transport calls.

TABLE 7-19: Transport Calls per Day, by Hour

Hour	Number of EMS Calls	Number of Transport Calls	Transport Calls per Day	EMS Calls per Day	Conversion Rate
0	39	31	0.1	0.1	79.5
1	23	18	0.1	0.0	78.3
2	37	30	0.1	0.1	81.1
3	20	17	0.1	0.0	85.0
4	15	11	0.0	0.0	73.3
5	29	24	0.1	0.1	82.8
6	33	28	0.1	0.1	84.8
7	45	39	0.1	0.1	86.7
8	73	65	0.2	0.2	89.0
9	79	69	0.2	0.2	87.3
10	105	95	0.3	0.3	90.5
11	99	81	0.3	0.2	81.8
12	107	87	0.3	0.2	81.3
13	114	88	0.3	0.2	77.2
14	92	80	0.3	0.2	87.0
15	127	97	0.3	0.3	76.4
16	118	83	0.3	0.2	70.3
17	98	73	0.3	0.2	74.5
18	88	63	0.2	0.2	71.6
19	88	74	0.2	0.2	84.1
20	82	63	0.2	0.2	76.8
21	60	53	0.2	0.1	88.3
22	62	47	0.2	0.1	75.8
23	61	44	0.2	0.1	72.1

FIGURE 7-13: Average Transport Calls per Day, by Hour



Observations:

- Average hourly transport calls per day peaked between 3:00 p.m. and 4:00 p.m., averaging 0.3 calls per day.
- Average hourly transport calls per day was lowest between 4:00 a.m. and 5:00 a.m., averaging less than 0.1 calls per day.

Calls by Type and Duration

Table 7-20 shows the average duration of transport and non-transport EMS calls by call type.

TABLE 7-20: Transport Call Duration by Call Type

Call Type	Non-transport		Transport	
	Average Duration	Number of Calls	Average Duration	Number of Calls
Breathing difficulty	28.3	13	51.6	140
Cardiac and stroke	44.9	6	62.5	29
Fall and injury	34.4	32	59.2	194
Illness and other	33.9	167	52.4	675
MVA	45.5	78	74.3	97
Overdose and psychiatric	37.2	8	58.6	90
Seizure and unconsciousness	37.9	30	54.8	135
EMS Total	**37.0**	**334**	**55.7**	**1,360**
Fire & Other Total	**24.4**	**826**	**68.0**	**46**
Total	**28.0**	**1,160**	**56.1**	**1,406**

Note: The duration of a call is defined as the longest deployed time of any of the units responding to the same call.

Observations:

- The average duration of a non-transport EMS call was 37.0 minutes.
- The average duration for an EMS call where one or more patients were transferred to a hospital was 55.7 minutes.

Transport Time Components

Table 7-21 gives the average deployed time for an ambulance on a transport call, along with three major components of the deployed time: on-scene time, travel to hospital time, and at-hospital time.

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

The 1,406 transport calls resulted in 1,447 transports, since more than one transport may occur on a call. Thirty-six runs were excluded from this analysis due to missing arrival times and 35 runs were excluded due to missing hospital travel times, leaving 1,376 runs for analysis.

TABLE 7-21: Time Component Analysis for Ambulance Transport Runs by Call Type

Call Type	Average Time in Minutes Spent per Run				Number of Runs
	On Scene	Traveling to Hospital	At Hospital	Deployed	
Breathing difficulty	12.3	3.2	32.3	51.5	134
Cardiac and stroke	12.4	3.1	29.6	48.8	28
Fall and injury	13.9	4.1	37.4	59.7	191
Illness and other	11.5	4.1	32.6	52.0	644
MVA	13.1	4.0	49.1	71.7	117
Overdose and psychiatric	11.1	3.6	39.0	57.6	87
Seizure and unconsciousness	12.2	4.5	33.2	53.8	134
EMS Total	**12.1**	**4.0**	**35.1**	**55.3**	**1,335**
Fire & Other Total	**14.6**	**10.9**	**37.1**	**71.1**	**41**
Total	**12.2**	**4.2**	**35.2**	**55.7**	**1,376**

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

Observations:

- The average time spent on-scene for a transport call was 12.2 minutes.
- The average travel time from the scene of the call to the hospital was 4.2 minutes.
- The average total deployed time spent on transport calls was 55.7 minutes.
- The average deployed time at the hospital was 35.2 minutes, which accounts for approximately 63 percent of the average total deployed time for a transport call.

