STANDARDS OF COVERAGE AND HEADQUARTERS SERVICES ASSESSMENT VOLUME 1 OF 2 - TECHNICAL REPORT

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EXECUTIVE SUMMARY

The City of Corona (City) Fire Department (Department) retained Citygate Associates, LLC (Citygate) to conduct a comprehensive update of its 2013 Standards of Coverage (SOC) and headquarters services assessment to provide an ongoing foundation for 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 has provided recommendations to improve Department operations and services.

This report is presented in several parts, including this Executive Summary outlining the most significant findings and recommendations; the fire station/crew deployment analysis supported by maps and response statistics; and an assessment of headquarters services. A separate Map Atlas (**Volume 2**) contains all the maps referenced throughout this report. Overall, there are 22 findings and 11 specific action recommendations.

POLICY CHOICES FRAMEWORK

There are no mandatory federal or state regulations directing the level of fire service staffing, response times, or outcomes. Thus, the level of fire protection services provided is a matter of *local policy decision*. Communities have the level of fire services they choose to "purchase" and 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 FIRE CREW DEPLOYMENT

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

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

If desired outcomes include limiting building fire damage to only part of the inside of an affected building and/or minimizing permanent impairment resulting from a medical emergency, then

initial units should arrive within 7:30 minutes from 9-1-1 notification, and a multiple-unit ERF should arrive within 11:30 minutes of 9-1-1 notification at the City's 9-1-1 dispatch center, all at 90 percent or better reliability. Total response time to emergency incidents includes three distinct components: (1) 9-1-1 call processing/dispatch time; (2) crew turnout time; and (3) travel time. Recommended best practices for these response components are 1:30 minutes, 2:00 minutes, and 4:00/8:00 minutes respectively for first-due and multiple-unit ERF responses in urban areas.

The City's current fire station system provides the following first-due unit response times across a variety of population density/risk areas for emergency medical and fire incident types. As Table 1 shows, no station area receives service close to 7:30 minutes, a best practice goal for an urban area.

Table 1—Call to Arrival Analysis

Station	2018
Department-wide	09:37
Station 1	08:56
Station 2	09:49
Station 3	09:32
Station 4	10:07
Station 5	11:28
Station 6	09:09
Station 7	10:19

The Department's dispatch processing time to 90 percent of the fire/EMS incidents is 3:23 minutes, more than double a national best practice recommendation of 1:30 minutes. At 2:12 minutes, the fire crew turnout times are *just* over a Citygate recommendation of 2:00 minutes. However, the times in Table 1 do reflect a slower *travel* time than the preferred 4:00 minutes for 90 percent of the incidents in an urban population density, as Table 2 displays.

Table 2—Travel Analysis – Surface Streets Only

Station	2018
Department-wide	05:17
Station 1	04:38
Station 2	05:27
Station 3	05:02
Station 4	05:39
Station 5	06:14
Station 6	04:59
Station 7	07:14

The overall longer-than-desired first-due unit travel times are *not* the result of a lack of fire stations. They are more the result of the non-grid street network in some sections of the City, topography, natural and built barriers (hills and highways), simultaneous incidents at peak hours of the day, and traffic congestion. The Department-wide call to arrival of 9:37 minutes could be improved with a reduction of 2:00 minutes from dispatch and crew turnout time, resulting in 7:37 minutes, which is very close to Citygate's recommendation of 7:30 minutes.

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 significant simultaneous incident rate of at least two incidents at once 47.5 percent of the time. If more than two medical incidents are active and a building fire should occur, the Department would need to depend on mutual aid which, given Corona's geographic isolation, does not come quickly from all sides.

As calls for service continue to increase and because three incidents occur simultaneously 14.3 percent of the time, the Department should keep close watch on response times and unit response capacity. As workload approaches Citygate's recommended threshold, the City should consider a peak-activity engine or squad during the highest workload times of the day/week.

Overall Summary of Headquarters Services

Across all the headquarters programs, there is insufficient Office Assistant (clerical) capacity. There are only three office support positions in the entire Department, supporting 16 technical positions across the Department's management and specialty program functions, in addition to fire station personnel with specialty assignments.

The absence of office support has significantly impacted the Department's ability to achieve many of its higher-level goals and objectives *in a timely, cost-effective manner*, including research, data collection, analysis, program evaluation, planning, and special projects. Chief officers and the

technical positions, such as fire prevention and emergency management, should be performing the higher-level tasks for which they are compensated. Further, in several areas, the Department's administration team has a single point of failure without redundant capacity for critical Department-level business processes and customer services, including accounts payable/receivable, payroll, grants management, and Fire-Department-specific human resources.

After the last Strategic Plan, including a detailed follow-up Master Plan, Fire Prevention has achieved most of its planned goals and does not need further recommendations at this time, other than increasing overall fire headquarters office support staff, which will provide redundancy and reduce single point-of-failure potential for support to their programs.

The City should consider adding 1.5 Office Assistant positions over the next two fiscal years to relieve critical workload capacity gaps and to provide redundant capacity for critical business services and processes in the Administration Division.

Further, many higher-level program management tasks are assigned to shift Battalion Chiefs. As such, approximately 60–70 percent of the Battalion Chiefs' work time is spent managing Department-level programs/projects and performing administrative and clerical tasks. They are *not spending adequate time* supervising, mentoring, and providing quality control for fire crews. Emergency responses also reduce the time available for administrative tasks. Finally, there are several large administrative projects approaching, including hiring and fire station replacement, which require management time. Two key programs—training and emergency medical services—are being supported by one Fire Captain each, not a chief officer.

The Department needs to add one 40-hour-per-week Administration Battalion Chief to relieve significant administrative workload capacity gaps in headquarters operations.

DEPLOYMENT KEY FINDINGS AND RECOMMENDATIONS

The following are findings and recommendations regarding deployment presented throughout this report.

Finding #1: 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, nor goals for all types of emergency risk outcomes.

Finding #2: The Department has a standard response plan that considers risk and establishes an appropriate initial response for each incident type; each type of call for service receives the combination of engines, trucks, specialty units, and command officers

customarily needed to effectively control that type of incident based on Department experience.

Finding #3: The current fire station placement provides a first response unit for all the City's major neighborhoods.

Finding #4: Fire unit travel times are longer than a best practice and Department goal of 4:00 minutes due to the terrain, curvilinear road network in many parts of the City, and traffic congestion.

Finding #5: Due to the road network design and terrain, absent traffic congestion, 75 percent of the City's public streets are within a 4:00-minute travel time of a fire station. Traffic congestion during many of the daylight hours reduces the 4:00-minute coverage to only 52 percent of the City's public streets, which is 23 percent less than without traffic congestion.

Finding #6: The Department's service demand is consistent, indicating the need for a 24-hour-per-day, seven-day-per-week fire and EMS emergency response system.

Finding #7: The overall number of simultaneous incidents has been slowly increasing since 2014. The largest impact of simultaneous incidents is felt in Station 1's district. This further shifts workload to other companies at peak hours of the day.

Finding #8: Call processing performance, at 3:23 minutes for 90 percent of the fire/EMS incidents, is significantly slower than a best practice recommendation of 1:30 minutes.

Finding #9: Crew turnout performance, at 2:12 minutes, is only slightly slower than a Citygate-recommended goal of 2:00 minutes or less to 90 percent of the fire/EMS incidents.

Finding #10: First-due unit travel time, at 5:17 minutes on *surface streets* to 90 percent of the fire/EMS incidents Citywide, is slower than the Department's and a best practice goal of 4:00 minutes.

Finding #11: The Department's call to arrival time to 90 percent of the fire/EMS incidents, at 9:37 minutes, is slower than Citygate's recommended goal of 7:30 minutes. This result is primarily due to longer call processing and travel times.

Finding #12: If a total of 2:00 minutes can be saved in dispatch and crew turnout time, then call to arrival is reduced from 9:37 minutes to 7:37 minutes, which is very close to a goal of 7:30 minutes.

Finding #13: The Effective Response Force (First Alarm) Call to Arrival times at 11:49 minutes, are very good and only slightly longer than the best practice and Citygate-recommended goal of 11:30 minutes.

The following Citygate recommendations are not listed in a priority order of importance; they are numbered in the order in which they appear in the technical report.

Recommendation #1: 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 and to keep small but serious fires from becoming more serious. With this is mind, Citygate recommends the following measures:

1.1 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.

1.2 Multiple-Unit Effective Response Force for Serious Emergencies: To confine building fires near the room of origin, keep vegetation fires under one acre in size, and treat multiple medical patients at a single incident, a multiple-unit ERF of at least 17 personnel, including at least one Battalion Chief, should arrive within 11:30 minutes from the time of 9-1-1 call receipt at City dispatch 90 percent of the time. This equates to a 90-second dispatch time, 2:00-minute company turnout time, and 8:00-minute travel time.

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

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

Recommendation #2: The City's 9-1-1 dispatch center must design and implement substantial personnel and/or technology improvements to lower fire and EMS incident processing times to a national best practice of 1:30 minutes.

Recommendation #3: The Department should closely track response time performance during peak hours and, when response time and/or unit workloads decay substantially, consider a peak-activity unit (engine or squad) to capture simultaneous incidents and to backfill units at training during peak hours of the day.

HEADQUARTERS SERVICES KEY FINDINGS AND RECOMMENDATIONS

The following are findings and recommendations regarding headquarters presented throughout the full report. These findings and recommendations are not listed in a priority order of importance; they are numbered in the order in which they appear in the technical report.

Finding #14: The office support and finance positions were reduced during the recession. The remaining three positions are insufficient to support all the headquarters programs and personnel. This results in senior managers performing their own support work instead of their core duties.

Finding #15: The City uses two 40-hour Fire Captains (ranked lower than platoon Battalion Chiefs) for training and EMS program oversight. As peers to the Fire Captains, they hold limited management authority. Also, many administrative programs have been delegated to shift personnel, resulting in the possibility of a single point of failure when the shift person is not available.

Finding #16: The Department does not have a robust career development program or succession plan training. Given the normal turnover the Department experiences, it must prepare future supervisors and leaders before they are urgently needed.

Finding #17: The Department's Emergency Services Coordinator had no dedicated staff until the recent addition of one grant-funded, part-time position. As such, the City's emergency management policies, procedures, and plans need review and updating.

Finding #18: The City's consolidated fleet maintenance program does not currently employ certified fire mechanics. As a result, the Department sends the fire apparatus to outside vendors, frequently at a higher labor rate—a blended $123 per hour as compared to the City's $75 per hour rate.

Finding #19: The use of outside fire apparatus vendors requires considerable coordination by the Department, as well as qualified drivers from the Fleet Division or Fire Department to deliver and pick up apparatus.

Finding #20: Overall, the fire apparatus repair program appears to be inefficient and requires considerable management time, and the high use of outside vendors may not be cost effective.

Finding #21: Since the recession, the City has been unable to fund more than small repairs to the oldest fire stations and has not funded the 2013 long-term rehabilitation plan that was prepared.

Finding #22: While the City has recently funded the replacement of two engines and two ladder trucks, it does not have a long-term plan for the timely replacement of all apparatus. Prior to these four purchases, the average apparatus replacement age was 28 years. A normal expectation for replacement age is 20 years.

Recommendation #4: The headquarters office support position plan to add 1.5 FTE positions from FY 20/21 through FY 21/22 is appropriate and should be funded.

Recommendation #5: The City should improve the sustainability of medical patient documentation and treatment review and follow-up. One shift-assigned firefighter/Paramedic manages the Continuous Quality Improvement program for all shifts. There is no replacement to fill this critical function when this employee is on leave or otherwise unavailable.

Recommendation #6: An Administrative Battalion Chief should be added to provide management oversight to training, EMS, and the two assigned 40-hour Fire Captains. Additionally, due to the complexity of the programs, Fleet Management and Facilities Management should be assigned to the Administrative Battalion Chief.

Recommendation #7: The Department must create a career development and succession plan based on planned needs due to the time in career for the oldest members of the Department at all ranks.

Recommendation #8: The Emergency Management Division needs to update all of Corona's emergency preparedness policies, procedures, and plans, which include the City's Emergency Operations Plan and the Continuity of Operations Plan. Additional focus should be given to revamping community preparedness programs.

Recommendation #9: The City should deeply study the fire apparatus repair program and verify that the current frequent use of outside vendors and lack of certified fire apparatus mechanics is cost effective from all measures of cost, safety, and best practices.

Recommendation #10: The City should identify a long-term funding strategy for capital repair and, as needed, replacement of the oldest fire stations.

Recommendation #11: The City should adopt a long-term replacement funding strategy for the timely replacement of fire apparatus instead of waiting until apparatus are overdue and identifying one-time funding sources.

NEXT STEPS

- Review and absorb the content, findings, and recommendations of this report.
- Adopt revised response performance goals as recommended.
- Request staff to identify immediate, medium-term, and long-term priorities.
- Request that staff return, as part of the budget process, with an implementation plan based on priorities that covers several fiscal years to implement the recommendations in this study.

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SECTION 1—INTRODUCTION AND BACKGROUND

The City of Corona (City) Fire Department (Department) retained Citygate Associates, LLC (Citygate) to conduct a comprehensive update of the 2013 Standards of Coverage (SOC) and headquarters services assessment to provide an ongoing 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 National Fire Protection Association (NFPA) and Insurance Services Office (ISO) publications as best practice guidelines, along with the self-assessment criteria of the Commission on Fire Accreditation International (CFAI).

1.1 REPORT ORGANIZATION

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

Executive Summary	Summary of current services and significant future challenges.
Section 1	Introduction and Background: An introduction to the study and background facts about the City of Corona.
Section 2	Standards of Coverage Assessment: An overview of the SOC process and detailed analysis of existing deployment policies, outcome expectations, community risk, critical tasks, distribution and concentration effectiveness, reliability and historical response effectiveness, and overall deployment evaluation.
Section 3	Headquarters Services Assessment: An assessment of the Department's headquarters staffing for administration and oversight.
Appendix A	Risk Assessment

In this report, the term "Department" will be used when referring to the fire agency itself, and the term "City" will be used when referring to the City of Corona.

1.1.1 Goals of the Report

This report cites findings and makes recommendations, as appropriate, related to each finding. Findings and recommendations throughout this report are sequentially numbered. A complete list of 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 the 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 for services, 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 or assess the cost of every alternative in detail. Once final strategic choices receive policy approval, City staff can conduct 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 Research Methods

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

In subsequent site visits, Citygate performed focused interviews of the Department's project team members and other project stakeholders. Citygate 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 and to facilitate 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. Citygate has proposed an approach to address current 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, conducting stakeholder listening sessions, and using strengths, weaknesses, opportunities, and threats (SWOT) questionnaires.
- Utilizing FireView™, a geographic mapping 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 mapping exhibits.
- Reviewing projected 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

The City of Corona is located approximately 45 miles southeast of Los Angeles in western Riverside County. The community is situated at the base of the mountainous Cleveland National Forest on an alluvial plain leading down, or north, to the Santa Ana River. In 2018, the City's population was 168,574 and the City limits covered approximately 39.2 square miles. However, the Fire Department responds to a larger service area, totaling 50.5 square miles and containing approximately 7,165 additional residents, due to contracts with Riverside County. In 2018, the City contained 30,630 housing units with an average population per unit of 3.41 people.

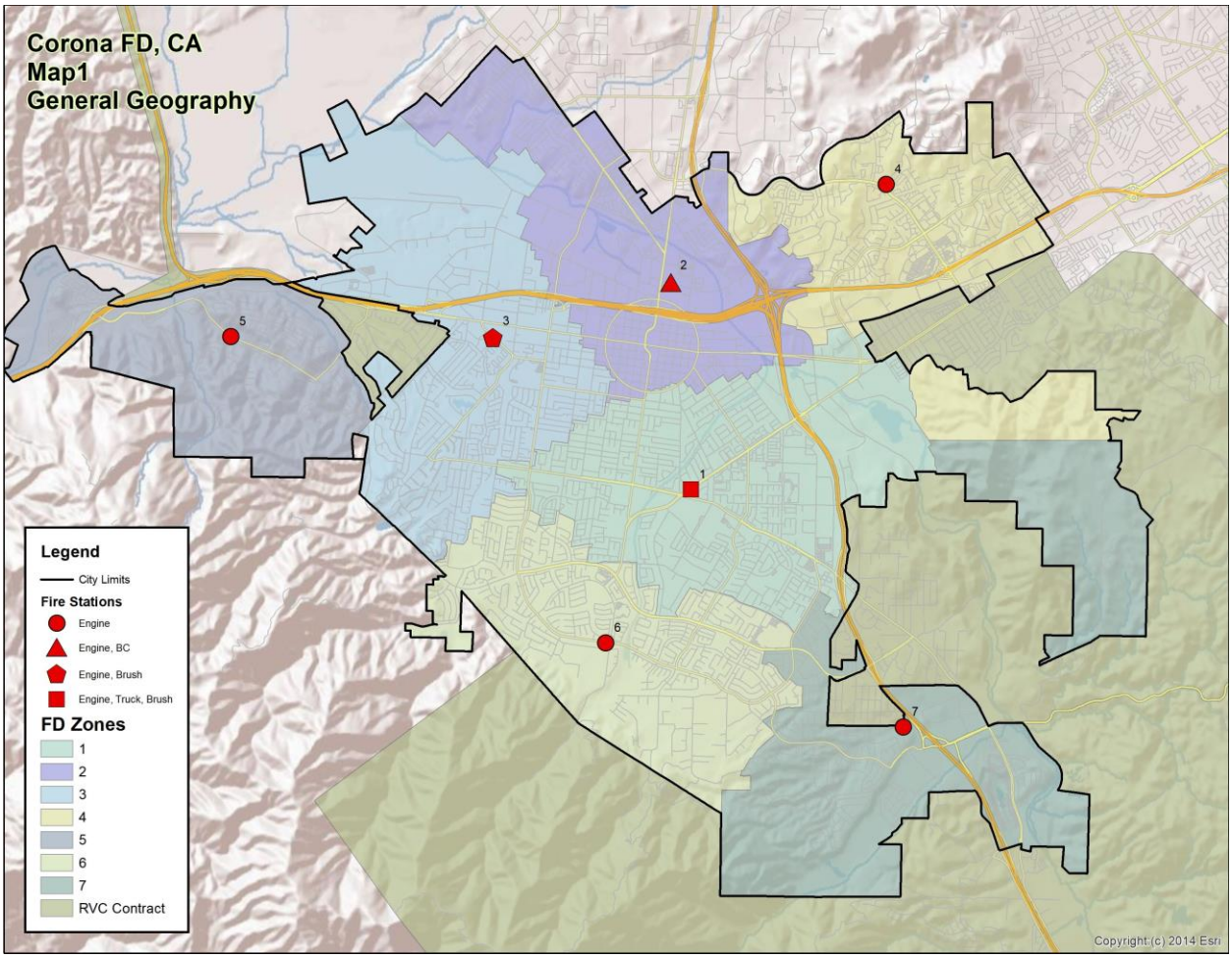
The City of Corona was incorporated in 1896 under the general laws of the State of California. The City operates under a Council-Manager form of government and provides the following

services: public safety (police and fire), highways and streets, electric, public library, parks, public improvements, planning and zoning, and public transportation. Water and water reclamation services are provided through the legally separate Corona Utility Authority, which functions as a department of the City of Corona.

The Corona Fire Department has a long and proud history. In 1898, a group of spirited citizens met with the goal of protecting their lives and property from fire and formed the Corona Fire Department. From the early days, when the Department purchased its first hose carts for $99, to the current days of 100-foot aerial tiller trucks being purchased at $1,000,000, the Department has grown with the community to provide its fire and first responder emergency medical services.

This commitment to public service is evidenced by the insurance underwriting industry's fire department classifications rating reductions the Department has received. In 1935, the City received an ISO rating of 9; 9 is the lowest and 1 is best possible rating. As of 1950, the rating improved to a 6. In 1970, the Corona Fire Department rating was 4. In 1980, the rating was 3. From 1990 through the latest rating in 2016, the Corona Fire Department joined a select group of departments Statewide with a rating of 2.

Figure 1—Fire Station Districts and General Geography



1.4 FIRE DEPARTMENT OVERVIEW

Corona's Fire Department operates out of seven strategically located fire stations. All fire stations deliver fire and emergency medical services (EMS). The Department has a daily constant (minimum/maximum) staffing of 33 firefighting personnel on duty operating seven fire engines (four firefighters each), one ladder truck (four firefighters), and one Battalion Chief. In addition, the Department also cross-staffs (using fire engine staff) two brush fire units and two specialty units for wildland responses, a water tender (large capacity vehicles carrying water for fire suppression) in areas where fire hydrants are not available, hazardous materials response units, an urban search and rescue unit, and reserve apparatus and light-duty vehicles.

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 AMR under contract to Riverside County.

Response personnel are also trained to the United States Department of Transportation Hazardous Material First Responder Operations level to provide initial hazardous material incident assessment, hazard isolation, and support for a hazardous material response team. Four personnel per shift are further trained to the Hazardous Materials Technician level as members of a regional hazardous materials response team.

All types of technical rescues for the Corona Fire Department are conducted by the on-duty staffing trained in confined space, trench rescue, and low-angle rescue. On-duty units are also trained to the operational level to assist the technicians.

1.4.1 Facilities and Resources

The Department provides services from seven fire stations, as shown in the following table.

Table 3—Stations and Assigned Resources

Minimum Per Unit	Staff Type and Amount		Extended
7 Engines	4	Firefighters per day	28
1 Ladder Truck	4	Firefighters per day	4
1 Battalion Chief	1	Per day for command	1
Total 24-Hour Personnel			**33**

SECTION 2—STANDARDS OF COVERAGE ASSESSMENT

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

2.1 STANDARDS OF COVERAGE PROCESS OVERVIEW

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

The SOC method evaluates deployment as part of a fire agency's self-assessment process. This approach uses risk and community expectations regarding outcomes to help elected officials make informed decisions regarding fire and EMS deployment. 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.

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

While working with multiple components to conduct a deployment analysis is admittedly more work, it yields a much better result than using only a single 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 4 describes the eight elements of the SOC process.

