CITYGATE ASSOCIATES, LLC
FIRE & EMERGENCY SERVICES

SAN DIEGO FIRE-RESCUE DEPARTMENT
VOLUME 2 OF 3 - TECHNICAL REPORT

STANDARDS OF RESPONSE COVER REVIEW

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PART ONE

Standards of Cover Assessment

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SECTION 1—INTRODUCTION AND BACKGROUND

Citygate Associates, LLC's Standards of Response Cover technical review for City of San Diego Fire-Rescue (Fire-Rescue) for field deployment functions is presented in this "Volume." Citygate's deployment scope of work and corresponding Work Plan was developed consistent with Citygate's Project Team members' experience in fire administration and deployment planning. Citygate utilizes various National Fire Protection Association (NFPA) publications as best practice guidelines, along with the self-assessment criteria of the Commission on Fire Accreditation International (CFAI).

1.1 DEPLOYMENT PART ORGANIZATION

This "Part" of **Volume 2** is structured into the sections listed below. *Part Two* of this volume contains an in-depth Community Risk Assessment. **Volumes 1** (Executive Summary) and **3** (Map Atlas) are separately bound.

Section 1 Introduction and Background: An introduction to the study and background facts about Fire-Rescue.

Section 2 Standards of Coverage Introduction: An introduction to the Standards of Coverage (SOC) process and methodology used by Citygate in this review.

Section 3 City Deployment Goals/Measures: An in-depth examination of the City's ability to provide deployment coverage for the community's risks and meet the community's expectations and emergency needs.

Section 4 Staffing and Geo-Mapping Analysis: A review of: (1) the critical tasks that must be performed to achieve the City's desired outcome; and (2) the City's existing fire station locations and possible future locations.

Section 5 Response Statistical Analysis: A statistical data analysis of the City's incident responses.

Section 6 SOC Evaluation and Deployment Recommendation: A summary of deployment priorities and an overall deployment recommendation.

Section 7 Next Steps: A summary of deployment short- and long-term next steps.

1.1.1 Goals of Deployment Analysis

As each of the sections mentioned above imparts information, this report will cite findings and make recommendations, if appropriate, that relate to each finding. There is a sequential numbering of all of the findings and recommendations throughout Sections 3 through 6 of this report. To provide a comprehensive summary, a complete listing of all these same findings and recommendations, in order, is found in the Executive Summary. Sections 6 and 7 of this report bring attention to the highest priority needs and possible next steps.

This document provides technical information about how fire services are deployed across the City, legally regulated, and how Fire-Rescue currently operates. This information is presented in the form of recommendations and policy choices for the City's leadership to discuss.

1.2 Standards of Response Coverage Scope of Work

The scope of the Standards of Response Coverage review included the following elements:

- Modeling the need and effects of the current fire station locations. Although this is not a study of fire agencies adjacent to the City, the study considered the impacts of the City's existing or potential automatic and mutual aid agreements on the City's needs.
- Establishing response time performance goals consistent with best practices and national guidelines from the NFPA and CFAI.
- Using an incident response time analysis program called StatsFD™ to review the statistics of prior historical performance.
- Using a geographic mapping response time measurement tool called FireView™ to measure fire unit driving time coverages.

1.2.1 SOC Study Questions

To prepare and develop this deployment study for Fire-Rescue, Citygate reviewed computer data, response times, and past performance. As a result, this study addresses the following questions:

- Is the type and quantity of apparatus and personnel adequate for the City's deployment to emergencies?
- What is the recommended deployment to deliver adequate emergency response times, both to the existing areas and new sections as growth continues to occur?

1.3 CITY OVERVIEW

San Diego, the eighth largest city in the United States and the second largest city in the State of California, has a population of over 1.39 million and is a very culturally diverse community covering 372 square miles and consisting of over 57,000 businesses employing (as of December 2016) approximately 688,300 people. In addition to residents and employment populations to protect, Fire-Rescue also has responsibilities for the majority of the region's annual tourism count of about 34 million. As the risk assessment section of this study will detail, Fire-Rescue has to protect almost every type of risk found in the United States, except a petro-chemical refinery.

Fire-Rescue's service capacity for building fire risk consists of a daily, on-duty response force of 256 personnel staffing 70 primary response apparatus from 47 active fire stations. These staffing and apparatus totals do not include the San Diego International Airport Aviation Fire-Rescue Station, Fire-Rescue's Helicopter program, the Lifeguard Division, or the multitude of specialty apparatus such as brush fire and hazardous material units. The adopted Fiscal Year 2017 budget for Fire-Rescue is $236,780,295.

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SECTION 2—STANDARDS OF COVERAGE INTRODUCTION

2.1 STANDARDS OF COVERAGE STUDY PROCESSES

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

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

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

While working with multiple components to conduct a deployment analysis is admittedly more work, it yields a much better result than using only a singular component. For instance, if only travel time is considered, and frequency of multiple calls is not considered, the analysis could

miss over-worked companies. If a risk assessment for deployment is not considered, and deployment is based only on travel time, a community could under-deploy to incidents.

The Standards of Response Coverage process consists of the following eight elements:

Table 1—Standards of Response Coverage Process Elements

Element	Meaning
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. (In this Citygate study, see *Part Two—Community Risk Assessment*.)
4. Critical Task Study	Reviewing the tasks that must be performed and the personnel required to deliver the stated outcome expectation for the Effective Response Force.
5. Distribution Study	Reviewing the spacing of first-due resources (typically engines) to control routine emergencies.
6. Concentration Study	Reviewing the spacing of fire stations so that building fires can receive sufficient resources in a timely manner (First Alarm Assignment or the Effective Response Force).
7. Reliability and Historical Response Effectiveness Studies	Using prior response statistics to determine the percent of compliance the existing system delivers.
8. Overall Evaluation	Proposing Standard of Cover statements by risk type as necessary.

Fire department deployment, simply stated, is about the speed and weight of the attack. Speed calls for first-due, all-risk intervention units (engines, trucks, and/or rescue ambulances) strategically located across a community responding in an effective travel time. These units are tasked with controlling moderate emergencies without the incident escalating to second alarm or greater size, which unnecessarily depletes departmental resources as multiple requests for service occur. Weight is about multiple-unit response for serious emergencies such as a room-and-contents structure fire, a multiple-patient incident, a vehicle accident with extrication required, or a heavy rescue incident. In these situations, enough firefighters must be assembled within a reasonable time frame to safely control the emergency, thereby keeping it from escalating to greater alarms.

This deployment design paradigm is reiterated in the following table:

Table 2—Fire Service Deployment Simplified

	Meaning	Purpose
***Speed* of Attack**	Travel time of first-due, all-risk intervention units strategically located across a department.	Controlling moderate emergencies without the incident escalating to second alarm or greater size.
***Weight* of Attack**	Number of firefighters in a multiple-unit response for serious emergencies.	Assembling enough firefighters within a reasonable time frame to safely control the emergency.

Thus, small fires and medical emergencies require a single- or two-unit response (engine and specialty unit) with a quick response time. Larger incidents require more crews. In either case, if the crews arrive too late or the total personnel sent to the emergency are too few for the emergency type, they are drawn into a losing and more dangerous battle. The science of fire crew deployment is to spread crews out across a community for quick response to keep emergencies small with positive outcomes, without spreading the crews so far apart that they cannot amass together quickly enough to be effective in major emergencies.

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SECTION 3—CITY DEPLOYMENT GOALS/MEASURES

3.1 WHY DOES FIRE-RESCUE EXIST AND HOW DOES IT DELIVER THE EXISTING FIRE CREW DEPLOYMENT SERVICES?

3.1.1 Existing Response Time Policies or Goals—Why Does the Agency Exist?

SOC ELEMENT 1 OF 8*
EXISTING DEPLOYMENT POLICIES
**Note: This is an overview of Element 1. The detail is provided on page 18.*

The City Council has adopted fire and EMS outcome-based response time goals, by ordinance and its General Plan Safety Element as updated in 2015. These are also reported on by Fire-Rescue in the budget and on-going performance reports. The City's performance goals are:

General Plan PF-D.1 Locate, staff, and equip fire stations to meet established response times as follows:

a. To treat medical patients and control small fires, the first-due unit should arrive within 7.5 minutes, 90 percent of the time from the receipt of the 9-1-1 call in fire dispatch. This equates to 1-minute dispatch time, 1.5 minutes company turnout time, and 5 minutes drive time in the most populated areas.

b. To provide an effective response force for serious emergencies, a multiple-unit response of at least 17 personnel should arrive within

10.5 minutes from the time of 9-1-1 call receipt in fire dispatch, 90 percent of the time.

i. This equates to 1-minute dispatch time, 1.5 minutes company turnout time, and 8 minutes drive time spacing for multiple units in the most populated areas.

ii. This response is designed to confine fires near the room of origin, to stop wildland fires to under 3 acres when noticed promptly, and to treat up to 5 medical patients at once.

Note: paramedic ambulance response times are addressed in the City's performance-based contract with the ambulance contractor.

General Plan TABLE PF-D.1 Deployment Measures to Address Future Growth by Population Density Per Square Mile

	Structure Fire Urban Area	Structure Fire Rural Area	Structure Fire Remote Area	Wildfires Populated Areas
	>1,000-people/sq. mi.	1,000 to 500 people/sq. mi.	500 to 50 people/sq. mi.*	Permanent open space areas
1st Due Travel Time	5	12	20	10
Total Reflex Time	7.5	14.5	22.5	12.5
1st Alarm Travel Time	8	16	24	15
1st Alarm Total Reflex	10.5	18.5	26.5	17.5

*Reflex time is the total time from receipt of a 9-1-1 call to arrival of the required number of emergency units.

General Plan PF-D.2. Determine fire station needs, location, crew size, and timing of implementation as the community grows.

a. Use the fire unit deployment performance measures (based on population density per square mile) shown in Table PF-D.1 to plan for needed facilities. Where more than one square mile is not populated at similar densities, and/or a contiguous area with different density types aggregates into a population cluster area, use the measures provided in Table PF-D.2.

b. Reflect needed fire-rescue facilities in community plans and associated facilities financing plans as a part of community plan updates and amendments.

General Plan TABLE PF-D.2 Deployment Measures to Address Future Growth by Population Clusters

Area	Aggregate Population	First-Due Unit Travel Time Goal
Metropolitan	>200,000 people	4 minutes
Urban-Suburban	<200,000 people	5 minutes
Rural	500-1,000 people	12 minutes
Remote	<500 people	> 15 minutes

General Plan PF-D.3. Adopt, monitor, and maintain adopted service delivery objectives based on time standards for all fire, rescue, emergency response, and lifeguard services.

General Plan PF-D.4. Provide a 3/4-acre fire station site area and allow room for station expansion with additional considerations:

a. Consider the inclusion of fire station facilities in villages or development projects as an alternative method to the acreage guideline;

b. Where density and development preclude a 3/4 acre site consider a multi-story station;

c. Acquire adjacent sites that would allow for station expansion as opportunities allow; and

d. Gain greater utility of fire facilities by pursuing joint use opportunities such as community meeting rooms or collocating with police, libraries, or parks where appropriate.

Nationally recognized standards and best practices suggest using a time line with several important time measurements that include a definition of response time. Ideally the clock start time is when the 9-1-1 police dispatcher receives the emergency call. The City of San Diego's 9-1-1 call receipt center is its Police Department and transfers fire and EMS incidents to Fire-Rescue's Emergency Command and Data Center (ECDC) for dispatching of the needed resources. In this setting, the Fire-Rescue response clock starts when the fire dispatcher receives the 9-1-1 incident into the computerized fire dispatch system. The time segments for Fire-Rescue's response include dispatch processing, crew alerting and leaving the station (commonly called turnout time), and actual travel time.

The City's adopted response goals would largely meet the Standards of Coverage model for the Commission on Fire Accreditation International (CFAI).

3.1.2 Outcome Expectations and Best Practices Response Time Measures

SOC ELEMENT 2 OF 8
COMMUNITY OUTCOME EXPECTATIONS

The Standards of Response Cover process begins with a review of existing emergency services outcome expectations. This can be restated as follows: for what purpose does the response system exist? Has the governing body adopted any response performance measures? If so, the time measures used need to be understood and good data collected.

Current best practice nationally is to measure percent completion of a goal (e.g., 90% of responses) instead of an average measure. Mathematically this is called a "fractile" measure.[1] This is because the measure of average only identifies the central or middle point of response time performance for all calls for service in the data set. Using an average makes it impossible to know how many incidents had response times that were way over the average or just over.

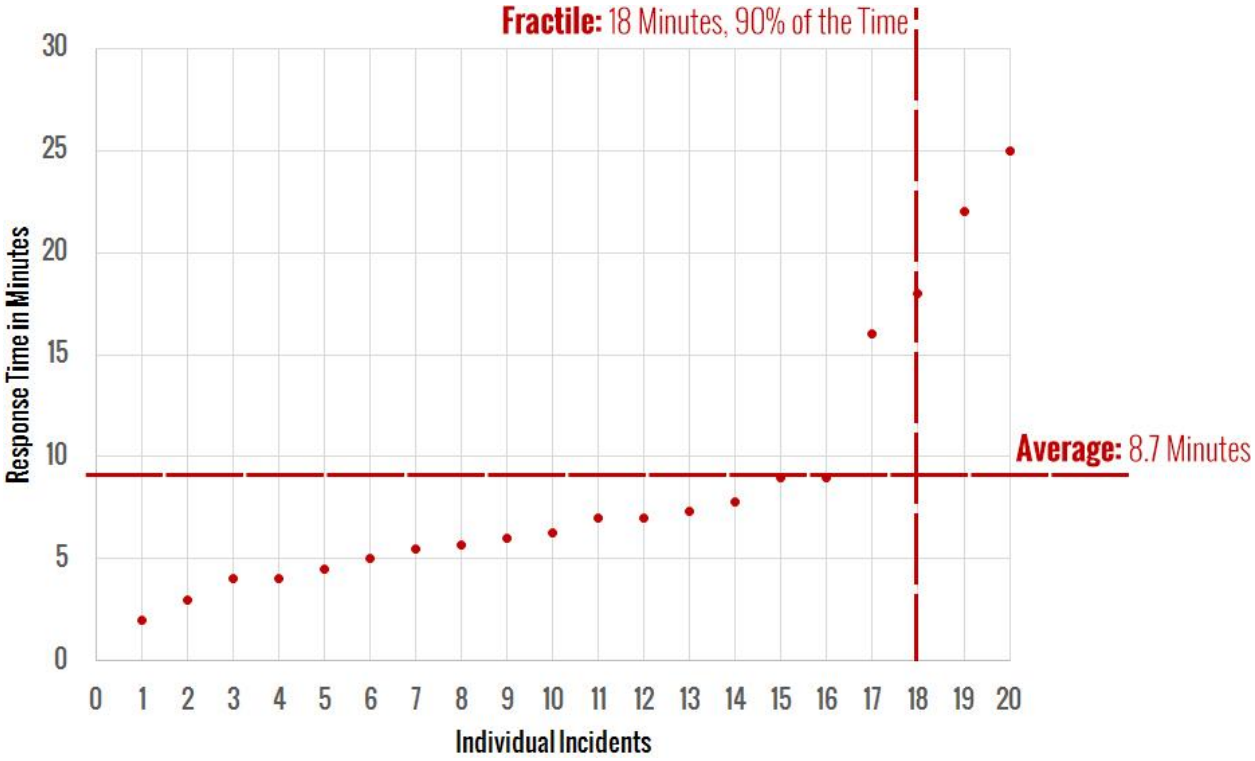
For example, Figure 1 shows response times for a fictitious city fire department in the United States. This city is small and receives 20 legitimate calls for service each month. Each response time for the calls for service has been plotted on the graph. The call response times have been plotted in order from shortest response time to longest response time.

The figure shows that the average response time is 8.7 minutes. However, the average response time fails to properly account for four calls for service with response times far exceeding a threshold in which positive outcomes could be expected. In fact, it is evident in Figure 1 that, in this fictitious U.S. city, 20% of responses are far too slow, and that this city has a potential life-threatening service delivery problem. Average response time as a measurement tool for fire departments 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% of responses in mind, this small city has a response time of 18 minutes, 90% of the time. This fractile measurement is far more accurate at reflecting the service delivery situation in this small city.

[1] 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 1—Fractile versus Average Response Time Measurements



More importantly within the Standards of Response Coverage process, positive outcomes are the goal, and from that crew size and response time can be calculated to allow efficient fire station spacing (distribution and concentrations). Emergency medical incidents have situations with the most severe time constraints. In a heart attack that stops the heart, a trauma that causes severe blood loss, or in a respiratory emergency, the brain can only live 8-10 minutes without oxygen. Not only heart attacks, but also other events can cause oxygen deprivation to the brain. Heart attacks make up a small percentage; drowning, choking, trauma constrictions, or other similar events have the same effect. In a building fire, a small incipient fire can grow to involve the entire room in 8 to 10 minutes. If fire service response is to achieve positive outcomes in severe emergency medical situations and incipient fire situations, ***all*** responding crews must arrive, size-up the situation, and deploy effective measures before brain death occurs or the fire leaves the room of origin.

Thus, from the time the 9-1-1 call is received, an effective deployment system is ***beginning*** to manage the problem within a 7- to 8-minute total response time. This is right at the point that brain death is becoming irreversible and the fire has grown to the point to leave the room of origin and become very serious. Thus, the City needs a first-due response goal within this time frame to give the situation hope for a positive outcome. It is important to note the fire or medical emergency continues to deteriorate from the time of inception, not the time the fire engine

actually 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, one minute. Then crew notification and travel time take additional minutes. Once arrived, the crew must walk to the patient or emergency, size-up the situation, and deploy its skills and tools. Even in easy-to-access situations, this step can take two or more minutes. This time frame may be increased considerably due to long driveways, apartment buildings with limited access, multi-storied apartments or office complexes, high rise downtown buildings, or shopping center buildings such as those found in parts of the City.

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

For this report, "total" response time is the sum of the call processing / fire dispatch, crew turnout, and road travel time steps. This is consistent with the recommendations of the CFAI.

Finding #1:	The City Council has adopted a complete and best-practices-based deployment measure for fire and emergency medical services incidents. Adopting a similar set of specialty response measures would meet the best practice recommendations of the Commission on Fire Accreditation International.

3.2 COMMUNITY RISK ASSESSMENT INTRODUCTION

SOC ELEMENT 3 OF 8
COMMUNITY RISK ASSESSMENT

Risk assessment is a major component of developing a Standards of Cover (SOC) document. A risk assessment identifies the type of incidents a fire department will respond to and what resources and staffing it will need to mitigate the situation.

To better understand risk, it is necessary to define the types and levels of risk a community can encounter. For risk assessment in an SOC study, it is typical to consider low, moderate, high/special, and maximum risk occupancies. Risk also can be classified by probability and consequences. Probability is defined as the likelihood of a fire occurring in an occupancy type. Consequences are defined as the effects of the fire on the property and community.

As part of this project, the City requested an in-depth risk assessment. This comprehensive review is contained in *Part Two* of this study and will not be repeated here.

3.3 COMMUNITY EXPECTATIONS

Given the City's adopted response time policy and historic funding level of fire services, it is reasonable to assume that residents, employees, and visitors of the City expect an effective level of fire service response. This response should keep time-sensitive events such as serious medical emergencies, fires, and hazardous material releases, from becoming more serious, or worse, catastrophic.

3.4 RISK ASSESSMENT RESULT

Citygate's evaluation of the values at risk and hazards likely to impact the City of San Diego yields the following conclusions:

1. The City has a very diverse population, with densities ranging from less than 1,000 per square mile to more than 56,000 per square mile.
2. The City's population is projected to grow by 24% over the next 18 years to 2035, with similar projected growth in residential housing units, non-residential development, and employment.
3. Approximately 23.35% of the City's population is under 10 years of age or over 65 years of age, which are considered at-risk populations for most emergencies.
4. Nearly 16% of the City's population is below the federal poverty level for the previous 12 months, an increase of 1.7% since 2000.
5. Nearly 82% of the City's population has health insurance coverage.
6. The City has 705 designated critical facilities/infrastructures to protect.
7. The City has significant economic values at risk as identified in this assessment.
8. A significant percentage of the City lies within a Very High Wildland Fire Hazard Severity Zone as identified by the California Department of Forestry and Fire Protection.
9. Fire-Rescue has developed and implemented multiple mitigation measures to effectively reduce wildland fire impact severity within the City.
10. The City's transportation network includes multiple highways and other primary vehicle transportation routes, airports, railways, and mass transportation nodes.

11. The City's overall risk for seven hazards related to emergency services provided by Fire-Rescue ranges from LOW to MAXIMUM as summarized in Table 3.

Table 3—Overall Risk by Hazard

Hazard	Planning Zone							
	Zone 1	Zone 2	Zone 3	Zone 4	Zone 5	Zone 6	Zone 7	Zone 8
Building Fire	HIGH	HIGH	HIGH	MODERATE	MODERATE	MODERATE	MODERATE	MODERATE
Wildland Fire	HIGH	HIGH	HIGH	MAXIMUM	MAXIMUM	HIGH	MAXIMUM	MAXIMUM
Medical Emergency	MODERATE	MODERATE	MODERATE	MODERATE	MODERATE	MODERATE	MODERATE	MODERATE
Hazardous Material	HIGH	HIGH	HIGH	MODERATE	MODERATE	HIGH	MODERATE	MODERATE
Technical Rescue	MODERATE	MODERATE	MODERATE	MODERATE	MODERATE	MODERATE	MODERATE	MODERATE
Marine Risk	HIGH	MODERATE	HIGH	LOW	MODERATE	LOW	LOW	MODERATE
Aviation Risk	LOW	MODERATE	LOW	LOW	LOW	LOW	LOW	LOW

Based on the aforementioned factors, the City has staffed and designed its response system to field an "Effective Response Force" of multiple units to reported serious fires in buildings and wildland areas, and provides paramedic ambulances for emergency medical responses via contract.

The City's multiple-unit force (First Alarm) is designed strong enough to stop the escalation of the emergency and keep it from spreading to greater alarms. These desired outcomes and adopted policy goals will be the foundation of updated deployment measures as part of this Standard of Response Cover process.

3.5 EXISTING CITY DEPLOYMENT

3.5.1 Existing Deployment Situation—What the City Has in Place Currently

SOC ELEMENT 1 OF 8*

EXISTING DEPLOYMENT POLICIES

**Note: Continued from page 11.*

For positive outcomes to building fires and serious medical emergencies which are consistent with the City's fire/EMS response goals, this study will benchmark Fire-Rescue's performance against the adopted goals, which are:

- Five (5) minutes travel time for the first-due unit to all types of emergencies.
- Eight (8) minutes travel time for multiple units needed at serious emergencies (First Alarm).

Fire-Rescue's service capacity for building fire risk consists of a daily, on-duty response force of 256 personnel staffing 70 primary response apparatus from 47 active fire stations. These staffing and apparatus totals do not include the San Diego International Airport Aviation Fire-Rescue Station, Fire-Rescue's Helicopter program, the Lifeguard Division, or the multitude of specialty apparatus such as brush fire and hazardous material units.

Table 4—Daily Minimum Staffing per Unit for the City – Fiscal Year 2016/17

Unit	Minimum	Staff	Extended Minimum
48 Engines @	4	Firefighters/day	192
13 Aerial Ladder Truck Companies @	4	Firefighters/day	52
1 Rescue Unit @	4	Firefighters/day	4
Subtotal firefighters			***248***
Shift Commander	1	Per day for command	1
Battalion Chiefs/Command	7	Per day for command	7
		Total	**256**

This daily staffing is adequate for the immediate response fire risk needs presented in most of the built-up urban areas of the City. On days when staffing levels allow, and the threat of wildland fire is serious, or there are many specialty civic events, Fire-Rescue can staff additional units with crews on focused overtime. However, for the daily staffing statement to be accurate as to adequacy for a building fire, the assumption is that the closest crews are available and all stations are staffed and not already operating on another emergency medical call or fire, which can and does happen. For example, if an engine and an ambulance unit are committed to an emergency medical services call, then an adjacent engine company or truck company must respond. This situation will be evaluated separately in Section 5 of this volume where simultaneous incident workload is analyzed.

Fire-Rescue has solid automatic aid partnerships with the surrounding fire agencies that will send their closest units into the City if the City's units are committed or not as close to other emergencies.

Services Provided

The City funds an "all-risk" fire department providing the people and assets it protects with services that include structure fire, wildland fire, ambulance paramedics, technical rescue, and hazardous materials response as well as other services.

Given these risks, Fire-Rescue uses a tiered approach of dispatching different types of apparatus to each incident category. The Emergency Command and Data Center dispatchers and computer-

aided-dispatch system selects the closest and most appropriate resource types and handles this function. As an example, here are the resources dispatched to common risk types:

Table 5—Resources Sent to Common Risk Types

Risk Type	Minimum Type of Resources Sent	Total Firefighters Sent
1-Patient EMS	1 Engine or Ladder Truck and 1 Paramedic Ambulance	4 FF + 2 Amb
Auto Fire	1 Engine	4 FF
Residential Building Fire	4 Engines, 1 Ladder Truck, 2 Battalion Chiefs, 1 Ambulance	22 FF + 2 Amb
Commercial Building Fire	4 Engines, 2 Ladder Trucks, 2 Battalion Chiefs, 1 Ambulance	26 FF + 2 Amb
Wildland Fire	2 Engines, 2 Brush Units, 2 Helicopters, 1 Water Tender, 4 Battalion Chiefs, 1 Shift Commander	26 FF
Hazardous Materials and Technical Rescue	1 Engine, 1 Ladder Truck, Specialty Unit(s) as needed, 1 Ambulance, 1 Battalion Chief	11-15 FF

Finding #2: Fire-Rescue follows best practices by using a standard response dispatching plan that considers the risk of different types of emergencies and pre-plans the response. Each type of call for service receives the combination of engine companies, truck companies, ambulances, specialty units, and command officers customarily needed to handle each type of incident based on experience.

3.5.2 Emergency Unit Staffing

All engine and ladder companies are staffed on a daily basis with a minimum staffing of four firefighters. The daily minimum shift staffing count is 248 firefighters *on firefighting units* plus eight supervisors. Per NFPA 1710, a minimum of 14-15 firefighters plus a command chief are required for a typical room and contents fire in a home in a suburban area. For a single-patient acute emergency medical services event, one fire company plus an ambulance are needed.