ATTACHMENT I: ACTIONS TAKEN ANALYSIS

TABLE 7-22: Actions Taken Analysis for Structure and Outside Fire Calls

Action Taken	Number of Calls	
	Outside Fire	Structure Fire
Assistance, other	1	0
Establish fire lines (wildfire)	2	0
Extinguishment by fire service personnel	12	4
Investigate	10	2
Investigate fire out on arrival	2	0
Salvage & overhaul	6	4
Standby	0	1

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

Observations:

- Out of 20 outside fires, 12 were extinguished by fire service personnel, which accounted for 60 percent of outside fires.
- Out of 4 structure fires, 4 were extinguished by fire service personnel, which accounted for 100 percent of structure fires.

ATTACHMENT II: CAR SEAT INSTALLATION AND NON-EMERGENCY SERVICE CALLS

Over the course of the year studied, PFD performed 121 car seat installations and handled 244 non-emergency service calls. These calls are further examined here.

Figure 7-14 shows the monthly variation in the average daily number of car seat installation and non-emergency service calls handled by PFD during the year studied. Similarly, Figure 7-15 illustrates the average number of calls handled each hour of the day over the course of the year.

FIGURE 7-14: Calls by Month – Car Seat Installation and Non-emergency Service

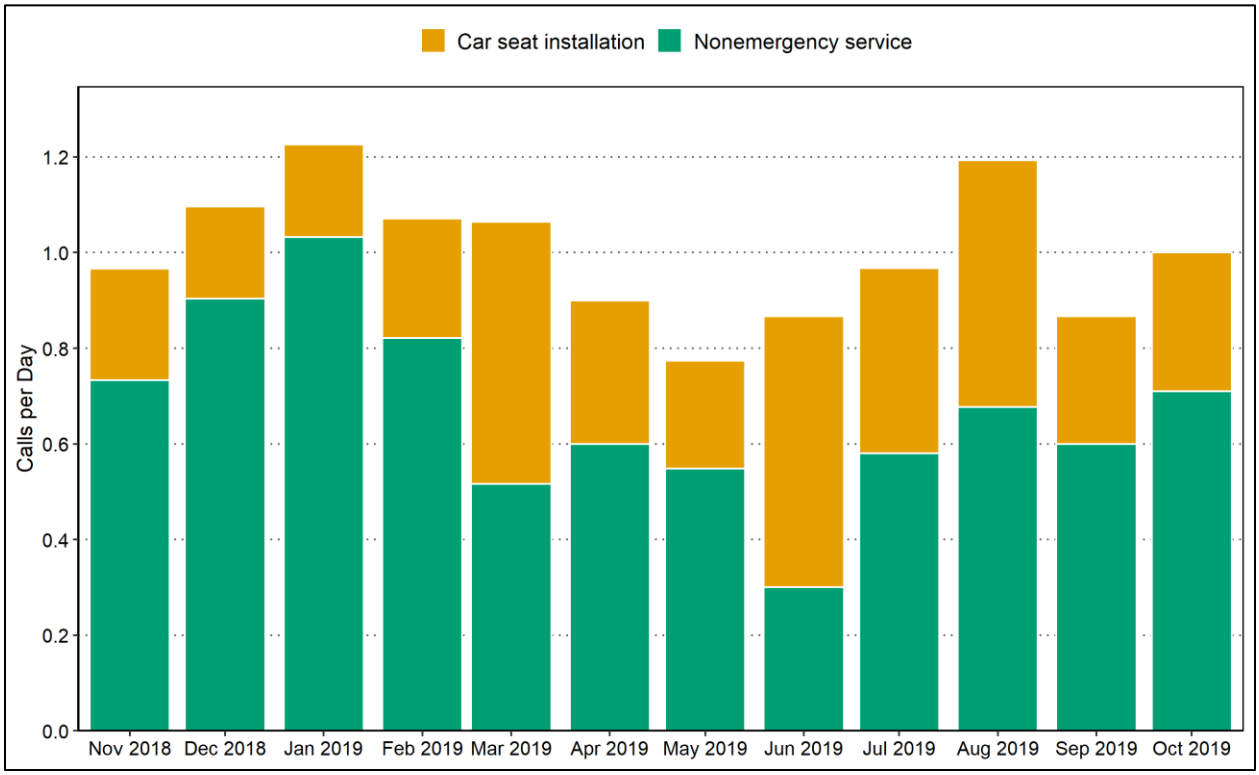
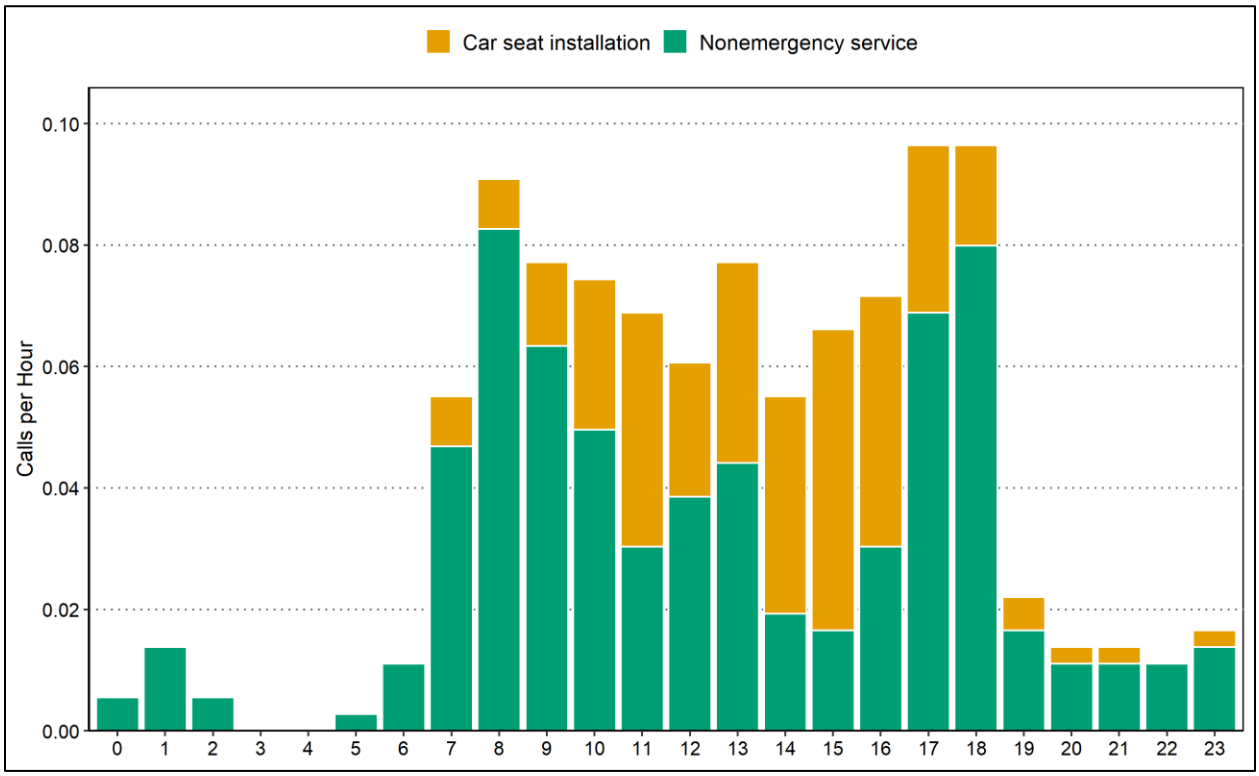


FIGURE 7-15: Calls by Hour – Car Seat Installation and Non-emergency Service



Observations:

Average Calls per Month

- Average car seat installation calls per day ranged from 0.2 in December 2018 and in January 2019 to 0.6 in June 2019.
- Average non-emergency service calls per day ranged from 0.3 in June 2019 to 1.0 in January 2019.
- Average car seat installation and non-emergency service calls combined ranged from 0.8 in May 2019 to 1.2 in January 2019.

Average Calls per Hour

- Average car seat installation calls per hour ranged from none between 10:00 p.m. and 11:00 p.m., and between midnight and 6:00 a.m., to 0.05 between 3:00 p.m. and 4:00 p.m.
- Non-emergency service calls ranged none between 3:00 a.m. and 5:00 a.m. to 0.08 calls per hour between 8:00 a.m. to 9:00 a.m.
- Average car seat installation and non-emergency service calls ranged from none between 3:00 a.m. and 5:00 a.m., to 0.1 between 5:00 p.m. to 7:00 p.m.

Table 7-23 provides a summary of each unit's* (or station level) non-emergency service runs. Table 7-24 shows the number of car seat installations each station performed.