Table 4—Standards of Coverage Process Elements

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

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

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

Table 5—Fire Service Deployment Paradigm

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

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

2.2 Current Deployment

SOC Element 1 of 8
Existing Deployment Policies

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

The following are the Department's response time goals, which have not been adopted by the City Council:

- First-due unit for all emergency types – 6:50 minutes from City dispatch answer to 90 percent of fire and EMS incidents
  - This total response time consists of 1:00 minute dispatch processing, 1:50 minutes crew turnout, and 4:00 minutes travel time

- For an Effective Response Force (First Alarm) to serious fires and technical events – 10:50 minutes from City dispatch answer
  - This total response time consists of 1:00 minute dispatch processing, 1:50 minutes crew turnout, and 8:00 minutes travel time for the last arriving unit

The Department reports these measures of performance to the City Council. However, these goals do not address response performance to other risks within the City, such as hazardous materials and technical rescue, as recommended by the CFAI. The Department also has a service-level history that can be documented in response times, number of response companies, and minimum staffing.

The NFPA Standard 1710, a recommended deployment standard for career fire departments in urban/suburban areas, currently recommends initial (first-due) intervention unit arrive within a 4:00-minute travel time and recommends arrival of all resources comprising the multiple-unit First Alarm within 8:00 minutes at 90 percent or better reliability.[1]

The most recent published best practices by the NFPA for dispatching have increased the dispatch processing time to 90 seconds and, if there are language barriers, 120 seconds. Further, for crew turnout time, 60 to 80 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 best practices, then a realistic, 90 percent, first-unit arrival goal is 7:30 minutes from the time of City dispatch receiving the call. This is comprised of 90 seconds dispatch, plus 2:00 minutes crew turnout, plus 4:00 minutes travel.

Finding #1: 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, nor goals for all types of emergency risk outcomes.

[1] 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).

2.2.1 Current Deployment Model

Resources and Staffing

The Department's current deployment model consists of seven engines and one ladder truck, staffed with a minimum of four personnel each, and one Battalion Chief, for a total daily minimum year-round continuous staffing of at least 33 personnel operating from seven 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. The Department has mutual- and/or automatic-aid agreements with other fire agencies in Riverside County, Orange County, and San Bernardino County, and is also a signatory to the County and State of California mutual-aid agreements.

Response Plan

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

Given these risks, the Department utilizes a tiered response plan calling for different types and numbers of resources depending on incident/risk type. The City's dispatch process selects and dispatches the closest and most appropriate resource types pursuant to the Department's response plan, as shown in Table 6.

Table 6—Response Plan by Incident Type

Incident Type	Resources Dispatched	Total Personnel
Single-Patient EMS	1 Engine/Truck, 1 Private Ambulance	6
Vehicle Fire	1 Engine or Truck	4
Building Fire	3 Engines, 1 Ladder Truck, 1 Battalion Chief	17
Wildland Fire	2 Engines, 2 Wildland Engines, 1 Battalion Chief	17
Rescue	2 Engines, 1 Truck, 1 Ambulance, 1 Battalion Chief	15
Hazardous Material	1 Engine, 1 Hazardous Materials Unit, 1 Battalion Chief	9

Source: Fire Department

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

2.3 OUTCOME EXPECTATIONS

SOC ELEMENT 2 OF 8
COMMUNITY OUTCOME EXPECTATIONS

The SOC 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 reliable 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.[2] 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 or just above the average.

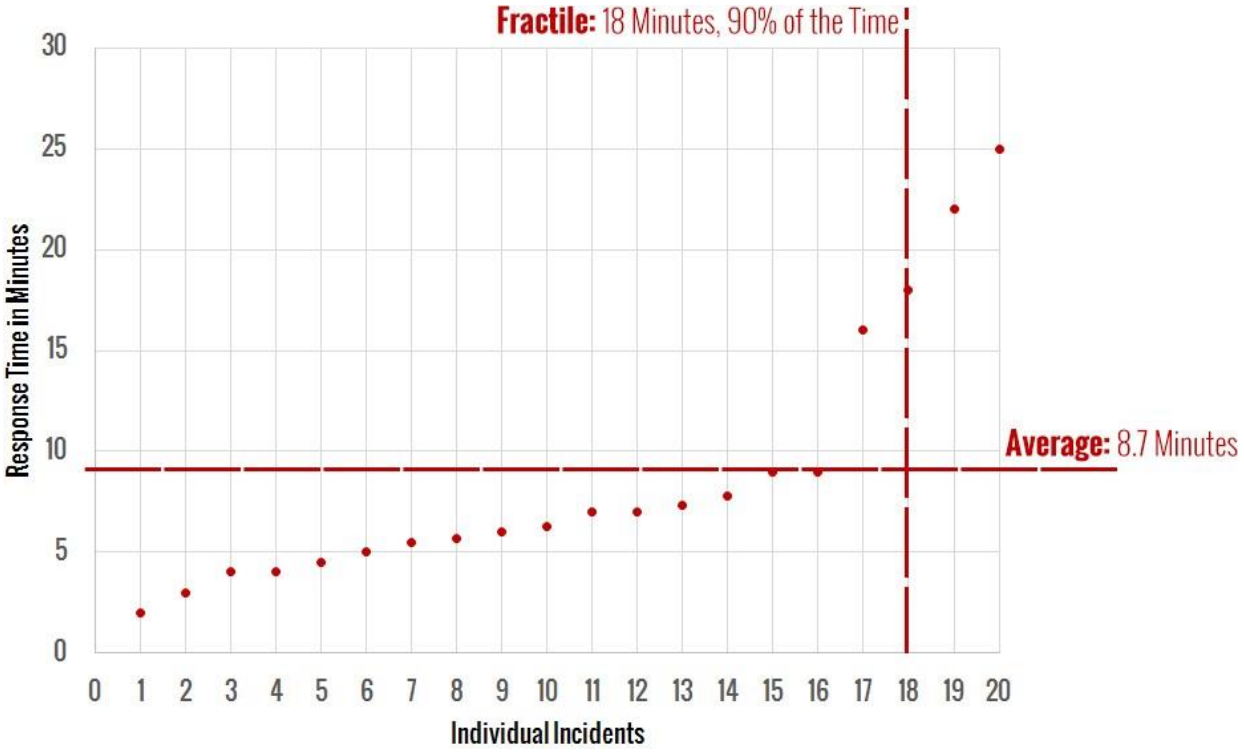
For example, Figure 2 shows response times for a fictitious fire department. This agency is small and receives 20 calls for service each month. Each response time has been plotted on the graph from shortest response time to longest response time.

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 greater than 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.

[2] 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 allow appropriate fire station spacing (distribution and concentration). 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, drowning, choking, trauma constrictions, or other similar events can cause oxygen deprivation to the brain. 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 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. 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 City's dispatch center dispatch processing, fire 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.

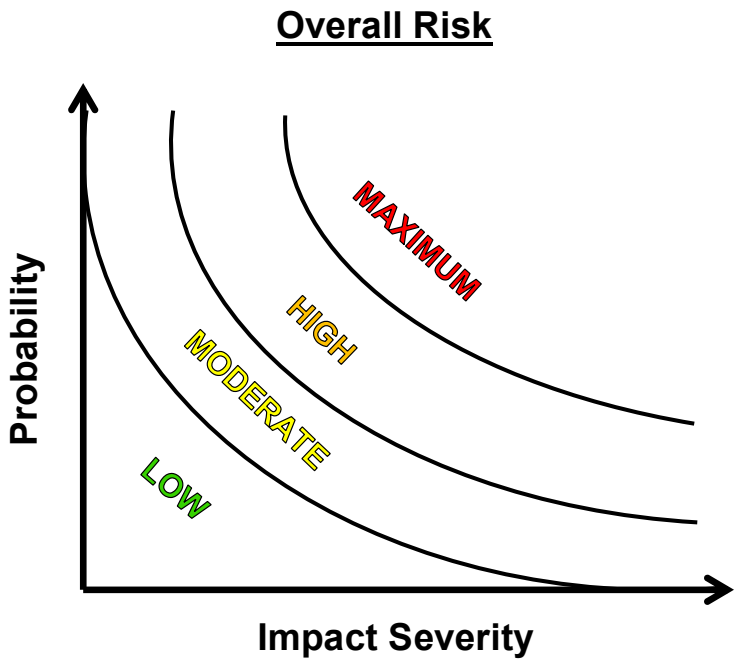
A *hazard* is broadly defined as a situation or condition that can cause or contribute to harm. Examples include fire, medical emergency, vehicle collision, earthquake, flood, etc. *Risk* is broadly defined as the *probability of hazard occurrence* in combination with the *likely severity of resultant 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 through a community or jurisdiction are vulnerable to harm from a hazard occurrence. Particularly vulnerable are specific at-risk populations, including those unable to care for themselves or self-evacuate in the event of an emergency. At-risk populations typically include children less than 10 years of age, the elderly, and people housed in institutional settings. Key demographic data for the City includes the following:

- Nearly 23 percent of the population is under 10 years or over 65 years of age.
- The City's population is predominantly Hispanic (44 percent), followed by White (26 percent), Asian (13 percent), other ethnicities (11 percent), and Black/African American (6 percent).
- Of the population over 24 years of age, 85 percent has earned at least a high school diploma or equivalent.
- Of the population over 24 years of age, nearly 36 percent has an undergraduate, graduate, or professional degree.
- Nearly 66 percent of the population 15 years of age or older is in the workforce; of those, 6.65 percent are unemployed.
- The population below the federal poverty level is 11.6 percent.
- Nearly 12 percent of the population does not have health insurance coverage.

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. A hazard occurrence with significant impact severity affecting one or more of these facilities would likely adversely impact critical public or community services.

Buildings

The City has more than 51,000 housing units, as well as a large inventory of non-residential occupancies, including office, research, professional services, and retail sales buildings; restaurants/bars; motels; churches; schools; government facilities; healthcare facilities; and other non-residential uses as described in **Appendix A**.

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 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
- Wildland Fire
- Medical Emergency
- Hazardous Material Release/Spill
- Technical Rescue

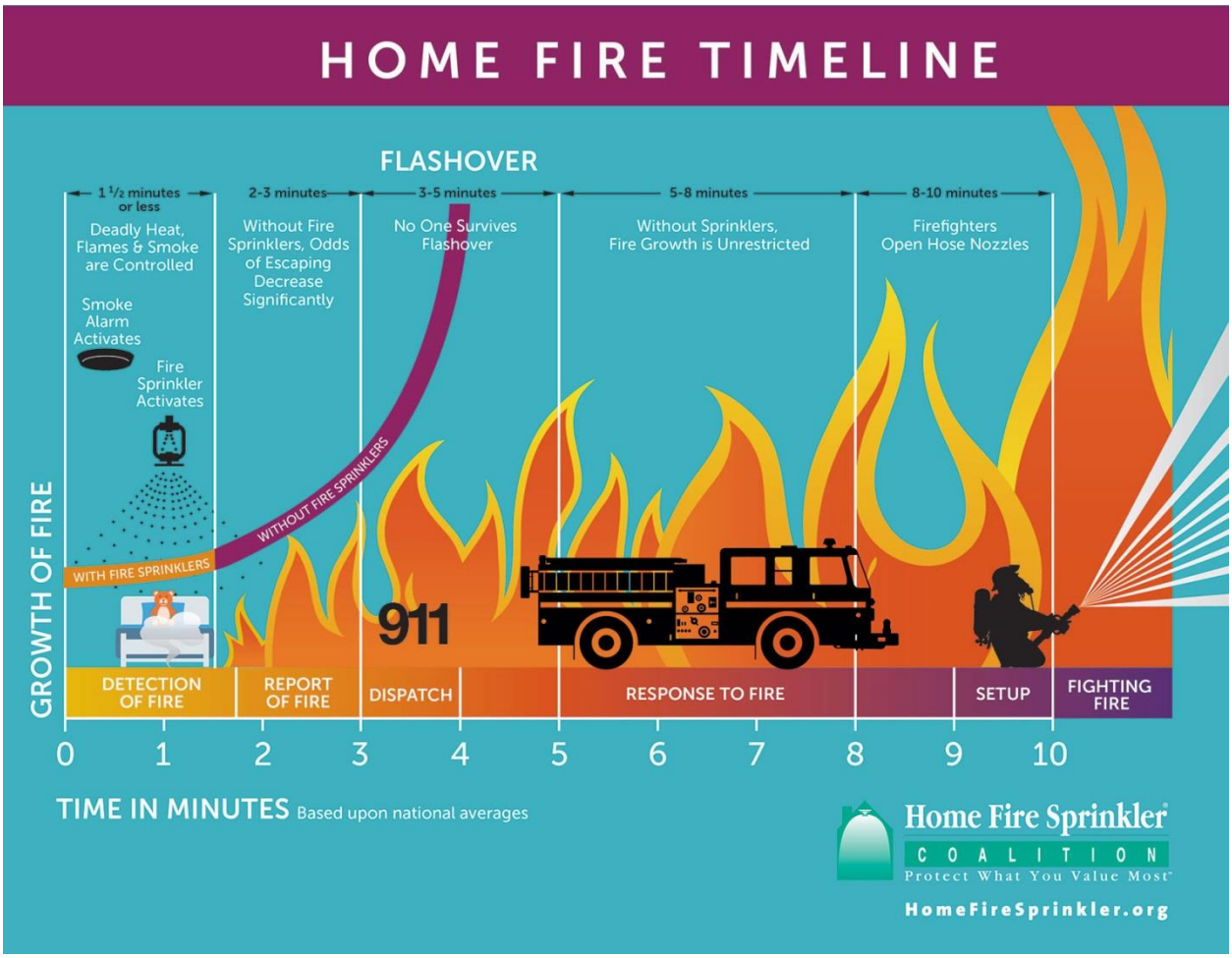
Because building fires and medical emergencies have the most severe time constraints if positive outcomes are to be achieved, the following is a brief overview of building fire and medical emergency risk. **Appendix A** contains the full risk assessment for all five hazards.

Building Fire Risk

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

Figure 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 3:00 to 5:00 minutes from the initial ignition. Human survival in a room after flashover is extremely improbable.

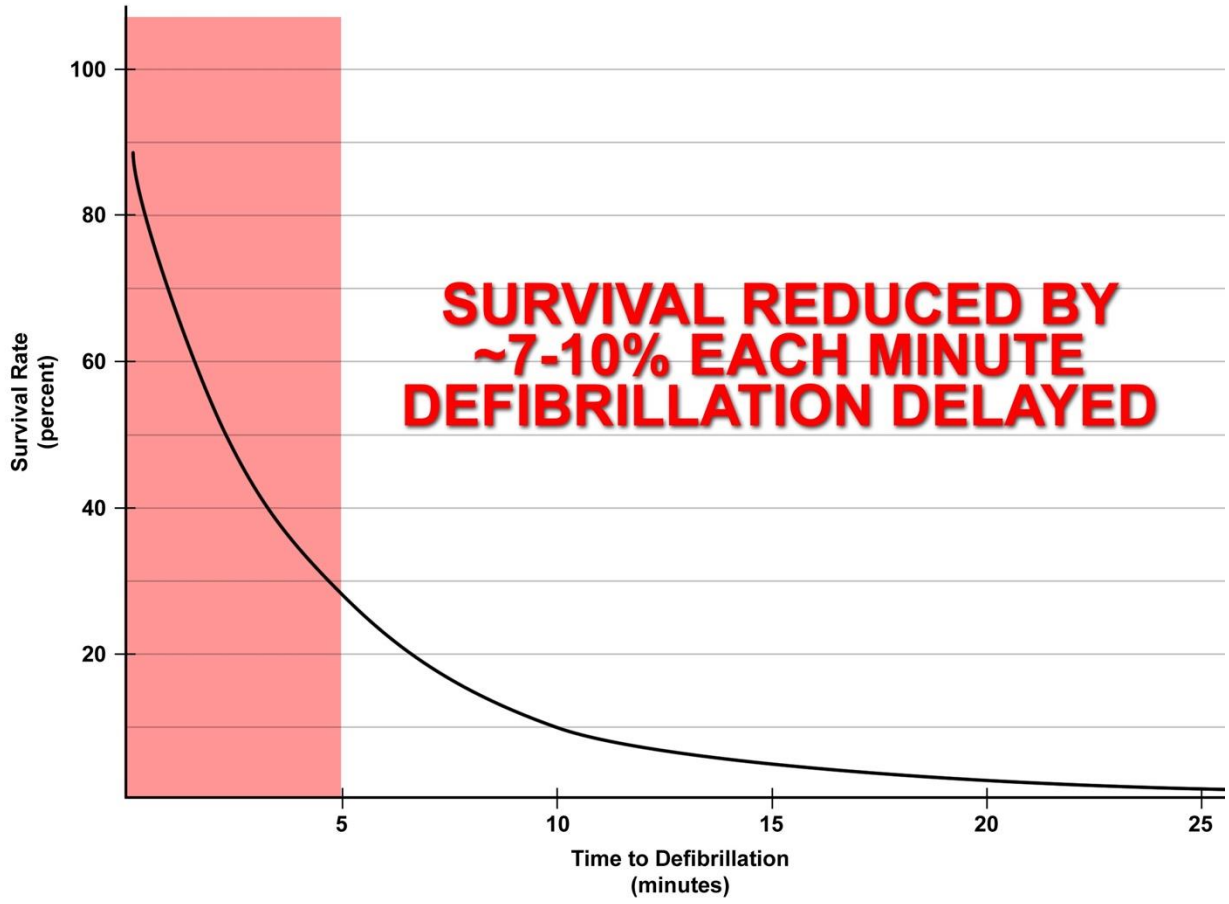
Figure 4—Building Fire Progression Timeline



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 to 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.

The City has a large inventory of residential, commercial, office, industrial, research, educational, and other non-residential use buildings typical of other California communities of similar size and demographics. The City has significant economic and other resource values to be protected, as identified in this assessment. The City has a mass emergency notification system to effectively communicate emergency information to the public in a timely manner.

The City's overall risk for the five hazards related to emergency services presented in this report range from **Low** to **High**, as summarized in Table 7.

Table 7—Overall Risk by Hazard (Taken from Table 18)

Hazard		Planning Zone						
		Sta. 1	Sta. 2	Sta. 3	Sta. 4	Sta. 5	Sta. 6	Sta. 7
1	Building Fire	*Low*	*Low*	*Low*	*Low*	*Low*	*Low*	*Low*
2	Wildland Fire	*Moderate*	*Moderate*	*Moderate*	*Moderate*	*High*	*High*	*High*
3	Medical Emergency	*High*	*High*	*High*	*Moderate*	*Moderate*	*Moderate*	*Moderate*
4	Hazardous Material*	*Moderate*	*Moderate*	*Moderate*	*Low*	*Low*	*Low*	*Low*
5	Technical Rescue	*Low*	*Low*	*Low*	*Low*	*Low*	*Low*	*Low*

* Hazardous Materials also includes CUPA sites in the analysis.

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 time frame to achieve desired objectives on fire and emergency medical incidents. Table 8 and Table 9 illustrate critical tasks typical of building fire and medical emergency incidents, including the minimum number of personnel required to complete each task. These tables are composites from Citygate clients in urban/suburban departments similar to the City, with units staffed with four personnel per engine or ladder truck. It is important to understand the following relative to these tables:

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

2.5.1 Critical Firefighting Tasks

Table 8 illustrates the critical tasks required to control a typical single-family dwelling fire with five response units (3 engines, 1 truck, 1 chief) from the City, for a total Effective Response Force

(ERF) of **17** personnel. 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, immediately ready to rescue them should trouble arise.

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

Table 8—First Alarm Residential Fire Critical Tasks – 17 Personnel

	Critical Task Description	Personnel Required
	1st Due Engine (4 personnel)	
1	Conditions report.	1
2	Establish supply line to hydrant.	2
3	Deploy initial fire attack line to point of building access.	1–2
4	Operate pump and charge attack line.	1
5	Establish incident command.	1
6	Conduct primary search.	2
	2nd Due Engine (4 personnel)	
7	If necessary, establish supply line to hydrant.	1–2
8	Deploy a backup attack line.	1–2
9	Establish Initial Rapid Intervention Crew.	2
	1st Due Truck (4 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.	2
15	Establish exterior command and scene safety.	1
	3rd Due Engine (4 personnel each)	
16	Establish Initial 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 8 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 9,000 EMS incidents annually, including cardiac arrests, vehicle accidents, strokes, heart attacks, difficulty breathing, falls, childbirths, and other medical emergencies.

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

Table 9—Cardiac Arrest Critical Tasks – Four Engine Personnel + AMR 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

That the time required to complete the critical tasks necessary to stop the escalation of an emergency (as shown in Table 8 and Table 9) 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 a room, fire will escalate to the point of flashover. At this point, the entire room is engulfed in fire, the entire building becomes threatened, and human survival near or in the

room of fire origin becomes impossible. Additionally, 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 plus automatic aid is sufficient to deliver a single ERF of 17 firefighters to a building fire, if they can arrive in time, which the statistical analysis of this report will discuss in depth. Mitigating an emergency event is a team effort once the units have arrived. This refers to the *weight* of response; if too few personnel arrive too slowly, 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 later or smaller.

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

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

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

If fewer firefighters arrive, *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.

Seventeen initial personnel could handle a moderate-risk, confined residential fire; however, even an ERF of 17 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 17 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, rather than 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 seven fire stations deploying seven engine companies, one aerial ladder truck, and one Battalion Chief as the duty Incident Commander. It is appropriate to understand, using geographic mapping tools, what the existing stations do and do not cover within travel time goals, if there are any coverage gaps needing one or more stations, and what, if anything, to do about them.

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

Distribution – the spacing of first-due fire units to control routine emergencies before they escalate and require additional resources.

Concentration – the spacing of fire stations sufficiently close to each other so that more complex emergency incidents can 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

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 four personnel daily.

Map #2a – Risk Assessment: Planning Zones

Map #2a shows the seven 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.

Map #2c – Critical Infrastructure Key Resources

Map #2c displays the locations of the critical infrastructure sites in the City as reviewed in the risk assessment found in **Appendix A**.

Map #2d – Risk Assessment: High Risk Occupancies

Map #2d displays the locations of the 993 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. It is apparent that there are high- or maximum-risk occupancies in every planning zone.

Map #2e – Risk Assessment: High Needed Fire Flow Locations

Map #2e displays the locations of 659 of the buildings within the City with needed fire flow greater than 2,500 gallons per minute, as determined by the ISO. As the map illustrates, these buildings are predominantly located in the commercial and industrial zoned areas of the City.