While some fire departments staff three firefighters per unit, larger, highly urban agencies staff four personnel per engine company and ladder truck, as funding allows. There is no question that a four-person team is more time-effective and safer to both the firefighters and the people being served. A four-person team can split into two, two-person teams and, under Occupational Safety and Health Administration (OSHA) regulations, operate safely in hazardous environments. In

chaotic incidents, a four-person team allows the Fire Captain or Supervisor to stand-back from the hands-on work and monitor the overall scene for bystander and traffic safety before the police arrive. When a fire engine paramedic must assist the ambulance paramedic with a patient transport to the hospital, a three-person engine crew is still in service to that neighborhood.

The daily staffing depth of the City is adequate to handle multiple medical emergencies and multiple serious building fires before relying on automatic aid. However, the City does not need to use all of its resources at once. In the automatic aid, closest-unit agreements, a mix of different agencies can be sent based on shortest response times. Doing so leaves other City units available for simultaneous calls for service.

Finding #3:	Minimum apparatus staffing per unit on engine and ladder truck companies at four is a recognized best practice for the City's size and risks.

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SECTION 4—STAFFING AND GEO-MAPPING ANALYSIS

4.1 CRITICAL TASK TIME MEASURES—WHAT MUST BE DONE OVER WHAT TIME FRAME TO ACHIEVE THE STATED OUTCOME EXPECTATION?

SOC ELEMENT 4 OF 8
CRITICAL TASK TIME STUDY

Standards of Coverage (SOC) studies use task time information to determine the number of firefighters needed within a timeframe to accomplish the desired fire control objective on moderate residential fires and modest emergency medical rescues. The time it takes to complete one specific task is called an "evolution." These task time evolutions are shown on Table 6 through Table 8 to demonstrate the amount of time the operations require. The following three tables start with the time of fire dispatch notification, and finish with the outcome achieved. These tables are composite tables from Citygate clients in metropolitan fire agencies very similar to San Diego, with unit staffing at four personnel per engine or ladder truck. These tasks and times are also consistent with national published studies.[2] There are several important themes contained in these tables:

[2] Report on Residential Fireground Field Experiments, National Institute of Standards and Technology Technical Note #1661, April 2010. NFPA 1710, Standard for the Organization and Deployment of Fire Suppression Operations, Emergency Medical Operations, and Special Operations to the Public by Career Fire Departments, 2016 Edition.

- The evolution test results were obtained at training centers under best conditions; the day was sunny and moderate in temperature. The structure fire response times are from actual events, showing how units arrive at staggered intervals.
- It takes a considerable amount of time after a task is ordered by command to actually accomplish the tasks and arrive at the desired outcome. This is because each task must be completed in order. The fewer the firefighters, the longer some task completion times will be. *Critical steps* are highlighted in ***grey*** in the table.
- Task completion time is usually a function of the number of personnel ***simultaneously*** available. This is desirable so that firefighters can complete some tasks simultaneously.
- Some tasks must be assigned to a minimum of two firefighters to comply with safety regulations. For example, two firefighters are required for searching a smoke-filled room for a victim.

Table 6 displays unit and individual duties that are required at a First Alarm fire scene for a typical single-family dwelling fire. This set of duties is taken from typical urban fire departments' operational procedures, which are entirely consistent with the customary findings of other agencies using the SOC process. No conditions existed to override the Occupational Safety and Health Administration (OSHA) 2-in/2-out safety policy which requires that firefighters enter serious building fires in teams of two, while two more firefighters are outside and immediately ready to rescue them should trouble arise.

The following table displays the critical tasks for Fire-Rescue's response to a typical house fire in built-up suburban areas with four engines, one ladder truck, one ambulance, and two Battalion Chiefs for a minimum force total of **22** firefighters plus an ambulance.

Scenario: *This was a simulated, two-story residential structure fire with an unknown rescue situation. Responding companies received dispatch information as typical for a witnessed fire. Upon arrival they were told approximately 1,000 square feet of the home was involved in fire.*

Table 6—First Alarm Structure Fire – 22 Firefighters and an Ambulance

Structure Fire Incident Tasks	Time from Arrival of First Engine	Total Reflex Time
Pre-arrival time of dispatch, turnout, and travel time at desired goal point		07:30
First engine on-scene	00:00	
Conditions report	02:37	
Supply line charged	03:00	
Charged line to second floor	03:48	
Rapid Intervention Team established	04:40	12:10
Forced entry	06:09	
First Battalion Chief and second engine arrival	03:38	
Ambulance, third and fourth engine arrival	05:45	
Back-up attack line at door charged	06:15	
Water on fire	07:04	14:34
Ladder truck and second Battalion Chief arrival	07:56	
Primary search for victims	08:10	15:40
Ladders positioned	11:05	
Utilities secured	12:45	
Positive pressure ventilation	12:32	
Secondary search complete	15:53	23:23
Check for fire extension in hidden spaces	15:58	
Fire out / **incident under control**	**17:15**	**24:45**

The duties in Table 6, grouped together, form an *Effective Response Force or First Alarm Assignment*. The above distinct tasks must be performed simultaneously and effectively to achieve the desired outcome; arriving on-scene does not stop the escalation of the emergency. While firefighters accomplish the above tasks, the clock keeps running, which has been running since the emergency first started.

Fire spread in a structure can double in size during its free burn period. Many studies have shown that a small fire can spread to engulf the entire room in less than 4-5 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 attack and search 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 serious danger to both firefighters and any occupants of the building.

For comparison purposes, Table 7 reviews the tasks needed on a typical auto accident rescue.

Scenario: *The situation modeled was a one-car collision with one patient. The driver required moderate extrication with power tools and the vehicle was upright with no fuel hazards. One engine, one ladder truck, one ambulance, and one Battalion Chief responded with a total of eleven personnel.*

Table 7—Single-Patient Traffic Collision – 8 Firefighters plus an Ambulance and Battalion Chief

Vehicle Extrication Critical Tasks	Time from Arrival of First Engine	Total Reflex Time
Pre-arrival time of dispatch, turnout, and travel time at desired goal point		07:30
Engine on scene	00:00	
Size up and upgrade to rescue response	00:15	
Initial report	02:00	
Vehicle stabilization initiated	02:00	09:30
Protection firefighting line in place	02:25	
Ambulance, Battalion Chief, and ladder truck arrival	02:00	
Patient assessed, vital signs obtained	03:48	11:18
Door forcibly opened and secured	04:48	
Patient on backboard and removed	05:40	13:10
Patient on gurney	06:00	
Patient under ambulance crew care and depart scene	**07:30**	**15:00**

As another comparison, Table 8 displays the critical tasks needed on a typical cardiac patient, full arrest:

Scenario: *This was a simulated one-patient full arrest indoors. A standard response of one engine and one ambulance responded with a total of six personnel.*

Table 8—Cardiac Arrest – 4 Firefighters plus an Ambulance

Cardiac Arrest Critical Tasks	Time from Arrival of First Engine	Total Reflex Time
Pre-arrival time of dispatch, turnout, and travel time at desired goal point		7:30
First-due engine on scene	00:00	
Engine crew determine full arrest and start CPR	00:55	8:25
Ambulance on-scene	01:35	
Cardiac monitor attached to patient	02:10	
Auto pulse CPR unit attached	03:18	
Intravenous line placed	03:24	10:54
Bag valve mask ventilation started	03:42	
Epinephrine administered	05:32	13:02
Intubation completed	06:10	13:40
Defibrillate, positive change in patient rhythm	06:53	14:23
Patient on gurney	07:28	
Patient in ambulance	**10:45**	**18:15**

4.1.1 Critical Task Analysis and Effective Response Force Size

What does a deployment study derive from a response time and company task time analysis? The total task completion times (as displayed in the tables) to stop the escalation of the emergency must be compared to outcomes. We know from nationally-published fire service "time vs. temperature" tables that after about 4-5 minutes of free burning, a room fire will grow to the point of flashover. At this point, the entire room is engulfed, the structure becomes threatened, and human survival near or in the fire room becomes impossible. Additionally, we know that brain death begins to occur within 4-6 minutes of the heart having stopped. Thus, the Effective Response Force must arrive in time to stop these catastrophic events from worsening.

The response and task completion times discussed previously show that the residents of the City are able to expect positive outcomes, and have a good chance of survival, in a *serious* fire or medical emergency, *if the neighborhood assigned unit is available to respond*.

Mitigating an emergency event is a team effort *once* the units have arrived. This refers back to the "weight" of response analogy. If too few personnel arrive too slowly, then the emergency will worsen instead of improve. Control of the structure fire incident in the simulation still took 17:15 minutes/seconds after the time of the first unit's arrival, or 24:45 minutes/seconds from fire dispatch notification. The outcome times, of course, will be longer, with less desirable results, if the arriving force is later or smaller.

In the City, the quantity of staffing and the arrival timeframe can be critical in a serious fire. Fires in older and/or multi-story buildings could well require the initial firefighters needing to rescue trapped or immobile occupants. If a lightly-staffed force arrives, it cannot simultaneously conduct rescue and firefighting operations.

Fires and complex medical incidents require that the other needed 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. In the critical task measures above, the departments that staff units similar to San Diego perform well in terms of time. However, major fires and medical emergencies in which the closest unit is not available to respond still challenge Fire-Rescue's response system to deliver good outcomes. This factor **must** be taken into account when fire station locations are considered. If fire stations are spaced too far apart, then when one unit has to cover another unit's area, or multiple units are needed, these units can be too far away and the emergency will worsen.

Previous critical task studies conducted by Citygate, the Standard of Response Cover documents reviewed from accredited fire agencies, and NFPA 1710 recommendations all arrive at the need for 15+ firefighters arriving within 8 minutes travel at a room and contents structure fire to be able to ***simultaneously and effectively*** perform the tasks of rescue, fire attack, and ventilation. Given that Fire-Rescue sends *at least* 22 of its own personnel (four engines, one ladder truck, one ambulance, and two Battalion Chiefs) to an incident involving a working house fire, it is clear that the City and its leaders understand that firefighting units arriving closely together, with adequate staffing, are needed to deliver a positive outcome that protects lives and property by stopping the escalation of the emergency.

A question one might ask is, "If fewer firefighters arrive, *what* from the list of tasks mentioned in Table 6 through Table 8 would not be done?" 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 above the first-floor deployment. Rescue is conducted with only two-person teams; thus, when rescue is essential, other tasks are not completed in a simultaneous, timely manner. Performing only one of these may negatively impact a victim's outcome. It must always be remembered: effective deployment is about the **speed** *(travel time)* and the **weight** *(firefighters)* of the attack.

Twenty-two initial firefighters can handle a moderate-risk house fire; however, even an Effective Response Force of 22 firefighters 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 personnel to the initial response or to add entire alarms of multiple units becomes important.

Delivering 22 personnel to a moderate risk residential building fire reflects the City's 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 built-out areas and requires more firefighters more quickly than the typical rural outcome of keeping the fire contained to the building, not room, of origin.

4.2 Distribution and Concentration Studies—How the Location of First-Due and First Alarm Resources Affects the Outcome

SOC Element 5 of 8
Distribution Study

SOC Element 6 of 8
Concentration Study

The City is served today by 47 active fire stations. Thus, the City currently has 48 engines (pumpers) *in neighborhoods* for first response firefighting. It is appropriate to understand what the existing stations do and do not cover, if there are any coverage gaps needing one or more stations, and what, if anything, to do about them. Additionally, as the City continues to develop, the number and location of additional fire stations that might be necessary must be considered.

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

- **Distribution** – the spreading out or spacing of first-due fire units to stop routine emergencies.
- **Concentration** – the clustering of fire stations close enough together so that building fires can receive sufficient resources from multiple fire stations quickly. As indicated, this is known as the **Effective Response Force**, or, more commonly, the "First Alarm Assignment"—the collection of a sufficient number of firefighters on scene, delivered within the concentration time goal, to stop the escalation of the problem.

To analyze first-due fire unit travel time coverage for this study, Citygate used a geographic mapping tool called *FireView*^{TM} that can measure theoretical travel time over the street network. For this time calculation, Citygate staff uses the base map and street travel speeds calibrated to actual fire company travel times from previous responses to simulate real-world coverage. Using these tools, Citygate ran several deployment tests and measured their impact on various parts of the City. The travel time measure used was 5 minutes for the first-due unit over the road

network, which is consistent with San Diego's adopted goal to deliver desirable outcomes in critical emergencies. For multiple unit incidents, 8 minutes travel was used per the City's goal.

When 60 seconds is added for dispatch time, and 90 seconds for crew turnout times, then the maps effectively show the area covered within 7:30 minutes for the first-due response, and 11:30 minutes for a First Alarm Assignment.

4.2.1 Traffic Congestion Impacts

Citygate's team members personally observed the current rush-hour traffic congestion in the City, and we have done this in many other cities since the great recession ended. The legacy approach to predict fire apparatus travel times over a street network is insufficient. The approach does not accurately result in response times at peak commute hours because the traditional data set during commute hours is not sufficient.

We thus obtained traffic throughput travel speed data from the company that provides real-time traffic data to internet-based traffic map applications. That company is a multi-national firm called HERE. This is the same data that drives internet-based map views of traffic congestion with red, yellow, and green segments to indicate flow impedance. HERE obtains traffic speed samples from a variety of public and private sources and measures traffic speeds in 15-minute time blocks, between intersections (segments), on a 24/7/365 basis for a rolling 36-month period.

To build the *traffic congestion* time-over-distance maps in this report, Citygate's model first uses actual fire apparatus travel times averaged over a 24-hour time period for one year. Then traffic speed data is used to build a congested traffic model. Overall, the congestion impacts can be measured in the quantity of streets in the City covered at peak and off-peak hours:

Table 9—Road Mile Coverage for First-Due and First Alarm Units (Active Stations)

Time Measure	Total Road Miles (Within City Limits)	Non-Congested Miles Reached by Open Fire Stations	Congested Road Miles	Difference in Miles Covered
5 Minute First-Due Unit	5,012	3,722 *(**74%** of total public miles)*		**1,290**
		3,722	2,535 *(**51%** of total public miles)*	**1,187**
8 Minute First Alarm	5,012	1,324 *(**26%** of total public miles)*		**3,688**
		1,324	304 *(**6%** of total public miles)*	**1,020**

As a starting point, **74%** of the City's public streets are within 5 minutes travel time of an *active* fire station. Of the active fire stations, their travel coverage at commute hours is negatively impacted down to **51%** of the road miles. More importantly, the multiple-unit coverage at commute hours is much more severely impacted from **26%** down to **6%** of the road miles, as multiple units must travel across large sections of the City. The following maps (see **Volume 3**) will show where this normal and reduced coverage occurs.

4.2.2 San Diego City Deployment Baselines

Please note that due to the vertical (north to south) length of San Diego, each type of map to follow has a north and south view.

Map #1a/b – General Geography, Station Locations, and Apparatus Types

These maps show in a north and south view the existing City fire station locations within the City and, using symbols, the primary, full-time staffed fire apparatus at each station. This is a reference map view for the other map displays that follow.

Map #2a/b – Risk Assessment – Planning Zones

Risk assessment is an effort by Fire-Rescue to classify properties by potential impact on service demand levels. The risk assessment analysis in San Diego categorized risks into eight zones, shown on the risk maps as differently shaded areas.

Map #2c/d – Risk Assessment – Critical Facilities

These maps show the locations of the identified critical facilities to be protected from fire and other hazards. These facilities are essential to the quality of life and economic operation of a major urban area.

Map #2e/f – Risk Assessment – Needed Fire Flow (NFF) Large Fire Flow Buildings

Building fire risk, separate from the housing areas, was examined by understanding the locations of the higher fire flow buildings as calculated by the Insurance Service Office (ISO) as a measure of how zoning locates the educational, commercial, and industrial uses in the City. These higher fire flow sites (shown in dark red) are the buildings that must receive a timely and effective First Alarm force to serious fires, thus requiring more firefighters in fewer minutes should a serious fire emerge. Most of these higher fire flow buildings are along the major road corridors.

While most prevalent in the downtown core, City zoning has placed commercial buildings in most all fire station districts and in all eight of this study's risk assessment zones. Thus, an Effective Response Force (First Alarm) capability is needed in all areas of the City, with a heavier unit response to the most densely built-up areas downtown.

Map #2g/h – Risk Assessment – Wildland Fire Threat Zones

As another measure of risk, these maps show the areas in and near the City limits where Fire-Rescue and CAL FIRE have determined there is significant exposure to buildings from wildland fires. These maps also show these areas exist in the pockets in the City as well as on the City's borders. As San Diego is all too aware, the City has a very high risk of wildfire.

To better serve these areas, Fire-Rescue has positioned wildfire apparatus in many of the City's fire stations where they are cross-staffed by a structure fire engine crew. Thus, the crew can deploy the right type of apparatus to different fire incidents.

Map #2i/j – Risk Assessment – Population Density for EMS Incidents

Another risk factor is the population density as there is a direct correlation between population and the demand for emergency medical services (EMS). More than 2,000 residents per square mile is considered, to some degree, to be urbanized by most national demographic planners. Due to historical zoning decisions, these areas exist not just downtown, but in all of the risk zones in this study. This means that Fire-Rescue's EMS system has to be deployed for a significant EMS demand in most areas of the City.

It must also be remembered that these maps only show reported residents, *not employment, homeless, or tourist* populations, which at some periods of the workday and/or at entrainment venues, add significant EMS risk exposure to Fire-Rescue's daily and hourly deployment plan.

Map #2k/l – Risk Assessment – Hazardous Materials Use Sites

Some commercial buildings use or store a significant amount of hazardous materials. Such sites are highly regulated by the Building and Fire Codes. The enforcement of the codes is conducted by Fire-Rescue and the San Diego County Environmental Health Agency. The location of these sites is mostly in the commercial and industrial zones of the City.

Map #3a/b – Fire Engine First-Due Unit Distribution at 5-Minute Travel

These two maps show, using light colored green street segments for uncongested traffic (non-rush-hour), the City's response coverage for first-due units within its stated goal of 5 minutes *travel* time. Therefore, the limit of green color per station area is the time an engine could reach within this time ***assuming*** it is in-station and encounters no unusual traffic delays. The mapping software uses actual fire company speed limits per roadway type. Thus, the green projection is realistic for fire trucks with normal traffic present.

As can be seen, there are several gap areas in the City not within reach of a fire station unit within 5 minutes travel time. A later map will examine these gaps and estimate how many added fire stations would be needed to close the gaps.

Citywide, actual dispatch data *shows* response times to be slower in most all areas of the City. This is due to the effects of the non-grid street design layout, open space areas, freeways that bisect parts of the City, traffic congestion, and simultaneous incident demand at peak hours of the day.

Additionally, using data for peak-hour congested traffic, the 5-minute engine coverage is shown as smaller coverage areas in **dark** green. Except for a few areas where there is historically close station spacing, most station areas lose significant coverage during peak traffic congestion hours.

Citygate obtains traffic congestion data for each day's morning and evening rush hours. We look for the mathematical variances and, if they are wide, produce maps by day of the week, or just morning or evening. Where the variances are small, and thus the congestion patterns are very similar, we use one mid-point congestion period to illustrate the most common impact.

The purpose of computer response mapping is to determine and balance station locations. This geo-mapping design is then checked in the study against actual dispatch time data, which reflects real world experience. There also should be some overlap between station areas so that a second-due unit can have a chance of an adequate response time when it covers a call in another fire company's first-due area.

Map #4a/b – ISO Coverage Areas

These maps display the Insurance Service Office (ISO) preference that stations cover a 1.5-mile distance response area. Depending on the road network, the 1.5-mile measure usually equates to a 3.5- to 4-minute travel time. However, a 1.5-mile measure is a conservative indicator of station spacing and overlap. As can be seen, the ISO coverage is similar, but less forgiving, than the 5-minute, *non-traffic-congested* travel time measure. This is because a "distance-based" measure cannot account for higher speeds on freeways and primary arterial streets that feed out into the neighborhoods.

These maps show that first-due fire company coverage gaps at the ISO 1.5-mile *distance measure* exist in several areas of the City outside of the downtown.

Finding #4:	Using the current 47 fire station locations, only the most-developed population density areas are within 5 minutes travel time of a fire engine. Traffic congestion has a marked negative impact on unit travel times in many fire station service areas.

Map #5a/b – Concentration (First Alarm Residential) at 8-Minute Travel; Normal and Traffic Congested

These maps show the Effective Response Force (ERF) *concentration* or massing of fire crews for serious fire or rescue calls. Building fires, in particular, require 15+ firefighters (per NFPA 1710) arriving within a reasonable time frame to work together and effectively to stop the escalation of the emergency. Otherwise, if too few firefighters arrive, or arrive too late in the fire's progress, the result is a greater alarm fire, which is more dangerous to the public and the firefighters.

The concentration map exhibits show the City's ability to send four engine companies, one truck company, one ALS ambulance, and two Battalion Chief officers to residential building fires within 8 minutes travel time (11:30 minutes total response time). This measure ensures that a minimum of 22 firefighters and an ambulance can arrive on-scene to work ***simultaneously*** and effectively to stop the spread of a serious building fire.

These maps show in light green *without traffic congestion*, where the City's current fire station system should deliver the initial Effective Response Force during off-peak traffic hours.

As can be seen, given a longer travel time measure of 8 minutes, only some of the City's core areas are covered by Fire-Rescue's multiple-unit force. As later maps show, most of the limitation on this coverage is due to the smaller quantity of ladder trucks and chief officer units.

When traffic congestion is applied, only the small areas shown as dark green can receive this multiple-unit force within 8 minutes of travel. Thus, in the north City area, **no** station areas receive the First Alarm within 8 minutes.

Finding #5:	Only some of City's core areas are within 8 minutes travel time of an Effective Response Force assignment of four engines, one ladder truck, one ambulance, and two Battalion Chiefs, with *no traffic congestion*. During traffic congestion this coverage *only occurs* in sections of downtown and Mission Valley.

Map #6a/b – Four Engines Only at 8-Minute Travel; Normal Traffic

The next few maps "take apart" the First Alarm force to show a different view of concentration by unit type. This map series only shows the 8-minute coverage of four engine companies or 16 firefighters. Here, the green color shows that the areas receiving four engines in 8 minutes travel time *given normal traffic*. The coverage for four engines is actually good except in the harder-to-serve edge areas of the City.

Map #7a/b – One Battalion Chief at 8-Minute Travel; Normal Traffic

These maps display the coverage for one Battalion Chief at 8 minutes travel time. Therefore, Maps #7a/b show the *minimum* City-provided chief officer. As can be seen, even with seven chief officers on duty, not all the edge areas can be covered *given normal traffic.*

Map #7c/d – Two Battalion Chiefs at 8-Minute Travel; Normal Traffic

Map series #5 measures Fire-Rescue's Effective Response Force concentration of units to serious fires, commonly called a First Alarm. Fire-Rescue's policy is to send two Battalion Chiefs. However, this significantly reduces the coverage of the entire First Alarm force. In map series #6 and #8 the coverage for up to four engines and one ladder truck is almost complete Citywide during normal traffic hours.

However, the Effective Response Force coverage in map series #5 is not nearly as complete. The reason or the limiting factor is the second Battalion Chief. Given only seven Battalion Chiefs cover the entire City, there are fewer areas that can be reached by both chiefs within 8 minutes travel.

Map series #7 shows the two-Battalion-Chief coverage in dark green and the single-chief coverage in light green. Clearly, the second chief officer is the limiting factor in map series #5, not the engines or ladder trucks.

Finding #6:	Even having grown over the years from five to seven Battalions, the northern and southern City station areas are not within 8 minutes travel time. It will take at least the addition of three more Battalion Supervisors per day to more completely cover the City. Adding these Battalion Supervisors also will increase the two-chief coverage on First Alarms.

Map #8a/b – One Ladder Truck Coverage at 8-Minute Travel; Normal Traffic

Maps #8a/b display the 8-minute travel time coverage for a minimum of one ladder truck. As can be seen, the City's current ladder trucks can cover most of the City too except for some edges of the City where the building fire frequency is also low.

Finding #7:	The *single* ladder truck coverage is adequate for the current needs of the City but the coverage will have to be re-evaluated as new growth areas are added beyond the identified infill gap fire stations.

Map #8c/d – Two Ladder Truck Coverage at 8-Minute Travel; Normal Traffic

Maps #8c/d display the coverage from two aerial ladder trucks, which is a *very hard* goal to achieve for most urban fire departments. The two-ladder coverage shrinks away from the edges of the City. However, the two-ladder coverage is most needed in the more heavily commercial and industrial areas where the coverage is better.

Map #9a/b – All Incident Locations – 1 Year

These maps show an overlay of the exact location for all incident types. It is apparent that there is a need for fire services on almost every street segment of the City. The greatest concentration of calls is also where the greatest concentration of City resources is available.

Map #10a/b – Emergency Medical Services and Rescue Incident Locations – 1 Year

These maps further show only the emergency medical and rescue call locations. With the majority of the calls for service being emergency medical, virtually all areas of the City need emergency medical services in any given year.

Map #11a/b – All Fire Type Locations – 1 Year

These maps show the location of all fires in the City for a one-year period. All fires include any type of fire call, from auto to dumpster to building. There are obviously fewer fires than medical or rescue calls. Even given this, it is evident that all first-due engine areas experience fires; the fires are more concentrated where the population is higher and the City's resources are more concentrated. These also happen to be the areas where the building stock is older and not built to the latest building and fire codes.

Map #12a/b – Structure Fire Locations – 1 Year

These maps show structure fire locations. While structure fires are a smaller subset of total fires, there are two meaningful findings from this map. First, there are still structure fires in every first-due fire company district. The location of many of the building fires parallels the older and higher risk building types in the City where more significant risk, and the ISO-evaluated buildings, are more common. These areas and buildings are of significant fire and life loss risk to the City. Second, fires in the more complicated building types must be controlled quickly or the losses can be very large.

Map #13a/b – EMS Incident Location Densities – 1 Year

This map view examines, by mathematical density, where clusters of emergency medical services incident activity occurred. In this set, the darker density color plots the highest concentration of all incidents. This type of map makes the location of frequent workload more meaningful than simply mapping all incident locations, as done in map series #10.

