CITYGATE ASSOCIATES, LLC
PUBLIC SAFETY SERVICES

STANDARDS OF COVERAGE ASSESSMENT

VOLUME 1 OF 2: TECHNICAL REPORT

CITY OF MERCED, CA

MARCH 29, 2018

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EXECUTIVE SUMMARY

The City of Merced (City) Fire Department (Department) retained Citygate Associates, LLC (Citygate) to conduct a comprehensive Standards of Coverage (SOC) Assessment to provide a foundation for future fire service planning. The goal of this assessment is to identify both current services as well as desired service levels, and then to assess the City's ability to provide them. After understanding any possible gaps in operations and resources, Citygate has provided recommendations to improve Department operations and services over time.

This assessment is presented in several parts, including this Executive Summary outlining the most significant findings and recommendations; the fire station/crew deployment analysis supported by maps and response statistics; and assessment of future service demand and alternative service models. Section 4 integrates all the findings and recommendations presented throughout the report. A separate Map Atlas (**Volume 2**) contains all the maps referenced throughout this study. Overall, there are 14 findings and 11 specific action recommendations.

POLICY CHOICES FRAMEWORK

There are no mandatory federal or state regulations directing the level of fire service staffing, response times, or outcomes. Thus, the level of fire protection services provided are a *local policy decision* and communities have the level of fire services that they can afford, which may not always be the level desired. However, if services are provided at all, local, state, and federal regulations relating to firefighter and citizen safety must be followed.

OVERALL SUMMARY OF CITY FIRE SERVICES

Citygate finds that that the Department is well organized to accomplish its mission to serve an urban population in a municipal land use pattern. Overall, the challenges facing the City relative to fire service deployment can be summarized in four themes: *(1) call processing performance; (2) ambulance response performance impacts; (3) initial unit (first-due) travel time coverage; and (4) overall fire and emergency medical service capacity.*

Challenge #1: Call Processing Performance

Total response time to emergency incidents includes three distinct components: (1) 9-1-1 call processing/dispatch time; (2) crew turnout time; and (3) travel time. The nationally recognized best practice standard for call processing[1] is 1:30 minutes or less for 90 percent of all 9-1-1 calls. The Merced Police Department Communications Center (Communications Center) serves as the

[1] NFPA Standard 1221 – Standard for the Installation, Maintenance, and Use of Emergency Services Communications Systems (2016)

primary Public Safety Answering Point (PSAP) for 9-1-1 calls within the City, and dispatches both police and fire resources. Other primary PSAPs, including the California Highway Patrol and the Merced County Sheriff's Department, also receive 9-1-1 calls for emergencies within the City and must then transfer the call to the Communications Center. For this analysis, call processing time begins when the Communications Center dispatcher receives either an original 9-1-1 call or a call transferred from another PSAP. As shown in Table 1, call processing performance is *40 percent slower* than the 1:30-minute best practice goal, missing the goal by 36 seconds. Also significant is the seven percent increase in call processing time in 2016.

Table 1—90th Percentile Call Processing Performance

Planning Zone	Overall	2014	2015	2016
Overall	2:06	2:02	2:01	2:15

Source: City of Merced Fire Department incident records and CAD data

Citygate's review of call processing performance identified that the Communication Center does not monitor call processing performance and is *chronically understaffed* to receive and appropriately process the approximately 500,000 calls currently received annually, including the more than 10,000 fire incidents, within recognized best practice call processing goals. Citygate recommends that the City evaluate Communications Center staffing as a critical element of its emergency response system during budget planning and that the Communications Center establish, implement, and monitor call processing performance standards consistent with recognized best practices.

Challenge #2: Ambulance Response Performance Impacts

Fire Department response personnel are trained to the Emergency Medical Technician (EMT) level capable of providing Basic Life Support (BLS) pre-hospital emergency medical care. Advanced Life Support (ALS) pre-hospital emergency medical care and ground ambulance transportation is provided by Riggs Ambulance Service (Riggs) under an exclusive operating area, performance-based contract with the Merced County Emergency Medical Services Agency (MCEMSA).

A review of ambulance contract compliance, as reported by MCEMSA, shows that ambulance response performance met the response time requirement of 10:59 minutes or less for 90 percent of Priority 1 (life-threatening) calls within the High-Density Zone,[2] including the City of Merced, from January 1, 2015 to May 31, 2017. However, contract compliance *fell below 90 percent* for June, August, and September of 2017, the most recent reporting periods available. Both Riggs and MCEMSA staff advise that a statewide shortage of licensed paramedics has impacted Riggs and

[2] Includes the incorporated Cities of Merced, Atwater, Dos Palos, Gustine, Livingston, and Los Banos.

other ALS ambulance service providers' ability to provide the number of paramedics needed daily to meet contractual response performance. In addition, a January 2017 EMS System Review Report[3] cites the delayed transfer of patients to emergency department personnel at Mercy Medical Center in Merced as a continuing problem. Transfer delays require that ambulance personnel maintain patient care until the receiving medical center can accept the patient; the ambulance is thus not available to respond to emergencies until the patient transfer occurs. A 2014 statewide report[4] also cited "very significant" to "extremely significant" patient offload delays in Merced County. This, combined with the reported shortage of paramedics, appears to be increasingly impacting ambulance response performance to emergency incidents in the City of Merced.

Citygate's analysis shows that three or more of the Department's six staffed resources were simultaneously committed on 780 occasions during a six-month period in 2017 for a total of 162.5 hours, or 3.6 percent of the total 189-day study period. While these results appear to suggest that simultaneous incident activity minimally impacts overall response capacity, they do not show the impacts on customer service, particularly for the EMS patients that comprise 64.5 percent of the Department's total calls for service.

For those customers, delayed ambulance response times and delayed emergency department transfer time impacts can be significant, particularly where ALS measures are indicated. In those cases, even though a small subset of all EMS responses, rapid initiation of appropriate ALS interventions can mean the difference between life and death, or at the least can result in a higher probability of a better medical outcome.

This impact could be at least partially mitigated by expanding the Department's current service level to include pre-hospital ALS (paramedic) emergency medical services. In addition to generally providing ALS services for EMS patients *faster* than the current ambulance-based model, this option would also likely reduce the need for an ALS ambulance on all EMS calls as the paramedic would have the authority to cancel the ambulance for the high percentage of calls not requiring ambulance transportation to a hospital emergency department.

While providing ALS service capacity would not of itself resolve the ambulance response performance issue, it could provide the foundation for the Department to negotiate an agreement to provide surge capacity ALS ambulance transportation whenever Riggs reaches a specified ambulance draw-down level. In exchange for this surge transport capability, the fire agency typically receives the revenue for the transport from the ambulance company. This, in combination with implementation of emergency department recommendations contained in the Merced County

[3] *Merced County EMS System Review Report*, Page, Wolfberg and Wirth, January 2017

[4] Toolkit to Reduce Ambulance Patient Offload Delays in the Emergency Department, California Hospital Association, August 2014

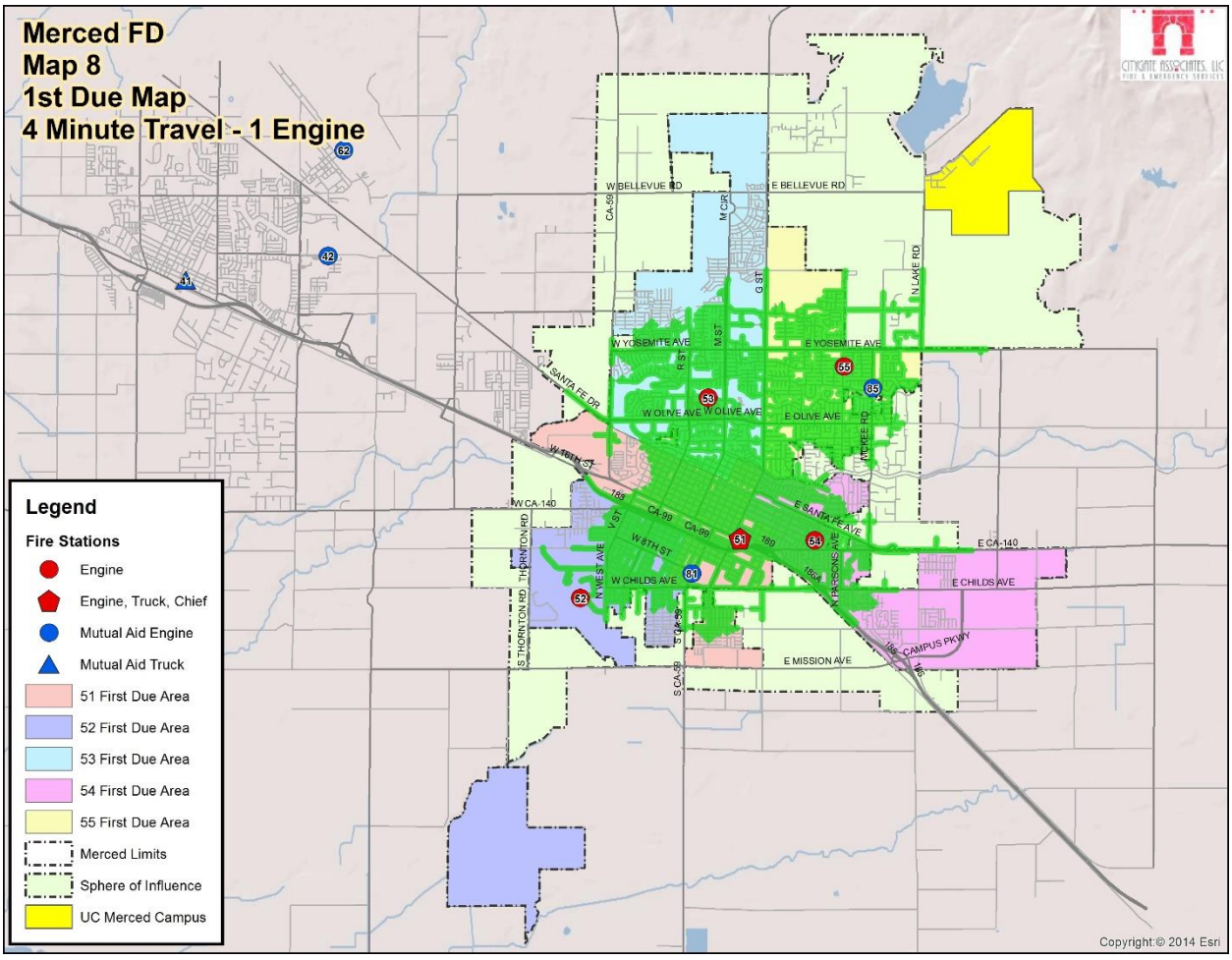
EMS System Review Report, could resolve many of the current pre-hospital EMS impacts within the City.

Challenge #3: Initial Unit (First-Due) Response Coverage

Fire service deployment, simply stated, is about the *speed* and *weight* of the response. *Speed* refers to initial response (first-due) of all-risk intervention resources (engines, trucks, and/or ambulances) strategically deployed across a jurisdiction for response to emergencies within a time interval to achieve desired outcomes. *Weight* refers to multiple-unit responses (Effective Response Force, or ERF) for more serious emergencies such as building fires, multiple-patient medical emergencies, vehicle collisions with extrication required, or technical rescue incidents. In these situations, a sufficient number of firefighters must be assembled within a reasonable time interval to safely control the emergency and prevent it from escalating into a more serious event.

If desired outcomes include limiting building fire damage to only part of the inside of an affected building and/or minimizing permanent impairment resulting from a medical emergency, then initial units should arrive within 7:30 minutes from 9-1-1 notification, and all ERF resources should arrive within 11:30 minutes of 9-1-1 notification, all at 90 percent or better reliability. Total response time to emergency incidents includes three distinct components: (1) 9-1-1 call processing/dispatch time; (2) crew turnout time; and (3) travel time. Recommended best practices for these response components are 1:30 minutes, 2:00 minutes, and 4:00/8:00 minutes respectively for first-due and ERF responses in urban areas.

Figure 1—Map #8 – 4:00-Minute Travel Coverage



While current response performance *is meeting or nearly meeting* the recommended 7:30-minute goal as discussed in Section 2.7.2, Geographic Information System (GIS) modeling of travel times from existing City fire station locations reveals five gap areas beyond the recommended 4:00-minute, best practice, first-due travel time (see Figure 1). Two of these gap areas could be resolved by relocating existing fire station facilities as capital planning and funding permit. The largest gap area in the northern section of the City will require an additional fire station facility to adequately serve existing and future development north of Merced College to about Bellevue Road without diluting services to the remainder of the City. The remaining two gap areas are too small within the current sphere of influence to cost-effectively resolve.

Challenge #4: Overall Fire and EMS Capacity

While the Department is currently meeting or nearly meeting recommended best practices for initial unit (first-due) response performance except for the gap areas discussed, and nearly meeting recommended best practices for Citywide ERF response performance, it is important to note that

available local/regional mutual aid resources are insufficiently staffed and/or too distant to substantively augment the City's fire service capacity. The City is thus a fire service "island" and must essentially be self-sufficient in providing first-due and ERF resources within desired response performance parameters to achieve desired outcomes. While the Department's minimum daily staffing of 19 personnel is nominally sufficient for a single ERF incident, increasing service demand and simultaneous incident activity are beginning to impact overall service capacity, especially for concurrent serious incidents requiring a multiple-unit response.

In addition to the additional fire station recommended to partially resolve Challenge #3, the City could explore a partnership with UC Merced to provide shared fire and emergency medical services for the campus and adjacent City areas. Implementation of one or both strategies would significantly augment the City's current fire service capacity until additional capacity is added to serve other future development within the City's current sphere of influence. For either of these strategies, the City could achieve incremental improvement in capacity by deploying one or more "rapid response" units staffed with two personnel until funding for a full three-person engine or truck company is available.

KEY FINDINGS AND RECOMMENDATIONS

Following are *key* findings and recommendations presented throughout the report. A complete list of all 14 findings and 11 recommendations can be found in Section 4.

Findings

Finding #1: The Department has established response performance objectives partially consistent with best practice recommendations as published by the Commission on Fire Accreditation International.

Finding #2: The Department has a standard response plan that considers risk and establishes an appropriate initial response for each incident type; each type of call for service receives the combination of engines, trucks, ambulances, specialty units, and command officers customarily needed to effectively control that type of incident based on Department experience.

Finding #4: Call to First Arrival performance *is meeting or nearly meeting* the recommended goal of 7:30 minutes or less to facilitate desired outcomes in urban areas.

Finding #5: Effective Response Force (ERF) Call to First Arrival performance is *slightly slower* than the recommended goal of 11:30 minutes or less to facilitate desired outcomes in urban areas.

Finding #6: Call processing performance *fails to meet* the best practice standard of 1:30 minutes or less by 40 percent.

Finding #7: Crew turnout performance *is slightly better* than a Citygate-recommended goal of 2:00 minutes or less.

Finding #8: First-due travel time performance *fails to meet* the recommended 4:00-minute goal by 40 seconds (17 percent).

Finding #9: Effective Response Force (ERF) travel time performance is *46 percent slower* (3:41 minutes) than the best practice goal of 8:00 minutes or less recommended to achieve desired outcomes in urban/suburban areas.

Finding #11: Simultaneous incident activity minimally impacts overall response performance but is increasing annually.

Finding #13: The City's population is projected to grow 22 percent over the next 13 years to 2030, or an annualized average of 1.5 percent.

Finding #14: Annual fire service demand is projected to increase an estimated 5–10 percent annually over the next 13 years to 2030, requiring additional incremental fire service capacity as the City continues to expand.

Recommendations

Recommendation #1: The City should consider Communications Center staffing as a critical element of its emergency response system during annual budget planning.

Recommendation #2: The Fire Department should collaborate with the Police Department Communications Center to establish and implement call processing performance standards consistent with industry-recognized best practices and to monitor and report call processing performance monthly.

Recommendation #3: **Adopt Updated Deployment Policies:** The City Council should adopt updated, complete performance measures to aid deployment planning and to monitor performance. The measures of time should be designed to deliver outcomes that will save patients medically salvageable upon arrival and to keep small but serious fires from becoming more serious. With this is mind, Citygate recommends the following measures for the City's planning zones:

3.1 Distribution of Fire Stations: To treat pre-hospital medical emergencies and control small fires, the first-due unit should arrive within 7:30 minutes, 90 percent of the time from the receipt of the 9-1-1 call; this equates to a 90-second dispatch time, 2:00-minute company turnout time, and 4:00-minute travel time.

3.2 Multiple-Unit Effective Response Force for Serious Emergencies: To confine building fires near the room of origin, keep vegetation fires under one acre in size, and treat multiple medical patients at a single incident, a multiple-unit ERF of at least 16 personnel, including at least one Chief Officer, should arrive within 11:30 minutes from the time of 9-1-1 call receipt in fire dispatch, 90 percent of the time; this equates to a 90-second dispatch time, 2:00-minute company turnout time, and 8:00-minute travel time.

3.3 Hazardous Materials Response: Provide hazardous materials response designed to protect the City from the hazards associated with uncontrolled release of hazardous and toxic materials. The fundamental mission of the Fire Department's response is to isolate the hazard, deny entry into the hazard zone, and notify appropriate officials/resources to minimize impact on the community. This can be achieved with a first-due total response time of 7:30 minutes or less to provide initial hazard evaluation and/or mitigation actions. After the initial evaluation is completed, a determination can be made whether to request additional resources from the regional hazardous materials team.

3.4 Technical Rescue: Respond to technical rescue emergencies as efficiently and effectively as possible with enough trained personnel to facilitate a successful rescue with a first-due total response time of 7:30 minutes or less to evaluate the situation and/or initiate rescue actions. Following the initial evaluation, assemble additional resources as needed within a total response time of 11:30 to safely complete rescue/extrication and delivery of the victim to the appropriate emergency medical care facility.

Recommendation #4: The City should initiate planning for an additional fire station to serve existing and future development generally north of Merced College.

Recommendation #5: The City should consider relocating Fire Station 52 and/or Fire Station 54 as capital planning and funding permit, to expand first-due travel time coverage in the southwest and southeast areas of the City.

Recommendation #6: The City should initiate fire station location planning and site acquisition to serve future development within the City's current/projected sphere of influence considering the deployment recommendations in this report.

Recommendation #7: As strategic planning and fiscal resources permit, the Department and City should consider a second ladder truck in the north/northeast section as the City continues to expand in that direction toward UC Merced.

Recommendation #8: As strategic planning and fiscal resources permit, the City should consider adding at least one additional staffed resource to provide expanded first-due and ERF service capacity.

Recommendation #9: The City and Department should consider expanding current EMS capacity to include ALS (paramedic) services as strategic planning and funding permit.

Recommendation #10: The City and Department should evaluate the advantages of deploying one or more "rapid response" apparatus as an incremental step to additional full engine/truck companies to serve current deployment gap areas and/or future growth areas.

Recommendation #11: The City should consider exploring a shared-cost fire and EMS partnership with UC Merced.

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SECTION 1—INTRODUCTION AND BACKGROUND

The City of Merced (City) Fire Department (Department) retained Citygate Associates, LLC (Citygate) to conduct a comprehensive Standards of Coverage (SOC) Assessment to provide a foundation for future fire service planning. The goal of this assessment is to identify both current services as well as desired service levels, and then to assess the City's ability to provide them. Citygate's scope of work and corresponding Work Plan was developed consistent with Citygate's Project Team members' experience in fire administration and deployment. Citygate utilizes various National Fire Protection Association (NFPA) and Insurance Services Office (ISO) publications as best practice guidelines, along with the self-assessment criteria of the Commission on Fire Accreditation International (CFAI).

1.1 REPORT ORGANIZATION

This report is organized into the following sections. **Volume 2** (Map Atlas) is separately bound.

Executive Summary: Summary of current services and significant future challenges.

Section 1 Introduction and Background: An introduction to the study and background facts about the City of Merced and Merced County.

Section 2 Standards of Coverage Assessment: An overview of the SOC process and detailed analysis of existing deployment policies, outcome expectations, community risk, critical tasks, distribution and concentration effectiveness, reliability and historical response effectiveness, and overall deployment evaluation.

Section 3 Future Service Needs and Alternative Service Models: A comprehensive assessment of the City's future fire service needs and identification and evaluation of potential alternative service delivery models.

Section 4 Findings and Recommendations: A list of all the findings and recommendations from this study.

Appendix A Risk Assessment

Appendix B Incident Statistical Analysis

1.1.1 Goals of the Report

This report cites findings and makes recommendations, as appropriate, related to each finding. Findings and recommendations throughout Sections 1–3 of this report are sequentially numbered.

To provide a comprehensive summary, a complete list of all these same findings and recommendations is provided in Section 4.

This document provides technical information about the way fire services are provided and legally regulated and the way the Department currently operates. This information is presented in the form of recommendations and policy choices for consideration by the Department and City.

The result is a solid technical foundation upon which to understand the advantages and disadvantages of the choices facing Department and City leadership regarding the best way to provide fire services and, more specifically, at what level of desired outcome and expense.

1.1.2 Limitations of Report

In the United States, there are no federal or state regulations requiring a specific minimum level of fire services. Each community, through the public policy process, is expected to understand the local fire and non-fire risks and its ability to pay, and then choose its level of fire services. *If* fire services are provided at all, federal and state regulations specify how to do so safely for the public and for the personnel providing the services.

While this report and technical explanation can provide a framework for the discussion of Department services, neither this report nor the Citygate team can make the final decisions, nor can they cost out every possible alternative in detail. Once final strategic choices receive policy approval, City staff can conduct any final costing and fiscal analysis as typically completed in its normal operating and capital budget preparation cycle.

1.2 Project Approach and Scope of Work

1.2.1 Project Approach and Research Methods

Citygate utilized multiple sources to gather, understand, and model information about the City and the Department. Citygate requested a large amount of background data and information to better understand current costs, service levels, history of service level decisions, and other prior studies.

In subsequent site visits, Citygate followed up with focused interviews of the Department's project team members and other project stakeholders. We reviewed demographic information about the City and the potential for future growth and development. Citygate also obtained map and response data from which to model current and projected future fire service deployment with the goal to identify the location(s) of stations and crew quantities required to best serve the City as it currently exists and to facilitate future deployment planning.

Once Citygate gained an understanding of the Department's service area and its fire and non-fire risks, the Citygate team then developed a model of fire services that was tested against the travel time mapping and prior response data to ensure an appropriate fit. We also evaluated future City growth and service demand by risk type and identified and evaluated potential alternative

emergency and non-emergency service delivery models. This resulted in Citygate proposing an approach to both address current needs with effective and efficient use of existing resources as well as long-range needs as the City continues to evolve. The result is a framework for enhancing Fire Department services while meeting reasonable community expectations and fiscal realities.

1.2.2 Project Scope of Work

Citygate's approach to this Standards of Coverage assessment involved:

- Reviewing Department- and City-provided information and conducting stakeholder listening sessions with project stakeholders.
- Utilizing a geographic mapping software program called FireView™ to model fire station travel time coverage.
- Using an incident response time analysis program called StatsFD™ to review the statistics of prior incident performance, plotting the results not only on graphs and charts, but also over Google Earth images using 3D tools.
- Identifying and evaluating future City population and related development growth.
- Projecting future service demand by risk type.
- Identifying and evaluating potential alternate service delivery models.
- Recommending appropriate risk-specific response performance goals.
- Identifying a long-term strategy, including incremental short- and mid-term goals to achieve desired response performance objectives.
- Utilizing the CFAI self-assessment criteria and NFPA 1201 – Standard for Providing Emergency Services to the Public, and other NFPA standards, as the basis for evaluating support services, including administration, dispatch, fire prevention, safety, training, and facility and equipment maintenance.

1.3 COMMUNITY OVERVIEW

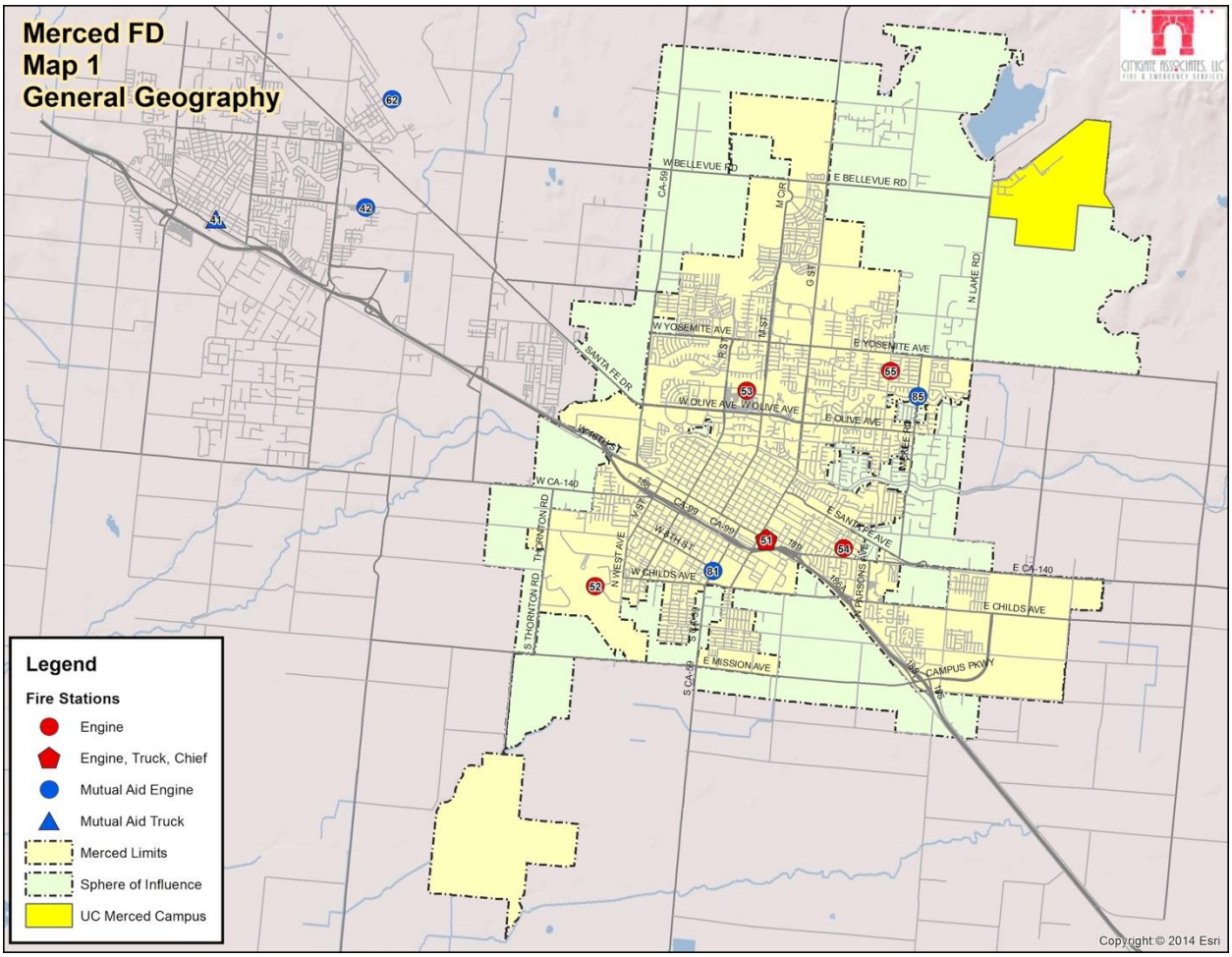
Located in the heart of California's central San Joaquin Valley between the Cities of Madera and Modesto, the City of Merced encompasses 23 square miles with a population of 84,000, as shown in Figure 2.

Incorporated in 1889, Merced is a Charter City operating under the Council-Manager form of government, with the Mayor elected at large and Council members elected by six single-member districts. Home to the newest University of California campus, Merced's economy has traditionally been focused on agriculture and neighboring Castle Air Force Base. After closure of the base in 1995, the City's economy has become more diversified with expanded manufacturing, packaging,

warehousing, and distribution industries. Merced has also experienced significant retail growth, averaging 3.4 percent annually over the past nine years, with several new major retail chains. With the opening of University of California, Merced in 2005, planning is underway to accommodate future campus growth for the projected 25,000-student campus community.

With flat topography at an elevation of about 180 feet, Merced's semi-arid climate is typical of the California's Central Valley with summer temperatures averaging 61–97º Fahrenheit, and winter temperatures averaging 36–55º Fahrenheit. Annual rainfall averages approximately 12 inches, occurring generally from November through April.

Figure 2—City of Merced General Geography



1.4 FIRE DEPARTMENT OVERVIEW

Created as a volunteer fire department in 1873, the City of Merced Fire Department transitioned to a combination department in 1949 and became a fully career-based department in 1952. The Department operates under the authority of the City Charter and provides fire suppression, Basic

Life Support (BLS) pre-hospital emergency medical, technical rescue, initial hazardous material spill/release, fire prevention, and community education services from five fire stations with 66 employees, as shown in Table 2 and Figure 3. The Department responds to more than 10,000 calls for service annually, with dispatch services provided by the Merced Police Department. The Department received an ISO Public Protection Class 2 rating in July 2016.

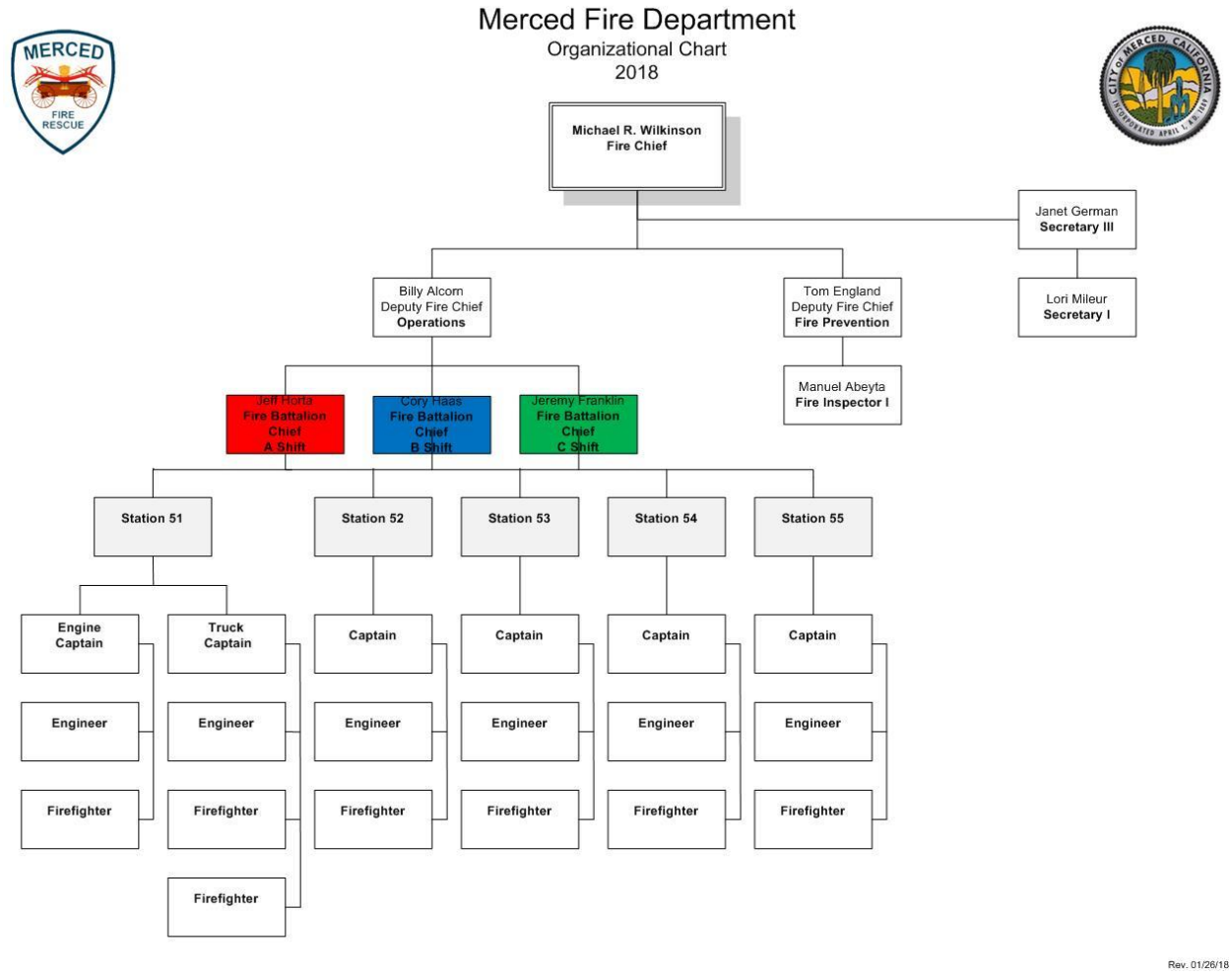
Table 2—Fire Department Organization

Function	Budgeted Positions
Administration	**5**
Operations	**60**
Fire Prevention	**1**
Total	**66**

Source: Merced Fire Department

Figure 3 shows the organizational structure of the Department.