Map #2f – Risk Assessment: Hazardous Materials Sites

Map #2f displays the locations of 759 sites within the City using hazardous materials regulated by the Department's Fire Prevention Bureau as determined by the City-managed, state-designated Certified Unified Program Agency (CUPA) plan. As the map illustrates, these buildings are also predominantly located in the commercial and industrial zoned areas of the City.

Map #2g – Risk Assessment: Wildfire Severity Zones

Map #2g displays the location of the urban interface areas where urbanization abuts wildland open space areas with differing fuels. The City identified these areas by using the CAL FIRE threat areas that are identified Statewide along with the City's historical wildfire history.

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

Map #3 show the areas within a 4:00-minute travel time of one of the City's seven fire stations. Green road segments indicate the City's current road network that a fire engine should be expected to reach within 4:00 minutes, assuming it is in station and encounters *no traffic congestion*. The modeling tool uses actual fire apparatus speed by roadway type.

The reduced quantity of red coverage in this map represents the reduced travel time coverage at peak morning/evening traffic congestion hours. As can be seen, severe traffic congestion can hamper fire unit travel time, even with traffic signal preemption technology. The impact is the largest in the more travelled, major road and commercial corridors. Also, the neighboring fire agency stations are too far away to be the primary provider to any of the Department's service area.

The purpose of response time modeling is to determine response time coverage across a jurisdiction's geography and station locations. This geo-mapping design is then validated against dispatch time data to reflect actual response times. There should be some overlap between station areas so that a second-due unit can have a chance of an acceptable response time when it responds to a call in a different station's first-due response area. As can be seen, coverage is very good for all but a few peripheral areas of the City. These small areas exist due to the street design or topography and thus are not large enough to warrant a fire station move or addition.

As detailed later in this section, the *travel* time to 90 percent of fire and EMS incidents is 5:17 minutes Department-wide in report year 2018. This is supported by the GIS model that shows 4:00-minute coverage does not extend out into some of the City's peripheral 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, and one Battalion Chief within 8:00 minutes

travel time *without traffic congestion*. There are only small gaps in some of the peripheral areas of the City. This is very good coverage *without* traffic congestion. However, with traffic congestion, shown in red, the five-unit coverage shrinks to the center of the City as the fourth- and fifth-due units cannot cross the City in 8:00 minutes or less.

Map #6 – Concentration: Three-Engine 8:00-Minute Travel Time Coverage

Map #6 only shows the coverage for three engines as part of the ERF force. As this measure includes only three units at 8:00 minutes travel time, this coverage extends past the core of the City, even given traffic congestion. However, traffic congestion means the third engine cannot get into the difficult-to-serve, peripheral fire station areas 4, 5, and 7.

Map #7 – 8:00-Minute Ladder Truck Travel Time Coverage – Traffic Congestion

Map #7 shows 8:00-minute travel time coverage for the ladder truck with and without traffic congestion. As can be seen, the ladder truck is centrally located at Station 1 and can reach almost all the City without traffic congestion. During traffic congestion, a single ladder truck cannot reach the peripheral fire station areas 4, 5, and 7 in 8:00 minutes or less.

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

Map #8 displays 8:00-minute travel time coverage for a Battalion Chief from Station 1 with and without traffic congestion. It is apparent that the single Battalion Chief travel time coverage includes all areas of the City during normal traffic hours, and during congested periods the Battalion Chief cannot reach peripheral fire station areas 4, 5, and 7 in 8:00 minutes or less.

Map #9 – All Incident Locations

Map #9 shows the location of all incidents for five years from January 2014 through December 2018. It is apparent that incidents occur in all areas of the City.

Map #10 – Emergency Medical Services and Rescue Incident Locations

Map #10 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 #11 – All Fire Locations

Map #11 identifies the location of all fires within the City over the past five years. All fires include any type of fire call, from vehicle to dumpster to building. There are obviously fewer fires than medical or rescue calls. Even given this fact, it is evident that fires occur in all fire station areas, but also more frequently in some of the central and highest-population-density areas of the City.

Map #12 – Structure Fire Locations

Map #12 displays the location of the structure fire incidents over the past five years. While the number of structure fires is a smaller subset of total fires, there are two meaningful findings from this map. First, there are structure fires in every fire station area, and second, there are a relatively small number of building fires in the City overall. In Citygate's experience, this is consistent with other similar cities in the western United States.

As with the previous map of all fire types, there are more building fires in some of the central and highest-population-density areas of the City. These locations are between Fire Stations 1, 2, and 3, so along with the ladder truck and Battalion Chief from Station 1, the areas with the highest quantity of building fires receive the full Effective Response Force (First Alarm) of three engines, one ladder truck, and the Battalion Chief in less than 11:30 minutes from the 9-1-1 call. This meets or is faster than national best practice recommendations.

Map #13 – Emergency Medical Services and Rescue Incident Location Densities

Map #13 shows, by mathematical density, where clusters of emergency medical services incident activity occurred. In this set, the darker density color plots the highest concentration of EMS/rescue incidents. This type of map makes the location of frequent workload more meaningful than simply mapping the locations of all EMS incidents, as was shown in Map #10.

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. Much of the density is in Station 1's area. This is fortunate, as Station 1 has both an engine and ladder truck crew to respond when simultaneous incidents occur.

Map #14 – All Fire Location Densities

Map #14 is like Map #11 but shows the hot spots of activity for all types of fires. Fire density is greater in the areas of the City with higher population density.

Map #15 – All Structure Fire Location Densities

Map #15 is like Map #12 but shows the hot spots for structure fire activity. 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 GIS software allows the miles of public streets covered at 4:00 or 8:00 minutes to be measured. The following table provides these metrics for the coverage versus the impacts of traffic congestion.

Table 10—Service Area Road Mile Coverage Comparison (No Mutual Aid)

Scenario	Total City Road Miles	Miles Covered	% Covered	Congested Road Miles	Congested % Covered	% loss
First-Due Unit Travel @ 4:00 Minutes	593	448	76%	310	52%	24%
First Alarm Travel @ 8:00 Minutes	593	459	77%	223	38%	39%

The existing 4:00-minute first-due unit coverage is reduced by 24 percent during traffic congestion. The ERF is good without traffic, but congestion significantly reduces it 39 percent.

The City's shape and road network is difficult to serve efficiently from a few fire stations and this is why the City utilizes seven fire stations. This is *a necessity* given the topography and roads. Traffic congestion travel time reductions do hurt the peripheral City areas. This means that when simultaneous incidents occur during peak hours of traffic congestion in the City's center, peripheral station areas 4, 5 and 7 cannot receive a second unit quickly if needed. For this reason, the Department must closely observe the peak-hour demands and will eventually need to add a peak-hour unit in the City's core to keep units more available Citywide.

Finding #3: The current fire station placement provides a first response unit for all the City's major neighborhoods.

Finding #4: Fire unit travel times are longer than a best practice and Department goal of 4:00 minutes due to the terrain, curvilinear road network in many parts of the City, and traffic congestion.

Finding #5: Due to the road network design and terrain, absent traffic congestion, 75 percent of the City's public streets are within a 4:00-minute travel time of a fire station. Traffic congestion during many of the daylight hours reduces the 4:00-minute coverage to only 52 percent of the City's public streets, which is 23 percent less than without traffic congestion.

2.7 STATISTICAL ANALYSIS

SOC ELEMENT 7 OF 8
RELIABILITY & HISTORICAL RESPONSE EFFECTIVENESS STUDIES

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

The following subsections provide summary statistical information regarding the Department and its services.

2.7.1 Demand for Service

The Department provided both NFIRS 5 incident and records management system (RMS) apparatus response data for the period of 1/1/2014 through 12/31/2018. These two data sets were merged, providing 62,094 incidents and 119,618 apparatus response records.

In 2018, the Department responded to 13,039 incidents. During this period, the Department had a daily demand of 35.72 incidents, 3.08 percent of which were to fire incidents, 72.42 percent were to EMS incidents, and 24.50 percent were to other incident types.

Figure 6—Annual Service Demand by Year

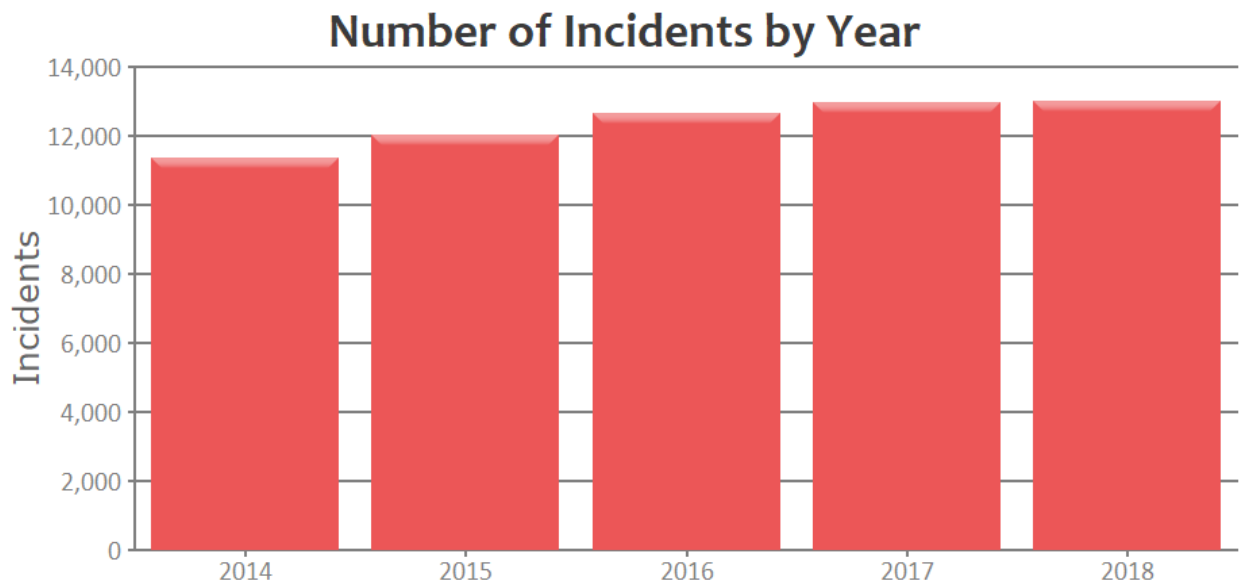


Figure 7 illustrates the number of incidents by incident type. The number of fire and EMS incidents peaked in 2017, while the number of other incident types increased each year.

Figure 7—Number of Incidents by Year by Incident Type

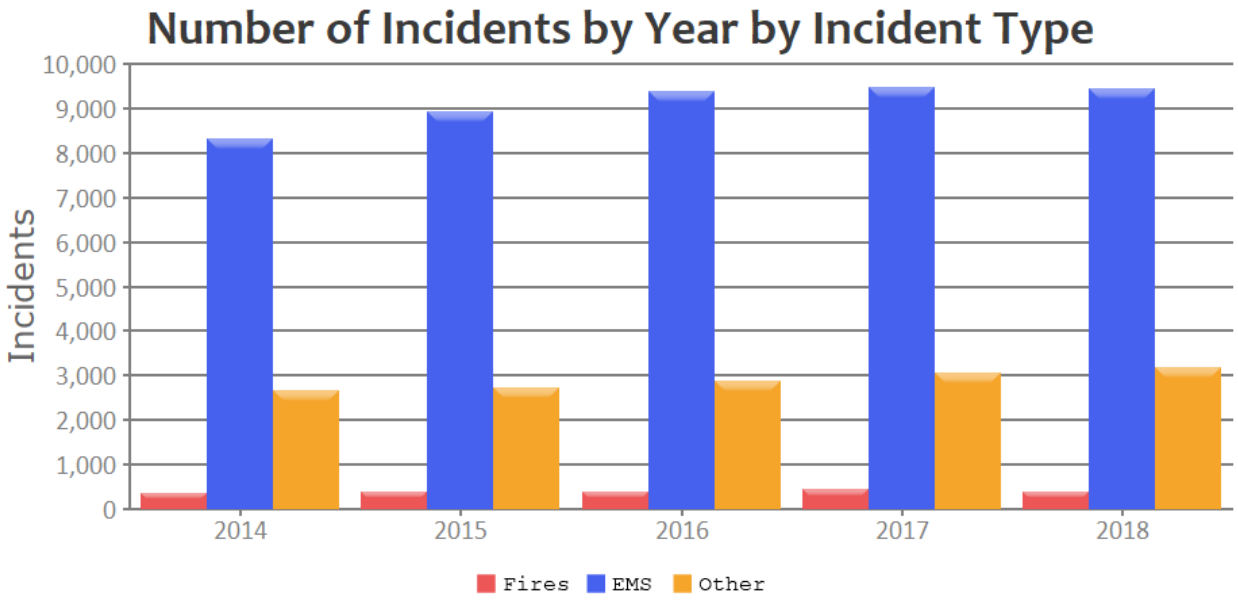
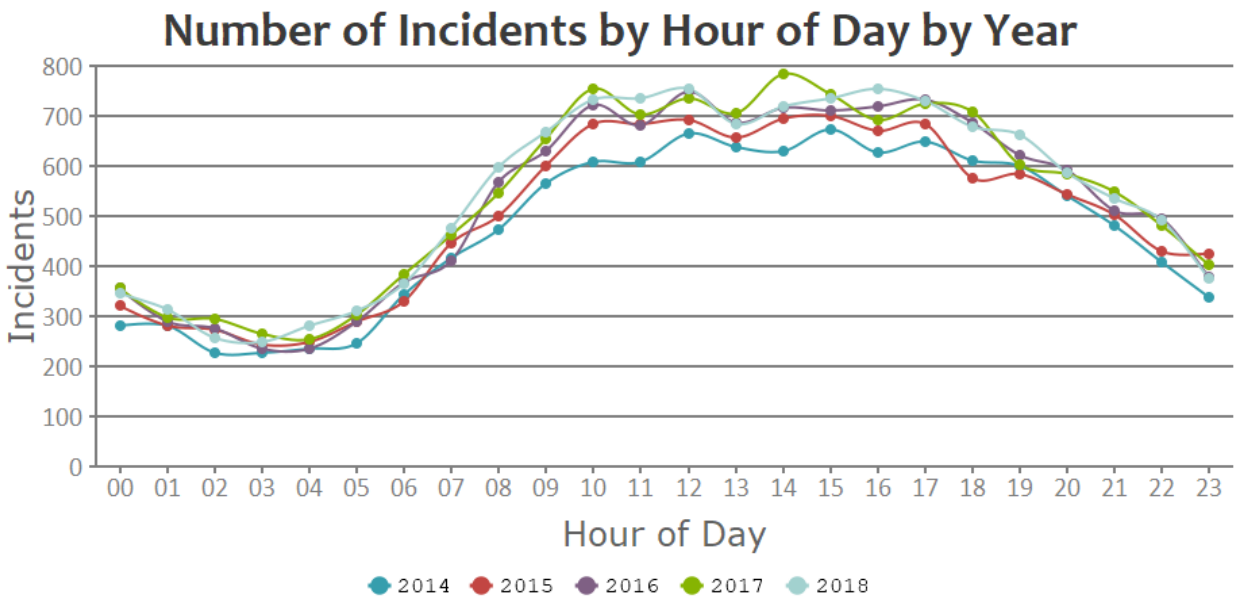


Figure 8 shows service demand by hour of day by year, illustrating that calls for service occur at every hour of the day and night, requiring fire and EMS response capability 24 hours per day, every day of the year.

Figure 8—Service Demand by Hour of Day and Year



Finding #6: The Department's service demand is consistent, indicating the need for a 24-hour-per-day, seven-day-per-week fire and EMS emergency response system.

The following figure illustrates the number of incidents by station for five years. Station 1 had the highest volume of activity. Stations 5 and 6 had the lowest volume.

Figure 9—Number of Incidents by Station – Five Years

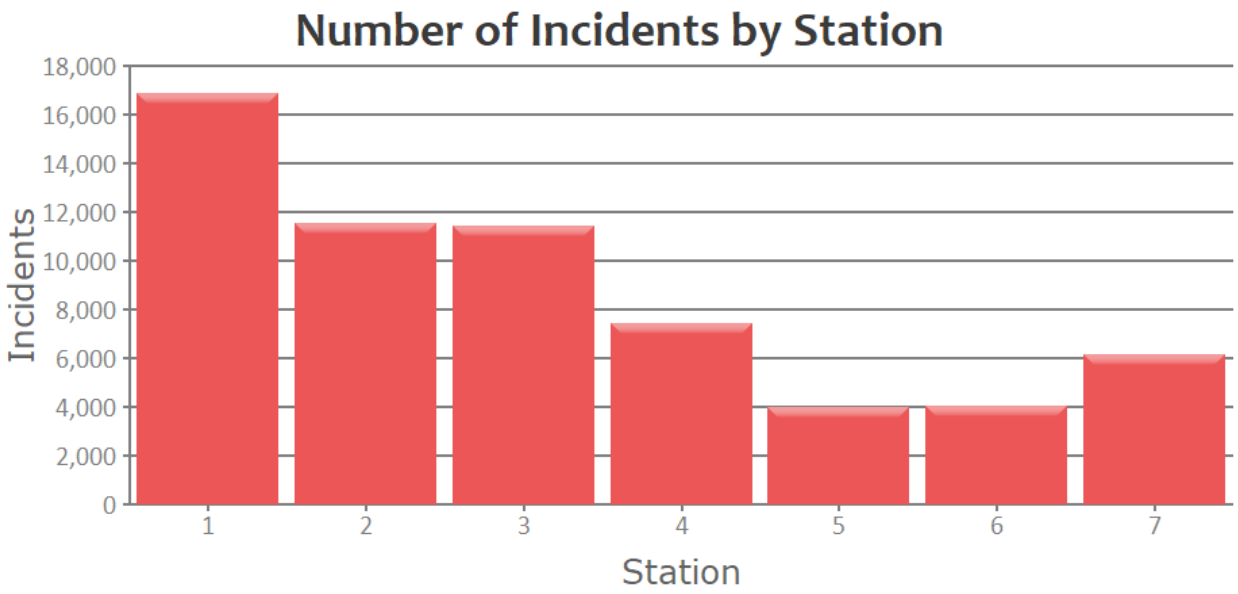


Table 11 lists the activity rankings of incidents by incident quantity for 2018 for those incidents with more than 40 occurrences in a year. Note the strong ranking for EMS incidents.

Table 11—Incidents: Quantity by Incident Type – 2018

Federal NFIRS #/ Incident Type	2018
321 EMS call, excluding vehicle accident with injury	6,501
311 Medical assist, assist EMS crew	1,823
611 Dispatched and canceled en route	984
322 Vehicle accident with injuries	642
553 Public service	447
622 No incident found on arrival of incident address	419
324 Motor vehicle accident no injuries	402
554 Assist invalid	193
651 Smoke scare, odor of smoke	108
552 Police matter	83
743 Smoke detector activation, no fire – unintentional	73
131 Passenger vehicle fire	70
745 Alarm system sounded, no fire – unintentional	67
736 CO detector activation due to malfunction	64
735 Alarm system sounded due to malfunction	62
600 Good intent call, other	62
412 Gas leak (natural gas or LPG)	59
151 Outside rubbish, trash or waste fire	58
700 False alarm or false call, other	57
111 **Building fire**	**48**
551 Assist police or other governmental agency	48
143 **Grass fire**	**44**
740 Unintentional transmission of alarm, other	43
113 Cooking fire, confined to container	42

Table 12 illustrates the ranking of incidents by property use in 2018. The highest rankings for incidents by property use are residential dwellings. Only those property types with 20 or more incidents are shown.

Table 12—Incidents: Quantity by Property Use – 2018

Federal NFIRS #/ Property Use	2018
419 1 or 2 family dwelling	4,415
429 Multi-family dwellings	1,639
961 Highway or divided highway	918
311 24-hour care nursing homes, 4 or more persons	825
Blank	727
963 Street or road in commercial area	571
965 Vehicle parking area	571
962 Residential street, road or residential driveway	452
960 Street, other	362
161 Restaurant or cafeteria	230
342 Doctor, dentist or oral surgeon's office	191
449 Hotel/motel, commercial	162
700 Manufacturing, processing	150
571 Service station, gas station	147
931 Open land or field	132
215 High school/junior high school/middle school	117
519 Food and beverage sales, grocery store	117
599 Business office	107
340 Clinics, doctors' offices, hemodialysis centers	94
213 Elementary school, including kindergarten	65
131 Church, mosque, synagogue, temple, chapel	59
331 Hospital – medical or psychiatric	59
459 Residential board and care	56
938 Graded and cared-for plots of land	53
439 Boarding/rooming house, residential hotels	52

2.7.2 Simultaneous Incident Activity

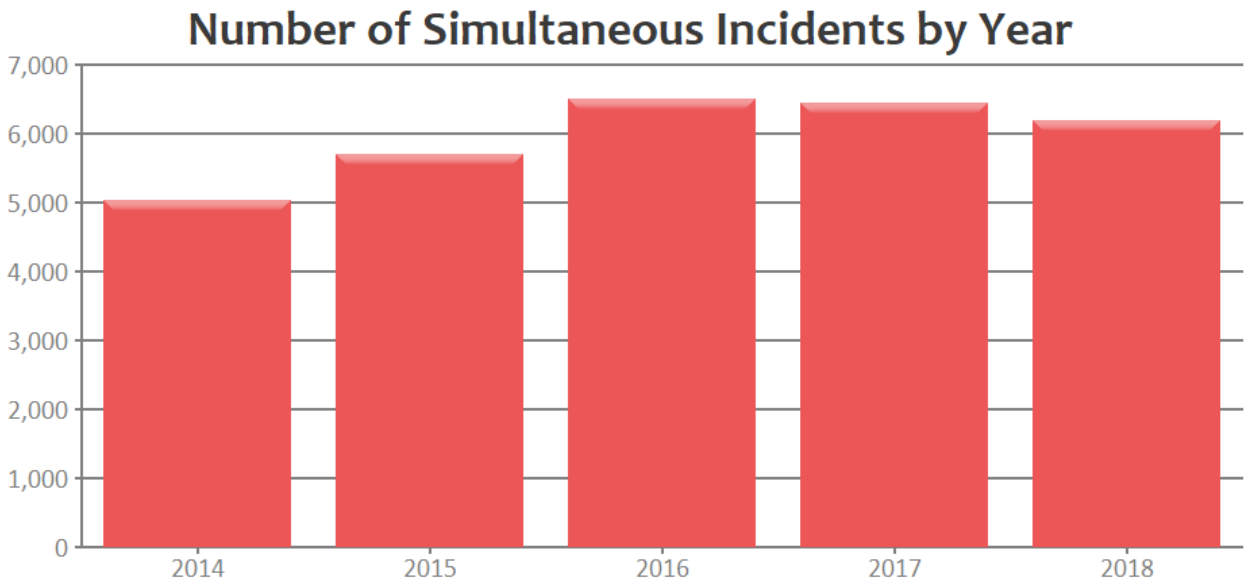
Simultaneous incidents occur when other incidents are underway at the time a new incident develops. During 2018, 47.53 percent of incidents occurred while one or more other incidents were

underway. The following is the percentage of simultaneous incidents broken down by the number of simultaneous incidents.