TABLE 7-23: Runs by Unit – Non-emergency Service

Station	Unit ID	Unit Type	Non-emergency Service	Average per Day
None	EMS*	EMS	1	0.0
	PFD*	Fire department	4	0.0
	Total		**5**	**0.0**
1	B1	Shift supervisor vehicle	29	0.1
	C1	Fire chief vehicle	27	0.1
	C2	Fire marshal / senior battalion chief vehicle	6	0.0
	C6	Safety officer / environmental officer	4	0.0
	E1	Engine	13	0.0
	EMS1	Ambulance	42	0.1
	EMS4	Ambulance	10	0.0
	EMS5	EMS cart	9	0.0
	F200	Fire chief	3	0.0
	F201	Housing chief	3	0.0
	F202	Fire marshal / senior battalion chief	3	0.0
	F203	Battalion chief	6	0.0
	F204	Battalion chief	4	0.0
	F205	Battalion chief	2	0.0
	FC1	Fire cart	1	0.0
	R1	Rescue	25	0.1
	STA1*	Station	20	0.1
	T1	Tower	3	0.0
	Total		**210**	**0.6**
2	E2	Engine	9	0.0
	EMS2	Ambulance	33	0.1
	STA2*	Station	1	0.0
	T2	Tower	4	0.0
	Total		**47**	**0.1**
3	C3	Support	11	0.0
	E3	Engine	12	0.0
	EMS3	Ambulance	60	0.2
	EMS6	EMS cart	3	0.0
	STA3*	Station	1	0.0
	Total		**87**	**0.2**
Total			**349**	**1.0**

Note: For some non-emergency service calls, no unit-level information was recorded. Instead, only the station, agency, or unit type involved in these calls was documented.

TABLE 7-24: Car Seat Installations

Station	Car Seat Installation	Average per Day
1	87	0.2
2	3	0.0
3	31	0.1
Total	**121**	**0.3**

Observations:

- On a station level, Station 1 was involved in the most non-emergency service runs (349, or an average of 1.0 runs per day).
- On a unit level, EMS3 was involved in the most non-emergency service runs (60, or an average of 0.2 runs per day).
- Station 1 was involved in the most car seat installations (87, or an average of 0.2 per day).

ATTACHMENT III: ADMINISTRATIVE WORKLOAD

TABLE 7-25: Workload of Administrative Units

Unit ID	Unit Type	Annual Hours	Annual Runs
C1	Fire chief vehicle	204.2	120
C2	Fire marshal / senior battalion chief vehicle	43.4	32
C3	Support	27.8	22
C4	Housing inspector vehicle	2.6	4
C6	Safety officer / environmental officer	23.4	30
F200	Fire chief	22.4	18
F201	Housing chief	32.0	41
F202	Fire marshal / senior battalion chief	11.2	11
F203	Battalion chief	18.7	18
F204	Battalion chief	24.5	43
F205	Battalion chief	26.0	45

ATTACHMENT IV: ADDITIONAL DISPATCH DELAY

When calculating the response times in the response time section, we measured the *dispatch time* as the time between when the call was received by the dispatch center and the time the unit was dispatched. There, we used the CAD system's 'time reported' timestamp—the time when the dispatch center begins speaking with the caller—as the time the call was received, since timestamp was recorded on all calls. Some calls, however, also had an earlier 'time received' timestamp.

In the following table, we look at the difference between the 'time received' and 'time reported' columns for these calls, by call type. This table measures the average and 90th percentile time difference between the earliest timestamp associated with a call and the 'time reported' timestamp.

TABLE 7-26: Additional Dispatch Delay Measures by Call Type

Call Type	Time in Minutes		Number of Calls
	Average	90th Percentile	
Breathing difficulty	1.3	1.8	116
Cardiac and stroke	1.2	1.6	27
Fall and injury	1.3	2.0	145
Illness and other	1.5	2.3	468
MVA	1.6	2.4	51
Overdose and psychiatric	1.5	2.3	33
Seizure and unconsciousness	1.2	1.7	115
EMS Total	**1.4**	**2.1**	**955**
False alarm	1.6	2.8	9
Good intent	1.5	1.9	6
Hazard	2.4	3.8	5
Outside fire	1.5	2.1	12
Public service	1.5	2.4	32
Structure fire	1.1	1.7	2
Fire Total	**1.6**	**2.5**	**66**
Total	**1.4**	**2.2**	**1,021**

- END -