CITYGATE ASSOCIATES, LLC
PUBLIC SAFETY SERVICES

COMMUNITY HAZARD AND RISK ASSESSMENT, STANDARDS OF COVER STUDY, AND STATION LOCATION ANALYSIS

VOLUME 1 OF 2: TECHNICAL REPORT

CITY OF MOUNTAIN VIEW FIRE DEPARTMENT

MAY 15, 2020

CITYGATE ASSOCIATES, LLC
CELEBRATING 30 YEARS! 1990 | 2020

WWW.CITYGATEASSOCIATES.COM

600 COOLIDGE DR., STE. 150 FOLSOM, CA 95630
PHONE: (916) 458-5100
FAX: (916) 983-2090

CITY OF MOUNTAIN VIEW

This page was intentionally left blank

TABLE OF CONTENTS

VOLUME 1 of 2 – Technical Report (this volume)

Table of Tables

Table of Figures

VOLUME 2 of 2 – Map Atlas (separately bound)

This page was intentionally left blank

EXECUTIVE SUMMARY

The City of Mountain View (City) Fire Department (Department) retained Citygate Associates, LLC (Citygate) to conduct a comprehensive Community Hazard and Risk Assessment, Standards of Cover Study, and Station Location Analysis to evaluate and make recommendations relative to the organization and deployment of fire suppression operations, emergency medical operations, and special operations in light of recent and projected future growth and related traffic volume as a foundation for future fire services planning.

The goal of this assessment is to identify both current services and desired service levels and then to assess the City's ability to provide them. After understanding any possible gaps in operations and resources, Citygate provides recommendations to improve Department operations and services over time. Citygate utilized various industry-recognized best practice guidelines and criteria in the field of deployment analysis, including National Fire Protection Association (NFPA) standards, the self-assessment criteria of the Commission on Fire Accreditation International (CFAI), Insurance Services Office (ISO) schedules, and federal and state mandates relative to emergency services.

This report is presented in three 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 the community hazards and risk assessment. A separate Map Atlas (**Volume 2**) contains all the maps referenced throughout this report. Overall, there are 16 findings and 3 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 is a *local policy decision.* 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 SERVICE DEPLOYMENT

Citygate finds that the Department is well organized to accomplish its mission to serve a diverse urban population across a varied municipal land-use pattern. The Department is using best practices and is data driven, as necessary.

Fire service deployment, simply summarized, is about the *speed* and *weight* of response. *Speed* refers to initial (first-due) response of all-risk resources (engines, ladder trucks, rescues, and ambulances) strategically deployed across a jurisdiction for response to emergencies within a time

interval to achieve desired outcomes. *Weight* refers to multiple-unit (Effective Response Force or ERF) responses to more serious emergencies, such as building fires, multiple-patient medical emergencies, vehicle collisions with extrication required, or technical rescue incidents. In these situations, enough firefighters must be assembled within a 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 from a medical emergency, then initial units should arrive within 7:30 minutes from 9-1-1 notification, and a multiple-unit ERF should arrive within 11:30 minutes of 9-1-1 notification at the City's 9-1-1 Police Department Communications Center, all at 90 percent or better reliability. Total response time to emergency incidents includes three separate 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 multiple-unit ERF responses in urban areas.

The City's existing fire station distribution provides first-due unit call-to-arrival response performance slightly longer (10 percent) than the 7:30-minute best practice goal for an urban area, as shown in Table 1 for Report Year (RY) 2018/19. This is the Department's and City's true customer service measure: how long it takes from the time a person needing help calls 9-1-1 until the first response unit arrives.

Table 1—90th Percentile First Unit Call-to-Arrival Performance (Taken from Table 21)

Station	RY 18/19
Department-Wide	**08:14**
Station 1	07:30
Station 2	08:21
Station 3	08:17
Station 4	08:43
Station 5	08:55

While the Department's crew turnout performance is *excellent*, call processing performance is significantly slower (54 percent) than a best practice goal of 1:30 minutes or less, as shown in Table 2.

Table 2—90th Percentile Call Processing Performance (Taken from Table 18)

Station	RY 18/19
Department-Wide	**02:19**
Station 1	02:25
Station 2	02:11
Station 3	02:15
Station 4	02:25
Station 5	02:26

In addition, first-due unit travel times are 42 percent slower than the preferred 4:00 minutes for 90 percent of the incidents in an urban population density, as shown in Table 3. These slower-than-desired travel times are not the result of too few fire stations, rather they are the result of traffic congestion and simultaneous incident activity at peak hours of the day.

Table 3—90th Percentile First-Due Unit Travel Time Performance (Taken from Table 20)

Station	RY 18/19
Department-Wide	**05:41**
Station 1	04:59
Station 2	05:42
Station 3	05:40
Station 4	06:24
Station 5	06:28

Citygate finds the Department's response unit types to be appropriate to protect against the hazards likely to impact the City, and the daily staffing of 21 personnel provides a minimum ERF sufficient for a single emerging or serious fire and one other minor simultaneous incident. Further, Citygate finds that no single fire unit or station area is approaching workload saturation; however, during peak hours of the day there is a simultaneous incident rate of at least two concurrent incidents 27 percent of the time.

Additionally, Citygate is concerned about the depth of staffing to provide resilience during serious or multiple incident activity given the City's current daytime population, projected future population growth, and increasing service demand. When combined with the Department's training model of using the Engine 54 crew Citywide, incident activity and traffic congestion thins out the available crews too much at peak hours of the day when both service demand and traffic congestion are highest.

The City currently staffs the rescue unit at Station 1 with two firefighters. Citygate recommends that the City and Department consider adding a third position per day to that unit to provide considerable additional deployment and response flexibility, allowing for:

- The use of a reserve engine or smaller Fast Response Unit (FRU) to cover Station 4 or other stations when Engine 54 or other companies are delivering training at another station.
- A full three-person crew to respond on either a reserve engine, FRU, or rescue to simultaneous incidents.
- The use of two personnel to respond to low-acuity EMS events in a reserve engine or FRU, leaving a driver on the rescue to enable it to respond with another engine anywhere in the City.

Stated this way, the addition of one more person on duty a day allows the rescue crew to become a triple-service team (by providing the three benefits identified above), not just two personnel who are attached to another unit, thus taking two units out of service for single-unit response incidents.

To maximize deployment and response flexibility of a three-person rescue crew *and* provide additional fire suppression capability for move-up and cover needs, Citygate further recommends that the City and Department consider adding an FRU at Station 1, as discussed in detail in Section 2.8.1.

Overall, Citygate finds that the Department is providing a high level of service to City residents, workers, and visitors. Making and testing the proposed staffing and equipment changes will cost-effectively enhance overall Citywide deployment capacity and flexibility.

FINDINGS AND RECOMMENDATIONS

The following are the findings and recommendations presented throughout this report:

Finding #1: The Department's response unit types are appropriate to protect against the hazards likely to impact the City, and the daily staffing of 21 personnel provides a minimum Effective Response Force sufficient for a single emerging or serious fire and one additional minor incident.

Finding #2: The Department has established response performance objectives partially consistent with best practice recommendations as published by the Commission on Fire Accreditation International. However, the City Council has not recently adopted a response time goal that begins with the 9-1-1 call receipt or goals for all types of emergency risk outcomes.

Finding #3: 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, specialty units, and command officers customarily needed to effectively control that type of incident based on Department experience.

Finding #4: When the Engine 54 crew or other crews are delivering training outside of their district, another engine must move up and cover Station 4 or the vacant station. Given only five engines are available, this leaves one or more stations uncovered, with a resultant longer travel time to incidents within those uncovered station areas.

Finding #5: The City's five fire stations are appropriately distributed to provide service to all major neighborhood areas.

Finding #6: The ladder truck and rescue are optimally located at Station 1 to provide Citywide coverage.

Finding #7: Analysis of the Department's service demand indicates the need for a 24-hours-per-day, seven-days-per-week fire and emergency medical services response system.

Finding #8: At least two simultaneous incidents are occurring 27 percent of the time.

Finding #9: The overall number of simultaneous incidents is increasing annually. As simultaneous incidents increase, the coverage provided by the busiest companies to their own and to adjacent station areas diminishes, which further shifts workload to other companies.

Finding #10: Concurrent incident activity is primarily impacting Stations 1, 2, and 3.

Finding #11: First-due travel times to Station 4's response area are 1:00 to 5:00 minutes longer if the station is uncovered while Engine 54 is out of service or training at another station.

Finding #12: At 2:19 minutes, 90th percentile call processing performance is 54 percent *slower* than the 1:30-minute recommended best practice.

Finding #13: At 1:20 minutes, 90th percentile crew turnout performance is 33 percent *better* than a Citygate-recommended goal of 2:00 minutes or less.

Finding #14: At 5:41 minutes, 90th percentile first-due unit travel time performance is 42 percent *slower* than the 4:00-minute best practice goal for urban areas.

Finding #15: At 8:14 minutes, 90th percentile first-due unit call-to-arrival performance is 10 percent slower than Citygate's recommended goal of 7:30 minutes, primarily due to longer-than-desired travel times.

Finding #16: At 12:07 minutes, 90th percentile Effective Response Force (First Alarm) call-to-arrival performance is just 5 percent slower than the Citygate-recommended goal of 11:30 minutes for urban areas.

Recommendation #1: The City and Department should consider adding a third person per day (Fire Captain) to form the rescue unit into a full three-person crew at Station 1 to provide additional deployment and response flexibility, including station move-up and cover capacity when Engine 54 or other engines are delivering training at another station.

Recommendation #2: To maximize deployment and service flexibility of a three-person rescue crew, Citygate recommends that the City and Department consider adding a Fast Response Unit to the fleet at Station 1 to provide initial fire suppression, rescue, and emergency medical service capacity in a smaller, more maneuverable vehicle.

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 when possible upon arrival and to keep small and expanding fires from becoming more serious. With this is mind, Citygate recommends the following measures:

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 at City dispatch; this equates to a 90-second dispatch time, a 2:00-minute company turnout time, and a 4:00-minute travel time.

3.2 Multiple-Unit Effective Response Force (ERF) 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 15 personnel, including at least one Battalion Chief, should arrive within 11:30 minutes from the time of 9-1-1 call receipt at the City's dispatch center 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: To protect the City from the hazards associated with uncontrolled release of hazardous and toxic materials, a multiple-unit ERF of at least 15 personnel, including on-duty hazardous materials specialists, the Department's hazardous materials response unit, and at least one Chief Officer, should arrive within 11:30 minutes from the time of 9-1-1 call receipt at City dispatch center 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.

3.4 Technical Rescue: To provide technical rescue services as needed with enough trained personnel to facilitate a successful rescue, a multiple-unit ERF of at least 12 personnel, including on-duty technical rescue specialists and at least one Chief Officer, should arrive within 11:30 minutes from the time of 9-1-1 call receipt at City dispatch center 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 to facilitate safe rescue/extrication and delivery of the victim to the appropriate emergency medical care facility.

NEXT STEPS

Citygate recommends the following near term and longer term next steps:

Near Term

- Review and absorb the content, findings, and recommendations of this report.
- Adopt revised response performance goals as recommended.
- Work with the Police Department Communications Center to reduce call processing time to more closely align with the 1:30-minute best practice goal.
- Authorize and implement the recommended Fast Response Unit and additional full-time equivalent at Station 1 as funding permits.

Longer Term

- Monitor response time performance and unit workload at least annually.
- Monitor simultaneous incident activity impacts.
- Monitor growth impacts.

This page was intentionally left blank

SECTION 1—INTRODUCTION AND BACKGROUND

The City of Mountain View (City) Fire Department (Department) retained Citygate Associates, LLC (Citygate) to conduct a comprehensive Community Hazard and Risk Assessment, Standards of Cover Study, and Station Location Analysis to evaluate and make recommendations relative to the organization and deployment of fire suppression operations, emergency medical operations, and special operations in light of recent and projected future growth and related traffic volume as a foundation for future fire service planning. The goal of this assessment is to identify both current services and desired service levels and then to assess the City's ability to provide them. Citygate's scope of work and corresponding Work Plan were developed consistent with Citygate's Project Team members' experience in fire administration and deployment. Citygate utilizes various industry-recognized best practice guidelines and criteria in the field of deployment analysis, including National Fire Protection Association (NFPA) standards, the self-assessment criteria of the Commission on Fire Accreditation International (CFAI), Insurance Services Office (ISO) schedules, and federal and state mandates relative to emergency services.

1.1 REPORT ORGANIZATION

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

Executive Summary—Summarizes fire service policy choices and key deployment findings and recommendations that can be used to strategically guide the City's and Department's efforts going forward.

Section 1 **Introduction and Background**—Describes Citygate's project approach, methodology, and scope of work and provides an overview of the City and Department.

Section 2 **Standards of Cover Assessment**—Describes in detail Citygate's analysis, findings, and recommendations for each of the eight Standards of Cover elements.

Appendix A **Community Hazard and Risk Assessment**—Provides a comprehensive analysis of the fire and non-fire hazards likely to impact the City.

1.1.1 Goals of the Report

In this report, Citygate cites findings and makes recommendations as appropriate related to each finding. Findings and recommendations throughout this report are sequentially numbered. A complete list of all these same findings and recommendations is provided in the Executive Summary.

This document provides technical information about how 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 safely provide them 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 analyses 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 Methodology

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

Citygate subsequently 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 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. Citygate also evaluated future City growth and service demand by risk type and evaluated potential alternative emergency service delivery models. This resulted in Citygate proposing an approach to address current and long-range needs with effective and efficient use of existing resources. The result is a framework for

enhancing Department services while meeting reasonable community expectations and fiscal realities.

1.2.2 Project Scope of Work

Citygate's approach to this SOC assessment involved:

- Reviewing information provided by the Department and City
- Interviewing the Department's executive management team members
- Utilizing FireView™, a geographic mapping software program, to model fire station travel time coverage
- Using StatsFD™, an incident response time analysis program, to review the statistics of prior incident performance and plot the results on graphs and geographic mapping exhibits
- 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, 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 CITY OVERVIEW

Incorporated in 1902 as a charter city, the City of Mountain View is located 39 miles southeast of San Francisco in the northwest corner of Santa Clara County. Encompassing 12.3 square miles and a resident population of 83,600, the City is home to many of the world's largest technology companies, including Google, LinkedIn, Microsoft, Mozilla Foundation, Symantec, and Intuit, resulting in a 73 percent daytime population increase to 144,700.[1]

While the City is abutted on the northwest by Palo Alto, on the southwest by Los Altos, and on the southeast by Sunnyvale, Mountain View's Sphere of Influence includes approximately the western half of Moffett Federal Airfield. Future development there and in other areas of the City

[1] Source: ESRI Community Profile (2019)

is projected to increase the population by 42 percent to approximately 119,000 residents at build-out.[2]

1.4 Fire Department Overview

1.4.1 Organization

The Fire Department provides services with a budgeted staff of 86.5 personnel organized into three divisions, as summarized in Table 4 and illustrated in Figure 1.

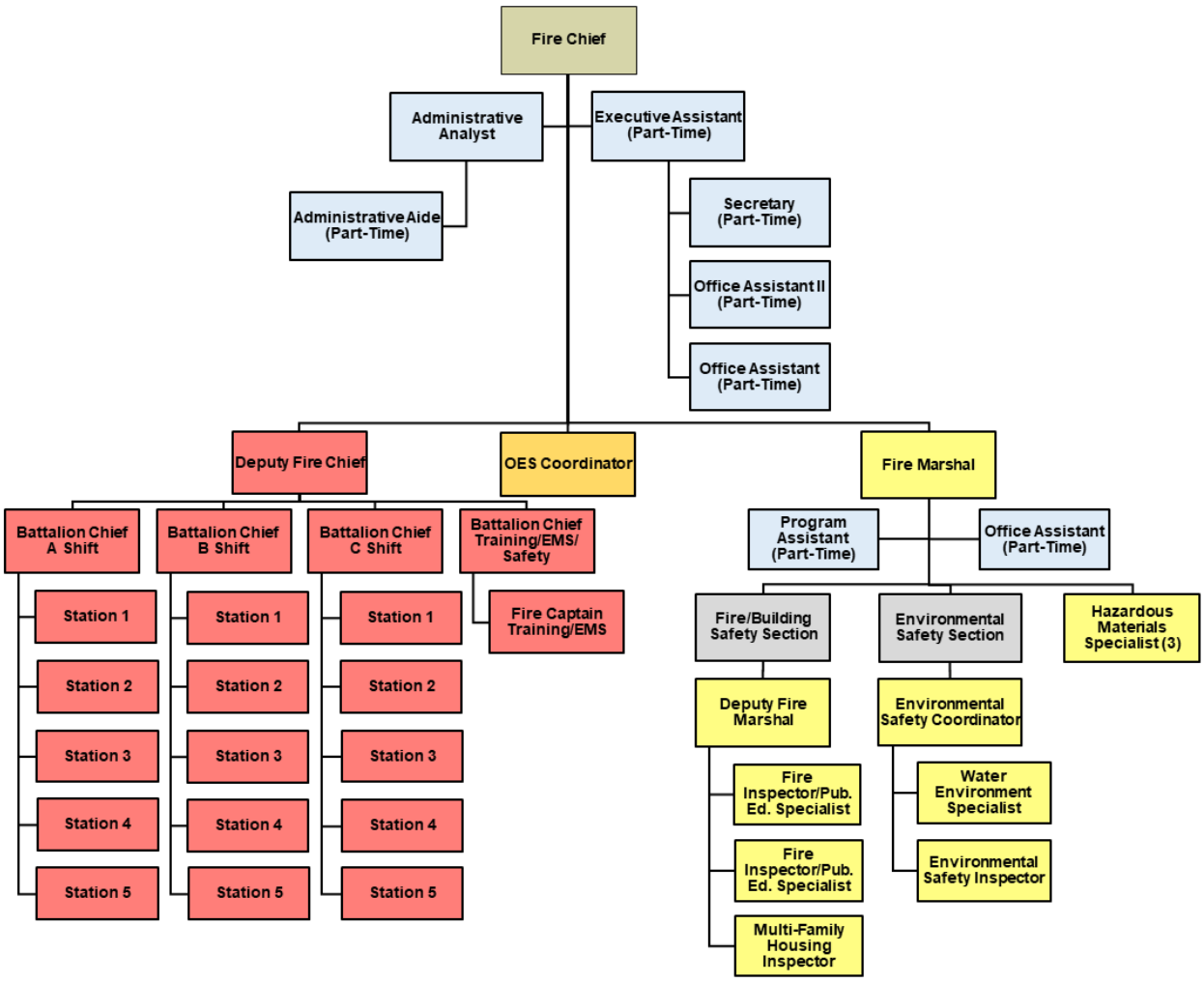
Table 4—Fire Department Positions

Division	Budgeted Positions
Administration	3.5
Suppression	69.0
Fire and Environmental Protection	14.0
Total	**86.5**

Reference: City of Mountain View Fiscal Year 2019-20 Adopted Budget

[2] Source: City of Mountain View Planning Division

Figure 1—Fire Department Organization



1.4.2 Facilities and Resources

The Department provides services from five fire stations with a minimum daily staffing of 21 personnel, as summarized in Table 5.