- 1 or more simultaneous incidents: 47.53 percent
- 2 or more simultaneous incidents: 14.29 percent
- 3 or more simultaneous incidents: 3.15 percent

The following figure shows the number of simultaneous incidents increased through 2016 and then decreased slightly in 2017 and again in 2018.

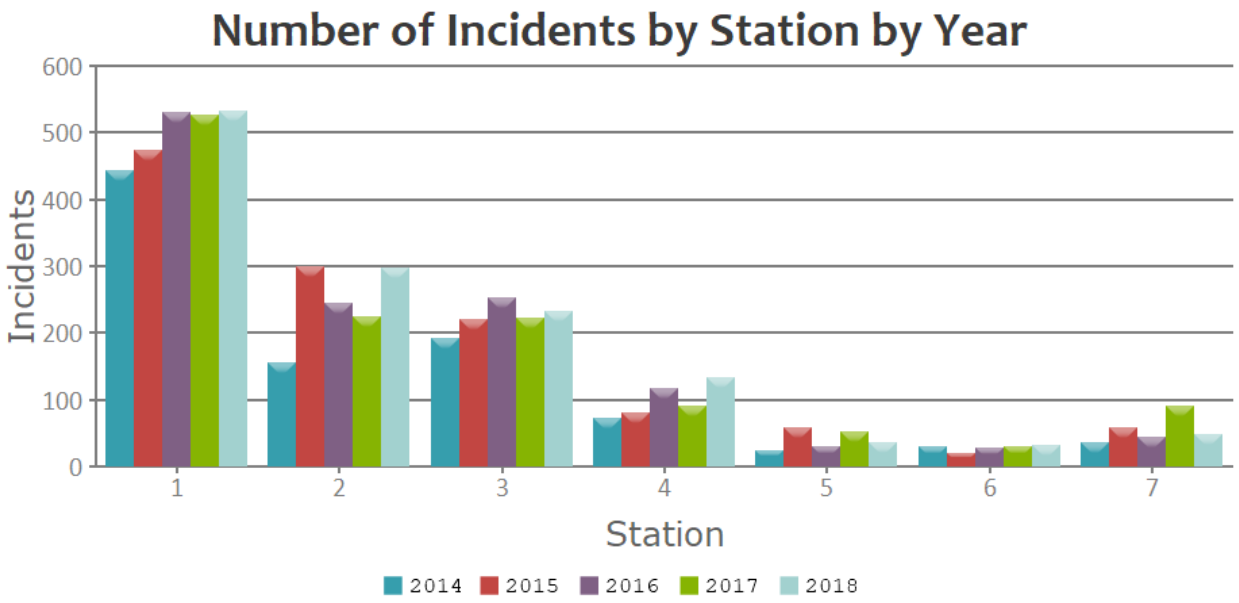
Figure 10—Number of Simultaneous Incidents by Year



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. Station 1 has the greatest number of single-station simultaneous incidents over five years, with Station 1's district having the greatest quantity. The figure also shows the unpredictable frequency of single-station simultaneous incidents.

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



Finding #7:	The overall number of simultaneous incidents has been slowly increasing since 2014. The largest impact of simultaneous incidents is felt in Station 1's district. This further shifts workload to other companies at peak hours of the day.

2.7.3 Operational Performance

Performance for the first apparatus to arrive on the scene of emergency incidents is measured by the time necessary for 90 percent completion of the following components:

- Call processing
- Turnout
- Travel
- Dispatch to arrival
- Call to arrival

2.7.4 Call Processing

Call processing measures the time from the first incident time stamp in the City's 9-1-1 dispatch center until apparatus are notified of the request for assistance.

The following table shows that call processing is 3:23 minutes for 90 percent compliance.

Table 13—Call Processing Analysis

Station	2018
Department-wide	03:23
Station 1	03:18
Station 2	03:27
Station 3	03:28
Station 4	03:28
Station 5	03:15
Station 6	03:08
Station 7	03:16

Finding #8: Call processing performance, at 3:23 minutes for 90 percent of the fire/EMS incidents, is significantly slower than a best practice recommendation of 1:30 minutes.

2.7.5 Turnout

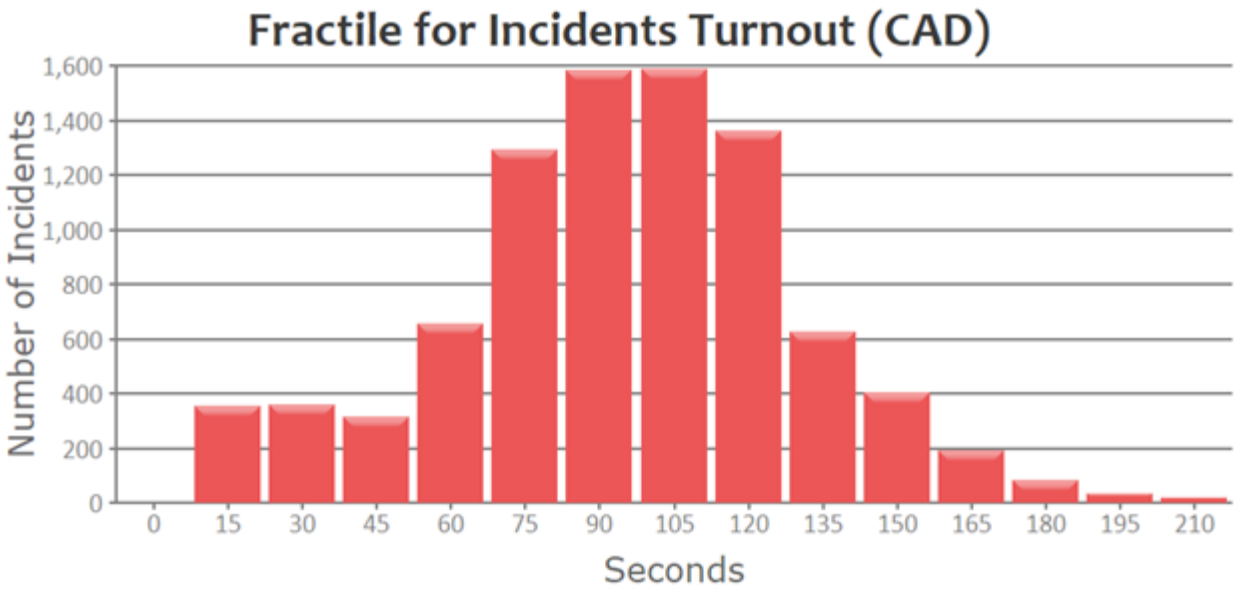
Turnout time measures the time from apparatus notification until the apparatus starts traveling to the scene. Citygate's goal for turnout time is 2:00 minutes. All the City's fire stations do not meet the 2:00-minute turnout time goal.

Table 14—Turnout Analysis

Station	2018
Department-wide	02:12
Station 1	02:06
Station 2	02:04
Station 3	02:13
Station 4	02:13
Station 5	02:21
Station 6	02:25
Station 7	02:19

Figure 12 illustrates fractile turnout time performance. The peak segment for turnout performance is approximately 105 seconds.

Figure 12—Fractile for Incidents Turnout (CAD)



Finding #9:	Crew turnout performance, at 2:12 minutes, is only slightly slower than a Citygate-recommended goal of 2:00 minutes or less to 90 percent of the fire/EMS incidents.

2.7.6 Travel

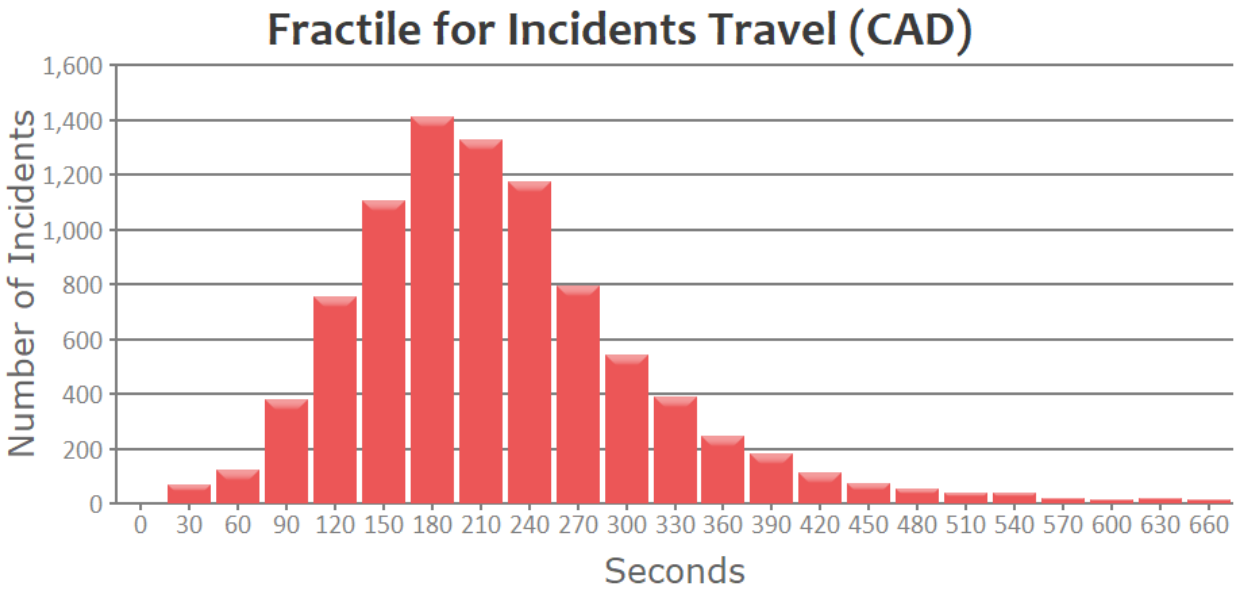
Travel time measures the time to travel to the scene of the emergency. In most urban and suburban fire departments, a 4:00-minute travel time 90 percent of the time would be considered highly desirable. Table 15 shows that no stations achieve that goal.

Table 15—Travel Performance (No Freeway Incidents) to 90 Percent of Fire and EMS Incidents

Station	2018
Department-wide	05:17
Station 1	04:38
Station 2	05:27
Station 3	05:02
Station 4	05:39
Station 5	06:14
Station 6	04:59
Station 7	07:14

The following figure illustrates fractile travel time performance.

Figure 14—Fractile for *All* Incidents Travel (CAD)



Finding #10: First-due unit travel time, at 5:17 minutes on *surface streets* to 90 percent of the fire/EMS incidents Citywide, is slower than the Department's and a best practice goal of 4:00 minutes.

2.7.7 Call to Arrival

Call to arrival measures time from receipt of the request for assistance until the apparatus arrives on the scene. Corona Fire Department goals are 1:00 minute for call processing, 1:50 minutes for turnout, and 4:00 minutes for travel. This adds up to 6:50 minutes.

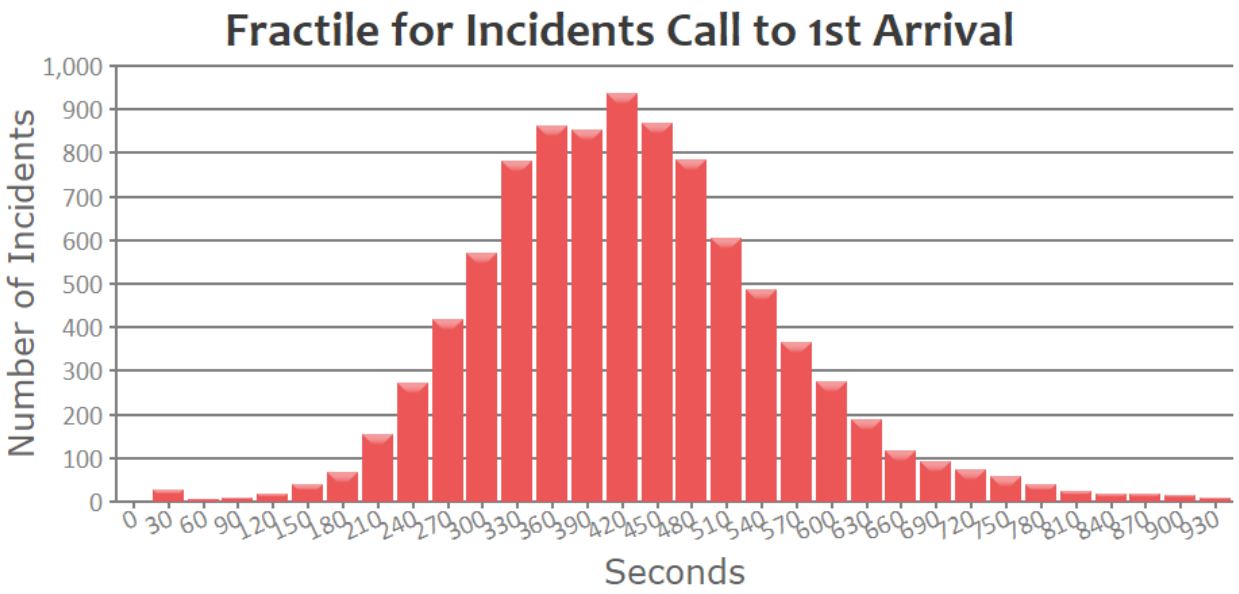
A Citygate-recommended call to arrival goal for Corona should be 90 percent compliance at 7:30 minutes. The goal is calculated as 1:30 minutes call processing plus 2:00 minutes turnout plus 4:00 minutes travel time.

Table 16—Call to Arrival Performance to 90 Percent of Fire and EMS Incidents

Station	2018
Department-wide	09:37
Station 1	08:56
Station 2	09:49
Station 3	09:32
Station 4	10:07
Station 5	11:28
Station 6	09:09
Station 7	10:19

The following figure illustrates fractile call to arrival performance. The peak segment is 420 seconds, or 7:00 minutes.

Figure 13—Fractile for Incidents Call to First Arrival



Finding #11: The Department's call to arrival time to 90 percent of the fire/EMS incidents, at 9:37 minutes, is slower than Citygate's recommended goal of 7:30 minutes. This result is primarily due to longer call processing and travel times.

Finding #12: If a total of 2:00 minutes can be saved in dispatch and crew turnout time, then call to arrival is reduced from 9:37 minutes to 7:37 minutes, which is very close to a goal of 7:30 minutes.

2.7.8 Effective Response Force (First Alarm) Concentration Measurements

The minimum ERF for structure fires from the Department is three engines and one ladder truck. Additionally, one Battalion Chief are sent for a total of 17 personnel. The numbers in the following table are very small for an appropriate sample size. Since 2014, there has not been one year in which all seven station districts had at least one ERF incident at which all the units were needed and reached the incident location.

Table 17—Distribution – Effective Response Force (First Alarm) – Call to Arrival Performance to 90 Percent of Fire and EMS Incidents

Station	2018 / Count
Department-wide	11:49 (14)
Station 1	10:35 (3)
Station 2	11:49 (3)
Station 3	11:39 (8)
Station 4	-
Station 5	-
Station 6	-
Station 7	-

Finding #13: The Effective Response Force (First Alarm) Call to Arrival times at 11:49 minutes, are very good and only slightly longer than the best practice and Citygate-recommended goal of 11:30 minutes.

2.8 Overall Deployment Evaluation

SOC Element 8 of 8
Deployment Evaluation

The Department serves a diverse urban population with a mixed residential and non-residential land-use pattern typical of a city in Riverside County and southern California.

While the State fire code now requires fire sprinklers even in residential dwellings, it will be many more decades before enough homes are built 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 for first-due arrival within 7:30 minutes from 9-1-1 dispatch notification, and for ERF arrival within 11:30 minutes of 9-1-1 notification, all at 90 percent or better reliability.

The Department's dispatch processing time to 90 percent of the fire/EMS incidents is 3:23 minutes, more than double a national best practice recommendation of 1:30 minutes. At 2:12 minutes, the fire crew turnout times are *just* over Citygate's recommendation of 2:00 minutes.

The overall longer-than-desired first-due unit travel times are not the result of a lack of fire stations. They are more the result of the non-grid street network in some sections of the City, topography,

natural and built barriers (hills and highways), simultaneous incidents at peak hours of the day, and traffic congestion. The Department-wide call to arrival of 9:37 minutes could be improved with a reduction of 2:00 minutes from dispatch and crew turnout time, resulting in 7:37 minutes, which is very close to Citygate's recommendation of 7:30 minutes.

Department resources and equipment are appropriate to protect against the hazards likely to impact the City. A daily staffing of 33 provides a total response force sufficient for a single emerging to serious fire incident, as discussed in **Section 2.2.1**, as well as a one- to five-patient EMS incident.

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 significant simultaneous incident rate of at least two incidents at once, 47.5 percent of the time. If more than two medical incidents are active and a building fire should occur, the Department would need to depend on mutual-aid assistance which, given Corona's geographic isolation, does not come quickly from all sides.

As calls for service continue to increase and because three incidents occur simultaneously 14.3 percent of the time, the Department should keep close watch on response times and unit response capacity. As workload approaches Citygate's recommended threshold, the City should consider a peak-activity engine or squad during the highest workload times of the day/week.

2.8.1 Deployment Recommendations

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

Recommendation #1:	**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 and to keep small but serious fires from becoming more serious. With this is mind, Citygate recommends the following measures:

1.1	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.
1.2	Multiple-Unit Effective Response Force for Serious Emergencies: To confine building fires near the room of origin, keep vegetation fires under one acre in size, and treat multiple medical patients at a single incident, a multiple-unit ERF of at least 17 personnel, including at least one Battalion Chief, should arrive within 11:30 minutes from the time of 9-1-1 call receipt at City dispatch 90 percent of the time. This equates to a 90-second dispatch time, 2:00-minute company turnout time, and 8:00-minute travel time.
1.3	Hazardous Materials Response: Provide hazardous materials response designed to protect the City from the hazards associated with uncontrolled release of hazardous and toxic materials. The fundamental mission of the Department's response is to isolate the hazard, deny entry into the hazard zone, and notify appropriate officials/resources to minimize impacts on the community. This can be achieved with a first-due total response time of 7:30 minutes or less to provide initial hazard evaluation and/or mitigation actions. After the initial evaluation is completed, a determination can be made whether to request additional resources from the regional hazardous materials team.

1.4	Technical Rescue: Respond to technical rescue emergencies as efficiently and effectively as possible with enough trained personnel to facilitate a successful rescue with a first-due total response time of 7:30 minutes or less to evaluate the situation and/or initiate rescue actions. Following the initial evaluation, assemble additional resources as needed within a total response time of 11:30 minutes to safely complete rescue/extrication and delivery of the victim to the appropriate emergency medical care facility.
Recommendation #2:	The City's 9-1-1 dispatch center must design and implement substantial personnel and/or technology improvements to lower fire and EMS incident processing times to a national best practice of 1:30 minutes.
Recommendation #3:	The Department should closely track response time performance during peak hours and, when response time and/or unit workloads decay substantially, consider a peak-activity unit (engine or squad) to capture simultaneous incidents and to backfill units at training during peak hours of the day.

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SECTION 3—HEADQUARTERS SERVICES ASSESSMENT

As part of this Standards of Coverage assessment, Citygate was asked to review and evaluate the Department's headquarters support services, including:

- General Department administration
- Administrative support staffing
- Emergency/disaster preparedness
- Fire prevention
- Employee health and wellness
- Finance systems for budgeting, purchasing, and inventory control

NFPA 1201 states, in part, "the [Department] shall have a leader and organizational structure that facilitates efficient and effective management of its resources to carry out its mandate as required [in its mission statement]."[3] Best practices call for a management organization and headquarters programs with adequate staffing to provide a properly trained, equipped, and supported response force to ensure prompt response and safe, competent service delivery. Compliance regulations for fire services operation are increasing, so the proper hiring, training, and supervision of operational personnel require a significant leadership and general management commitment.

3.1 HEADQUARTERS SERVICES ASSESSMENT SUMMARY

Citygate's headquarters services assessment yielded the following summary results:

3.1.1 Strengths

- Very highly qualified, professional, and dedicated personnel with a strong commitment to serve the organization and the community.
- Strong work ethic/culture.
- Knowledgeable emergency response personnel that have become subject matter experts in critical lines of training and service.
- High-quality customer service and pride in serving the community.
- High confidence in organizational leadership.

[3] NFPA 1201 – Standard for Providing Emergency Services to the Public (2015 Edition).

- Productive and respectful labor–management relationships.
- Positive relationship with City Council, the local EMS agency, and regional fire department leadership.

3.1.2 Weaknesses/Concerns

- Insufficient clerical-level support for the administration, suppression, and training/EMS functions.
- Heavy administrative workload for non-clerical staff.
- Insufficient management authority with 40-hour Fire Captains and insufficient support for training, EMS programs, and personnel.
- Significant ongoing administrative workload capacity gaps.
- Inefficient fleet maintenance program.
- Lack of a thorough, adopted, durable equipment replacement plan and budget.
- Limited delivery of public information and education plan.
- Aged and constraining fire stations, training facilities, and related resources.
- Insufficient health and safety features at fire stations, including diesel exhaust exposure at fire stations, lack of NFPA-compliant occupational medical exams, and poor fitness facilities.

3.1.3 Opportunities

- Potential to narrow or resolve ongoing workload capacity gaps across multiple divisions with two to three new full-time equivalent (FTE) staff with appropriate skill sets.
- Potential to reduce costs and increase operational depth of coverage associated with fleet maintenance work.
- Increased program sustainability through succession planning and development of a deeper bench of subject matter experts.

3.1.4 Threats

- Multiple potential single points of failure.
- Suppression chief officer burnout due to heavy administrative workload.
- Significant ongoing administrative workload capacity gaps.