Figure 3—Merced Fire Department Organizational Chart



Source: Merced Fire Department

1.4.1 Facilities and Resources

The Department provides services from five fire stations as shown in Table 3.

Table 3—Merced Fire Department Facilities and Assigned Resources

Station	Location	Assigned Resources	Minimum Staffing
51	99 E. 16th Street	**Engine 51** **Truck 51** **Battalion Chief** Engine 251 (Reserve) Truck 251 (Reserve) Hazmat Decontamination Trailer Rescue Trailer	**3** **3** **1**
52	1400 Falcon Way	**Engine 52** ARFF-52	**3**
53	800 Loughborough Drive	**Engine 53** Engine 253 (Reserve)	**3**
54	1425 E. 21st Street	**Engine 54** OES-279 Engine 254 (Reserve)	**3**
55	3520 Parsons Avenue	**Engine 55** OES Rescue Trailer Rescue Boat	**3**
		Total	**19**

Source: Merced Fire Department

Response personnel work a 48/96-hour shift schedule of two consecutive 24-hour days on duty followed by four days off duty. The Department provides services with nine Type-I structural fire engines, two Type-I aerial ladder trucks, one rescue boat, two technical rescue trailers, and one hazardous materials (hazmat) decontamination trailer.

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SECTION 2—STANDARDS OF COVERAGE ASSESSMENT

This section provides a detailed, in-depth analysis of the Department's current ability to deploy and mitigate emergency risks within its service area. The response analysis uses prior response statistics and geographic mapping to help the Department and the community to visualize what the current response system can and cannot deliver.

2.1 STANDARDS OF COVERAGE PROCESS OVERVIEW

The core methodology used by Citygate in the scope of its deployment analysis work is "Standards of Response Coverage" (SOC) 5th and 6th Editions, which is a systems-based approach to fire department deployment published by the CFAI. This approach uses local risk and demographics to determine the level of protection best fitting a community's needs.

The SOC method evaluates deployment as part of a fire agency's self-assessment process. This approach uses risk and community expectations on outcomes to help elected officials make informed decisions on fire and emergency medical services deployment levels. Citygate has adopted this methodology as a comprehensive tool to evaluate fire station locations. Depending on the needs of the study, the depth of the components may vary.

Such a systems approach to deployment, rather than a one-size-fits-all prescriptive formula, allows for local determination. In this comprehensive approach, each agency can match local needs (risks and expectations) with the costs of various levels of service. In an informed public policy debate, a governing board "purchases" the fire and emergency medical service levels the community needs and can afford.

While working with multiple components to conduct a deployment analysis is admittedly more work, it yields a much better result than using only a singular component. For instance, if only travel time is considered, and frequency of multiple calls is not considered, the analysis could miss over-worked companies. If a risk assessment for deployment is not considered, and deployment is based only on travel time, a community could under-deploy to incidents.

Table 4 describes the eight elements of the Standards of Coverage process.

Table 4—Standards of Coverage Process Elements

SOC Element		Description
1	Existing Deployment Policies	Reviewing the deployment goals the agency has in place today.
2	Community Outcome Expectations	Reviewing the expectations of the community for response to emergencies.
3	Community Risk Assessment	Reviewing the assets at risk in the community. (For this study, see Appendix A—Risk Assessment.)
4	Critical Task Analysis	Reviewing the tasks that must be performed and the personnel required to deliver the stated outcome expectation for the ERF.
5	Distribution Analysis	Reviewing the spacing of first-due resources (typically engines) to control routine emergencies.
6	Concentration Analysis	Reviewing the spacing of fire stations so that more complex emergencies can receive sufficient resources in a timely manner (First Alarm Assignment or the ERF).
7	Reliability and Historical Response Effectiveness Analysis	Using prior response statistics to determine the percent of compliance the existing system delivers.
8	Overall Evaluation	Proposing Standard of Coverage statements by risk type as necessary.

Source: CFAI *Standards of Cover*, 5th Edition

Fire service deployment, simply summarized, is about the ***speed*** and ***weight*** of the response. *Speed* refers to initial response (first-due), all-risk intervention resources (engines, trucks, and/or ambulances) strategically deployed across a jurisdiction for response to emergencies within a specified time interval to control routine to moderate emergencies without the incident escalating to greater size or severity. *Weight* refers to multiple-unit responses for more serious emergencies such as building fires, multiple-patient medical emergencies, vehicle collisions with extrication required, or technical rescue incidents. In these situations, a sufficient number of firefighters must be assembled within a reasonable time interval to safely control the emergency and prevent it from escalating into a more serious event. Table 5 illustrates this deployment paradigm.

Table 5—Fire Service Deployment Paradigm

Element	Description	Purpose
Speed of Response	Travel time of initial response of all-risk intervention units strategically located across a jurisdiction.	Controlling routine to moderate emergencies without the incident escalating in size or complexity.
Weight of Response	Number of firefighters in a multiple-unit response for serious emergencies.	Assembling enough firefighters within a reasonable time frame to safely control a more complex emergency without escalation.

Thus, smaller fires and less complex emergencies require a single-unit or two-unit response (engine and/or specialty resource) within a relatively short response time. Larger or more complex incidents require more units and personnel to control. In either case, if the crews arrive too late or the total number of personnel is too few for the emergency, they are drawn into an escalating and more dangerous situation. The science of fire crew deployment is to spread crews out across a community or jurisdiction for quick response to keep emergencies small with positive outcomes, without spreading resources so far apart that they cannot assemble quickly enough to effectively control more serious emergencies.

2.2 Current Deployment

SOC Element 1 of 8
Existing Deployment Policies

Nationally recognized standards and best practices suggest using several incremental measurements to define response time. Ideally, the clock start time is when the 9-1-1 dispatcher receives the emergency call. In some cases, the call must then be transferred to a separate fire dispatch center. In this setting, the response time clock starts when the dispatcher receives the 9-1-1 call into its computerized fire dispatch (CAD) system. Response time increments include dispatch center call processing, crew alerting and response unit boarding (commonly called turnout time), and actual driving (travel) time.

Department policy 312 establishes a response performance objective to arrive on the scene of emergency incidents within 4:00 to 6:00 minutes, 90 percent of the time, including the following incremental response goals:

1. 60 seconds or less for call/dispatch processing 90 percent of the time
2. 80 seconds or less for turnout 90 percent of the time
3. 240 seconds or less travel time for the arrival of the first engine company at a fire suppression incident 90 percent of the time

4. 480 seconds or less travel time for the arrival of a full first alarm assignment at a fire suppression incident 90 percent of the time

5. 240 seconds or less travel time for the arrival of a unit with first responder or higher level of capability and an automatic external defibrillator (AED) at an emergency medical incident 90 percent of the time.

Policy 312 further states "the Department shall annually evaluate its level of service, deployment delivery and response time objectives. The evaluation shall be based on data relating to level of service, deployment and the achievement of each response time performance objective in the geographic area of the jurisdiction." While this policy addresses response performance goals for fire and medical emergencies, it does not address response performance to other risks within the City, such as hazardous materials and technical rescue, as recommended by the CFAI. The Department also has a service level history that can be documented in response times, number of response companies, and minimum staffing.

Another source for deployment policy is the Safety Element of the City General Plan, which states, "the Fire Department's response objective is to arrive at the scene of an emergency within 4:00 to 6:00 minutes 90 percent of the time within the resource constraints of the City."[5] However, this statement does not specify if the timeframe is from the time of receipt of the 9-1-1 call or time of dispatch.

NFPA Standard 1710,[6] a recommended deployment standard for career fire departments in urban/suburban areas, recommends initial (first-due) intervention unit arrival within 6:50 minutes from the time of call receipt in fire dispatch, and recommends arrival of all the resources comprising the ERF within 10:50 minutes, at 90 percent or better reliability. The standard further identifies a minimum initial ERF of 14–15 personnel for a fire in a typical 2,000 square-foot, single-story, single-family dwelling without a basement or other exposed buildings.

In Citygate's experience, very few fire agencies can meet this response performance standard, primarily due to existing resource distribution and the costs associated with relocating those resources. Citygate therefore recommends that its urban/suburban client agencies consider a first-due performance measure of 7:30 minutes or less from fire dispatch notification, 90 percent of the time, and a performance measure of 11:30 minutes or less for arrival of the last ERF resource.

[5] Merced Vision 2030 General Plan, Chapter 11-Safety

[6] NFPA 1710 – Standard for the Organization and Deployment of Fire Suppression Operations, Emergency Medical Operations, and Special Operations to the Public by Career Fire Departments (2016 Edition)

Finding #1:	The Department has established response performance objectives partially consistent with best practice recommendations as published by the Commission on Fire Accreditation International.

2.2.1 Current Deployment Model

Resources and Staffing

The Department's current deployment model consists of five engines and one ladder truck staffed with a minimum of three personnel each, and one Battalion Chief, for a total daily staffing of at least 19 personnel operating from five fire stations. This deployment model meets the minimum staffing standards for building fires as recommended by NFPA 1710 or, as the critical tasking section of this report will review, provides minimally sufficient personnel for serious fire incidents. The Department has mutual aid agreements with Merced County and the adjacent City of Atwater, and is also a signatory to the Merced County and State of California Mutual Aid Agreements; however, mutual aid resources available to Merced either lack sufficient on-duty staffing[7] and/or are not available within desired ERF travel time to provide any substantive augmentation to City fire service capacity.

Response Plan

The Department is an "all-risk" fire agency providing the people it protects with services that include fire suppression, pre-hospital BLS EMS, hazardous material and technical rescue response, and other non-emergency services, including fire prevention, community safety education, and other related services.

Given these risks, the Department utilizes a tiered response plan calling for different types and numbers of resources depending on incident/risk type. The Merced Police Department's 9-1-1's computer-aided dispatch (CAD) system selects and dispatches the closest and most appropriate resource types pursuant to the Department's response plan using Automated Vehicle Locating (AVL) technology, as shown in Table 6.

[7] Mutual aid resources are staffed with one or two personnel

Table 6—Response Plan by Incident Type

Incident Type	Resources Dispatched	Total Personnel
Single-Patient EMS	1 Engine/Truck + Ambulance	**5**
Vehicle Fire	1 Engine	**3**
Building Fire	4 Engines, Truck, Battalion Chief	**16**
Vegetation Fire	2 Engines, Battalion Chief	**7**
Rescue	2 Engines, Truck, Battalion Chief	**10**
Hazardous Material	3 Engines, Truck, Battalion Chief	**13**

Source: Merced Fire Department

Finding #2: The Department has a standard response plan that considers risk and establishes an appropriate initial response for each incident type; each type of call for service receives the combination of engines, trucks, ambulances, specialty units, and command officers customarily needed to effectively control that type of incident based on Department experience.

2.3 Outcome Expectations

SOC Element 2 of 8
Community Outcome Expectations

The Standards of Coverage process begins by reviewing existing emergency services outcome expectations. This includes determining for what purpose the response system exists and whether the governing body has adopted any response performance measures. If so, the time measures used must be understood and good data must be available.

Current national best practice is to measure percent completion of a goal (e.g., 90 percent of responses) instead of an average measure. Mathematically, this is called a "fractile" measure.[8] This is because the measure of average only identifies the central or middle point of response time performance for all calls for service in the data set. Using an average makes it impossible to know how many incidents had response times that were way above the average, or just above.

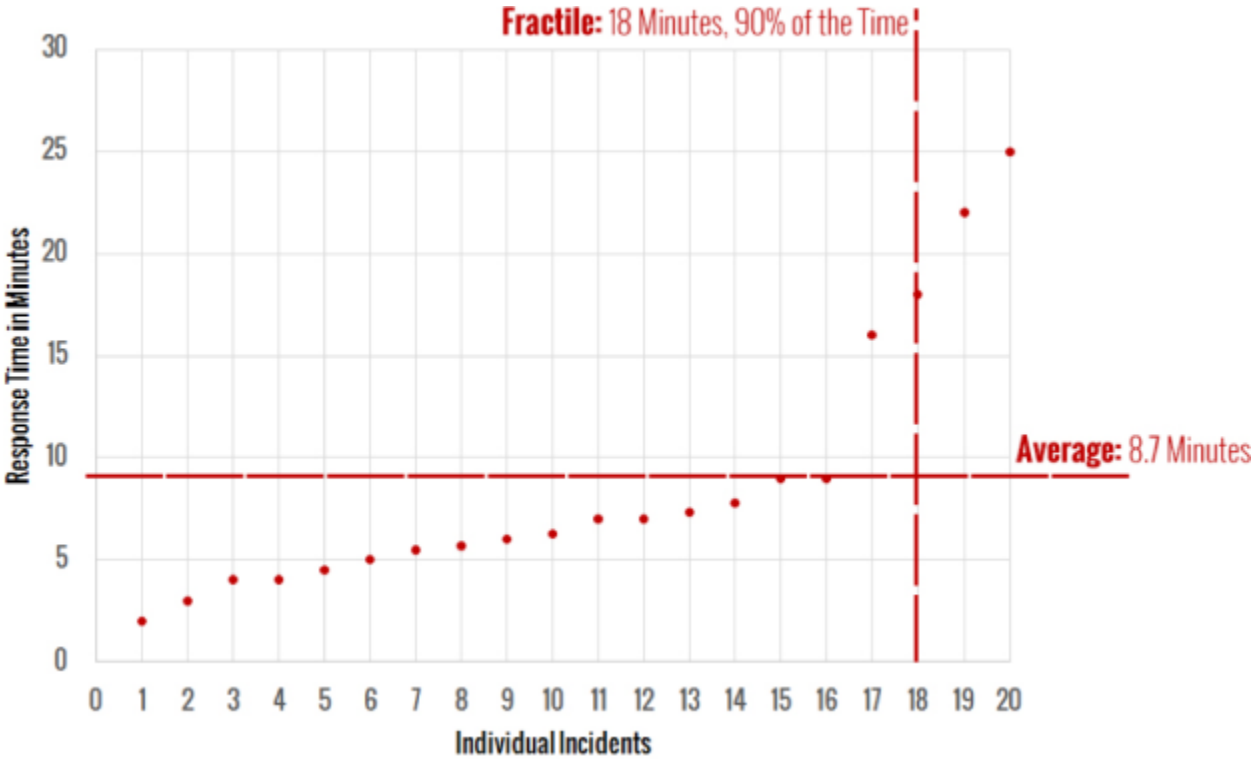
[8] A *fractile* is that point below which a stated fraction of the values lie. The fraction is often given in percent; the term percentile may then be used.

For example, Figure 4 shows response times for a fictitious fire department. This agency is small and receives 20 calls for service each month. Each response time has been plotted on the following graph from shortest response time to longest response time.

Figure 4 shows that the average response time is 8.7 minutes. However, the average response time fails to properly account for four calls for service with response times far exceeding a threshold in which positive outcomes could be expected. In fact, it is evident in Figure 4 that 20 percent of responses are far too slow, and that this jurisdiction has a potential life-threatening service delivery problem. Average response time as a measurement tool for fire services is simply not sufficient. This is a significant issue in larger cities, if hundreds or thousands of calls are answered far beyond the average point.

By using the fractile measurement with 90 percent of responses in mind, this small jurisdiction has a response time of 18:00 minutes, 90 percent of the time. This fractile measurement is far more accurate at reflecting the service delivery situation of this small agency.

Figure 4—Fractile versus Average Response Time Measurements



More importantly, within the Standards of Coverage process, positive outcomes are the goal, and from that crew size and response time can be calculated to allow appropriate fire station spacing (distribution and concentration). Emergency medical incidents have situations with the most severe time constraints. The brain can only survive 4:00 to 6:00 minutes without oxygen. Heart

attacks and other events can cause oxygen deprivation to the brain. Heart attacks make up a small percentage; drowning, choking, trauma constrictions, or other similar events have the same effect. In a building fire, a small incipient fire can grow to involve the entire room in a 6:00- to 8:00-minute timeframe. If fire service response is to achieve positive outcomes in severe emergency medical situations and incipient fire situations, ***all*** responding crews must arrive, assess the situation, and deploy effective measures before brain death occurs or the fire spreads beyond the room of origin.

Thus, from the time of 9-1-1 receiving the call, an effective deployment system is ***beginning*** to manage the problem within a 7:00- to 8:00-minute total response time. This is right at the point that brain death is becoming irreversible and the fire has grown to the point of leaving the room of origin and becoming very serious. Thus, the City needs a first-due response goal that is within a range to give the situation hope for a positive outcome. It is important to note the fire or medical emergency continues to deteriorate from the time of inception, not the time the fire engine starts to drive the response route. Ideally, the emergency is noticed immediately and the 9-1-1 system is activated promptly. This step of awareness—calling 9-1-1 and giving the dispatcher accurate information—takes, in the best of circumstances, 1:00 minute. Then crew notification and travel time take additional minutes. Upon arrival, the crew must approach the patient or emergency, assess the situation, and deploy its skills and tools appropriately. Even in easy-to-access situations, this step can take 2:00 minutes or more. This time frame may be increased considerably due to long driveways, apartment buildings with limited access, multiple-storied apartments or office complexes, or shopping center buildings.

Unfortunately, there are times when the emergency has become too severe, even before the 9-1-1 notification and/or fire department response, for the responding crew to reverse; however, when an appropriate response time policy is combined with a well-designed deployment system, then only anomalies like bad weather, poor traffic conditions, or multiple emergencies slow the response system down. Consequently, a properly designed system will give citizens the hope of a positive outcome for their tax dollar expenditure.

For this report, "total" response time is the sum of the 9-1-1 call processing, dispatch, crew turnout, and road travel time steps. This is consistent with CFAI best practice recommendations.

2.4 COMMUNITY RISK ASSESSMENT

SOC ELEMENT 3 OF 8
COMMUNITY RISK ASSESSMENT

The third element of the SOC process is a community risk assessment. Within the context of an SOC study, the objectives of a community risk assessment are to:

- Identify the values at risk to be protected within the community or service area

- Identify the specific hazards with the potential to adversely impact the community or service area
- Quantify the overall risk associated with each hazard
- Establish a foundation for current/future deployment decisions and risk-reduction/hazard mitigation planning and evaluation.

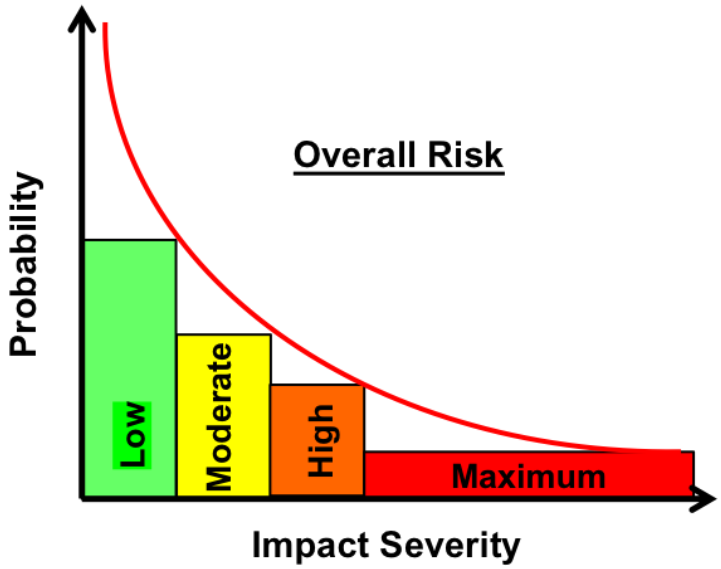
A *hazard* is broadly defined as a situation or condition that can cause or contribute to harm. Examples include fire, medical emergency, vehicle collision, earthquake, flood, etc. *Risk* is broadly defined as the *probability of hazard occurrence* in combination with the *likely severity of resultant impacts* to people, property, and the community as a whole.

2.4.1 Risk Assessment Methodology

The methodology employed by Citygate to assess community risks as an integral element of an SOC study incorporates the following elements:

- Identification of geographic planning sub-zones (risk zones) appropriate to the community or jurisdiction.
- Identification and quantification (to the extent data is available) of the specific values at risk to various hazards within the community or service area.
- Identification of the fire and non-fire hazards to be evaluated.
- Determination of the probability of occurrence for each hazard.
- Identification and evaluation of multiple relevant impact severity factors for each hazard by planning zone using agency/jurisdiction-specific data and information.
- Quantification of overall risk for each hazard based on probability of occurrence in combination with probable impact severity as shown in Figure 5.

Figure 5—Overall Risk



Source: Commission on Fire Accreditation International (CFAI): *Community Risk Assessment: Standards of Coverage (6th Edition)*

2.4.2 Values at Risk to be Protected

Values at risk, broadly defined, are those tangibles of significant importance or value to the community or jurisdiction potentially at risk of harm or damage from a hazard occurrence. Values at risk typically include people, critical facilities/infrastructure, buildings, and key economic, cultural, historic, and/or natural resources.

People

Residents, employees, visitors, and travelers through a community or jurisdiction are vulnerable to harm from a hazard occurrence. Particularly vulnerable are specific at-risk populations, including those unable to care for themselves or self-evacuate in the event of an emergency. At-risk populations typically include children less than 10 years of age, the elderly, and people housed in institutional settings. Key demographic data for the City includes the following:

- Slightly more than 27 percent of the population is under 10 or over 64 years of age.
- The City's population is predominantly White (56 percent), followed by Asian (13 percent), Black/African American (7 percent), and other ethnicities (22 percent).
- Of the population over 24 years of age, 68 percent has completed high school or equivalent.

- Of the population over 24 years of age, 17 percent has an undergraduate, graduate, or professional degree.
- Just less than 60 percent of the population 16 years of age or older are in the workforce; of those, 17 percent are unemployed.
- Nearly 32 percent of the population is below the federal poverty level.
- Nearly 13 percent of the population has no health insurance coverage.
- The City's population density ranges from less than 500 to more than 10,000 people per square mile.

Critical Facilities/Infrastructure

The U.S. Department of Homeland Security defines "Critical Infrastructure / Key Resources" (CIKR) as those physical assets essential to the public health and safety, economic vitality, and resilience of a community. For this assessment, the Department identified 135 critical facilities/infrastructure. A hazard occurrence with significant impact severity affecting one or more of these facilities would likely adversely impact critical public or community services.

Buildings

The City has an inventory of more than 27,000 housing units, as well as an equally large inventory of office, commercial, professional services, retail sales, restaurants/bars, motels, churches, schools, government facilities, healthcare facilities, industrial, and other non-residential occupancies, including 938 high- or maximum-risk occupancies as described in **Appendix A**.

Economic, Natural, Cultural, and Historic Resources

The City has numerous economic and natural resources to be protected. No cultural or historic resources were identified for this assessment.

2.4.3 Hazard Identification

Citygate utilizes prior risk studies where available, fire and non-fire hazards as identified by the CFAI, and agency-/jurisdiction-specific data and information to identify the hazards to be evaluated for this study.

Following review and evaluation of the hazards identified in the City of Merced Local Hazard Mitigation Plan and the fire and non-fire hazards as identified by the CFAI as they relate to services provided by the Department, Citygate evaluated the following five hazards for this risk assessment:

1. Building Fire
2. Vegetation/Wildland Fire

3. Medical Emergency
4. Hazardous Material Release/Spill
5. Technical Rescue.

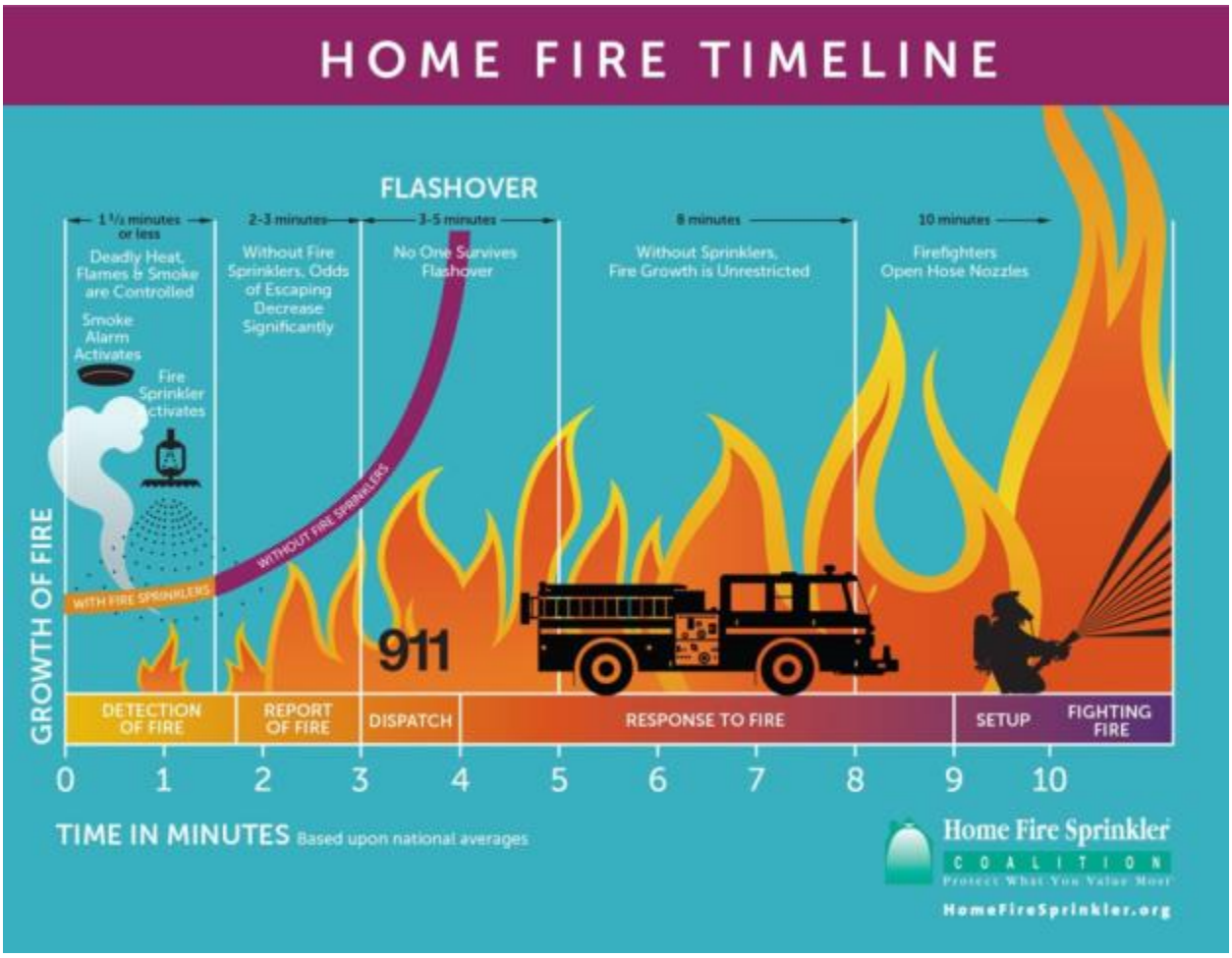
Because building fires and medical emergencies have the most severe time constraints if positive outcomes are to be achieved, the following is a brief overview of building fire and medical emergency risk. **Appendix A** contains the full risk assessment for all five hazards.

Building Fire Risk

One of the primary hazards in any community is building fire. Building fire risk factors include building density, size, age, occupancy, and construction materials and methods, as well as the number of stories, the required fire flow, the proximity to other buildings, built-in fire protection/alarm systems, an available fire suppression water supply, building fire service capacity, fire suppression resource deployment (distribution/concentration), staffing, and response time.

Figure 6 illustrates the building fire progression timeline and shows that flashover, which is the point at which the entire room erupts into fire after all the combustible objects in that room reach their ignition temperature, can occur as early as 3:00 to 5:00 minutes from the initial ignition. Human survival in a room after flashover is extremely improbable.

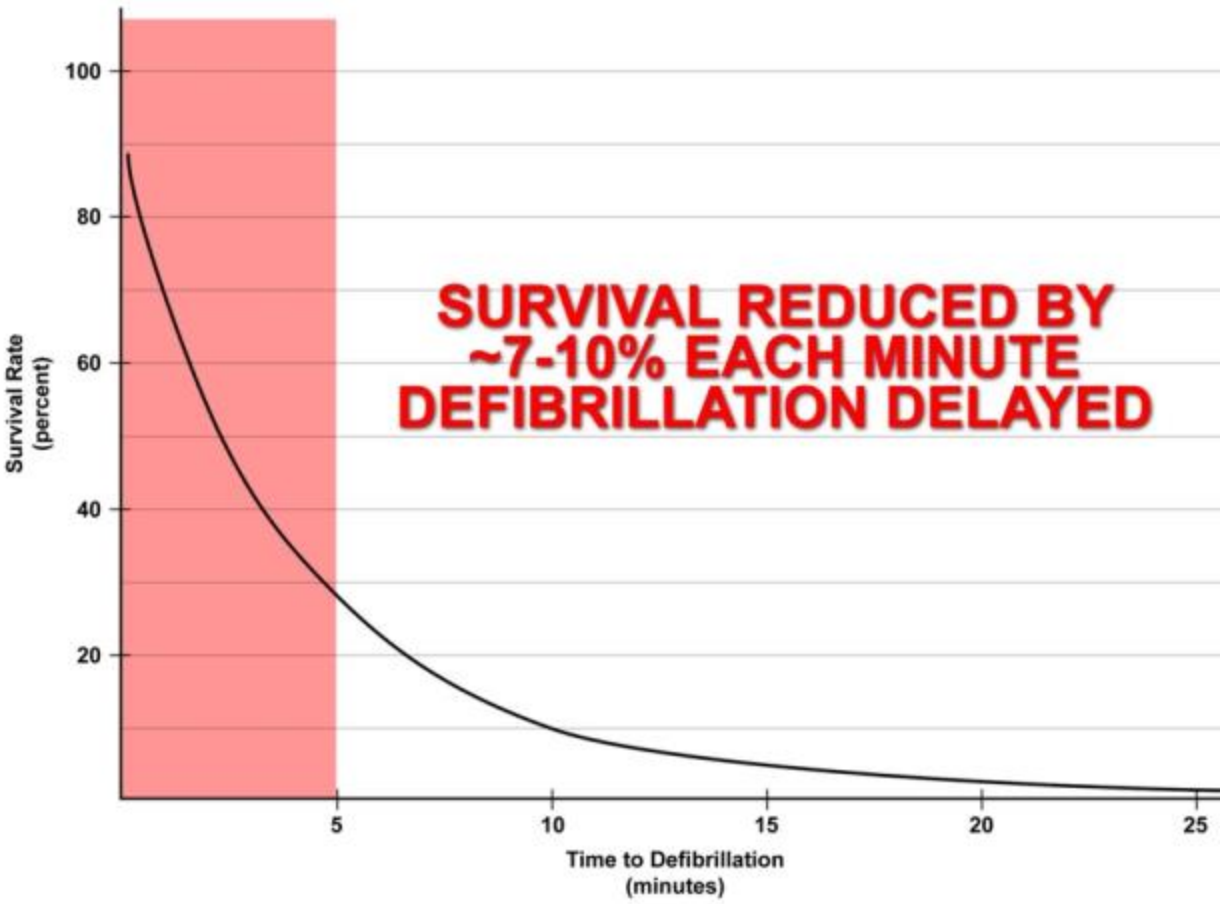
Figure 6—Building Fire Progression Timeline



Medical Emergency Risk

Fire agency service demand in most jurisdictions is predominantly for medical emergencies. Figure 7 illustrates the reduced survivability of a cardiac arrest victim as time to defibrillation increases.