This perspective is important because the deployment system needs an overlap of units to ensure the delivery of multiple units when needed for serious incidents, or to handle simultaneous calls for service. When this type of map is compared with the concentration of engines in map series #6, the best concentration should be where the greatest density of calls for service occurs. This occurs in the core of the City where the fire station spacing is the closest.

Map #14a/b – All Fire Types Incident Location Densities – 1 Year

This map view is similar to map series #11, but displays the densities of all types of fire incidents, again following a population and building density pattern.

Map #15a/b – Structure Fire Densities – 1 Year

These maps show only the building fire workload by density. While there are small clusters of building fire occurrences, the greatest densities occur in the oldest and most densely developed sections of the City.

4.2.3 Fire Station Area Gap Coverage Analysis

The preceding mapping analysis showed that the current fire station locations cover 74% of the current City of San Diego public road system at a 5-minute drive time. The challenge then is to determine the number of gaps that are large enough to justify covering in the sixth minute of travel (5:01 to 5:59) to provide an equitable level of responder access to all neighborhoods, while not slowing the time needed to reach 90% of the road miles, as traffic congestion worsens and call for service demand increases.

The next step in this analysis is to look at the size, location, and risks in the gap areas beyond 5-minute coverage. Some gaps will be too small to ever be a candidate for an additional fire station. Other gaps could be the size of an entire fire station area or larger. Since the 2010 study, consistent with Citygate's recommendation's, Fire-Rescue has begun the pilot use of two-person squads that can be deployed in gaps and has also programmed additional fire stations that are now in the Capital Improvement Program (CIP) budget. The gap size information can be combined with a review of the frequency of response activity by adjacent fire companies. If the adjacent fire company that covers the gap is very busy, then the gap may not be just 5 to 6 minutes from another fire station, it could be much longer—8 to 10 minutes if the next closest unit is already committed to another emergency.

Map #16a-f – 5-Minute Travel Gap Analysis – Committed Future Fire Stations

Maps #16a/b were prepared using polygons around each proposed new fire station in a gap area beyond 5 minutes travel time coverage from a fire station. There are now six fire stations in various steps of development in the City's CIP process, four of which address significant gaps from the 2010 study recommendations. The near term future fire station list represented on this map is shown in the following table:

Table 10—Future Fire Stations in Current CIP Development

Station	Location	Funding	Status
Home Avenue Fire Station (no number assigned yet)	47th and Fairmount	Partially funded	Negotiating land purchase. Part of fire station design standardization project.
UCSD[1] Fire Station (no number assigned yet)	East side of North Torrey Pines Road, between Genesee and North Point Drive	To be determined	In negotiations with UCSD.
Bayside Fire Station (Station 02)	**875 West Cedar Street**	**Fully funded**	**Under construction. Anticipated completion late 2017.**
Black Mountain Fire Station (Station 48)	Northwest corner, Carmel Valley Road and Winecreek Road	Partially funded	Have secured land. In negotiations with developer; potential reimbursement agreement.
Otay Mesa (Station 49)	**Ocean View Hills Area**	**To be determined**	**Planned as developer agreement (no activity at this time).**
North University City (Station 50)	Southeast corner, Nobel Drive and Shoreline Drive	Partially funded	In design; construction late 2019.

[1] University of California, San Diego

The two stations listed in **bold** above were *not in the list of 10 priority added stations in the Citygate 2010 study. Station 2 was added to the west side of the railroad / light rail tracks improving downtown coverage. Station 49 is a new area and the station will be developer funded. The other four sites were identified in the 2010 study "top ten."*

Maps #16a-d show the north and south coverage from the six added stations in the CIP development list at both normal and congested traffic conditions. As can be seen, the six stations are located appropriately to infill gaps and new growth areas in the north coast, central, and Otay Mesa areas. All of them add significant new coverage during peak traffic congestion periods.

The next map pair #16e/f shows the north City First Alarm or Effective Response Force multiple unit coverage at normal and congested traffic conditions. There is a positive additional coverage in the greater UCSD areas. There is not better multiple-unit coverage in the upper I-15 corridor area. There is no *southern* map view as the added stations in the south do not significantly increase multiple-unit coverage. They do, however, add needed redundancy at peak hours of the day when units are committed to multiple incidents and all the needed units may not be available in a battalion sized area.

Finding #8:	Completing the six station sites currently being programmed in the near term Capital Improvement Program will add significant new coverage at peak hours of the day.

After the above six planned fire stations are active, the number of additional fire stations needed to improve 5-minute travel time first-due unit coverage must be determined. Following is a table showing road miles covered *with the addition of the six fire stations under various steps of development in the current CIP budget:*

Table 11—Currently Planned Six Stations Added Road Mile Coverage for First-Due and First Alarm Units

Time Measure	Total Road Miles (Within City Limits)	Non-Congested Miles Reached by Open Fire Stations	Congested Road Miles	Difference in Miles Covered
5-Minute First-Due Unit	5,012	3,793 *(**76%** of total public miles)*		**1,219**
			2,639 (**53%** of total public miles)	**1,154**
8-Minute First Alarm	5,012	1,727 *(**34%** of total public miles)*		**3,285**
		1,727	495 *(**10%** of total public miles)*	**1,232**

When the six stations in the current CIP budget work plan are on line, the first-due coverage improves by only 71 road miles or 1% of the Citywide total. These six stations also improve First Alarm multiple-unit coverage by a more significant 403 road miles, or 3% of the Citywide total. These measures illustrate why it is so expensive to increase station coverage and "catch up" for the years or even decades of growth creating station coverage gaps, and why at least more than the six currently being planned stations are necessary.

Map #17a-f – 5-Minute Travel Gap Analysis – Remaining Fire Station Gaps

After adding the stations in the current CIP budget work plan, Citygate then measured the remaining larger 5-minute gaps and identified gaps that would be *greater than 25 road miles*. We prepared the following data table to evaluate various demographics about each gap in addition to road miles underserved:

- Gap approximate size across in road miles
- Resident population and prior emergency incident demand.

Table 12—5-Minute Gaps and Identified Gaps Greater than 25 Road Miles

Gap Station Measures	Gap Size (Greater Than 25 Road Miles)	Incident Count (Based on Last Year of Data)	Approximate Population
Gap 1 Pacific Beach	35.84	387	12,848
Gap 2 University City	26.73	207	11,881
Gap 3 Torrey Pines	73.81	279	21,636
Gap 4 Southeast	46.78	303	15,940
Gap 5 Rancho Bernardo	33.14	336	9,113
Gap 6 Sabre Springs	29.01	129	8,618
Total	**245.31**	**1,641**	**80,036**
Percent of Citywide Total	**4.9%**	**1.8%**	**5.7%**

The gaps shown above are **not** listed in order of construction priority. Determining the timing of adding additional fire stations is complicated with issues other than the population, incidents, and 5-minute covered miles measured by Citygate in this study. The other issues to consider in siting a station are new growth proposed nearby, land cost, availability, zoning, environmental, and traffic safety to mention a few. The timing of all infill sites will be determined by City staff as they address the siting issues and forward to the City Council CIP budget requests as part of the normal budget cycle. Thus, even if all the above six sites are added to the six already in the current CIP development budget, it will take several years of work before final construction priorities can be set.

While it will take several years to at least add another six large gap infill stations to the current six new growth and infill gap stations already in the CIP development budget, a total of 12 added fire stations will add another almost 5% to 5-minute coverage, which raises the percent of coverage for the existing road miles *up to 80.6*%. This would be very good coverage given the challenging topography of San Diego.

Map series #17a-f shows in close detail the streets in each gap and their relationship to adjoining fire stations.

In conclusion, the Citygate 2010 study identified 10 priority infill gaps fire stations and 9 other smaller gaps better suited to the use of Fast Response Squads. At present, four infill gap stations are in process of being sited and funded. Others are in preliminary research and development.

If an additional six gap fire stations identified in the 2010 and 2017 update study were to be funded, then there would be 10 infill fire stations deployed in the identified 5-minute travel gaps on the existing road network. This quantity of 10 infill stations needed *is the same count* as in the

2010 study. Stated this way, San Diego is programming at present four of the 10 largest needed infill fire stations.

Please see Appendix A for a complete list of all the fire station areas identified in the 2010 and 2017 studies and their current status in the planning process.

Finding #9:	If six of the largest gaps identified in the 2017 Citygate study were filled over time with a fire station and at least one fully-staffed engine, as funds allow, the total population receiving improved coverage would amount to 80,036 residents at current population levels. In the last year, these gaps experienced a total incident demand of 1,641.
Finding #10:	If the currently programmed four infill gap fire stations plus the six largest gaps identified in the 2017 Citygate study (totaling ten) were added to the fire station system, Citywide 5-minute travel time coverage would improve from 74.7% to 80.6%.
Finding #11:	If the City public road miles remain static, then Citygate would not recommend adding more than 10 infill gap fire stations to the present system. The remaining gaps are too small and, if necessary, could be covered with the use of Fast Response Squads or peak activity engine companies during daylight hours. Of course, any completely new growth areas could also be large enough to justify added fire stations in addition to the 10 infill gap stations identified.

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SECTION 5—RESPONSE STATISTICAL ANALYSIS

5.1 HISTORICAL EFFECTIVENESS AND RELIABILITY OF RESPONSE—WHAT STATISTICS SAY ABOUT EXISTING SYSTEM PERFORMANCE

SOC ELEMENT 7 OF 8
RELIABILITY & HISTORICAL RESPONSE EFFECTIVENESS STUDIES

The map sets described in Section 4 show the ideal situation for response times and the responses' effectiveness given perfect conditions with no competing calls, normal traffic conditions, units all in place, and no simultaneous calls for service. Examination of the actual response time data provides a picture of how response times are in the "real" world of simultaneous calls, rush hour traffic conditions, units out of position for training, and delayed travel time for events such as periods of severe weather.

5.1.1 Data Set Identification

The San Diego Fire-Rescue Department provided National Fire Incident Reporting System 5 (NFIRS 5) incident and Computer-Aided Dispatch (CAD) apparatus response data for the time period of January 1, 2013 to April 30, 2016. These date ranges were used to obtain the latest data possible when this study started. Thus the data was assembled into the following three Reporting Years (RY) years:

- RY 13/14 May 1, 2013 to April 30, 2014
- RY 14/15 May 1, 2014 to April 30, 2015
- RY 15/16 May 1, 2015 to April 30, 2016

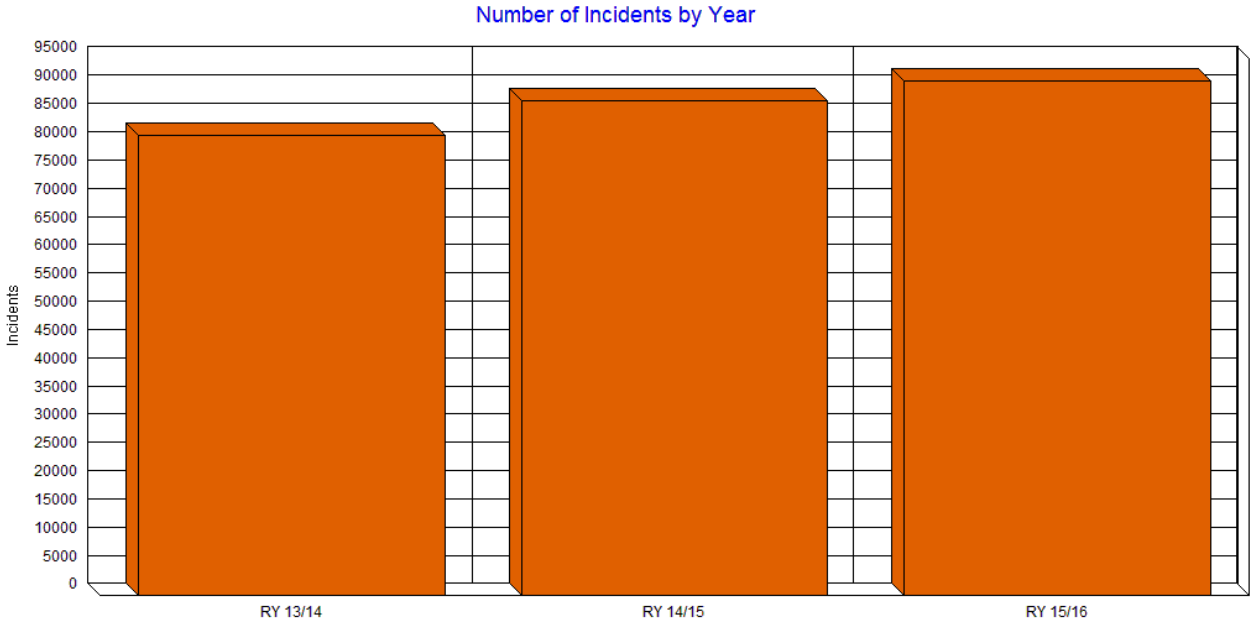
Throughout the data sections to follow when date ranges are identified the term Report Year or "RY" will be used.

5.2 SERVICE DEMAND

In RY 15/16, Fire-Rescue primary apparatus responded to 91,251 incidents. During this time period, San Diego had a daily incident demand of 250 incidents, of which 2.39% were to fire incidents, 83.92% were to EMS incidents, and 13.69% were to "Other" incident types.

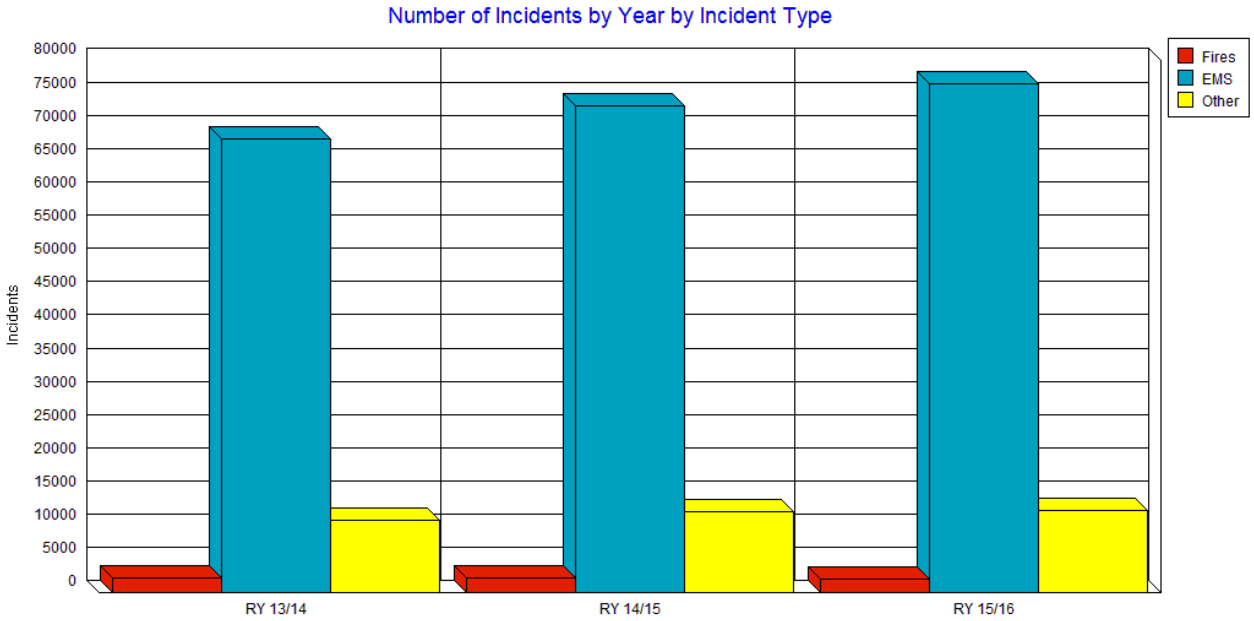
During this same period, there were 165,762 apparatus responses. This means there was an average of 1.82 San Diego primary apparatus responses per incident. Fire-Rescue experienced a steady growth in the number of incidents from RY 13/14 through RY 14/15.

Figure 2—Number of Incidents by Year



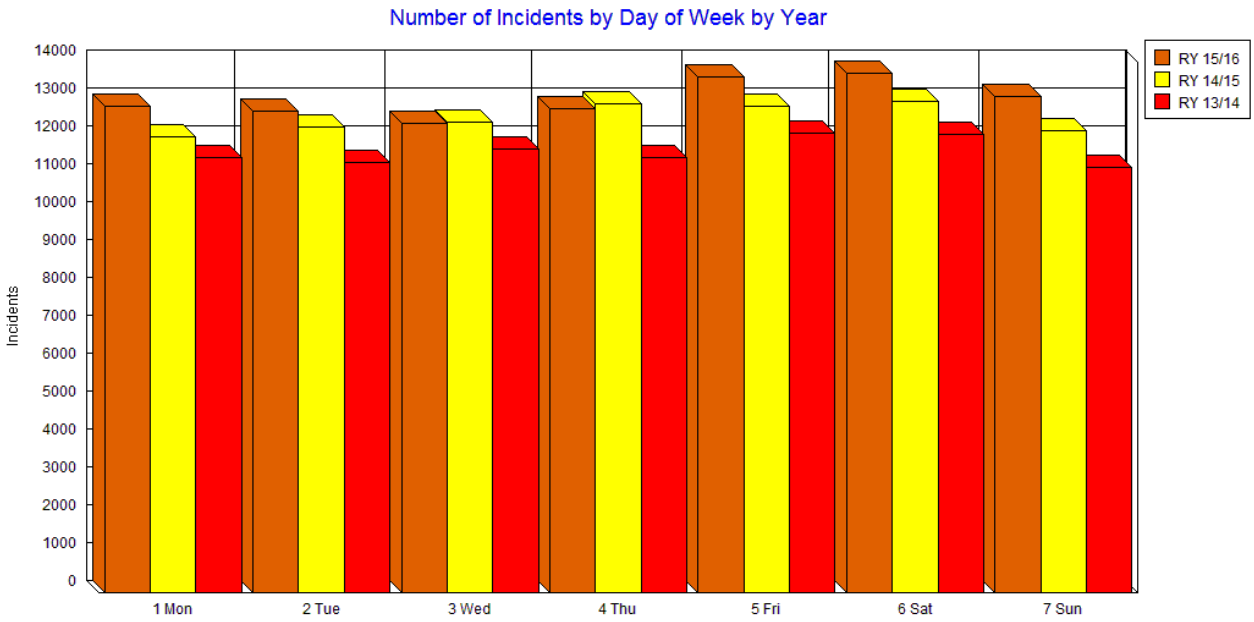
The following figure illustrates the number of incidents by incident type and volume per year:

Figure 3—Number of Incidents by Year by Incident Type



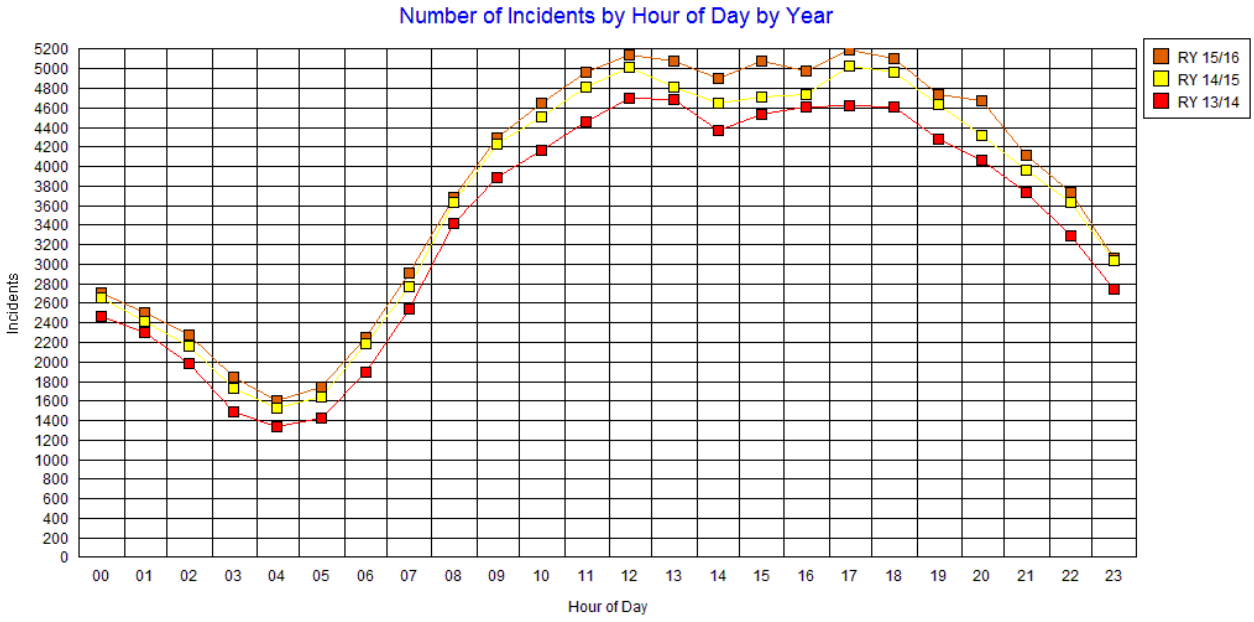
In the next graph, when broken down by day of week, incident activity rises slightly on Friday and Saturday.

Figure 4—Number of Incidents by Day of Week by Year



The following displays the breakdown of incidents by hour of the day by year. The increase in RY 15/16 incidents during afternoon and early evening hours is evident.

Figure 5—Number of Incidents by Hour of Day by Year



The following table shows hourly incident totals by hours of day and day of week in FY 15/16. Green areas have the least activity. Red areas have the heaviest activity. It is evident that the greatest incident activity is in the late morning through the early evening hours.

Table 13—Hourly Incident Totals by Hours of Day and Day of Week

Hour	1 Mon	2 Tue	3 Wed	4 Thu	5 Fri	6 Sat	7 Sun	Total
00	375	308	308	337	392	478	507	**2,705**
01	314	250	268	275	340	497	567	**2,511**
02	322	264	225	233	300	426	502	**2,272**
03	232	242	181	263	235	351	347	**1,851**
04	243	200	192	197	227	275	267	**1,601**
05	263	218	237	263	235	256	266	**1,738**
06	337	337	330	316	334	315	277	**2,246**
07	470	438	436	462	430	364	312	**2,912**
08	574	524	523	550	596	447	471	**3,685**
09	697	633	619	567	660	574	543	**4,293**
10	722	642	654	737	673	626	588	**4,642**
11	689	720	708	735	768	701	647	**4,968**
12	734	777	745	723	765	743	659	**5,146**
13	715	737	708	680	792	705	738	**5,075**
14	670	715	707	726	753	714	623	**4,908**
15	683	755	743	729	733	756	686	**5,085**
16	654	800	742	734	734	695	625	**4,984**
17	719	778	712	743	801	732	705	**5,190**
18	752	749	721	714	739	700	733	**5,108**
19	646	674	657	671	678	726	690	**4,742**
20	646	587	602	685	700	741	711	**4,672**
21	545	531	564	582	625	648	621	**4,116**
22	476	431	480	463	599	722	565	**3,736**
23	381	405	348	416	523	544	448	**3,065**

A detailed review of the types of properties to which Fire-Rescue responds finds, in summary, that of the serious fire and EMS incidents in RY 15/16, 50% occurred in residential dwelling and rental units (such as hotels) of all types. Another 27% occurred on roads, on highways, and in parking areas. The remaining 23% occurred across a variety of commercial, industrial, and open

space properties. Given that, in most cities, the predominant land use type is residential, these incident locations in San Diego are normal.

Finding #12: The highest volume hours for incidents span from 9 am through 9 pm, and even later on Friday and Saturday. Given this, where additional units are needed for high workload volumes, they could be peak-hour units for 12 hours per day, 7 days per week.

5.2.1 Simultaneous Incident Demand

Simultaneous incidents are incidents that begin when other incidents have already been underway. In San Diego during RY 15/16, 99.88% of incidents occurred while one or more other incidents were underway. The percentage of simultaneous incidents, broken-down by number of simultaneous incidents, is shown in the following table where "1 or more" means that there are two incidents open, "2 or more" means there are three incidents open, etc.:

Table 14—Simultaneous Incident Activity

Number of Simultaneous Incidents	Percentage
1 or more	99.88%
2 or more	99.37%
3 or more	98.03%
4 or more	95.37%
5 or more	91.34%
6 or more	85.93%
7 or more	79.07%
8 or more	71.15%
9 or more	62.56%
10 or more	53.55%
11 or more	44.53%
12 or more	35.88%
13 or more	28.07%
14 or more	21.06%

In a large 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.

The following table shows the quantities of simultaneous incidents within a single station area for the three years of data. The table is organized to show the stations with the highest simultaneous incident activity first. Year-to-year trends in each station area can be easily seen. *(Note: this table is continued on following page.)*

Table 15—Number of Simultaneous Incidents by Station

Station	RY 13/14	RY 14/15	RY 15/16
17	1,518	1,827	1,742
04	1,017	1,200	1,349
12	1,187	1,112	1,129
01	893	1,042	1,311
29	877	894	1,054
05	652	749	1,263
35	741	849	949
20	687	774	935
21	644	698	809
07	543	592	829
19	577	631	753
10	499	551	716
28	518	474	501
201	428	461	524
14	436	473	416
26	338	418	421
32	406	400	323
03	322	309	446
18	302	348	399
23	262	318	367
11	276	277	372
30	242	288	349
36	260	265	306
33	222	269	295
45	188	280	294
25	182	246	282
27	177	231	254
15	187	225	225

Station	RY 13/14	RY 14/15	RY 15/16
38	176	198	252
08	168	180	223
44	157	173	182
24	140	161	188
06	147	166	175
40	134	127	166
22	123	142	141
31	91	111	182
13	117	135	127
39	88	101	120
34	79	78	121
09	87	73	82
41	73	81	73
42	68	66	65
51	4	2	99
16	36	30	37
43	27	36	37
37	31	33	24
46	2	6	10
47	4	3	5

5.3 Response Time Analysis

Once the types of incidents are quantified, incident analysis shifts to the time required to respond to those incidents. Fractile breakdowns track the percentage (and count the number) of incidents meeting defined criteria, such as the first apparatus to reach the scene within progressive time segments.