- Trained staff recruited away from Corona by other regional fire departments.
- In Citygate's opinion, the workload capacity gaps and potential single points of failure identified pursuant to this assessment could be significantly narrowed or resolved with the addition of 1.5 additional FTE non-sworn clerical-level positions and one additional chief officer FTE.

3.2 Assessment Methodology

For this assessment, Citygate reviewed all administrative position descriptions and conducted follow-up interviews with individual personnel as needed to assess function/program strengths, weaknesses, opportunities, and threats (SWOT), as well as to identify and evaluate:

- *Key* primary and secondary responsibilities for each administrative support position.
- Approximate amount/percentage of time spent annually on each responsibility.
- Critical workload capacity gaps, including what key responsibilities/expectations are not being performed or not being performed to desired/expected levels or timeline.
- Single points of failure, if any, for critical business functions, processes, and/or services.
- Workload capacity gaps relative to critical business systems and assigned key primary and secondary responsibilities.

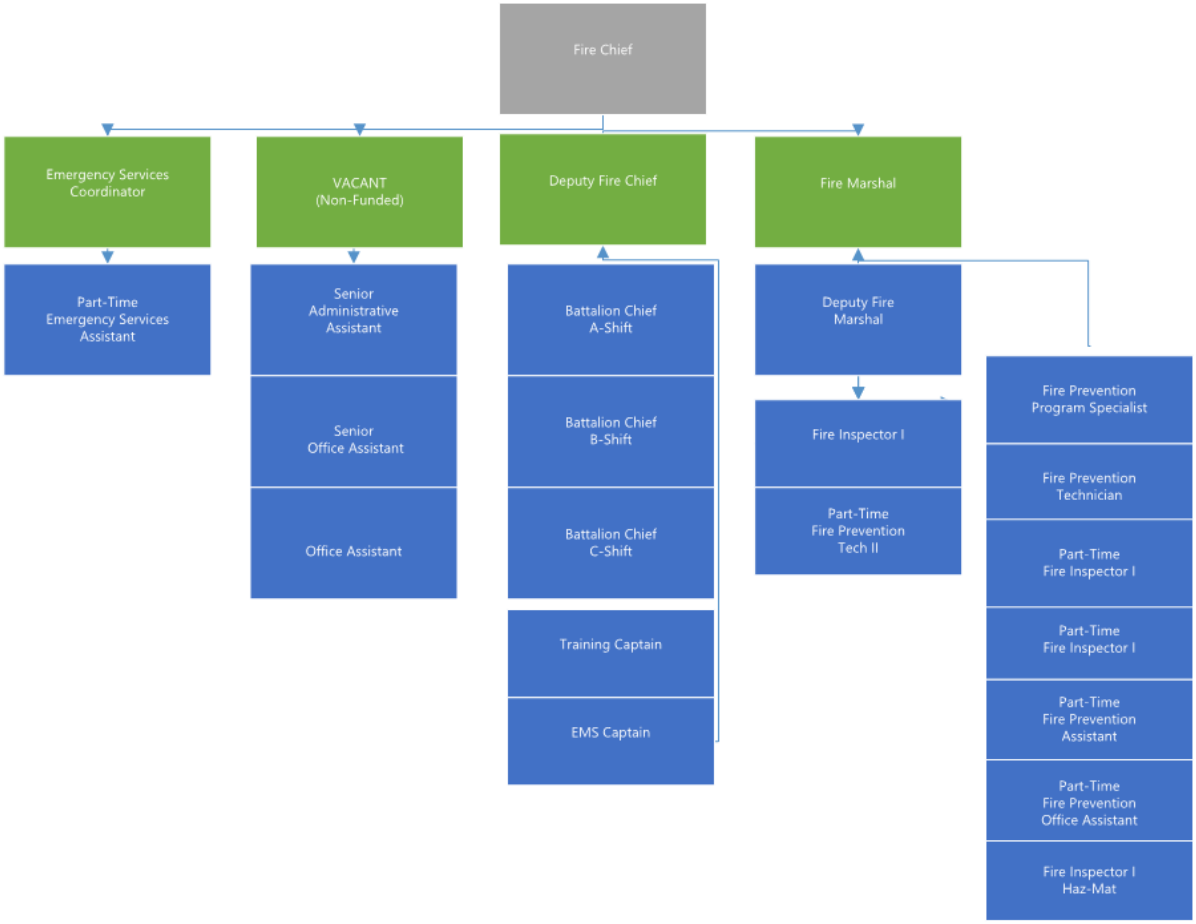
3.3 Administrative Organization

The City's 2018/2019 Department budget authorizes two FTEs and one half-time administrative support positions dedicated to supporting the Fire Department. An additional half-time administrative support position serves the City Office of Emergency Management (OEM). This staff is responsible for the overall administration, management, and clerical support of all Department programs and services and most administrative support functions, including general Department administration, fire prevention, training, health and safety, emergency preparedness and management, public education/information, policies and procedures, coordination with other

local/regional service providers/stakeholders, and other related administrative and program support responsibilities. Department Divisions include:

- Administration
- Operations
- Fire Prevention

Figure 14—Fire Department Administrative Organization



Source: City of Corona Fire Department

3.4 ADMINISTRATION DIVISION

The Administration Division consists of the Fire Chief and one Administrative Assistant, one Office Assistant, and one half-time Office Worker.

3.4.1 Key Program Responsibilities

Key Administration Division program responsibilities include:

- Overall leadership for the Department.
- Administrative systems and procedures.
- Budget and fiscal policy.
- Labor/management issues.
- Strategic planning.
- Implementation of best practices in all areas of service.
- Compliance with federal, State, and local laws, regulations, codes, ordinances, rules, and professional standards.
- Connecting the Department with the Corona community and key stakeholders.

3.4.2 Key Fire Chief Responsibilities

- Plans, organizes, directs, and coordinates all Department functions and services.
- Provides highly responsible and technical staff assistance to the City Manager and City Council.
- Directs development and implementation of Department goals, objectives, priorities, policies, procedures, and operating guidelines.
- Develops and manages the Department budget.
- Ensures the development and execution of a fire protection plan suited for the community.
- Represents the City in relationships with the public, community groups, professional organizations, and outside agencies.

3.4.3 Key Administrative Assistant and Office Assistant Responsibilities

- Processes and inputs data to create various Department reports.
- Maintains Department records.
- Provides the main point of contact for individuals and agencies contacting the Department through walk-in, phone, email, and online (Infoweb).
- Assists with meeting management by assembling agendas, producing support materials, and capturing minutes.

- Assists with the preparation of the Department annual budget.

3.4.4 Administrative Support Analysis

Citygate reviewed the job descriptions for Administrative Support personnel prior to administering a SWOT analysis and conducting interviews. Citygate's assessment of Administrative Division administrative workload yielded the following.

Finding #14: The office support and finance positions were reduced during the recession. The remaining three positions are insufficient to support all the headquarters programs and personnel. This results in senior managers performing their own support work instead of their core duties.

Recommendation #4: The headquarters office support position plan to add 1.5 FTE positions from FY 20/21 through FY 21/22 is appropriate and should be funded.

3.5 Operations Division

The Operations Division administrative staff consists of a Deputy Fire Chief, two 40-hour Fire Captains, and three Battalion Chiefs assigned to a 56-hour shift schedule with collateral operational responsibilities. The Division has no dedicated administrative clerical support. Instead, the Office Assistant assigned to the Administrative Division functions as the primary Operations administrative support person.

3.5.1 Key Program Responsibilities

Key Operations Division administrative responsibilities include:

- Administrative systems and procedures.
- Employee training for fire, rescue, and emergency medical service skills.
- Labor/management issues.
- Strategic planning.
- Risk management.
- Implementation of best practices.

3.5.2 Key Deputy Fire Chief Responsibilities

- Plans, organizes, directs, and coordinates all fire suppression, rescue, and emergency medical services.
- Provides highly responsible and technical staff assistance to the Fire Chief, City Manager, and City Council.
- Directs development and implementation of Division goals, objectives, priorities, policies, procedures, and operating guidelines.
- Directs the forecasting of the funds needed for staffing, equipment, materials, and supplies in assisting with the development and management of the Department budget.
- Directs the monitoring and approval of expenditures.
- Conducts organizational and operational studies and investigations and creates reports and recommendations, including implementation of discipline procedures, as necessary.
- Represents the City in relationships with the public, community groups, professional organizations, and outside agencies.
- Responds as needed to provide high-level chief officer support at all times.

3.5.3 Key Operations Battalion Chief Administrative Responsibilities

- Plans, coordinates, and manages activities during multiple-company emergency responses, including fires, technical rescue operations, and mass casualty incidents.
- Performs professional administrative and managerial duties for assigned shift.
- Ensures operational readiness of fire crews by managing a platoon to ensure all positions are filled, daily updates and Daily Accountability spreadsheets are complete, and available resources are best deployed for Citywide coverage in response.
- Serves as the Incident Command chief officer for all emergencies as needed on their assigned platoon.
- Monitors daily fire crew productivity, including equipment and station maintenance, company drills and training, company fire inspections, and other operational and administrative functions.

- Oversees and participates in the training and development of assigned company personnel to meet the goals and objectives of individuals and the overall goals of the Department, including those related to health and fitness.
- Works with other management staff to maintain, revise, and improve overall Department operations.
- Supervises, trains, schedules, and evaluates assigned staff.
- Manages sub-Department program(s) as assigned, including operational oversite for Fleet Management.
- Assists with and works on special projects as assigned.

3.5.4 Key Training and EMS Captain Responsibilities

- Functions as the Department's primary point of contact for all fire, rescue, and emergency medical training.
- Develops training schedule to ensure completion of all required certification-based training and education.
- Oversees the Department's training records management system.
- Provides leadership to peer teams and subject matter experts who assist with training development and delivery.
- Provides functional supervision to emergency response personnel assigned to manage critical Department programs, including a shift-based fire captain that manages the state-mandated EMS Continuous Quality Improvement (CQI) program.

Recommendation #5:	The City should improve the sustainability of medical patient documentation and treatment review and follow-up. One shift-assigned firefighter/Paramedic manages the Continuous Quality Improvement program for all shifts. There is no replacement to fill this critical function when this employee is on leave or otherwise unavailable.

3.5.5 Operations Division Assessment

Citygate's assessment of Division administrative workload yielded the following.

Finding #15: The City uses two 40-hour Fire Captains (ranked lower than platoon Battalion Chiefs) for training and EMS program oversight. As peers to the Fire Captains, they hold limited management authority. Also, many administrative programs have been delegated to shift personnel, resulting in the possibility of a single point of failure when the shift person is not available.

Finding #16: The Department does not have a robust career development program or succession plan training. Given the normal turnover the Department experiences, it must prepare future supervisors and leaders before they are urgently needed.

Citygate's assessment of the Operations Division identified one significant single point of failure relative to critical functions, processes, and services in the administration of the Department's state- and locally mandated EMS CQI program.

Recommendation #6: An Administrative Battalion Chief should be added to provide management oversight to training, EMS, and the two assigned 40-hour Fire Captains. Additionally, due to the complexity of the programs, Fleet Management and Facilities Management should be assigned to the Administrative Battalion Chief.

Recommendation #7: The Department must create a career development and succession plan based on planned needs due to the time in career for the oldest members of the Department at all ranks.

3.6 Fire Prevention Division Assessment

The Fire Prevention Division consists of one Fire Marshal, one Deputy Fire Marshal, two Fire Inspector I's, one Fire Prevention Program Specialist, one Fire Prevention Technician, two part-time Fire Inspector I's, one part-time Fire Prevention Technician, one part-time Fire Prevention Assistant, one part-time Office Assistant, and four on-shift Fire Investigators.

3.6.1 Key Program Responsibilities

Key Fire Prevention Division program responsibilities include:

- Adoption and enforcement of the California Fire Code.
- Review of all new development projects and building permits for conformance with applicable fire and life safety codes, ordinances, and regulations.
- Inspection of new building construction for conformance with applicable fire and life safety codes, ordinances, and regulations.
- Plan review and inspection of fire protection and detection systems for conformance with applicable codes, ordinances, and regulations, as well as appropriate design, installation, and operation.
- Regular inspection of designated building occupancies for conformance with applicable fire and life safety codes, ordinances, and regulations.
- Vegetation management, weed abatement, and Wildland Urban Interface issues.
- Code enforcement and hazard abatement.
- Public fire safety education.
- Fire investigations to determine cause and origin.
- Administer the Hazardous Materials Program under the Certified Unified Program Agency (CUPA) for the City.

3.6.2 Key Fire Marshal Responsibilities

- Plans, organizes, directs, and evaluates all Fire Prevention Division functions and services.
- Provides responsive technical and administrative management of a comprehensive program of fire prevention, loss management, and hazardous materials/environmental protection.
- Reviews building and fire protection system plans and specifications and advises builders and developers.
- Oversees public relations and education programs.
- Manages the City's weed abatement program.
- Manages the City's Wildland Urban Interface Program.
- Manages the City's CUPA program.

- Manages the four Shift Fire Investigators.

3.6.3 Key Deputy Fire Marshal Responsibilities

The Deputy Fire Marshal is also a Fire Investigator for the City. In that role he investigates all arson-related incidents from beginning to case closed after criminal adjudication, including:

- Assisting in planning, directing, and evaluating Fire Prevention Division functions, programs, and services.
- Assisting in formulating program policies, goals, and procedures; collecting and compiling relevant data.
- Conducting surveys, research, and statistical analyses; preparing summary reports.
- Assisting in the development of new program elements and/or program modifications to meet stated goals and objectives.
- Monitoring and coordinating daily operation of assigned program area(s), performing detailed administrative work, maintaining appropriate records and statistics, monitoring progress, and evaluating work measurement of programs.
- Developing and analyzing quantitative data and preparing summary reports.

3.6.4 Key Fire Prevention Inspector I Responsibilities

- Performing technical inspections and investigative work to enforce compliance with applicable laws, ordinances, and regulations pertaining to the prevention and control of fires.
- Performing hazardous materials inspections.
- Performing fire investigations.

3.6.5 Key Fire Prevention Technician Responsibilities

- Performing technical inspections and investigative work to enforce compliance with applicable laws, ordinances, and regulations pertaining to the fire and life safety codes for the City and the California State Fire Marshal's Office.

3.6.6 Key Fire Prevention Assistant Responsibilities

- Weed abatement monitoring and inspections.
- Fire Code Permit issuance and compliance inspections.
- Fire and Life safety complaints from citizens and other City departments.

- Out-of-service Fire Alarms and detection systems monitoring.
- Knox box key entry boxes and installations.

3.6.7 Key Office Assistant Responsibilities

- Provides technical, complex, and specialized office support for the Fire Prevention Division.

3.6.8 2014 Fire Prevention Master Plan Remaining Recommendations

Citygate's assessment of the Fire Prevention Division indicates a progressive fire prevention and life safety program responsible for many programs. In 2014, Fire Prevention went through a deep assessment resulting in a Divisional Master Plan. The Fire Marshal has been diligently implementing the recommendations as funds could be provided, including a re-organization of internal personnel and duties, along with an appropriate use of outside private contractors for construction plan reviews.

The two largest remaining exposures at this review point are the limited office support staff time, meaning inspectors must conduct much of their own support work. As the fire prevention transactions are very technical, only having one trained support person leads to a possible single point of failure if they were to be absent for long periods of time.

The other issue is gaining an inspector to better support the weed and wildland fuel abatement work. While the City has effective codes and a modest program, more could be done given the wildfire exposure in the City. The City has not had the resources to undertake a thorough Community Wildfire Protection Program Plan. While the more dangerous wildfire areas are outside the City limits on Federal or State lands, having such a plan would help position Corona to make the best possible policies for wildland fire and community education programs.

Citygate's assessment of the Fire Prevention Division indicates a progressive fire prevention and life safety program responsible for many programs with limited staffing.

- The Vegetation Management program is vital to Corona's Fire Prevention Program and its Wildland Urban Interface areas. It is recommended that, when funding becomes available, a permanent budgeted position be instituted to manage the program and assist in other prevention areas.
- The Department should embrace the use of Geographical Information Systems (GIS) and prior fire incident cause to enhance and improve its fire inspection program. By using GIS data, the Department can identify and quantify the risks and hazards in the community. At the conclusion of this data collection and review, the Department can develop a list of target hazards in the community and develop a frequency of inspections based on risk, better utilizing its time and effort.

- The Department should investigate the incorporation and use of GIS programs having the ability to locate incidents, occupancies, and the data to develop a good management audit of its programs, identifying trends and potential needs.
- The City, as funds permit, should evaluate, redesign, and fund the delivery of fire prevention education to all aspects of the community. This program does not have to be overseen by a Fire Department sworn officer. The public education programs deserve emphasis as a key Fire Department service to the community and should include the requisite staffing hours and media material resources for public outreach.

3.7 EMERGENCY MANAGEMENT DIVISION

The Emergency Management Division consists of the Emergency Services Coordinator. The Division recently reallocated grant funding for FY 2019/2020, which will be used for part-time Emergency Management Assistants.

3.7.1 Key Program Responsibilities

Key Division program responsibilities include:

- Developing and maintaining the City's Multiple-Hazard Emergency Operations Plan.
- Developing and maintaining the City's Continuity of Operations Plan.
- Developing and maintaining the City's Continuity of Government Plan.
- Ensuring Federal and State management systems are adhered to.
- Coordinating public emergency alert and warning systems.
- Conducting public education and outreach programs.
- Managing grant programs for emergency management.
- Coordinating disaster recovery efforts.
- Coordinating disaster response training for City staff.
- Maintaining operational readiness of the City's Emergency Operations Center.
- Coordinating and maintaining operational awareness with the Riverside County Emergency Management Department.

3.7.2 Key Emergency Services Coordinator and Assistant's Responsibilities

- Planning, developing, and implementing all disaster response and training activities for the City, including staff training, exercises, and community education programs.
- Developing and maintaining the City's Emergency Operations Plan and associated Essential Support Function documents, policies, and procedures.
- Maintaining the City's Local Hazard Mitigation Plan and ensuring it complies and supplants Riverside County's Hazard Mitigation Plan.
- Maintaining and evaluating the Continuity of Operations Plan specific for the City of Corona.
- Ensuring a Continuity of Government Plan specifically for the City of Corona is available.
- Ensuring Emergency Operations Center (EOC) policies, procedures, and checklists for key positions are available during an EOC activation.
- Planning, maintaining, and coordinating the maintenance and activation of the EOC, including tests of telecommunications equipment.
- Designing and conducting employee training and exercises for EOC activations.
- Serving as a liaison between City, County, and State governmental agencies regarding emergency management and disaster preparedness.

3.7.3 Emergency Management Division Assessment

With the projected addition of the two part-time positions, the following is the Division's workplan for the next 12 months:

1. Improve EOC Organization and Readiness
   - Update 24-hour contact information and emergency notification system for EOC Responders
   - Implement section-specific training schedule for EOC Responder Staff
   - Complete Review of City Emergency Operations Plan
     - Review County ESFs for incorporation
     - Focus on communications/transportation/sheltering
   - Begin the Continuity of Operations Plan

2. Enhance the use and acquisition of Emergency Management Grants
   - Create schedule for grant reporting
   - Create schedule and priorities for quarterly grant purchases
   - Create checklist and associated timeframe for closeout process
3. Enhance the CERT program and its volunteers
   - Reconcile CERT contacts
   - Develop a CERT training schedule
     - Standard, teen, Spanish
     - Advance module training
4. Enhance the Emergency Management Education / Public Outreach Program.
   - Establish the foundation for an Emergency Preparedness / Public Education Program

Citygate finds these 12-month goals are very appropriate for the needs of the City in the short-term.

Finding #17: The Department's Emergency Services Coordinator had no dedicated staff until the recent addition of one grant-funded, part-time position. As such, the City's emergency management policies, procedures, and plans need review and updating.

Recommendation #8: The Emergency Management Division needs to update all of Corona's emergency preparedness policies, procedures, and plans, which include the City's Emergency Operations Plan and the Continuity of Operations Plan. Additional focus should be given to revamping community preparedness programs.

3.8 Fleet and Facilities Maintenance/Support Programs

3.8.1 Fleet

Citygate conducted a high-level review of the fire apparatus fleet program and learned that the City, in recent years, has shifted to outsourcing major repairs as it was unable to retain certified

fire apparatus mechanics. This change, whether cost effective or not, still creates operational impacts:

- A year ago, a Fire Engineer spent almost half a day per week on overtime, coordinating the scheduling and movement of apparatus between City and outside vendor repairs. There was not an easy central coordination point to smooth out the scheduling decisions.
- Time is lost when City shop or fire personnel, utilizing overtime, need to get apparatus to and from outside vendors.
- There are no easy methods to move fire units back after hours if they need to be pressed into service after completing only essential repairs. Many departments in disaster conditions will recall their mechanics and work non-stop to return units safely to service.

Citygate then undertook a high-level review of labor hours, costs, and parts expenses for City and outside repairs from July 2018 to April 2019. Citygate observed the outside shops' "blended" labor rates across all types of repairs amounted to $123 per hour, with $171,086 spent on parts. Citygate did not review the outside contracts and does not know what handling mark-up, if any, is on the parts. City labor rates, at a blended rate, amounts to $75 per hour and a total of $658 spent on parts, likely without any handling charges. Citygate does not suggest the outside charges are more than market rate and does not know, without further study by City staff, what will be required to transfer some of the fire apparatus work internally if that can even be cost-effectively achieved.

The newer Fleet Superintendent has significantly improved City shop throughput, the Fire Department's preventive maintenance schedule is now current, far fewer fire apparatus are going to outside vendors, and City mechanics are now licensed to drive the apparatus to outside repair vendors. While the shop issues have improved, Citygate still recommends the City fleet and fire team ensure the three issues outlined do not return and attempt to train and retain certified fire apparatus mechanics.

Recently, when the City did replace several aging fire apparatuses, monies used were from one-time funds, not a long-term saving strategy. While the new apparatus reduce maintenance costs for a while, the City should identify a viable replacement plan over a 25-year timeline for these essential units.

3.8.2 Fire Stations

Citygate and a fire station specialist architect conducted a Fire Department Facilities Assessment as one component of the Department's 2013 Strategic Plan. Many of the conditions recommended for remediation in the 2013 report have not been addressed. The Department is getting funding for minor repairs, but the 2013 study found four stations ranging from 20 to 40 years of service and

these stations' designs, and in some cases sites, are too small to meet current standards and fire service needs.