Figure 7—Survival Rate versus Time of Defibrillation



Source: www.suddencardiacarrest.com

As referenced in Sections 1.4 and A.1.6, the Department currently provides BLS pre-hospital emergency medical services, with operational personnel trained to the EMT level, with ALS paramedic ambulance transport services provided by Riggs under an exclusive operating area, performance-based contract with the MCEMSA.

According to Department staff, medical emergency service capacity is increasingly impacted by prolonged ALS ambulance response times, due in part to (1) a current statewide shortage of paramedics affecting Riggs ability to staff the appropriate number of ALS transport ambulances daily to meet contract response performance requirements, as well as (2) prolonged patient offload times at Mercy Medical Center.

2.4.4 Risk Assessment Summary

Citygate's assessment of the values at risk and hazards likely to impact the City yields the following. See **Appendix A** for the full risk assessment.

- The City has a diverse urban population.
- The City's population is projected to grow 22 percent over the next 13 years to 2030, or an average of 1.5 percent annually.
- The City has an inventory of residential, commercial, office, industrial, educational, and other non-residential uses typical of other central California communities of similar size and demographics.
- The City has economic and natural resource values to be protected, as identified in this assessment.
- Some sections in the very northern and southern portions of the City lie within a *recommended* ***Moderate*** wildland Fire Hazard Severity Zone (FHSZ), as determined by the California Department of Forestry and Fire Protection (CAL FIRE).
- The City has established appropriate emergency evacuation protocols, procedures, and resources in its Emergency Operations Plan.
- Merced County has established a mass emergency telephone notification system to effectively communicate emergency information to the public in a timely manner, including the City of Merced.
- The City's overall risk for five hazards related to emergency services provided by the Fire Department range from ***LOW*** to ***HIGH***, as summarized in Table 7.

Table 7—Overall Risk by Hazard

Hazard		Planning Zone				
		Sta. 51	Sta. 52	Sta. 53	Sta. 54	Sta. 55
1	Building Fire	*HIGH*	*MODERATE*	*HIGH*	*MODERATE*	*MODERATE*
2	Vegetation/Wildland Fire	*LOW*	*LOW*	*MODERATE*	*LOW*	*LOW*
3	Medical Emergency	*HIGH*	*HIGH*	*HIGH*	*HIGH*	*HIGH*
4	Hazardous Material	*HIGH*	*MODERATE*	*MODERATE*	*HIGH*	*MODERATE*
5	Technical Rescue	*MODERATE*	*MODERATE*	*MODERATE*	*MODERATE*	*MODERATE*

2.5 Critical Task Time Measures—What Must be Done Over What Time Frame to Achieve the Stated Outcome Expectation?

SOC Element 4 of 8
Critical Task Time Study

Standards of Coverage (SOC) studies use critical task information to determine the number of firefighters needed within a timeframe to achieve desired objectives on fire and emergency medical incidents. Table 8 and Table 9 illustrate critical tasks typical of building fire and medical emergency incidents, including the minimum number of personnel required to complete each task. These tables are composites from Citygate clients in urban/suburban departments similar to the City of Merced, with units staffed with three to four personnel per engine or ladder truck. It is important to understand the following relative to these tables:

- It can take a considerable amount of time after a task is ordered by command to complete the task and arrive at the desired outcome.
- Task completion time is usually a function of the number of personnel that are *simultaneously* available. The fewer firefighters available, the longer some tasks will take to complete. Conversely, with more firefighters available, some tasks are completed concurrently.
- Some tasks must be conducted by a minimum of two firefighters to comply with safety regulations. For example, two firefighters are required to search a smoke-filled room for a victim.

2.5.1 Critical Firefighting Tasks

Table 8 illustrates the critical tasks required to control a typical single-family dwelling fire with five response units (engines/trucks/rescue) and one Chief Officer for a total *Effective Response Force* of **15**–**16** personnel. These tasks are taken from typical fire departments' operational procedures, which are consistent with the customary findings of other agencies using the Standards of Coverage process. No conditions existed to override the Occupational Safety and Health Administration (OSHA) "2-in/2-out" safety policy, which requires that firefighters enter Immediately Dangerous to Life and Health (IDLH) atmospheres, such as building fires, in teams of two, while two more firefighters are outside and immediately ready to rescue them should trouble arise.

Scenario: *Simulated approximately 2,000 square-foot, two-story residential fire with unknown rescue situation. Responding companies receive dispatch information typical for a witnessed fire. Upon arrival, they find approximately 50 percent of the second floor involved in fire.*

Table 8—First Alarm Residential Fire Critical Tasks – 15/16 Personnel

Critical Task Description		Personnel Required
1st-Due Engine (3 personnel)		
1	Conditions report	1
2	Establish supply line to hydrant	2
3	Deploy initial fire attack line to point of building access	1-2
4	Operate pump and charge attack line	1
5	Establish incident command	1
6	Conduct primary search	2
2nd-Due Engine (3 personnel)		
7	If necessary, establish supply line to hydrant	1-2
8	Deploy a backup attack line	1-2
9	Establish Initial Rapid Intervention Crew (IRIC)	2
1st-Due Truck (3 personnel)		
10	Conduct initial search and rescue if not already completed	2
11	Deploy ground ladders to roof	1-2
12	Establish horizontal or vertical building ventilation	1-2
13	Open concealed spaces as required	2
1st-Due Chief Officer		
14	Transfer of incident command	2
15	Establish exterior command and scene safety	1
3rd-Due Engine (3 personnel)		
16	Secure utilities	1
17	Deploy second attack line as needed	2
18	Conduct secondary search	2
4th-Due Engine / Rescue (2-3 personnel)		
19	Establish treatment/rehab as necessary	2

The duties in Table 8, grouped together, form an *Effective Response Force (ERF)* or *First Alarm Assignment*. These distinct tasks must be performed to effectively achieve the desired outcome; arriving on-scene does not stop the emergency from escalating. While firefighters accomplish these tasks, the incident progression clock keeps running.

Fire in a building can double in size during its *free-burn* period before fire suppression is initiated. Many studies have shown that a small fire can spread to engulf an entire room in less than 4:00 to 5:00 minutes after free burning has started. Once the room is completely superheated and involved in fire (known as flashover), the fire will spread quickly throughout the structure and into the attic

and walls. For this reason, it is imperative that fire suppression and search/rescue operations commence before the flashover point occurs if the outcome goal is to keep the fire damage in or near the room of origin. In addition, flashover presents a life-threatening situation to both firefighters and any occupants of the building.

A 2010 National Institute of Standards (NIST) study[9] tested multiple crew staffing and arrival timing scenarios relative to the completion of 22 critical tasks for a low-hazard residential building fire using four fire companies (three engines and one truck). The study found that the three-person crews completed all 22 critical tasks nearly 7 percent faster (on average) than the two-person crews, and the four-person crews completed the same tasks nearly 25 percent faster than the three-person crews. These findings support the CFAI critical time task element of the SOC analysis process.

2.5.2 Critical Medical Emergency Tasks

The Department responds to more than 6,600 EMS incidents annually, including vehicle accidents, strokes, heart attacks, difficulty breathing, falls, childbirths, and other medical emergencies.

For comparison, Table 9 summarizes the critical tasks required for a cardiac arrest patient.

[9] NIST Technical Note 1661, Report on Residential Fireground Field Experiments (April 2010)

Table 9—Cardiac Arrest Critical Tasks – 3 Personnel + ALS Ambulance

Critical Task		Personnel Required	Critical Task Description
1	Chest compressions	1-2	Compression of chest to circulate blood
2	Ventilate/oxygenate	1-2	Mouth-to-mouth, bag-valve-mask, apply O_2
3	Airway control	1-2	Manual techniques/intubation/cricothyroidomy
4	Defibrillate	1-2	Electrical defibrillation of dysrhythmia
5	Establish I.V.	1-2	Peripheral or central intravenous access
6	Control hemorrhage	1-2	Direct pressure, pressure bandage, tourniquet
7	Splint fractures	2-3	Manual, board splint, HARE traction, spine
8	Interpret ECG	2	Identify type and treat dysrhythmia
9	Administer drugs	2	Administer appropriate pharmacological agents
10	Spinal immobilization	2-5	Prevent or limit paralysis to extremities
11	Extricate patient	3-4	Remove patient from vehicle, entrapment
12	Patient charting	1-2	Record vitals, treatments administered, etc.
13	Hospital communication	1-2	Receive treatment orders from physician
14	Treat enroute to hospital	2-3	Continue to treat/monitor/transport patient

2.5.3 Critical Task Analysis and Effective Response Force Size

What does a deployment study derive from a critical task analysis? The time required to complete the critical tasks (as shown in Table 8 and Table 9) necessary to stop the escalation of an emergency must be compared to outcomes. We know from nationally-published fire service "time vs. temperature" tables that after approximately 4:00 to 5:00 minutes of free burning a room fire will escalate to the point of flashover. At this point, the entire room is engulfed in fire, the entire building becomes threatened, and human survival near or in the room of fire origin becomes impossible. Additionally, we know that brain death begins to occur within 4:00 to 6:00 minutes of the heart stopping. Thus, the ERF must arrive in time to prevent these emergency events from becoming worse.

The Department's daily staffing level is sufficient to deliver a single ERF of 16 firefighters to a building fire—if they can arrive in time, which the statistical analysis of this study (**Appendix B**) will show is not always possible. Mitigating an emergency event is a team effort once the units have arrived. This refers to the *weight* of response analogy; if too few personnel arrive too slowly, then the emergency will escalate instead of improving. The outcome times, of course, will be longer and yield less desirable results if the arriving force is later or smaller.

The quantity of staffing and the arrival time frame can be critical in a serious fire. Fires in older and/or multiple-story buildings could well require the initial firefighters needing to rescue trapped or immobile occupants. If the ERF is too small, rescue and firefighting operations *cannot* be conducted simultaneously.

Fires and complex medical incidents require that additional units arrive in time to complete an effective intervention. Time is one factor that comes from *proper station placement*. Good performance also comes from *adequate staffing* and training. But where fire stations are spaced too far apart, and one unit must cover another unit's area, or multiple units are needed, these units can be too far and the emergency will escalate and/or result in less than desirable outcome.

Previous critical task studies conducted by Citygate and NFPA Standard 1710 find that all units need to arrive with 15+ firefighters within 11:30 minutes (from the time of 9-1-1 call) at a building fire to be able to *simultaneously and effectively* perform the tasks of rescue, fire suppression, and ventilation.

A question one might ask is, "If fewer firefighters arrive, *what* from the list of tasks mentioned would not be completed?" Most likely, the search team would be delayed, as would ventilation. The attack lines would only consist of two firefighters, which does not allow for rapid movement of the hose line above the first-floor in a multiple-story building. Rescue is conducted with at least two-person teams; thus, when rescue is essential, other tasks are not completed in a simultaneous, timely manner. Effective deployment is about the **speed** *(travel time)* and the **weight** *(firefighters)* of the response.

Sixteen initial firefighters could handle a moderate-risk, confined residential fire; however, even an ERF of 16 personnel will be seriously slowed if the fire is above the first floor in a low-rise apartment building or commercial/industrial building. This is where the capability to add additional personnel and resources to the standard response becomes critical.

Given that the Department's First Alarm plan (ERF) delivers 16 personnel to a moderate risk building fire, it reflects a goal to confine serious building fires to or near the room of origin and to prevent the spread of fire to adjoining buildings. This is a typical desired outcome in urban/suburban areas and requires more firefighters more quickly than the typical rural outcome of keeping the fire contained to the building, not room, of origin.

The Department's current physical response to building fires is, in effect, its de-facto deployment measure to more densely populated urban areas—*if those areas are within a reasonable travel time from a fire station*. Thus, this becomes the baseline policy for the deployment of firefighters.

2.6 Distribution and Concentration Studies—How the Location of First-Due and First Alarm Resources Affects Emergency Incident Outcomes

SOC Element 5 of 8
Distribution Study

SOC Element 6 of 8
Concentration Study

The City is served today by five fire stations deploying five engine companies, one aerial ladder truck, and one Battalion Chief as the duty Incident Commander. It is appropriate to understand using geographic mapping tools what the existing stations do and do not cover within travel time goals, if there are any coverage gaps needing one or more stations, and what, if anything, to do about them.

In brief, there are two geographic perspectives to fire station deployment:

- **Distribution** – the spacing of first-due fire units to control routine emergencies before they escalate and require additional resources.
- **Concentration** – the spacing of fire stations sufficiently close to each other so that more complex emergency incidents can receive sufficient resources from multiple fire stations quickly. As indicated, this is known as the **Effective Response Force**, or, more commonly, the "First Alarm Assignment"—the collection of a sufficient number of firefighters on scene, delivered within the concentration time goal to stop the escalation of the problem.

To analyze first-due fire unit travel time coverage, Citygate used a geographic mapping tool called FireView™ that can measure theoretical travel time over a street network. For this calculation, Citygate used the base map and street travel speeds calibrated to actual fire apparatus travel times from previous responses to simulate real-world travel time coverage. Using these tools, Citygate ran several deployment tests and measured their impact on various parts of the City. A 4:00-minute first-due and 8:00-minute ERF travel time were used consistent with best practice response performance goals for positive outcomes in urban areas.

2.6.1 Traffic Congestion Impacts

Citygate team members personally observed daily traffic congestion in parts of the City, particularly the G Street, M Street, and R Street traffic across Bear Creek, as well as the traffic interruptions caused by daily train service on separate Union Pacific and Burlington Northern Santa Fe railroad tracks traversing the City.

While Citygate can obtain traffic throughput travel speed data to provide traffic congestion analysis as it relates to fire apparatus travel time from the same company that provides real-time traffic data to internet-based traffic mapping applications, this option was not included in this assessment since first-due response performance is meeting best practice recommendations as

discussed in Section 2.7.2. It should be noted, however, that the limited number of streets crossing Bear Creek, the two current separate railway tracks traversing the City, and the unknown impacts of the California High-Speed Rail Project, all impact fire apparatus travel time performance in certain parts of the City to some degree.

2.6.2 Deployment Baselines

Map #1 – General Geography, Station Locations, and Response Resource Types

Map #1 shows the City boundary, Sphere of Influence, and fire station locations, including mutual aid stations. This is a reference map for other maps that follow. Station symbols denote the type of staffed fire apparatus at each station. All City engines and the ladder truck are staffed with a minimum of three personnel daily.

Map #2 – Risk Assessment: Planning Zones

Map #2 shows the five risk planning zones used for this study, as recommended by the CFAI, which are the same as each station's initial (first-due) response area.

Map #3 – Risk Assessment: Critical Facilities

Map #3 shows the locations of 117 of the City's 135 critical facilities as described in Appendix A.1.4. The other 18 facilities could not be mapped due to insufficient location data.

Map #4 – Risk Assessment: High Needed Fire Flow Locations

Map #4 displays the locations of the 354 of the 361 buildings within the City with needed fire flow (NFF) greater than 1,500 gallons per minute as determined by the ISO. As the map illustrates, these buildings are predominantly located in the commercial/industrial-zoned zoning areas of the City. The other seven buildings could not be mapped due to insufficient location data.

Map #5 – Risk Assessment: Population Density

Map #5 shows the City's population density, aggregated by census block group, ranging from less than 500 to more than 10,000 per square mile. The higher population density areas are also the areas where the calls for service and building densities tend to be higher, as shown in Map #15. These are also the areas where the City's ERF (First Alarm) response performance will need to be 11:30 minutes or less to facilitate desired outcomes.

Map #6 – Risk Assessment: High Risk Building Occupancies

This map displays the locations of the 938 higher-risk building occupancies within the City as defined by CFAI. These building occupancies typically require a larger initial ERF due to the higher risks associated with these specific occupancies. It is apparent that there are high or maximum risk occupancies in every planning zone.

Map #7 – Risk Assessment: Hazardous Materials Sites

Map #7 shows the location of the 112 businesses requiring a State or County hazardous material operating permit or Hazardous Materials Business Plan (HMBP).

Map #8 – Distribution: 4:00-Minute First-Due Travel Time Coverage

This map shows first-due travel time coverage from the City's current fire station locations, with green indicating the 72 percent of the City's current road network that a fire engine should be expected to reach within 4:00 minutes, assuming it is in station and encounters *no traffic congestion*. The modeling tool uses actual fire apparatus speed by roadway type.

The purpose of response time modeling is to determine response time coverage across a jurisdiction's geography and station locations. This geo-mapping design is then validated against dispatch time data to reflect actual response times. There should be some overlap between station areas so that a second-due unit can have a chance of an acceptable response time when it responds to a call in a different station's first-due response area. As can be seen, coverage is very good for the core areas of the City with the highest population and building densities; however, there are significant coverage gaps in the northwestern, eastern, and southeastern sections as discussed further in Section 2.8.

As discussed in Appendix B.1.5, 90th percentile first-due *travel time* ranges by station area, from 4:26 to 4:50 minutes.

Map #9 – Distribution: 5:00-Minute, 6:00-Minute, 7:00-Minute, and 8:00-Minute First-Due Travel Time Coverage

Map #9 shows first-due travel times to reach all segments of the City's current road network. As can be seen, while nearly all road segments should be within 5:00 minutes travel time, some segments require up to 7:00 minutes *without traffic congestion*.

Map #10 – Distribution: 5:00-Minute, 6:00-Minute, 7:00-Minute, and 8:00-Minute First-Due Travel Time Coverage WITH NO RAILROAD CROSSINGS

This map shows first-due travel times to reach all segments of the City's current road network without crossing an existing railroad track. As can be seen, this scenario reduces travel time coverage, with most areas of the City within 6:00 minutes travel time, and some areas still requiring up to 7:00 minutes *without traffic congestion*.

Map #11 – ISO 1.5-Mile Coverage Areas

This map displays the ISO recommendation that urban stations cover a 1.5-mile *distance* response area. Depending on a jurisdiction's road network, the 1.5-mile measure usually equates to a 3:30- to 4:30-minute travel time. However, a 1.5-mile measure is a reasonable indicator of station

spacing and overlap. As can be seen, the 1.5-mile ISO coverage is very close to the 4:00-minute first-due coverage in Map #8.

Map #12 – Concentration: Effective Response Force 8:00-Minute Travel Time Coverage

Map #12 shows, in green, the 91 percent of the City where Department's current response plan *should* deliver the initial ERF of four engines, one ladder truck, and one Battalion Chief within 8:00 minutes travel time *without traffic congestion*. There is a gap in the very southeastern section of the City.

Map #13 – 8:00-Minute Ladder Truck Travel Time Coverage

This map shows 8:00-minute travel time coverage for Truck 51 *without traffic congestion*. As can be seen, this specialized resource *should* reach nearly all areas of the City within 8:00 minutes travel time; however, ERF travel time performance, as discussed in Section 2.7.2, suggests that Truck 51 is likely not able to reach all the areas indicated.

Map #14 – Battalion Chief 8:00-Minute Travel Time Coverage

Map #14 displays 8:00-minute travel time coverage for a Battalion Chief from Station 51 *without traffic congestion*. It is apparent that Battalion Chief travel time coverage includes nearly all areas of the City.

Map #15 – All Incident Locations

Map #15 shows the location of all incidents from January 2014 through December 2016. It is apparent that incidents occur in all five planning zones.

Map #16 – Emergency Medical Services and Rescue Incident Locations

Map #16 further illustrates only the emergency medical and rescue incident locations. With the majority of the calls for service being medical emergencies, virtually all areas of the City need pre-hospital emergency medical services.

Map #17 – All Fire Locations

This map identifies the location of all fires within the City over the past three years. All fires include any type of fire call, from vehicle to dumpster to building. There are obviously fewer fires than medical or rescue calls. Even given this, it is evident that fires occur in all five planning zones.

Map #18 – Structure Fire Locations

Map #18 displays the location of the 293 structure fire incidents over the past three years. While the number of structure fires is a smaller subset of total fires, there are two meaningful findings from this map. First, there are structure fires in every planning zone, and second, there are a relatively small number of building fires in the City overall.

Map #19 – Emergency Medical Services and Rescue Incident Location Densities

This map examines, by mathematical density, where clusters of emergency medical services incident activity occurred. In this set, the darker density color plots the highest concentration of EMS/rescue incidents. This type of map makes the location of frequent workload more meaningful than simply mapping the locations of all EMS incidents, as was done for Map #16.

This perspective is important because the deployment system needs an overlap of units to ensure the delivery of multiple units when needed for more serious incidents or to handle simultaneous calls for service, as is evident for the higher population density areas of the City.

Map #20 – All Fire Location Densities

This map is similar to Map #19 but shows the hot spots of activity for all types of fires. Fire density is greater in the higher population density areas of the City.

Map #21 – All Structure Fire Location Densities

This map is similar to Map #20 but shows the hot spots for structure fire activity.

2.7 STATISTICAL ANALYSIS

SOC ELEMENT 7 OF 8
RELIABILITY & HISTORICAL RESPONSE EFFECTIVENESS STUDIES

The map sets described in Section 2.6 and presented in **Volume 2** show the ideal situation for response times and the response effectiveness given perfect conditions with no competing calls, traffic congestion, units out of place, or simultaneous calls for service. Examination of the actual response time data provides a picture of actual response performance with simultaneous calls, rush hour traffic congestion, units out of position, and delayed travel time for events such as periods of severe weather.

The following subsections provide summary statistical information regarding the Department and its services. The complete statistical analysis is provided in **Appendix B**.

2.7.1 Service Demand

For 2016, the Department responded to 10,086 calls for service (incidents) for an average daily service demand of 27.6 incidents. Of those, 4.46 percent were fire incidents, 66.38 percent were EMS incidents, and 29.16 percent were other incident types (e.g., alarm activation with no fire, false alarm, no incident found, public assist, smoke scare, assist other agency, smoke or odor removal, electrical problem, water leak, rescue, hazardous material incident, animal problem, etc.).

Annual service demand increased 46 percent from 2014 to 2015, primarily due to a policy change resulting in response to all Priority 1 (potentially life-threatening) and Priority 2 (non-life threatening) medical emergencies. Prior to 2015, the Department only responded to Priority 1

medical calls. Service demand then increased nearly nine percent the subsequent year as shown in Table 10 and Figure 8, or about seven times more than the population change over the same period.

Table 10—Annual Service Demand

Year	Incidents	Change
2014	6,362	N/A
2015	9,276	45.8%
2016	10,086	8.7%
Total	**25,724**	

Source: City of Merced Fire Department incident records

Figure 8—Annual Service Demand by Year

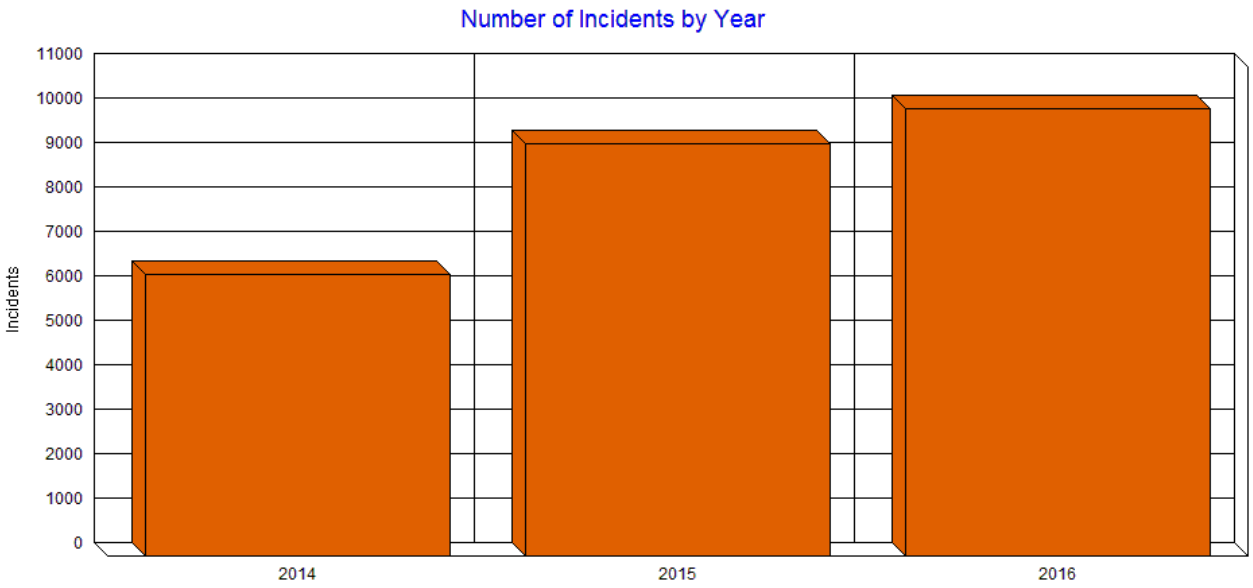
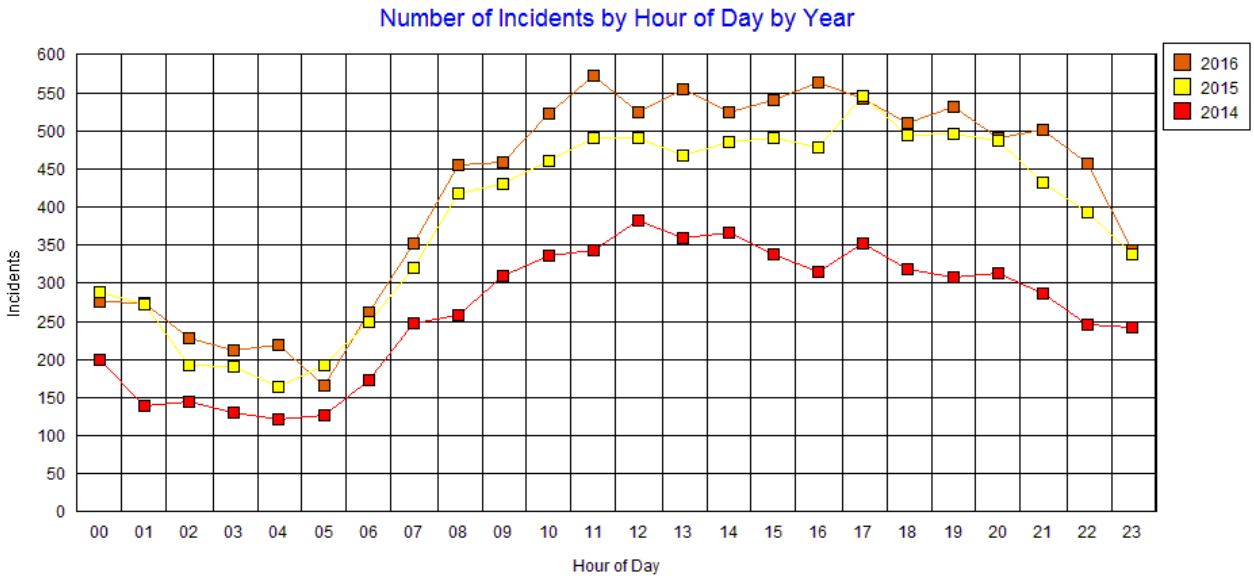


Figure 9 shows service demand by hour of day, illustrating that calls for service occur at every hour of the day and night, requiring fire and EMS response capability 24 hours per day, every day of the year.

Figure 9—Service Demand by Hour of Day and Year



Finding #3: The Department's day-of-week and month-of-year service demand are consistent, indicating the need for a 24-hour-per-day, seven-days-per-week fire and EMS emergency response system.

2.7.2 Operational Performance

Once incident types are quantified, the analysis shifts to the time required to respond to those emergencies. Fractile analyses track the percentage (and count the number) of incidents meeting defined criteria, such as the first apparatus to reach the scene within progressive time segments. Based on national best practice recommendations and Citygate's experience, this study's response time test measurement is for the 90 percent call to arrival to be *7:30 minutes or less* for urban/suburban planning (demand) zones. This is comprised of three component elements: call processing time, turnout time, and travel time.

Call to First Arrival Performance

A person needing help in an emergency measures the speed of the fire department response from the time assistance is first requested until the help arrives. This measure, referred to as "call to first arrival," is the primary measure of customer service. As Table 11 shows, overall call to arrival performance *is meeting or nearly meeting* the Citygate-recommended goal of 7:30 minutes or less to facilitate desired outcomes in urban areas. Of note, however, is the increased total response time for 2016 compared to the two prior years.

Table 11—90th Percentile Call to First Arrival Performance

Planning Zone	Overall	2014	2015	2016
Overall	7:32	7:26	7:20	7:43

Source: City of Merced Fire Department incident records and CAD data

Finding #4: Call to First Arrival performance *is meeting or nearly meeting* the recommended goal of 7:30 minutes or less to facilitate desired outcomes in urban areas.

ERF Call to Arrival Performance

The Department's ERF (First Alarm) for building fires is four engines, one ladder truck, and one Battalion Chief. Over the three-year study period, there were 81 incidents where the full ERF deployment arrived at the incident.

ERF call to arrival performance measures the time interval from receipt of a 9-1-1 call to arrival of the last ERF unit. Citygate's recommended 90th percentile performance goal is 11:30 minutes or less to facilitate desired outcomes in urban/suburban areas. As Table 13 shows, ERF call to arrival performance is *slightly slower* (4.6 percent) than the recommended goal.

Table 12—90th Percentile ERF Call to Arrival Performance

Planning Zone	Overall	2014	2015	2016
Overall	12:02	13:38	10:05	11:54

Source: City of Merced Fire Department incident records and CAD data

Finding #5: Effective Response Force (ERF) Call to First Arrival performance is *slightly slower* than the recommended goal of 11:30 minutes or less to facilitate desired outcomes in urban areas.

Call Processing Performance

Call processing time is the time it takes to answer the 9-1-1 call, determine the nature of the emergency, enter information into the CAD system, and dispatch the appropriate resource(s). Best practice[10] is for 90 percent of calls to be processed and dispatched within 90 seconds where no

[10] NFPA Standard 1221 – Standard for the Installation, Maintenance, and Use of Emergency Services Communications Systems (2016)

language barriers exist, or medical self-help instructions are not needed. The Merced Police Department Communications Center serves as the primary Public Safety Answering Point (PSAP) for 9-1-1 calls within the City, and dispatches both police and fire resources. Other primary PSAPs, including the California Highway Patrol and the Merced County Sheriff's Department, also receive 9-1-1 calls for emergencies within the City and must then transfer the call to the Communications Center. For this analysis, call processing time begins when the Communications Center dispatcher receives either an original 9-1-1 call or a call transferred from another PSAP. As Table 13 shows, call processing performance is *40 percent slower* than the 90-second best practice goal by 36 seconds. Also significant is the seven percent increase in call processing time for 2016.