5.3.1 Response Time Performance

A person calling 9-1-1 measures the speed of fire department response from the time assistance is requested until the assistance arrives. This measurement is called "Call to First Apparatus Arrival" (or "Call to Arrival"). Police departments, under state law, act as a Public Safety Answering Point (PSAP) for 9-1-1 calls. All 9-1-1 calls for fire or medical service in the City are routed to the San Diego Police Communications Center. Upon a cursory review, fire, EMS, and other rescue calls are routed to the Fire-Rescue Emergency Command and Data Center (ECDC)

for processing and crew dispatching. This center handles all fire service dispatching in the City plus others under contract and allows for a coordinated, closest-unit response, regardless of jurisdiction of incident origin.

Based upon the adopted City of San Diego 5-minute *travel* time goal, the total response time measure is 7:30 minutes (or 450 seconds). This is made up of three component parts:

Table 16—Response Time Components

Time Component	Minutes	Description
Call Processing Time	60 seconds	Receive, determine need, alert crew
Turnout Time	90 seconds	Notify, don required protective gear, get moving
Travel Time	5 minutes	Drive to scene
Call to Arrival	**7:30 minutes/seconds**	**Time from 9-1-1 ECDC receipt to first unit arrival**

There are three fundamental measurements of operational performance: call processing, turnout time, and travel time.

- Call processing begins when a request for assistance is first received and ends when the dispatch center communicates the location and nature of the emergency to responders.
- Turnout begins with responder notification and ends when the fire apparatus begins "wheels turning" to the scene of the emergency.
- Travel begins with "wheels turning" and ends when the apparatus arrives at the scene of the emergency.

Each of these basic measurements is calculated as the amount of time it takes to reach 90% compliance. Using call processing as an example, a set of incidents is selected and the amount of time it takes for 90% of requests for assistance to be dispatched to one or more apparatus can be calculated.

Also measured is the performance of a team of apparatus commonly called a "First Alarm" but more properly known in fire service deployment as an Effective Response Force (ERF). This team is dispatched to serious or high risk incidents such as building and wildland fires or technical rescues. It is a best practice to measure "ERF Travel" from the first apparatus in the ERF to start "wheels turning" until the last apparatus necessary to establish the ERF team arrives on the scene. Thus, there are six types of response time performance outlined below to meet best practices as recommended by the NFPA and the Commission on Fire Accreditation International:

1. Call Processing
2. Turnout
3. Travel
4. Dispatch to Arrival
5. Call to Arrival
6. ERF Travel

Information on each performance category is provided below. The following performance measurements are based on apparatus response data timestamps from RY 15/16. Only "in-jurisdiction" fire and EMS incidents (where no mutual or auto aid was provided/given) were used for this analysis.

The times are shown in minutes and seconds and show the amount of time necessary for 90% of emergency incidents to be handled. The number in parenthesis to the right of the time is the number of incidents used to perform the calculation. This number represents fire and EMS incidents with first arriving apparatus having call processing performance meeting outlier specifications. Outlier specifications eliminate times that are unrealistically too low or too high.

5.3.2 Call Processing Performance

Table 17—Call Processing Analysis (90% Baseline Performance in RY 15/16)

Battalion	Time
Department-Wide	01:35

Finding #13: National best practices as recommended by National Fire Protection Association Standard 1221 are for call processing to be 90 seconds, 90% of the time, and 120 seconds, 99% of the time. Fire-Rescue is substantially meeting this goal.

5.3.3 Turnout Performance

Table 18—Turnout Time Analysis (90% Baseline Performance in RY 15/16)

Battalion	Time
Department-Wide	01:27

Station design can profoundly affect turnout time. However, other factors such as location confirmation, gearing-up, and other essential and non-essential response preparations can have an effect on turnout time.

Finding #14:	Fire-Rescue's realistic goal for turnout time is 90 seconds to 90% of the emergent incidents. San Diego is just under this goal and is to be commended for its performance meeting a best-practices-based goal.

5.3.4 Travel Time Performance

Given the size of the City of San Diego and a desirable goal for every neighborhood to have equitable access to fire and emergency medical services, the following travel times are reported by fire station areas and thus provide correlation to the geographic information systems mapping projections. Only four fire station areas meet the 5:00-minute travel time goal, as shown in light grey:

Table 19—Travel Time Analysis (90% Baseline Performance in RY 15/16)

Battalion/Station	Time
Department-Wide	**06:09**
Battalion 01	05:06
Station 01	04:43
Station 03	06:34
Station 04	04:45
Station 07	04:44
Station 11	05:42
Battalion 02	05:58
Station 05	05:42
Station 08	05:15
Station 14	04:59
Station 18	05:55
Station 23	06:09
Station 28	06:31
Station 36	06:35
Battalion 03	06:26
Station 15	05:47
Station 20	06:26
Station 21	05:48
Station 22	06:21
Station 25	06:59
Station 27	06:54
Battalion 4	06:00
Station 10	05:52
Station 17	05:33
Station 26	05:36
Station 31	06:25
Station 34	05:59
Station 39	06:35
Station 45	07:01

Battalion/Station	Time
Battalion 5	07:18
Station 09	06:51
Station 13	05:41
Station 16	07:28
Station 24	07:50
Station 35	07:14
Station 41	08:00
Station 47	06:59
Battalion 6	06:03
Station 06	06:04
Station 12	05:41
Station 19	05:32
Station 29	06:15
Station 30	05:33
Station 32	05:55
Station 43	09:19
Station 51	05:35
Battalion 7	06:41
Station 33	06:57
Station 37	06:56
Station 38	06:22
Station 40	06:38
Station 42	06:31
Station 44	06:36
Station 46	07:07

Finding #15: In the Report Year 15/16 measurement period, Fire-Rescue had a 90% travel time Citywide of 6:09 minutes/seconds. This travel time is 1:09 minutes longer than the City's goal of 5:00 minutes. This travel time is fairly consistent across urbanized areas of the City, as only four station areas in San Diego were under a 5-minute travel time goal. To substantially reduce travel time, more fire stations are necessary.

5.3.5 Travel Time Comparison

It is valuable to compare the travel time Citywide from the 2010 study to this 2017 update:

Table 20—Travel Time Comparison from 2010 to 2017

Year	Travel Time % at 5 Minutes	Minutes/Seconds @ 90%
2010	74.5%	6:20
2017	77.1%	6:15

While travel time performance is slightly better, even with post-recession traffic congestion, the City has not to date added enough resources to bring Citywide travel down to 5 minutes to 90% of the incidents.

5.3.6 Fire Crew Dispatch to Arrival Time Performance

Fire-Rescue's goal for fire crew dispatch to arrival of the first crew on scene is 6:30 minutes to 90% of the fire and EMS incidents. Actual crew dispatch to arrival performance was over the 90% Fire-Rescue goal of 6:30 minutes by 36 seconds.

Table 21—Crew Dispatch to Arrival Time Analysis (90% Baseline Performance in RY 15/16)

Battalion/Station	Time
Department-Wide	**07:06**

5.3.7 Call to Arrival Time Performance

This measure combines the steps of dispatch processing, crew notification with turnout, and travel time to 90% of the fire and EMS incidents. San Diego's adopted goal for this "total response time" is 7:30 minutes/seconds. As can be seen in light grey shading in the following

table, only seven station areas meet a 90% best practice goal of 7:30 minutes/seconds from fire dispatch receipt to first unit on scene:

Table 22—Fire Dispatch Receipt to *Arrival* Time Analysis (90% Baseline Performance in RY 15/16)

Battalion/Station	Time
Department-Wide	**08:10**
Battalion 01	07:14
Station 01	06:53
Station 03	08:55
Station 04	06:56
Station 07	06:46
Station 11	07:47
Battalion 02	07:52
Station 05	07:43
Station 08	07:10
Station 14	06:50
Station 18	07:48
Station 23	08:04
Station 28	08:30
Station 36	08:29
Battalion 03	08:25
Station 15	07:46
Station 20	08:29
Station 21	07:45
Station 22	08:36
Station 25	08:53
Station 27	08:41
Battalion 4	07:58
Station 10	07:49
Station 17	07:29
Station 26	07:39
Station 31	08:25
Station 34	08:02
Station 39	08:15
Station 45	08:56

Battalion/Station	Time
Battalion 5	09:19
Station 09	08:53
Station 13	07:49
Station 16	09:05
Station 24	09:55
Station 35	09:23
Station 41	10:03
Station 47	09:26
Battalion 6	08:05
Station 06	07:57
Station 12	07:43
Station 19	07:30
Station 29	08:16
Station 30	07:38
Station 32	07:51
Station 43	11:36
Station 51	07:35
Battalion 7	08:41
Station 33	09:04
Station 37	08:48
Station 38	08:17
Station 40	08:40
Station 42	08:22
Station 44	08:39
Station 46	09:26

Finding #16: Due to longer travel times, with the current quantity of fire stations, Fire-Rescue only has seven station areas performing better than the City's adopted Emergency Command and Data Center 9-1-1 call receipt to arrival time of 7:30 minutes/seconds. The station areas with the longer travel times also have the longest call receipt to arrival times.

5.3.8 First Alarm (Effective Response Force) Performance to Building Fires

In Fire-Rescue, the response plan *for a single-family home fire* is for four engines, one ladder truck, one ambulance, and two Battalion Chiefs for a minimum force total of **22** firefighting personnel plus an ambulance. The adopted travel time goal for Fire-Rescue and NFPA 1710 for career fire departments in urban areas is that the last unit arrive within 8 minutes *travel time* to 90% of the First Alarms.

Table 22 shows the 90% ERF travel for 272 incidents in three years where at least four engines and one ladder truck all arrived at the incident. Not all fires are serious enough for all of the units to be needed, so the resultant ERF count is small and not as statistically significant. Thus, the following table only aggregates ERF measures by Battalion areas:

Table 18—Travel Time for ERF Incidents (90% Baseline Performance in 3 Years)

Battalion	Time
Department-Wide	**10:02**
Battalion 01	08:33
Battalion 02	08:33
Battalion 03	14:23
Battalion 04	07:01
Battalion 05	08:07
Battalion 06	06:35
Battalion 07	14:33

The travel times shown in the prior table are reflective of Battalions with more stations, and the sheer size of some of the station and Battalion areas where more stations are needed. Even then, three of seven Battalions come close to or beat the 8:00 goal. This is reflective of areas with tighter fire station spacing and efficient road networks.

5.3.9 Engine and Truck Workload Capacity Analysis

Due to the simultaneous incident rates measured in this study and the lengthy travel times in many areas approaching 6 minutes, this section of incident measures presents demand on units by the hour of day it occurs, and determines if the peak-hour demand is so high that response times suffer because units must cross the City to cover for overly busy units.

In the tables to follow, the different colors illustrate the variation in demand; the lowest rates of activity are green, progressing up to yellow, and finally red which indicates the greatest quantity of incidents or rate of activity. The following tables depict a Unit-Hour Utilization (UHU) summary. The percentage listed is the percentage likelihood a particular unit is assigned to a 9-1-1 incident at any given hour. This number considers not only the number of emergency incidents, but also the duration of the incidents. The busiest units are listed first.

In the tables to follow, it is important to consider the ideal maximum utilization percentage on a firefighting unit. During the 9-hour daytime work period, when crews on a 24-hour shift need to also pay attention to apparatus checkout, station duties, training, public education, and paperwork, plus required physical training and meal breaks, understanding all of the factors that go into a fire crew duty shift, Citygate recommends the maximum commitment UHU per hour *for a fire engine or ladder company* should not exceed 30%. Beyond that, the most important element to suffer will be training hours.

There is a need to gain maximum economic efficiency out of an ambulance unit that is expensive to staff. For an ambulance or low acuity squad working *less than* a 24-hour shift, such as an 8- to 12-hour shift, then the UHU can rise to 40-50% at a maximum. At that UHU level, peak-hour ambulance squad crews must then have additional duty days for training only, and not responding to incidents, to meet their annual continuing education and training hours requirements. Citygate recommends that a Fast Response Squad or ambulance crew on a 24- to 48-hour shift also should not be worked above 30% UHU and, if done so for most of its core workday hours, its training and other commitments to Fire-Rescue duties will suffer.

The following table is a unit-hour utilization summary for the busiest 10 San Diego engine companies. The busiest engines are listed first.

Table 23—RY 15/16 Unit-Hour Utilization – Engine Companies

Hour	E17	E12	E5	E4	E35	E14	E29	E7	E10	E20
00	19.34%	16.25%	11.55%	19.26%	12.73%	12.98%	15.07%	12.31%	16.19%	9.30%
01	15.63%	10.87%	15.15%	17.07%	11.82%	14.91%	9.06%	15.50%	12.97%	6.97%
02	19.56%	11.69%	19.56%	16.20%	11.33%	12.80%	11.32%	8.92%	10.37%	6.73%
03	13.13%	11.01%	9.54%	9.98%	8.47%	7.90%	9.84%	7.05%	9.32%	6.75%
04	10.57%	10.06%	9.23%	7.52%	8.46%	7.89%	9.22%	5.19%	7.21%	5.54%
05	11.40%	11.12%	8.74%	10.02%	10.72%	9.31%	8.85%	8.71%	7.35%	7.70%
06	14.24%	13.27%	10.68%	12.32%	12.91%	8.85%	10.59%	8.33%	11.19%	8.77%
07	16.31%	13.44%	16.10%	13.36%	13.52%	11.98%	9.46%	11.40%	9.33%	10.98%
08	21.25%	15.25%	14.63%	14.26%	22.99%	11.35%	10.85%	14.03%	14.37%	12.40%
09	22.07%	18.08%	17.39%	12.55%	18.94%	14.20%	15.48%	14.01%	13.94%	15.87%
10	24.74%	15.82%	18.25%	12.25%	16.15%	18.87%	16.40%	15.60%	13.24%	14.47%
11	19.64%	20.51%	17.07%	14.08%	16.18%	16.91%	16.29%	15.31%	13.32%	13.66%
12	22.72%	21.33%	21.23%	21.69%	24.40%	16.46%	19.31%	17.22%	16.96%	18.67%
13	25.46%	21.30%	23.92%	20.95%	18.35%	18.93%	19.68%	18.37%	17.32%	22.80%
14	24.43%	20.71%	23.29%	21.97%	20.62%	18.71%	16.29%	22.56%	14.23%	19.23%
15	24.46%	21.58%	21.16%	20.71%	19.90%	18.74%	19.64%	15.51%	13.61%	19.65%
16	22.91%	22.15%	19.65%	17.49%	20.21%	19.99%	18.77%	15.81%	16.33%	19.67%
17	24.89%	22.38%	18.07%	20.11%	19.19%	20.95%	18.96%	19.83%	16.33%	19.03%
18	26.72%	21.56%	22.75%	19.25%	20.51%	17.05%	16.53%	17.77%	22.28%	16.82%
19	22.24%	25.79%	19.62%	21.16%	18.40%	14.04%	16.74%	19.65%	20.57%	16.69%
20	23.96%	23.50%	21.59%	19.62%	19.10%	15.81%	17.90%	16.17%	19.30%	20.06%
21	20.63%	18.57%	19.06%	20.45%	15.30%	17.62%	14.47%	16.21%	17.18%	13.86%
22	18.08%	17.81%	17.51%	16.97%	13.93%	12.32%	14.59%	15.99%	12.61%	15.92%
23	18.18%	13.91%	14.00%	14.24%	14.31%	11.88%	14.94%	12.72%	13.84%	11.06%
Overall	**20.11%**	**17.42%**	**17.07%**	**16.40%**	**16.19%**	**14.60%**	**14.59%**	**14.34%**	**14.14%**	**13.86%**

The following table displays a unit-hour utilization summary for the busiest 10 ladder companies:

Table 24—RY 15/16 Unit-Hour Utilization – Ladder Companies

Hour	T35	T12	T14	T20	T10	T11	T1	T28	T29	T21
00	2.82%	5.02%	3.49%	1.39%	3.74%	1.36%	2.56%	1.69%	2.43%	1.40%
01	2.86%	1.41%	4.30%	1.78%	2.73%	1.16%	1.22%	2.46%	2.80%	2.74%
02	2.95%	3.48%	2.79%	1.24%	2.14%	2.80%	2.15%	0.83%	1.43%	8.18%
03	2.50%	1.72%	1.24%	0.61%	2.43%	1.40%	2.04%	0.41%	1.16%	0.69%
04	2.30%	0.78%	3.17%	0.78%	0.70%	0.61%	1.50%	0.83%	0.62%	0.98%
05	2.84%	1.28%	2.16%	2.70%	1.91%	0.66%	2.45%	1.25%	1.74%	0.47%
06	2.56%	1.66%	1.24%	1.98%	2.04%	0.57%	1.68%	1.45%	0.88%	0.80%
07	4.41%	3.04%	3.32%	4.23%	1.78%	3.39%	4.10%	2.38%	1.96%	1.33%
08	8.00%	4.19%	3.83%	3.20%	6.12%	2.40%	2.78%	2.59%	4.06%	2.68%
09	7.82%	7.22%	5.88%	5.14%	5.38%	4.69%	4.92%	4.55%	5.01%	2.82%
10	8.61%	6.87%	10.23%	6.74%	6.37%	10.73%	12.05%	7.19%	4.66%	5.16%
11	8.34%	9.21%	5.73%	6.84%	6.03%	7.39%	9.15%	5.38%	6.08%	3.31%
12	7.59%	7.21%	6.50%	5.83%	3.53%	3.91%	4.20%	6.54%	5.50%	3.03%
13	7.18%	6.28%	5.91%	6.93%	6.13%	5.29%	4.82%	5.75%	5.21%	3.69%
14	7.68%	8.85%	7.10%	8.74%	7.61%	7.49%	3.47%	5.59%	4.92%	5.20%
15	8.75%	7.35%	8.61%	7.31%	6.51%	6.30%	6.61%	7.86%	7.54%	5.80%
16	6.73%	6.34%	9.35%	5.72%	6.06%	5.22%	3.83%	4.80%	4.38%	4.07%
17	5.53%	7.23%	5.86%	5.90%	5.34%	4.56%	3.92%	6.66%	4.17%	4.16%
18	8.58%	6.34%	5.72%	5.22%	6.21%	3.36%	2.77%	5.18%	3.16%	3.54%
19	5.91%	7.23%	4.05%	3.81%	3.94%	5.32%	2.99%	2.22%	2.73%	3.29%
20	5.62%	7.44%	6.84%	7.79%	5.07%	4.64%	2.14%	4.66%	3.11%	4.28%
21	4.30%	4.55%	4.21%	3.37%	3.76%	3.64%	3.41%	2.25%	3.55%	1.62%
22	4.39%	4.79%	2.38%	4.42%	2.66%	2.35%	2.64%	1.14%	3.04%	2.15%
23	3.42%	2.78%	2.56%	1.71%	2.01%	3.32%	3.84%	0.66%	2.64%	2.71%
Overall	**5.49%**	**5.09%**	**4.85%**	**4.31%**	**4.18%**	**3.86%**	**3.80%**	**3.51%**	**3.45%**	**3.09%**

Finding #17: While some engines reach mid-20% Unit-Hour Utilization workloads, no engines approach a Citygate-recommended threshold of 30% hour after hour. At peak hours of the day, while many engines are busy responding to EMS events, adding flexibly deployed engines into gap areas would provide the greatest possible reduction to response times to neighborhoods the farthest from fire stations.

Finding #18:	The busiest ladder trucks only approach 10% Unit-Hour Utilization workloads and at this time, relief or added ladder trucks are not necessary where there is already adequate ladder truck coverage.

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SECTION 6—SOC EVALUATION AND RECOMMENDATIONS

6.1 OVERALL EVALUATION

SOC ELEMENT 8 OF 8
OVERALL EVALUATION

San Diego Fire-Rescue serves a very diverse land use pattern with a geographically challenging and limited road network in some areas. Population drives service demand and development brings population.

While the state-mandated Fire Code requires fire sprinklers even in dwellings, it will be many more decades before enough buildings are replaced or remodeled using automatic fire sprinklers. For the foreseeable future, the City will need both a first-due firefighting unit and Effective Response Force (First Alarm) coverage in all parts of the City, consistent with current best practices, if the risk of the fire is to be limited to only part of the inside of the affected building.

Fire-Rescue is not meeting the City's goal of "*5:00 minutes travel time.*" The reality is instead of a 5:00-minute response time from crew notification, the actual Citywide performance is 06:09 minutes (or 1:09) longer. Citygate submits there are three principal reasons for this situation: (1) too few stations; (2) traffic congestion; and (3) high workload rates on many key companies.

As the 2010 study identified, over several decades as the City grew outward from its historic core neighborhoods, it did not add enough fire stations to equitably cover all areas with best-practices-based response times. The only way to materially improve response times is to add the fire stations identified in this study.

Fire-Rescue is to be commended; it is meeting its goals for dispatch and crew turnout time, so these times cannot be materially lowered.

Citygate's 2010 study identified 10 priority infill fire stations. At present, four are in process of being sited and funded. If the six gap fire stations identified in this 2017 update study were to be funded, then there would be 10 infill fire stations deployed in the identified 5-minute travel gaps on the existing road network. This quantity of 10 infill stations needed *is the same count* in both the 2010 and 2017 studies. Stated this way, San Diego is programming at present four of the needed total 10 infill fire stations.

Adding 10 infill gap area fire stations will increase the number of road miles covered to 80.6%. This is very good coverage given the challenging topography of San Diego.

6.1.1 The Path Ahead

If the City wants to provide the following three outcomes, the City will have to increase its deployment of fire crews by adding at least 10 key missing fire stations. The three outcomes are:

- Provide equitable response times to all similar risk neighborhoods.
- Provide for depth of response when multiple incidents occur.
- Provide for a concentration of response forces in the core for high-risk venues.

If the City chooses not to continue these three policy goals for fire services delivery, then it should adopt a travel time goal that it can afford, understanding that longer response times will mean the most time-sensitive emergencies could experience worse than desired outcomes.

In addition to the added fire stations, the City will eventually need to add at least three more geographic area Battalions.

Last, to maintain response times and training schedules during peak incident demand hours of the day, Fire-Rescue should increase the use of peak-hour activity units, using squads and/or full engine companies.

Determining the timing of adding additional fire stations is complicated with issues other than the population, incidents, and 5-minute covered miles measured by Citygate in this study. The other issues to consider in siting a station are new growth proposed nearby, land cost, availability, zoning, environmental, and traffic safety to mention a few. The timing of these six infill sites will be determined by City staff as they address all the siting issues and forward Capital Improvement Program (CIP) budget requests to the City Council as part of the normal budget cycle.

6.1.2 Complete List of Findings

Finding #1: The City Council has adopted a complete and best-practices-based deployment measure for fire and emergency medical services incidents. Adopting a similar set of specialty response measures would meet the best practice recommendations of the Commission on Fire Accreditation International.

Finding #2: Fire-Rescue follows best practices by using a standard response dispatching plan that considers the risk of different types of emergencies and pre-plans the response. Each type of call for service receives the combination of engine companies, truck companies, ambulances, specialty units, and command officers customarily needed to handle each type of incident based on experience.

Finding #3: Minimum apparatus staffing per unit on engine and ladder truck companies at four is a recognized best practice for the City's size and risks.

Finding #4: Using the current 47 fire station locations, only the most-developed population density areas are within 5 minutes travel time of a fire engine. Traffic congestion has a marked negative impact on unit travel times in many fire station service areas.

Finding #5: Only some of City's core areas are within 8 minutes travel time of an Effective Response Force assignment of four engines, one ladder truck, one ambulance, and two Battalion Chiefs, with *no traffic congestion*. During traffic congestion this coverage *only occurs* in sections of downtown and Mission Valley.

Finding #6: Even having grown over the years from five to seven Battalions, the northern and southern City station areas are not within 8 minutes travel time. It will take at least the addition of three more Battalion Supervisors per day to more completely cover the City. Adding these Battalion Supervisors also will increase the two-chief coverage on First Alarms.

Finding #7: The *single* ladder truck coverage is adequate for the current needs of the City but the coverage will have to be re-evaluated as new growth areas are added beyond the identified infill gap fire stations.

Finding #8: Completing the six station sites currently being programmed in the near term Capital Improvement Program will add significant new coverage at peak hours of the day.

Finding #9: If six of the largest gaps identified in the 2017 Citygate study were filled over time with a fire station and at least one fully-staffed engine, as funds allow, the total population receiving improved coverage would amount to 80,036 residents at current population levels. In the last year, these gaps experienced a total incident demand of 1,641.

Finding #10: If the currently programmed four infill gap fire stations plus the six largest gaps identified in the 2017 Citygate study (totaling ten) were added to the fire station system, Citywide 5-minute travel time coverage would improve from 74.7% to 80.6%.

Finding #11: If the City public road miles remain static, then Citygate would not recommend adding more than 10 infill gap fire stations to the present system. The remaining gaps are too small and, if necessary, could be covered with the use of Fast Response Squads or peak activity engine companies during daylight hours. Of course, any completely new growth areas could also be large enough to justify added fire stations in addition to the 10 infill gap stations identified.

Finding #12: The highest volume hours for incidents span from 9 am through 9 pm, and even later on Friday and Saturday. Given this, where additional units are needed for high workload volumes, they could be peak-hour units for 12 hours per day, 7 days per week.

Finding #13: National best practices as recommended by National Fire Protection Association Standard 1221 are for call processing to be 90 seconds, 90% of the time, and 120 seconds, 99% of the time. Fire-Rescue is substantially meeting this goal.

Finding #14: Fire-Rescue's realistic goal for turnout time is 90 seconds to 90% of the emergent incidents. San Diego is just under this goal and is to be commended for its performance meeting a best-practices-based goal.

Finding #15: In the Report Year 15/16 measurement period, Fire-Rescue had a 90% travel time Citywide of 6:09 minutes/seconds. This travel time is 1:09 minutes longer than the City's goal of 5:00 minutes. This travel time is fairly consistent across urbanized areas of the City, as only four station areas in San Diego were under a 5-minute travel time goal. To substantially reduce travel time, more fire stations are necessary.

Finding #16: Due to longer travel times, with the current quantity of fire stations, Fire-Rescue only has seven station areas performing better than the City's adopted

Emergency Command and Data Center 9-1-1 call receipt to arrival time of 7:30 minutes/seconds. The station areas with the longer travel times also have the longest call receipt to arrival times.