The City needs to develop a long-term plan to address these aging infrastructure issues well before one or more stations has a safety or livability concern that causes, at a minimum, a temporary closure, thus lengthening response times in the affected neighborhood.

Finding #18: The City's consolidated fleet maintenance program does not currently employ certified fire mechanics. As a result, the Department sends the fire apparatus to outside vendors, frequently at a higher labor rate—a blended $123 per hour as compared to the City's $75 per hour rate.

Finding #19: The use of outside fire apparatus vendors requires considerable coordination by the Department, as well as qualified drivers from the Fleet Division or Fire Department to deliver and pick up apparatus.

Finding #20: Overall, the fire apparatus repair program appears to be inefficient and requires considerable management time, and the high use of outside vendors may not be cost effective.

Finding #21: Since the recession, the City has been unable to fund more than small repairs to the oldest fire stations and has not funded the 2013 long-term rehabilitation plan that was prepared.

Finding #22: While the City has recently funded the replacement of two engines and two ladder trucks, it does not have a long-term plan for the timely replacement of all apparatus. Prior to these four purchases, the average apparatus replacement age was 28 years. A normal expectation for replacement age is 20 years.

Recommendation #9: The City should deeply study the fire apparatus repair program and verify that the current frequent use of outside vendors and lack of certified fire apparatus mechanics is cost effective from all measures of cost, safety, and best practices.

Recommendation #10:	The City should identify a long-term funding strategy for capital repair and, as needed, replacement of the oldest fire stations.
Recommendation #11:	The City should adopt a long-term replacement funding strategy for the timely replacement of fire apparatus instead of waiting until apparatus are overdue and identifying one-time funding sources.

3.9 Overall Headquarters Evaluation

SOC Element 8 of 8
Headquarters Evaluation

With a highly commendable degree of commitment and pride in service, all Department levels and areas contribute significantly to make ends meet for the administrative functions that keep the organization capable of delivering high quality service to the community. This widespread culture of participation is noble, but the circumstances that underlie its necessity are the result of professional staff reductions that pose a risk to the Department's ability to continue to deliver promised services.

Due to insufficient Office Assistant (clerical) capacity, clerical duties are transferred to Department management and field personnel, decreasing efficiency and increasing the cost of service. The three office support positions serve 16 technical positions across the Department's management and specialty program functions, in addition to fire station personnel with specialty assignments. These positions also serve as the first point of contact for citizens and businesses who reach out to the Department in person, via business phone lines, and through electronic means.

Additionally, the reduction of dedicated budget and systems analyst capabilities in the organization places more work on fire managers. This is not their core specialty, and it hinders them from doing what their job descriptions require.

Other reductions and staffing challenges impact the Department's capacity to fully execute on programs such as fleet management, training, medical services including CQI, and facilities management.

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.

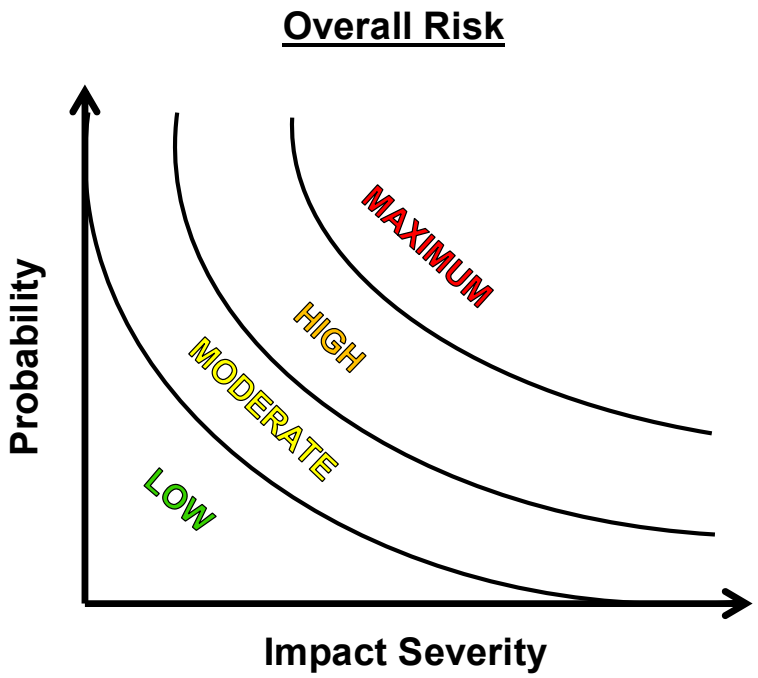
A.1.1 Risk Assessment Methodology

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

- 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 15

Figure 15—Overall Risk



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

- 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
- Riverside County Operational Area Hazard Mitigation Plan
- City of Corona Local 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 yields the following:

- The Fire Department serves a diverse population, with densities averaging 4,225 people per square mile, over a widely varied land use pattern.
- 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.
- The City has several significant areas where the wildland risk is high. This determination is due to historical data analysis, in conjunction with recent historical perspectives and reviews.
- The City has significant economic and other resource values to be protected, as identified in this assessment.
- The City of Corona and Riverside County have mass emergency notification systems to effectively communicate emergency information to the public in a timely manner.
- The City's overall risk for five hazards related to emergency services provided range from **Low** to **High**, as summarized in Table 18.

Table 18—Overall Risk by Hazard

Hazard		Planning Zone						
		Sta. 1	Sta. 2	Sta. 3	Sta. 4	Sta. 5	Sta. 6	Sta. 7
1	Building Fire	*Low*	*Low*	*Low*	*Low*	*Low*	*Low*	*Low*
2	Wildland Fire	*Moderate*	*Moderate*	*Moderate*	*Moderate*	*High*	*High*	*High*
3	Medical Emergency	*High*	*High*	*High*	*Moderate*	*Moderate*	*Moderate*	*Moderate*
4	Hazardous Material*	*Moderate*	*Moderate*	*Moderate*	*Low*	*Low*	*Low*	*Low*
5	Technical Rescue	*Low*	*Low*	*Low*	*Low*	*Low*	*Low*	*Low*

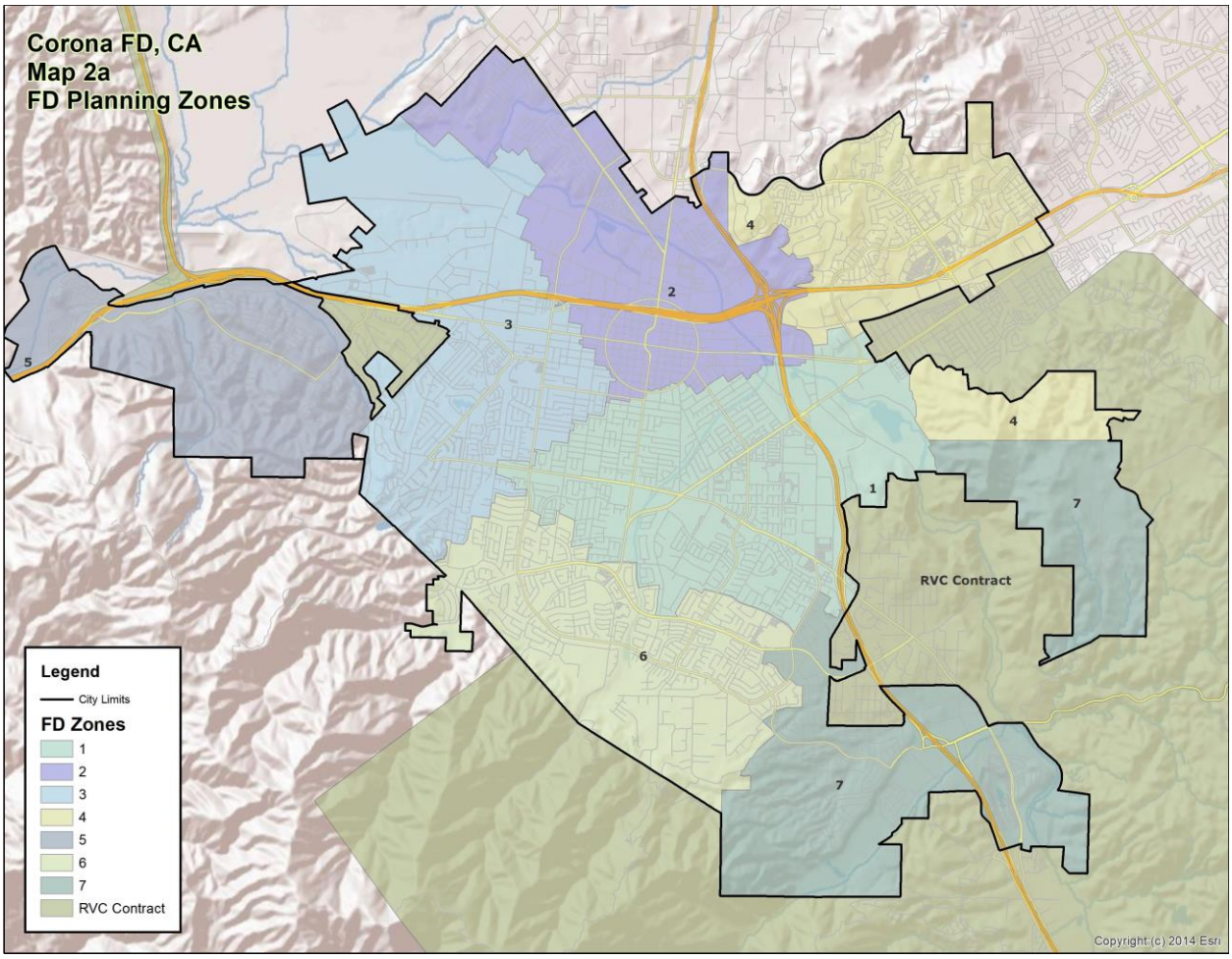
* Hazardous Materials also includes CUPA sites in the analysis

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 were to be evaluated on a jurisdiction-wide basis, the predominant moderate risk could outweigh the high or maximum risk and may not be a significant factor in an overall assessment of risk. If,

however, those high- or maximum-risk occupancies are a larger percentage of the risk in a smaller planning zone, then it becomes a more significant risk factor. Another consideration in establishing planning zones is that the jurisdiction's record management system must also track the specific zone for each incident to be able to appropriately evaluate service demand and response performance relative to each specific zone. For this assessment, Citygate utilized seven planning zones, incorporating each fire station's first-due response area, as shown in Figure 16.

Figure 16—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 less than 10 years of age, the elderly, and people housed in institutional settings. Table 19 summarizes key demographic data for Corona.

Table 19—Key Demographic Data – City of Corona

Demographic	2017	Percentage
Population	163,585	
Under 10 years	21,692	13.26%
10 – 19 years	24,393	14.91%
20 – 64 years	101,713	62.18%
65 – 74 years	9,627	5.89%
75 years and older	6,160	3.77%
Median age	34.7	N/A
Housing Units	51,774	
Owner-Occupied	32,404	62.59%
Renter-Occupied	17,549	33.90%
Average Household Size	3.30	N/A
Ethnicity		
Asian	21,985	13.44%
White	42,665	**26.08%**
Hispanic/Latino	71,506	**43.71%**
Black/African American	10,148	**6.20%**
Other	17,281	**10.56%**
Education (population over 24 yrs. of age)	105,465	64.47%
High School Graduate	89,548	84.91%
Undergraduate Degree	28,069	26.61%
Graduate/Professional Degree	9,462	8.97%
Employment (population over 15 yrs. of age)	126,969	77.62%
In Labor Force	83,684	65.91%
Unemployed	5,562	6.65%
Population Below Poverty Level	18,976	11.60%
Population without Health Insurance Coverage	19,193	11.73%

Source: U.S. Census Bureau (2017)

Of note from Table 19 is the following:

- Nearly 23 percent of the population is under 10 years or over 65 years of age.
- The City's population is predominantly Hispanic (44 percent) and White (26 percent), Asian (13 percent), followed by other ethnicities (11 percent) and Black/African American (6 percent).
- Of the population over 24 years of age, nearly 85 percent has earned a high school diploma or equivalent.
- Of the population over 24 years of age, nearly 36 percent has an undergraduate, graduate, or professional degree.
- Nearly 66 percent of the population 15 years of age or older is in the workforce; of those, 6.65 percent are unemployed.
- The population below the federal poverty level is 11.6 percent.
- Nearly 12 percent of the population does not have health insurance coverage.

Buildings

The City has more than 51,000 housing units, as well as a large inventory of non-residential occupancies including office, research, professional services, and retail sales buildings; restaurants/bars; motels; churches; schools; government facilities; healthcare facilities; and other non-residential uses.

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 of 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 of 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 reveals 1,393 high- or maximum-risk building uses as they relate to the CFAI building fire risk categories as summarized in Table 20.

Table 20—Building Occupancy Inventory by High Risk Category

Building Occupancy Classification[1]		Number	Risk Category[2]
A-1	Assembly	4	High
E	Education (pre-school/private/middle/high/colleges)	71	High
H	Hazardous	66	High
I	Institutional	15	High
R-1	Hotel/Motel	18	High
R-2	Multi-Family Residential	1,138	High
R-2.1	Residential Care (more than 6 occupants)	3	High
R-3	Residential Board and Care Facilities	44	High
R-3.1	Residential Care (6 or fewer occupants)	34	High
Total		**1,393**	

[1] Source: City of Corona Fire Department.
[2] CFAI *Standards of Cover* (5th Edition).

Critical Infrastructure / Key Resources

The U. S. Department of Homeland Security defines critical infrastructure / key resources (CIKR) as those physical assets essential to the public health and safety, economic vitality, and resilience of a community, such as lifeline utilities infrastructure, telecommunications infrastructure, essential government services facilities, public safety facilities, schools, hospitals, airports, etc. The City of Corona's Local Hazard Mitigation Plan[4] identifies 81 critical facilities within the City as shown in Table 21 and Figure 17. A hazard occurrence with significant impact severity affecting one or more of these facilities would likely adversely impact critical public or community services.

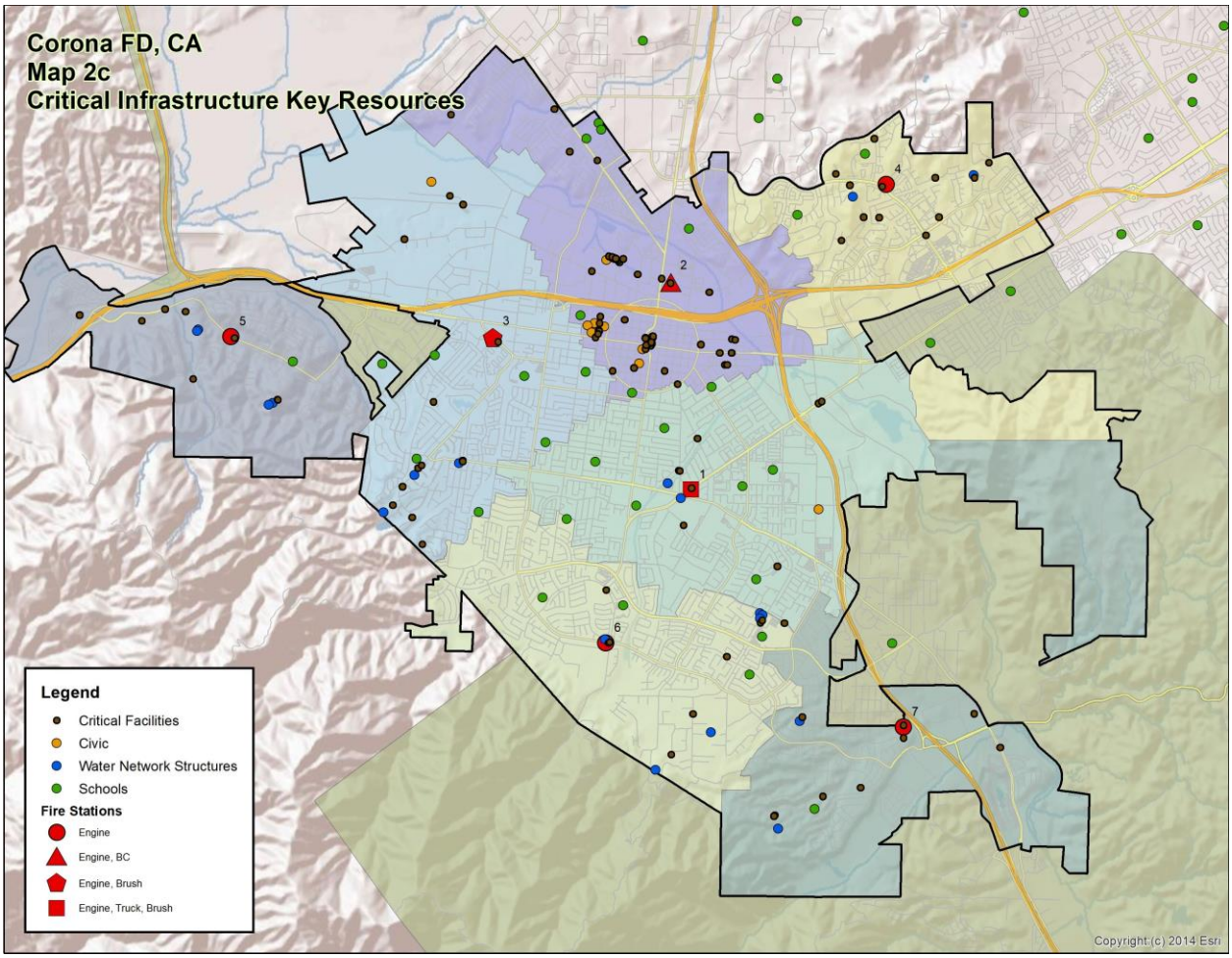
[4] City of Corona 2017 Local Hazard Mitigation Plan, Section 4.1.

Table 21—City of Corona Critical Facilities

Critical Facilities Type	Quantity
Public Safety Dispatch	1
Emergency Operations Center	1
City Services	2
Fire Stations	7
Water Reservoirs	15
Water Treatment Plants	3
Wastewater Treatment Plants	3
Hospitals	2
Police Facilities	1
City Maintenance Yard	1
Senior Care	11
Schools	27
Radio Repeaters	7
Total	**81**

Reference: City of Corona 2017 Local Hazard Mitigation Plan, Figure 4.1.1

Figure 17—Critical Facilities



Economic Resources

Key economic drivers for the City include manufacturing, professional, scientific, technology, and information systems. Major employers include:

- Corona Norco School District
- Corona Regional Medical Center
- Kaiser Permanente
- All American Asphalt
- City of Corona
- Fender USA
- TWR Framing

- Monster Energy
- Thermal Structures
- CoreMark International
- Dart Container Corporation
- Veg-Fresh Farms
- U.S. Food Service
- CIRCOR Aerospace
- Advanced Flow Engineering

Natural Resources

Natural resources within the City include numerous smaller community/regional parks, and multiple small lakes/ponds and minor waterways.

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 Corona Local Hazard Mitigation Plan identifies the following hazards and related risk categories for the City of Corona.

Table 22—Hazard Risk Ranking – City of Corona[1]

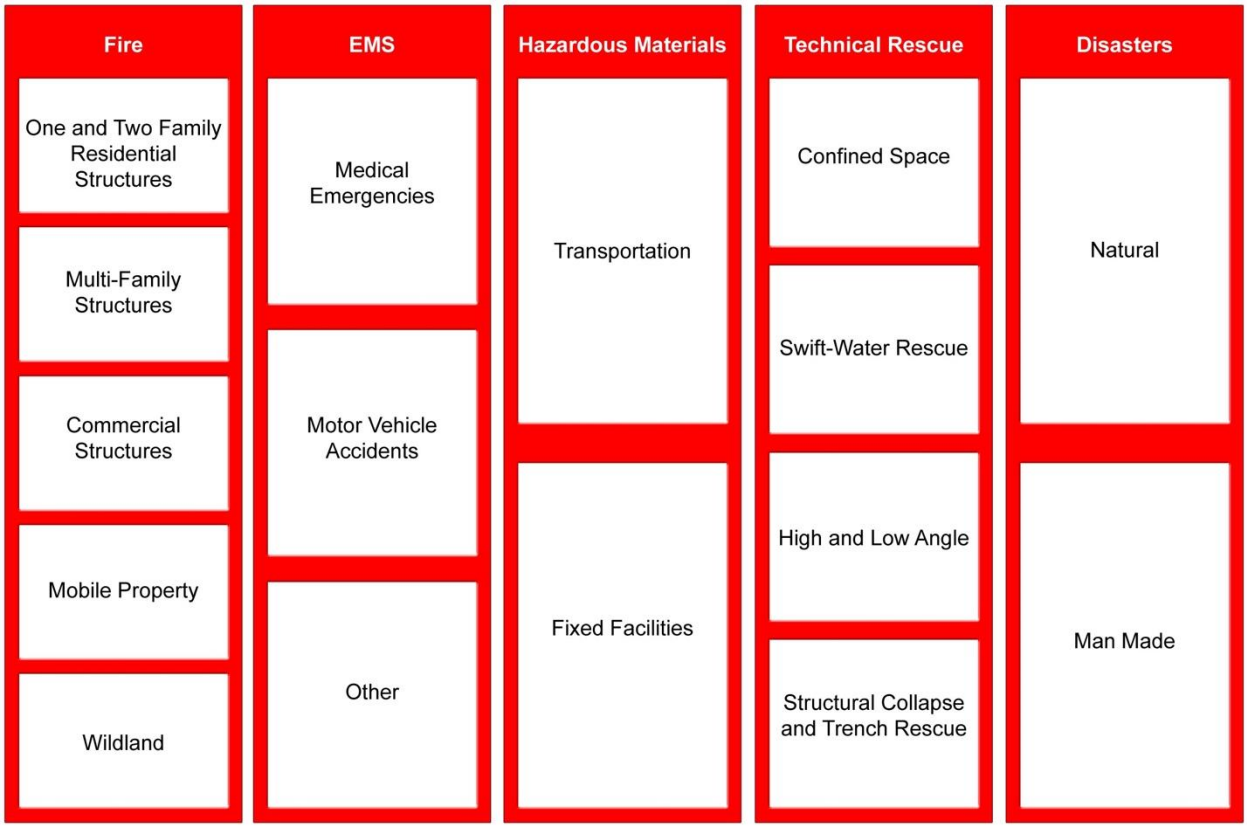
Rank	Hazard	Risk Category
1	Earthquake	High
2	Wildland Fire	High
3	Electrical Failure	Medium
4	Terrorist Event	Medium
5	Water Supply Disruption/Contamination	Medium
6	Flood	High
7	Emergent Disease/Contamination	Medium
8	Transportation Failure	High
9	Communications Failure	Medium
10	Pandemic Flu	Low

[1] Source: Corona Local Hazard Mitigation Plan

Although the Fire Department has no legal authority or responsibility to mitigate these risks, other than for wildland fire, it does provide services related to these hazards, including fire suppression, emergency medical services, technical rescue, and hazardous materials response.