Table 13—90th Percentile Call Processing Performance

Planning Zone	Overall	2014	2015	2016
Overall	2:06	2:02	2:01	2:15

Source: City of Merced Fire Department incident records and CAD data

Police Department Communications Supervisor Marvin Dillsaver advised Citygate that the Communications Center currently handles approximately 500,000 incidents annually for the City Police and Fire Departments with a minimum shift staffing of two dispatch personnel and no dedicated call-taker. He further advised Citygate that the Communications Center does not monitor call processing performance and, in his opinion, minimum shift staffing should be three to four dispatchers plus a dedicated call-taker to appropriately handle the current workload. Although the Fire Department has no direct control over 9-1-1 call processing performance, it is a *significant* element of its overall response performance and customer service, and Citygate therefore recommends that the Department collaborate with the Police Department and City Manager's Office to seek solution(s) to improve call processing performance to a level more in alignment with industry-recognized best practice standards.

Finding #6: Call processing performance *fails to meet* the best practice standard of 1:30 minutes or less by 40 percent.

Recommendation #1: The City should consider Communications Center staffing as a critical element of its emergency response system during annual budget planning.

Recommendation #2:	The Fire Department should collaborate with the Police Department Communications Center to establish and implement call processing performance standards consistent with industry-recognized best practices and to monitor and report call processing performance monthly.

Crew Turnout Performance

Turnout time is the time it takes for the crew(s) to hear the dispatch message, confirm the response travel route, don appropriate safety clothing, and board the apparatus for response. While nationally recommended crew turnout best practice is 60 to 80 seconds,[11] it has long been recognized as a standard rarely met in practical experience. Citygate has long recommended that, due to this and the floor plan design of some fire stations, most agencies should be able to reasonably achieve 2:00-minute crew turnout performance at 90 percent compliance. As Table 14 shows, crew turnout performance *is meeting* this recommended 2:00-minute goal.

Table 14—90th Percentile Crew Turnout Performance

Planning Zone	Overall	2014	2015	2016
Overall	1:55	1:57	1:55	1:53

Source: City of Merced Fire Department incident records and CAD data

Finding #7:	Crew turnout performance *is slightly better* than a Citygate-recommended goal of 2:00 minutes or less.

Travel Time

Travel time is defined as the time segment that begins with the start of apparatus movement and ends when that apparatus stops moving on arrival at the emergency. It is important to understand that this time segment *does not include* the time required to exit the apparatus and walk to an EMS patient or to deploy a hose line on a fire incident.

[11] NFPA 1710 – Standard for the Organization and Deployment of Fire Suppression Operations, Emergency Medical Operations, and Special Operations to the Public by Career Fire Departments (2016)

First-Due Travel Time

Best practice standards for first-due travel time is 4:00 minutes or less for urban demand zones.[12] As Table 15 shows, overall first-due travel time performance is 17 percent *slower* (40 seconds) than the recommended 4:00-minute target.

Table 15—90th Percentile First-Due Travel Time Performance

Planning Zone	Overall	2014	2015	2016
Overall	4:40	4:34	4:37	4:45

Source: City of Merced Fire Department incident records and CAD data

Finding #8: First-due travel time performance *fails to meet* the recommended 4:00-minute goal by 40 seconds (17 percent).

Effective Response Force Travel Time

Best practice standards for ERF travel time is 8:00 minutes or less for urban/suburban areas.[13] As Table 16 shows, 90th-percentile ERF travel time performance for four apparatus and one Battalion Chief is *46 percent slower* (3:41 minutes) than the 8:00-minute target.

Table 16—90th Percentile ERF Travel Time Performance

Planning Zone	Overall	2014	2015	2016
Citywide	11:41	12:54	10:01	10:14

Source: City of Merced Fire Department incident records and CAD data

Finding #9: Effective Response Force (ERF) travel time performance is *46 percent slower* (3:41 minutes) than the best practice goal of 8:00 minutes or less recommended to achieve desired outcomes in urban/suburban areas.

[12] NFPA 1710 – Standard for the Organization and Deployment of Fire Suppression Operations, Emergency Medical Operations, and Special Operations to the Public by Career Fire Departments (2016)

[13] NFPA 1710 – Standard for the Organization and Deployment of Fire Suppression Operations, Emergency Medical Operations, and Special Operations to the Public by Career Fire Departments (2016)

2.7.3 Simultaneous Incident Activity

Simultaneous incident activity measures the percentage of concurrent or overlapping incidents. For multiple-station departments, simultaneous incident activity in different station areas may have very little operational impact. Figure 10 illustrates that simultaneous incident activity is increasing annually, with more than 2,800 simultaneous incidents in 2016. Table 17 shows that about 140 (five percent) of these occurrences involve three or more simultaneous incidents. In these instances, 50 percent or more of the Department's available resources are concurrently committed, leaving three or fewer units available should a building fire or other emergency occur.

Figure 10—Simultaneous Activity by Year

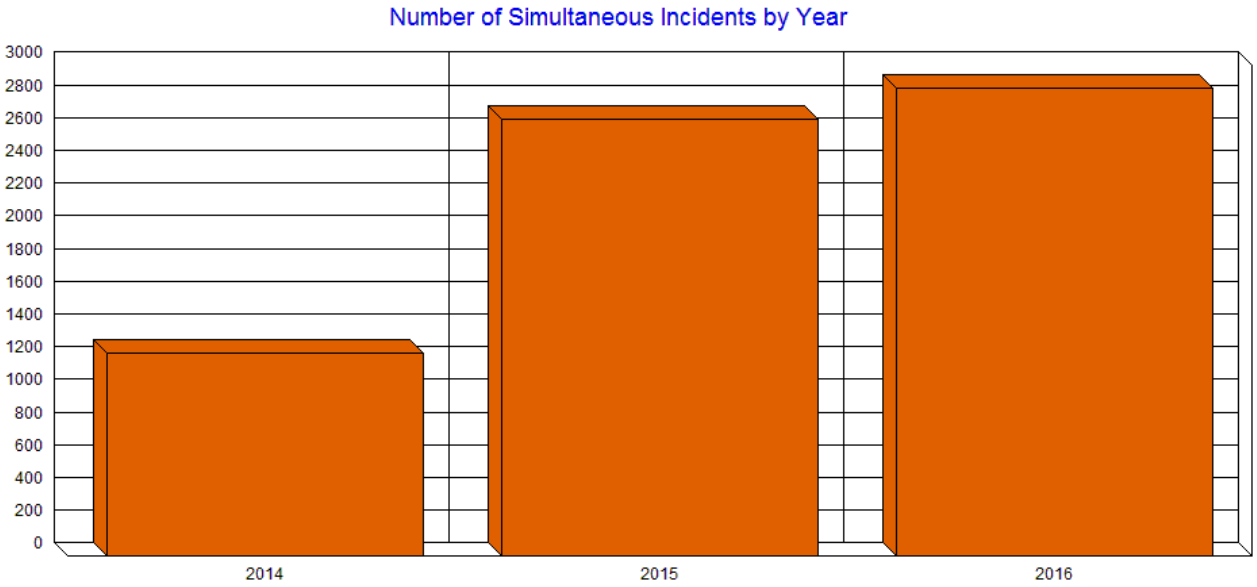


Table 17—Simultaneous Incident Activity

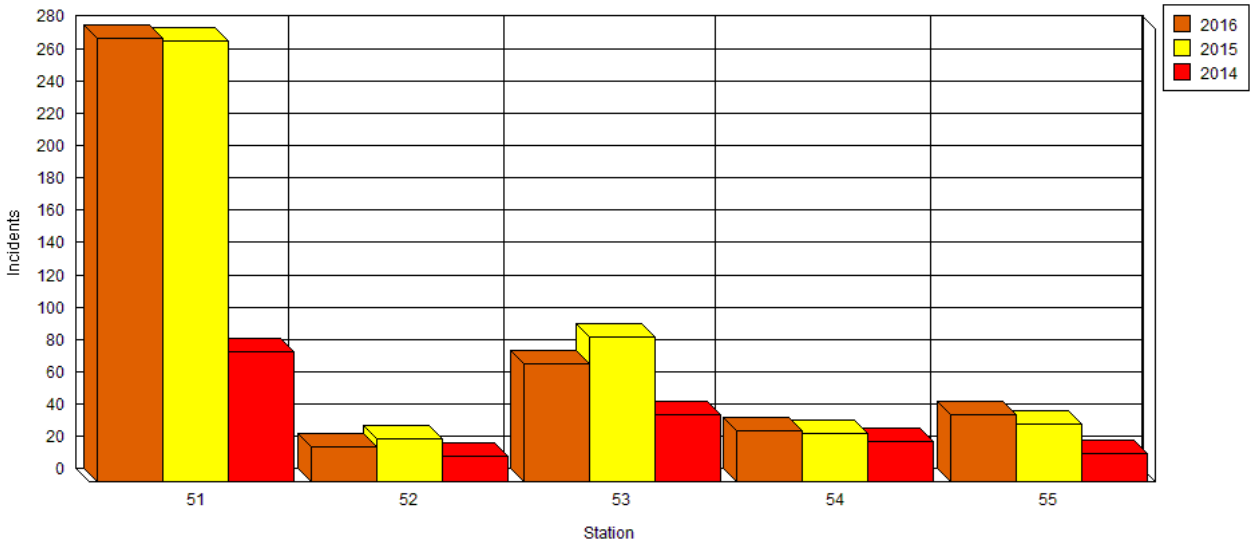
Simultaneous Incidents	Percentage
2 or more	28.39%
3 or more	5.03%
4 or more	0.83%

Source: City of Merced Fire Department incident records and CAD data

Simultaneous incidents within a *single station response area*, however, can result in significantly longer response times because the second or successive concurrent call must be handled by an engine/resource from a more distant station. While Figure 10 shows simultaneous incident activity across the entire Department, Figure 11 shows simultaneous incident activity within each station's response area; Station 51 had more than 270 simultaneous calls in 2015 and 2016; however, since

two staffed resources are assigned to this station, simultaneous incident activity should not be expected to significantly impact first-due response performance. Simultaneous incident activity for the other four stations also has minimal impact on overall first-due response performance.

Figure 11—Simultaneous Incident Activity within Same Station Response Area



Finding #10: Of all incident activity in 2016, slightly more than 28 percent involved two or more simultaneous (concurrent) incidents.

Finding #11: Simultaneous incident activity minimally impacts overall response performance but is increasing annually.

Finding #12: Simultaneous incident activity *within the same station response area* does not yet significantly impact first-due response performance.

After this initial analysis, the Department voiced a concern that it is experiencing an increasing number of times when multiple units are concurrently committed, primarily due to delayed ambulance arrival at medical emergencies. Citygate conducted a supplemental analysis to identify the impact of more recent simultaneous incident activity. During the period from April 14, 2017 through October 19, 2017, half or more of the Department's staffed units were simultaneously committed 780 times for a total of 162.5 hours, representing 3.6 percent of the total time. Of those 780 events, 186 were more than 10:00 minutes in duration, comprising 2.1 percent of the total time.

During the same period, two-thirds or more of the Department's staffed units were simultaneously committed 315 times for a total of 73.5 hours, comprising 1.6 percent of the total time. Of those, only 83 were more than 10:00 minutes in duration, representing less than one percent of the total time. This analysis reveals that concurrent resource commitment impacts overall response capacity less than four percent of the time, which, in Citygate's opinion, is not yet significant.

2.7.4 Statistical Analysis Summary

Citygate's analysis of the most recent three calendar years of incident data yields the following conclusions. See **Appendix B** for the full statistical analysis.

- There are more than 10,000 calls for service annually in the City, or more than 27 calls per day.
- Annual service demand is trending up an average of more than 27 percent annually over the most recent two years.
- 4.5 percent of calls were fire incidents.
- 66.4 percent were EMS incidents.
- 29.2 percent were other incidents (e.g., alarm activation with no fire, false alarm, no incident found, public assist, smoke scare, assist other agency, smoke or odor removal, electrical problem, water leak, rescue, hazardous material incident, animal problem, etc.).
- Station 51 and Station 53 have the highest service demand; Station 52 has the lowest service demand.
- Less than one percent of all calls were aid to other jurisdictions.
- Simultaneous incident activity minimally impacts first-due response performance but is increasing annually.
- Overall hourly station service demand and unit-hour utilization percentages are well below recommended maximum saturation rates.
- 9-1-1 call processing and dispatch performance is *40 percent slower* (36 seconds) than the 90-second best practice standard.
- Overall crew turnout time performance *is meeting* a recommended goal of 2:00 minutes or less.
- Overall first-due travel time performance is *17 percent slower* (40 seconds) than a 4:00-minute best practice goal for positive outcomes in urban areas.

- Overall call-to-first-arrival performance *is meeting or nearly meeting* a recommended best practice goal of 7:30 minutes or less to achieve positive outcomes in urban areas.
- ERF call to arrival performance for four apparatus and one Chief Officer is *slightly slower* than the recommended best practice goal of 11:30 minutes for urban areas.

2.8 Overall Evaluation

SOC Element 8 of 8
Overall Evaluation

The Department serves a diverse urban population with a mixed residential and non-residential land use pattern typical of a medium sized Central California City.

While the state Fire Code requires fire sprinklers even in residential dwellings, it will be many more decades before enough homes are replaced or remodeled with automatic fire sprinklers. If desired outcomes include limiting building fire damage to only part of the inside of an affected building and/or minimizing permanent impairment resulting from a medical emergency, then the City will need both first-due and ERF coverage in all planning zones consistent with Citygate's response performance recommendations of first-due arrival within 7:30 minutes from 9-1-1 notification and ERF arrival within 11:30 minutes of 9-1-1 notification, all at 90 percent or better reliability.

Although call processing and first-due travel time performance are slower than best practice standards by 40 percent and 17 percent respectively, the Department's current deployment system can deliver first-due response performance *meeting or nearly meeting* best practice recommendations to facilitate desired outcomes in urban population density areas.

The Department's concentration (ERF) travel time performance, on the other hand, is *significantly slower* than the best practice recommended goal of 8:00 minutes or less. The location of the truck at Station 51, while appropriate for the downtown area risks, is likely a factor in this performance measure; adding a second truck in the north/northeastern section of the City as development continues to expand in that direction should be considered.

Department resources and equipment are appropriate to protect against the hazards likely to impact the City, and daily staffing provides a total response force minimally sufficient for a single serious fire incident as discussed in Section 2.2.1.

2.8.1 Response Performance Gap Analysis

The next step in this analysis is to assess the size, location, and risks in the gap areas beyond the 7:30-minute first-due response time goal for positive outcomes. Assuming call processing and turnout times within a recommended total of 3:00 to 3:30 minutes, that leaves 4:00 to 4:30 minutes

for travel time. As shown in Map #8, areas of the City not covered in 4:00-minute travel time, *without traffic congestion*, include:

Gap Area 1: The area of the City generally north of Merced College, including the Merino Park area.

Gap Area 2: A portion of the western area of the City generally bounded by the Burlington Northern Santa Fe railroad tracks on the north, Bear Creek on the east, Wardrobe Avenue on the south, and the City boundary on the west.

Gap Area 3: A small section in the east-central section of the City generally bounded by Bear Creek on the north, McKee Road on the east, Stretch Road on the south, and Ada Givens Elementary School on the west.

Gap Area 4: The southeast section of the City generally bounded by Highway 140 on the north, the City boundary on the east and south, and the extension of McKee Road on the west.

Gap Area 5: A small area of the southernmost section of the City generally bounded by John Court and Gerard Avenue on the north, and the City boundary on the east, south, and west.

Another factor to evaluate is the values at risk within these gap coverage areas, the two most significant of which are people and economic resources. All five gap areas are currently predominantly residential, with population densities ranging from 500 to 5,000 people per square mile as shown in Map #5. While all five areas include comparable values at risk, Gap Areas 1, 2, and 4 represent the largest geographic areas.

Potential strategies to close these performance gaps include:

Gap Area 1: Adding a sixth fire station in the norther section of the City in the general area of M Street and West Cardella Road. This location would extend 4:00-minute first-due travel time coverage north to Bellevue Road, except for west of Fahrens Creek, unless Lehigh Drive or another street in the same area is planned to extend across the creek. If not, alternate sites should be evaluated to provide equitable first-due coverage for the Merino Park neighborhood.

Gap Area 2: Relocating Fire Station 52 northeast of the airport to the general area of V Street and West Avenue would also resolve first-due travel time for some of Gap Area 5.

Gap Area 3: It is not economically feasible to close this performance gap by relocating an existing fire station, or by adding an additional fire station to serve this small geographic area. As the City expands further east within its current sphere of

influence, however, an additional fire station in the general area of McKee Road and Bear Creek would extend 4:00-minute first-due travel time coverage for the east-central area of the City and facilitate 8:00-minute ERF travel time coverage for the eastern half of the City.

Gap Area 4: Relocating Fire Station 54 southeast to the general area of East Childs Avenue and South Coffee Street would extend 4:00-minute first-due travel coverage to the entire southeast section of the City within the current sphere of influence. Rapid access to Highway 140 and the proposed Campus Parkway should also be considered. This move would also impact call volume for Station 51, adding calls occurring within a portion of Station 54's current response area.

Gap Area 5: It is economically impractical to resolve first-due coverage for this small gap area except as discussed under Gap Area 2. Should the City's sphere of influence expand further south in the future, consideration should be given to an additional fire station to serve that area.

2.8.2 Recommended Response Performance Goals

Based on the technical analysis and findings contained in this Standards of Coverage assessment, Citygate offers the following deployment recommendations:

Recommendation #3: **Adopt Updated Deployment Policies:** The City Council should adopt updated, complete performance measures to aid deployment planning and to monitor performance. The measures of time should be designed to deliver outcomes that will save patients medically salvageable upon arrival and to keep small but serious fires from becoming more serious. With this is mind, Citygate recommends the following measures for the City's planning zones:

3.1 Distribution of Fire Stations: To treat pre-hospital medical emergencies and control small fires, the first-due unit should arrive within 7:30 minutes, 90 percent of the time from the receipt of the 9-1-1 call; this equates to a 90-second dispatch time, 2:00-minute company turnout time, and 4:00-minute travel time.

3.2 Multiple-Unit Effective Response Force for Serious Emergencies: To confine building fires near the room of origin, keep vegetation fires under one acre in size, and treat multiple medical patients at a single incident, a multiple-unit ERF of at least 16 personnel, including at least one Chief Officer, should arrive within 11:30 minutes from the time of 9-1-1 call receipt in fire dispatch, 90 percent of the time; this equates to a 90-second dispatch time, 2:00-minute company turnout time, and 8:00-minute travel time.

3.3 Hazardous Materials Response: Provide hazardous materials response designed to protect the City from the hazards associated with uncontrolled release of hazardous and toxic materials. The fundamental mission of the Fire Department's response is to isolate the hazard, deny entry into the hazard zone, and notify appropriate officials/resources to minimize impacts on the community. This can be achieved with a first-due total response time of 7:30 minutes or less to provide initial hazard evaluation and/or mitigation actions. After the initial evaluation is completed, a determination can be made whether to request additional resources from the regional hazardous materials team.

3.4 Technical Rescue: Respond to technical rescue emergencies as efficiently and effectively as possible with enough trained personnel to facilitate a successful rescue with a first-due total response time of 7:30 minutes or less to evaluate the situation and/or initiate rescue actions. Following the initial evaluation, assemble additional resources as needed within a total response time of 11:30 to safely complete rescue/extrication and delivery of the victim to the appropriate emergency medical care facility.

SECTION 3—FUTURE SERVICE NEEDS AND ALTERNATIVE SERVICE MODELS

This section of the report details Citygate's analysis of the City's future fire service needs and prospective alternate emergency and non-emergency service models.

3.1 FUTURE SERVICE NEEDS

3.1.1 Future Growth and Development

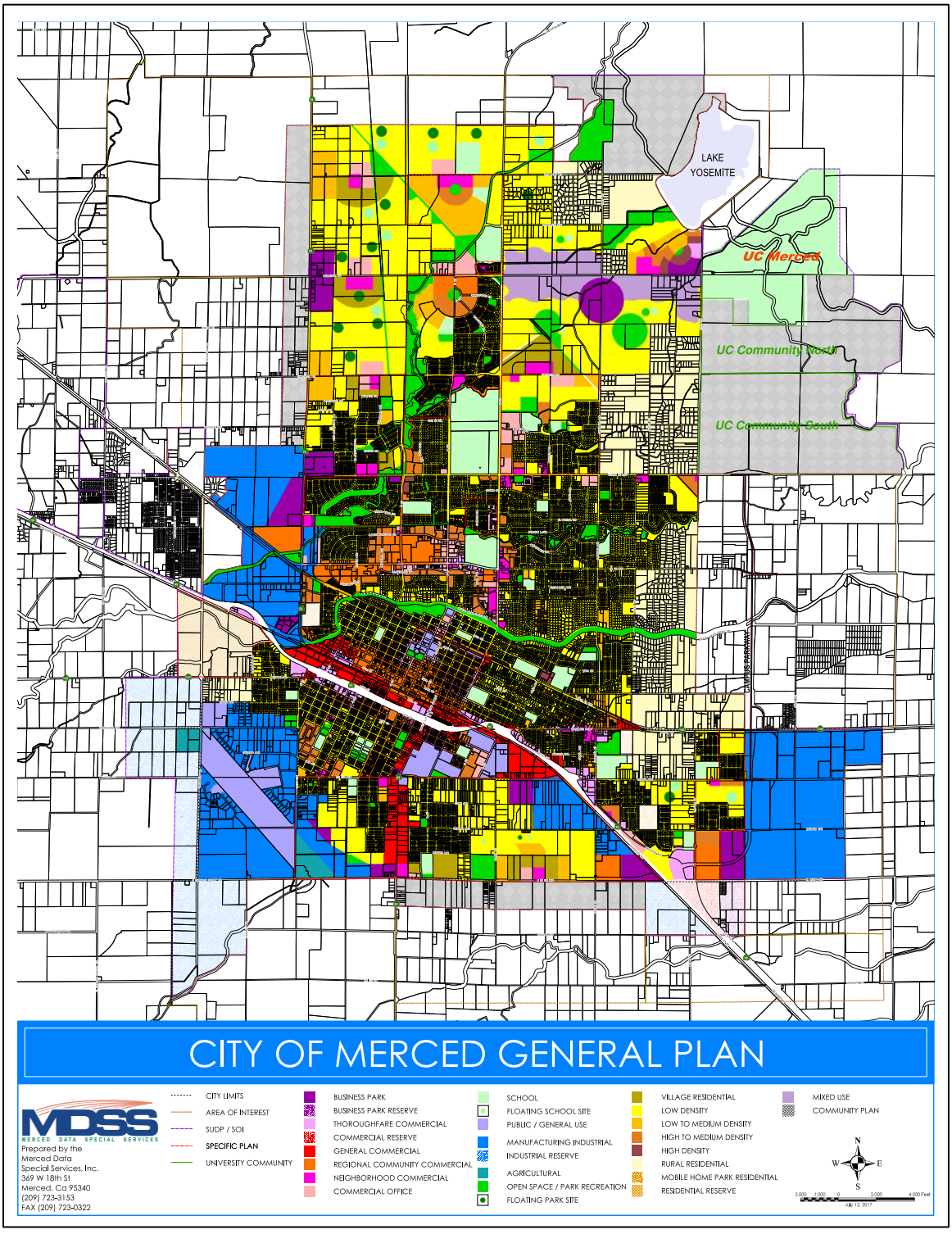
Land Use

The Merced Vision 2030 General Plan establishes 17 land use goals as follows:

1. Housing opportunities in balance with jobs created in the Merced Urban Area.
2. A wide range of residential densities and housing types in the City.
3. Preservation and enhancement of existing neighborhoods.
4. Quality residential environments.
5. Mixed-use, transit, and pedestrian-friendly residential environments.
6. Ensure adequate housing is available to all segments of the population.
7. Increased employment opportunities for the citizens of Merced.
8. A diverse and balanced economy.
9. Preservation and expansion of the City's economic base.
10. High quality industrial areas, including technology parks.
11. More high-quality research and development parks.
12. Ready access to commercial centers and services throughout the City.
13. A distinguished Downtown.
14. Living environments which encourage people to use a variety of transportation alternatives.
15. A compact urban village design for new growth areas.
16. Self-sustaining, mixed use, pedestrian-friendly neighborhoods.
17. Transit-oriented development adjacent to the high-speed rail station.

Figure 12 illustrates the various land use designations for the City.

Figure 12—City of Merced Land Use Map



Future Growth

Table 18 summarizes projected population and housing unit growth within the City of Merced to the year 2030.

Table 18—Projected Population and Housing Unit Growth

Planning Area	Growth Factor								
	Population				Housing Units				
	2017[1]	2030[2]	Projected Growth (Units)	Projected Growth (Percent)	2017[1]	Persons Per Household[3]	2030[4]	Projected Growth (Units)	Projected Growth (Percent)
City of Merced	84,464	102,952	18,488	**21.89%**	27,718	3.16	32,580	4,862	**17.54%**

[1] California Department of Finance, Table E-5
[2] Merced County Forecast Summary, University of the Pacific, Eberhardt School of Business, Center for Business and Policy Research (July, 2016) – Table 1
[3] Merced City Vision 2030 General Plan, Land Use Element
[4] Calculated from projected population and persons per household

As Table 18 shows, population and housing units within the City are projected to grow by nearly 22 percent and 18 percent respectively over the next 13 years to 2030, or an average annualized growth rate of 1.5 and 1.2 percent. Although no data was available relative to current or projected non-residential development, it would be reasonable to anticipate a similar growth rate.

> **Finding #13:** The City's population is projected to grow 22 percent over the next 13 years to 2030, or an annualized average of 1.5 percent.

Communication with the City's Economic Development Department indicates there is prospective interest to develop areas within the City's current northeast Sphere of Influence that would provide substantial additional housing units and related commercial development.

3.1.2 Future Service Demand

Service demand (calls for service) for fire agencies is predominantly a function of population and demographics: higher population densities and lower socio-economic demographics drive service demand up.

As Map #5 illustrates, the population density in the City ranges from less than 500 to more than 10,000 people per square mile. Also, as Table 21 in Appendix A.1.4 shows, the City's population is generally educated, employed, and covered by health insurance. In addition, a majority of the housing units are owner-occupied. While the poverty rate is relatively high, the violent crime rate

within the City is low. These factors, in aggregate, tend to result in lower service demand than other communities of similar population density with lower socio-economic demographics.

Although service demand data prior to 2014 was not reviewed for this assessment, service demand over the past three years has increased an average of 29.3 percent annually as shown in Table 19. The preponderance of that service demand increase, however, is due to a policy change in 2015 resulting in response to all Priority 1 and Priority 2 medical emergencies, rather than just Priority 1 medical emergencies as in previous years. While building fire service demand has trended upward slightly, the number of building fire incidents remains low.

Table 19—Service Demand History

Year	Incidents	Change
2014	6,352	N/A
2015	9,267	45.89%
2016	10,077	8.74%
Total	**25,696**	**58.64%**

Source: City of Merced Fire Department incident records

Given the City's demographics, zoning regulations, service demand history, and projected growth, Citygate projects a continued service demand increase, averaging approximately 5-10 percent annually, over the next 13 years to 2030. In Citygate's opinion, this projected service demand increase will require additional incremental fire service capacity, particularly in the north and northeastern areas of the City as growth expands toward the UC Merced campus.

Finding #14: Annual fire service demand is projected to increase an estimated 5–10 percent annually over the next 13 years to 2030, requiring additional incremental fire service capacity as the City continues to expand.

3.1.3 Future Facility, Resource, and Staffing Needs

Facilities

As discussed in Section 2.8, current fire station locations preclude equitable first-due and ERF response performance to all areas of the City. *If* desired outcomes include minimizing permanent impairment resulting from a medical emergency, and/or limiting building fire damage to only part of the inside of an affected building, then the City will need first-due response coverage within a recommended 7:30 minutes (4:00 minutes travel time) from 9-1-1 notification, and ERF response coverage within 11:30 minutes (8:00 minutes travel time) of 9-1-1 notification, in all planning zones.

As further discussed in Section 2.8, there are currently six areas within the City beyond 4:00 minutes first-due travel time from an existing fire station, and thus more than the 7:30-minute total response time recommended to achieve desired outcomes. For two of these areas, Gap Area 2 and Gap Area 5, this could be resolved by relocating existing fire station facilities as capital planning and funding permit. The largest gap area, Gap Area 1, will require an additional fire station facility to adequately serve existing and future development north of Merced College to about Bellevue Road without diluting services to the remainder of the City. In addition to these current response gaps, one or more additional fire station facilities will eventually be needed to serve future growth areas within the City's current/projected sphere of influence.

In planning fire station siting to optimize deployment, Citygate recommends that agencies/jurisdictions consider the following key principles:

- Strive to serve the most population in the least amount of travel time.
- To the extent possible, provide a 360-degree first-due service area within the desired response performance goal.
- Avoid crossing political boundaries and/or natural or human-built travel barriers[14] within a station's first-due travel time goal.

Recommendation #4:	The City should initiate planning for an additional fire station to serve existing and future development generally north of Merced College.
Recommendation #5:	The City should consider relocating Fire Station 52 and/or Fire Station 54 as capital planning and funding permit, to expand first-due travel time coverage in the southwest and southeast areas of the City.
Recommendation #6:	The City should initiate fire station location planning and site acquisition to serve future development within the City's current/projected sphere of influence considering the deployment recommendations in this report.

Resources

As Map #13 shows, the Department's single ladder truck at Station 51 *should* provide 8:00-minute travel time coverage to nearly the entire City without traffic congestion. However; analysis of 81

[14] Such as freeways, railroads, rivers, lakes, open-space areas, etc.

incidents over the three-year study period, where the Department's full ERF response of four engines, the aerial ladder truck, and a Battalion Chief arrived at the incident, shows a 90th percentile ERF travel time of 11:41, which is 3:41 (46 percent) *slower* than the 8:00-minute best practice standard. Although this analysis does not identify which resource was last to arrive at each of these incidents, in Citygate's experience, the aerial ladder truck is often the last to arrive when it must traverse more than two station response areas to get to the incident. While Citygate considers the ladder truck's current location appropriate given the risks in the downtown area, it is reasonable to conclude that travel time coverage for that specialized resource is impacted by traffic congestion and/or train movements, particularly to the northern areas of the City. In addition to its aerial and ground ladder capabilities, this apparatus carries other specialized firefighting and rescue equipment not provided on other Department apparatus. Because of these specialized capabilities, and the travel distance and time from Station 51, the Department and City should consider adding a second ladder truck in the north/northeast section of the City as development continues to expand in that direction as strategic planning and fiscal resources permit.

Recommendation #7:	As strategic planning and fiscal resources permit, the Department and City should consider a second ladder truck in the north/northeast section as development continues to expand in that direction toward UC Merced.