Table 5—Fire Department Facilities, Resources, and Daily Response Staffing

Station	Address	Year Built	Assigned Resources[1]	Minimum Daily Staffing
1	251 S. Shoreline Blvd.	1994	**Engine 51** **Truck 51** **Rescue 51** **Battalion Chief 51**	**3** **3** **2** **1**
2	160 Cuesta Dr.	2002	**Engine 52** Engine 652	**3**
3	301 N. Rengstorff Ave.	1961	**Engine 53** OES 404	**3**
4	229 N. Whiseman Rd.	1968	**Engine 54** Engine 152 Engine 154 Battalion 151 Utility 54	**3**
5	2195 N. Shoreline Blvd.	2011	**Engine 55** HazMat 55 Truck 155	**3**
			Total Daily Staffing	**21**

[1] Staffed resources are shown in **bold**; other resources are staffed as needed by on-duty station personnel or recalled off-duty personnel
Source: City of Mountain View 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 five Type 1 structural fire engines, one aerial ladder truck, one rescue, and one Battalion Chief. A hazardous materials response unit is cross-staffed by on-duty Station 5 personnel as needed. An Urban Search and Rescue (USAR) Type 1 company was formed in April 2020. All units except the Battalion Chief provide Advanced Life Support (ALS) with a minimum of one firefighter/paramedic or engineer/paramedic assigned.

1.4.3 Service Capacity

All response personnel are trained to either the Emergency Medical Technician (EMT) level, capable of providing Basic Life Support (BLS) pre-hospital emergency medical care, or EMT-Paramedic (paramedic) level, capable of providing ALS pre-hospital emergency medical care. All staffed response resources include a minimum of one EMT-Paramedic. Ground paramedic ambulance service is provided by Santa Clara County Ambulance operated by Rural/Metro Corporation of Northern California, a private-sector ambulance provider operating under a non-

exclusive operating area contract administered by the Santa Clara County Emergency Medical Services Agency. Air ambulance services, when needed, are provided by CALSTAR (Gilroy) and Life Flight (Palo Alto). Emergency room services are available at El Camino Hospital in Mountain View, as well as Stanford Medical Center in Palo Alto and Santa Clara Valley Medical Center in San Jose. Stanford Medical Center and Santa Clara Valley Medical Center are also Level 1 trauma centers.

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 support for a hazardous material response team. In addition, 27 personnel (nine per shift) are trained to the Hazardous Materials Specialist or Technician level to staff the Department's Type 2 hazardous materials response unit from Station 5 as needed. Additional hazardous materials response capacity is available from the Central Santa Clara County Fire District and City of San Jose by mutual aid if needed.

The Department also staffs a two-person CalOES-certified USAR Type 1 company from Station 1, which includes tools, equipment, and personnel qualified to perform USAR services, including confined space rescue, low/high-angle rope rescue, breaching, shoring, excavation, and trench, transportation, and shore-based water rescue operations.

Finding #1:	The Department's response unit types are appropriate to protect against the hazards likely to impact the City, and the daily staffing of 21 personnel provides a minimum Effective Response Force sufficient for a single emerging or serious fire and one additional minor incident.

This page was intentionally left blank

SECTION 2—STANDARDS OF COVER ASSESSMENT

This section provides a detailed analysis of the Department's current ability to deploy and mitigate hazards 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 COVER PROCESS OVERVIEW

The core methodology used by Citygate in the scope of its deployment analysis work is *Standards of Cover*, 5th and 6th editions, which is a systems-based approach to fire department deployment published by the Commission on Fire Accreditation International (CFAI). This approach uses local risk and demographics to determine the level of protection best fitting a community's needs.

The Standards of Cover (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 multiple-part systems approach as a comprehensive tool to evaluate fire station locations. Depending on the needs of the study, the depth of the components may vary.

In contrast to a one-size-fits-all prescriptive formula, such a systems approach to deployment 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, 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 6 describes the eight elements of the SOC process.

Table 6—Standards of Coverage Process Elements

SOC Element		Description
1	Existing Deployment System	Overview of the community served, authority to provide services, and current deployment model and performance metrics
2	Community Outcome Expectations	Review of the community's expectations relative to response services provided by the agency
3	Community Risk Assessment	Description of the values at risk within the community and analysis of risk from natural and human-caused hazards
4	Critical Task Analysis	Review of the essential tasks that must be performed and the personnel required to deliver a stated outcome for an Effective Response Force (ERF)
5	Distribution Analysis	Review of the spacing of initial response (first-due) resources (typically engines) to control routine emergencies to achieve desired outcomes
6	Concentration Analysis	Review of the spacing of fire stations so that larger or more complex emergencies receive sufficient resources in a timely manner (ERF) to achieve desired outcomes
7	Reliability and Historical Response Effectiveness Analysis	Using recent prior response statistics, determining the percentage of conformance to established response performance goals the existing deployment system delivers
8	Overall Evaluation	Proposing Standards of Coverage statements by risk type as appropriate

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

Fire service deployment, simply summarized, is about the *speed* and *weight* of response. *Speed* refers to initial response (first-due) of all-risk intervention resources (engines, ladder trucks, rescues, and ambulances) strategically deployed across a jurisdiction for response to emergencies within a time interval sufficient 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, enough firefighters must be assembled within a time interval to safely control the emergency and prevent it from escalating into an even more serious event. Table 7 illustrates this deployment paradigm.

Table 7—Fire Service Deployment Paradigm

Element	Description	Purpose
***Speed** of Response*	Response time of initial 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- 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 fire center receives the 9-1-1 call into its computer-aided 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.

Table 8 summarizes the Department's current response performance goals.

Table 8—Current Response Performance Goals

Response Component	Current Performance Goal (Minutes)	Percentage Reliability Goal
Call Processing/Dispatch	None	n/a
Crew Turnout	1:30	90%
First-Due Travel	4:00	90%
ERF (First Alarm) Travel	6:30	90%
Dispatch to First Unit Arrival	5:30	90%
Dispatch to ERF Arrival	8:00	90%

Source: City of Mountain View Fire Department

As Table 8 indicates, there is currently no performance expectation or goal for call processing as provided by the Police Department Communications Center. Thus, these goals do not begin the time measure from the receipt of the 9-1-1 call consistent with best practice guidelines and recommendations. They also do not address risk-specific response performance as recommended by the CFAI. In addition, the Safety Element of the City's 2030 General Plan references a 6:00-minute emergency response goal, but it does not specify the start point of that goal.

NFPA Standard 1710, a recommended deployment standard for career fire departments in urban/suburban areas, recommends initial (first-due) intervention units arrive within 4:00 minutes travel time and recommends arrival of all the resources comprising the multiple-unit First Alarm within 8:00 minutes, at 90 percent or better reliability.[3]

The most recent published NFPA best practices have increased the dispatch processing time to 1:30 minutes, or 2:00 minutes if there are language barriers. Further, for crew turnout time, 60 to 90 seconds is recommended, depending on the type of protective clothing that must be donned.

If the travel time measures recommended by the NFPA (and Citygate) are added to dispatch processing and crew turnout times recommended by Citygate and NFPA best practices, then a realistic 90 percent first-due unit response performance goal is now 7:30 minutes from the time of the Police Department Communications Center receiving the call. This includes 1:30 minutes call processing/dispatch, 2:00 minutes crew turnout, and 4:00 minutes travel time.

[3] 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 #2:	The Department has established response performance objectives partially consistent with best practice recommendations as published by the Commission on Fire Accreditation International. However, the City Council has not recently adopted a response time goal that begins with the 9-1-1 call receipt or goals for all types of emergency risk outcomes.

2.2.1 Current Deployment Model

Resources and Staffing

The Department's current deployment model consists of five engines and one aerial ladder truck each staffed with three personnel each, one rescue staffed with two personnel, and one Battalion Chief, for a total daily minimum year-round continuous staffing of 21 personnel operating from five fire stations. This deployment model meets the minimum staffing standards for building fires as recommended by NFPA 1710 and provides minimally sufficient personnel for serious fire incidents or other emergencies requiring a multiple-unit response to effectively resolve, with sufficient additional response capacity for simultaneous incidents. The Department also has an automatic mutual aid agreement with the City of Palo Alto, the City of Sunnyvale, and the Central Fire District (also known as the Santa Clara County Fire Department), and is a signatory to the Santa Clara County Mutual Aid Plan.

Response Plan

The Department is an all-risk fire agency providing the population it protects with services that include fire suppression; pre-hospital paramedic (ALS) emergency medical services; hazardous material and USAR technical rescue response; and other non-emergency services, including fire prevention, environmental protection, hazardous materials storage regulations, multi-family housing inspections, and community safety education. The Department also manages the Emergency Operations Center via the Office of Emergency Services, all 1,150 Community Emergency Response Team volunteers, the ham radio operators, 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 Police Department Communications Center's CAD system selects and dispatches the closest and most appropriate resource(s) pursuant to the Department's response plan, as summarized in Table 9.

Table 9—Response Plan by Type of Emergency

Incident Type	Response	Total Personnel
Medical Emergency	1–2 Engines	**3-6**
Building Fire	3 Engines, 2 Trucks, Rescue, 2 BCs	**19**[1]
Commercial Building Fire	3 Engines, 2 Trucks, Rescue, 2 BCs	**19**[1]
Vegetation Fire	2 Engines, BC	**7**
Vehicle Fire	2 Engines	**6**
Commercial Vehicle Fire	2 Engines, Truck, Rescue, BC	**12**
Vehicle Collision	2 Engines, Rescue, BC	**9**
Hazardous Materials	2 Engines, Truck, Hazmat Engine, Rescue, BC	**15**
Technical Rescue	2 Engines, Truck, Rescue, BC	**12**
Aircraft Crash	3 Engines, 2 Trucks, Rescue, 2 BCs	**19**[1]
Railcar Incident	2 Engines, Truck, Rescue, BC	**12**
Water Rescue	2 Engines, Truck, Rescue, BC	**12**

[1] Second truck and Battalion Chief (BC) provided through automatic mutual aid by the City of Palo Alto Fire Department
Source: City of Mountain View Fire Department

Finding #3: 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, specialty units, and command officers customarily needed to effectively control that type of incident based on Department experience.

Training

The Department's training program utilizes Station 4's engine crew, under the supervision of an administrative Training Battalion Chief, to deliver training to the other stations' crews in addition to their primary emergency response duties. This training model impacts the Department's response capacity when Engine 54 is delivering training at another station, resulting in longer response times to emergencies back into vacant Station 4's response area.

The Department generally utilizes Engine 55 to cover Station 4 and other stations in these situations due to its lower service demand; however, when Engine 55 is out of its station the hazardous materials response unit is also unavailable. The Department also does not use the rescue or ladder truck for station coverage as these units do not have fire suppression capability including a water tank, pump, and hose.

Finding #4:	When the Engine 54 crew or other crews are delivering training outside of their district, another engine must move up and cover Station 4 or the vacant station. Given only five engines are available, this leaves one or more stations uncovered, with a resultant longer travel time to incidents within those uncovered station areas.

2.3 OUTCOME EXPECTATIONS

SOC ELEMENT 2 OF 8
COMMUNITY OUTCOME EXPECTATIONS

The Standards of Cover 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 it has, 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.[4] This is because measuring the 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 far above the average or just above.

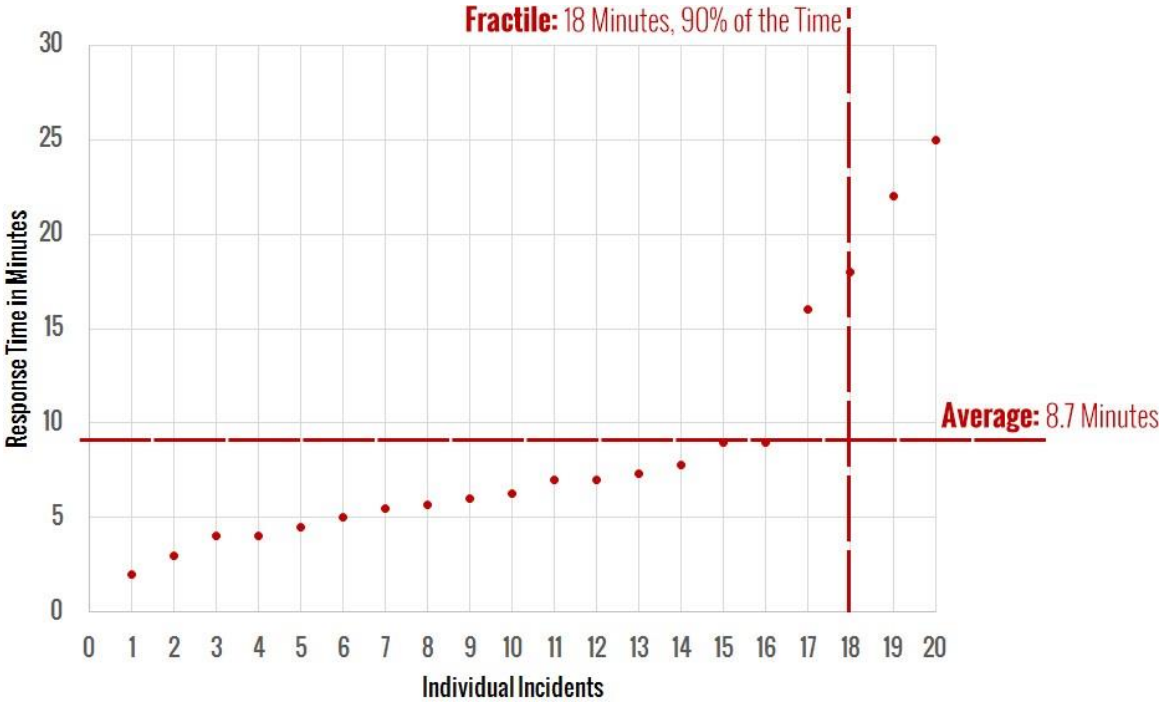
For example, Figure 2 shows response times for a fictitious fire department. This agency is small and receives 20 calls for service each month. Each response time has been plotted on the graph from shortest response time to longest response time.

Figure 2 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 2 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.

[4] 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.

Figure 2—Fractile versus Average Response Time Measurements



More importantly, within the SOC process, positive outcomes are the goal. From that, crew size and response time can be calculated to provide appropriate fire station spacing (distribution and concentration) to achieve the desired goal. Emergency medical incidents include situations with the most severe time constraints. The brain can only survive 4:00 to 6:00 minutes without oxygen. Cardiac arrest and other events can cause oxygen deprivation to the brain. Cardiac arrests 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 time frame. 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 that the fire or medical emergency continues to deteriorate from the time of inception, not from 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 appropriately deploy its skills and tools. 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-story 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 down the response system. 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 Communications Center's dispatch processing, 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.

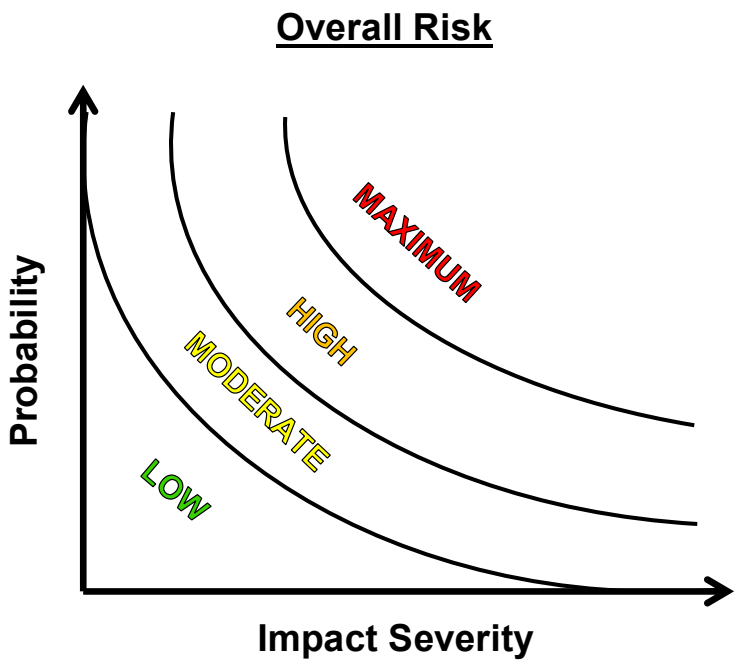
A *hazard* is broadly defined as a situation or condition that can cause or contribute to harm. Examples include fire, medical emergency, vehicle collision, earthquake, flood, etc. *Risk* is broadly defined as the *probability of hazard occurrence* in combination with the *likely severity of resultant 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 3.