The CFAI groups hazards into fire and non-fire categories, as shown in Figure 18. 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 risks.

Figure 18—Commission on Fire Accreditation International Hazard Categories



Source: CFAI *Standards of Cover* (5th Edition).

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, wildland fire, medical emergency, hazardous materials, and technical rescue risk consists of 33 personnel on duty daily staffing seven Type-1 fire engines and one aerial ladder truck. Each is staffed with a minimum of one EMT-Paramedic, all operating from the Department's seven 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 transport service is provided by American

Medical Response (AMR), a private-sector ambulance provider operating under an exclusive operating area contract administered by the Riverside County Emergency Medical Services Agency.

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 23 describes the five probability of occurrence categories and related scoring criteria used for this analysis.

Table 23—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 24 describes the five impact severity categories and related scoring criteria used for this analysis.

Table 24—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 • No or inconsequential damage • No 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 • Multiple 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 possible • Local/regional hospitals impacted • Large number of persons displaced for an extended duration • Extensive damage • Widespread loss of critical lifeline services • Community unable to function without significant support • Significant environmental impacts and/or permanent environmental damage • Catastrophic financial loss

A.1.9 Overall Risk

Overall hazard risk is determined by multiplying the *probability of occurrence score* by the *impact severity score*. The resultant total determines the overall *risk rating* as described in Table 25.

Table 25—Overall Risk Score and Rating

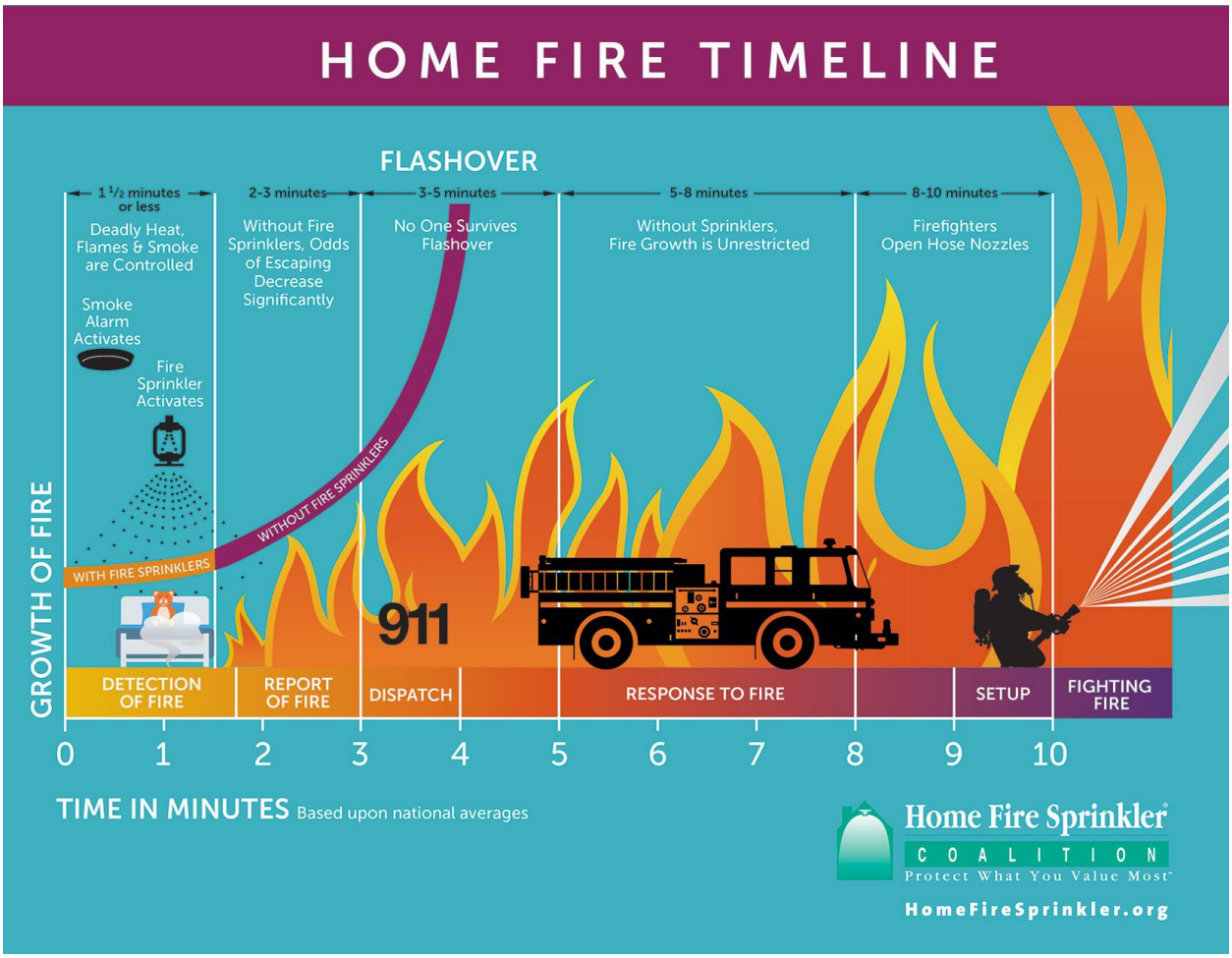
Overall Risk Score	Overall Risk Rating
0–5.99	*LOW*
6.0–11.99	*MODERATE*
12.0–19.99	*HIGH*
20.0–25.0	*MAXIMUM*

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

Figure 19—Building Fire Progression Timeline



Source: http://www.firesprinklerassoc.org.

Population Density

Population density within the City ranges from less than 3,000 people per square mile to more than 14,000 per square mile. Although risk analysis across a wide spectrum of other Citygate clients shows no direct correlation between population density and building fire *occurrence*, it is reasonable to conclude that building fire *risk* relative to potential impact on human life is greater as population density increases, particularly in areas with high density, multiple-story buildings.

High Fire Flow Requirements

One of the many factors evaluated by the ISO is needed fire flow (NFF), which is the amount of water that would be required in gallons per minute (GPM) if the building were seriously involved in fire. For Corona, the ISO database evaluated 2,224 buildings, 342 of which have an NFF of more than 2,500 GPM, as shown in Map #2e in **Volume 2** (Map Atlas).

This is a significant amount of firefighting water to deploy, and a major fire at any one of these buildings would require commitment of the Department's entire on-duty force plus mutual aid. Using a generally accepted figure of 50 GPM per firefighter on large building fires, a fire in a building requiring 2,500 GPM would require 50 firefighters, which exceeds the Department's daily response force by 17 personnel. A significant fire in any of these buildings not protected by an automatic fire sprinkler and/or a fire detection/alarm system would likely have a high impact severity.

Water Supply

A reliable public water system providing adequate volume, pressure, and flow duration in close proximity to all buildings is a critical factor in mitigating the potential impact severity of a community's building fire risk. Potable water is provided by the City, and according to Fire Department staff, available fire flow is sufficient throughout the City, with no areas of sub-standard flow or pressure.

Building Fire Service Demand

For the five-year period from January 1, 2014, through December 31, 2018, the City experienced 325 building fire incidents, as summarized in Table 26.

Table 26—Building Fire Service Demand

Risk	Year	Planning Zone							Total Incidents
		Sta. 1	Sta. 2	Sta. 3	Sta. 4	Sta. 5	Sta. 6	Sta. 7	
Building Fire	2014	18	7	14	8	2	6	4	**59**
	2015	19	18	13	18	4	6	3	**81**
	2016	12	15	21	8	6	9	4	**75**
	2017	5	8	10	9	3	8	3	**46**
	2018	6	7	22	8	8	8	4	**63**
Total		**60**	**55**	**80**	**51**	**23**	**37**	**18**	**324**

As Table 26 illustrates, building fire service demand was consistent across the five-year study period, with the highest volume of incidents occurring at Station 3 and the lowest at Station 7. Overall, the Department's building fire service demand is very low, comprising less than one percent of all calls for service, which is typical of other California jurisdictions of similar size and demographics.

Probability of Building Fire Occurrence

Table 27 summarizes Citygate's scoring of building fire probability by planning zone based on building fire service demand from Table 26.

Table 27—Building Fire Probability Scoring

Building Fire	Planning Zone						
	Sta. 1	Sta. 2	Sta. 3	Sta. 4	Sta. 5	Sta. 6	Sta. 7
Probability	1.50	1.50	1.50	1.50	1.25	1.25	1.25

Building Fire Impact Severity

Table 28 summarizes Citygate's scoring of the City's probable building fire impact severity by planning zone.

Table 28—Building Fire Impact Severity Scoring

Building Fire	Planning Zone						
	Sta. 1	Sta. 2	Sta. 3	Sta. 4	Sta. 5	Sta. 6	Sta. 7
Impact Severity	3.0	3.0	3.0	3.0	3.0	3.0	3.0

Overall Building Fire Risk

Table 29 summarizes the City's overall building fire risk scores and ratings by planning zone.

Table 29—Overall Building Fire Risk

Building Fire	Planning Zone						
	Sta. 1	Sta. 2	Sta. 3	Sta. 4	Sta. 5	Sta. 6	Sta. 7
Total Risk Score	4.50	4.50	4.50	4.50	3.75	3.75	3.75
Risk Rating	*Low*	*Low*	*Low*	*Low*	*Low*	*Low*	*Low*

A.1.11 Vegetation/Wildland Fire Risk

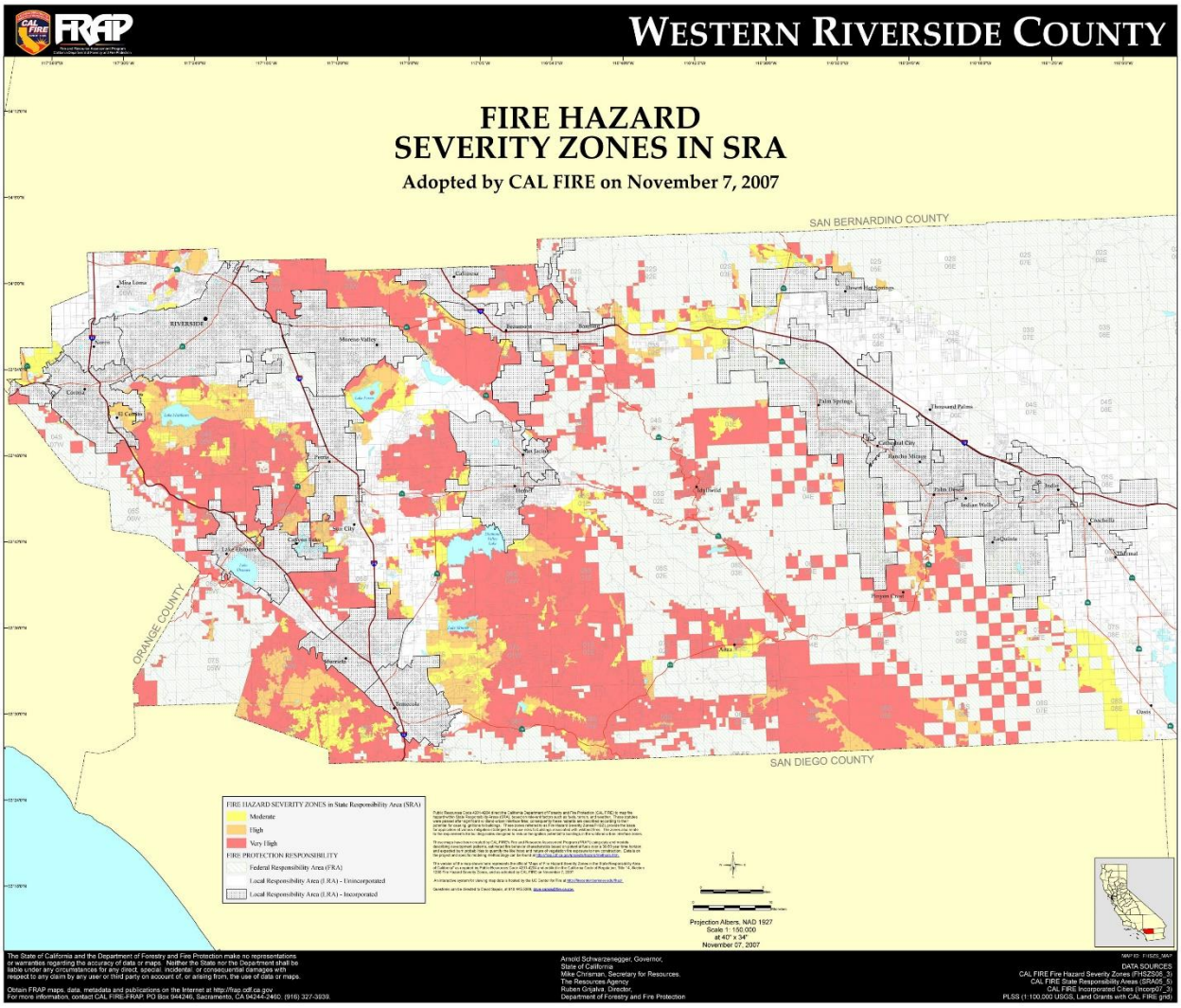
Many areas of the City are susceptible to a vegetation/wildland fire.

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

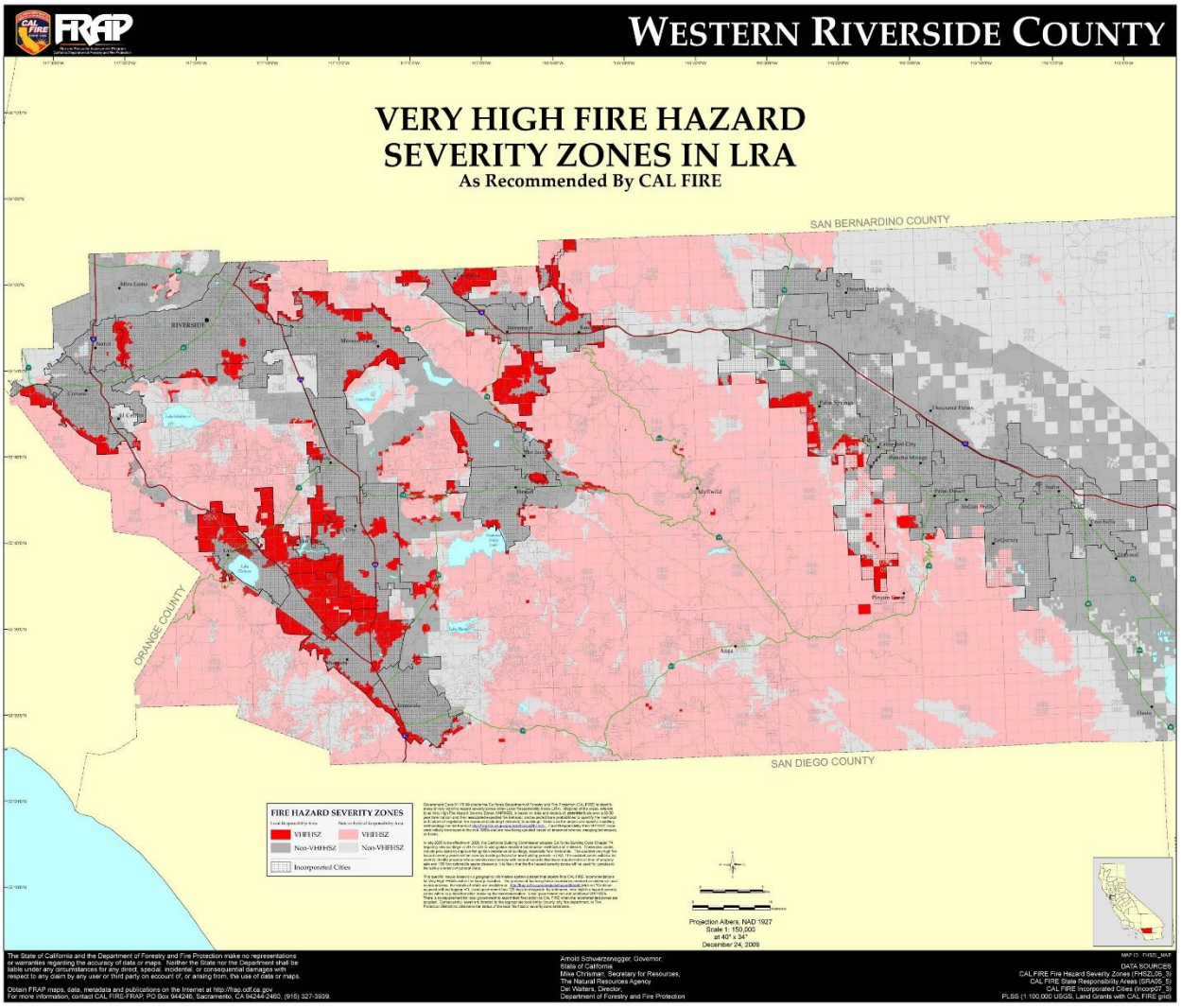
hazard factors and modeling of potential wildland fire behavior. For State Responsibility Areas (SRAs) where CAL FIRE has fiscal responsibility for wildland fire protection, CAL FIRE designates Moderate, High, and Very High FHSZs by county, as shown in Figure 20 for Riverside County. Note that many areas of the City are classified as ***Moderate***, ***High***, or ***Very High*** FHSZ.

Figure 20—SRA Wildland Fire Hazard Severity Zones – Riverside 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. No wildland fire hazard severity zones have been recommended by CAL FIRE for Corona.

Figure 21—LRA Wildland Fire Hazard Map



Wildland Fuels

Wildland fuel factors influencing fire intensity and spread include fuel type (vegetation species), height, arrangement, density, and moisture. In addition to decorative landscape species, vegetative fuels within the City consist of a mix of annual grasses and weeds, as well as 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. Wildland fire season, when wildland fires are most likely to occur due to fuel and weather conditions, occurs from approximately May through October in Riverside County.

Topography

The City sits at the northern base of the Santa Ana Mountains and borders the Cleveland National Forest. The shared boundary between the City and the forest is about 12 miles in length. The fuels include heavy brush with oaks, sycamore, and pines on the slopes and drainages. Residential structures are immediately adjacent to this forest area throughout the entire boundary. Some residences are newer structures with good clearances, and some are much older with less clearance.

The western portion of the City sits at the base of Prado Dam, which is the headwater for the Santa Ana River Canyon. The Santa Ana River Canyon's steep topography and east-west alignment serve as a wind funnel. The geography increases the wind's speed and magnifies the effects of fire on the available fuel bed, contributing to the rapid rate of fire spread. The northern side of this canyon comprises primarily light flashy fuels due to frequent burning and fuel-type conversion, and the southern side comprises primarily heavy brush. There is significant fire history in this canyon area. State Route 91 parallels the Santa Ana River throughout the canyon. Developments contain structures that sit adjacent to wildland areas throughout the western areas of the City.

The northwest area of the City sits in the Prado Basin behind the Prado Dam and there are several developments that adjoin some heavy fuels.

The northeast area sits in the Corona Hills and developments are built up to and on top of the hills. These hills comprise primarily of light flashy fuels due to frequent burning and fuel-type conversion.

The eastern edge of the City is bordered by hills and Eagle Valley. This area has not been developed and is comprised of light flashy fuels due to frequent burning and fuel-type conversion. Fires occur frequently, but there is very little structural threat. The City's hilly terrain can contribute to wildland fire behavior and spread.

Water Supply

Another significant vegetation fire impact severity factor is water supply immediately available for fire suppression. According to Department staff, available fire flow is sufficient within the areas of the City likely to experience a vegetation fire.

Wildland Fire Hazard Mitigation

Hazard mitigation refers to specific actions or measures taken to prevent a hazard from occurring and/or to minimize the severity of impacts resulting from a hazard occurrence. While none of the

hazards subject to this study can be entirely prevented, measures *can* be taken to minimize the consequences. The City of Corona's Hazard Mitigation Plan identifies the following wildfire hazard mitigation alternatives:

- Clear potential fuels, such as dry underbrush and diseased trees, on property
- Implement best management practices on public lands
- Create and maintain defensible space around structures and infrastructure
- Enhance building code to include use of fire-resistant materials in high hazard areas
- Use fire-resistant plantings in buffer areas of high wildfire threat
- Increase public outreach and education efforts, including an active Firewise program
- Identify fire response and alternative evacuation routes
- Become a Firewise community
- Use academia to study impacts/solutions to wildfire risk
- Establish/maintain mutual-aid agreements between fire service agencies
- Create/implement fire plans
- Consider the probable impacts of climate change on the risk associated with the wildfire hazard in future land-use decisions

Vegetation/Wildland Fire Service Demand

The City experienced 218 vegetation/wildland fires over the five-year study period, summarized in Table 30.

Table 30—Vegetation/Wildland Fire Service Demand

Risk	Year	Planning Zone							Total Incidents
		Sta. 1	Sta. 2	Sta. 3	Sta. 4	Sta. 5	Sta. 6	Sta. 7	
Vegetation Fire	2014	9	12	7	7	2	0	0	**37**
	2015	5	7	11	4	2	0	3	**32**
	2016	3	10	6	9	6	5	2	**41**
	2017	8	7	14	7	11	6	7	**60**
	2018	13	5	17	7	4	0	2	**48**
Total		**38**	**41**	**55**	**34**	**25**	**11**	**14**	**218**

As Table 30 shows, vegetation/wildland fire service demand was consistent over the five-year study period, with the overall highest occurrence at Station 3 and the lowest occurrence at Station 6. Overall, vegetation fire service demand is extremely low.

The Department identified 40 major wildland fires impacting the City since 1948, including six in the last decade. In addition, CAL FIRE's wildland FHSZ map for western Riverside County identifies **Moderate**, **High**, and **Very High** FHSZs in the north, northwest, west, southwest, east, and southeast sections of the City.