Finding #17: While some engines reach mid-20% Unit-Hour Utilization workloads, no engines approach a Citygate-recommended threshold of 30% hour after hour. At peak hours of the day, while many engines are busy responding to EMS events, adding flexibly deployed engines into gap areas would provide the greatest possible reduction to response times to neighborhoods the farthest from fire stations.

Finding #18: The busiest ladder trucks only approach 10% Unit-Hour Utilization workloads and at this time, relief or added ladder trucks are not necessary where there is already adequate ladder truck coverage.

6.1.3 Overall Deployment Recommendations

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

Recommendation #1: **Address Service Gaps by Adding Fire Stations and Resources:**

1.1 Identify the funding and timing to complete the current six fire stations in the City's Capital Improvement Program budget.

1.2 Identify the sites for six infill fire stations to lower the Citywide travel time performance closer to 5 minutes in the most urbanized areas per the City's adopted policy.

Recommendation #2: **Add Battalions:** In addition to the added fire stations, the City should eventually add at least three more geographic area Battalions.

Recommendation #3: **Add Peak-Hour Units:** Fire-Rescue needs to continue to add peak-hour, flexibly-deployed units, squads, and/or engines to support the busiest areas at peak hours of the day and to allow full-time crews to go off-line for training in rotation.

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SECTION 7—NEXT STEPS

7.1 NEXT STEPS

The purpose of a Standards of Cover study is to compare the City's current performance against the local risks to be protected and nationally recognized best practices. This analysis of performance forms the base from which to make recommendations for changes, if any, in fire station locations, equipment types, staffing, and headquarters programs.

Since the recession, the City has started to address adding fire stations to both infill gaps and new growth areas. The goals identified in Recommendation #1 will continue to expand this program. Measurement and planning as the City continues to evolve over time will be necessary for the City to meet these goals. Citygate recommends that the City's next steps be to work through the issues identified in this study over the following time lines:

7.1.1 Short-Term Steps

- Absorb the policy recommendations of this fire services study.
- Direct staff to commence work to site, procure, and program funding for the needed infill gap fire stations.
- Develop the costs and a timeline for the balance of the stations not already having City-owned sites and/or committed construction funding.

7.1.2 Long-Term Steps

- Add at least three more geographic area Battalions to increase the two-chief coverage on First Alarms.
- Monitor the effect of growth and traffic congestion on incident demand volume at peak hours of the day.
- If traffic congestion continues to decay response times, even with additional fire crews, then more peak-hour squads and/or engines will become necessary to maintain response times to critical events.
- Once the added station construction schedule is better determined, build a staffing impacts model to allow Fire-Rescue to budget ahead of time for the hiring and promotional testing necessary to bring more fire crews on line.

PART TWO

Community Risk Assessment

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SECTION 8—COMMUNITY RISK ASSESSMENT

8.1 COMMUNITY RISK ASSESSMENT

SOC ELEMENT 3 OF 8
COMMUNITY RISK ASSESSMENT

The third element of the SOC process is a community risk assessment. The broad objectives of a community risk assessment relative to a Standards of Response Coverage Study are to:

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

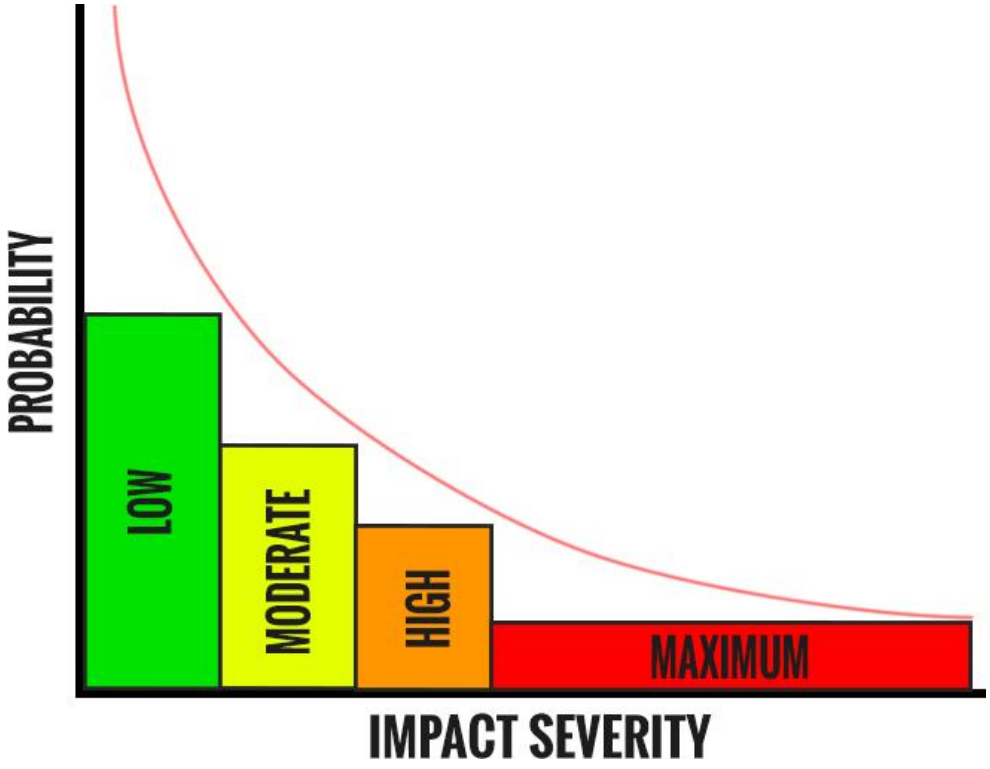
Hazard is broadly defined as a situation or condition that can cause or contribute to harm. Hazard examples include fire, medical emergency, vehicle collision, earthquake, flood, etc. *Risk* is broadly defined as the *probability of hazard occurrence* in combination with the *likely severity of resultant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

8.1.1 Risk Assessment Methodology

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

1. Identification of geographic planning sub-zones (risk zones) appropriate to the community or jurisdiction.
2. Identification of the specific values at risk to the various hazards within the community or service area.
3. Identification of the fire and non-fire hazards to be evaluated.
4. Determination of the *probability of occurrence* for each hazard.
5. Identification and evaluation of multiple relevant *impact severity factors* for each hazard by planning zone using agency- and jurisdiction-specific data and information.
6. Determination of *overall risk* for each hazard based on probability of occurrence in combination with probable impact severity as shown in Figure 6.

Figure 6—Overall Risk Categories



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

Citygate used multiple data sources for this study to understand the hazards and values to be protected in San Diego as follows:

- U.S. Census Bureau population data and demographics.
- Insurance Services Office (ISO) building fire flow and construction data.
- City of San Diego Geographical Information Systems (GIS) data.
- City of San Diego General Plan and Zoning information.
- 2010 San Diego County Multi-Jurisdictional Hazard Mitigation Plan.

8.1.2 Risk Assessment Summary

Citygate's evaluation of the values at risk and hazards likely to impact the City of San Diego yields the following conclusions:

1. The City has a very diverse population, with densities ranging from less than 1,000 per square mile to more than 56,000 per square mile.
2. The City's population is projected to grow by 24% over the next 18 years to 2035, with similar projected growth in residential housing units, non-residential development, and employment.
3. Approximately 23.35% of the City's population is under 10 years of age or over 65 years of age, which are considered at-risk populations for most emergencies.
4. Nearly 16% of the City's population is below the federal poverty level for the previous 12 months, an increase of 1.7% since 2000.
5. Nearly 82% of the City's population has health insurance coverage.
6. The City has 705 designated critical facilities/infrastructures to protect.
7. The City has significant economic values at risk as identified in this assessment.
8. A significant percentage of the City lies within a Very High Wildland Fire Hazard Severity Zone as identified by the California Department of Forestry and Fire Protection.
9. The San Diego Fire-Rescue Department (Fire-Rescue) has developed and implemented multiple mitigation measures to effectively reduce wildland fire impact severity within the City.
10. The City's transportation network includes multiple highways and other primary vehicle transportation routes, airports, railways, and mass transportation nodes.

11. The City's overall risk for seven hazards related to emergency services provided by Fire-Rescue ranges from ***LOW*** to ***MAXIMUM*** as summarized in Table 3.

Table 25—Overall Risk by Hazard

Hazard	Planning Zone							
	Zone 1	Zone 2	Zone 3	Zone 4	Zone 5	Zone 6	Zone 7	Zone 8
Building Fire	***HIGH***	***HIGH***	***HIGH***	***MODERATE***	***MODERATE***	***MODERATE***	***MODERATE***	***MODERATE***
Wildland Fire	***HIGH***	***HIGH***	***HIGH***	***MAXIMUM***	***MAXIMUM***	***HIGH***	***MAXIMUM***	***MAXIMUM***
Medical Emergency	***MODERATE***	***MODERATE***	***MODERATE***	***MODERATE***	***MODERATE***	***MODERATE***	***MODERATE***	***MODERATE***
Hazardous Material	***HIGH***	***HIGH***	***HIGH***	***MODERATE***	***MODERATE***	***HIGH***	***MODERATE***	***MODERATE***
Technical Rescue	***MODERATE***	***MODERATE***	***MODERATE***	***MODERATE***	***MODERATE***	***MODERATE***	***MODERATE***	***MODERATE***
Marine Risk	***HIGH***	***MODERATE***	***HIGH***	***LOW***	***MODERATE***	***LOW***	***LOW***	***MODERATE***
Aviation Risk	***LOW***	***MODERATE***	***LOW***	***LOW***	***LOW***	***LOW***	***LOW***	***LOW***

8.1.3 Service Area Description

Located on the southern California coast immediately north of the Baja Mexico border, the City of San Diego is the second largest city in California, and eighth largest in the United States, with a population of more than 1.39 million. Encompassing 372 square miles and stretching nearly 40 miles from north to south, the City includes 93 miles of Pacific Ocean shoreline.

With elevations ranging from sea level to 1,594 feet, San Diego has a unique and varied topography composed mostly of mesas intersected by canyons. Mission Valley is a prominent geographical feature near the center of the City. San Diego also has dramatic climate variations, with summer high temperatures averaging in the low 70s in the coastal areas, while inland areas average in the mid- to upper-80s. Rainfall averages only 10 inches per year.

San Diego has a varied economy, with both high- and low-wage industries prominent. The higher-wage economic sectors include telecommunications, software, biotech, and higher education. The tourism and visitor sectors of the economy provide many of the lower-wage jobs. There are relatively few middle-income jobs, resulting increasingly in an "hourglass" economy. The military has long been a mainstay of the local economy, offering middle-income jobs, although it is not as dominant as it once was. Defense industry jobs have declined over the past two decades.

San Diego is a major tourism and convention destination. The most visited sites are Balboa Park, SeaWorld, Cabrillo National Monument, and Old Town State Historic Park. The village area of La Jolla and the Gaslamp Quarter downtown are also popular destinations.

San Diego's population grew rapidly from 1940 to 1960, and again from 1970 to 1990. The population was approximately 200,000 in 1940, 700,000 in 1970 and over 1.22 million in 2000. During the last few years, the rate of population growth in the City has slowed. Lack of vacant land and high housing costs relative to local incomes have deterred recent growth.

San Diego has a diverse population, with slightly less than half composed of non-Hispanic White, 25-30% Hispanic/Latino, 15-20% Asian/Pacific Islander, and 7% Black/African American. The Hispanic/Latino and Asian populations are younger and are increasing, while the non-Hispanic White and Black/African American populations have been stagnant or declining in recent years. The overall average age of 33.5 years has been increasing, with the fastest growing segment being people over the age of 65.

The San Diego Fire-Rescue Department was established in 1889 by City Charter Amendment. Fire-Rescue is a full-service, all-hazard agency providing planning, prevention, education, fire suppression, emergency medical, hazardous material, technical rescue, lifeguard, emergency management, and other related fire protection services, with a staff of 1,300 personnel operating from 47 strategically located fire stations and 8 permanent and 43 seasonal lifeguard stations. Fire-Rescue responds to more than 91,000 calls for service annually, or an average of 250 calls per day.

8.1.4 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, Fire-Rescue utilized the eight existing medical response zones as shown in Figure 7 and Figure 8.

Figure 7—Planning Zones (North)

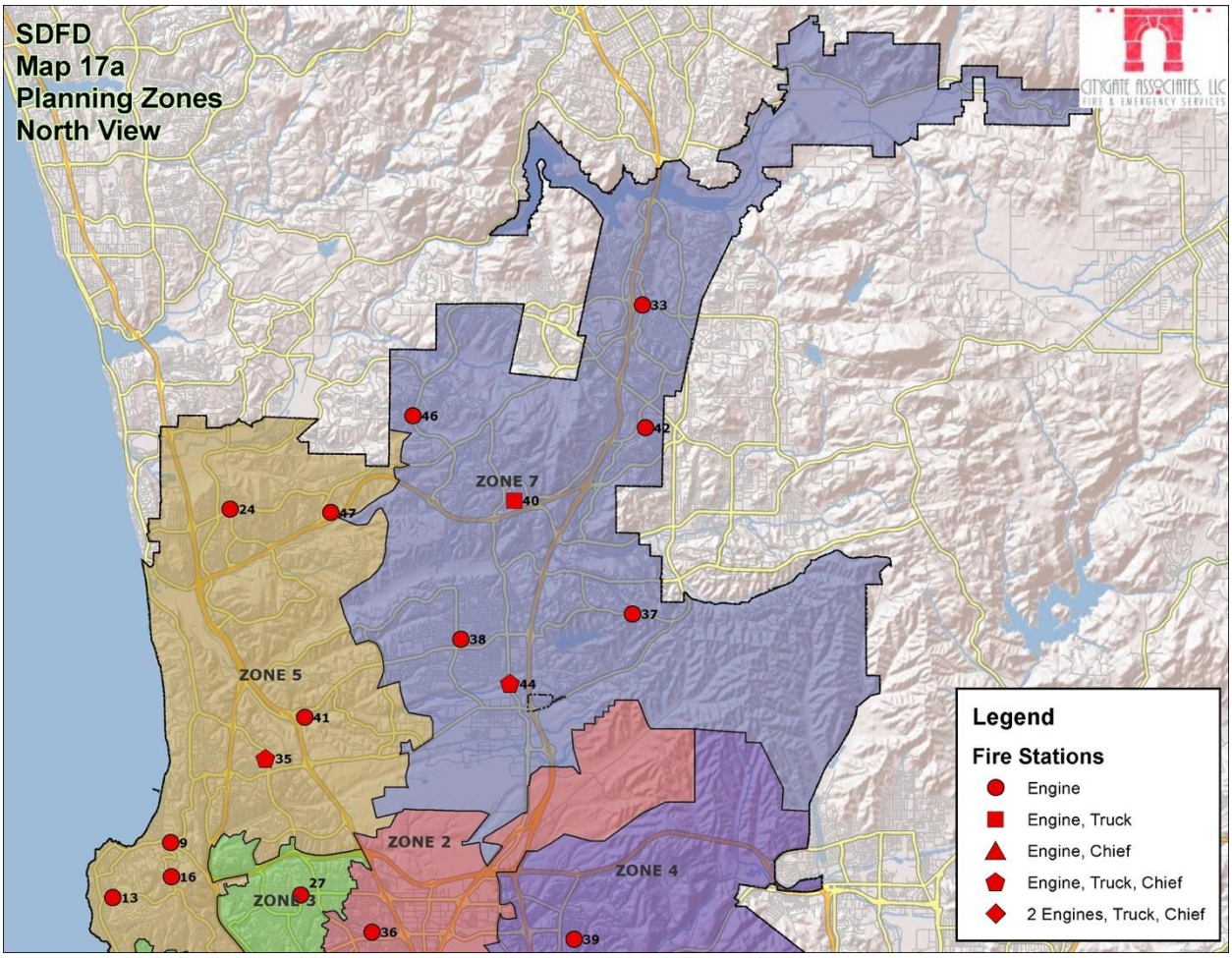
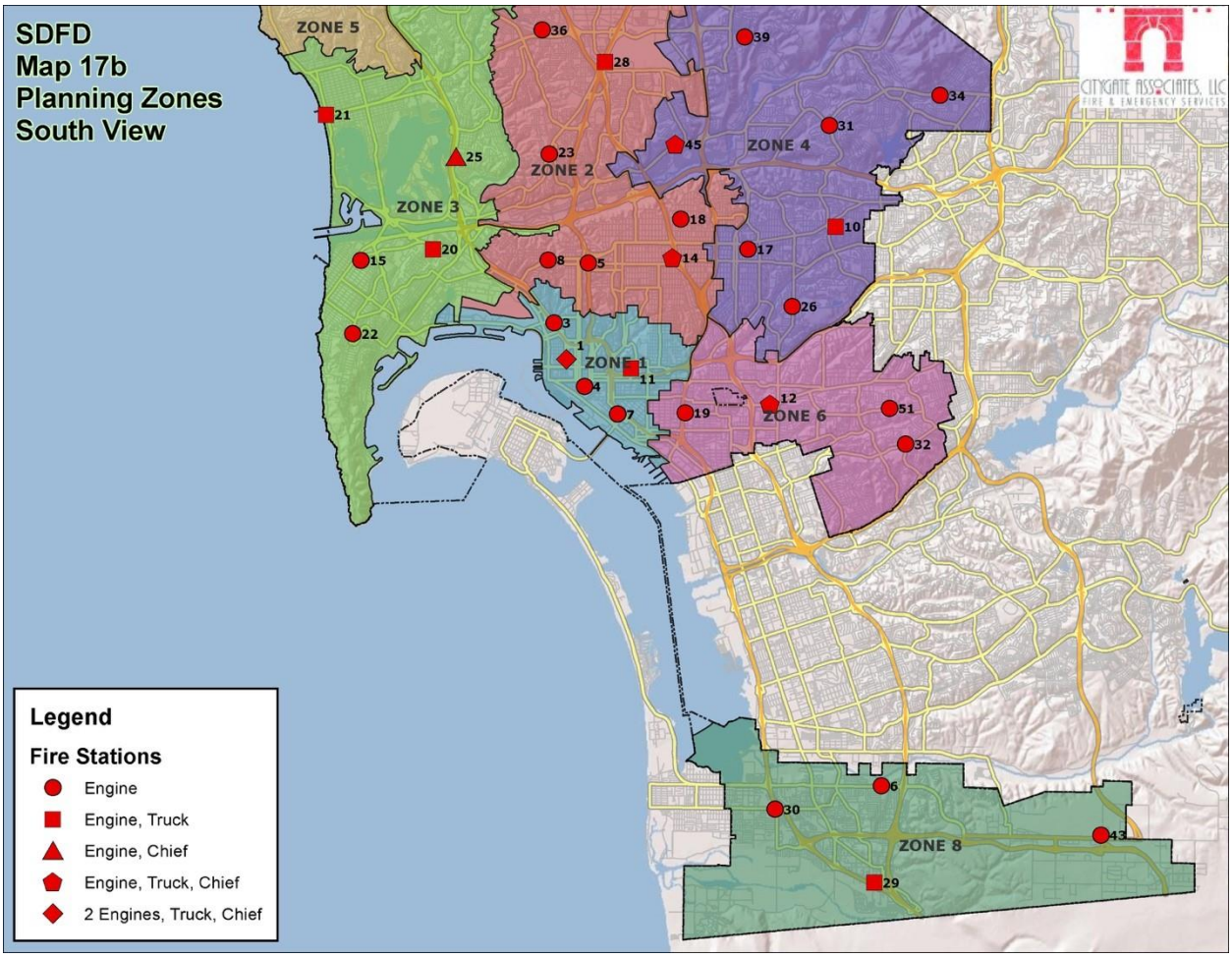


Figure 8—Planning Zones (South)



8.1.5 Values at Risk

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

People

Residents, employees, visitors, and travelers through a community or jurisdiction are generally considered to be most 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 factors for San Diego are summarized in Table 26.

Table 26—Key San Diego Demographic Data

Demographic	2000	Percentage	2014	Percentage / *Percent Change*
Population	**1,223,400**		**1,341,510**	***9.65%***
Under 5 years	82,523	6.75%	6.15%	***-0.59%***
5-9 years	87,347	7.14%	5.79%	***-1.35%***
10-19 years	165,184	13.50%	12.18%	***-1.32%***
20-64 years	760,338	62.15%	64.48%	***2.33%***
65-74 years	65,922	5.39%	6.10%	***0.72%***
Over 75 years	62,086	5.07%	5.13%	***0.06%***
Median age	**32.5**		**33.9**	***4.31%***
Housing Units	**469,689**		**518,300**	***10.35%***
Owner-Occupied	223,280	47.54%	233,158	44.99%
Renter-Occupied	227,411	48.42%	249,934	48.22%
Vacant	18,998	4.04%	32,941	6.36%
Median Value	N/A		$448,000	N/A
Ethnicity				
White	470,900	38.49%	38.66%	***0.17%***
Hispanic	310,752	25.40%	29.54%	***4.14%***
Asian	189,413	15.48%	19.00%	***3.52%***
Black/African American	109,470	8.95%	8.00%	***-0.95%***
Other	142,865	11.68%	4.80%	***-6.88%***
Education (age 25 and over)	**779,242**		**888,185**	
High School Graduate	405,109	51.99%	58.60%	***6.61%***
Undergraduate Degree	168,723	21.65%	25.30%	***3.65%***
Graduate/Professional Degree	104,062	13.35%	17.00%	***3.65%***
Employment (age 16 and over)	**959,432**		**1,088,580**	***13.46%***
Management/Professional	233,054	24.29%	45.30%	***21.01%***
Service	88,462	9.22%	19.20%	***9.98%***
Sales/Office	147,136	15.34%	22.60%	***7.26%***
Construction/Maintenance	37,174	3.87%	5.70%	***1.83%***
Production/Transportation	50,165	5.23%	7.10%	***1.87%***
Median Household Income	$45,733		$78,414	***71.46%***
Population Below Poverty Level	172,527	14.10%	15.80%	***1.70%***
Health Insurance Coverage	N/A	N/A	1,098,622	81.89%
Birthplace				
U.S.	909,114	74.31%	73.70%	***-0.61%***
Foreign-Born	314,227	25.68%	26.30%	***0.61%***

Source: U.S. Census Bureau

Notes from Table 26 include the following:

- Population has increased 9.65% since 2000; housing units have increased 10.35%.
- 23.35% of the population is under 10 years of age or over 65 years of age.
- The City's population is 38% White, 29% Asian, and 19% Black/African American; the percentage of population claiming Asian and Black/African American has increased 4% and 3.5% respectively since 2000.
- 74% of the population was born in the United States, while 26% was foreign-born.
- The percentage of population 25 years of age and older that have completed high school (or equivalent) has increased 6.6% since 2000, and the percentage of the same population with a college degree has increased 3.65%.
- Nearly 68% of the population over 15 years of age is in the workforce.
- The City's median household income is $78,414, an increase of over 71% from 2000.
- Nearly 16% of the population is below the federal poverty level for the previous 12 months, an increase of 1.7% since 2000.
- Nearly 82% of the population has health insurance coverage.

Figure 9 and Figure 10 illustrate the widely varying population densities within the City.