Staffing

The City of Merced is somewhat unique in that it is essentially an urban "island" for fire protection services. Although the Merced County Fire Department has one fire station within the current City limits and another within the City's sphere of influence, both stations are staffed with one on-duty Fire Captain or Engineer supported by paid-call firefighters as available. While this staffing model may be suitable for rural population density areas, it is inadequate to provide expected first-due fire and EMS in urban populated areas and does little to augment the City Department's on-duty capacity for serious emergency incidents. This is further exacerbated by the fact that the City and County do not have an automatic mutual aid agreement and are dispatched by separate dispatch/communication centers, thus delaying any potential assistance as may be needed.

In addition, the City of Atwater, located approximately seven miles (10:00 minutes travel time) northwest of downtown Merced, has two fire stations, each staffed with two on-duty personnel. Like Merced County, the City of Atwater County does not have an automatic mutual aid agreement with the City of Merced and is dispatched by a separate dispatch/communication center, thus delaying any potential assistance as may be needed.

Local and regional mutual aid resources available to Merced thus either lack sufficient on-duty staffing and/or are not available within desired ERF travel time to provide any substantive

augmentation to City fire service capacity. The City must therefore be essentially self-sufficient in providing first-due and ERF resources within desired response performance parameters. While the Department's current minimum daily staffing of 19 personnel is nominally sufficient for a single serious fire incident as previously discussed, the City should consider adding at least one additional staffed resource as funding is available and additional staffed resource(s) over the longer term as the City completes expansion within its current sphere of influence.

Recommendation #8:	As strategic planning and fiscal resources permit, the City should consider adding at least one additional staffed resource to provide expanded first-due and ERF service capacity.

3.1.4 Prospective Alternative Service Delivery Models

As discussed in Section A.1.6, EMS capacity appears to be increasingly impacted by prolonged ALS ambulance response times due to a reported statewide paramedic shortage and significant patient offload delays at Mercy Medical Center impacting ambulance availability for subsequent emergency responses.

This impact could be at least partially mitigated should the Department choose to expand its current service capacity to include pre-hospital ALS (paramedic) emergency medical services. In addition to generally providing ALS services for EMS patients *faster* than the current service model, this option would also likely reduce the need for an ALS ambulance on all EMS calls as the paramedic would have the authority to cancel the ambulance for the high percentage of calls not requiring ambulance transportation to a hospital emergency department.

While providing ALS service capacity would not of itself remedy the extended EMS on-scene impact, it could provide the foundation for the Department to negotiate an agreement with Riggs to provide surge capacity ALS ambulance transportation whenever Riggs reaches a specified ambulance draw-down level. In exchange for this surge transport capability, the fire agency typically receives the revenue for the transport from the ambulance company. This, in combination with implementation of emergency department recommendations contained in the Merced County EMS System Review Report, could resolve many of the current pre-hospital EMS impacts within the City.

Additionally, as an incremental step to providing expanded first-due EMS and initial firefighting service capacity for one or more of the five gap areas identified in Section 2.8.1, the Department

might also consider adding one or more "rapid response"[15] units staffed with two personnel, including at least one paramedic if the Department chooses to provide ALS services.

A third potential service delivery alternative involves shared fire and EMS with UC Merced. Under this model, a fire station could be sited to serve both the UC campus and adjacent City areas, with costs proportionately shared between the two jurisdictions.

Recommendation #9:	The City and Department should consider expanding current EMS capacity to include ALS (paramedic) services as strategic planning and funding permit.
Recommendation #10:	The City and Department should evaluate the advantages of deploying one or more "rapid response" apparatus as an incremental step to additional full engine/truck companies to serve current deployment gap areas and/or future growth areas.
Recommendation #11:	The City should consider exploring a shared-cost fire and EMS partnership with UC Merced.

[15] Smaller (1- to 1.5-ton) apparatus with EMS and fire suppression service capability

SECTION 4—FINDINGS AND RECOMMENDATIONS

The following is a complete list of the findings and recommendations contained in this report.

4.1 FINDINGS

Finding #1: The Department has established response performance objectives partially consistent with best practice recommendations as published by the Commission on Fire Accreditation International.

Finding #2: The Department has a standard response plan that considers risk and establishes an appropriate initial response for each incident type; each type of call for service receives the combination of engines, trucks, ambulances, specialty units, and command officers customarily needed to effectively control that type of incident based on Department experience.

Finding #3: The Department's day-of-week and month-of-year service demand are consistent, indicating the need for a 24-hour-per-day, seven-days-per-week fire and EMS emergency response system.

Finding #4: Call to First Arrival performance *is meeting or nearly meeting* the recommended goal of 7:30 minutes or less to facilitate desired outcomes in urban areas.

Finding #5: Effective Response Force (ERF) Call to First Arrival performance is *slightly slower* than the recommended goal of 11:30 minutes or less to facilitate desired outcomes in urban areas.

Finding #6: Call processing performance *fails to meet* the best practice standard of 1:30 minutes or less by 40 percent.

Finding #7: Crew turnout performance *is slightly better* than a Citygate-recommended goal of 2:00 minutes or less.

Finding #8: First-due travel time performance *fails to meet* the recommended 4:00-minute goal by 40 seconds (17 percent).

Finding #9: Effective Response Force (ERF) travel time performance is *46 percent slower* (3:41 minutes) than the best practice goal of 8:00 minutes or less recommended to achieve desired outcomes in urban/suburban areas.

Finding #10: Of all incident activity in 2016, slightly more than 28 percent involved two or more simultaneous (concurrent) incidents.

Finding #11: Simultaneous incident activity minimally impacts overall response performance but is increasing annually.

Finding #12: Simultaneous incident activity *within the same station response area* does not yet significantly impact first-due response performance.

Finding #13: The City's population is projected to grow 22 percent over the next 13 years to 2030, or an annualized average of 1.5 percent.

Finding #14: Annual fire service demand is projected to increase an estimated 5–10 percent annually over the next 13 years to 2030, requiring additional incremental fire service capacity as the City continues to expand.

4.2 RECOMMENDATIONS

Recommendation #1: The City should consider Communications Center staffing as a critical element of its emergency response system during annual budget planning.

Recommendation #2: The Fire Department should collaborate with the Police Department Communications Center to establish and implement call processing performance standards consistent with industry-recognized best practices and to monitor and report call processing performance monthly.

Recommendation #3: **Adopt Updated Deployment Policies:** The City Council should adopt updated, complete performance measures to aid deployment planning and to monitor performance. The measures of time should be designed to deliver outcomes that will save patients medically salvageable upon arrival and to keep small but serious fires from becoming more serious. With this is mind, Citygate recommends the following measures for the City's planning zones:

3.1 Distribution of Fire Stations: To treat pre-hospital medical emergencies and control small fires, the first-due unit should arrive within 7:30 minutes, 90 percent of the time from the receipt of the 9-1-1 call; this equates to a 90-second dispatch time, 2:00-minute company turnout time, and 4:00-minute travel time.

3.2 Multiple-Unit Effective Response Force for Serious Emergencies: To confine building fires near the room of origin,

keep vegetation fires under one acre in size, and treat multiple medical patients at a single incident, a multiple-unit ERF of at least 16 personnel, including at least one Chief Officer, should arrive within 11:30 minutes from the time of 9-1-1 call receipt in fire dispatch, 90 percent of the time; this equates to a 90-second dispatch time, 2:00-minute company turnout time, and 8:00-minute travel time.

3.3 Hazardous Materials Response: Provide hazardous materials response designed to protect the City from the hazards associated with uncontrolled release of hazardous and toxic materials. The fundamental mission of the Fire Department's response is to isolate the hazard, deny entry into the hazard zone, and notify appropriate officials/resources to minimize impact on the community. This can be achieved with a first-due total response time of 7:30 minutes or less to provide initial hazard evaluation and/or mitigation actions. After the initial evaluation is completed, a determination can be made whether to request additional resources from the regional hazardous materials team.

3.4 Technical Rescue: Respond to technical rescue emergencies as efficiently and effectively as possible with enough trained personnel to facilitate a successful rescue with a first-due total response time of 7:30 minutes or less to evaluate the situation and/or initiate rescue actions. Following the initial evaluation, assemble additional resources as needed within a total response time of 11:30 to safely complete rescue/extrication and delivery of the victim to the appropriate emergency medical care facility.

Recommendation #4: The City should initiate planning for an additional fire station to serve existing and future development generally north of Merced College.

Recommendation #5: The City should consider relocating Fire Station 52 and/or Fire Station 54 as capital planning and funding permit, to expand first-due travel time coverage in the southwest and southeast areas of the City.

Recommendation #6: The City should initiate fire station location planning and site acquisition to serve future development within the City's current/projected sphere of influence considering the deployment recommendations in this report.

Recommendation #7: As strategic planning and fiscal resources permit, the Department and City should consider a second ladder truck in the north/northeast section as the City continues to expand in that direction toward UC Merced.

Recommendation #8: As strategic planning and fiscal resources permit, the City should consider adding at least one additional staffed resource to provide expanded first-due and ERF service capacity.

Recommendation #9: The City and Department should consider expanding current EMS capacity to include ALS (paramedic) services as strategic planning and funding permit.

Recommendation #10: The City and Department should evaluate the advantages of deploying one or more "rapid response" apparatus as an incremental step to additional full engine/truck companies to serve current deployment gap areas and/or future growth areas.

Recommendation #11: The City should consider exploring a shared-cost fire and EMS partnership with UC Merced.

SECTION 5—NEXT STEPS

The purpose of a Standards of Coverage Assessment is to compare the Department's current performance against the local risks to be protected and recognized best practices. This analysis of performance forms the basis from which to make recommendations for changes, if any, in fire station locations, staffing, and equipment. Citygate suggests that Department leadership work through the issues identified in this study as follows:

5.1 NEAR-TERM

- Review and absorb the content, findings, and recommendations of this report.
- Share key elements of this report with other project stakeholders.
- Adopt revised response performance goals as recommended in Section 2.8.2.
- Initiate collaboration with the Police Department and City Manager's Office to address the call processing performance issue identified in Section 2.7.2.

5.2 LONGER-TERM

- Develop and implement a strategic plan to minimally prioritize and address the recommendations contained in this report.
- Collaborate with the City Manager's Office to initiate location planning and site acquisition for future fire stations within the City's current/projected sphere of influence considering the deployment recommendations in Sections 2.8 and 3.1.3.
- Monitor response performance and adjust deployment policies as appropriate.

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APPENDIX A—RISK ASSESSMENT

A.1 COMMUNITY RISK ASSESSMENT

SOC ELEMENT 3 OF 8
COMMUNITY RISK ASSESSMENT

The third element of the SOC process is a community risk assessment. Within the context of an SOC study, the objectives of a community risk assessment are to:

1. Identify the values at risk to be protected within the community or service area.
2. Identify the specific hazards with the potential to adversely impact the community or service area.
3. Quantify the overall risk associated with each hazard.
4. Establish a foundation for current/future deployment decisions and risk-reduction/hazard mitigation planning and evaluation.

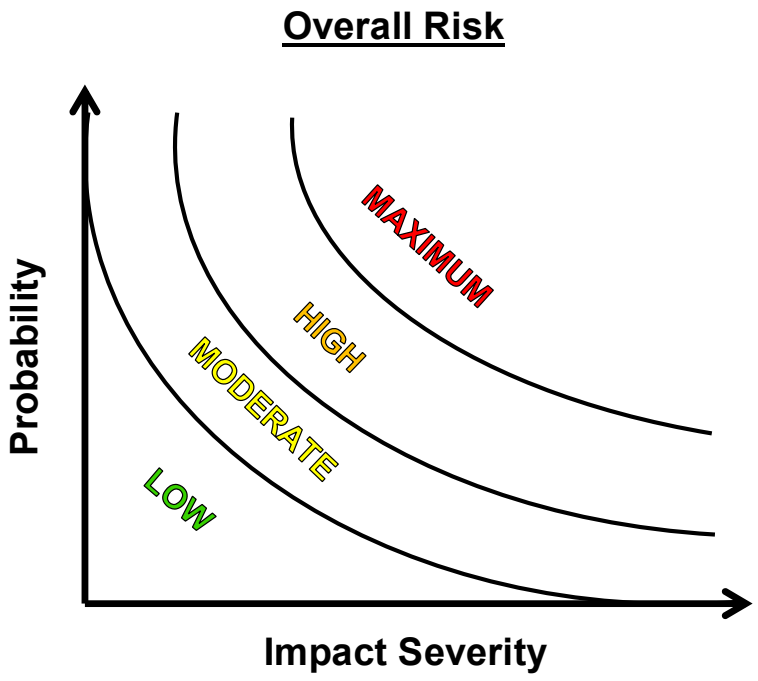
A *hazard* is broadly defined as a situation or condition that can cause or contribute to harm. Examples include fire, medical emergency, vehicle collision, earthquake, flood, etc. *Risk* is broadly defined as the *probability of hazard occurrence* in combination with the *likely severity of resultant impacts* to people, property, and the community as a whole.

A.1.1 Risk Assessment Methodology

The methodology employed by Citygate to assess community risks as an integral element of an SOC study incorporates the following elements:

- Identification of geographic planning sub-zones (risk zones) appropriate to the community or jurisdiction.
- Identification and quantification (to the extent data is available) of the specific values at risk to various hazards within the community or service area.
- Identification of the fire and non-fire hazards to be evaluated.
- Determination of the probability of occurrence for each hazard.
- Identification and evaluation of multiple relevant impact severity factors for each hazard by planning zone using agency/jurisdiction-specific data and information.
- Quantification of overall risk for each hazard based on probability of occurrence in combination with probable impact severity as shown in Figure 13.

Figure 13—Overall Risk



Source: Commission on Fire Accreditation International (CFAI): *Community Risk Assessment: Standards of Coverage (6th Edition)*

Citygate used multiple data sources to understand the hazards and values to be protected in the District as follows:

- U.S. Census Bureau population and demographic data.
- Insurance Services Office (ISO) building fire flow and construction data.
- City of Merced Geographical Information Systems (GIS) data.
- City of Merced General Plan and zoning information.
- City of Merced Local Hazard Mitigation Plan.
- City of Merced Fire Department data and information.

A.1.2 Risk Assessment Summary

Citygate's evaluation of the values to be protected and probable hazards likely to impact the City yields the following conclusions.

- The City has a diverse urban population.

- The City's population is projected to grow 22 percent over the next 13 years to 2030, or an average of 1.5 percent annually.
- The City has an inventory of residential, commercial, office, industrial, educational, and other non-residential uses typical of other central California communities of similar size and demographics.
- The City has economic and natural resource values to be protected, as identified in this assessment.
- Some sections in the very northern and southern portions of the City lie within a *recommended* ***Moderate*** wildland Fire Hazard Severity Zone (FHSZ), as determined by the California Department of Forestry and Fire Protection (CAL FIRE).
- The City has established appropriate emergency evacuation protocols, procedures, and resources in its Emergency Operations Plan.
- Merced County has established a mass emergency telephone notification system to effectively communicate emergency information to the public in a timely manner, including the City of Merced.
- The City's overall risk for five hazards related to emergency services provided by the Fire Department range from ***LOW*** to ***HIGH***, as summarized in Table 20.

Table 20—Overall Risk by Hazard

Hazard		Planning Zone				
		Sta. 51	Sta. 52	Sta. 53	Sta. 54	Sta. 55
1	**Building Fire**	***HIGH***	***MODERATE***	***HIGH***	***MODERATE***	***MODERATE***
2	**Vegetation/Wildland Fire**	***LOW***	***LOW***	***MODERATE***	***LOW***	***LOW***
3	**Medical Emergency**	***HIGH***	***HIGH***	***HIGH***	***HIGH***	***HIGH***
4	**Hazardous Material**	***HIGH***	***MODERATE***	***MODERATE***	***HIGH***	***MODERATE***
5	**Technical Rescue**	***MODERATE***	***MODERATE***	***MODERATE***	***MODERATE***	***MODERATE***

A.1.3 Planning Zones

The CFAI recommends that jurisdictions establish geographic planning zones to better understand risk at a sub-jurisdictional level. For example, portions of a jurisdiction may contain predominantly moderate risk building occupancies, such as detached single-family residences, while other areas contain high or maximum risk occupancies, such as commercial and industrial buildings with a high hazard fire load. If risk were to be evaluated on a jurisdiction-wide basis, the predominant

moderate risk could outweigh the high or maximum risk and may not be a significant factor in an overall assessment of risk. If, however, those high or maximum risk occupancies are a larger percentage of the risk in a smaller planning zone, then it becomes a more significant risk factor. Another consideration in establishing planning zones is that the jurisdiction's record management system must also track the specific zone for each incident to be able to appropriately evaluate service demand and response performance relative to each specific zone. For this assessment, Citygate utilized five planning zones incorporating each fire station's first-due response areas as shown in Map #2.

A.1.4 Values at Risk to be Protected

This section identifies, describes, and quantifies (as data is available) the values at risk to be protected within the City. *Values at risk,* broadly defined, are tangibles of significant importance or value to the community or jurisdiction potentially at risk of harm or damage from a hazard occurrence. Values to be protected typically include people, critical facilities/infrastructure, buildings, and key economic, cultural, historic, and/or natural resources.

People

Residents, employees, visitors, and travelers through a community or jurisdiction are vulnerable to harm from a hazard occurrence. Particularly vulnerable are specific at-risk populations, including those unable to care for themselves or self-evacuate in the event of an emergency. At-risk populations typically include children less than 10 years of age, the elderly, and people housed in institutional settings. Table 21 summarizes key City demographic data.

Table 21—Key Merced City Demographic Data

Demographic	2015	Percentage
Population	**81,120**	
Under 10 years	14,404	17.76%
10 – 19 years	13,219	16.30%
20 – 64 years	45,781	56.44%
65-74 years	4,587	5.65%
75 years and older	3,129	3.86%
Median age	**28.9**	N/A
Housing Units	**27,161**	
Owner-Occupied	10,383	38.23%
Renter-Occupied	15,060	55.48%
Median Household Size	**3.16**	N/A
Ethnicity		
White	44,837	56.50%
Hispanic/Latino[1]	40,876	50.39%
Black/African American	5,403	6.66%
Asian	10,922	13.46%
Other	18,158	22.38%
Education (population over 24 yrs. of age)	**45,400**	**68.51%**
High School Graduate	30,869	67.99%
Undergraduate Degree	4,739	10.44%
Graduate/Professional Degree	2,954	6.51%
Employment (population over 15 yrs. of age)	**58,300**	**81.57%**
In Labor Force	34,741	59.59%
Unemployed	5,931	17.07%
Population Below Poverty Level	25,877	31.90%
Population without Health Insurance Coverage	10,315	12.56%

[1] Subset of "White" in U.S. Census Bureau data

Source: U.S. Census Bureau

Of note from Table 21 is the following:

- Slightly more than 27 percent of the population is under 10 or over 64 years of age.
- The City's population is predominantly White (56 percent), followed by Asian (13 percent), Black/African American (7 percent), and other ethnicities (22 percent).
- Of the population over 24 years of age, 68 percent has completed high school or equivalent.
- Of the population over 24 years of age, 17 percent has an undergraduate, graduate, or professional degree.
- Just less than 60 percent of the population 16 years of age or older are in the workforce; of those, 17 percent are unemployed.
- Nearly 32 percent of the population is below the federal poverty level.
- Nearly 13 percent of the population has no health insurance coverage.
- The City's population density ranges from less than 500 to more than 10,000 people per square mile.

Buildings

The City has an inventory of more than 27,000 housing units, as well as an equally large inventory of office, commercial, professional services, retail sales, restaurants/bars, motels, churches, schools, government facilities, healthcare facilities, industrial, and other non-residential occupancies, including 938 high- or maximum-risk occupancies.

Building Occupancy Risk Categories

CFAI identifies four risk categories that relate to building occupancy, as follows:

Low Risk – includes detached garages, storage sheds, outbuildings, and similar building occupancies that pose a relatively low risk of harm to humans or the community if damaged or destroyed by fire.

Moderate Risk – includes detached single-family or two-family dwellings; mobile homes; commercial and industrial buildings less than 10,000 square feet without a high hazard fire load; aircraft; railroad facilities; and similar building occupancies where loss of life or property damage is limited to the single building.

High Risk – includes apartment/condominium buildings; commercial and industrial buildings more than 10,000 square feet without a high hazard fire load; low-occupant load buildings with high fuel loading or hazardous materials; and similar occupancies with potential for substantial loss of life or unusual property damage or financial impact.

Maximum Risk – includes buildings or facilities with unusually high risk requiring an ERF involving a significant augmentation of resources and personnel and where a fire would pose the potential for a catastrophic event involving large loss of life and/or significant economic impact to the community.

Table 22, Table 23, and Map #6 summarize the City's inventory of ***High*** and ***Maximum*** risk building occupancies.

Table 22—High Risk Building Inventory

Occupancy Classification		Number	CFAI Risk Category
Assembly	A-1 Theater	**7**	**Maximum**
	A-2 Bar/Restaurant	**97**	**High**
	A-3 Public Assembly	**95**	**High**
	A-4 Indoor Sports	**2**	**Maximum**
Education	Schools, Day Care	**33**	**High**
Factory	F-1 Moderate Risk	**33**	**High**
	F-2 Low Risk	**10**	**High**
Hazardous	H-2 Accelerated Fire Hazard	**13**	**Maximum**
	H-3 High Physical Hazard	**27**	**Maximum**
	H-4 Health Hazard	**2**	**Maximum**
Institutional	I-2 Medical Care Facility	**11**	**High**
	I-2.1 Ambulatory Care	**6**	**High**
	I-3 Detention Facility	**4**	**High**
	I-4 Day Care	**63**	**High**
Residential	R-1 Hotel/Motel	**21**	**High**
	R-2 Multi-Family	**470**	**High**
	R-2.1 Assisted Living	**7**	**High**
	R-3.1 Residential Care ≤ 6	**31**	**High**
	R-4 Residential Care > 6	**6**	**High**
	Total	**938**	

Source: City of Merced Fire Department

Table 23 further summarizes the distribution of high-risk building occupancies by planning zone.

Table 23—High Risk Building Occupancy Distribution

Risk Factor	Planning Zone					Total[1]
	Sta. 51	Sta. 52	Sta. 53	Sta. 54	Sta. 55	
High Risk Occupancies	385	148	160	120	96	**909**
Percentage of Total	*42.35%*	*16.28%*	*17.60%*	*13.20%*	*10.56%*	***100.00%***

[1] Unable to map all identified sites due to lack of address or geo-coordinates
Source: City of Merced Fire Department

Critical Facilities/Infrastructure

The U.S. Department of Homeland Security defines "Critical Facilities / Key Resources" (CIKR) as those physical assets essential to the public health and safety, economic vitality, and resilience of a community. For this assessment, the Department identified 135 critical facilities as summarized in Table 24 and Map #3. A hazard occurrence with significant impact severity affecting one or more of these facilities would likely adversely impact critical public or community services.

Table 24—Critical Facilities Distribution

Risk Factor	Planning Zone					Total[1]
	Sta. 51	Sta. 52	Sta. 53	Sta. 54	Sta. 55	
Critical Facilities	63	9	23	12	10	**117**
Percentage of Total	*53.85%*	*7.69%*	*19.66%*	*10.26%*	*8.55%*	***100.00%***

[1] Unable to map all identified sites due to lack of address or geo-coordinates
Source: City of Merced Fire Department

Economic Resources[16]

Key employers within the City include the County of Merced, UC Merced, Mercy Medical Center, Merced City School District, Merced Union High School District, Merced College, City of Merced, Quad Graphics, AT&T Mobility, and Walmart, employing more than 10,000 employees in aggregate.

[16] City of Merced Comprehensive Annual Financial Report, 2010

Natural Resources

Natural resources within the City of Merced include Bear, Cottonwood, Fahrens, and Black Rascal creeks, numerous smaller tributaries and canals, and numerous neighborhood parks and open spaces.

Cultural/Historic Resources

No cultural or historic resources were identified for this study.

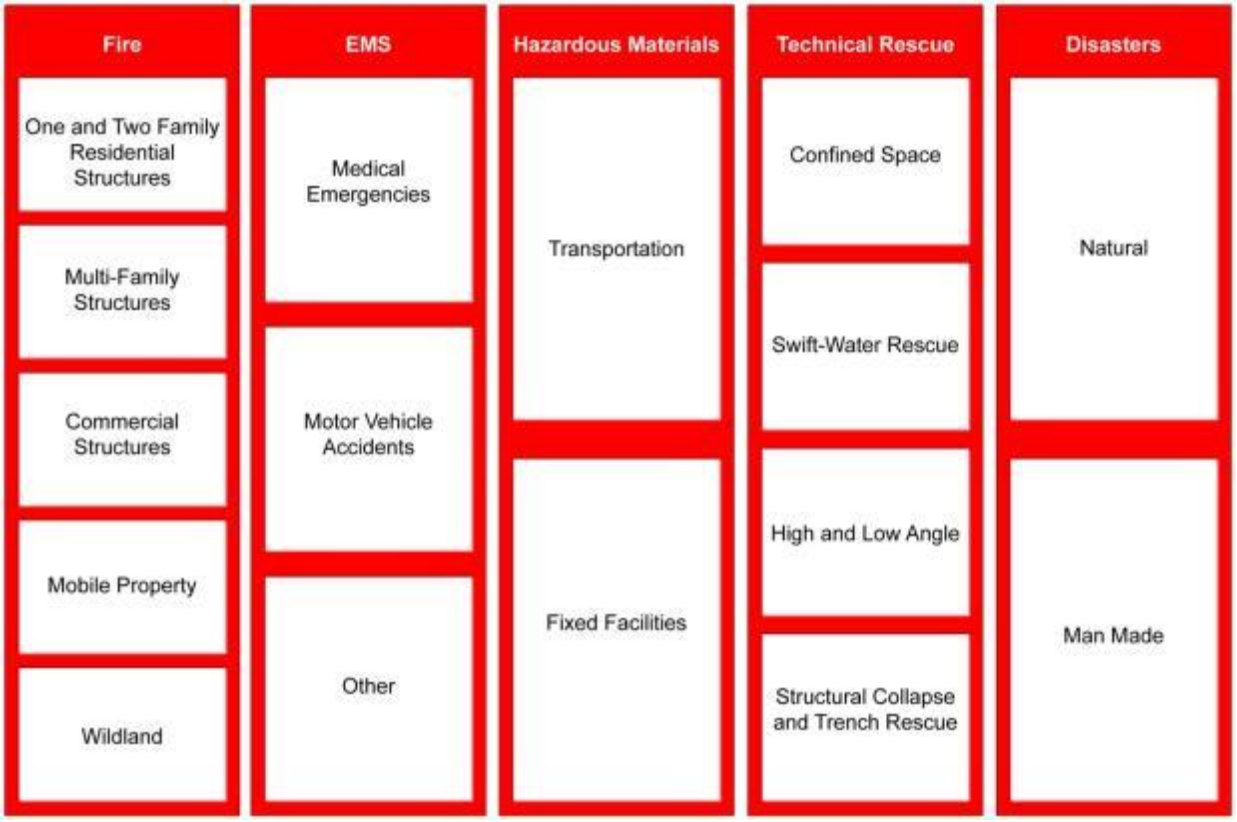
A.1.5 Hazard Identification

Citygate utilizes prior risk studies where available, fire and non-fire hazards as identified by the CFAI, and agency-/jurisdiction-specific data and information to identify the hazards to be evaluated for this study.

The 2015 City of Merced Local Hazard Mitigation Plan (LHMP) identifies six hazards relating to services provided by the Fire Department, including dam failure, earthquake, fire, flooding, hazardous materials, and storm-related hazards. Although the City has no legal authority or responsibility to mitigate dam failure, earthquake, or flood risk other than for City-owned facilities, the Fire Department does provide services related to these hazards, including fire suppression, emergency medical services, technical rescue, and hazardous materials response.

The CFAI groups hazards into fire and non-fire categories, as shown in Figure 14. Identification, qualification, and quantification of the various fire and non-fire hazards are important factors in evaluating how resources are or can be deployed to mitigate those risks.

Figure 14—CFAI Hazard Categories



Source: CFAI *Standards of Coverage* (5th Edition)

Following review and evaluation of the hazards identified in the 2015 City of Merced LHMP, and the fire and non-fire hazards as identified by the CFAI as they relate to services provided by the Department, Citygate evaluated the following five hazards for this risk assessment:

1. Building Fire.
2. Vegetation/Wildland Fire.
3. Medical Emergency.
4. Hazardous Material Release/Spill.
5. Technical Rescue.

A.1.6 Service Capacity

Service capacity refers to the Department's available response force; the size, types, and condition of its response fleet and any specialized equipment; core and specialized performance capabilities and competencies; resource distribution and concentration; availability of automatic and/or mutual

aid; and any other agency-specific factors influencing its ability to meet current and prospective future service demand relative to the risks to be protected.

Fire Department service capacity consists of a minimum daily on-duty force of 19 personnel staffing five fire engines, one ladder truck, and one command unit from five stations. Department response personnel are trained to the EMT level capable of providing BLS pre-hospital emergency medical care. ALS pre-hospital emergency medical care and ground ambulance transportation is provided by Riggs Ambulance Service under an exclusive operating area, performance-based contract with the MCEMSA. Air ambulance services, when needed, are provided by Air Methods and CalStar from the Merced Municipal Airport, and PHI from Modesto. Mercy Medical Center is the single hospital providing emergency medical services in Merced. The nearest trauma centers are Doctors Medical Center and Memorial North in Modesto, both of which are Level 2 trauma centers.

A review of ambulance contract compliance, as reported by the MCEMSA, shows that ambulance response performance met the response time requirement of 10:59 minutes or less for 90 percent of Priority 1 (life-threatening) calls within the High-Density Zone[17] from January 1, 2015 to May 31, 2017. Contract compliance *fell below 90 percent,* however, for June, August, and September of 2017, the most recent reporting period available. Both Riggs and County EMS staff advised Citygate that a statewide shortage of licensed paramedics has impacted Riggs and other ALS ambulance service providers' ability to provide the number of paramedics needed daily to meet contractual response performance. In addition, a January 2017 EMS System Review Report[18] cites the delayed transfer of patients to emergency department personnel at Mercy Medical Center in Merced as a continuing problem. Transfer delays require that ambulance personnel maintain patient care until the receiving medical center can accept the patient; the ambulance is thus not available to respond to emergencies until the patient transfer occurs. A 2014 statewide report[19] also cited "very significant" to "extremely significant" patient offload delays in Merced County. This, combined with the reported shortage of paramedics, is increasingly impacting the Department's available service capacity due to prolonged ALS ambulance response times and associated extended on-scene times for Department resources at EMS incidents.

All Department response personnel are also trained to the U.S. Department of Transportation Hazardous Material First Responder Operational level to provide initial hazardous material incident assessment, hazard isolation, and decontamination assistance for the Merced County Fire

[17] Includes the incorporated Cities of Merced, Atwater, Dos Palos, Gustine, Livingston, and Los Banos.

[18] *Merced County EMS System Review Report*, Page, Wolfberg and Wirth, January 2017

[19] Toolkit to Reduce Ambulance Patient Offload Delays in the Emergency Department, California Hospital Association, August 2014

Department Hazardous Materials Response Team. The Department does not have enough qualified personnel or equipment to enter and mitigate a hazardous materials incident.

All Department response personnel are trained to the Office of the State Fire Marshal Rescue Systems I level for technical rescue, which now includes Low Angle Rope Rescue Operational (LARRO). Most personnel have also been trained to the Trench Rescue Technician level, and some personnel have been further trained to the Rescue Systems II, Rescue Systems III, Swift Water Rescue Technician, and/or Confined Space Rescue Technician level. Future Department goals include training all personnel to the Rope Rescue Technician and High Angle Rope Rescue levels. The Department operates a cross-staffed OES Type-II medium rescue unit from Station 55 that includes tools and equipment to conduct heavy wall construction, high-angle rope, confined space, trench, and excavation rescue operations.