Figure 3—Overall Risk



2.4.2 Values at Risk to Be Protected

Broadly defined, *values at risk* are those tangibles of significant importance or value to the community or jurisdiction that are 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 in 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 younger than 10 years, the elderly, and people housed in institutional settings. Key demographic data for the City includes the following:[5]

- The daytime population is nearly double the resident population
- Nearly 25 percent of the City population is under 10 years or over 65 years of age
- The City's population is predominantly White (49 percent), followed by Asian (33 percent), Hispanic/Latino (21 percent), other ethnicities (16 percent), and Black / African American (2 percent)
- Of the population over 24 years of age, nearly 94 percent has completed high school or equivalency
- Of the population over 24 years of age, 69 percent has an undergraduate, graduate, or professional degree
- Nearly 60 percent of the population 15 years of age or older is in the workforce; of those, just over 3 percent are unemployed
- Per capita income is nearly $75,000
- The population below the federal poverty level is just under 8 percent
- Only slightly more than 6 percent of the population does not have health insurance coverage.

Buildings

The City currently has more than 37,000 housing units and more than 2,300 non-residential buildings including industrial, manufacturing, research, technology, office, professional services, retail sales, restaurants/bars, motels, churches, schools, government facilities, healthcare facilities, and other non-residential uses as described in **Appendix A**.

Critical Infrastructure / Key Resources

The U.S. Department of Homeland Security defines Critical Infrastructure / Key Resources as those physical assets essential to the public health and safety, economic vitality, and resilience of a community, such as lifeline utilities infrastructure, telecommunications infrastructure, essential

[5] Source: ESRI Community Profile (2019)

government services facilities, public safety facilities, schools, hospitals, airports, etc. Volume 2 of the 2017 Santa Clara County Operational Area Hazard Mitigation Plan identifies numerous critical facilities and infrastructure within the City as illustrated in Map #2c (**Volume 2—Map Atlas**). A hazard occurrence with significant impact severity affecting one or more of these facilities would likely adversely impact critical public or community services.

2.4.3 Hazard Identification

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

Following an evaluation of the hazards identified in the 2017 Santa Clara County Operational Area 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:

- Building Fire
- Vegetation Fire
- Medical Emergency
- Hazardous Materials
- Technical Rescue

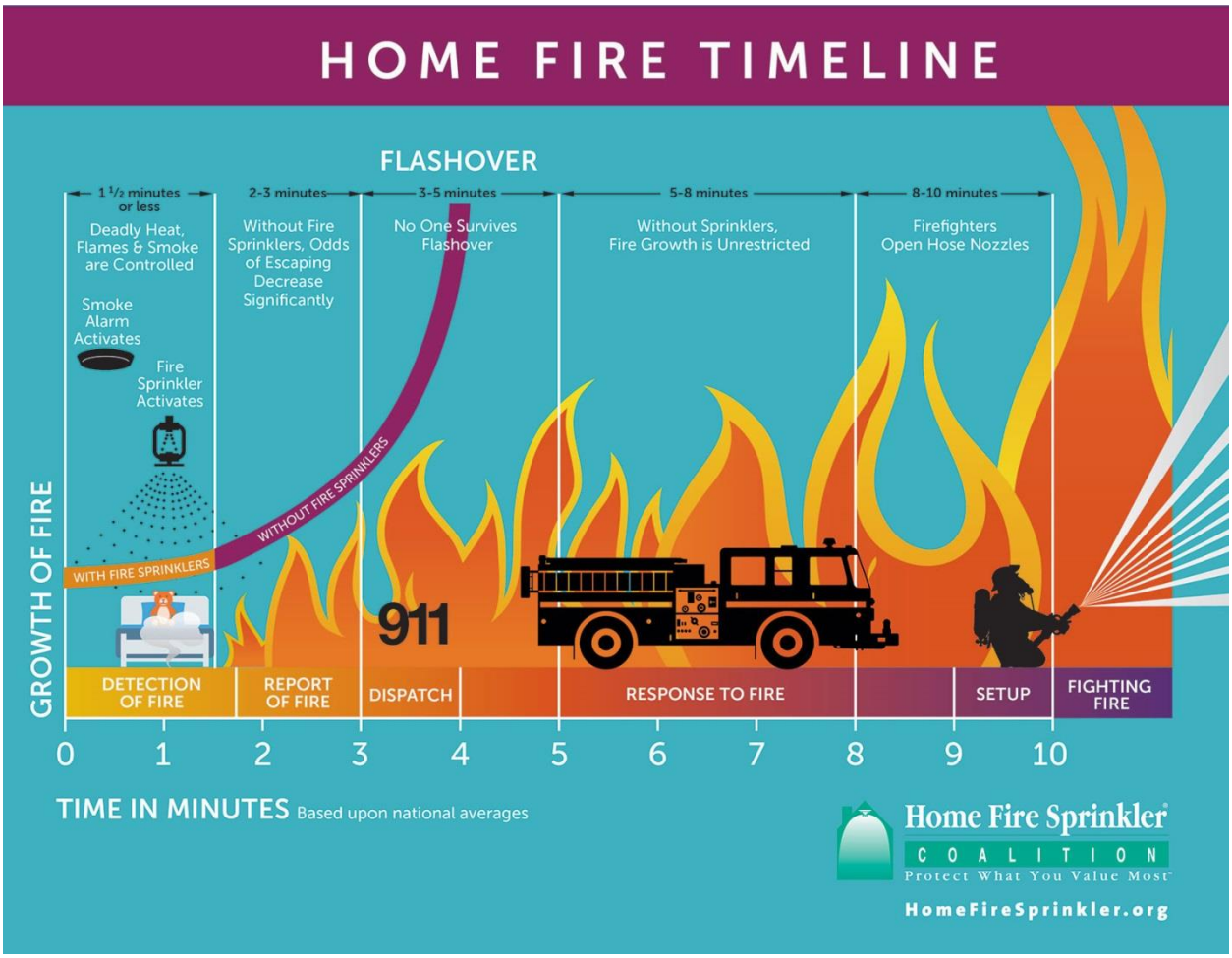
Because building fires and medical emergencies have the most severe time constraints if positive outcomes are to be achieved, the following is a brief overview of building fire and medical emergency risk. **Appendix A** contains the full risk assessment for all five hazards.

Building Fire Risk

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

Figure 4 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 three to five minutes from the initial ignition. Human survival in a room after flashover is extremely improbable.

Figure 4—Building Fire Progression Timeline

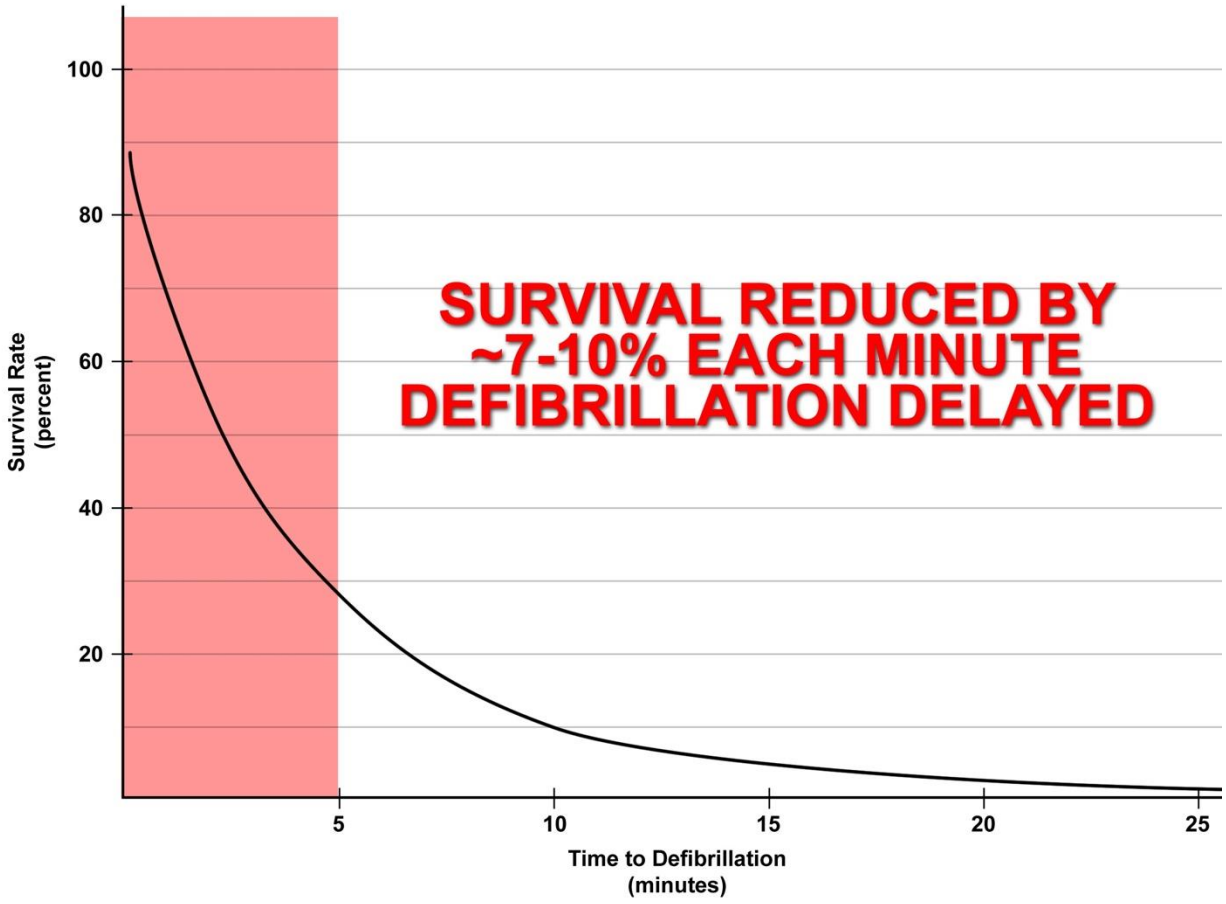


Source: http://www.firesprinklerassoc.org

Medical Emergency Risk

Fire agency service demand in most jurisdictions is predominantly for medical emergencies. Figure 5 illustrates the reduced survivability of a cardiac arrest victim as time to defibrillation increases.

Figure 5—Survival Rate versus Time of Defibrillation



Source: www.suddencardiacarrest.org

The Department currently provides ALS pre-hospital emergency medical services, with operational personnel trained to the EMT or EMT-Paramedic level.

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.

1. The Fire Department serves a diverse population, with densities ranging from fewer than 1,000 to more than 50,000 people per square mile, over a widely varied urban land use pattern.

2. The City's population is projected to grow by approximately 42 percent to 119,000 with currently planned and projected future development.

3. The City has a large inventory of residential, commercial, office, industrial, research, educational, and other non-residential uses typical of other California communities of similar size and demographics.

4. The City has significant economic and other resource values to be protected, as identified in this assessment.

5. Santa Clara County has a mass emergency notification system to effectively communicate emergency information to the public in a timely manner.

6. 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 10.

Table 10—Overall Risk by Hazard

Hazard		Planning Zone				
		Sta. 1	Sta. 2	Sta. 3	Sta. 4	Sta. 5
1	Building Fire	*Moderate*	*Low*	*Low*	*Low*	*Low*
2	Vegetation Fire	*Low*	*Low*	*Low*	*Low*	*Low*
3	Medical Emergency	*High*	*High*	*High*	*Moderate*	*Moderate*
4	Hazardous Materials	*Moderate*	*Low*	*Moderate*	*Low*	*Moderate*
5	Technical Rescue	*Moderate*	*Low*	*Moderate*	*Low*	*Low*

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

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 11 and Table 12 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, with units staffed with three personnel per engine or ladder truck. It is important to understand the following relative to these tables:

- It can take considerable time after a task is ordered by command to complete the task and achieve 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 11 illustrates the critical tasks required to control a typical single-family dwelling fire with six response units from just the City, for a total Effective Response Force (ERF) of **15** personnel (three engines, one ladder truck, one rescue, and one Battalion Chief).[6] These tasks are taken from typical fire departments' operational procedures, which are consistent with the customary findings of other agencies using the SOC process. No conditions exist to override the Occupational Safety and Health Administration (OSHA) two-in/two-out safety policy, which requires that firefighters enter atmospheres that are immediately dangerous to life and health, 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.*

[6] The Department also dispatches to all building fires a second ladder truck and Battalion Chief via automatic aid (for a total of 19 personnel), although their response is not guaranteed.

Table 11—First Alarm Residential Fire Critical Tasks – 15 City Personnel

	Critical Task Description	Personnel Required
First-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	Or skip the above and establish incident command.	1
6	Conduct primary search within OSHA regulations	2
Second-Due Engine (3 Personnel)		
7	If necessary, establish supply line to hydrant.	1–2
8	Deploy an attack or backup attack line.	1–2
9	Establish Initial Rapid Intervention Crew.	2
First-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
Chief Officer		
14	Transfer of incident command from first- or second-in Captain.	1
15	Establish exterior command and scene safety.	(Mutual Aid)
Third-Due Engine (3 Personnel) and Rescue (2 Personnel)		
16	Establish full Rapid Intervention Crew.	3
17	Secure utilities.	2
18	Deploy second attack line as needed.	2
19	Conduct secondary search.	2

Grouped together, the duties in Table 11 form an 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.

2.5.2 Critical Medical Emergency Tasks

The Department responds to more than 4,000 EMS incidents annually, including vehicle accidents, strokes, heart attacks, difficulty breathing, falls, childbirths, and other medical emergencies. For comparison, Table 12 summarizes the critical tasks required for a cardiac arrest patient.

Table 12—Cardiac Arrest Critical Tasks – Three Engine 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/cricothyroidotomy
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 en route 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 necessary to stop the escalation of an emergency (as shown in Table 11 and Table

12) must be compared to outcomes. As shown in nationally published fire service time-versus-temperature tables, after approximately 4:00 to 5:00 minutes of free burning in an enclosed room, a building fire will escalate to the point of flashover. At this point, the entire room is engulfed in fire, the fire extends rapidly both horizontally and vertically, and human survival near or in the room of fire origin becomes impossible. Additionally, 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 provides a single ERF of 15 firefighters to a building fire—if they can arrive in time, which the statistical analysis of this report will discuss in depth. The Department also receives a second ladder truck and Battalion Chief on automatic aid from Palo Alto for all building fires. 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 improve. The outcome times, of course, will be longer and yield less-desirable results if the arriving force is smaller or arrives later.

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 require the initial firefighters 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. However, 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 away, and the emergency will escalate and/or result in a 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** *(number of firefighters)* of the response.

Nineteen initial response personnel could handle a moderate-risk, confined residential fire; however, even an ERF of 15-19 personnel (City plus automatic mutual aid 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 ERF plan delivers 15 City 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, one rescue, 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 quickly receive sufficient resources from multiple fire stations. As indicated, this is known as the **Effective Response Force** (ERF), 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 FireView™, a geographic mapping tool 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 Deployment Baselines

All maps referenced can be found in **Volume 2** (Map Atlas).

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

Map #1 shows the City boundary and fire station locations. 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, and the rescue is staffed with two personnel.

Map #2a – Risk Assessment: Planning Zones

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

Map #2b – Risk Assessment: Population Density

Map #2b shows the population density across the City for *resident* population. People drive EMS incident demand, and the highest population density areas are typically the locations with the highest EMS demand. As Map #2b shows, the City's resident population density ranges from less than 1,000 to more than 50,000 people per square mile.

Map #2c – Risk Assessment: Critical Facilities

Map #2c shows the location of the critical facilities as identified by Department staff. A hazard occurrence with significant impact severity affecting one or more of these facilities would likely adversely impact critical public or community services.

Map #2d – Risk Assessment: High Risk Occupancies

Map #2d displays the locations of the higher-risk building occupancies within the City, as defined by the CFAI. These building occupancies typically require a larger initial ERF due to the higher risks associated with these specific occupancies. As Map #2d illustrates, while there are high- or maximum-risk occupancies in every planning zone, the majority are located within the central area of the City between U.S. 101 and State Route 82.

Map #2e – Risk Assessment: Hazardous Material Locations

Map #2e displays the locations of the occupancies within the City using hazardous materials regulated by the Department's Fire and Environmental Protection Division as determined by the

state-designated Certified Unified Program Agency (CUPA) program that is managed by the County Health Department. As the map illustrates, these buildings are also predominantly located in the commercial and industrial zoned areas of the City.

Map #3 – Distribution: 4:00-Minute First-Due Travel Time Coverage

Map #3 shows first-due travel time coverage from the City's five current fire station locations, with orange indicating the City's current road network that a fire engine should be expected to reach within 4:00 minutes *with traffic congestion* assuming it is in station, and green indicating the additional 4:00-minute coverage expected *without 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 actual response data to reflect actual travel 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 the map shows, and as we further explain in Table 13, non-congested coverage is very good at 80 percent of total public road miles, with traffic congestion reducing that coverage by 17 percent to 63 percent coverage of public City roads. The areas not covered are not large enough to warrant a fire station move or addition.

> **Finding #5:** The City's five fire stations are appropriately distributed to provide service to all major neighborhood areas.

Map #4 – Insurance Services Office 1.5-Mile Coverage Areas

Map #4 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 4:00-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 #3.