Figure 9—Population Densities (North)

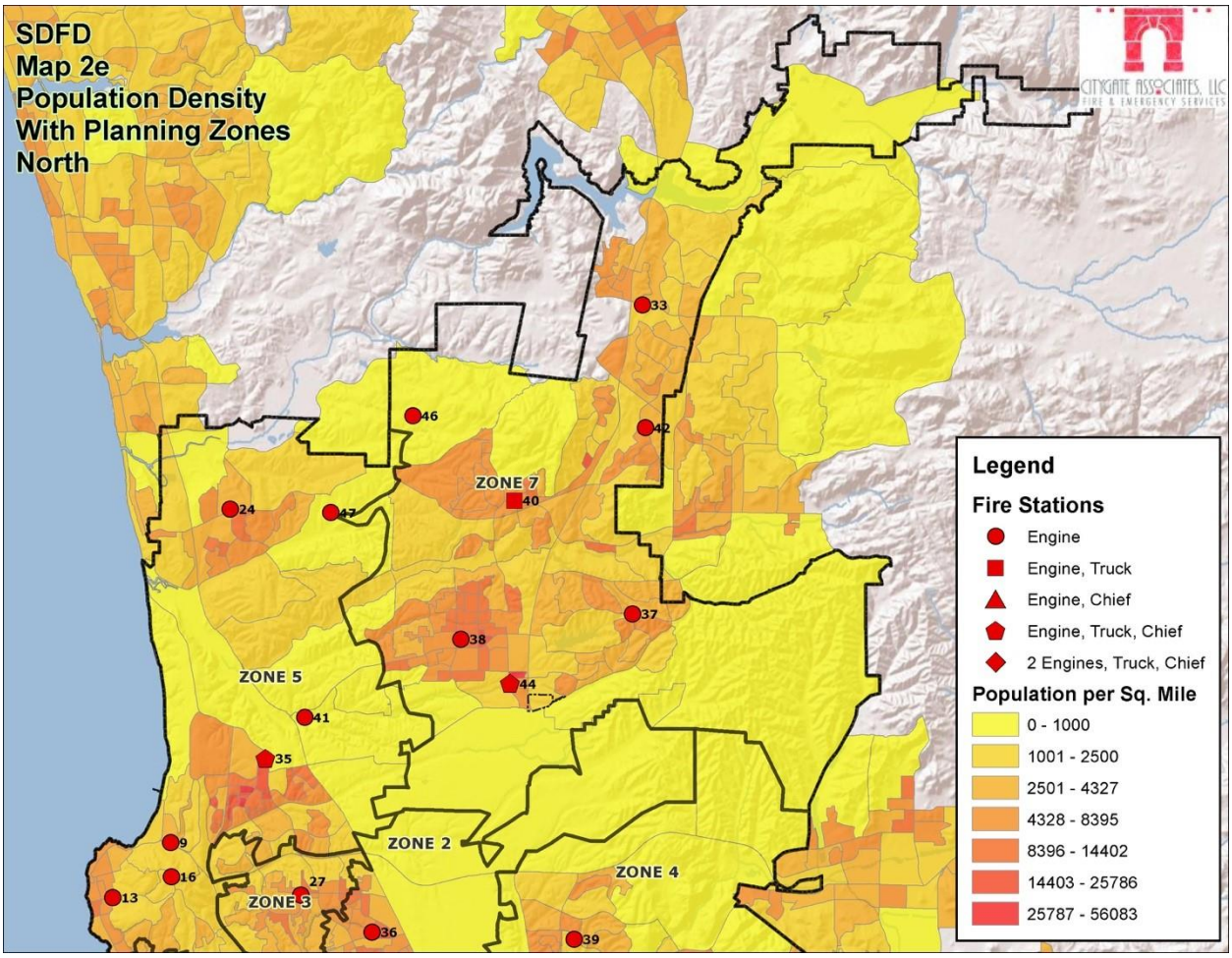
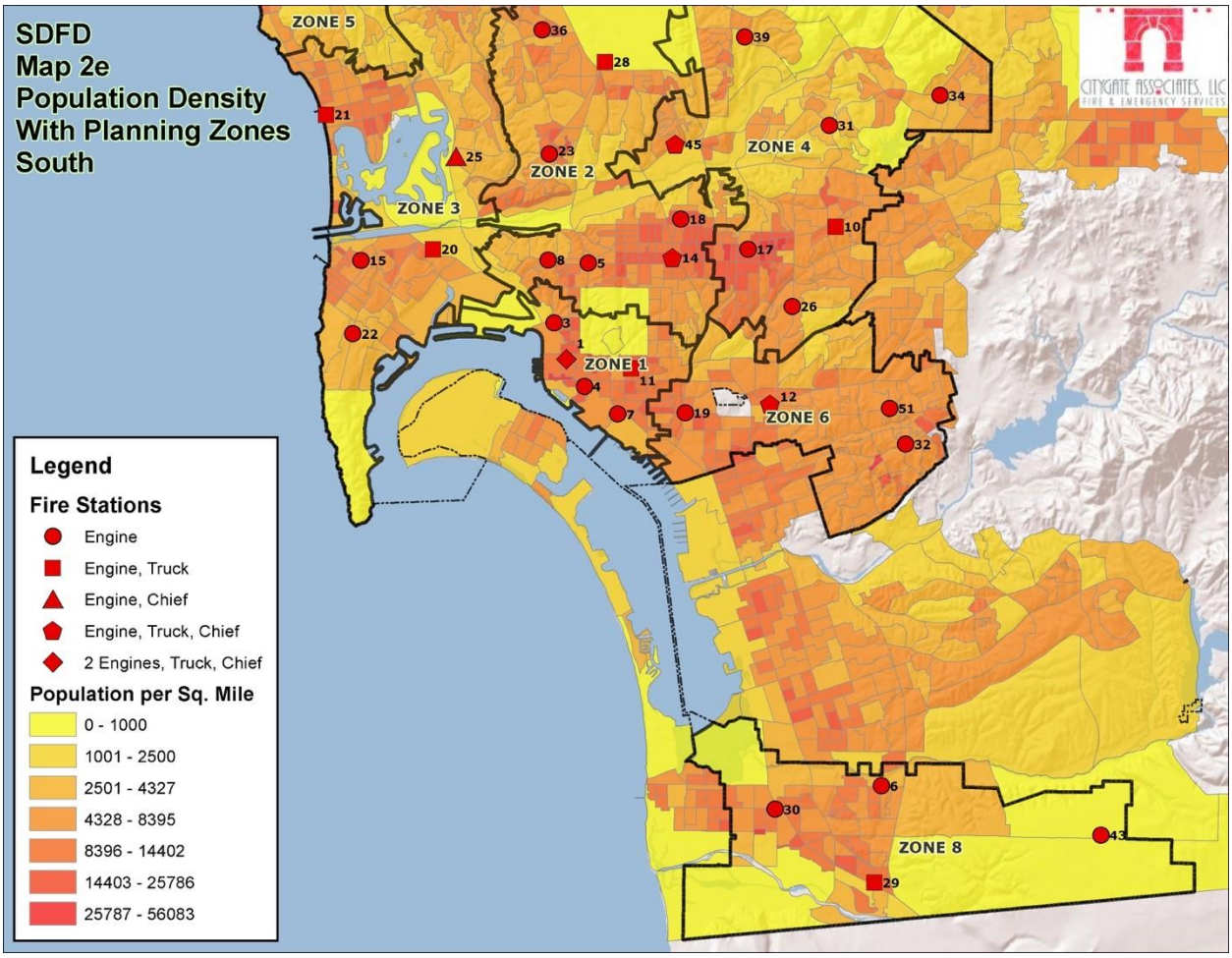


Figure 10—Population Densities (South)



Critical Facilities/Infrastructure

For this study, the City identified 705 critical facilities and/or infrastructure as summarized in Table 27, Figure 11, and Figure 12. These facilities provide essential public or community services, or are high-value cultural or historical sites. A hazard occurrence with significant consequence severity in one or more of these facilities would likely adversely impact critical public or community services.

Table 27—Critical Facilities/Infrastructure

Hazard	Zone 1	Zone 2	Zone 3	Zone 4	Zone 5	Zone 6	Zone 7	Zone 8	Total
Critical Facilities	164	143	86	89	73	39	69	42	**705**
Percentage of Total	23.26%	20.28%	12.20%	12.62%	10.35%	5.53%	9.79%	5.96%	**100.00%**

Source: City of San Diego Fire-Rescue Department

Figure 11—Critical Facilities/Infrastructure (North)

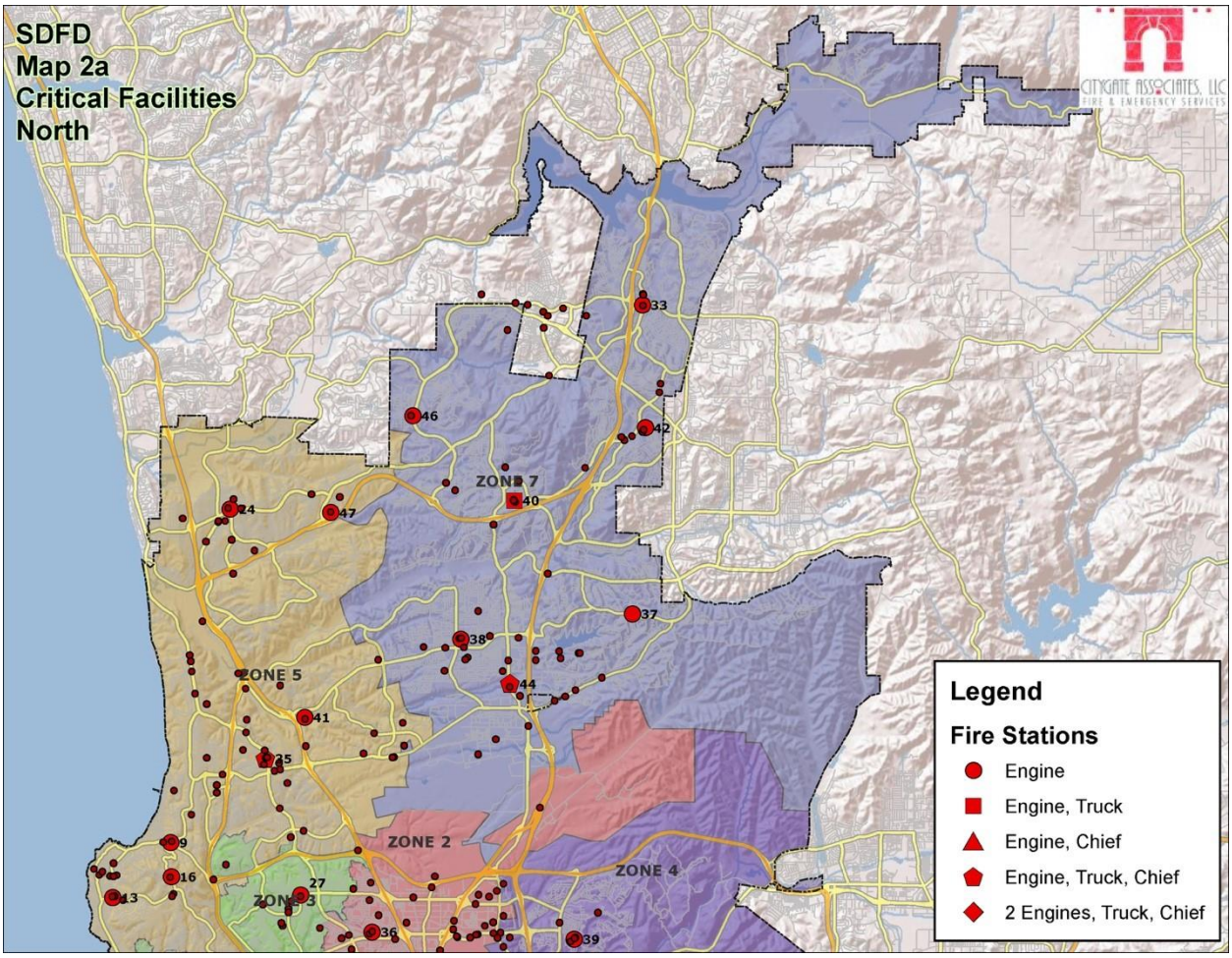
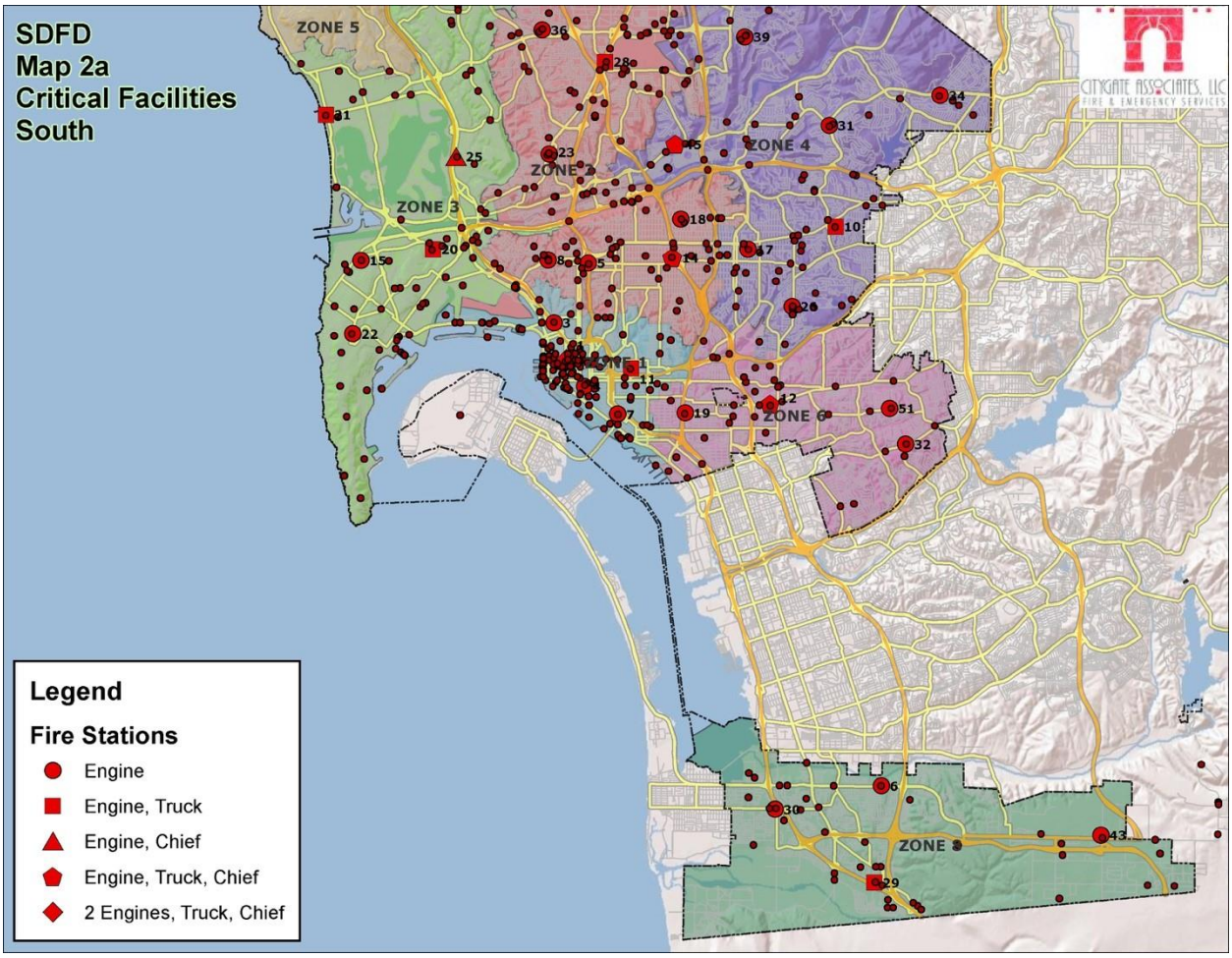


Figure 12—Critical Facilities/Infrastructure (South)



Buildings

The City of San Diego has more than 518,000 housing units, and more than 400 million square feet of non-residential building space.

Building Occupancy Risk Categories

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

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

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

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

Maximum Risk – includes buildings or facilities with unusually high risk requiring an 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.

Economic Resources[3]

San Diego has a strong, diverse economy that continues to undergo a dynamic transformation from one based on military and defense spending to an economy that is propelled by tourism and high-technology companies competing in the international marketplace. These mostly small- and mid-sized high-tech firms produce the products and services most in demand in the new global economy. Since a recession of the early 1990s, San Diego has seen dramatic increases in its gross regional product, exports, per capita income, and employment. San Diego is one of the top ten cities in the country for job growth through 2025, and emerging high-tech companies are creating many of these new jobs. San Diego hosts more than 34 million visitors annually, spending nearly $10 million, and 14 advanced technology industries produce $42.1 billion in products. The top industries contributing to the City's economy include:

- U.S. Navy
- U.S. Marine Corps
- Hotels and Motels
- Amusement Parks and Museums
- Beach and Bay Businesses
- Maquiladoras
- Logistics
- Warehousing and Distribution
- Port of San Diego

[3] Reference: City of San Diego Economic Development Department webpage

- Otay Mesa Port-of-Entry
- Defense and Security Systems
- Biotech and Medical Devices
- Electronics and Telecommunications
- Software and Web Development
- Food and Beverage Production
- Clean technology Industries
  - Solar Panels
  - Biofuels
  - Clean Gas Technology

Natural Resources[4]

Natural resources to be protected within the City include:

- More than 40,000 acres of open space
- More than 26 miles of Pacific Ocean shoreline

Cultural and Historical Resources

The City of San Diego recognizes the benefits of historical resource preservation to the community as well as to individual property owners. Preservation efforts stabilize neighborhoods and promote cultural tourism. City staff works with other governmental agencies and citizens seeking to preserve the historical structures and character of their neighborhoods.

The Historical Resources Board (HRB) and its staff work with the City's Housing Commission, Centre City Development Corporation, the Park and Recreation Department, the San Diego Regional Airport Authority, as well as other entities in evaluating and preserving cultural and historic resources. To date, the HRB has identified six historical districts and more than 2,500 individual cultural and historical sites, including 83 on the National Historic Building Register.

[4] Reference: Ventura County Resource Conservation District; Ventura County Resource Management Agency;

8.1.6 Future Growth and Development

Overview[5]

The 2008 City of San Diego General Plan incorporates a City of Villages strategy, focusing growth into mixed-use activity centers that are pedestrian-friendly districts linked to an improved regional transit system. The strategy is designed to sustain the long-term economic, environmental, and social health of the City and its many communities. It recognizes the value of San Diego's distinctive neighborhoods and open spaces that together form the City as a whole. The strategy identifies the following five village types:

1. Downtown
2. Sub-Regional Employment Areas
3. Urban Village Centers
4. Community and Neighborhood Village Centers
5. Transit Corridors

Land Use and Projected Future Growth

The City General Plan incorporates the following ten land use principles:

1. An open space network formed by parks, canyons, river valleys, habitats, beaches, and ocean.
2. Diverse residential communities formed by the open space network.
3. Compact and walkable mixed-use villages of different scales within communities.
4. Employment centers for a strong economy.
5. An integrated regional transportation system network of walkways, bikeways, transit, roadways, and freeways that efficiently link communities and villages to each other and to employment centers.
6. High quality, affordable, and well-maintained public facilities to serve the City's population, workforce, and visitors.
7. Historic districts and sites that respect our heritage.

[5] Reference: 2008 City of San Diego General Plan

8. Balanced communities that offer opportunities for all San Diegans to share Citywide responsibilities.

9. A clean and sustainable environment.

10. A high aesthetic standard.

Table 28 through Table 31 summarize projected population, housing, non-residential development, and employment growth for San Diego to 2035.

Table 28—Projected Population Growth

City	Population				
	2014[1]	2020[2]	2035[2]	Total Projected Change (Units)	Total Projected Change (Percent)
San Diego	1,341,510	1,454,150	1,664,684	**323,174**	**24.09%**

[1] Source: US Census Bureau
[2] Source: San Diego Association of Governments (SANDAG) – Series 13 Sub-Regional Growth Forecast

Table 29—Projected Residential Housing Growth

City	Residential Housing Units				
	2014[1]	2020[2]	2035[2]	Total Projected Change (Units)	Total Projected Change (Percent)
San Diego	518,300	559,197	640,194	**121,894**	**23.52%**

[1] Source: US Census Bureau
[2] Source: San Diego Association of Governments (SANDAG) – Series 13 Sub-Regional Growth Forecast

Table 30—Projected Non-Residential Growth

City	Commercial/Industrial/Office Space (KSF)				
	2014[1]	2020[1]	2035[1]	Total Projected Change (Units)	Total Projected Change (Percent)
San Diego	405,642	454,192	488,815	**83,173**	**20.50%**

[1] Source: San Diego Association of Governments (SANDAG) – Series 13 Sub-Regional Growth Forecast

Table 31—Projected Employment Growth

City	Employment				
	2014[1]	2020[2]	2035[2]	Total Projected Change (Units)	Total Projected Change (Percent)
San Diego	735,464	867,567	933,938	**198,474**	**26.99%**

[1] Source: US Census Bureau
[2] Source: San Diego Association of Governments (SANDAG) – Series 13 Sub-Regional Growth Forecast

As Table 28 through Table 31 show, population, housing, non-residential development, and employment are projected to grow between 20-27% over the next 18 years to 2035.

8.1.7 Hazard Identification

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

The 2010 San Diego County Multi-Jurisdictional Hazard Mitigation Plan (MJHMP) identifies the following 11 hazards related to services provided by Fire-Rescue:

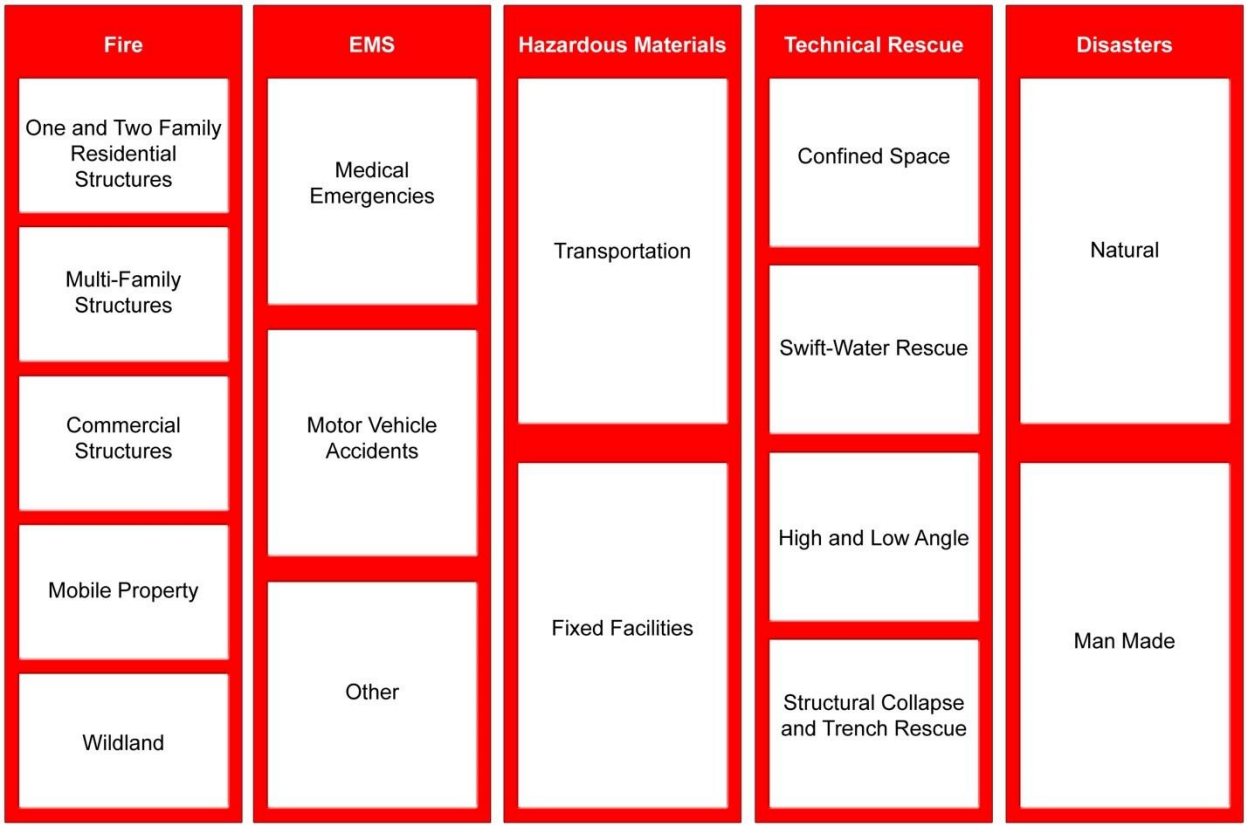
1. Coastal Storms
2. Dam Failure
3. Earthquake
4. Flooding
5. Hazardous Materials Release
6. Landslide
7. Liquefaction
8. Nuclear Materials Release
9. Terrorism
10. Tsunami
11. Wildfire / Structure Fire

Although the Fire-Rescue has no legal authority or responsibility to mitigate dam failure, earthquake, flooding, landslide, liquefaction, nuclear materials release, terrorism, or tsunami,

other than for Fire-Rescue facilities, it does provide services related to these hazards including fire suppression, emergency medical services, technical rescue, and hazardous materials response.

CFAI groups hazards into fire and non-fire categories as shown in Figure 13. Identification, qualification, and quantification of the various fire and non-fire risks are important factors in evaluating the way fire resources are or can be deployed to mitigate those risks.

Figure 13—Hazard Categories



Source: Commission on Fire Accreditation International (5th Edition)

Following review and evaluation of the hazards identified in the 2010 San Diego County MJHMP, and the fire and non-fire hazards as identified by CFAI as they relate to services provided by Fire-Rescue, Citygate evaluated the following seven hazards for this risk assessment:

1. Building Fire
2. Wildland Fire
3. Medical Emergency

4. Hazardous Materials Release/Spill
5. Technical Rescue
6. Marine Risk
7. Aviation Risk

8.1.8 Service Capacity

Service capacity refers to an agency'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.

8.1.9 Probability of Occurrence

Probability of occurrence refers to the likely future occurrence of a hazard during a specific time 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 32 describes the five probability of hazard occurrence categories used for this analysis.

Table 32—Probability of Hazard Occurrence

Probability of Occurrence	Description	General Characteristics
Very Low	**Rare**	• Hazard *may occur* in exceptional circumstances.
Low	**Unlikely**	• Hazard *could occur* at some time. • No recorded incidents and/or any anecdotal evidence. • No recent occurrences. • Little opportunity, reason, or means to occur.
Moderate	**Possible**	• Hazard *should occur* at some time. • Few infrequent, random recorded occurrences and/or little anecdotal evidence. • Very few recent occurrences. • Some opportunity, reason, or means to occur.
High	**Likely**	• Hazard *will probably occur.* • Regular recorded occurrences and/or strong anecdotal evidence. • Considerable opportunity, reason, or means to occur.
Very High	**Almost Certain**	• Hazard is *expected to occur.* • High level of recorded occurrences and/or very strong anecdotal evidence. • Strong likelihood hazard will re-occur. • Strong opportunity, reason, or means to occur.

Reference: Vision 20/20: *Community Risk Assessment – A Guide for Conducting a Community Risk Assessment* (February 2016)

Citygate's Standards of Response Coverage Study uses recent multiple-year hazard response data to determine the probability of hazard occurrence during the next 12 months.

8.1.10 Impact Severity Factors

Elements to be evaluated in a community risk assessment include factors that influence the potential severity of impacts of a hazard occurrence. Impact severity refers to the potential negative effects a hazard occurrence may have on a community relative to people, property, the environment, economic stability, and overall community resilience. It is important to note that while some impact severity factors contribute to more severe impacts, other factors, such as response capacity and effective mitigation measures, can also contribute to *reducing* potential impact severity.

In determining hazard-specific impact severity factors, Citygate examines prior risk studies, community demographics including current and projected population, population demography, land use, future development potential, employment, violent crime data, building occupancy data

as available, prior risk-specific service demand data, hazard-specific service capacity, and other relevant factors as appropriate.

8.1.11 Probable Impact Severity

Subsequent to identification and evaluation of specific impact severity factors for each identified hazard, Citygate makes a subjective determination of probable impact severity by hazard using the criteria described in Table 33.

Table 33—Probable Impact Severity

Overall Impact Severity	General Characteristics
Insignificant	• No serious injuries or fatalities; small number of people displaced for only a short duration; little or no personal support required. • Inconsequential or no damage; little or no disruption to community. • No measurable environmental impacts. • Little or no financial loss.
Minor	• Few injuries / no fatalities expected; minor medical treatment required; some displacement of people for less than 24 hours; some personal support required. • Some minor damage / disruption to community. • Minimal environmental impacts with no lasting effects. • Minor financial loss.
Moderate	• Medical treatment required; some hospitalizations/fatalities; localized displacement of people for up to 24 hours; personal support satisfied through local arrangements. • Localized damage; normal community functioning with some inconvenience. • Some environmental impacts with no lasting effects, or small environmental impact with long-term effect. • Moderate financial loss.
Major	• Extensive injuries with fatalities expected; significant hospitalizations; significant displacement of people for more than 24 hours; external resources required for personal support. • Significant damage that requires external resources; community services disrupted; some services unavailable. • Some environmental impacts with long-term effects. • Major financial loss; some financial assistance required.
Catastrophic	• Large number of severe injuries and fatalities expected; significant hospitalizations; large number of people displaced for an extended duration; extensive personal support required. • Extensive damage; community unable to function without significant support. • Significant environmental impacts and/or permanent damage. • Catastrophic financial loss; inability to function without significant financial support.