While the Department has mutual aid agreements with Merced County and the adjacent City of Atwater, mutual aid resources generally lack suitable on-duty staffing and/or are not available within desired ERF travel time to provide any substantive augmentation to City fire service capacity.

A.1.7 Probability of Occurrence

Probability of occurrence refers to the probability of a future hazard occurrence during a specific time. Because the CFAI Agency Accreditation process requires annual review of an agency's risk assessment and baseline performance measures, Citygate recommends using the 12 months following completion of an SOC study as an appropriate period for the probability of occurrence evaluation. Table 25 summarizes the five probability of occurrence categories and related scoring criteria used for this analysis.

Table 25—Probability of Occurrence Scoring Criteria

Score	Probable Occurrence	Description	General Criteria
0 – 1.0	**Very Low**	Improbable	Hazard occurrence is *unlikely*
1.25 – 2.0	**Low**	Rare	Hazard *could occur*
2.25 – 3.0	**Moderate**	Infrequent	Hazard *should occur* infrequently
3.25 – 4.0	**High**	Likely	Hazard *likely to occur* regularly
4.25 – 5.0	**Very High**	Frequent	Hazard is *expected to occur* frequently

Citygate's Standards of Coverage assessments use recent multiple-year hazard response data to determine the probability of hazard occurrence for the ensuing 12-month period.

A.1.8 Impact Severity

Impact severity refers to the extent of hazard occurrence impacts on people, buildings, lifeline services, the environment, and the community as a whole. Table 26 summarizes the five impact severity categories and related scoring criteria used for this analysis.

Table 26—Impact Severity Scoring Criteria

Score	Impact Severity	General Criteria
0 – 1.0	Insignificant	• No serious injuries or fatalities • Few persons displaced for only a short duration • None or inconsequential damage • None or very minimal disruption to community • No measurable environmental impacts • Little or no financial loss
1.25 – 2.0	Minor	• Some minor injuries; no fatalities expected • Some persons displaced for less than 24 hours • Some minor damage • Minor community disruption; no loss of lifeline services • Minimal environmental impacts with no lasting effects • Minor financial loss
2.25 – 3.0	Moderate	• Some hospitalizations; some fatalities expected • Localized displacement of persons for up to 24 hours • Localized damage • Normal community functioning with some inconvenience • Minor loss of critical lifeline services • Some environmental impacts with no lasting effects, or small environmental impact with long-term effect • Moderate financial loss
3.25 – 4.0	Major	• Extensive serious injuries; significant number of persons hospitalized • Many fatalities expected • Significant displacement of many people for more than 24 hours • Significant damage requiring external resources • Community services disrupted; some lifeline services potentially unavailable • Some environmental impacts with long-term effects • Major financial loss
4.25 – 5	Catastrophic	• Large number of severe injuries and fatalities • Local/regional hospitals impacted • Large number of persons displaced for an extended duration • Extensive damage • Widespread loss of critical lifeline services • Community unable to function without significant support • Significant environmental impacts and/or permanent environmental damage • Catastrophic financial loss

A.1.9 Overall Risk

Overall hazard risk is determined by multiplying the *probability of occurrence score* by the *impact severity score*. The resultant total determines the *overall risk rating* as described in Table 27.

Table 27—Overall Risk Score and Rating

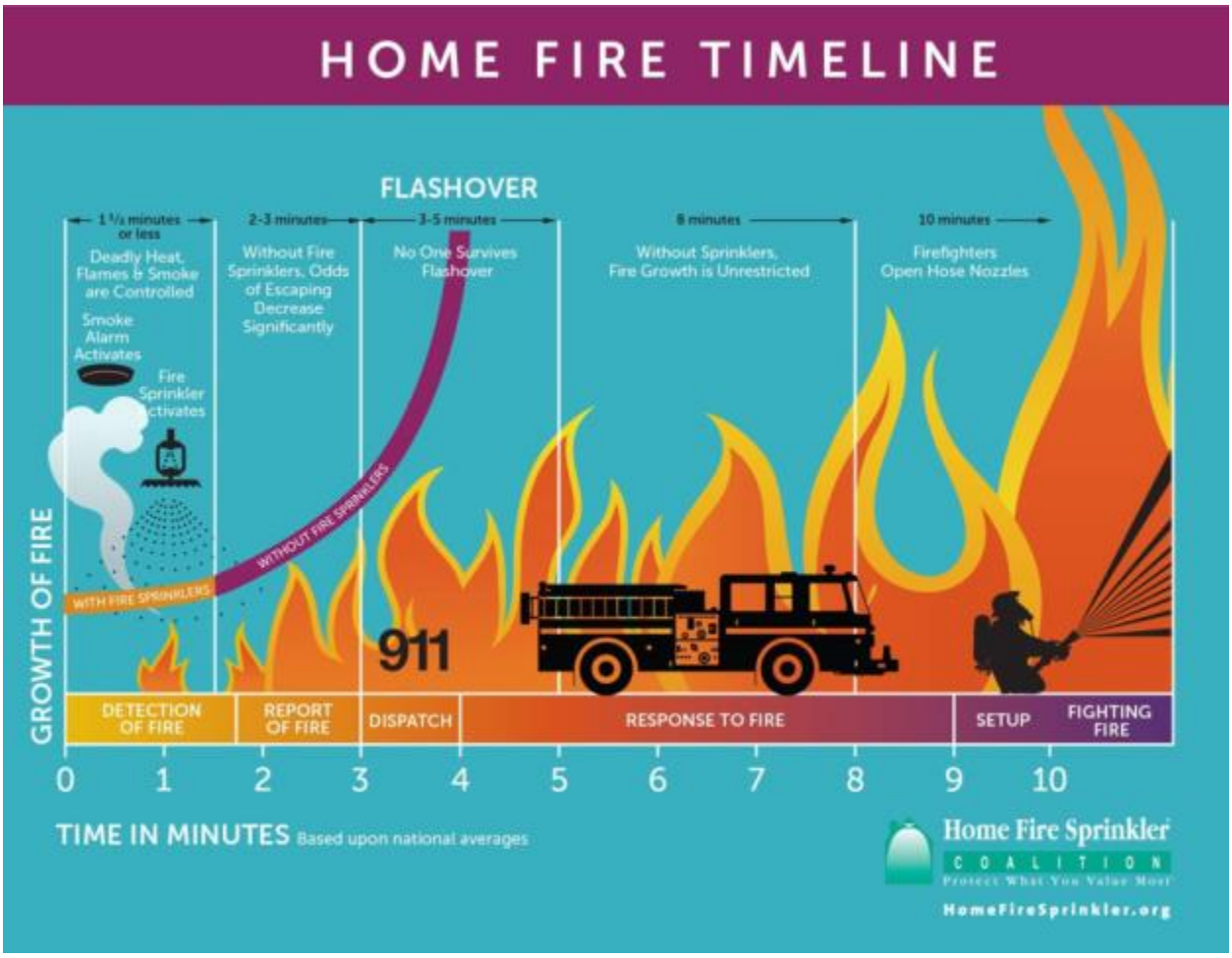
Overall Risk Score	Overall Risk Rating
0–4.99	*Low*
5–11.99	*Moderate*
12–19.99	*High*
20–25	*Maximum*

A.1.10 Building Fire Risk

One of the primary hazards in any community is building fire. Building fire risk factors include building density, size, age, occupancy, and construction materials and methods, as well as number of stories above ground level, required fire flow, proximity to other buildings, built-in fire protection/alarm systems, available water supply, building fire service capacity, fire suppression resource deployment (distribution/concentration), staffing, and response time. Citygate used available data from the City, the U.S. Census Bureau, and the ISO to assist in determining the City's building fire risk.

Figure 15 illustrates the building fire progression timeline and shows that flashover, which is the point at which the entire room erupts into fire after all the combustible objects in that room reach their ignition temperature, can occur as early as 3:00 to 5:00 minutes from the initial ignition. Human survival in a room after flashover is extremely improbable.

Figure 15—Building Fire Progression Timeline



Source: http://www.firesprinklerassoc.org

Population Density

Population density within the City ranges from less than 500 to more than 10,000 people per square mile, as illustrated in Map #5. Although risk analysis across a wide spectrum of other Citygate clients shows no direct correlation between population density and building fire *occurrence*, it is reasonable to conclude that building fire *risk* relative to potential impact on human life is greater as population density increases, particularly in areas with high density, multiple-story buildings.

High Risk Building Occupancies

The City has 938 high risk building occupancies as described in Section A.1.4.

High Fire Flow Requirements

One of the many factors evaluated by the ISO is needed fire flow (NFF), which is the amount of water that would be required in gallons-per-minute (GPM) if the building were seriously involved in fire. For the City, the ISO database identifies 1,112 buildings evaluated, 354 of which have an NFF greater than 1,500 GPM, as shown in Table 28 and Map #4.

Table 28—High Needed Fire Flow Occupancies

Risk Factor	Planning Zone					Total[1]
	Sta. 51	Sta. 52	Sta. 53	Sta. 54	Sta. 55	
High NFF Occupancies	176	25	88	40	25	**354**
Percentage of Total	*49.72%*	*7.06%*	*24.86%*	*11.30%*	*7.06%*	***100.00%***

[1] Unable to map all identified sites due to lack of address or geo-coordinates

Source: Insurance Services Office

This is a significant amount of firefighting water to deploy, and a major fire at any one of these buildings would require commitment of the Department's entire on-duty force plus mutual aid. Using a generally accepted figure of 50 gallons-per-minute per firefighter on large building fires, a fire in a building requiring 1,500 gallons-per-minute would require 30 firefighters, which is 11 more personnel than the Department's daily staffing level. A significant fire in any of these buildings not protected by an automatic fire sprinkler and/or fire detection/alarm system would likely have a high impact severity.

Water Supply

A reliable public water system providing adequate volume, pressure, and flow duration in close proximity to all buildings is a critical factor in mitigating the potential impact severity of a community's building fire risk. The Water Division of the City Public Works Department operates and maintains the potable water production and distribution system, which consists of 17 active wells, over 500 miles of distribution pipeline, and nearly 3,000 fire hydrants, to provide a peak daily usage and available fire flow of more than 35 million gallons per day for City residents and businesses.

According to Fire Department staff, available fire flow is very good throughout the City, with no specific areas of concern.

Building Fire Service Demand

For the three-year period from January 1, 2014, through December 31, 2016, the City experienced 293 building fire incidents comprising 1.14 percent of total service demand over the same period, as summarized in Table 29 and Map #18.

Table 29—Building Fire Service Demand

Risk	Year	Planning Zone					Total	Percent of Total Service Demand
		Sta. 51	Sta. 52	Sta. 53	Sta. 54	Sta. 55		
Building Fire	2014	14	14	37	22	15	102	1.61%
	2015	31	13	20	16	6	86	1.13%
	2016	43	13	19	16	14	105	1.04%
Total		88	40	76	54	35	293	1.14%
Percent of Total Service Demand		1.08%	1.26%	1.15%	1.25%	1.01%	1.14%	

Source: City of Merced Fire Department incident records

As Table 29 shows, building fire service demand decreased 16 percent in 2015 from the previous year, then increased 22 percent in 2016, with the highest volume of incidents occurring at Station 51 and the lowest at Station 55. Overall, the City's building fire service demand is very low, comprising slightly more than one percent of all calls for service, which is typical of other California communities of similar size and demographics.

Probability of Building Fire Occurrence

Table 30 summarizes Citygate's scoring of the City's probability of building fire occurrence by planning zone based on service demand from Table 29.

Table 30—Building Fire Probability Score

Building Fire	Planning Zone				
	Sta. 51	Sta. 52	Sta. 53	Sta. 54	Sta. 55
Probability of Occurrence	4.0	3.25	4.0	3.25	3.25

Building Fire Impact Severity

Table 31 summarizes Citygate's scoring of probable building fire impact severity by planning zone.

Table 31—Building Fire Impact Severity Score

Building Fire	Planning Zone				
	Sta. 51	Sta. 52	Sta. 53	Sta. 54	Sta. 55
Probable Impact Severity	3.0	3.0	3.0	3.0	3.0

Overall Building Fire Risk

Table 32 summarizes Citygate's overall assessment of the City's building fire risk by planning zone.

Table 32—Overall Building Fire Risk Rating

Building Fire	Planning Zone				
	Sta. 51	Sta. 52	Sta. 53	Sta. 54	Sta. 55
Overall Risk Score	12.0	9.75	12.0	9.75	9.75
Risk Rating	*HIGH*	*MODERATE*	*HIGH*	*MODERATE*	*MODERATE*

A.1.11 Vegetation/Wildland Fire Risk

Wildland fire is also significant risk for some cities, particularly those with large undeveloped or open space areas, or wildland urban interface (WUI) areas where human population and related development exist within a predominantly wildland vegetation fuel environment. In other cities, there is little or no risk of a wildland fire given the topography, lack of significant quantity and concentration of wildland vegetative fuels, and predominantly concentrated urban development. These communities, however, generally have undeveloped areas, dedicated open spaces, and/or vacant lots that pose some level of fire risk when annual grasses, weeds, and/or brush dry out during the summer months and become a fire hazard. While most urban communities have a weed abatement program to mitigate such risk, a fire in any vegetative fuel has the potential to spread to other combustibles, including buildings. Thus, even a small vegetation fire can pose significant risk to an urban community under the right conditions.

Wildland Fire Hazard Severity Zones

The California Department of Forestry and Fire Protection (CAL FIRE) designates wildland Fire Hazard Severity Zones (FHSZ) throughout the state based on analysis of multiple wildland fire

hazard factors and modeling of potential wildland fire behavior. For State Responsibility Areas (SRAs) where CAL FIRE has fiscal responsibility for wildland fire protection, CAL FIRE designates ***Moderate***, ***High***, and ***Very High*** FHSZs by county. Incorporated cities, federal, and military lands are specifically *excluded* as State Responsibility Areas.

CAL FIRE also identifies recommended FHSZs for Local Responsibility Areas (LRAs), where a local jurisdiction bears the fiscal responsibility for wildland fire protection, including the City of Merced, as shown in Figure 16.

Figure 16—LRA Wildland Fire Hazard Severity Zones

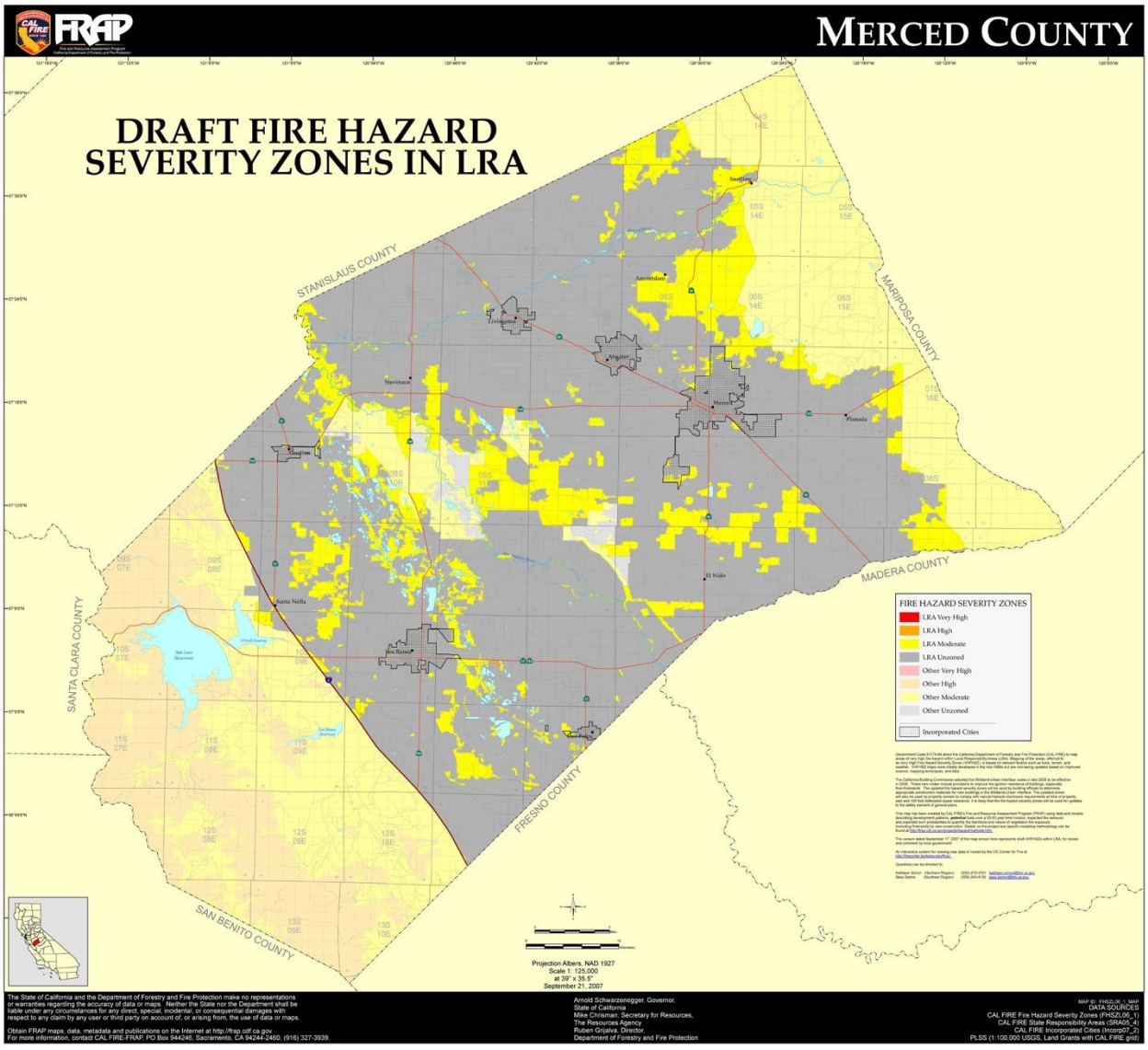
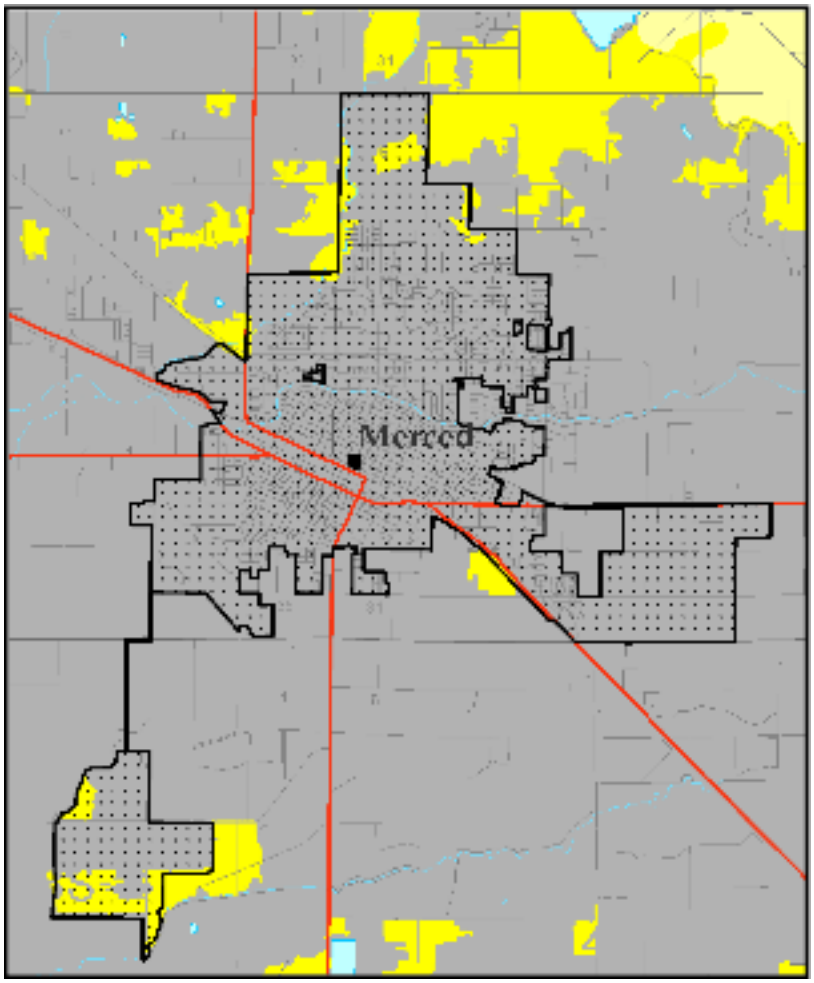


Figure 17 shows a close-up view of Figure 16 as it relates specifically to the City of Merced.

Figure 17—Fire Hazard Severity Zones – City of Merced



As Figure 16 and Figure 17 show, sections in the very northern and southern sections of the City lie within a *recommended* ***Moderate*** LRA FHSZ with up to hundreds of contiguous acres of wildland fuels.

Vegetation/Wildland Fuels

Wildland fuel factors influencing fire intensity and spread include fuel type (vegetation species), height, arrangement, density, and moisture. Vegetative fuels within the City consist of a mix of annual grasses and weeds, shrubs, and deciduous and evergreen trees. Once ignited, vegetation fires can burn intensely and contribute to rapid fire spread under the right fuel, weather, and topographic conditions.

Weather

Weather elements such as temperature, relative humidity, wind, and lightning also affect vegetation fire potential and behavior. High temperatures and low relative humidity dry out vegetative fuels, creating a situation where fuels will more readily ignite and burn more intensely. Wind is the most significant weather factor influencing vegetation fire behavior; higher wind speeds increase fire spread and intensity. The annual wildland fire season in Merced County, when vegetation fires are most likely to occur due to fuel and weather conditions, is generally from mid to late May through late October / early November.

Topography

The City's flat topography has minimal impact on the spread of a wildland fire.

Water Supply

Another significant wildland fire impact severity factor is water supply immediately available for suppression. Available fire flow is very good throughout the City.

Vegetation/Wildland Fire Hazard Mitigation

Hazard mitigation refers to specific actions or measures taken to prevent a hazard from occurring and/or to minimize the severity of impacts resulting from a hazard occurrence. While none of the hazards subject to this study can be entirely prevented, measures *can* be taken to minimize the consequences or impacts when those hazards do occur.

The Merced City Code includes a special nuisance abatement proceeding for weeds and rubbish that allows the City to abate such hazards pursuant to appropriate notice and failure of the property owner to abate the hazard. The Fire Prevention Division administers and manages the City's weed abatement program.

Vegetation/Wildland Fire Service Demand

The City experienced 283 vegetation/wildland fires from January 2014 through December 2016, comprising 1.10 percent of total service demand over the same period, as summarized in Table 33.

Table 33—Vegetation/Wildland Fire Service Demand History

Risk	Year	Planning Zone					Total	Percent of Total Service Demand
		Sta. 51	Sta. 52	Sta. 53	Sta. 54	Sta. 55		
Vegetation / Wildland Fire	2014	15	5	17	16	5	58	0.91%
	2015	20	11	59	8	20	118	1.27%
	2016	26	7	41	24	9	107	1.06%
Total		61	23	117	48	34	283	1.10%
Percent of Total Service Demand		0.75%	0.72%	1.78%	1.11%	0.98%	1.10%	

Source: City of Merced Fire Department incident records

As Table 33 shows, vegetation/wildland fire service demand increased more than 100 percent in 2015 from the previous year, remaining stable in 2016, with Station 53 having the highest demand and Station 52 having the lowest. Overall, the City's vegetation/wildland fire service demand is very low.

Probability of Occurrence

Table 34 summarizes Citygate's scoring of the City's probability of vegetation/wildland fire occurrence by planning zone based on service demand history from Table 33.

Table 34—Wildland Fire Probability Scoring

Vegetation/Wildland Fire	Planning Zone				
	Sta. 51	Sta. 52	Sta. 53	Sta. 54	Sta. 55
Probability of Occurrence	3.75	3.25	4.25	3.5	3.25

Wildland Fire Impact Severity

Table 35 summarizes Citygate's scoring of the City's probable vegetation/wildland fire impact severity by planning zone.

Table 35—Wildland Fire Impact Severity Scoring

Vegetation/Wildland Fire	Planning Zone				
	Sta. 51	Sta. 52	Sta. 53	Sta. 54	Sta. 55
Probable Impact Severity	1.25	1.25	1.25	1.25	1.25

Overall Vegetation/Wildland Fire Risk Rating

Table 36 summarizes Citygate's overall assessment of the City's vegetation/wildland fire risk by planning zone.

Table 36—Overall Vegetation/Wildland Fire Risk Rating

Vegetation/Wildland Fire	Planning Zone				
	Sta. 51	Sta. 52	Sta. 53	Sta. 54	Sta. 55
Overall Risk Score	4.6875	4.0625	5.3125	4.375	4.0625
Risk Rating	*LOW*	*LOW*	*MODERATE*	*LOW*	*LOW*

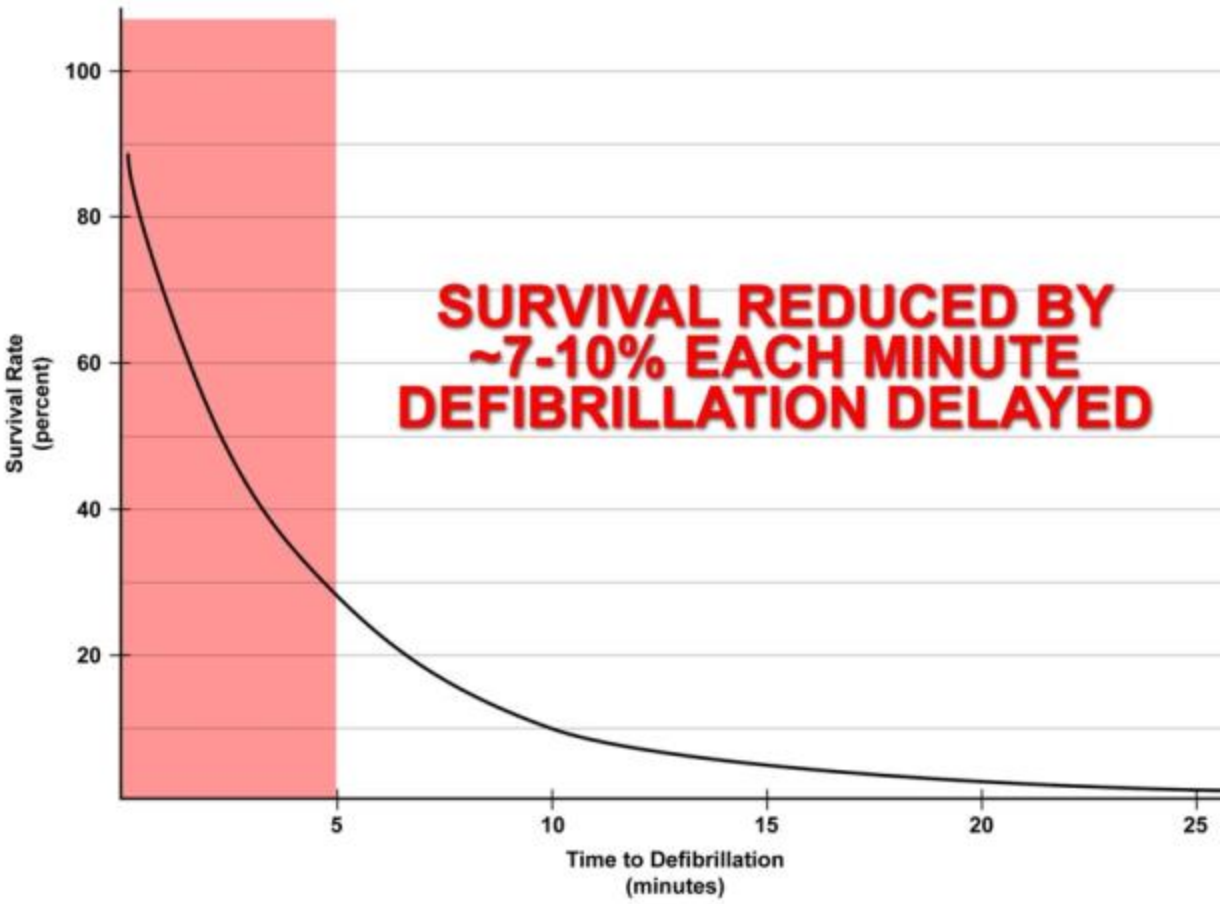
A.1.12 Medical Emergency Risk

Medical emergency risk in most communities is predominantly a function of population density, demography, violence, health insurance coverage, and vehicle traffic.

Medical emergency risk can also be categorized as either a medical emergency resulting from a health-related condition or event, or a traumatic injury.

Figure 18 illustrates the reduced survivability of a cardiac arrest victim as time to defibrillation increases. While early defibrillation is one factor in cardiac arrest survivability, other factors can influence survivability as well, such as early CPR and pre-hospital advanced life support interventions.

Figure 18—Survival Rate versus Time of Defibrillation



Source: www.suddencardiacarrest.com

Population Density

Because medical emergencies involve people, it seems logical that higher population densities generate higher medical emergency service demand than lower population densities. In Citygate's experience, this is particularly true for urban population densities. As illustrated in Map #5, the City's population density ranges from less than 500 per square mile to more than 10,000 per square mile.

Demography

Medical emergency risk tends to be higher among older, poorer, less-educated, and uninsured populations. According to the U.S. Census Bureau, 9.5 percent of the City's population is 65 and older; 31.9 percent of the population is at or below poverty level; 32 percent of the population over

24 years of age has less than a high school diploma or equivalent; and 12.5 percent of the population does not have health insurance coverage.[20]

Violence

As would be expected, medical emergency risk is also higher in communities or segments of communities with higher rates of violence. From 2010 through 2014, the most recent year of available data, there were a total of 2,988 violent crimes committed in the City of Merced, or an annual average of 598.[21] Given the City's 81,000 population, this represents a violent crime rate of 0.74 percent, suggesting that violent crime minimally influences the City's medical emergency risk.

Vehicle Traffic

Medical emergency risk tends to be higher in those areas of a community with high daily vehicle traffic volume, particularly those areas with high traffic volume travelling at high speeds. The City's transportation network includes Highways 59, 99, and 140, which carry a combined annual average daily traffic volume of more than 96,000 vehicles, with a peak-hour load of more than 7,800 vehicles.[22]

Medical Emergency Service Demand

Medical emergency service demand over the previous three years includes 16,573 calls for service comprising 64.5 percent of total service demand over the same period, as summarized in Table 37.

Table 37—Medical Emergency Service Demand History

Risk	Year	Planning Zone					Total	Percent of Total Service Demand
		Sta. 51	Sta. 52	Sta. 53	Sta. 54	Sta. 55		
Medical Emergency	2014	1,087	495	1,111	677	443	3,813	60.03%
	2015	1,994	737	1,490	1,043	819	6,083	65.64%
	2016	2,080	766	1,811	1,123	897	6,677	66.26%
Total		**5,161**	**1,998**	**4,412**	**2,843**	**2,159**	**16,573**	**64.50%**
Percent of Total Service Demand		**63.48%**	**62.93%**	**66.95%**	**65.60%**	**62.27%**	**64.50%**	

Source: City of Merced Fire Department incident records

[20] Source: U.S. Census Bureau (2015)

[21] Source: Federal Bureau of Investigation, Uniform Crime Reporting Statistics

[22] Source: California Department of Transportation (2015)

As Table 37 shows, medical emergencies comprise the majority of the Department's overall service demand. While medical emergency service demand varies by station, overall it is trending upward an average of 34 percent annually over the past two years. Overall, the City's medical emergency service demand is typical of other California cities with similar demographics.