Map #5 – Concentration: Effective Response Force 8:00-Minute Travel Time Coverage

Map #5 shows, in green, the streets where the Department's current response plan *should* deliver the initial ERF of three engines, one ladder truck, one rescue, and one Battalion Chief within 8:00 minutes travel time *without traffic congestion*, and in red *with traffic congestion*. As the map shows, and as we further explain in Table 13, both non-congested and congested coverage are excellent, covering 94 percent and 84 percent of the City's public road network, respectively, with only small gaps in some of the edge areas.

Map #6 – 8:00-Minute Ladder Truck Travel Time Coverage

Map #6 shows 8:00-minute travel time coverage for the ladder truck from Station 1 without traffic congestion. As can be seen, this specialized resource should reach approximately 94 percent of the City within 8:00 minutes travel time. This 8:00-minute travel time coverage also applies to the rescue from Station 1.

Finding #6:	The ladder truck and rescue are optimally located at Station 1 to provide Citywide coverage.

Map #7 – Battalion Chief 8:00-Minute Travel Time Coverage

Map #7 displays 8:00-minute travel time coverage for a Battalion Chief from Station 1 without traffic congestion. It is apparent that the single Battalion Chief travel time coverage includes nearly all areas of the City.

Note: Maps #8 through #14 are all based on incident data from October 2016 through September 2019.

Map #8 – All Incident Locations

Map #8 shows the location of all incidents, which occur in all areas of the City.

Map #9 – Emergency Medical Services and Rescue Incident Locations

Map #9 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 #10 – All Fire Locations

Map #10 identifies the location of all fires within the City. 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 fact, it is evident that fires occur in all fire station areas.

Map #11 – Building Fire Locations

Map #11 displays the location of building fire incidents. While the number of building fires is a smaller subset of total fires, there are two meaningful findings from this map. First, building fires occurred in every fire station area, and second, there are a relatively small number of building fires in the City overall, which in Citygate's experience is consistent with other similar cities in the western United States.

Map #12 – Emergency Medical Services and Rescue Incident Location Densities

Map #12 shows, by mathematical density, where clusters of EMS and rescue incident activity occurred. In this set, the darker density color plots the highest concentration of EMS and rescue incidents. This type of map makes the location of frequent workload more meaningful than simply mapping the locations of all EMS and rescue incidents, as was shown in Map #9.

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 medical incident density areas of the City.

Map #13 – All Fire Location Densities

Map #13 shows the hot spots of activity for all types of fires (shown in Map #10). Fire density is greater in the higher building/population density areas of the City, which also includes older buildings.

Map #14 – All Building Fire Location Densities

Map #14 shows the hot spots for building fire activity (shown in Map #11). Given the location of the ladder truck and Battalion Chief at Station 1, the multiple-unit coverage is closest to the greatest quantity of building fires.

2.6.2 Road Mile Coverage Measures

In addition to the visual displays of coverage that maps provide, the geo-mapping software allows the miles of public streets covered at 4:00 or 8:00 minutes *travel* time to be measured. Table 13 summarizes non-congested coverage versus the impacts of traffic congestion.

Table 13—Travel Time Coverage Summary – Congested versus Non-Congested (No Mutual Aid)

Travel Time Measure	Total Public Road Miles	Road Miles Covered				Difference	
		Non-Congested	Percent of Total	Congested	Percent of Total	Miles	Percentage Loss
1st-Due Engine @ 4:00 Min.	274.94	220.19	**80.09%**	173.43	**63.08%**	46.76	**17.01%**
Rescue @ 4:00 Min.	274.94	83.86	**30.50%**	54.67	**19.88%**	29.19	**10.62%**
ERF @ 8:00 Min.	274.94	258.29	**93.94%**	231.99	**84.38%**	26.30	**9.57%**
Truck/BC at @ 8:00 Min.	274.94	258.43	**94.00%**	252.50	**91.84%**	5.93	**2.16%**

As can be seen, the existing 4:00-minute first-due unit coverage is reduced by 17 percent during traffic congestion. With 4:00 minutes as a desirable travel time goal, and prior data indicating the Department's 90 percent travel time is 5:41 minutes, traffic congestion is, at least in part, impacting

the additional 1:41 minutes of travel time. ERF travel coverage is *excellent* without traffic, and still good with congestion. In Citygate's experience, many communities struggle to have stations located to provide 4:00-minute travel coverage at 80 percent or better, uncongested.

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, 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.

2.7.1 Demand for Service

Incident data was provided for Report Years (RY) October 1, 2016 through September 30, 2019. In RY 18/19, the Department responded to 6,515 incidents. During this period, the City had a daily demand of 17.85 incidents, of which 1.55 percent were to fire incidents, 68 percent were to EMS incidents, and 30.45 percent were to other incident types. During this same period, there were 10,251 apparatus movements, meaning an average of 1.57 apparatus responses per incident. The Department experienced a slight reduction in service demand from RY16/17 to RY 17/18, and then a greater increase from RY 17/18 to RY 18/19 as shown in Figure 6.

Figure 6—Annual Service Demand by Year

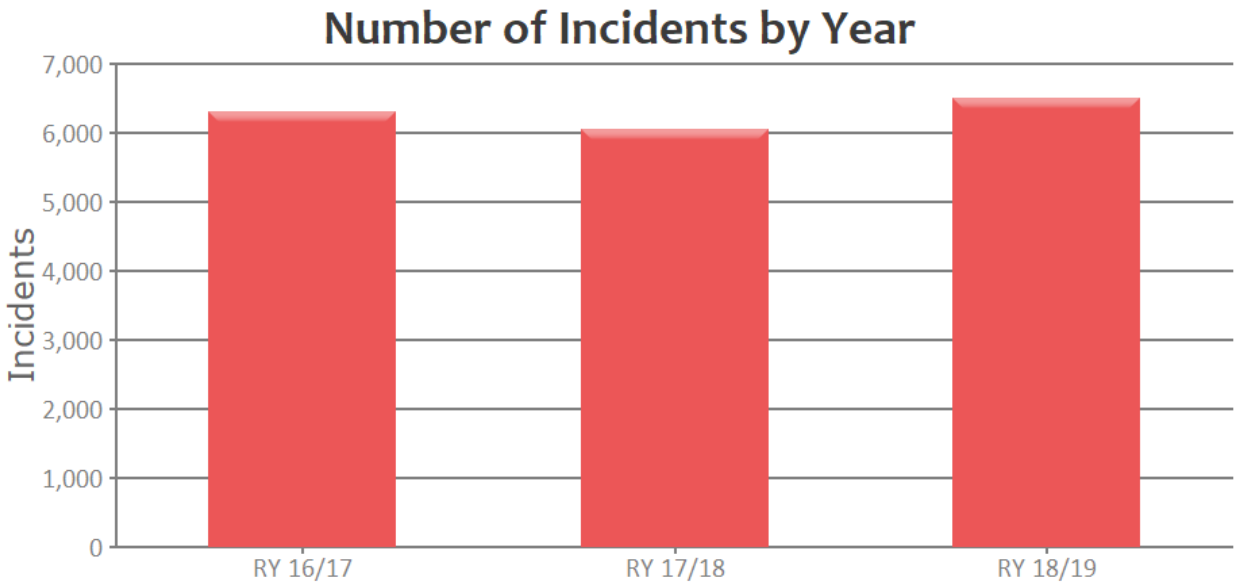


Figure 7 illustrates the number of incidents by incident type. As in overall service demand, EMS service demand decreased from RY 16/17 to RY 17/18, and then increased in RY 18/19. The number of fire incidents remained steady at slightly over 100 across all three years.

Figure 7—Number of Incidents by Year by Incident Type

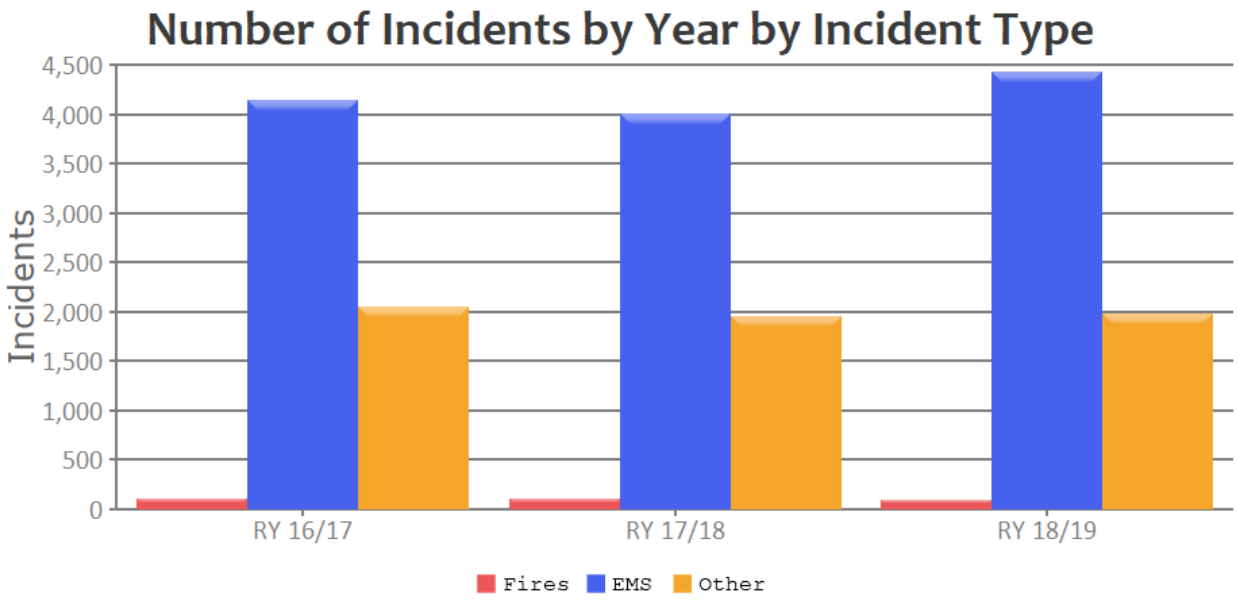
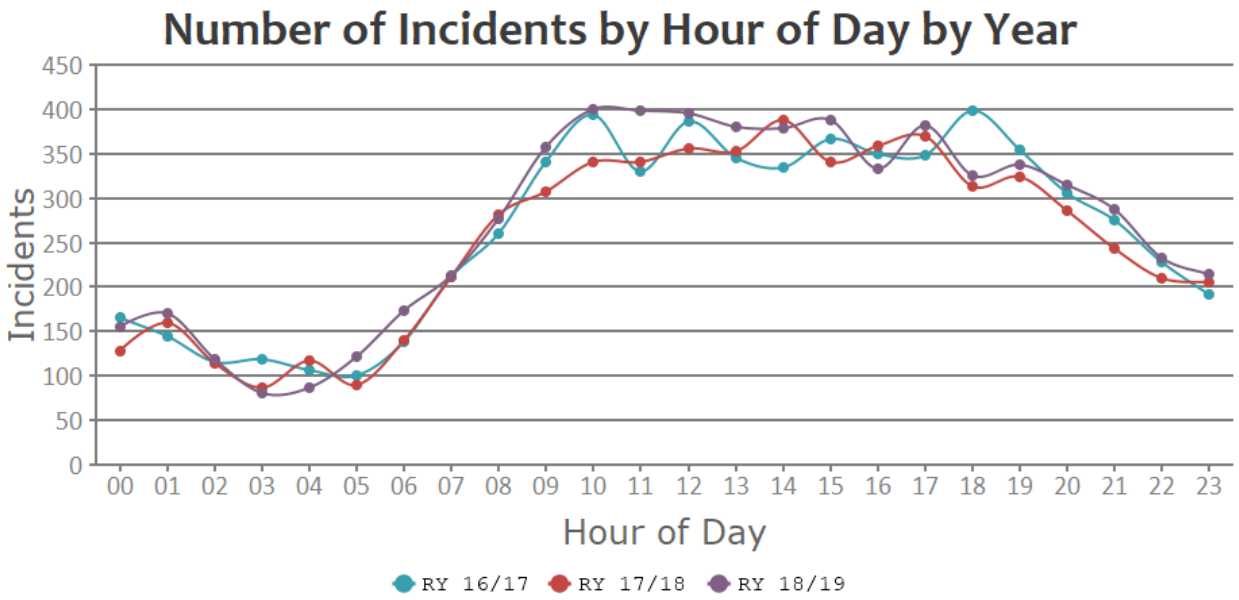


Figure 8 shows service demand by hour of day by year, illustrating an annual variance in hourly volume during the late morning, afternoon, and early evening hours, with peak activity in the late morning to noon hours.

Figure 8—Service Demand by Hour of Day and Year



Finding #7:	Analysis of the Department's service demand indicates the need for a 24-hours-per-day, seven-days-per-week fire and emergency medical services response system.

Figure 9 shows the number of incidents by station area by year and shows that Station 1 had the highest demand and Station 5 had the lowest. In addition, all five stations had an increase in service demand from RY 17/18 to RY 18/19.

Figure 9—Number of Incidents by Station by Year

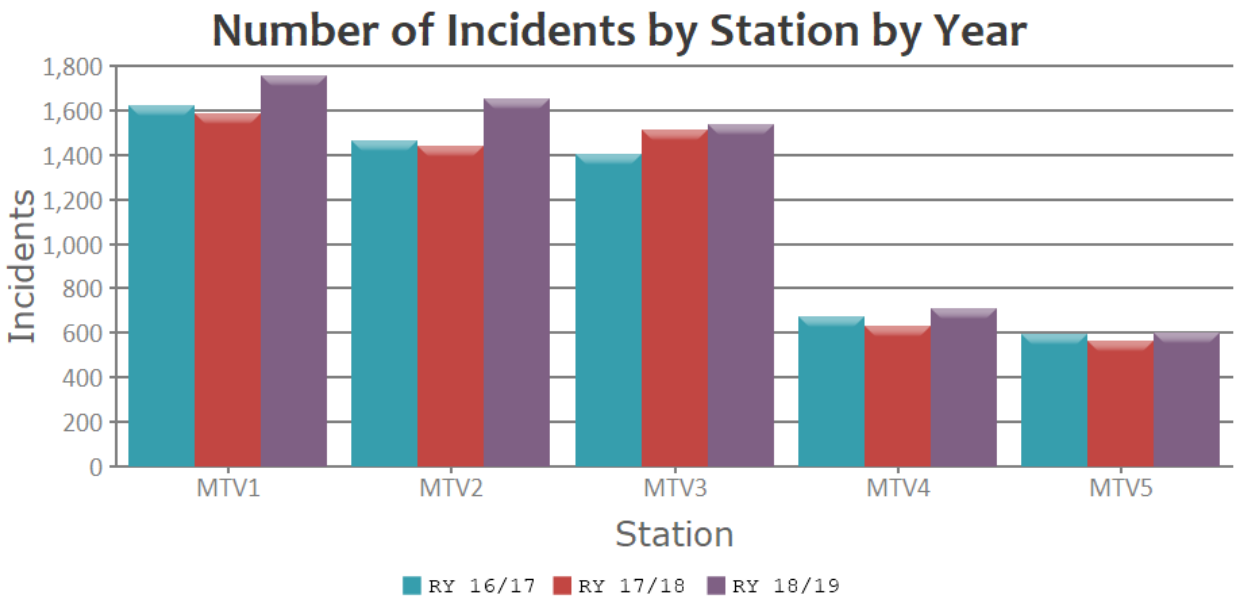


Table 14 lists the activity rankings of incidents by quantity for RY 18/19 for those incidents with more than 50 occurrences. Note the strong ranking for EMS-related incidents.

Table 14—Incidents: Quantity – Year by Incident Type – RY 18/19

Incident Type	RY 18/19
321 EMS call	3,974
611 Dispatched and cancelled en route	405
700 False alarm or false call, other	309
322 Motor vehicle accident with injuries	268
622 No incident found on arrival at dispatch address	171
554 Assist invalid	148
745 Alarm system activation, no fire – unintentional	92
500 Service call, other	83
324 Motor vehicle accident with no injuries.	72
743 Smoke detector activation, no fire	56

Table 15 illustrates the ranking of incidents by property use. The highest rankings for incidents by property type are residential dwellings. Only those property types with 50 or more incidents are shown.