Reference: Vision 20/20: *Community Risk Assessment – A Guide for Conducting a Community Risk Assessment* (February 2016)

8.1.12 Overall Risk

Subsequent to determining the probability of hazard occurrence and impact severity, Citygate makes a subjective determination of overall risk by hazard using the criteria described in Table 34.

Table 34—Overall Risk

Overall Risk	Description
LOW	Risk is regularly and effectively managed/mitigated by existing agency/jurisdiction service capacity and/or mitigation measures with insignificant to minor overall impact severity.
MODERATE	Risk is routinely managed/mitigated effectively by existing agency/jurisdiction service capacity and/or mitigation measures with moderate or lower overall impact severity.
HIGH	Risk is generally managed/mitigated effectively by existing agency/jurisdiction service capacity and/or mitigation measures with major or lower overall impact severity; occasional augmentation of local service capacity and/or mitigation measures may be required to effectively mitigate specific hazard occurrences or locations.
MAXIMUM	Substantial risk likely requiring frequent or regular local service capacity augmentation for effective hazard occurrence mitigation; or likely adverse impact on additional available service capacity for concurrent hazard occurrence(s).

8.1.13 Building Fire Risk

One of the primary hazards in any community is building fire. Citygate used available data from the City of San Diego, the U.S. Census Bureau, San Diego Association of Governments, and the Insurance Services Office (ISO) to assist in determining the City's building fire risk.

Building Fire Impact Severity Factors

Population Density

As illustrated previously in Figure 9 and Figure 10, population density within San Diego ranges from less than 1,000 people per square mile to more than 56,000 per square mile. Although risk analysis across a wide spectrum of other Citygate client agencies shows no direct correlation between population density and building fire *occurrence*, it is reasonable to assume that building fire *risk* relative to potential impact on human life is greater as population density increases, particularly in areas with high density, multi-story buildings.

Built-in Fire Protection Systems

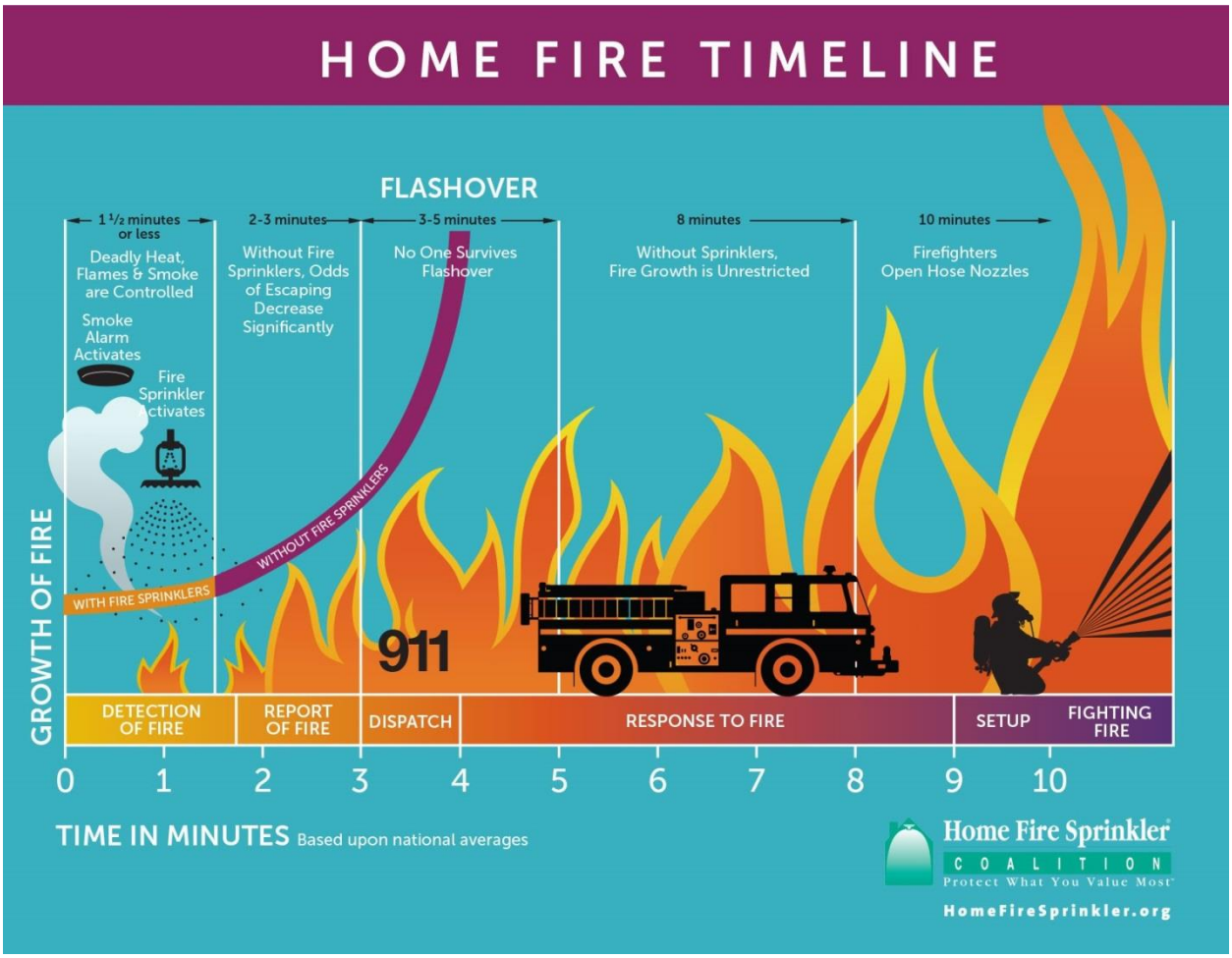
Many of the City's higher-risk building occupancies are protected by automatic fire sprinkler systems and/or automatic fire detection and alarm systems. These are proven to effectively

reduce impact severity in most building fire events where those systems have been properly designed, installed, and maintained. While the City- and State-mandated Fire Code requires automatic fire sprinklers in all new buildings including residential dwellings, many more decades before buildings constructed prior to these requirements are remodeled or replaced. In addition, no data was available to specifically identify the number of buildings protected by automatic fire sprinkler systems by occupancy classification or location.

In addition to mitigation measures which include construction materials/methods and automatic fire protection systems, resource deployment (distribution/concentration), staffing, and response time are three critical factors influencing impact severity for building fire risk. Figure 14 illustrates the building fire progression timeline, and shows that a response time[6] of 5:00 minutes or less is necessary to stop a building fire before it reaches 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. Human survival in a room after flashover is extremely improbable.

[6] Time interval from time of receipt of 9-1-1 call to initiation of suppression actions

Figure 14—Building Fire Progression Timeline



Source: http://www.firesprinklerassoc.org

High Fire Flow Requirements

One of the factors evaluated by the Insurance Services Office (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 San Diego, the ISO database identifies 14,402 buildings evaluated, 1,240 of which have a NFF of 3,500 GPM or greater as shown in Table 35, Figure 15, and Figure 16.

This is a significant amount of firefighting water to deploy, and a major fire at any one of these buildings would require a significant commitment of Fire-Rescue's on-duty force. Using a generally accepted figure of 50 gallons-per-minute per firefighter on large building fires, a fire in a building requiring 2,000 gallons-per-minute would require 40 firefighters, which is approximately 14 more personnel than Fire-Rescue's current initial ERF of 26 firefighters for a commercial building fire, and about 15% of Fire-Rescue's minimum daily staffing level. A

significant fire in any of these buildings not protected by an automatic fire sprinkler and/or fire detection/alarm system would likely have a high impact severity.

Table 35—High Needed Fire Flow Sites

Needed Fire Flow	Zone 1	Zone 2	Zone 3	Zone 4	Zone 5	Zone 6	Zone 7	Zone 8	Total
NFF ≥ 3,500 GPM	118	292	125	136	268	26	153	122	**1,240**
Percentage of Total	9.52%	23.55%	10.08%	10.97%	21.61%	2.10%	12.34%	9.84%	**100.00%**

Source: Insurance Services Office

Figure 15—High Needed Fire Flow Sites (North)

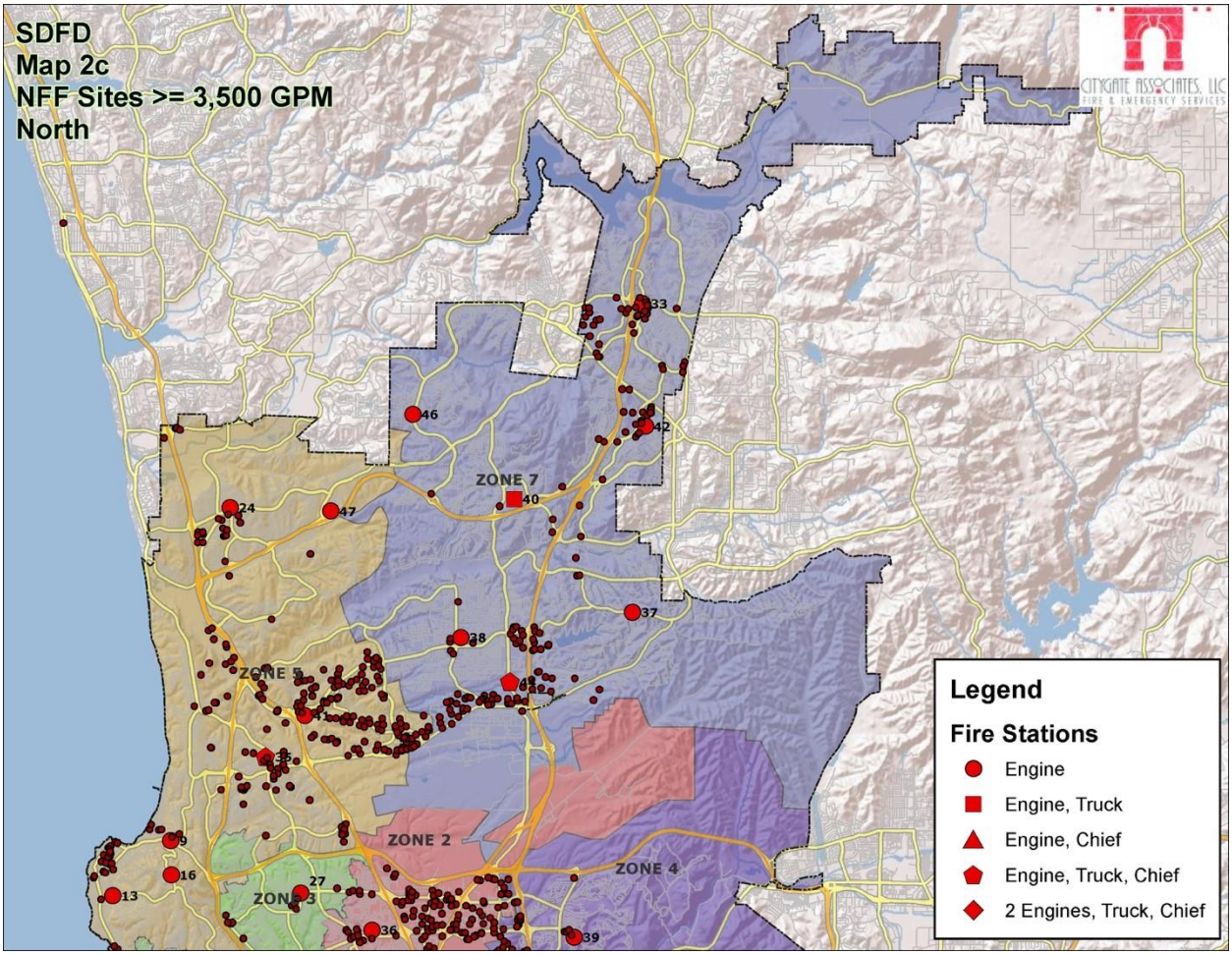
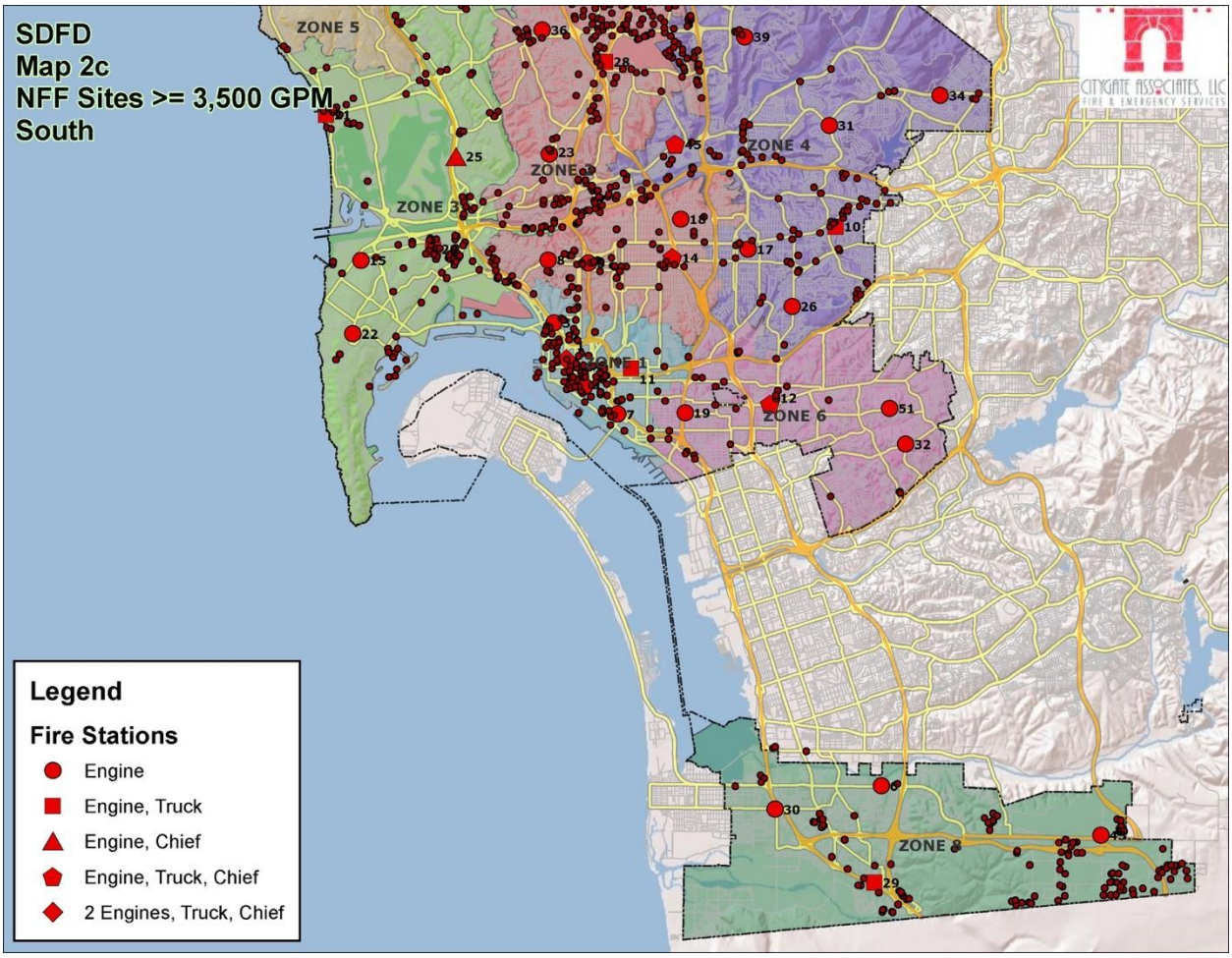


Figure 16—High Needed Fire Flow Sites (South)



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. Multiple water utilities provide water for City residents and businesses as follows:

- City of San Diego – Public Utilities Department
- California American Water Company (southern areas)
- Otay Water District (southern areas)
- Helix Water District (Navajo and college communities)
- Padre Dam Municipal Water District (Santee area)

According to Fire-Rescue staff, available fire flow and fire hydrant or static water source spacing is adequate throughout the City.

Building Fire Risk Service Capacity

Fire-Rescue's service capacity for building fire risk consists of a daily, on-duty response force of 256 personnel staffing 70 primary response apparatus from 47 active fire stations. These staffing and apparatus totals do not include the San Diego International Airport Aviation Fire-Rescue Station, Fire-Rescue's Helicopter program, the Lifeguard Division, or the multitude of specialty apparatus such as brush fire and hazardous material units.

The Effective Response Force (ERF or First Alarm) for *residential* building fires includes four engines, one ladder truck, one ALS ambulance, and two Battalion Chiefs, for a total of 22 firefighters plus an ambulance. Fire-Rescue's ERF for a *commercial* building fire includes one additional ladder truck, bringing the total staff to 26 firefighters plus an ambulance. A response to a *high-rise building fire* adds a fifth engine and an Urban Search and Rescue (US&R) unit, bringing the total personnel to 34 firefighters plus an ambulance.

In addition, Fire-Rescue has automatic aid or mutual aid agreements with adjacent fire agencies, and is also a signatory to the San Diego County Mutual Aid Agreement. This service capacity is adequate to minimize the City's building fire impact severity exclusive of a catastrophic disaster event.

Building Fire Service Demand

For the three-year period from July 1, 2013 through June 30, 2016, the City experienced 2,463 building fire incidents comprising 1.02% of total service demand over the same time period, as summarized in Table 36.

Table 36—Building Fire Service Demand

Hazard	Year	Planning Zone								Total	Percent of Total Service Demand
		Zone 1	Zone 2	Zone 3	Zone 4	Zone 5	Zone 6	Zone 7	Zone 8		
Building Fire	**2013-14**	83	136	103	169	75	91	75	73	**805**	**0.33%**
	2014-15	104	149	121	149	73	102	61	66	**825**	**0.34%**
	2015-16	93	179	117	158	50	109	70	57	**833**	**0.34%**
Total		**280**	**464**	**341**	**476**	**198**	**302**	**206**	**196**	**2,463**	**1.02%**
Percent of Total Service Demand		**0.72%**	**1.08%**	**1.04%**	**1.16%**	**0.87%**	**1.26%**	**0.98%**	**1.08%**	**1.02%**	

Source: San Diego Fire-Rescue Department incident records

As Table 36 shows, building fire service demand increased slightly each year over the three-year study period, with the highest volume of incidents occurring in Zone 4, and the lowest in Zone 8. Overall, the City's building fire service demand is very low, which is typical of other California cities of similar size and demographics.

Probability of Occurrence

Table 37 summarizes Citygate's determination of probability of future building fire occurrence during the next 12 months based on building fire service demand history from Table 36.

Table 37—Probability of Future Building Fire Occurrence

Hazard	Planning Zone							
	Zone 1	Zone 2	Zone 3	Zone 4	Zone 5	Zone 6	Zone 7	Zone 8
Building Fire	*Very High*	*Very High*	*Very High*	*Very High*	*Very High*	*Very High*	*Very High*	*Very High*

Building Fire Impact Severity

Table 38 summarizes Citygate's determination of building fire impact severity based on evaluation of the following building fire impact severity factors: critical facility and high/maximum risk building occupancy inventories, population density, high fire flow sites, water supply, and building fire service capacity.

Table 38—Building Fire Impact Severity by Planning Zone

Hazard	Planning Zone							
	Zone 1	Zone 2	Zone 3	Zone 4	Zone 5	Zone 6	Zone 7	Zone 8
Building Fire	*Major*	*Major*	*Major*	*Moderate*	*Moderate*	*Moderate*	*Moderate*	*Moderate*

Overall Building Fire Risk

Table 39 summarizes Citygate's determination of overall building fire risk based on probability of occurrence from Table 37 in combination with probable impact severity from Table 38.

Table 39—Overall Building Fire Risk by Planning Zone

Hazard	Planning Zone							
	Zone 1	Zone 2	Zone 3	Zone 4	Zone 5	Zone 6	Zone 7	Zone 8
Building Fire	*HIGH*	*HIGH*	*HIGH*	*MODERATE*	*MODERATE*	*MODERATE*	*MODERATE*	*MODERATE*

8.1.14 Wildland Fire Risk

Most of San Diego County is susceptible to a wildland fire; however, the highest risk is in the wildland-urban interface (WUI) areas where human population and related development exist within a predominantly wildland vegetation fuel environment.

Wildland Fire Impact Severity Factors

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 (SRA) where CAL FIRE has fiscal responsibility for wildland fire protection, CAL FIRE designates Moderate, High, and Very High FHSZs by county. CAL FIRE also identifies recommended Very High FHSZs for Local Responsibility Areas (LRA), where a local jurisdiction bears the fiscal responsibility for wildland fire protection, including the City of San Diego as shown in Figure 17 through Figure 19.

Figure 17—City of San Diego Very High Wildland Fire Hazard Severity Zones

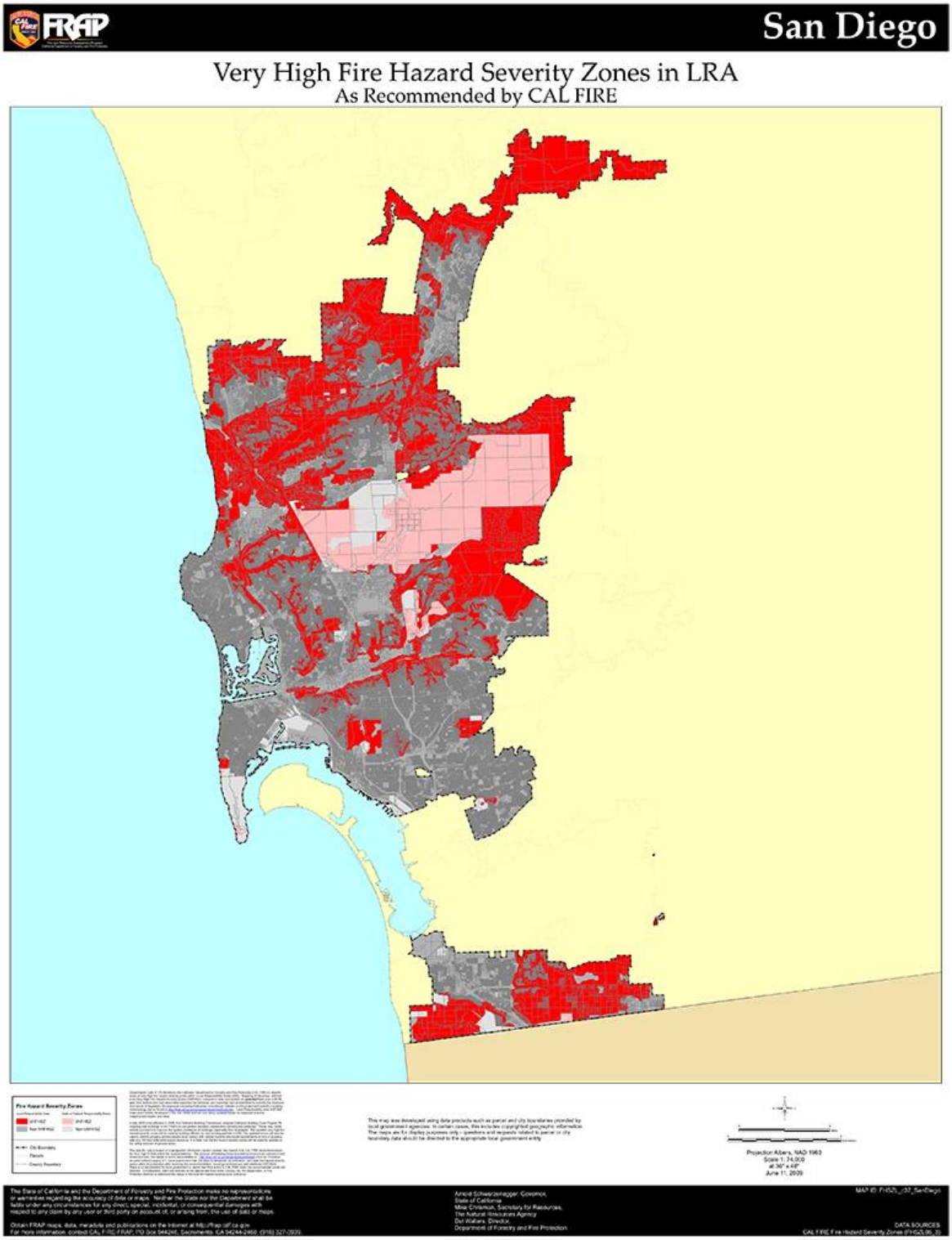


Figure 18—Wildland Fire Hazard Severity Zones (North)