Probability of Occurrence

Table 38 summarizes Citygate's scoring of the City's probability of medical emergency occurrence by planning zone based on service demand history from Table 37.

Table 38—Probability of Medical Emergency Occurrence

Medical Emergency	Planning Zone				
	Sta. 51	Sta. 52	Sta. 53	Sta. 54	Sta. 55
Probability of Occurrence	5.0	4.25	5.0	4.5	4.5

Medical Emergency Impact Severity

Table 39 summarizes Citygate's scoring of the City's probable medical emergency impact severity by planning zone.

Table 39—Medical Emergency Impact Severity

Medical Emergency	Planning Zone				
	Sta. 51	Sta. 52	Sta. 53	Sta. 54	Sta. 55
Probable Impact Severity	3.0	3.0	3.0	3.0	3.0

Overall Medical Emergency Risk

Table 40 summarizes Citygate's overall assessment of the City's medical emergency risk by planning zone.

Table 40—Overall Medical Emergency Risk

Medical Emergency	Planning Zone				
	Sta. 51	Sta. 52	Sta. 53	Sta. 54	Sta. 55
Overall Risk Score	15.0	12.75	15.0	13.5	13.5
Risk Rating	*HIGH*	*HIGH*	*HIGH*	*HIGH*	*HIGH*

A.1.13 Hazardous Material Risk

Hazardous material risk factors include fixed facilities that store, use, or produce hazardous chemicals or waste; underground pipelines conveying hazardous materials; aviation, railroad, maritime, and vehicle transportation of hazardous materials into or through a jurisdiction; vulnerable populations; emergency evacuation planning and related training; and specialized hazardous material service capacity.

The Merced County Health Department Environmental Health Division, serving as the designated Certified Unified Program Agency (CUPA) for the County, identified 173 facilities within the City requiring a State or County hazardous material operating permit or Hazardous Materials Business Plan (HMBP), as summarized in Table 41 and Map #7.

Table 41—Hazardous Material Site Distribution

Risk Factor	Planning Zone					Total[1]
	Sta. 51	Sta. 52	Sta. 53	Sta. 54	Sta. 55	
Hazardous Material Sites	54	29	9	16	4	112
Percentage of Total	*48.21%*	*25.89%*	*8.04%*	*14.29%*	*3.57%*	***100.00%***

[1] Unable to map all identified sites due to lack of address or geo-coordinates
Source: Merced County Division of Environmental Health

The City also has transportation-related hazardous material risk as a result of its road transportation network, including Highway 99 with heavy daily truck traffic volume, as summarized in Table 42. In addition, three railway tracks run generally northwest/southeast through the City carrying more than 60 trains daily,[23] although no data was available quantifying the amount or types of hazardous materials transported.

[23] Source: Federal Railroad Administration

Table 42—Average Annual Daily Truck Traffic

Highway	Crossing	AADT[1]	Truck AADT by Axles				% Truck AADT by Axles			
			2	3	4	5+	2	3	4	5+
59	Hwy. 99 / 140	1,151	230	334	219	368	20.00%	29.00%	19.00%	32.00%
99	Hwy. 59 / 140	10,840	2,168	867	434	7,371	20.00%	8.00%	4.00%	68.00%
140	Hwy. 59 / 99	882	194	247	168	273	22.00%	28.00%	19.00%	31.00%
	Total	**12,873**	**2,592**	**1,448**	**821**	**8,012**	**20.14%**	**11.25%**	**6.38%**	**62.24%**

[1] AADT=Average Annual Daily Trips
Source: California Department of Transportation (2015)

Population Density

Because hazardous material emergencies have the potential to adversely impact human health, it is logical that the higher the population density, the greater the potential population exposed to a hazardous material release or spill. As previously illustrated in Map #5, the City's population density ranges from less than 500 per square mile to more than 10,000 per square mile.

Vulnerable Populations

Persons vulnerable to a hazardous material release/spill include those individuals or groups unable to self-evacuate, generally including children under the age of 10, the elderly, and persons confined to an institution or other setting where they either cannot or are unable to leave voluntarily. More than 27 percent of the City's population is under age 10 or age 65 and older.

Emergency Evacuation Planning, Training, Implementation, and Effectiveness

Another significant hazardous material impact severity factor is a jurisdiction's shelter-in-place / emergency evacuation planning and training. In the event of a hazardous material release or spill, time can be a critical factor in notifying potentially affected persons, particularly at-risk populations, to either shelter-in-place or to evacuate to a safe location. Essential to this process is an effective emergency plan that incorporates one or more mass emergency notification capabilities, as well as pre-established evacuation procedures. It is also essential to conduct regular, periodic exercises involving these two emergency plan elements to evaluate readiness and to identify and remediate any planning and/or training gaps to ensure ongoing emergency incident readiness and effectiveness.

The City has established emergency evacuation protocols, procedures, and resources as referenced in its Emergency Operations Plan, and is also a subscriber to the Merced County Emergency Notification System, a mass emergency telephone notification system administered by the Merced County Sheriff's Department 9-1-1 Dispatch Center. Authorized local public safety officials can directly request emergency notifications through the 9-1-1 dispatcher. This system is regularly

utilized throughout the County, and both public safety personnel and 9-1-1 Dispatch Center staff are well-versed with its use and procedures.

Hazardous Material Service Demand

The City experienced 207 hazardous material incidents over the past three years, comprising 0.81 percent of total service demand over the same period, as summarized in Table 43.

Table 43—Hazardous Material Service Demand History

Risk	Year	Planning Zone					Total	Percent of Total Service Demand
		Sta. 51	Sta. 52	Sta. 53	Sta. 54	Sta. 55		
Hazardous Material	2014	18	10	10	8	15	61	0.96%
	2015	26	8	17	19	14	84	0.91%
	2016	12	5	16	11	18	62	0.62%
Total		56	23	43	38	47	207	0.81%
Percent of Total Service Demand		0.69%	0.72%	0.65%	0.88%	1.36%	0.81%	

Source: City of Merced Fire Department incident records

As Table 43 indicates, hazardous material service demand varies by planning zone with the highest demand in Station 51's response area. Overall, hazardous materials service demand is very low and relatively consistent from year to year.

Probability of Occurrence

Table 44 summarizes Citygate's scoring of the City's probability of a hazardous materials occurrence by planning zone based on service demand history from Table 43.

Table 44—Probability of Hazardous Material Occurrence

Hazardous Material	Planning Zone				
	Sta. 51	Sta. 52	Sta. 53	Sta. 54	Sta. 55
Probability of Occurrence	3.75	3.25	3.5	3.5	3.5

Hazardous Material Impact Severity

Table 45 summarizes Citygate's scoring of the City's probable hazardous materials impact severity by planning zone.

Table 45—Hazardous Material Impact Severity

Hazardous Material	Planning Zone				
	Sta. 51	Sta. 52	Sta. 53	Sta. 54	Sta. 55
Probable Impact Severity	3.0	2.5	2.5	3.0	2.5

Overall Hazardous Material Risk

Table 46 summarizes Citygate's overall assessment of the City's hazardous materials risk by planning zone.

Table 46—Overall Hazardous Material Risk

Hazardous Material	Planning Zone				
	Sta. 51	Sta. 52	Sta. 53	Sta. 54	Sta. 55
Overall Risk Score	11.25	8.125	8.75	10.5	8.75
Risk Rating	*HIGH*	*MODERATE*	*MODERATE*	*HIGH*	*MODERATE*

A.1.14 Technical Rescue Risk

Technical rescue risk factors include active construction projects; structural collapse potential; confined spaces, such as tanks and underground vaults; bodies of water and rivers or streams; industrial machinery; transportation volume; and earthquake, flood, and landslide potential.

Construction Activity

There is continuous construction activity within the City, including residential, commercial, industrial, and infrastructure.

Confined Spaces

There are numerous confined spaces within the City, including tanks, vaults, open trenches, etc.

Bodies of Water

There are numerous creeks, canals, and smaller bodies of water within the City, including Bear, Cottonwood, Fahrens, and Black Rascal creeks.

Transportation Volume

Another risk factor is transportation-related incidents requiring technical rescue. This factor is primarily a function of vehicle, railway, maritime, and aviation traffic. Vehicle traffic volume is the greatest of these factors within the City, with Highways 59, 99, and 140 carrying more than

96,000 vehicles daily with peak-hour flow of more than 7,800 vehicles. In addition, there are three railway tracks running generally northwest/southeast through the City carrying more than 60 trains daily.[24] The California High-Speed Rail Project (HSRP) will add an average of 120 trains per day during Phase 1 (initial service), and 336-360 per day by Horizon Year 2035.[25] The Merced Regional Airport is a general aviation facility located on the western edge of the City. Citygate was unable to locate data quantifying flight activity for this airport.

Earthquake Risk[26]

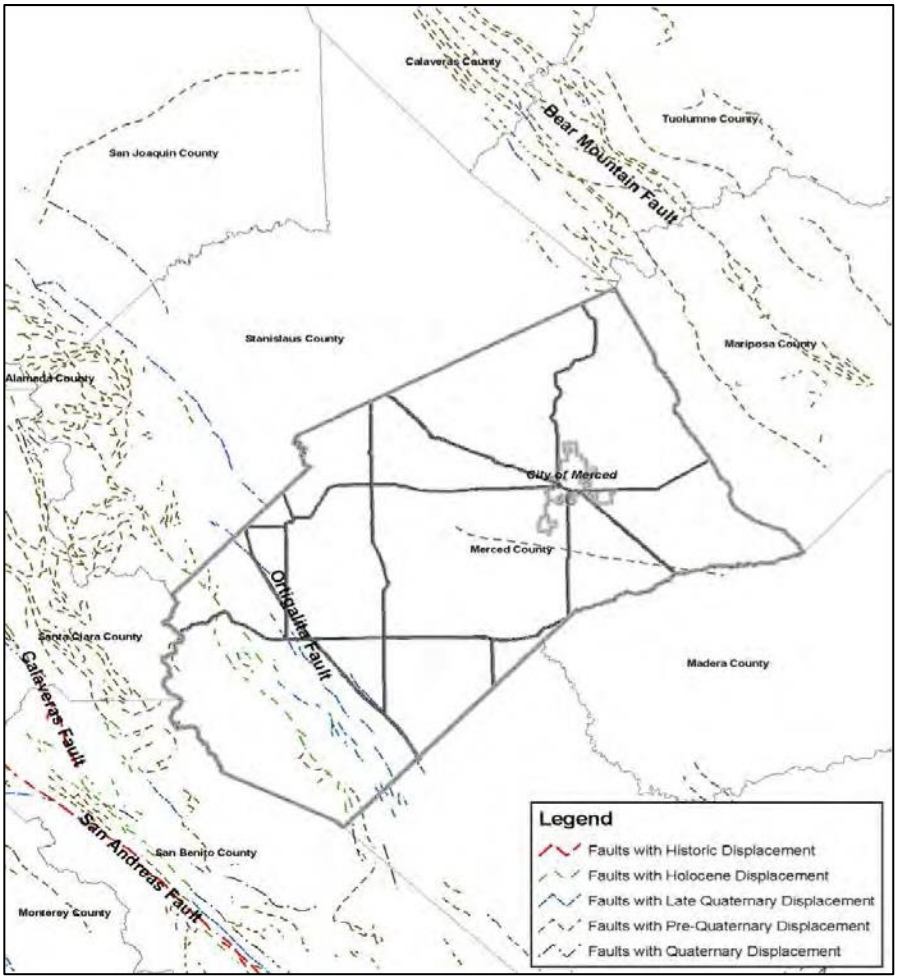
Although no know faults occur in the City, there are several active and potentially active fault lines to the east and west of Merced as shown in Figure 19.

[24] Source: Federal Railroad Administration

[25] Source: California High-Speed Train Project EIR/EIS Fresno to Bakersfield Section, Appendix 2-C, Operations and Service Plan Summary

[26] Reference: City of Merced Local Hazard Mitigation Plan

Figure 19—Earthquake Fault Zones



Source: City of Merced Local Hazard Mitigation Plan

A cooperative probable seismic hazards study conducted by the California Division of Mines and Geology and U.S. Geological Survey concluded that the City of Merced is located in an area identified to have to lowest level of Peak Ground Acceleration, corresponding to magnitude 4.0 to 4.5, or light perceived shaking and little or no perceived damage.

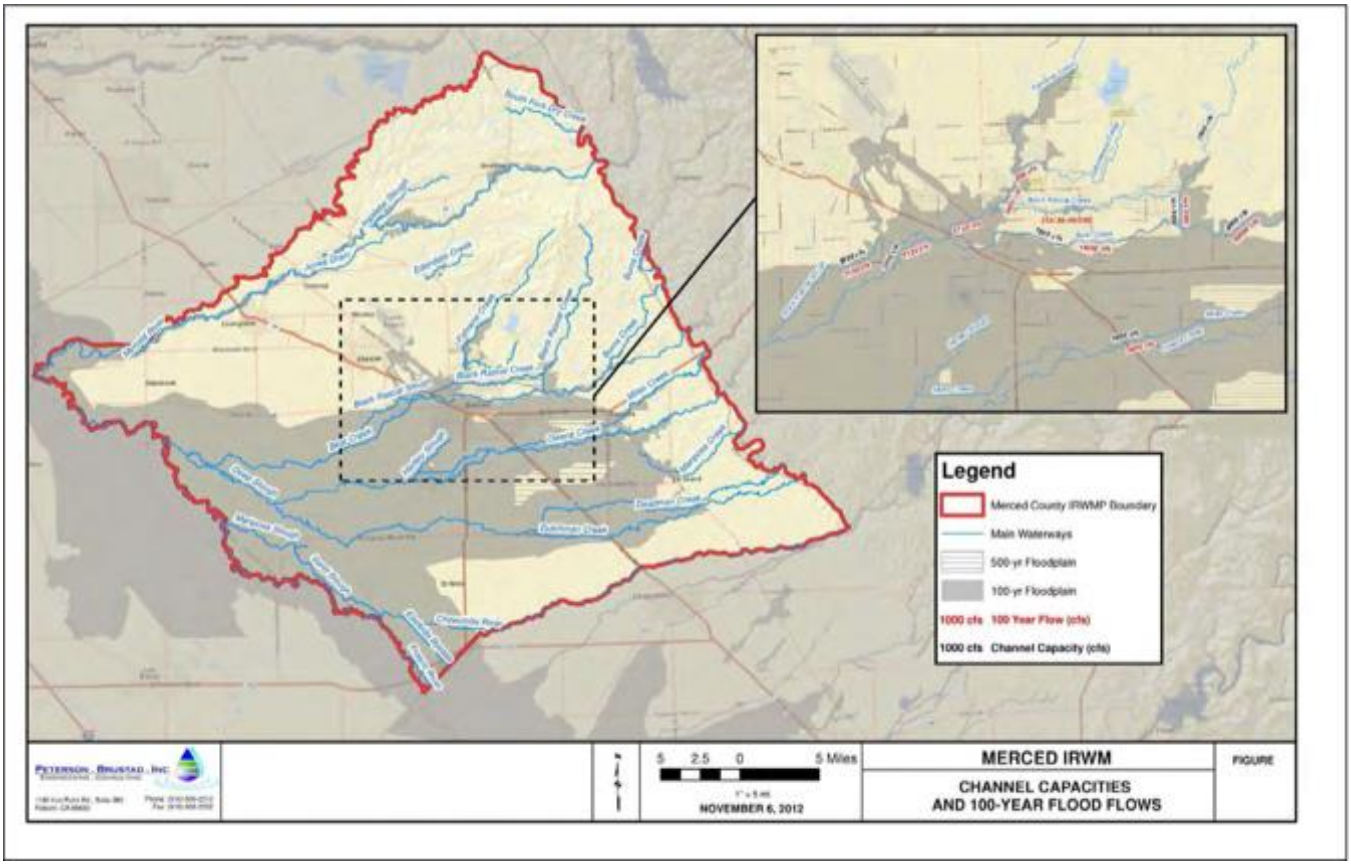
Flood Risk[27]

Merced has no major rivers but is traversed from east to west by four creeks: Bear Creek, Black Rascal Creek, Cottonwood Creek, and Fahrens Creek. Figure 20 identifies flood-prone areas of the City as identified by FEMA, including 382 acres (.018 percent) identified as floodway, 5,375 acres (27 percent) within a 100-year floodplain, and 6,876 acres (32 percent) within a 500-year

[27] Reference: City of Merced Local Hazard Mitigation Plan

floodplain. Most flooding in the City occurs as a result of extended rainfall, with recent flooding events occurring in 1997, 1998, 2000, 2001, 2002, 2005, 2006, 2007, and 2011.

Figure 20—Merced Flood Hazard Areas



Source: City of Merced Local Hazard Mitigation Plan

Technical Rescue Service Demand

Over the most recent three years, there were 32 technical rescue incidents comprising 0.12 percent of total service demand for the same period, as summarized in Table 47.

Table 47—Technical Rescue Service Demand

Risk	Year	Planning Zone					Total	Percent of Total Service Demand
		Sta. 51	Sta. 52	Sta. 53	Sta. 54	Sta. 55		
Technical Rescue	2014	4	1	2	1	0	8	0.13%
	2015	8	1	3	2	0	14	0.15%
	2016	7	0	0	2	1	10	0.10%
Total		19	2	5	5	1	32	0.12%
Percent of Total Service Demand		0.23%	0.06%	0.08%	0.12%	0.03%	0.12%	

Source: City of Merced Fire Department incident records

As Table 47 shows, technical rescue service demand is extremely low, with the predominant demand in the Station 51 planning zone.

Probability of Occurrence

Table 48 summarizes Citygate's scoring of the City's probability of a technical rescue occurrence by planning zone based on service demand history from Table 47.

Table 48—Probability of Technical Rescue Occurrence

Technical Rescue	Planning Zone				
	Sta. 51	Sta. 52	Sta. 53	Sta. 54	Sta. 55
Probability of Occurrence	3.25	2.25	2.25	2.25	2.25

Technical Rescue Impact Severity

Table 49 summarizes Citygate's scoring of the City's probable technical rescue impact severity by planning zone.

Table 49—Technical Rescue Impact Severity

Technical Rescue	Planning Zone				
	Sta. 51	Sta. 52	Sta. 53	Sta. 54	Sta. 55
Probable Impact Severity	2.5	2.5	2.5	2.5	2.5

Overall Technical Rescue Risk

Table 50 summarizes Citygate's overall assessment of the City's technical rescue risk by planning zone.

Table 50—Overall Technical Rescue Risk

Technical Rescue	Planning Zone				
	Sta. 51	Sta. 52	Sta. 53	Sta. 54	Sta. 55
Overall Risk Score	8.125	5.625	5.625	5.625	5.625
Risk Rating	*MODERATE*	*MODERATE*	*MODERATE*	*MODERATE*	*MODERATE*

APPENDIX B—INCIDENT STATISTICAL ANALYSIS

B.1 STATISTICAL ANALYSIS

B.1.1 Historical Effectiveness and Reliability of Response—What Statistics Say About Existing System Performance

SOC ELEMENT 7 OF 8
RELIABILITY & HISTORICAL RESPONSE EFFECTIVENESS STUDIES

The map sets described in Section 2.6 show the ideal situation for response times and the response effectiveness given perfect conditions with no competing calls, traffic congestion, units out of place, or simultaneous calls for service. Examination of the actual response time data provides a picture of how response times are in the real world of simultaneous calls, rush hour traffic congestion, units out of position, and delayed travel time for events such as periods of severe weather.

B.1.2 Data Set Identification

The Department furnished three years of National Fire Incident Reporting System (NFIRS 5) data and related apparatus response times that were merged into a single data file. The resulting database includes 25,724 incidents and 31,364 apparatus movements.

Dataset strengths include:

- Multiple years of data available.
- Use of seconds in time fields.
- Standardized incident numbers in NFIRS 5 and apparatus response data.
- Incident geospatial coordinates tracked in CAD (98.62 percent complete).

B.1.3 Analysis Period

The date range for this statistical analysis is January 1, 2014, through December 31, 2016. This period incorporates 36 consecutive months over three calendar years.

B.1.4 Service Demand

For 2016, the Department responded to 10,086 calls for service (incidents) for an average daily service demand of 27.6 incidents. Of those, 4.46 percent were fire incidents, 66.38 percent were medical incidents, and 29.16 percent were other incident types (e.g., alarm activation with no fire, false alarm, no incident found, public assist, smoke scare, assist other agency, smoke or odor removal, electrical problem, water leak, rescue, hazardous material incident, animal problem, etc.).

Annual service demand is trending upward an average of more than 27 percent annually over the most recent two-year period, as shown in Table 51 and Figure 21.

Table 51—Annual Service Demand

Year	Incidents	Change
2014	6,362	N/A
2015	9,276	45.8%
2016	10,086	8.7%
Total	**25,724**	

Source: City of Merced Fire Department incident records

Figure 21—Annual Service Demand by Year

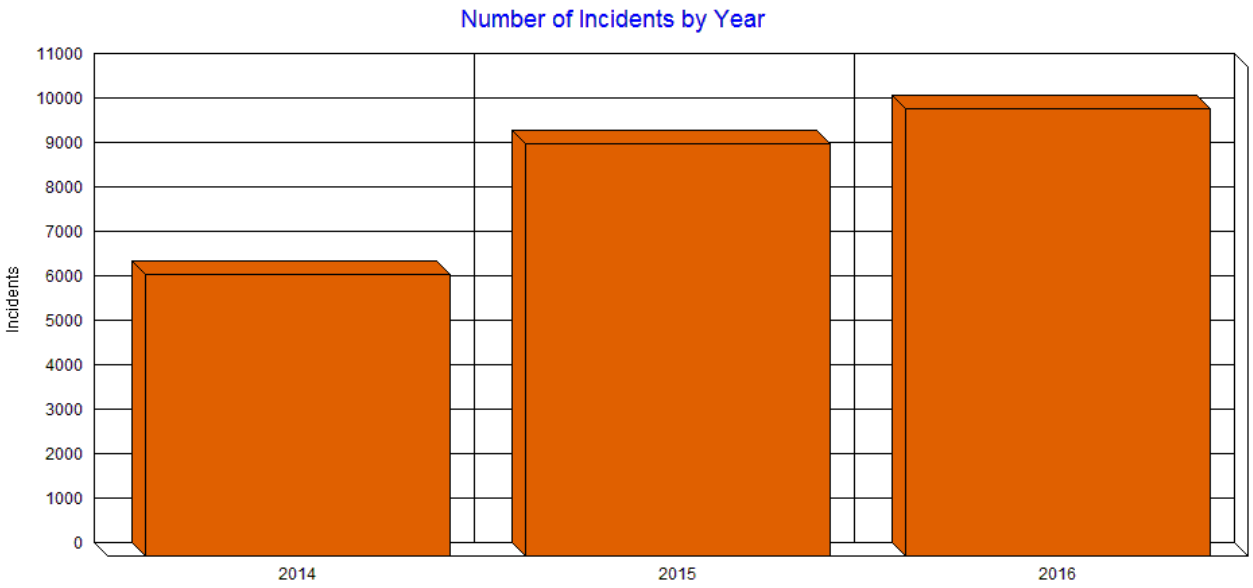
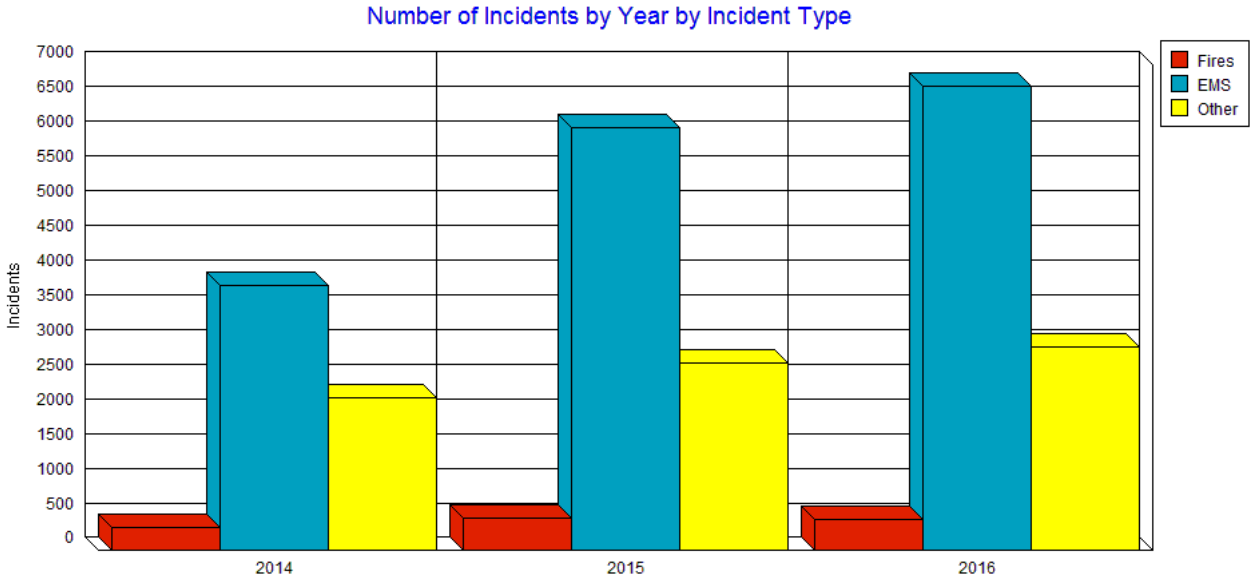


Figure 22 illustrates annual service demand by incident category. While fire incident service demand has remained relatively steady, note the increase in EMS and "Other" incidents over the three-year study period.

Figure 22—Annual Service Demand by Incident Type



Service Demand Over Time

Figure 23 illustrates annual service demand by month. Note the increased service demand during the summer months and December/January. Also note the significant change from 2014 to 2015, and the smaller changes from 2015 to 2016.

Figure 23—Number of Incidents by Month by Year

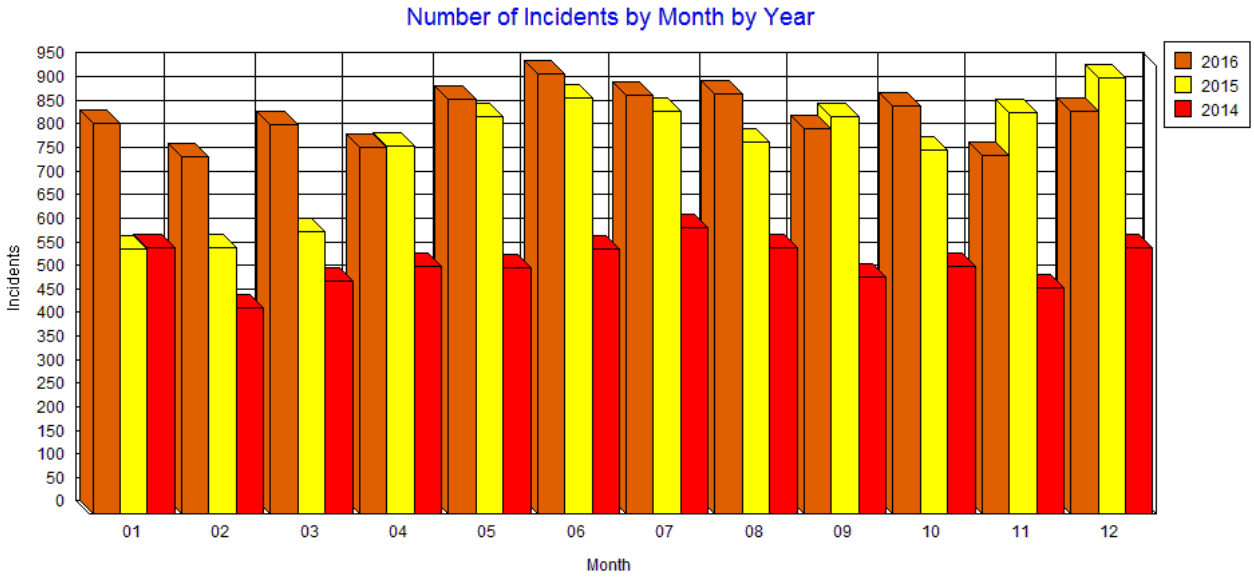


Figure 24 illustrates that service demand is highest on Mondays and slowing gradually through the week. Also note the increase in activity in 2015 and 2016.

Figure 24—Number of Incidents by Day of Week by Year

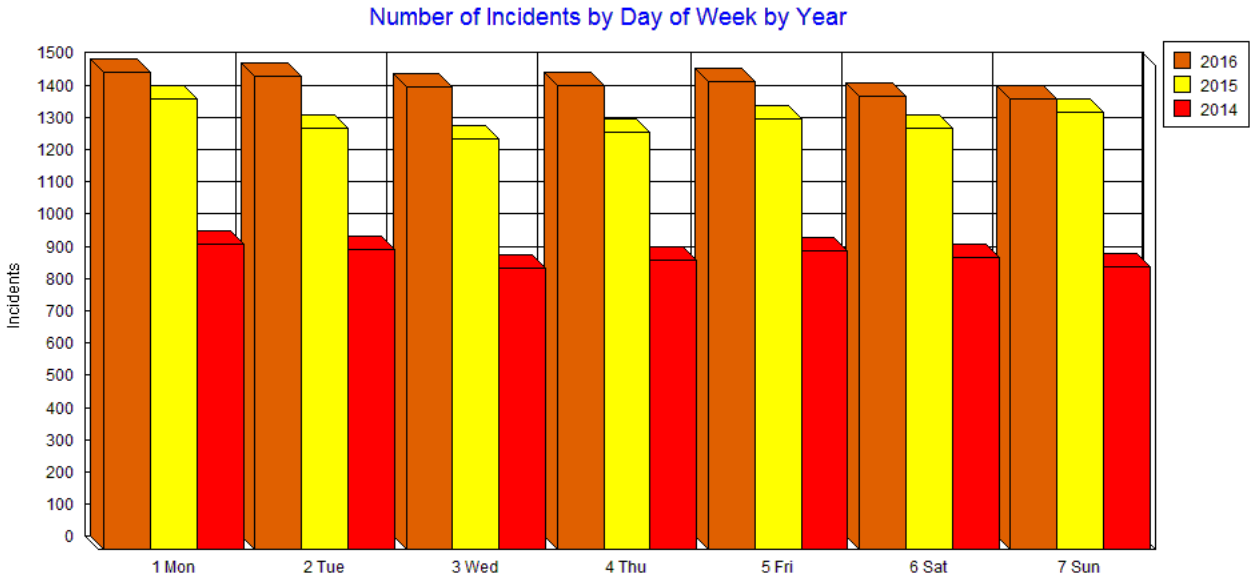
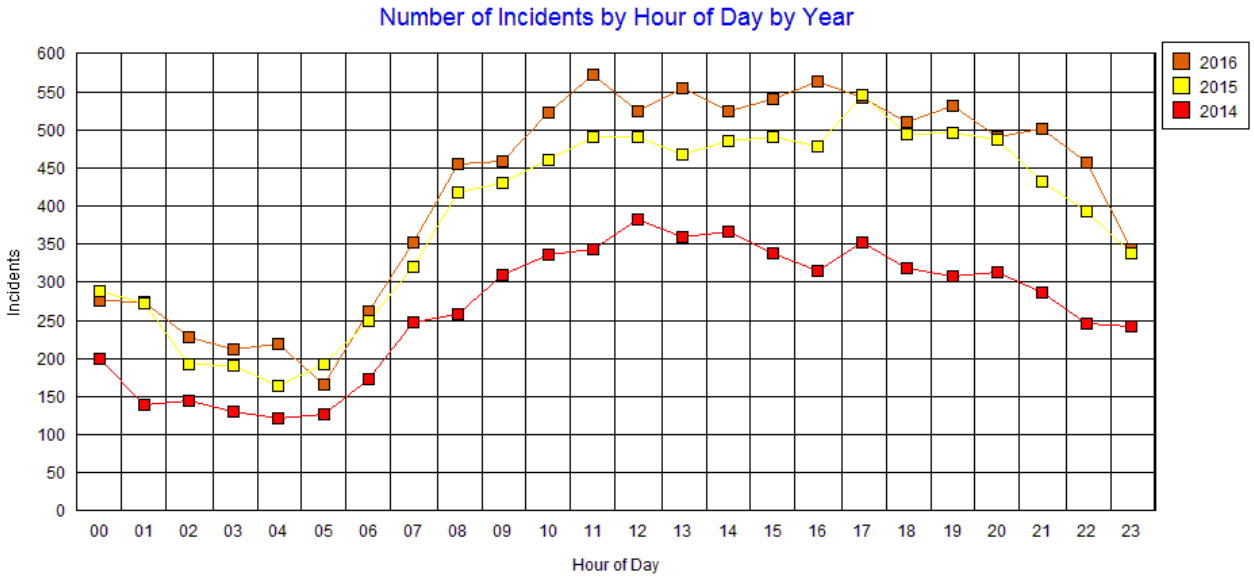


Figure 25 illustrates annual service demand by hour of day. Of note again is the significant increase in calls for service from 2014 to 2015, and the smaller increase from 2015 to 2016, particularly in the mid-morning through early evening hours.