Table 15—Incidents: Quantity – Year by Property Use – RY 18/19

Property Use	RY 18/19
419 1 or 2 family dwelling	1,473
429 Multi-family dwelling	1,350
963 Street or road in commercial area	530
599 Business office	389
965 Vehicle parking area	387
962 Residential street, road or residential driveway	292
340 Clinics, doctors offices, hemodialysis center, other	288
961 Highway or divided highway	236
311 24-hour care nursing homes, 4 or more persons	193
341 Clinic, clinic-type infirmary	88
519 Food and beverage sales, grocery store	86
9602 Street, subject has no known residence	68
449 Hotel/motel, commercial	65
161 Restaurant or cafeteria	61
141 Athletic/health club	52

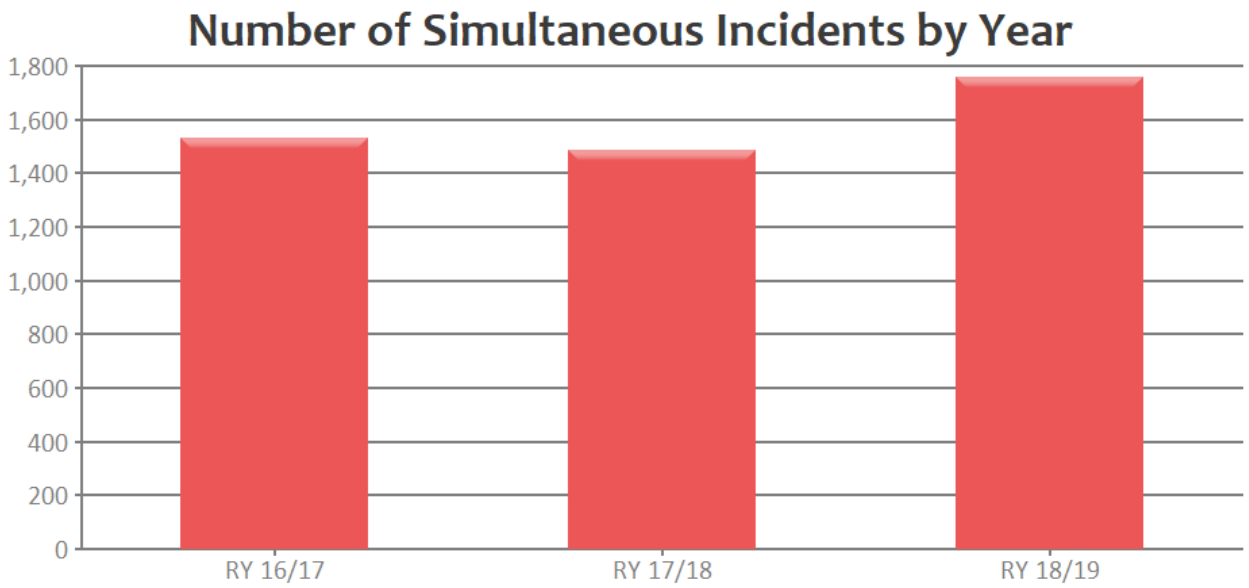
2.7.2 Simultaneous Incident Activity

Simultaneous incidents occur when other incidents are underway at the time a new incident develops. During RY 18/19, 27.03 percent of incidents occurred while one or more other incidents were underway. Following is the percentage of simultaneous incidents broken down by the number of simultaneous incidents.

- 1 or more simultaneous incidents: 27.03 percent
- 2 or more simultaneous incidents: 4.82 percent
- 3 or more simultaneous incidents: 0.52 percent

Figure 10 shows that the highest number of simultaneous incidents occurred in RY 18/19.

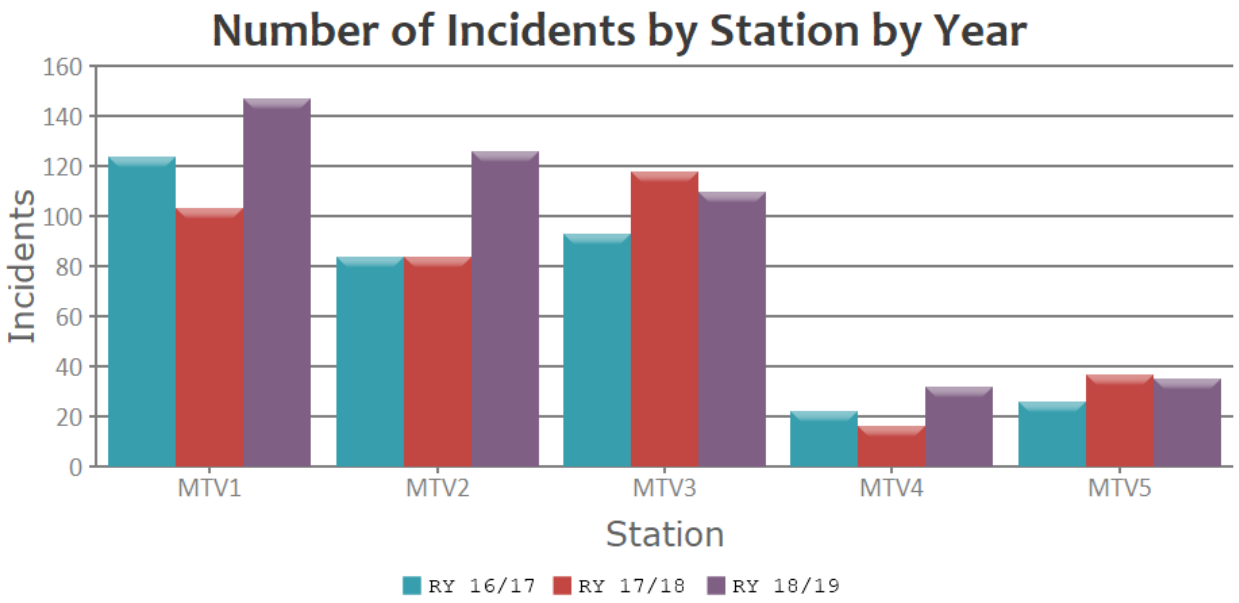
Figure 10—Number of Simultaneous Incidents by Year



In a larger city, simultaneous incidents in different station areas have very little operational consequence. However, when simultaneous incidents occur within a single station area, there can be significant delays in response times.

Figure 11 illustrates the number of single-station simultaneous incidents by station area by year and shows that Station 1 had the greatest number of in-station-area simultaneous incidents, followed by Station 3.

Figure 11—Number of Single-Station Simultaneous Incidents by Station by Year



Finding #8:	At least two simultaneous incidents are occurring 27 percent of the time.
Finding #9:	The overall number of simultaneous incidents is increasing annually. As simultaneous incidents increase, the coverage provided by the busiest companies to their own and to adjacent station areas diminishes, which further shifts workload to other companies.
Finding #10:	Concurrent incident activity is primarily impacting Stations 1, 2, and 3.

2.7.3 Apparatus Deployment

Table 16 illustrates primary apparatus responses for RY 18/19. The columns represent the assigned station for each primary apparatus resource, and the rows represent the station area where the incidents occurred. Multiple-company stations will have multiple apparatus assigned under that station.

The table displays the number of times resources responded to incidents in each station area. Cells highlighted in green indicate resources responding to incidents within their home station area, with the first row representing incidents in Station 1's response area. Resources assigned to Station 1 responded to those incidents 1,431 times, or 85 percent of all calls for service in that response area. Of those calls for service not answered by Station 1 resources, Engine 53 responded to 91 incidents

(5 percent), with Engine 52 and Engine 54 responding to 4 percent and 3.5 percent, respectively. Similarly, Station 1 resources responded to 35 percent of Station 3's calls for service (534 incidents).

Table 16—Responses by Station Area – RY 18/19

Incident Location	Station 1	Station 2	Station 3	Station 4	Station 5	Total
Station 1	1,431	73	**91**	59	24	**1,678**
Station 2	441	1,041	9	74	10	**1,575**
Station 3	**534**	11	946	11	40	**1,542**
Station 4	313	26	9	397	20	**765**
Station 5	190	6	76		307	**579**
Total	**2,909**	**1,157**	**1,131**	**541**	**401**	**6,139**

Table 17 shows the response time differences for incidents within each station's response area, with the green-shaded cells showing 90th percentile travel time performance by resource, and the number in parenthesis representing the number of incidents. For example, for the 1,431 incidents that Station 1 resources responded to within their own response area, 90th percentile travel time was 5:07 minutes. When Engine 53 responded to calls for service in Station 1's response area, 90th percentile travel time was 5:15 minutes, or 8 seconds longer than Station 1 resources. Similarly, when Station 1 resources responded to calls for service in Station 3's response area, 90th percentile travel time was nearly 2:00 minutes *longer* than if Engine 53 had responded.

Table 17—90th Percentile Travel Time Performance by Station Response Area – RY 18/19

Incident Location	Station 1	Station 2	Station 3	Station 4	Station 5
Station 1	05:07 (1,431)	05:18 (73)	**05:15 (91)**	06:00 (59)	07:07 (24)
Station 2	07:33 (441)	05:30 (1,041)	10:54 (9)	08:07 (74)	08:04 (10)
Station 3	**07:26 (534)**	06:11 (11)	05:28 (946)	07:35 (11)	08:36 (40)
Station 4	08:49 (313)	07:48 (26)	11:29 (9)	06:23 (397)	08:49 (20)
Station 5	08:46 (190)	09:33 (6)	06:50 (76)		05:57 (307)

Finding #11: First-due travel times to Station 4's response area are 1:00 to 5:00 minutes longer if the station is uncovered while Engine 54 is out of service or training at another station.

2.7.4 Operational Performance

Measurements for the performance of the first apparatus to arrive on the scene of emergency incidents are the number of minutes and seconds necessary for 90 percent completion of the following response components:

- Call processing/dispatch
- Crew turnout
- Travel
- Dispatch to arrival
- Call to arrival

Call Processing

Call processing performance measures the time from the initial incident time stamp in the City's 9-1-1 Police Department Communications Center until the appropriate response resources are dispatched. As Table 18 shows, overall call processing for RY 18/19 is 02:19 minutes for 90 percent compliance, or 54 percent *slower* than the 1:30-minute recommended best practice.[7]

Table 18—90th Percentile Call Processing Performance – RY 18/19

Station	RY 18/19
Department-Wide	**02:19**
Station 1	02:25
Station 2	02:11
Station 3	02:15
Station 4	02:25
Station 5	02:26

Finding #12: At 2:19 minutes, 90th percentile call processing performance is 54 percent *slower* than the 1:30-minute recommended best practice.

[7] NFPA 1221 Standard for the Installation, Maintenance, and Use of Emergency Services Communications Systems

Turnout

Turnout performance measures the time from dispatch notification until the apparatus starts traveling to the scene. As Table 19 shows, turnout performance is well within Citygate's recommended best practice goal of 2:00 minutes or less.

Table 19—90th Percentile Turnout Performance – RY 18/19

Station	2017/18
Department-Wide	**01:20**
Station 1	01:24
Station 2	01:19
Station 3	01:17
Station 4	01:22
Station 5	01:14

Finding #13: At 1:20 minutes, 90th percentile crew turnout performance is 33 percent *better* than a Citygate-recommended goal of 2:00 minutes or less.

Travel

Travel performance measures the interval from start of first-due apparatus movement to arrival at the emergency incident. For most urban/suburban jurisdictions, a 4:00-minute first-due unit travel time 90 percent of the time would be considered highly desirable. As Table 20 illustrates, the Department's 90th percentile first-due unit travel time performance for RY 18/19 was 5:41 minutes, which is 42 percent *slower* than the 4:00-minute goal.

Table 20—90th Percentile First-Due Unit Travel Time Performance – RY 18/19

Station	RY 18/19
Department-Wide	**05:41**
Station 1	04:59
Station 2	05:42
Station 3	05:40
Station 4	06:24
Station 5	06:28

Finding #14: At 5:41 minutes, 90th percentile first-due unit travel time performance is 42 percent *slower* than the 4:00-minute best practice goal for urban areas.

Call to Arrival

Call-to-arrival performance is a fire agency's primary customer service metric that measures time from receipt of the 9-1-1 call in the dispatch center until the first-due unit arrives at the emergency incident. For urban population areas, Citygate recommends a 7:30-minute first-due unit call-to-arrival goal at 90 percent compliance.[8] As Table 21 shows, the Department's 90th percentile call to first-due unit arrival performance was 8:14 minutes, or 10 percent slower than the recommended 7:30-minute goal, primarily due to slower-than-desired travel times.

Table 21—90th Percentile First-Due Unit Call-to-Arrival Performance – RY 18/19

Station	RY 18/19
Department-Wide	**08:14**
Station 1	07:30
Station 2	08:21
Station 3	08:17
Station 4	08:43
Station 5	08:55

Finding #15: At 8:14 minutes, 90th percentile first-due unit call-to-arrival performance is 10 percent slower than Citygate's recommended goal of 7:30 minutes, primarily due to longer-than-desired travel times.

Effective Response Force (First Alarm) Call to Arrival

The Department's minimum ERF for building fires includes three engines, one ladder truck, one rescue, and one Battalion Chief for a total of 15 personnel. One automatic mutual aid ladder truck and a second Battalion Chief are also dispatched from Palo Alto to provide a total ERF of 19 personnel. ERF call-to-arrival performance for this study only includes City of Mountain View resources. There were only eight incidents in RY 18/19 where the entire City ERF arrived, with a

[8] 7:30-minute call to first unit arrival goal in urban areas includes 1:30 minutes call processing/dispatch time, 2:00 minutes crew turnout time, and 4:00 minutes travel time

90th percentile call-to-arrival performance of 12:07 minutes, which is just 5 percent slower than Citygate's recommended 11:30-minute goal for urban areas.

Table 22—90th Percentile ERF Call-to-Arrival Performance – RY 18/19

Station	RY 18/19
Department-Wide	12:07

Finding #16: At 12:07 minutes, 90th percentile Effective Response Force (First Alarm) call-to-arrival performance is just 5 percent slower than the Citygate-recommended 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 other Silicon Valley cities.

While the state fire code now 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 unit and multiple-unit ERF coverage in all neighborhoods consistent with a Citygate response performance recommendation of first-due arrival within 7:30 minutes from 9-1-1 dispatch notification and ERF arrival within 11:30 minutes of 9-1-1 notification, all at 90 percent or better reliability.

The Department's excellent crew turnout performance helps mitigate slower-than-recommended best practice call processing and travel time performance, resulting in first-due unit call-to-arrival performance only 10 percent slower than Citygate's 7:30-minute best practice goal for urban areas.

Citygate finds the Department's response resources to be nearly appropriate to protect against the hazards likely to impact the City, and the daily staffing of 21 personnel provides a minimum ERF sufficient for a single emerging or serious fire or other multiple-unit emergency incident as discussed in Section 2.2.1 with reserve capacity for one minor simultaneous incident.

As the geographic mapping analysis indicates, the City's five fire stations are appropriately distributed to provide service to all major neighborhood areas. The overall longer-than-desired first-due unit travel times are *not* the result of a lack of fire stations, rather they are more the result of traffic congestion and simultaneous incidents at peak hours of the day.

In terms of emergency incident workload per unit, no single fire unit or station area is approaching workload saturation; however, during peak hours of the day there is a simultaneous incident rate of at least two incidents at once, 27 percent of the time.

Additionally, Citygate is concerned about the depth of staffing to provide resilience during serious or multiple incident activity, given the City's current daytime population, projected future population growth, and increasing service demand. When combined with the Department's training model of using the Engine 54 crew Citywide, incident activity and traffic congestion thins out the available crews too much at peak hours of the day when both service demand and traffic congestion are highest.

Overall, the Department has good response performance, with first-due unit and ERF call-to-arrival performance very close to Citygate's recommended best practice 7:30-minute and 11:30-minute goals, respectively.

2.8.1 Potential Alternative Service Model

The City currently staffs the rescue unit at Station 1 with two firefighters. Citygate recommends that the City and Department consider adding a third position per day to that unit to provide considerable additional deployment and response flexibility, allowing for:

- The use of a reserve engine or smaller Fast Response Unit (FRU) to cover Station 4 or other stations when Engine 54 or other companies are delivering training at another station.
- A full three-person crew to respond on either a reserve engine, FRU, or rescue to simultaneous incidents.
- The use of two personnel to respond to low-acuity EMS events in a reserve engine or FRU, leaving a driver on the rescue to enable it to respond with another engine anywhere in the City.

Stated this way, the addition of one more person on duty a day allows the rescue crew to become a triple-service team (by providing the three benefits identified above), not just two personnel who are attached to another unit, thus taking two units out of service for single-unit response incidents.

To maximize deployment and response flexibility of a three-person rescue crew *and* provide additional fire suppression capability for move-up and cover needs, Citygate further recommends that the City and Department consider adding an FRU at Station 1. First utilized in the City of San Diego pursuant to a Citygate deployment study recommendation, and currently also being deployed in the City of Los Angeles and other jurisdictions, an FRU is significantly smaller than a traditional fire engine, yet can be configured to provide initial fire suppression, rescue, and ALS EMS service capability. Typically built on a commercial heavy-duty 1.5-ton truck chassis with a four-person crew cab and utility body, an FRU includes a fire pump, water tank, and fire hose of

sufficient capacity to suppress smaller or emerging fires, and ample storage capacity for personal protective clothing and safety and EMS equipment. Because these units are smaller than traditional fire engines, they are also more maneuverable in traffic and on narrower streets. More information and photos of the Los Angeles City Fire Department's Fast Response Vehicle Program are available at the following link:
https://www.lafd.org/news/lafd-unveils-innovative-fast-response-vehicles.

Citygate believes that, in addition to providing increased deployment capacity and flexibility, this is a cost-effective solution to provide fire suppression-capable station move-up and cover capacity.

Recommendation #1:	The City and Department should consider adding a third person per day (Fire Captain) to form the rescue unit into a full three-person crew at Station 1 to provide additional deployment and response flexibility, including station move-up and cover capacity when Engine 54 or other engines are delivering training at another station.
Recommendation #2:	To maximize deployment and service flexibility of a three-person rescue crew, Citygate recommends that the City and Department consider adding a Fast Response Unit to the fleet at Station 1 to provide initial fire suppression, rescue, and emergency medical service capacity in a smaller, more maneuverable vehicle.

2.8.2 Overall Deployment Recommendation

Based on the technical analysis and findings contained in this SOC assessment, Citygate offers the following overall deployment recommendation:

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 when possible upon arrival and to keep small and expanding fires from becoming more serious. With this is mind, Citygate recommends the following measures:

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 at City dispatch; this equates to a 90-second dispatch time, a 2:00-minute company turnout time, and a 4:00-minute travel time.

3.2 Multiple-Unit Effective Response Force (ERF) 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 15 personnel, including at least one Battalion Chief, should arrive within 11:30 minutes from the time of 9-1-1 call receipt at the City's dispatch center 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: To protect the City from the hazards associated with uncontrolled release of hazardous and toxic materials, a multiple-unit ERF of at least 15 personnel, including on-duty hazardous materials specialists, the Department's hazardous materials response unit, and at least one Chief Officer, should arrive within 11:30 minutes from the time of 9-1-1 call receipt at City dispatch center 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.