Probability of Vegetation/Wildland Fire Occurrence

Table 31 summarizes Citygate's scoring of vegetation/wildland fire probability by planning zone based on service demand history from Table 30 and local wildland fire history.

Table 31—Vegetation/Wildland Fire Probability Scoring

Vegetation/Wildland Fire	Planning Zone						
	Sta. 1	Sta. 2	Sta. 3	Sta. 4	Sta. 5	Sta. 6	Sta. 7
Probability	2.00	2.00	2.00	2.75	3.00	3.00	3.00

Wildland Fire Impact Severity

Table 32 summarizes Citygate's scoring of vegetation/wildland fire impact severity by planning zone.

Table 32—Vegetation/Wildland Fire Impact Severity Scoring

Vegetation/Wildland Fire	Planning Zone						
	Sta. 1	Sta. 2	Sta. 3	Sta. 4	Sta. 5	Sta. 6	Sta. 7
Impact Severity	3.00	3.00	3.00	4.00	4.25	4.25	4.25

Overall Wildland Fire Risk

Table 33 summarizes the Department's overall vegetation fire risk scores and ratings by planning zone.

Table 33—Overall Vegetation/Wildland Fire Risk

Vegetation/Wildland Fire	Planning Zone						
	Sta. 1	Sta. 2	Sta. 3	Sta. 4	Sta. 5	Sta. 6	Sta. 7
Total Risk Score	6.00	6.00	6.00	11.00	12.75	12.75	12.75
Risk Rating	*Moderate*	*Moderate*	*Moderate*	*Moderate*	*High*	*High*	*High*

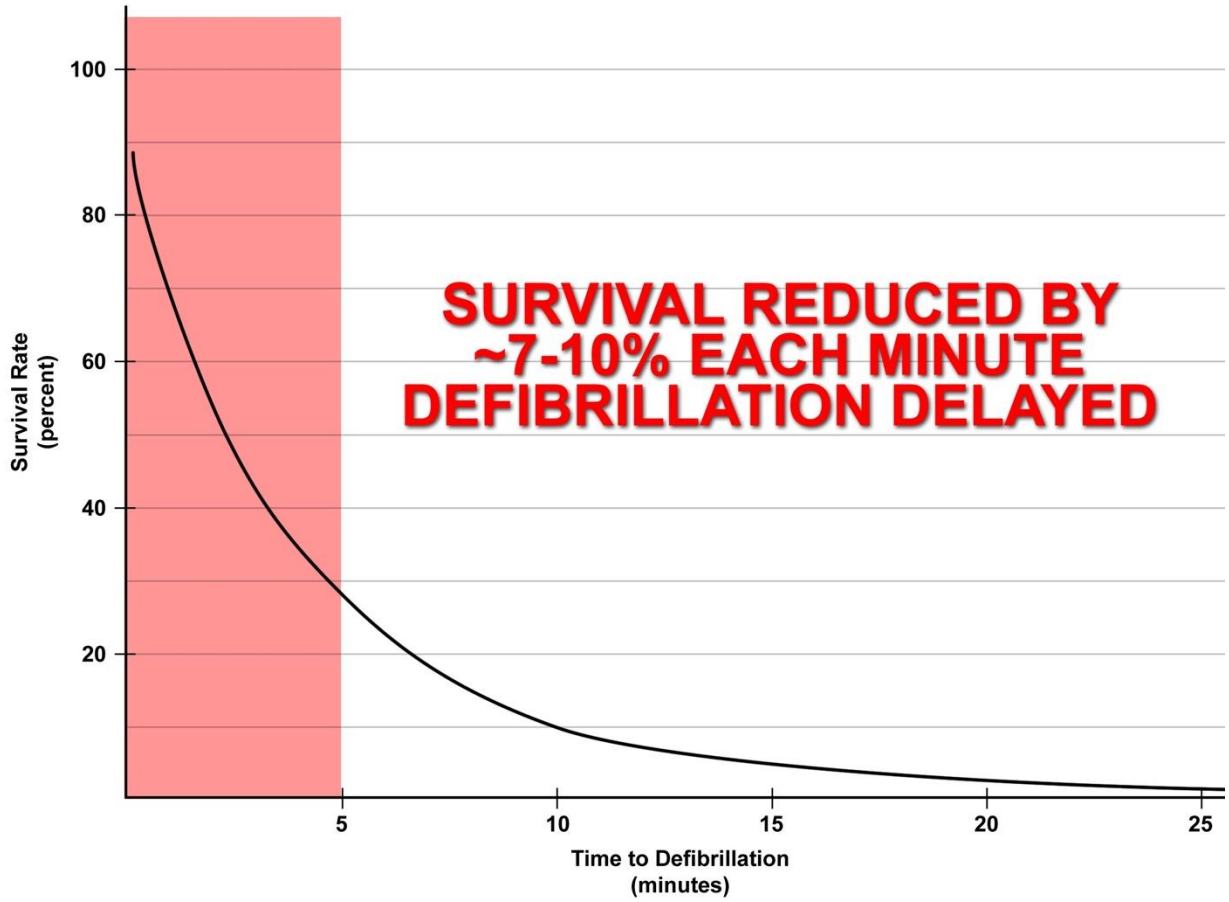
A.1.12 Medical Emergency Risk

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 a serious medical emergency, among many, where there is an interruption or blockage of oxygen to the brain.

Figure 22 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 22—Survival Rate versus Time to Defibrillation



Source: www.suddencardiacarrest.org.

Population Density

The City's population density ranges from less than 3,000 people per square mile to 14,000 per square mile, as shown in Map #2b in **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 10 percent of the City's population is 65 and older; 11.6 percent of the population is at or below poverty level; 21 percent of the

population over 24 years of age has less than a high school education or equivalent; and 11.7 percent of the population does not have health insurance coverage.[5]

Vehicle Traffic

Medical emergency risk tends to be higher in those areas of a community with high daily vehicle traffic volume, particularly in areas with high traffic volume traveling at high speeds. The City's transportation network includes Highways 15 and 91, which carry an aggregate annual average daily traffic volume of 420,000 vehicles with a peak-hour load of 28,700 vehicles.[6]

Medical Emergency Service Demand

Medical emergency service demand over the five-year study period includes nearly 40,000 calls for service, comprising slightly more than 71 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 Incidents
		Sta. 1	Sta. 2	Sta. 3	Sta. 4	Sta. 5	Sta. 6	Sta. 7	
Medical Emergency	2014	2,253	1,218	1,389	1,180	419	489	417	**7,365**
	2015	2,449	1,314	1,408	824	387	538	400	**7,320**
	2016	2,501	1,423	1,929	966	398	541	391	**8,149**
	2017	2,557	1,450	1,541	814	370	616	398	**7,746**
	2018	2,444	1,600	1,506	1,010	496	626	404	**8,086**
Total		**12,204**	**7,005**	**7,773**	**4,794**	**2,070**	**2,810**	**2,010**	**38,666**

* This number includes only NFIRS Codes 311 and 321 in the calculations

As Table 34 shows, medical emergency service demand varies significantly by planning zone and is trending fairly stable for each station's response area. Overall, the City's medical emergency service demand is typical of other jurisdictions with similar demographics.

Probability of Medical Emergency Occurrence

Table 35 summarizes Citygate's scoring of medical emergency probability by planning zone based on recent medical emergency service demand from Table 34.

[5] Source: U. S. Census Bureau (2016).

[6] Source: California Department of Transportation (2017).

Table 35—Medical Emergency Probability Scoring

Medical Emergency	Planning Zone						
	Sta. 1	Sta. 2	Sta. 3	Sta. 4	Sta. 5	Sta. 6	Sta. 7
Probability	4.50	4.00	4.00	3.75	3.25	3.50	3.25

Medical Emergency Impact Severity

Table 36 summarizes Citygate's scoring of probable medical emergency impact severity by planning zone.

Table 36—Medical Emergency Impact Severity Scoring

Medical Emergency	Planning Zone						
	Sta. 1	Sta. 2	Sta. 3	Sta. 4	Sta. 5	Sta. 6	Sta. 7
Impact Severity	3.0	3.0	3.0	3.0	3.0	3.0	3.0

Overall Medical Emergency Risk

Table 37 summarizes the Department's overall medical emergency risk scores and ratings by planning zone.

Table 37—Overall Medical Emergency Risk

Medical Emergency	Planning Zone						
	Sta. 1	Sta. 2	Sta. 3	Sta. 4	Sta. 5	Sta. 6	Sta. 7
Total Risk Score	13.50	12.00	12.00	11.25	9.75	10.50	9.75
Risk Rating	*High*	*High*	*High*	*Moderate*	*Moderate*	*Moderate*	*Moderate*

A.1.13 Hazardous Material Risk

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

Fixed Hazardous Materials Facilities

The City of Corona, serving as the State-designated CUPA for the County, identified 799 facilities within the City requiring a state or county hazardous material operating permit.

Transportation-Related Hazardous Materials

The City has transportation-related hazardous material risk as a result of its road transportation network with heavy daily truck traffic volume, including State Highway 91 and I-15. The City also has transportation-related hazardous material risk due to the more than 56 daily train movements through the City, many of which transport hazardous materials.[7]

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. The City's population density ranges from less than 3,000 people per square mile to 14,000 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. Nearly 23 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 remediate any planning and/or training gaps to ensure ongoing emergency incident readiness and effectiveness.

Although the City does not have a formal written emergency evacuation plan, it offers a free, subscription-based, mass emergency notification system that can provide emergency alerts, notifications, and other emergency information to email accounts, cell phones, smartphones,

[7] Source: Federal Railroad Administration (2018).

tablets, and landline telephones. Additionally, Riverside County also has its own alerting system known as Alert RivCo.

Hazardous Material Service Demand

The City experienced 918 hazardous material incidents over the five-year study period, as summarized in Table 38.

Table 38—Hazardous Material Service Demand

Risk	Year	Planning Zone							Total Incidents
		Sta. 1	Sta. 2	Sta. 3	Sta. 4	Sta. 5	Sta. 6	Sta. 7	
Hazardous Materials	2014	42	31	40	12	9	12	5	**151**
	2015	28	54	35	18	6	10	9	**160**
	2016	118	60	33	14	9	11	10	**255**
	2017	44	47	31	22	6	1	11	**162**
	2018	41	54	45	13	13	13	11	**190**
Total		**273**	**246**	**184**	**79**	**43**	**47**	**46**	**918**

As Table 38 indicates, hazardous material service demand varies by planning zone and was relatively constant over the past five years, with Station 1 having the highest demand and Stations 5 and 7 the lowest. Overall, the City's hazardous material service demand is moderate.

Probability of Hazardous Material Occurrence

Table 39 summarizes Citygate's scoring of hazardous materials probability by planning zone based on hazardous material service demand from Table 38.

Table 39—Hazardous Material Probability Scoring

Hazardous Materials	Planning Zone						
	Sta. 1	Sta. 2	Sta. 3	Sta. 4	Sta. 5	Sta. 6	Sta. 7
Probability	**3.00**	**3.00**	**2.75**	**1.25**	**1.25**	**1.25**	**1.25**

Hazardous Material Impact Severity

Table 40 summarizes Citygate's scoring of probable hazardous material impact severity by planning zone.

Table 40—Hazardous Material Impact Severity Scoring

Hazardous Materials	Planning Zone						
	Sta. 1	Sta. 2	Sta. 3	Sta. 4	Sta. 5	Sta. 6	Sta. 7
Impact Severity	3.00	3.00	3.00	3.00	3.00	3.00	3.00

Overall Hazardous Material Risk

Table 41 summarizes the City's overall hazardous material risk scores and ratings by planning zone.

Table 41—Overall Hazardous Material Risk

Hazardous Materials	Planning Zone						
	Sta. 1	Sta. 2	Sta. 3	Sta. 4	Sta. 5	Sta. 6	Sta. 7
Total Risk Score	9.00	9.00	8.25	3.75	3.75	3.75	3.75
Risk Rating	*Moderate*	*Moderate*	*Moderate*	*Low*	*Low*	*Low*	*Low*

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.

Transportation Volume

Another 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

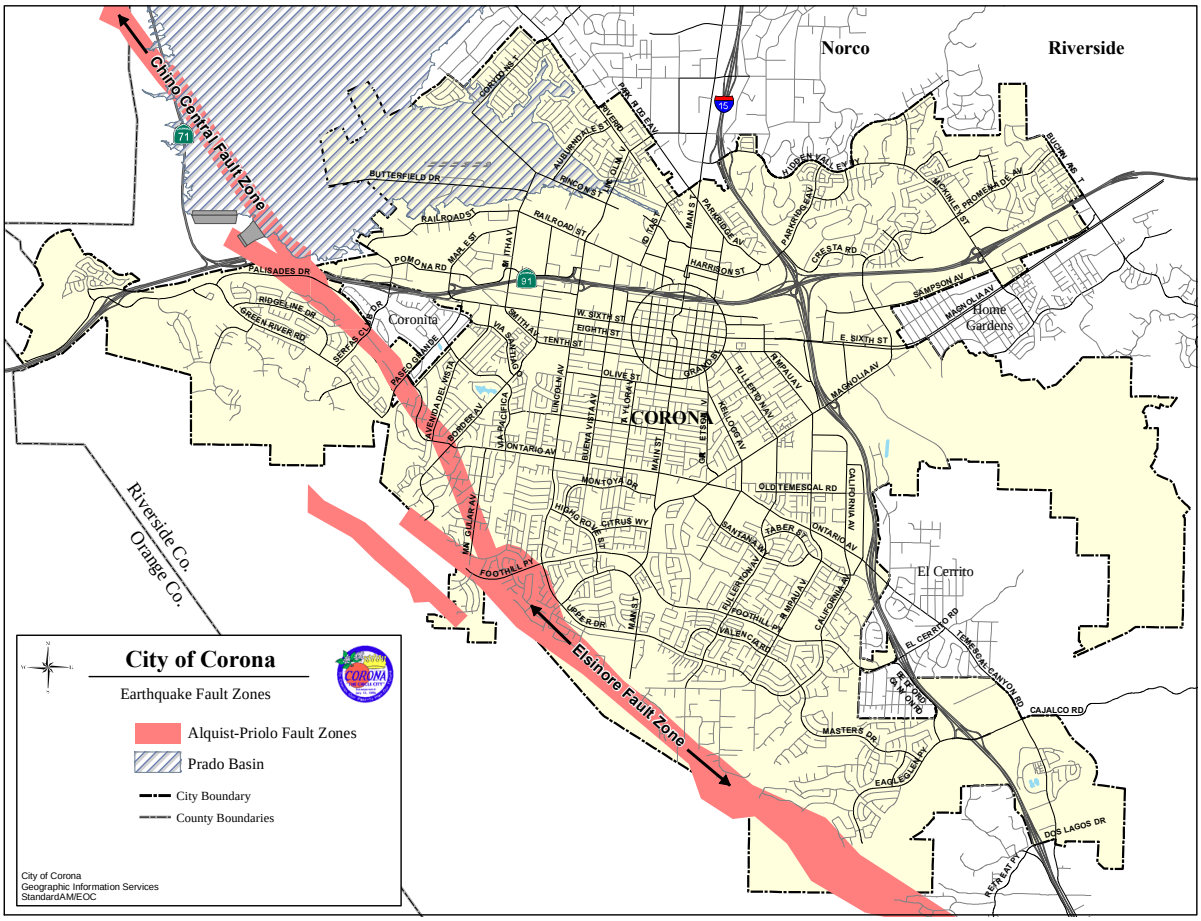
the greatest of these factors within the City, with Highway 91 and I-15 carrying more than 420,000 vehicles daily.

Earthquake Risk[8]

Three major seismic faults within the region have the potential to impact Corona, including the Elsinore Fault and the Tin Mine Fault. The City of Corona is considered to be seismically active, as is most of Southern California. Several known active or potentially active faults are located in and around Corona as shown in Figure 23. The Elsinore Fault zone is the closest major fault system to the City and one of the largest in Southern California. Historically, the Elsinore Fault zone has also been one of the least active systems. At its northern end, near the City, the Elsinore Fault zone splays into two segments, the Chino-Central Avenue Fault and the Whittier Fault. Along the southwestern portion of the City the Elsinore Fault zone is also referred to as the Glen Ivy Fault.

[8] City of Corona 2017 Local Hazard Mitigation Plan, Section 4.4.

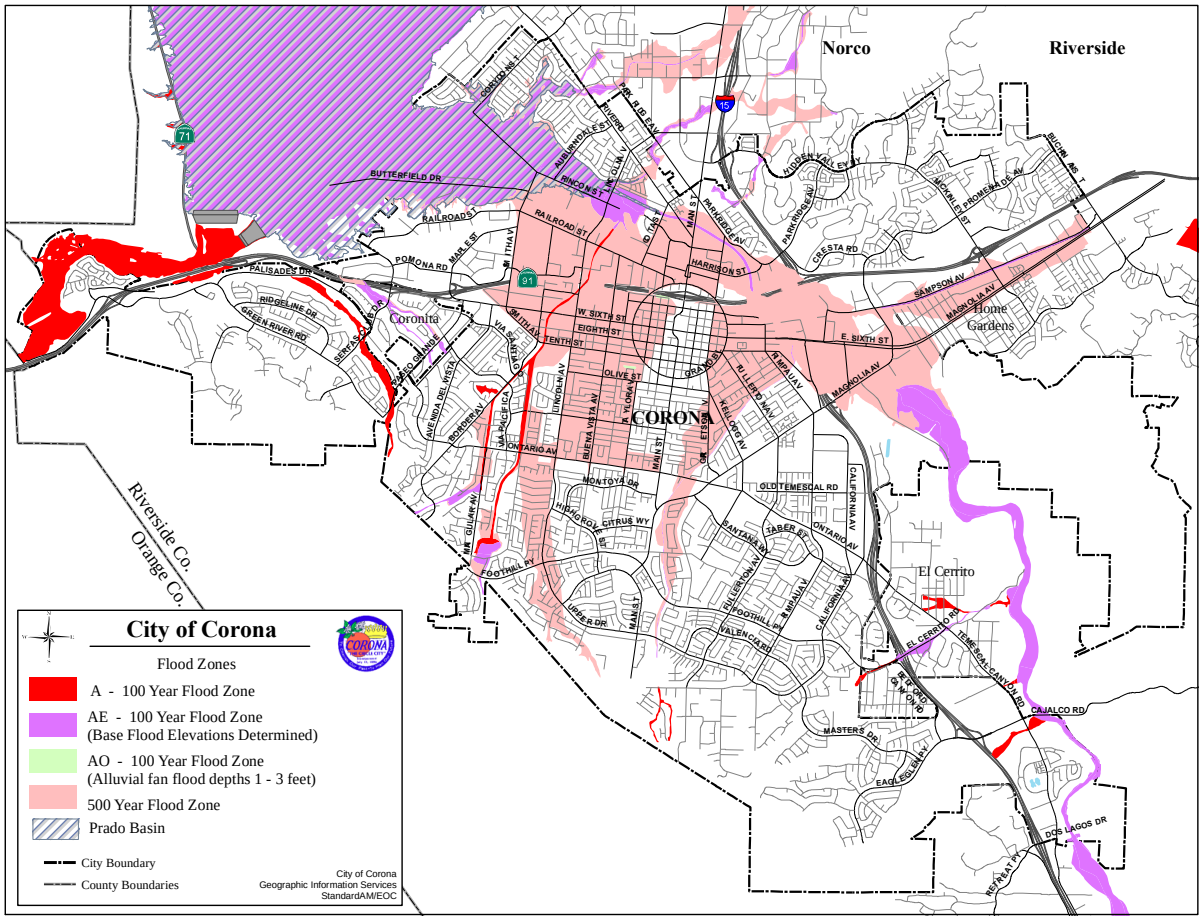
Figure 23—Earthquake Faults



Flood Risk[9]

Figure 24 shows the flood hazard areas for the City as identified by the Federal Emergency Management Agency.

Figure 24—Flood Hazard Areas



[9] Reference: Riverside County Operational Area Hazard Mitigation Plan.

Technical Rescue Service Demand

Over the five-year study period, there were 147 technical rescue incidents as summarized in Table 42.

Table 42—Technical Rescue Service Demand

Risk	Year	Planning Zone							Total Incidents
		Sta. 1	Sta. 2	Sta. 3	Sta. 4	Sta. 5	Sta. 6	Sta. 7	
Technical Rescue	2014	4	7	4	2	2	1	1	**21**
	2015	11	13	2	3	0	1	1	**31**
	2016	10	9	5	3	1	0	0	**28**
	2017	13	13	5	3	3	1	0	**38**
	2018	8	9	4	4	1	1	2	**29**
Total		**46**	**51**	**20**	**15**	**7**	**4**	**4**	**147**

As Table 42 shows, technical rescue service demand is very low, with Station 2 experiencing the highest demand.

Probability of Technical Rescue Occurrence

Table 43 summarizes Citygate's technical rescue probability scoring by planning zone based on service demand from Table 42.

Table 43—Technical Rescue Probability Scoring

Technical Rescue	Planning Zone						
	Sta. 1	Sta. 2	Sta. 3	Sta. 4	Sta. 5	Sta. 6	Sta. 7
Probability	**1.25**	**1.25**	**1.25**	**1.25**	**1.25**	**1.25**	**1.25**

Technical Rescue Impact Severity

Table 44 summarizes Citygate's scoring of probable technical rescue impact severity by planning zone.

Table 44—Technical Rescue Impact Severity Scoring

Technical Rescue	Planning Zone						
	Sta. 1	Sta. 2	Sta. 3	Sta. 4	Sta. 5	Sta. 6	Sta. 7
Impact Severity	**3.00**	**3.00**	**3.00**	**3.00**	**3.00**	**3.00**	**3.00**

Overall Technical Rescue Risk

Table 45 summarizes the Department's overall technical rescue risk scores and ratings by planning zone.

Table 45—Overall Technical Rescue Risk

Technical Rescue	Planning Zone						
	Sta. 1	Sta. 2	Sta. 3	Sta. 4	Sta. 5	Sta. 6	Sta. 7
Total Risk Score	3.75	3.75	3.75	3.75	3.75	3.75	3.75
Risk Rating	*Low*	*Low*	*Low*	*Low*	*Low*	*Low*	*Low*