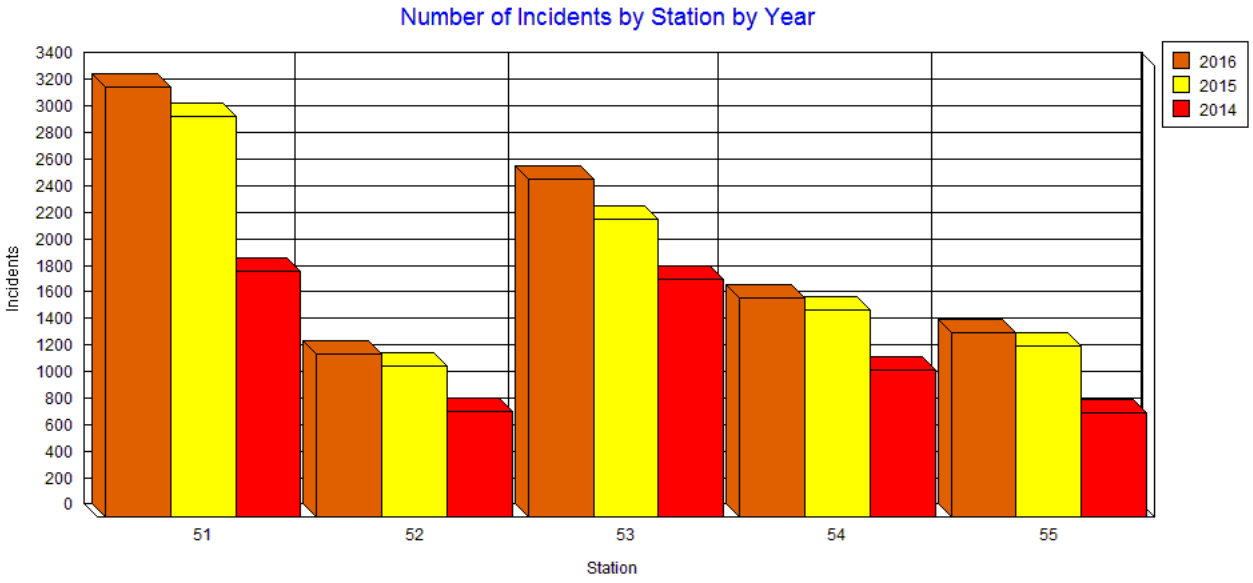
Figure 25—Service Demand by Hour of Day and Year



Service Demand by Station

Figure 26 illustrates annual service demand by station over the three-year study period. Note that Station 51 has the highest service demand, and Station 52 the lowest. Also, of note is the increasing service demand trend across all five stations.

Figure 26—Service Demand by Station by Year



Service Demand by Incident Type

Table 52 ranks service demand by NFIRS 5 incident type for the most recent reporting year. Of note is the strong ranking of EMS-related incidents, with cancelled prior to arrival ranking third. Building fires ranked 10th by volume. Only incident categories with 50 or more incidents for 2016 are shown.

Table 52—Service Demand by Incident Type

	NFIRS Incident Type	2016
1	321 EMS call, excluding vehicle accident with injury	3,542
2	381 Rescue or EMS standby	1,666
3	611 Dispatched & canceled prior to arrival	1,673
4	311 Medical Assist, assist EMS crew	1,130
5	554 Assist invalid	319
6	322 Vehicle accident with injuries	151
7	324 Motor vehicle accident; no injuries	148
8	622 No incident found on arrival	114
9	151 Outside rubbish, trash, or waste fire	84
10	111 Building fire	66
11	162 Dumpster or other outside trash receptacle fire	62
12	743 Smoke detector activation; no fire	59
13	143 Grass fire	58
14	733 Smoke detector activation due to malfunction	56
15	551 Assist police or other governmental agency	55
16	651 Smoke scare; odor of smoke	55
17	561 Unauthorized burning	53
18	745 Alarm system activation; no fire	52

Source: City of Merced Fire Department incident records

Another way to understand fire department service delivery is to review the types of properties at which incidents occur. Table 53 summarizes annual service demand by NFIRS property use categories, indicating that nearly 65 percent of the Department's annual service demand is generated by residential and roadway property uses. Only property types with greater than 100 occurrences over the three-year period of the dataset are shown.

Table 53—Service Demand by Property Use by Year

Property Use	2014	2015	2016	Total
419 1- or 2-family dwelling	2,458	3,708	3,918	**10,084**
429 Multi-family dwellings	1,358	1,782	1,867	**5,007**
962 Residential street, road or residential driveway	308	380	448	**1,136**
963 Street or road in commercial area	307	361	361	**1,029**
BLANK	198	210	402	**810**
459 Residential board and care	103	252	293	**648**
161 Restaurant or cafeteria	149	187	205	**541**
449 Hotel/motel, commercial	106	172	131	**409**
311 24-hour care Nursing homes, 4 or more persons	67	157	178	**402**
581 Department or discount store	69	120	192	**381**
599 Business office	97	122	128	**347**
519 Food and beverage sales, grocery store	60	94	119	**273**
215 High school/junior high school/middle school	62	85	106	**253**
439 Boarding/rooming house, residential hotels	70	74	108	**252**
965 Vehicle parking area	65	101	85	**251**
142 Clubhouse	71	75	82	**228**
960 Street, other	35	76	102	**213**
961 Highway or divided highway	50	76	82	**208**
938 Graded and cared-for plots of land	50	74	76	**200**
342 Doctor, dentist or oral surgeon's office	30	68	88	**186**
931 Open land or field	50	54	62	**166**
571 Service station, gas station	35	54	68	**157**
511 Convenience store	37	42	55	**134**
340 Clinics, Doctors offices, hemodialysis centers	22	48	61	**131**
464 Barracks, dormitory	36	64	30	**130**
331 Hospital - medical or psychiatric	30	57	41	**128**
131 Church, mosque, synagogue, temple, chapel	24	45	54	**123**
579 Motor vehicle or boat sales, services, repair	28	43	45	**116**
900 Outside or special property, other	29	44	34	**107**

Source: City of Merced Fire Department incident records

Aid Provided and Received

Table 54 summarizes automatic and mutual aid provided by the Department to other agencies/jurisdictions, as well as automatic and mutual aid received from other agencies/jurisdictions. As Table 54 shows, the City receives minimal aid from other agencies/jurisdictions, and aid provided to other agencies accounts for only 0.55 percent of total service demand over the three-year study period.

Table 54—Aid Provided and Received by Year

Aid Type	2014	2015	2016	Total
Mutual Aid Received	8	17	14	**39**
Automatic Aid Received	1	1	0	**2**
Mutual Aid Provided	53	47	41	**141**
Automatic Aid Provided	0	0	1	**1**
Total	**62**	**65**	**56**	**183**

Source: City of Merced Fire Department incident records

Simultaneous Incident Activity

Simultaneous incident activity measures the percentage of concurrent or overlapping incidents. Figure 27 shows simultaneous incident occurrence by year for the Department. Of note is that simultaneous incident activity is trending up.

Figure 27—Simultaneous Activity by Year

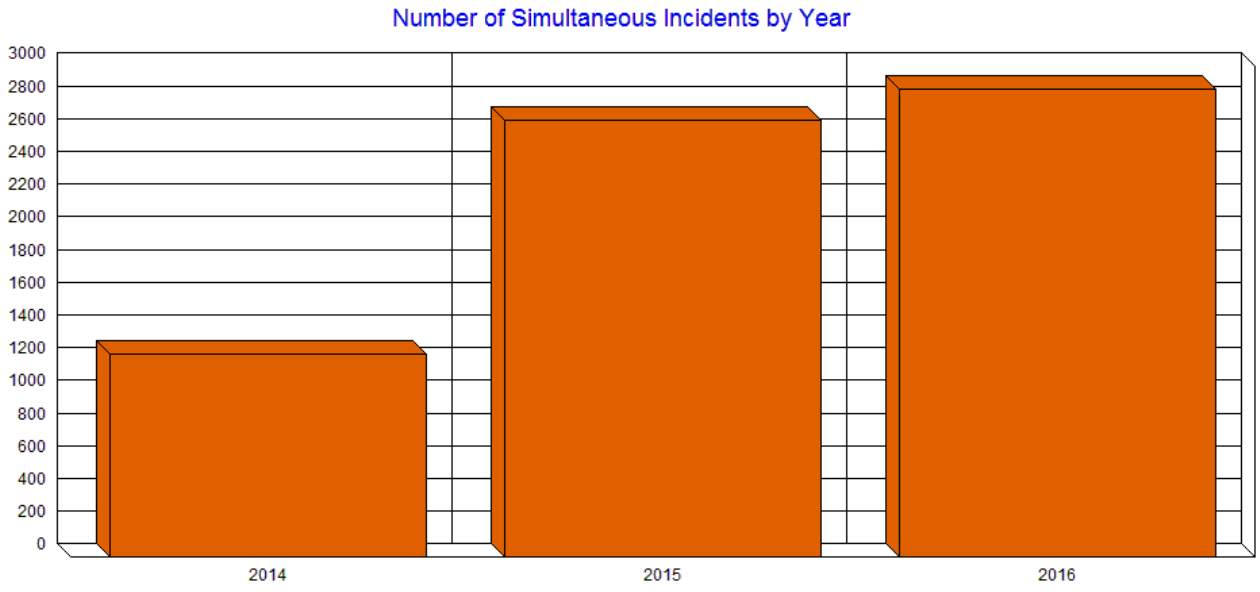


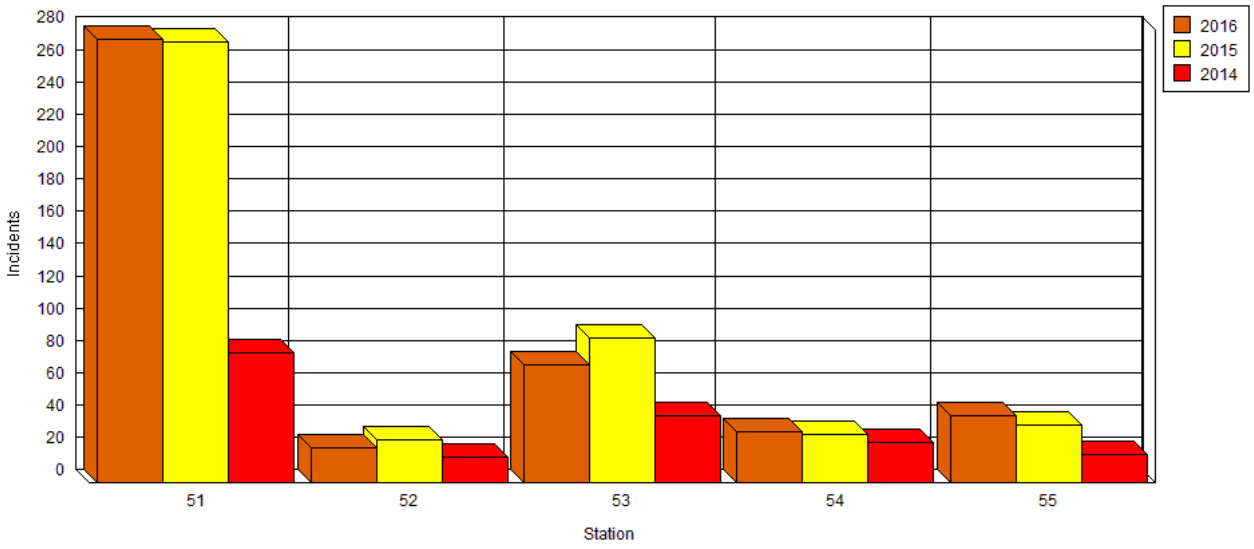
Table 55 shows the percentage of simultaneous incident activity for 2016.

Table 55—Simultaneous Incident Activity

Number of Simultaneous Incidents	Percentage of All Incidents
1 or more	**28.39%**
2 or more	**5.03%**
3 or more	**0.83%**

For multiple-station departments, simultaneous incident activity in different station areas may have very little operational impact. However, simultaneous incidents within a single station response area can result in significantly slower response times because the second or successive concurrent call must be handled by an engine/resource from a more distant station. Figure 28 shows simultaneous incident activity within the same station response area by station. As can be seen, Station 51 has the most simultaneous incident activity with nearly 280 incidents in 2016; however, with two staffed resources assigned to that station, simultaneous incident activity should not be expected to significantly impact first-due response times.

Figure 28—Simultaneous Incident Activity within Same Station Response Area



After this initial analysis, the Department voiced a concern that it was sensing a significant increase in the amount of time that multiple units were concurrently committed, primarily due to delayed ambulance arrival at medical emergencies. Citygate subsequently conducted a supplemental analysis to identify the impact of more recent simultaneous incident activity. Table 56, Table 57,

and Table 58 summarize simultaneous incident activity impacts from April 14, 2017 through October 19, 2017.

Table 56—Three or More Units Committed Simultaneously

Duration of Concurrent Commitment	Number of Events	Percentage of Total Events	Total Duration
Less than 2:00	**80**	10.26%	2:04:33
2:00–4:59	**209**	26.79%	11:25:22
5:00–9:59	**305**	39.10%	12:54:03
10:00–14:59	**80**	10.26%	16:00:37
15:00–29:59	**55**	7.05%	17:00:38
30:00–60:00	**14**	1.79%	10:10:24
1 hour–2 hours	**25**	3.21%	13:12:51
More than 2 hours	**12**	1.54%	7:37:57
Total	**780**	**100.00%**	**162:26:25**

Table 57—Four or More Units Committed Simultaneously

Duration of Concurrent Commitment	Number of Events	Percentage of Total Events	Total Duration
Less than 2:00	**21**	6.67%	0:33:10
2:00–4:59	**73**	23.17%	4:03:11
5:00–9:59	**138**	43.81%	16:23:28
10:00–14:59	**40**	12.70%	8:00:06
15:00–29:59	**17**	5.40%	5:21:45
30:00–60:00	**8**	2.54%	5:52:30
1 hour–2 hours	**13**	4.13%	19:33:13
More than 2 hours	**5**	1.59%	13:45:29
Total	**315**	**100.00%**	**73:32:52**

Table 58—Five or More Units Committed Simultaneously

Duration of Concurrent Commitment	Number of Events	Percentage of Total Events	Total Duration
Less than 2:00	**10**	8.77%	0:15:39
2:00–4:59	**32**	28.07%	1:52:35
5:00–9:59	**42**	36.84%	4:54:46
10:00–14:59	**17**	14.91%	3:24:44
15:00–29:59	**7**	6.14%	2:10:21
30:00–60:00	**3**	2.63%	1:53:18
1 hour–2 hours	**2**	1.75%	3:24:46
More than 2 hours	**1**	0.88%	2:56:28
Total	**114**	**100.00%**	**20:52:37**

As Table 56 illustrates, half or more of the Department's staffed units were simultaneously committed 780 times for a total of 162.5 hours, representing 3.6 percent of the total 189-day time. Of those 780 events, 186 were more than 10:00 minutes in duration, comprising 2.1 percent of the total time.

As Table 57 shows, two-thirds or more of the Department's staffed units were simultaneously committed 315 times for a total of 73.5 hours, comprising 1.6 percent of the total time. Of those, only 83 were more than 10:00 minutes in duration, representing 0.99 percent of the total time.

This analysis reveals that concurrent resource commitment currently impacts overall response capacity less than four percent of the time, which is not yet significant in Citygate's opinion.

Station Demand Percentage and Unit-Hour Utilization

Table 59 shows hourly service demand percentage by station for 2016, with the different colors illustrating variation in demand; the lowest rates of activity are green, progressing from yellow to red to indicate the highest quantity of incidents or rate of activity. The busiest stations are listed first. The percentage listed is the probability that a particular station is involved in an incident at any given hour. This percentage considers the number and duration of incidents over the three-year data set.

Table 59—Hourly Service Demand Percentage by Station

Time of Day	Sta. 51	Sta. 53	Sta. 54	Sta. 55	Sta. 52
00:00	6.53%	5.33%	3.93%	2.37%	2.08%
01:00	8.63%	5.88%	2.76%	3.58%	2.12%
02:00	6.06%	4.80%	2.92%	2.98%	1.76%
03:00	3.10%	4.38%	2.90%	1.66%	1.42%
04:00	4.41%	3.61%	3.11%	3.47%	2.00%
05:00	2.99%	2.66%	1.84%	2.92%	1.60%
06:00	7.12%	5.91%	3.82%	3.00%	2.27%
07:00	10.26%	6.97%	3.30%	2.41%	3.74%
08:00	9.65%	8.36%	4.38%	6.24%	4.10%
09:00	8.03%	9.21%	5.35%	5.17%	3.53%
10:00	12.16%	8.77%	4.52%	5.67%	4.23%
11:00	13.09%	10.06%	8.81%	6.61%	3.33%
12:00	10.54%	10.65%	7.11%	5.55%	4.72%
13:00	12.92%	10.98%	6.34%	5.92%	4.85%
14:00	16.58%	10.28%	9.00%	6.03%	5.43%
15:00	12.19%	9.97%	6.21%	5.13%	4.24%
16:00	12.80%	9.93%	7.57%	8.38%	5.25%
17:00	11.22%	8.01%	7.72%	8.18%	5.95%
18:00	11.16%	10.39%	5.76%	4.56%	3.69%
19:00	12.19%	7.92%	6.74%	4.53%	3.84%
20:00	10.81%	9.07%	5.62%	5.16%	3.14%
21:00	11.45%	7.19%	6.51%	4.48%	3.10%
22:00	15.68%	8.55%	10.13%	4.52%	3.00%
23:00	8.64%	5.44%	4.61%	3.18%	2.99%
Overall	**9.93%**	**7.68%**	**5.46%**	**4.65%**	**3.43%**

Table 59 shows that Station 51 is the busiest station, with peak service demand occurring from about 7:00 am to 11:00 pm. Overall hourly service demand is low, ranging from 3.43 percent to 9.93 percent.

Table 60 shows unit-hour utilization for 2016. The percentage shown is the probability that the apparatus is involved in an incident during that hour of the day.

Table 60—Unit-Hour Utilization Percentage

Time of Day	E-51	E-53	E-54	E-55	E-52
00:00	6.86%	5.91%	4.18%	2.44%	2.31%
01:00	8.56%	8.00%	5.14%	5.53%	2.77%
02:00	7.40%	5.79%	3.38%	3.42%	2.82%
03:00	3.56%	4.41%	3.04%	1.66%	1.45%
04:00	4.43%	4.77%	4.04%	4.51%	3.43%
05:00	3.48%	3.14%	2.69%	3.94%	1.60%
06:00	8.18%	6.21%	5.25%	3.37%	3.67%
07:00	8.76%	7.91%	3.75%	2.52%	4.49%
08:00	9.06%	9.65%	5.35%	6.75%	4.38%
09:00	7.28%	9.55%	5.91%	5.58%	4.03%
10:00	10.81%	10.71%	8.03%	7.90%	6.24%
11:00	11.36%	10.79%	10.06%	7.12%	3.96%
12:00	10.90%	11.13%	7.26%	6.02%	5.60%
13:00	11.60%	11.63%	6.87%	6.78%	4.54%
14:00	13.84%	12.30%	15.74%	9.10%	9.28%
15:00	11.06%	10.36%	7.01%	5.26%	4.81%
16:00	12.16%	12.29%	8.25%	9.55%	8.63%
17:00	13.09%	10.61%	11.46%	8.71%	7.89%
18:00	10.46%	11.49%	6.30%	4.76%	4.26%
19:00	12.48%	8.45%	7.41%	4.97%	4.35%
20:00	9.74%	9.51%	6.16%	5.55%	3.47%
21:00	10.38%	7.59%	6.94%	4.85%	3.38%
22:00	16.44%	14.21%	13.19%	9.26%	10.23%
23:00	7.90%	6.08%	5.38%	3.40%	3.37%
Overall	**9.58%**	**8.85%**	**6.78%**	**5.54%**	**4.62%**

What should be the maximum utilization percentage for a firefighting unit? For a nine-hour daytime work period, when crews on a 24-hour shift need to also pay attention to apparatus checkout, station duties, training, public education, and paperwork, plus required physical training and meal breaks, Citygate believes the maximum commitment UHU per hour *for an engine, ladder truck, or 24-hour paramedic squad* should not exceed 30 percent. Beyond that, the most important element likely to suffer will be training.

As Table 60 shows, Engines 51 and 53 have the highest unit-hour utilization rates; however, overall unit-hour utilization percentages are low to moderate, ranging from 4.62 percent to 9.58 percent, which is well below the 30 percent saturation rate.

B.1.5 Operational Performance

Once incident types are quantified, the analysis shifts to the time required to respond to those emergencies. Fractile analyses track the percentage (and count the number) of incidents meeting defined criteria, such as the first apparatus to reach the scene within progressive time segments. Based on national best practice recommendations and Citygate's experience, this study's response time test measurement is for the 90 percent call to arrival to be *7:30 minutes or less* for urban planning zones. This is comprised of three component elements: call processing time, turnout time, and travel time.

Call Processing Performance

Call processing time is the time it takes to answer the 9-1-1 call, determine the nature of the emergency, enter information into the computer-aided dispatch system, and dispatch the appropriate resource(s). Best practice[28] is for 90 percent of calls to be processed and dispatched within 90 seconds. Where language barriers exist, or medical self-help instructions are needed, these calls should be dispatched within 120 seconds. The Merced Police Department Communications Center serves as the primary Public Safety Answering Point (PSAP) for 9-1-1 calls within the City. Table 61 shows 90th percentile call processing performance.

Table 61—90th Percentile Call Processing Performance

Planning Zone	Overall	2014	2015	2016
Citywide	**2:06**	**2:02**	**2:01**	**2:15**
Sta. 51	**2:17**	2:20	2:08	2:23
Sta. 52	**1:54**	2:01	1:49	1:56
Sta. 53	**1:59**	1:55	1:56	2:04
Sta. 54	**2:07**	1:53	2:01	2:22
Sta. 55	**2:07**	1:56	1:58	2:17

Source: City of Merced Fire Department incident records and CAD data

As Table 61 shows, Citywide call processing performance is *40 percent slower* (0:36) than best practice standards over the three-year study period. Merced Police Department Communications

[28] NFPA Standard 1221 – Standard for the Installation, Maintenance, and Use of Emergency Services Communications Systems (2016)

Supervisor Marvin Dillsaver advised Citygate that the Communications Center currently handles approximately 500,000 incidents annually for the City Police and Fire Departments with a minimum shift staffing of two dispatch personnel and no dedicated call-taker. He further advised Citygate that the Communications Center does not monitor call processing performance, and in his opinion, minimum shift staffing should be 3-4 dispatchers plus a dedicated call-taker to appropriately handle current workload. Although the Fire Department has no direct control over 9-1-1 call processing performance, it is a significant element of its overall response performance and associated customer service, and Citygate suggests that the Department collaborate with the Police Department and City Manager's Office to seek solution(s) to improve call processing performance to a level more in alignment with industry-recognized best practice standards.

Turnout Performance

Turnout time is the time it takes for station crew(s) to hear the dispatch message, confirm the response travel route, don appropriate safety clothing, and board the apparatus for response. While a nationally recognized best practice for crew turnout is 60 to 80 seconds,[29] it has long been recognized as a standard rarely met in practical experience. Citygate has long recommended that, due to this and the floor plan design of some fire stations, most agencies should be able to reasonably achieve 2:00-minute crew turnout performance at 90 percent compliance. Table 62 shows 90th percentile crew turnout performance.

Table 62—90th Percentile Crew Turnout Performance

Planning Zone	Overall	2014	2015	2016
Citywide	**1:55**	**1:57**	**1:55**	**1:53**
Sta. 51	**1:53**	2:00	1:51	1:50
Sta. 52	**1:45**	1:43	1:41	1:48
Sta. 53	**1:51**	1:52	1:51	1:49
Sta. 54	**1:58**	2:01	1:56	1:57
Sta. 55	**2:12**	2:18	2:15	2:05

Source: City of Merced Fire Department incident records and CAD data

As Table 62 shows, Citywide turnout time performance is *better* than the Citygate-recommended 2:00-minute target by 5 seconds (4.17 percent) over the three-year study period.

[29] NFPA 1710 – Standard for the Organization and Deployment of Fire Suppression Operations, Emergency Medical Operations, and Special Operations to the Public by Career Fire Departments (2016)

Travel Time

Travel time is defined as the time segment that begins with the start of apparatus movement and ends when that apparatus stops moving upon arrival at the emergency. It is important to understand that this time segment *does not include* the time required to exit the apparatus and walk to an EMS patient or to deploy a hose line on a fire.

First-Due Travel Time

The best practice standard for first-due travel time is 4:00 minutes or less for urban demand zones.[30] Table 63 shows 90th percentile first-due travel time performance.

Table 63—90th Percentile First-Due Travel Time Performance

Planning Zone	Overall	2014	2015	2016
Citywide	**4:40**	**4:34**	**4:37**	**4:45**
Sta. 51	**4:37**	4:29	4:33	4:45
Sta. 52	**4:45**	4:32	4:48	4:52
Sta. 53	**4:26**	4:20	4:24	4:31
Sta. 54	**4:46**	4:51	4:43	4:47
Sta. 55	**4:50**	4:51	4:43	4:52

Source: City of Merced Fire Department incident records and CAD data

As Table 63 shows, first-due travel time performance for 90 percent of incidents fails to meet the recommended 4:00-minute goal by nearly 17 percent (40 seconds).

Effective Response Force Travel Time

The Department's ERF for building fires is four engines, one ladder truck, and one Battalion Chief. Over the three-year study period, there were 81 incidents where the full ERF deployment arrived at the incident. Best practice standards for ERF travel time is 8:00 minutes or less for urban/suburban areas.[31] As Table 64 shows, Citywide 90th-percentile ERF travel time performance for four apparatus and one Battalion Chief is 3:41 *slower* (46 percent) than the 8:00-minute target over the three-year study period. It is also important to note that while the Citywide analysis involves a relatively stable sample size of 81 incidents, many of the individual station travel time

[30] NFPA 1710 – Standard for the Organization and Deployment of Fire Suppression Operations, Emergency Medical Operations, and Special Operations to the Public by Career Fire Departments (2016)

[31] NFPA 1710 – Standard for the Organization and Deployment of Fire Suppression Operations, Emergency Medical Operations, and Special Operations to the Public by Career Fire Departments (2016)

analyses involve a much smaller sample size. Smaller sample sizes are more volatile and can readily change significantly from year-to-year depending on the number and locations of incidents.

Table 64—90th Percentile ERF Travel Time Performance

Planning Zone	Overall	2014	2015	2016
Citywide	**11:41**	**12:54**	**10:01**	**10:14**
Sta. 51	**10:14**	7:40	12:15	9:54
Sta. 52	**9:52**	9:52	8:43	12:33
Sta. 53	**9:40**	8:59	10:01	8:50
Sta. 54	**12:54**	13:09	8:56	11:41
Sta. 55	**13:44**	8:04	7:53	13:44

Source: City of Merced Fire Department incident records and CAD data

Dispatch to First Arrival Performance

Citygate's recommended dispatch to first unit arrival time for positive outcomes is 6:00 minutes or less in urban/suburban zones. Dispatch to arrival time includes crew turnout time and travel time. Table 65 summarizes dispatch to first arrival performance over the three-year study period.

Table 65—90th Percentile Dispatch to First-Due Performance

Planning Zone	Overall	2014	2015	2016
Citywide	**6:00**	**5:59**	**5:55**	**6:04**
Sta. 51	**5:53**	6:01	5:49	5:52
Sta. 52	**6:03**	5:52	6:02	6:09
Sta. 53	**5:49**	5:42	5:47	5:55
Sta. 54	**6:10**	6:14	5:57	6:14
Sta. 55	**6:16**	6:17	6:05	6:20

Source: City of Merced Fire Department incident records and CAD data

As Table 65 shows, Citywide dispatch to first arrival performance *meets* the recommended best practice goal of 6:00 minutes or less for positive outcomes in urban planning zones.

Call to Arrival Performance

A person needing help in an emergency measures the speed of the fire department response from the time assistance is first requested until the help arrives. This measure, referred to as "call to first arrival," is the primary measure of customer service. Citygate's recommended best practice for

call to first arrival is 7:30 minutes or less for urban/suburban areas at 90 percent or better reliability. Table 66 summarizes call to first arrival performance by station by year.

Table 66—90th Percentile Call to First Arrival Performance

Planning Zone	Overall	2014	2015	2016
Citywide	**7:32**	**7:26**	**7:20**	**7:43**
Sta. 51	**7:32**	7:35	7:16	7:41
Sta. 52	**7:30**	7:16	7:33	7:38
Sta. 53	**7:15**	7:12	7:01	7:30
Sta. 54	**7:36**	7:26	7:24	7:52
Sta. 55	**7:54**	8:07	7:36	8:04

Source: City of Merced Fire Department incident records and CAD data

As Table 66 indicates, Citywide call to arrival performance *meets* the recommended goal of 7:30 minutes or less to facilitate desired outcomes in urban areas.

Table 67 summarizes call to ERF arrival performance for serious incidents requiring three engines, the ladder truck, and a Chief Officer to resolve. Citygate's recommended best practice for call to ERF arrival is 11:30 minutes or less for urban/suburban areas at 90 percent or better reliability. As Table 67 shows, call to ERF arrival performance *nearly meets* the recommended 11:30-minute goal.

Table 67—90th Percentile Call to ERF Arrival Performance

Planning Zone	Overall	2014	2015	2016
Citywide	**12:02**	**13:38**	**10:05**	**11:54**
Sta. 51	11:30	08:30	14:21	10:04
Sta. 52	10:59	10:59	09:32	14:55
Sta. 53	10:36	09:50	12:17	11:54
Sta. 54	13:38	13:44	09:57	12:16
Sta. 55	10:46	10:10	09:06	10:46

Source: City of Merced Fire Department incident records and CAD data