3.4 Technical Rescue: To provide technical rescue services as needed with enough trained personnel to facilitate a successful rescue, a multiple-unit ERF of at least 12 personnel, including on-duty technical rescue specialists and at least one Chief Officer, should arrive within 11:30 minutes from the time of 9-1-1 call receipt at City dispatch center 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 to facilitate safe rescue/extrication and delivery of the victim to the appropriate emergency medical care facility.

This page was intentionally left blank

APPENDIX A—RISK ASSESSMENT

A.1 COMMUNITY RISK ASSESSMENT

SOC ELEMENT 3 OF 8
COMMUNITY RISK ASSESSMENT

The third element of the Standards of Coverage (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.

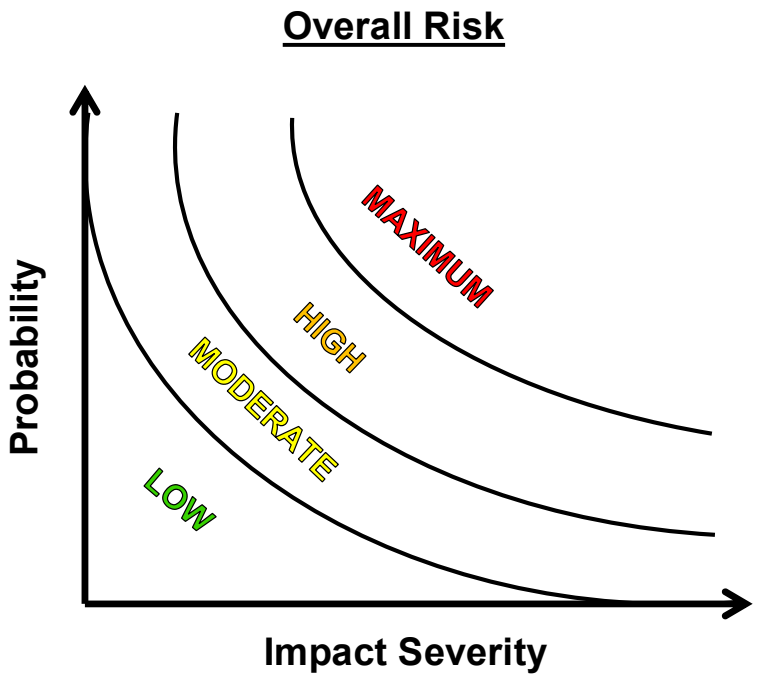
A hazard is broadly defined as a situation or condition that can cause or contribute to harm. Examples include fire, medical emergency, vehicle collision, earthquake, flood, etc. Risk is broadly defined as the *probability of hazard occurrence* in combination with the *likely severity of resultant impacts*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

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 12.

Figure 12—Overall Risk



Citygate used the following data sources for this study to understand the hazards and values to be protected in the service area:

- U. S. Census Bureau population and demographic data
- Insurance Services Office (ISO) building fire flow and construction data
- City Geographical Information Systems (GIS) data
- City General Plan and Zoning information
- Santa Clara County Operational Area Hazard Mitigation Plan
- Fire Department data and information.

A.1.2 Risk Assessment Summary

Citygate's evaluation of the values at risk and hazards likely to impact the City of Mountain View yields the following:

1. The Fire Department serves a diverse population, with densities ranging from fewer than 1,000 to more than 50,000 people per square mile, over a widely varied urban land use pattern.

2. The City's population is projected to grow by approximately 42 percent to 119,000 with currently planned and projected future development.

3. The City has a large inventory of residential, commercial, office, industrial, research, educational, and other non-residential uses typical of other California communities of similar size and demographics.

4. The City has significant economic and other resource values to be protected, as identified in this assessment.

5. Santa Clara County has a mass emergency notification system to effectively communicate emergency information to the public in a timely manner.

6. 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 23.

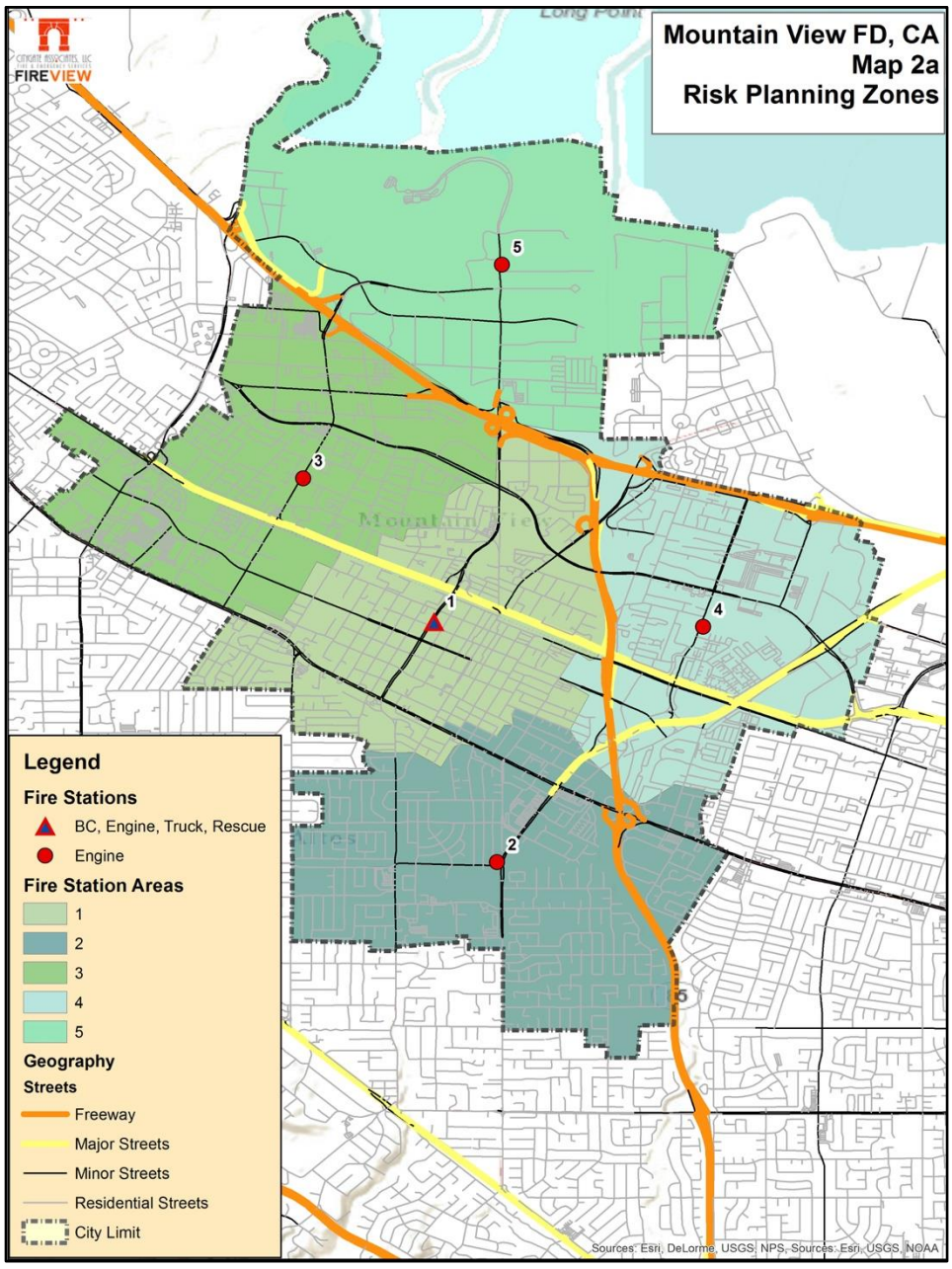
Table 23—Overall Risk by Hazard

Hazard		Planning Zone				
		Sta. 1	Sta. 2	Sta. 3	Sta. 4	Sta. 5
1	Building Fire	*Moderate*	*Low*	*Low*	*Low*	*Low*
2	Vegetation Fire	*Low*	*Low*	*Low*	*Low*	*Low*
3	Medical Emergency	*High*	*High*	*High*	*Moderate*	*Moderate*
4	Hazardous Materials	*Moderate*	*Low*	*Moderate*	*Low*	*Moderate*
5	Technical Rescue	*Moderate*	*Low*	*Moderate*	*Low*	*Low*

A.1.3 Planning Zones

The Commission on Fire Accreditation International (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 was 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 corresponding to each fire station's first-due response area, as shown in Figure 13.

Figure 13—Risk Planning Zones



A.1.4 Values at Risk to Be Protected

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 at risk typically include people, critical facilities/infrastructure, buildings, and key economic, cultural, historic, and/or natural resources.

People

Residents, employees, visitors, and travelers in 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 younger than 10 years, the elderly, and people housed in institutional settings. Table 24 summarizes relevant demographic data for the City of Mountain View.

Table 24—Key Demographic Data – City of Mountain View

Demographic	2019	Percentage
Population	**83,604**	
Under 10 Years	9,698	11.60%
10–14 Years	4,515	5.40%
15–64 Years	58,606	70.10%
65–74 Years	6,187	7.40%
75 Years and Older	4,598	5.50%
Median Age	37.2	N/A
Daytime Population	144,693	173.07%
Housing Units	**37,250**	
Owner-Occupied	14,379	38.60%
Renter-Occupied	21,084	56.60%
Vacant	1,788	4.80%
Average Household Size	2.35	N/A
Median Home Value	$1,314,600	N/A
Ethnicity		
Caucasian	41,133	49.20%
Hispanic/Latino (included as Caucasian)	17,390	20.80%
Asian	27,422	32.80%
Black/African American	1,839	2.20%
Other	13,209	15.80%
Education (population over 24 yrs. of age)	**60,387**	**72.23%**
High School Graduate	56,703	93.90%
Undergraduate Degree	17,693	29.30%
Graduate/Professional Degree	23,974	39.70%
Employment (population over 15 yrs. of age)	**50,129**	**59.96%**
In Labor Force	48,425	96.60%
Unemployed	1,704	3.40%
Per Capita Income	$74,778	N/A
Population below Poverty Level	6,605	7.90%
Population without Health Insurance Coverage	5,434	6.50%

Source: ESRI and U.S. Census Bureau

Of note from Table 24 is the following:

- The daytime population is nearly double the resident population
- Nearly 25 percent of the City population is under 10 years or over 65 years of age
- The City's population is predominantly White (49 percent), followed by Asian (33 percent), Hispanic/Latino (21 percent), other ethnicities (16 percent), and Black / African American (2 percent)
- Of the population over 24 years of age, nearly 94 percent has completed high school or equivalency
- Of the population over 24 years of age, 69 percent has an undergraduate, graduate, or professional degree
- Nearly 60 percent of the population 15 years of age or older is in the workforce; of those, just over 3 percent are unemployed
- Per capita income is nearly $75,000
- The population below the federal poverty level is just under 8 percent
- Only slightly more than 6 percent of the population does not have health insurance coverage.

While the City of Mountain View is abutted on the northwest by the City of Palo Alto, on the southwest by the City of Los Altos, and on the southeast by the City of Sunnyvale, its sphere of influence includes approximately the western half of the current Moffett Federal Airfield. Future development in this and other areas of the City is projected to increase the population by 42 percent to approximately 119,000 residents at build-out.[9]

Buildings

The City currently has more than 37,000 housing units and more than 2,300 non-residential buildings including industrial, manufacturing, research, technology, office, professional services, retail sales, restaurants/bars, motels, churches, schools, government facilities, healthcare facilities, and other non-residential uses.[10] In addition, there are a significant number of "soft story" buildings in the downtown area of the City, which are multiple-story buildings with partially open and structurally weak ground floors that put them at risk of collapse in a strong earthquake.

[9] Source: City of Mountain View Planning Division
[10] Source: ESRI Community Business Summary (2019) and City of Mountain View Fire Department

Building Occupancy Risk Categories

The CFAI identifies the following four risk categories that relate to building occupancy:

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 Effective Response Force (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.

Evaluation of the City's building inventory identified 948 high/maximum-risk building uses as they relate to the CFAI building fire risk categories as summarized in Table 25 and Map #2d (**Volume 2—Map Atlas**).

Table 25—Building Occupancy Inventory by Risk Category

Building Occupancy Classification		Number[1]	Risk Category[2]
A-1	Assembly	4	***High***
E	Education	70	***High***
H	Hazardous	458	***High***
I	Institutional	6	***High***
R-1	Hotel/Motel	18	***High***
R-2	Multi-Family Residential	842	***High***
R-2.1	Residential Care Facilities	4	***High***
R-3.1	Assisted Living Facilities	4	***High***
	Total	**948**	

[1] Source: City of Mountain View Fire Department
[2] Source: CFAI *Standards of Cover* (Fifth Edition)

Critical Infrastructure / Key Resources

The U.S. Department of Homeland Security defines Critical Infrastructure / Key Resources as those physical assets essential to the public health and safety, economic vitality, and resilience of a community, such as lifeline utilities infrastructure, telecommunications infrastructure, essential government services facilities, public safety facilities, schools, hospitals, airports, etc. The Department has identified 29 critical facilities and infrastructure as shown in Table 26 and Map #2c (**Volume 2—Map Atlas**). A hazard occurrence with significant impact severity affecting one or more of these facilities would likely adversely impact critical public or community services.

Table 26—Critical Facilities

Critical Facility Category	Number of Facilities
Community Services	1
Emergency Services	6
Government Services	2
Healthcare/Public Health	1
Utilities	19
Total	**29**

Source: City of Mountain View Fire Department

Economic Resources

As one of the major cities in Silicon Valley, technology, life science, and retail sales are the primary economic drivers for the City. Key economic companies and facilities include:

- Google
- Symantec
- Intuit
- El Camino Hospital
- Microsoft
- Synopsys
- LinkedIn
- Mozilla
- Samsung Electronics

- Pure Storage
- Mountain View Whisman School District
- The Village at San Antonio Center

Natural Resources

Natural resources within the City include:

- San Francisco Bay and Tidelands
- Adobe Creek
- Permanente Creek
- Stevens Creek
- Shoreline Lake
- Charleston Slough
- Mountain View Slough
- Shoreline Slough
- Multiple small neighborhood/regional parks

Cultural/Historic Resources

Cultural/historic resources within the City include:

- Computer History Museum
- Mountain View Center for the Performing Arts
- Rengstorff House
- Shoreline Amphitheater
- Multiple adobe buildings

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 2017 Santa Clara County Operational Area Hazard Mitigation Plan identifies the following nine hazards of concern:

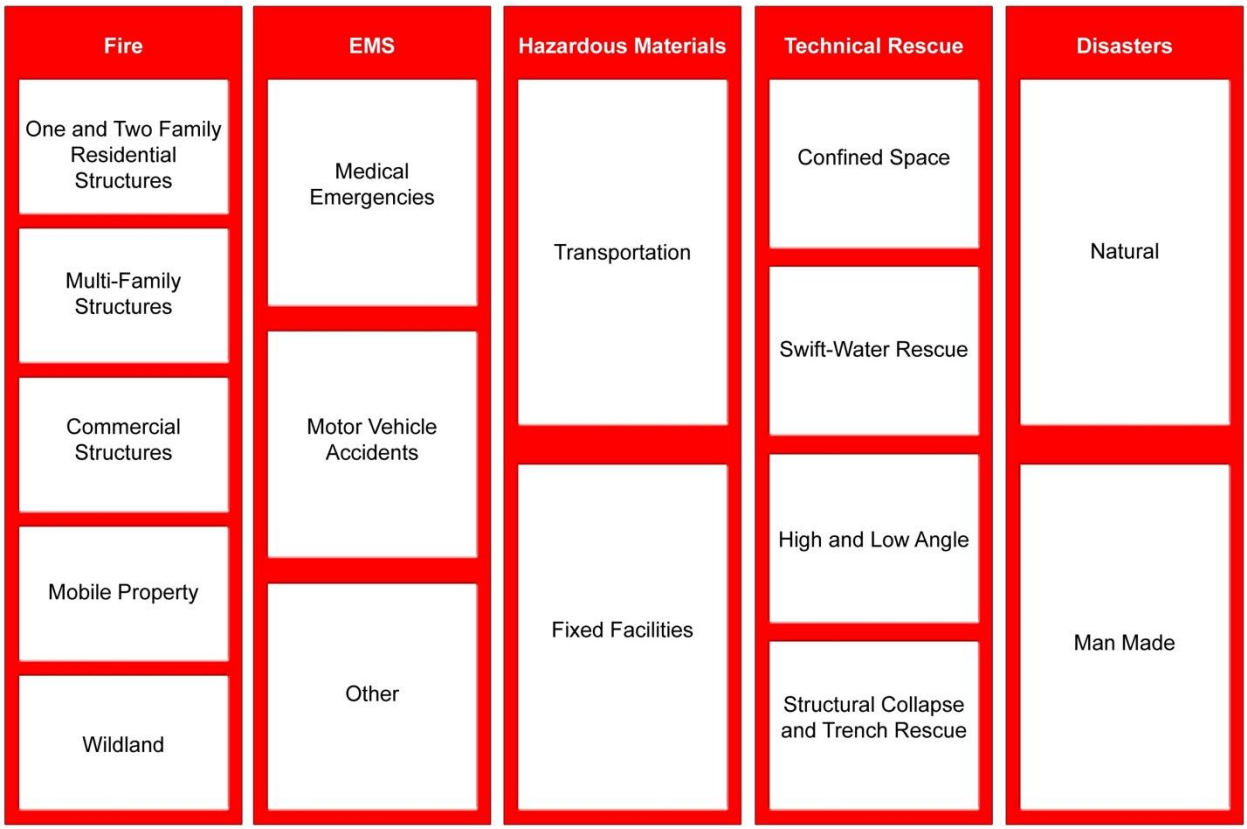
1. Climate change / sea level rise

2. Dam/levee failure
3. Drought
4. Earthquake
5. Flood
6. Landslide
7. Severe weather
8. Tsunami
9. Wildfire

Although the Fire Department has no legal authority or responsibility to mitigate any of these hazards other than possibly for wildfire, it does provide services related to each hazard, 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—Commission on Fire Accreditation International Hazard Categories



Source: CFAI *Standards of Cover* (Fifth Edition).

Subsequent to review and evaluation of the hazards identified in the Santa Clara County Operational Area 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 Fire
3. Medical Emergency
4. Hazardous Materials
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.

The Department's service capacity for building fire, vegetation fire, medical emergency, hazardous materials, and technical rescue risk consists of 21 personnel on duty daily staffing five Type 1 fire engines, one aerial ladder truck, and one rescue, each staffed with at least one EMT-Paramedic, plus a Battalion Chief, all operating from the Department's five fire stations.

All response personnel are trained to either the Emergency Medical Technician (EMT) level, capable of providing Basic Life Support (BLS) pre-hospital emergency medical care, or EMT-Paramedic (paramedic) level, capable of providing Advanced Life Support (ALS) pre-hospital emergency medical care. Ground paramedic ambulance service is provided by Rural/Metro Ambulance of Northern California, a private-sector ambulance provider operating under a non-exclusive operating area contract administered by the Santa Clara County Emergency Medical Services Agency. Air ambulance services, when needed, are provided by CALSTAR/Reach Air Medical Services in Gilroy or Life Flight in Palo Alto. There is one hospital in the City, El Camino Hospital, that provides emergency medical services. Other regional hospitals with emergency services include Santa Clara Valley Medical Center in San Jose and Stanford Medical Center in Palo Alto, both of which are also Level-I trauma centers.

All response personnel are trained to the U.S. Department of Transportation Hazardous Material First Responder Operational (FRO) level to provide initial hazardous material incident assessment, hazard isolation, and support for a hazardous material response team. The Department also has 27 personnel (nine per shift) trained to the California Specialized Training Institute (CSTI) Hazardous Materials Technician and/or Specialist level to cross-staff the Type 2 hazardous materials response unit at Station 5 as needed.

All response personnel are further trained to the Rescue Systems 1, Rope Rescue Technician, Low Angle Rope Rescue Operations (LARRO), Confined Space Operations, Trench Rescue Operations, and Heavy Lift Operations levels, with many personnel also trained to the Rescue Systems 2, Rescue Systems 3, and Structural Collapse Technician levels. The Department staffs a rescue unit with two personnel and a ladder truck with three personnel. These two units carry the equipment and personnel required to perform most day-to-day technical rescue emergencies. The Department is also a CalOES-certified Type 1 USAR Company. In addition, the Department has seven personnel who are members of Federal Emergency Management Agency (FEMA) USAR Task Force 3 hosted by the Menlo Park Fire District.

A.1.7 Probability of Occurrence

Probability of occurrence refers to the probability of a future hazard occurrence during a specific period. 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 27 describes the five probability of occurrence categories and related scoring criteria used for this analysis.

Table 27—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 SOC 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 a hazard occurrence impacts people, buildings, lifeline services, the environment, and the community as a whole. Table 28 describes the five impact severity categories and related scoring criteria used for this analysis.

Table 28—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 possible • 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 possible • 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
4.25–5.0	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 ranking as described in Table 29.

Table 29—Overall Risk Score and Rating

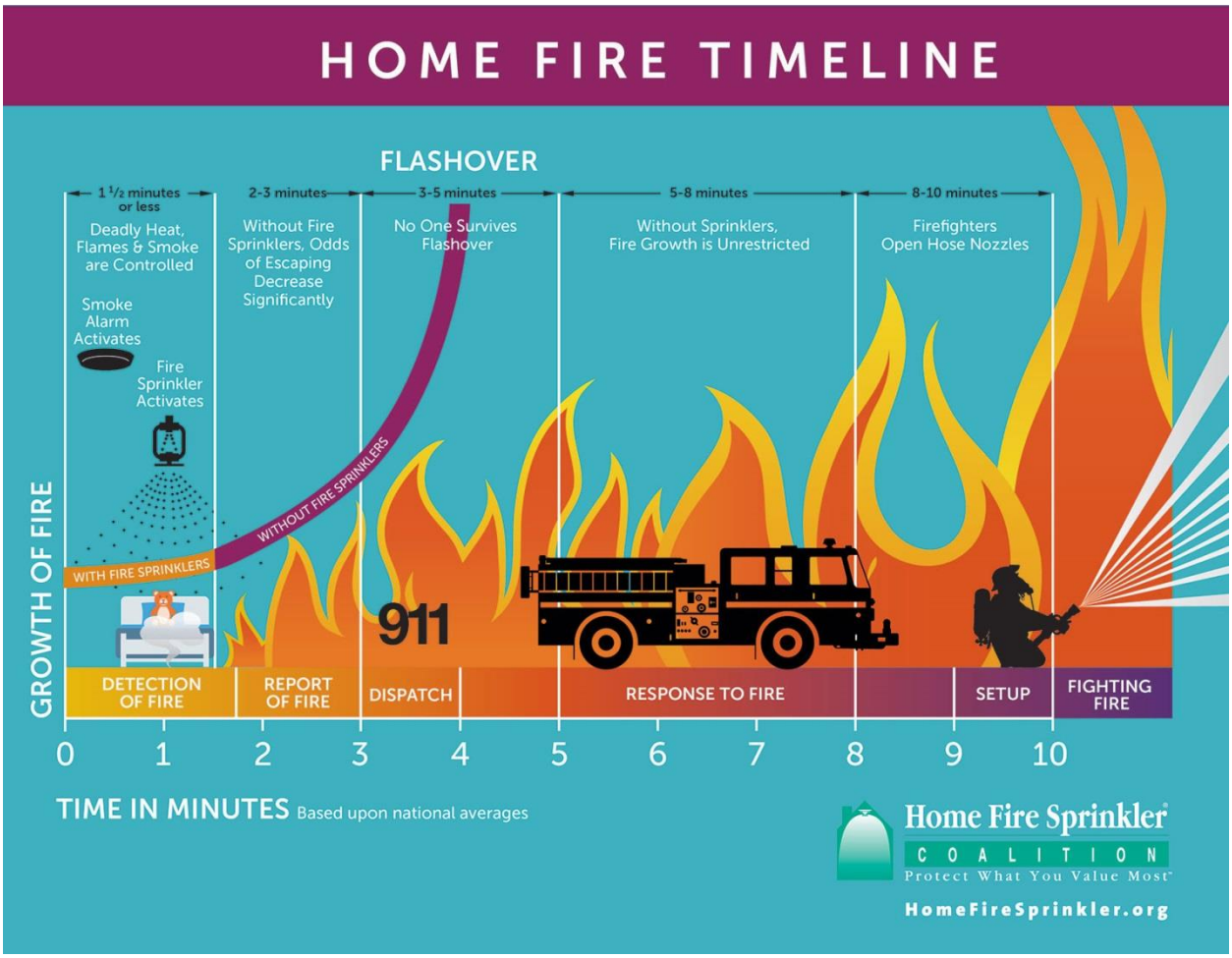
Overall Risk Score	Overall Risk Rating
0–5.99	*Low*
6.0–11.99	*Moderate*
12.0–19.99	*High*
20.0–25.0	*Maximum*

A.1.10 Building Fire Risk

One of the primary hazards in any community is building fire. Building fire risk factors include building size, age, construction type, density, occupancy, number of stories above ground level, required fire flow, proximity to other buildings, built-in fire protection/alarm systems, available fire suppression water supply, building fire service capacity, fire suppression resource deployment (distribution/concentration), staffing, and response time. Citygate used available data from the Department, the U.S. Census Bureau, and the Insurance Services Office (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 three to five 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 fewer than 1,000 to more than 50,000 people per square mile as illustrated in Map #2b (**Volume 2—Map Atlas**). 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.

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. Potable water is provided by the City, and according to Fire

Department staff, firefighting water supply is sufficient throughout the City with no areas of sub-standard flow or pressure.

Building Fire Service Demand

For the three Report Years (RY) from October 1, 2016, through September 30, 2019, the City experienced 77 building fire incidents comprising 0.41 percent of total service demand over the same period, as summarized in Table 30.

Table 30—Building Fire Service Demand

Risk	Year	Planning Zone					Total	Percent Total Service Demand
		Sta. 1	Sta. 2	Sta. 3	Sta. 4	Sta. 5		
Building Fire	RY 16/17	16	2	5	4	2	**29**	**0.46%**
	RY 17/18	5	5	7	2	0	**19**	**0.31%**
	RY 18/19	13	4	9	1	2	**29**	**0.45%**
Total		**34**	**11**	**21**	**7**	**4**	**77**	**0.41%**
Percent of Total Service Demand		**0.68%**	**0.24%**	**0.47%**	**0.35%**	**0.23%**	**0.41%**	

As Table 30 illustrates, building fire service demand was consistent across the three-year study period, with the highest volume of incidents occurring at Station 1 and the lowest at Station 5. Overall building fire service demand is low, comprising less than one-half of one percent of all calls for service, which is comparable to other California jurisdictions of similar size and demographics.

Building Fire Risk Assessment

Table 31 summarizes Citygate's assessment of the City's building fire risk by planning zone.

Table 31—Building Fire Risk Assessment

Building Fire	Planning Zone				
	Sta. 1	Sta. 2	Sta. 3	Sta. 4	Sta. 5
Average Annual Incidents	11	4	7	2	1
Probability of Occurrence	2.00	1.25	1.50	1.25	1.00
Probable Impact Severity	3.00	3.00	3.00	3.00	3.00
Total Risk Score	**6.00**	**3.75**	**4.50**	**3.75**	**3.00**
Risk Rating	***Moderate***	***Low***	***Low***	***Low***	***Low***

A.1.11 Vegetation Fire Risk

Some areas of the City are susceptible to a vegetation fire. Vegetation fire risk factors include vegetative fuel types and configuration, weather, topography, prior service demand, water supply, mitigation measures, and vegetation fire service capacity.

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. CAL FIRE also identifies recommended FHSZs for Local Responsibility Areas (LRAs), where a local jurisdiction bears the fiscal responsibility for wildland fire protection, including incorporated cities. There are no CAL FIRE-recommended FHSZs within the City of Mountain View.

Vegetative Fuels

Vegetative fuel factors influencing fire intensity and spread include fuel type (vegetation species), height, arrangement, density, and moisture. Vegetative fuels within the City, in addition to decorative landscape species, consist of a mix of annual grasses and weeds, and deciduous, eucalyptus, and mixed conifer 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. Fuel and weather conditions most conducive to vegetation fires occur generally from approximately May through October in Santa Clara County.

Topography

Vegetation fires tend to burn more intensely and spread faster when burning uphill and up-canyon, except for a wind-driven downhill or down-canyon fire. The City's flat terrain contributes minimally to vegetation fire behavior and spread.

Water Supply

Another significant vegetation fire impact severity factor is water supply immediately available for fire suppression. According to Fire Department staff, available fire flow is sufficient throughout the City.

Vegetation 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 impacts when those hazards do occur. The Department's Fire and Environmental Protection Division responds to and investigates all fire hazard complaints and takes appropriate actions as authorized by City ordinances and regulations to eliminate or mitigate the hazard.

Vegetation Fire Service Demand

The City experienced 47 vegetation fires over the three-year study period, comprising 0.25 percent of total service demand over the same period, as summarized in Table 32.

Table 32—Vegetation Fire Service Demand

Risk	Year	Planning Zone					Total	Percent Total Service Demand
		Sta. 1	Sta. 2	Sta. 3	Sta. 4	Sta. 5		
Vegetation Fire	RY 16/17	3	4	2	3	4	**16**	**0.25%**
	RY 17/18	6	3	2	4	2	**17**	**0.28%**
	RY 18/19	4	3	2	3	2	**14**	**0.21%**
Total		**13**	**10**	**6**	**10**	**8**	**47**	**0.25%**
Percent of Total Service Demand		**0.26%**	**0.22%**	**0.13%**	**0.49%**	**0.45%**	**0.25%**	

As Table 32 shows, vegetation fire service demand was consistent over the three-year study period, with the highest occurrence at Station 1 and the lowest occurrence at Station 3. Overall, vegetation fire service demand is extremely low.

Vegetation Fire Risk Assessment

Table 33 summarizes Citygate's assessment of the City's vegetation fire risk by planning zone.

Table 33—Vegetation Fire Risk Assessment

Vegetation Fire	Planning Zone				
	Sta. 1	Sta. 2	Sta. 3	Sta. 4	Sta. 5
Average Annual Incidents	4	3	2	3	3
Probability of Occurrence	1.25	1.50	1.50	1.25	1.25
Probable Impact Severity	1.25	3.00	3.00	1.25	2.25
Total Risk Score	**1.56**	**4.50**	**4.50**	**1.56**	**2.81**
Risk Rating	***Low***	***Low***	***Low***	***Low***	***Low***

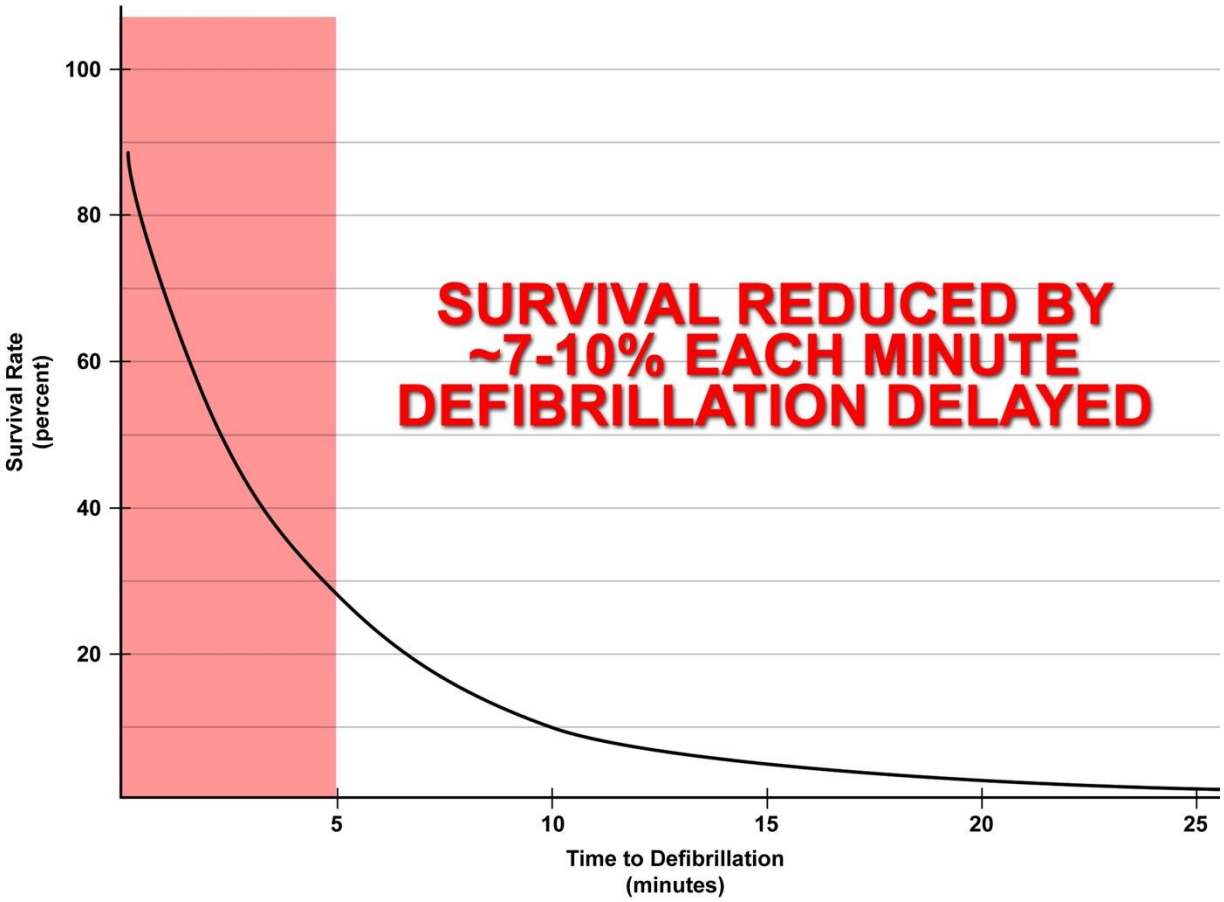
A.1.12 Medical Emergency Risk

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

Medical emergency risk can also be categorized as either a medical emergency resulting from a traumatic injury or a health-related condition or event. Cardiac arrest is one serious medical emergency among many where there is an interruption or blockage of oxygen to the brain.

Figure 16 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 16—Survival Rate versus Time to Defibrillation



Source: www.suddencardiacarrest.org.

Population Density

Mountain View's population density ranges from fewer than 1,000 to more than 50,000 per square mile as shown in Map #2b (**Volume 2—Map Atlas**). Risk analysis across a wide spectrum of other Citygate clients shows a direct correlation between population density and the *occurrence* of medical emergencies, particularly in high urban population density zones.

Demographics

Medical emergency risk tends to be higher among older, poorer, less educated, and uninsured populations. According to the U.S. Census Bureau, nearly 13 percent of the City's population is 65 and older; just under 8 percent of the population is at or below poverty level; slightly more than

6 percent of the population over 24 years of age has less than a high school education or equivalent; and 6.5 percent of the population does not have health insurance coverage.[11]

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 traveling at high speeds. The City's transportation network includes Highways 82, 85, 101, and 237 which carry an aggregate annual average daily traffic volume of nearly 500,000 vehicles, with a peak-hour load of 38,200 vehicles.[12]

Medical Emergency Service Demand

Medical emergency service demand over the three-year study period includes more than 12,000 calls for service comprising slightly less than 65 percent of total service demand over the same period, as summarized in Table 34.

Table 34—Medical Emergency Service Demand

Risk	Year	Planning Zone					Total	Percent Total Service Demand
		Sta. 1	Sta. 2	Sta. 3	Sta. 4	Sta. 5		
Medical Emergency	RY 16/17	1,106	1,076	946	417	387	**3,932**	**62.33%**
	RY 17/18	1,119	1,024	978	400	362	**3,883**	**64.04%**
	RY 18/19	1,185	1,172	1,070	460	408	**4,295**	**65.93%**
Total		**3,410**	**3,272**	**2,994**	**1,277**	**1,157**	**12,110**	**64.12%**
Percent of Total Service Demand		**68.65%**	**71.72%**	**67.15%**	**63.06%**	**65.70%**	**64.12%**	

As Table 34 shows, medical emergency service demand varies significantly by planning zone and is trending upward an average of approximately 4.5 percent annually over the past two years. Overall, the City's medical emergency service demand is typical of other jurisdictions with similar demographics.

Medical Emergency Risk Assessment

Table 35 summarizes Citygate's assessment of the City's medical emergency risk by planning zone.

[11] Source: ESRI and U. S. Census Bureau
[12] Source: California Department of Transportation (2017)

Table 35—Medical Emergency Risk Assessment

Medical Emergency	Planning Zone				
	Sta. 1	Sta. 2	Sta. 3	Sta. 4	Sta. 5
Average Annual Incidents	1,137	1,091	998	426	386
Probability of Occurrence	5.00	5.00	4.75	4.25	4.25
Probable Impact Severity	2.75	2.75	2.75	2.75	2.50
Total Risk Score	**13.75**	**13.75**	**13.06**	**11.69**	**10.63**
Risk Rating	***High***	***High***	***High***	***Moderate***	***Moderate***

A.1.13 Hazardous Materials 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 commodities into or through a jurisdiction; vulnerable populations; emergency evacuation planning and related training; and specialized hazardous material service capacity.

Fixed Hazardous Materials Facilities

The Santa Clara County Department of Environmental Health, serving as the state-designated Certified Unified Program Agency (CUPA) for the County, identified 459 facilities within the City requiring a state or County hazardous material operating permit, or a Hazardous Materials Business Plan as shown on Map #2e (**Volume 2—Map Atlas**).

High-pressure natural gas transmission pipelines are also generally located along Highway 101, West Middlefield Road, North Whisman Road / Grant Road, and the North El Monte / Farley Street alignments.

Transportation-Related Hazardous Materials

The City also has transportation-related hazardous material risk as a result of its road transportation network, including Highways 82, 85, 101, and 237 with heavy daily truck traffic volume, many carrying hazardous commodities, as summarized in Table 36.

Table 36—Average Annual Daily Truck Traffic

Highway	Crossing	AADT[1]	Truck AADT[1] by Axles				% Truck AADT[1] by Axles			
			2	3	4	5+	2	3	4	5+
82	Route 85	1,166	908	112	41	105	77.87%	9.61%	3.52%	9.01%
85	Route 237	3,188	1,435	560	78	1,115	45.01%	17.57%	2.45%	34.97%
101	Route 85	11,579	6,346	1,753	408	3,072	54.81%	15.14%	3.52%	26.53%
237	Route 85	3,581	1,879	547	22	1,133	52.47%	15.28%	0.61%	31.64%
Total		**19,514**	**10,568**	**2,972**	**549**	**5,425**	**54.16%**	**15.23%**	**2.81%**	**27.80%**

[1] Average Annual Daily Trips
Source: California Department of Transportation (2017)

The City also has transportation-related hazardous material risk due to the nearly 100 train movements daily into and through the City, many of which are transporting hazardous commodities.[13]

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 shown in Map #2b (**Volume 2—Map Atlas**), the City's population density ranges from fewer than 1,000 to more than 50,000 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 are unable to leave voluntarily. As shown in Table 24, slightly under 25 percent of the City's population is under age 10 or is 65 years of age 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 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

[13] Source: Federal Railroad Administration (2019 data)

remediate any planning and/or training gaps to ensure ongoing emergency incident readiness and effectiveness.

Although the City does not have a formal emergency evacuation plan, it is a participating member of the Santa Clara County Alert System (AlertSCC) administered and operated by the Santa Clara County Office of Emergency Services. AlertSCC is a free, subscription-based, mass emergency notification system that can provide emergency alerts, notifications, and other emergency information to email accounts, cell phones, tablets, and landline telephones. Within Mountain View, AlertSCC notifications can be initiated by designated Fire or Police Department personnel. The City also conducts regular Emergency Operations Center training, and although protocols prohibit testing, AlertSCC is utilized regularly throughout the County.

Hazardous Materials Service Demand

The City experienced 191 hazardous material incidents over the three-year study period, comprising 1.01 percent of total service demand over the same period, as summarized in Table 37.

Table 37—Hazardous Material Service Demand

Risk	Year	Planning Zone					Total	Percent Total Service Demand
		Sta. 1	Sta. 2	Sta. 3	Sta. 4	Sta. 5		
Hazardous Materials	RY 16/17	18	12	15	12	11	**68**	**1.08%**
	RY 17/18	15	8	15	7	11	**56**	**0.92%**
	RY 18/19	20	8	19	8	12	**67**	**1.03%**
Total		**53**	**28**	**49**	**27**	**34**	**191**	**1.01%**
Percent of Total Service Demand		**1.07%**	**0.61%**	**1.10%**	**1.33%**	**1.93%**	**1.01%**	

As Table 37 indicates, hazardous material service demand varies by planning zone and was consistent over the past three years, with Station 1 having the highest demand and Station 4 the lowest. Overall, the City's hazardous material service demand is low.

Hazardous Materials Risk Assessment

Table 38 summarizes Citygate's assessment of the City's hazardous materials risk by planning zone.

Table 38—Hazardous Materials Risk Assessment

Hazardous Materials	Planning Zone				
	Sta. 1	Sta. 2	Sta. 3	Sta. 4	Sta. 5
Average Annual Incidents	18	9	16	9	11
Probability of Occurrence	2.25	1.75	2.25	1.75	2.00
Probable Impact Severity	3.00	3.00	3.00	3.00	3.00
Total Risk Score	**6.75**	**5.25**	**6.75**	**5.25**	**6.00**
Risk Rating	***Moderate***	***Low***	***Moderate***	***Low***	***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, including rivers and streams; industrial machinery use; transportation volume; and earthquake, flood, and landslide potential.

Construction Activity

There is ongoing residential, commercial, industrial, and/or infrastructure construction activity occurring within the City.

Confined Spaces

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

Unreinforced Masonry Buildings

The downtown area of the City contains numerous older buildings constructed with unreinforced masonry that are at a higher risk of collapse from a seismic event than are buildings meeting newer building code standards.

High-Density Residential Housing Units

The central-western area of the City contains numerous multiple-story high-density residential housing units that can present unique rescue challenges in fire or seismic events.

Bodies of Water

There are multiple bodies of water within the City, including San Francisco Bay and tidelands, Adobe Creek, Permanente Creek, Stevens Creek, Shoreline Lake, Charleston Slough, Mountain View Slough, Shoreline Slough, and numerous other smaller ponds and minor waterways.

Transportation Volume

Another technical rescue risk factor is transportation-related incidents requiring technical rescue. This risk 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 82, 85, 101, and 237 carrying an aggregate annual average daily traffic volume of nearly 500,000 vehicles.

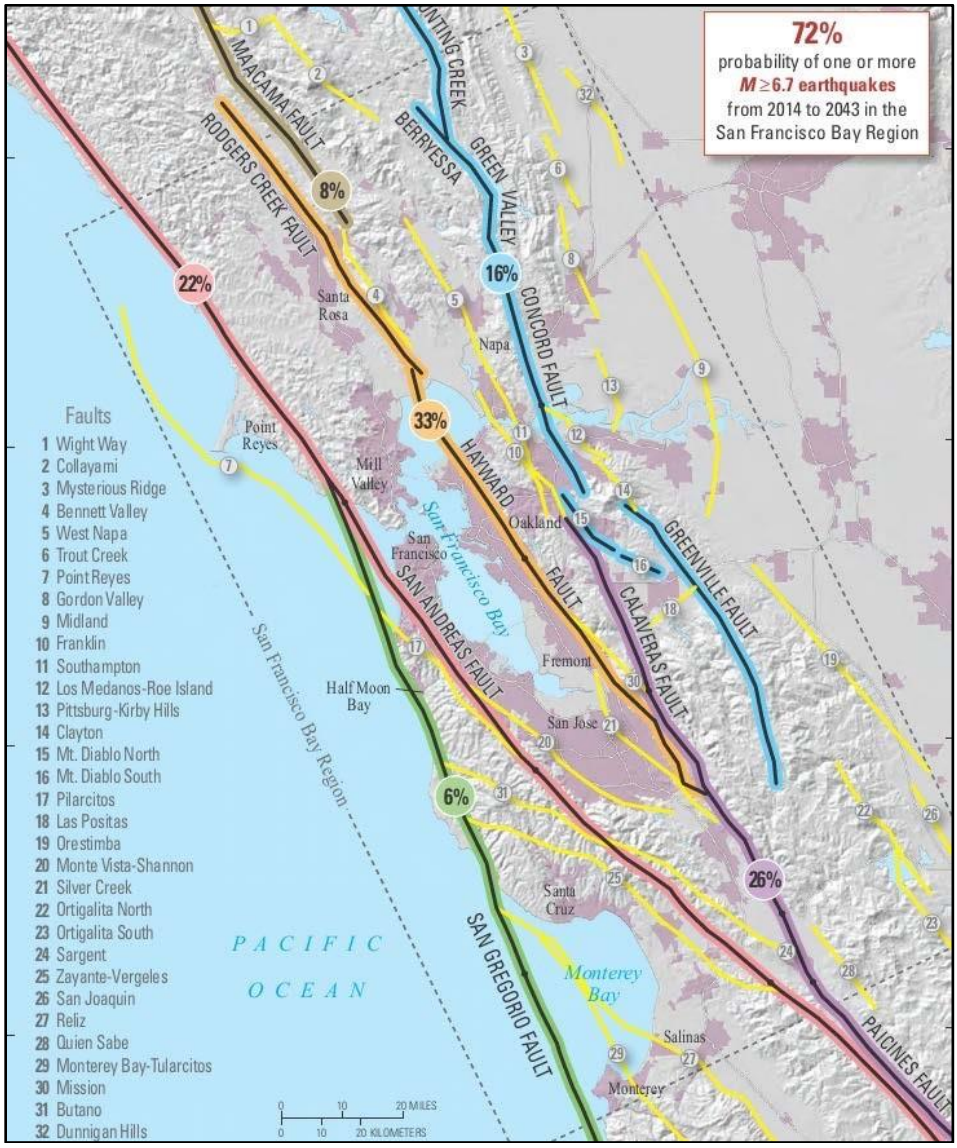
Earthquake Risk[14]

Three major seismic faults within the region have the potential to impact the study area, including the Calaveras, Hayward, and San Andreas Faults. Significant historical seismic activity includes 14 earthquakes with a magnitude of 5.0 or greater within 100 miles of Santa Clara County since 1985. According to the United States Geological Survey, there is a 72 percent probability of a magnitude 6.7 or greater earthquake in the San Francisco Bay Area region within the next 23 years. Figure 17 shows the location of the various Bay Area seismic faults.

It should also be noted that the Department would likely only have its own resources available for the first 72 hours in the event of a major regional disaster.

[14] Reference: 2017 Santa Clara County Operational Area Hazard Mitigation Plan, Section 8

Figure 17—Earthquake Faults

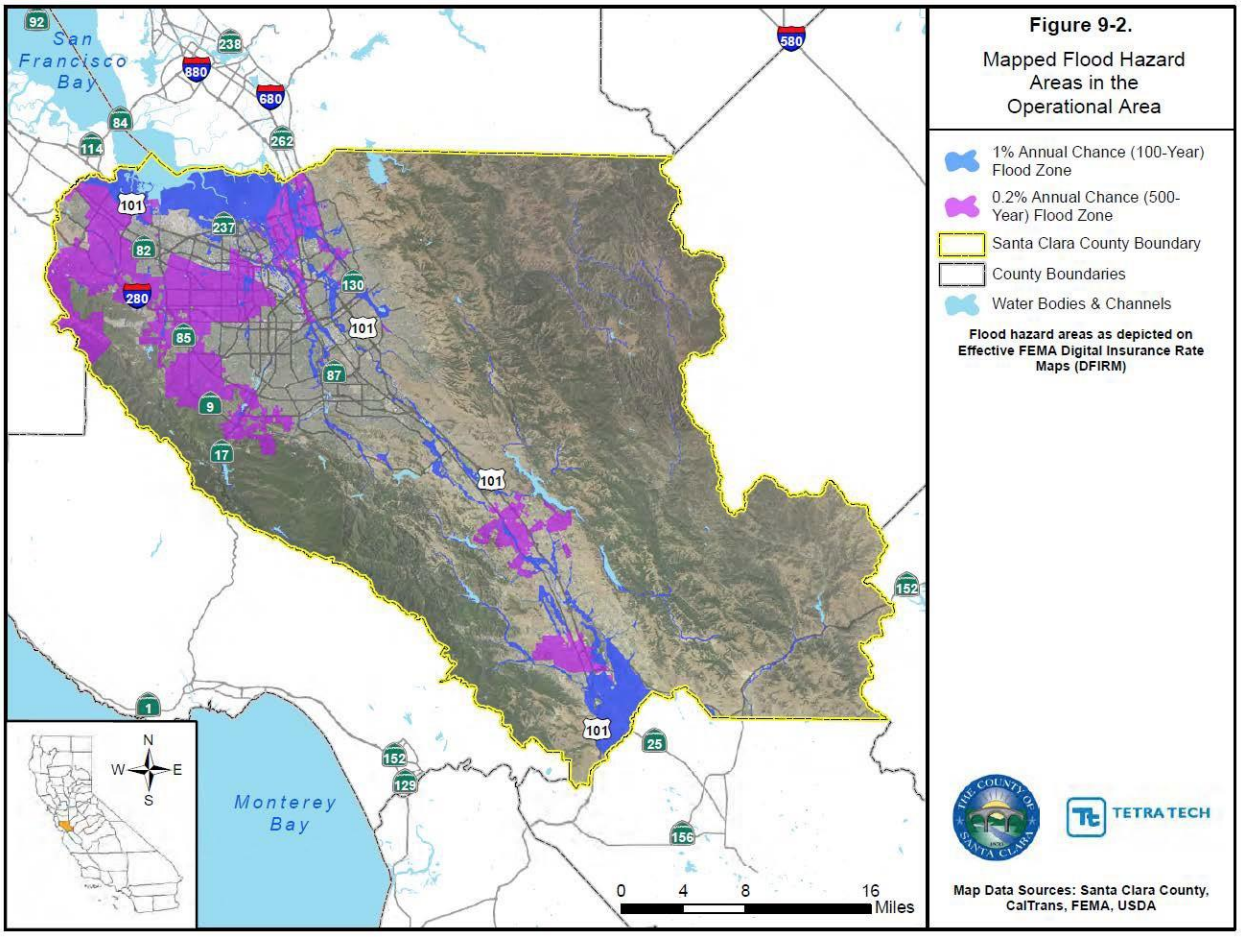


Flood Risk[15]

Figure 18 shows the flood hazard areas in Santa Clara County as identified by the Federal Emergency Management Agency (FEMA).

[15] Reference: 2017 Santa Clara County Operational Area Hazard Mitigation Plan, Part II

Figure 18—Santa Clara County Flood Hazard Areas



Principal flooding sources for Mountain View include Adobe, Permanente, and Stevens Creeks, as well as San Francisco Bay. According to the 2017 Santa Clara County Operational Area Hazard Mitigation Plan, approximately 50 residents are exposed to a 10-year flood event, 2,100 to a 100-year flood event, and 5,600 to a 200-year flood event.

Technical Rescue Service Demand

Over the three-year study period, there were 79 technical rescue incidents comprising 0.42 percent of total service demand for the same period, as summarized in Table 39.

Table 39—Technical Rescue Service Demand

Risk	Year	Planning Zone					Total	Percent Total Service Demand
		Sta. 1	Sta. 2	Sta. 3	Sta. 4	Sta. 5		
Technical Rescue	RY 16/17	5	4	10	1	0	**20**	**0.32%**
	RY 17/18	8	3	3	0	2	**16**	**0.26%**
	RY 18/19	7	11	18	5	2	**43**	**0.66%**
Total		**20**	**18**	**31**	**6**	**4**	**79**	**0.42%**
Percent of Total Service Demand		**0.40%**	**0.39%**	**0.70%**	**0.30%**	**0.23%**	**0.42%**	

As Table 39 shows, technical rescue service demand is very low, with Station 3 experiencing the highest demand.

Technical Rescue Risk Assessment

Table 40 summarizes Citygate's assessment of the City's technical rescue risk by planning zone.

Table 40—Technical Rescue Risk Assessment

Technical Rescue	Planning Zone				
	Sta. 1	Sta. 2	Sta. 3	Sta. 4	Sta. 5
Average Annual Incidents	7	6	10	2	1
Probability of Occurrence	2.00	1.50	2.00	1.25	1.00
Probable Impact Severity	3.50	2.50	3.00	2.50	2.50
Total Risk Score	**7.00**	**3.75**	**6.00**	**3.13**	**2.50**
Risk Rating	***Moderate***	***Low***	***Moderate***	***Low***	***Low***