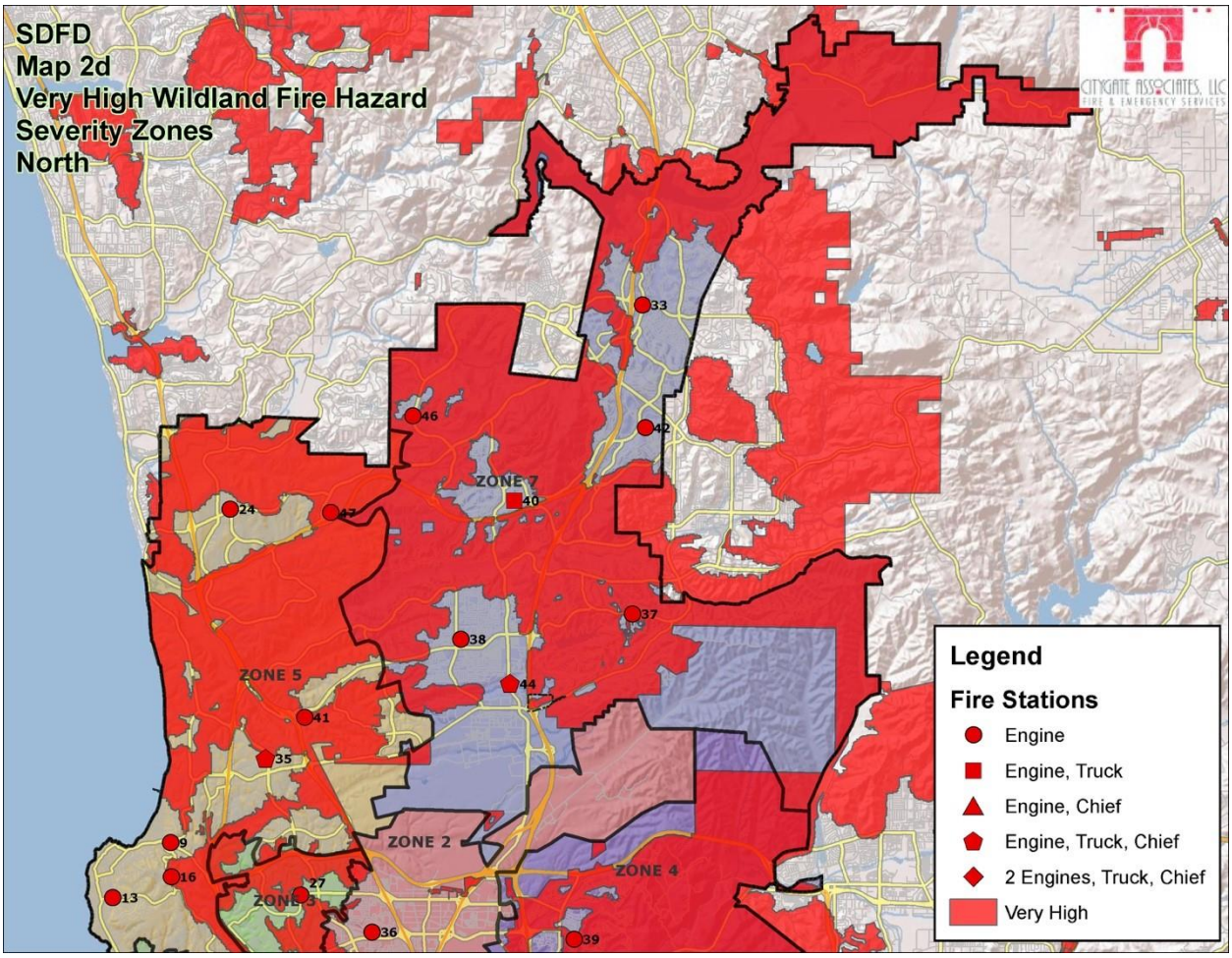


Figure 19—Wildland Fire Hazard Severity Zones (South)

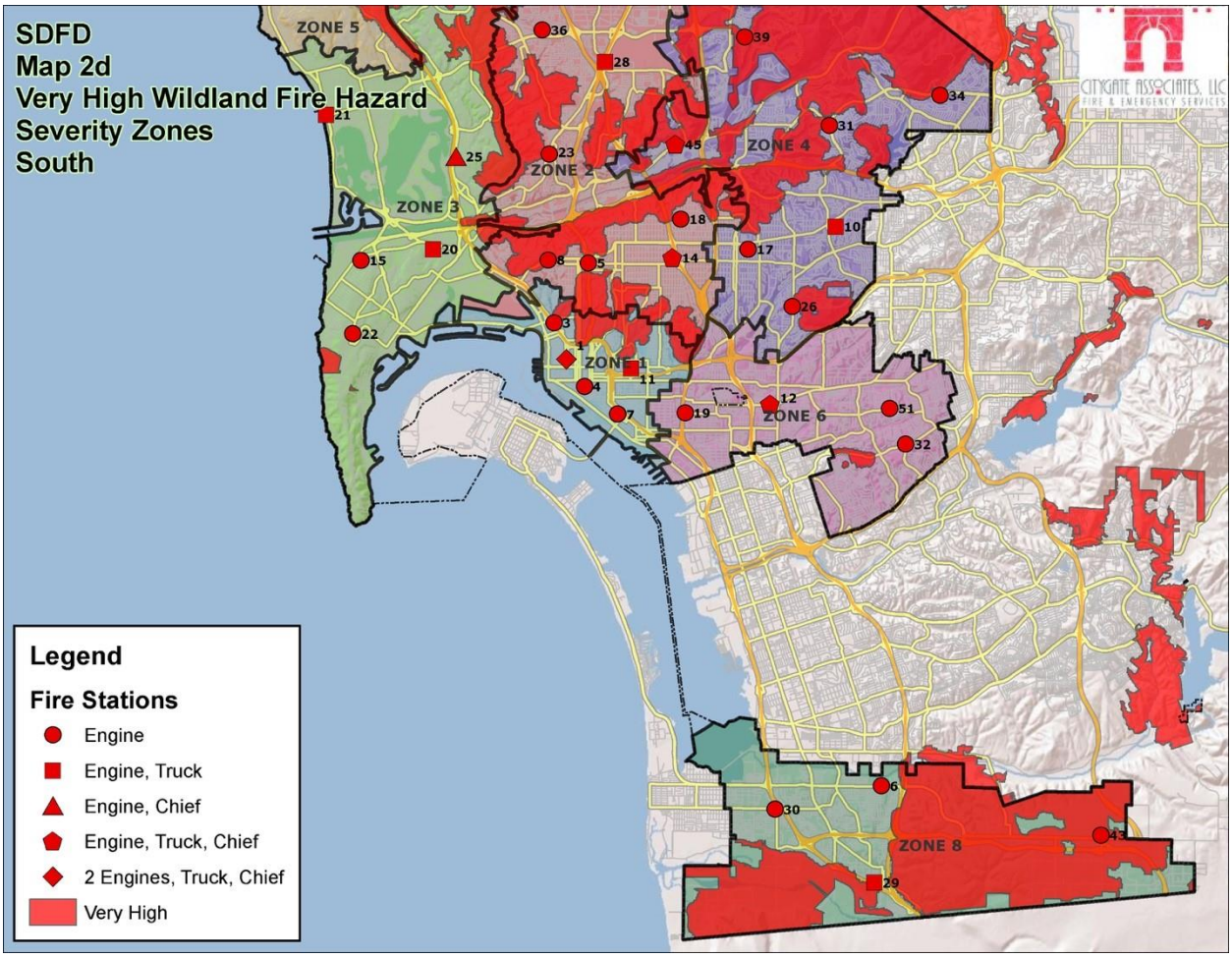


Table 40 summarizes the percentage of each planning zone within a Very High FHSZ. These areas include 6,990 residential dwellings, 208 commercial buildings, 72 critical facilities, and a population of 20,153.[7]

Table 40—Wildland Fire Hazard Severity Zone Area

Area	Planning Zone							
	Zone 1	Zone 2	Zone 3	Zone 4	Zone 5	Zone 6	Zone 7	Zone 8
Area within Very High FHSZ	16.00%	24.00%	16.00%	51.00%	62.00%	1.50%	65.00%	58.00%

[7] Reference: 2010 San Diego County Multi-Jurisdictional Hazard Mitigation Plan, Table 5.16-1

Wildland Fuels

Wildland fuel factors influencing fire intensity and spread include fuel type (vegetation species), height, arrangement, density, and fuel moisture. Wildland fuels within the City consist of a mix of annual grasses and weeds, brush, and deciduous and evergreen trees. Once ignited, wildland 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 wildland fire potential and behavior. High temperatures and low relative humidity dry out wildland fuels creating a situation where fuel will more readily ignite and burn more intensely. Wind is the most significant weather factor influencing wildland fire behavior; higher wind speeds increase fire spread and intensity. The annual wildland fire season in San Diego County, when wildland fires are most likely to occur due to fuel and weather conditions, is all year due to a predominant climate pattern of low annual rainfall; warm, dry summers; and moderate winds. Wildland fire risk during drought conditions or offshore wind events is even greater.

Topography

The City's varied topography, ranging from sea level to 1,594 feet, is composed mostly of mesas intersected by canyons. This topography also influences wildland fire behavior and spread as fires tend to burn more intensely and spread faster when burning uphill and up-canyon, except for a wind-driven downhill or down-canyon fire.

Wildland Fire History

San Diego County has a long history of large damaging wildland fires as summarized in Table 41.

Table 41—Large Damaging Wildfire History – San Diego County

Fire Name	Date	Acres Burned	Structures Destroyed	Structures Damaged	Deaths
Conejos	July 1956	62,000	Not Available	Not Available	0
Laguna	October 1970	190,000	382	Not Available	5
Harmony	October 1996	8,600	122	142	1
La Jolla	September 1999	7,800	2	2	1
Viejas	January 2001	10,353	23	6	0
Gavilan	February 2002	6,000	43	13	0
Pines	July 2002	61,690	45	121	0
Cedar	October 2003	280,278	5,171	63	14
Paradise	October 2003	57,000	415	15	2
Otay	October 2003	46,291	6	0	0
Roblar	October 2003	8,592	0	0	0
Mataguay	July 2004	8,867	2	0	0
Horse	July 2006	16,681	Not Available	Not Available	0
Witch Creek	October 2007	197,990	1,125	77	2
Harris	October 2007	90,440	255	12	5
Poomacha	October 2007	49,410	139	Not Available	0
Ammo	October 2007	21,004	Not Available	Not Available	0
Rice	October 2007	9,472	208	Not Available	0

Source: 2010 San Diego County Multi-Jurisdictional Hazard Mitigation Plan, Table 4.3-3

Water Supply

Another significant impact severity factor is water supply immediately available for wildland fire suppression in high/very high fire hazard severity zones. Multiple water utilities provide potable water, and available fire flow, fire hydrant, or static water source spacing is adequate throughout the City according to Fire-Rescue staff.

Wildland Fire Hazard Mitigation

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

The 2010 San Diego County Multi-Jurisdictional Hazard Mitigation Plan identifies six goals for the City of San Diego relative to hazard mitigation, including Goal 3 relating specifically to

wildland fire: *Reduce the possibility of damage and losses to existing assets, particularly people, critical facilities/infrastructure, and State-owned facilities due to structural fire/wildfire, coastal storms/erosion/tsunami, earthquake, dam failure, flood, landslide, and other manmade hazards.* Although the Plan further identifies nine specific action items, none directly address actions or projects to reduce/minimize wildland fire impacts.

Citygate also reviewed the Draft 2015 San Diego County Multi-Jurisdictional Hazard Mitigation Plan, which *does* identify four specific actions to reduce/mitigate wildland fire impacts within the City of San Diego as follows:

Action 3.A.1 Perform brush management activities within the open space, public owned brush management zone, on a bi-annual basis.

Action 3.A.2 Maintain brush management inspection cycle of 42,505 parcels that are divided into 19 inspection areas and accomplished every 3.8 years.

Action 3.A.3 Create buffer zones around residential and non-residential structures through the removal or reduction of flammable vegetation, including vertical clearance of tree branches and removal of dead or dry leaves, needles, twigs, and combustibles from roofs, decks, eaves, porches, and yards.

Action 3.A.4 Create buffer zones around power lines, oil and gas lines, and other infrastructure systems, including replacing flammable vegetation with less flammable.

Fire-Rescue's Wildland Management and Enforcement Section is currently developing a Citywide Community Risk Assessment emphasizing "Sharing the Responsibility" between neighbors and the community. The objectives of this program include creating awareness of wildland risk in the City's Wildland Urban Interface (WUI); providing information on wildfire preparedness, "Ready, Set, Go", defensible space, and structure hardening that can assist homeowners in reducing their wildland fire risk. Section personnel will also be working with homeowners and other groups to create community organizations, such as Fire Safe Councils and Fire Wise, with the goal of reducing the wildland fire risk and increase the survivability of homes.

The Wildland Management and Enforcement Section currently oversees four vegetation management programs to ensure residential homes within the City's Wildland Urban Interface/Very High Fire Severity Zones have appropriate defensible space. These four programs encompass more than 49,000 parcels. The programs identify private and public parcels requiring inspection, and map and track the inspection status to ensure that each parcel is inspected and eliminates the potential for duplicate or missed inspections. The system also tracks parcels found to be in violation; however, vegetation management activities are prohibited during the

California Gnatcatcher breeding season, which is generally from late February to mid-July. Inspection and mitigation of publicly-owned parcels are conducted bi-annually, and the inspection cycle for privately-owned parcels is every 3.8 years.

Fire-Rescue has also participated in the regional development and standardization of WUI pre-fire plans. Under Urban Area Security Initiative (UASI) grants, several pre-plans addressing fire management of high risk targeted areas have been developed. These pre-plans are available electronically to field incident commanders.

Finding #19:	A significant percentage of the City lies within a ***Very High*** Wildland Fire Hazard Severity Zone as identified by the California Department of Forestry and Fire Protection (CAL FIRE).
Finding #20:	The Draft 2015 San Diego County Multi-Jurisdictional Hazard Mitigation Plan identifies four actions to address wildland fire risk in the City of San Diego.
Finding #21:	Fire-Rescue inspects more than 49,000 parcels within the City's Very High Wildland Fire Hazard Severity Zones and Wildland Urban Interface areas to ensure that required defensible space is appropriately established and maintained.
Finding #22:	Fire-Rescue has developed standardized Wildland Urban Interface pre-fire plans addressing management of wildland fires within targeted high-risk areas of the City.
Finding #23:	Fire-Rescue is currently developing a Citywide Community Risk Assessment emphasizing "Sharing the Responsibility." The program is aimed at enhancing wildland fire risk awareness in the City's Wildland Urban Interface (WUI) by providing information on wildfire preparedness, "Ready, Set, Go", defensible space, and structure hardening that can assist homeowners in reducing the impacts of a wildland fire.

Wildland Fire Service Capacity

Fire-Rescue's Response Plan for wildland fires during high fire hazard conditions includes two engines, two brush units, two helicopters, one water tender, four Battalion Chiefs, and one Shift Commander for a total of 26 personnel. In addition, Fire-Rescue has automatic aid or mutual aid agreements with adjacent fire agencies, and is a signatory to the San Diego County and

California Mutual Aid Agreements. This wildland fire service capacity is adequate to minimize the City's wildland fire impact severity exclusive of a large-scale event involving multiple operational periods or multiple serious concurrent events.

Wildland Fire Service Demand

The City experienced 524 wildland fires from January 2013 through December 2105, comprising 0.22% of total service demand over the same time period as summarized in Table 42.

Table 42—Wildland Fire Service Demand History

Hazard	Year	Planning Zone								Total	Percent of Total Service Demand
		Zone 1	Zone 2	Zone 3	Zone 4	Zone 5	Zone 6	Zone 7	Zone 8		
Wildland Fire	**2013-14**	19	22	29	43	8	45	21	28	**215**	**0.09%**
	2014-15	9	22	23	32	15	25	20	22	**168**	**0.07%**
	2015-16	10	22	10	29	12	30	10	18	**141**	**0.06%**
Total		**38**	**66**	**62**	**104**	**35**	**100**	**51**	**68**	**524**	**0.22%**
Percent of Total Service Demand		**0.10%**	**0.15%**	**0.19%**	**0.25%**	**0.15%**	**0.42%**	**0.24%**	**0.37%**	**0.22%**	

Source: San Diego Fire-Rescue Department incident records

As Table 42 shows, wildland fire service demand is trending downward over the past two years, with the highest occurrence in Zone 4 and the lowest occurrence in Zone 5.

Probability of Occurrence

Table 43 summarizes Citygate's determination of probability of future wildland fire occurrence over the next 12 months based on wildland fire service demand from Table 42.

Table 43—Probability of Future Wildland Fire Occurrence

Hazard	Planning Zone							
	Zone 1	Zone 2	Zone 3	Zone 4	Zone 5	Zone 6	Zone 7	Zone 8
Wildland Fire	***Very High***	***Very High***	***Very High***	***Very High***	***Very High***	***Very High***	***Very High***	***Very High***

Wildland Fire Impact Severity

Table 44 summarizes Citygate's determination of wildland fire impact severity by planning zone based on evaluation of the following wildland fire impact severity factors: area within very high

fire hazard severity zone, wildland fuels, weather, topography, fire history, water supply, mitigation measures, and wildland fire service capacity.

Table 44—Probable Wildland Fire Impact Severity

Hazard	Planning Zone							
	Zone 1	Zone 2	Zone 3	Zone 4	Zone 5	Zone 6	Zone 7	Zone 8
Wildland Fire	*Moderate*	*Moderate*	*Moderate*	*Major*	*Major*	*Moderate*	*Major*	*Major*

Overall Wildland Fire Risk

Table 45 summarizes Citygate's determination of overall wildland fire risk based on probability of occurrence from Table 43 in combination with probable impact severity from Table 44.

Table 45—Overall Wildland Fire Risk by Planning Zone

Hazard	Planning Zone							
	Zone 1	Zone 2	Zone 3	Zone 4	Zone 5	Zone 6	Zone 7	Zone 8
Wildland Fire	*HIGH*	*HIGH*	*HIGH*	*MAXIMUM*	*MAXIMUM*	*HIGH*	*MAXIMUM*	*MAXIMUM*

8.1.15 Medical Emergency Risk

Medical Emergency Impact Severity Factors

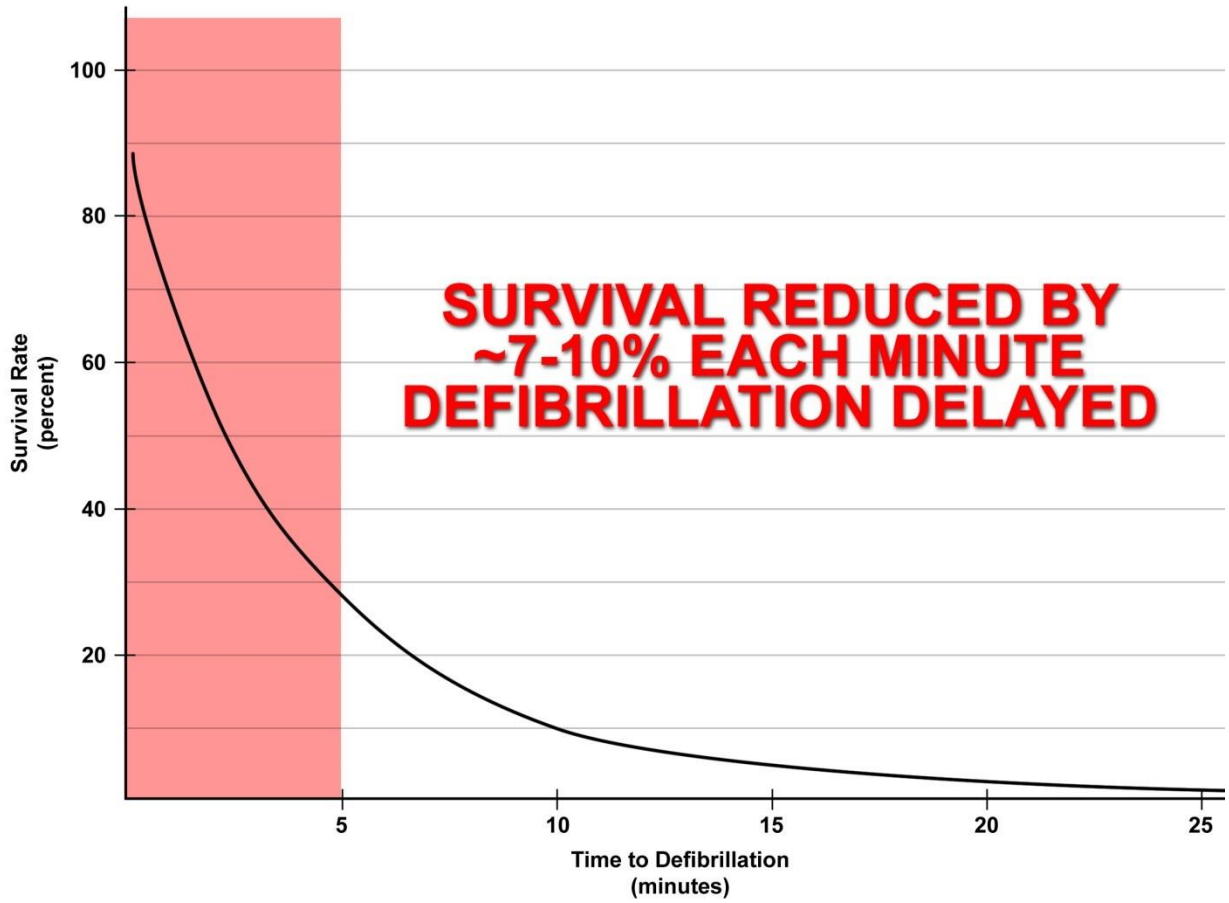
Medical emergency risk in most communities is predominantly a function of population density, demography, violence, and vehicle traffic. Relative to population demography, medical emergency risk tends to be higher among poorer, older, less-educated, and uninsured populations. As would be expected, medical emergency risk is also higher in communities or segments of communities with higher rates of violence. The risk is also higher in those areas of a community with high daily vehicle traffic volume, particularly those areas with high traffic volume travelling at higher speeds. The City's transportation network includes 13 highways: Interstates 5, 8, 15, 805, and State Routes 52, 54, 56, 75, 78, 94, 125, 163, and 905. These highways and freeways carry an annual average daily traffic volume of over 1.9 million vehicles, with a peak hour load of more than 163,000 vehicles.[8]

[8] Source: California Department of Transportation (2014)

Medical emergency risk can also be categorized as either a medical emergency resulting from a health-related condition or event, or a traumatic injury. One serious medical emergency is cardiac arrest or some other event where there is an interruption or blockage of oxygen to the brain.

Figure 20 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 20—Survival Rate versus Time of Defibrillation



Source: www.suddencardiacarrest.com

According to the U.S. Census Bureau, 11.23% of the City's population is 65 and older, and 8.2% of the population over 18 years of age is at or below poverty level.[9] The City also has multiple high-speed transportation routes contributing to its medical emergency risk.

Population Density

Because medical emergencies involve people, it seems logical that higher population densities generate higher medical emergency service demand than lower population densities. In Citygate's experience, this is particularly true for urban population densities. As illustrated in Figure 9 and Figure 10, the City's population density ranges from less than 1,000 per square mile to more than 56,000 per square mile.

Violent Crime Activity

Table 22 summarizes recent violent crime activity for San Diego.

Table 46—Violent Crime Summary – City of San Diego

Crime	2013	2014	2015	Total
Aggravated Assault	3,492	3,493	3,601	**10,586**
Homicide	39	32	37	**108**
Rape	316	371	566	**1,253**
Robbery	1,456	1,318	1,378	**4,152**
Total	**5,303**	**5,214**	**5,582**	**16,099**
Percentage of all Part 1 Crimes	7.69%	8.86%	8.71%	**8.39%**

Source: FBI Uniform Crime Statistics

Given the estimated 1.39 million population, these statistics represent a low rate of violent crime and suggest that violent crime minimally influences the City's medical emergency risk.

Medical Emergency Service Capacity

Fire-Rescue's medical emergency service capacity consists of a daily on-duty response force of 256 personnel staffing 70 response apparatus from 47 fire stations. All Fire-Rescue response personnel are trained to either the Emergency Medical Technician (EMT) level, able to provide Basic Life Support (BLS) pre-hospital emergency care; or Paramedic (EMT-P) level, able to provide Advanced Life Support (ALS) pre-hospital emergency medical care. Minimum daily

[9] Source: U.S. Census Bureau (2014)

staffing includes at least one paramedic on all staffed emergency response apparatus except command vehicles.

Fire-Rescue apparatus are dispatched to all medical emergencies. Fire-Rescue also has specialized two-person ALS Mobile Operations Detail (MOD) teams on bicycles or two-wheeled self-balancing electric personal transporters for special events, as well as Special Trauma and Rescue (STAR) units and STAR Medics to support Police Department Special Weapons and Tactics (SWAT) teams. Fire-Rescue also operates at least one Type-II ALS rescue helicopter from Montgomery Gibbs Executive Airport that is staffed with at least one Helicopter Rescue Medic.

AMR (formally known as Rural Metro) provides emergency ground paramedic ambulance transportation services in San Diego under an exclusive operating area contract with the City. This is a performance-based contract with a 90% maximum response time performance standards for each of eight medical response zones.

There are 13 hospitals within the San Diego City area, some of which provide medical control for paramedics, and provide emergency medical care services as follows:

1. Alvarado Hospital
2. Kaiser Hospital San Diego
3. Naval Medical Center
4. Rady Children's Hospital
5. Scripps Memorial Hospital – La Jolla
6. Scripps Mercy Hospital
7. Sharp Memorial Hospital
8. UC San Diego Thornton
9. UC San Diego Medical Center
10. Veterans Healthcare – La Jolla
11. Scripps Chula Vista
12. Sharp Chula Vista
13. Sharp Grossmont

In addition, regionally, Palomar Hospital, Children's Hospital, Scripps Memorial Hospital (La Jolla), Sharp Memorial Hospital, and UC San Diego are designated Trauma Centers. This service

capacity is adequate to minimize the City's medical emergency impact severity exclusive of a catastrophic disaster event.

Medical Emergency Service Demand

Medical emergency service demand over the previous three years involved 199,630 calls for service comprising 82.64% of total service demand over the same period, as summarized in Table 47.

Table 47—Medical Emergency Service Demand History

Hazard	Year	Planning Zone								Total	Percent of Total Service Demand
		Zone 1	Zone 2	Zone 3	Zone 4	Zone 5	Zone 6	Zone 7	Zone 8		
Medical Emergency	**2013-14**	9,364	10,347	7,806	10,168	4,974	6,348	5,266	4,717	**58,990**	**24.42%**
	2014-15	11,133	11,892	9,457	12,351	5,869	6,901	5,824	5,434	**68,861**	**28.51%**
	2015-16	11,914	12,894	9,686	12,375	5,841	7,236	6,207	5,626	**71,779**	**29.71%**
Total		**32,411**	**35,133**	**26,949**	**34,894**	**16,684**	**20,485**	**17,297**	**15,777**	**199,630**	**82.64%**
Percent of Total Service Demand		**83.87%**	**81.89%**	**82.34%**	**84.77%**	**72.89%**	**85.58%**	**82.08%**	**86.61%**	**82.64%**	

Source: San Diego Fire-Rescue Department incident records

As Table 47 shows, medical emergency service demand varies significantly by planning zone, and is trending upward an average of approximately 10% annually over the past two years. Overall, the City's emergency service demand is typical of other large metropolitan cities with similar demographics.

Probability of Occurrence

Table 48 summarizes Citygate's determination of probability of future medical emergency occurrence over the next 12 months based on medical emergency service demand history from Table 47.

Table 48—Probability of Medical Emergency Occurrence

Hazard	Planning Zone							
	Zone 1	Zone 2	Zone 3	Zone 4	Zone 5	Zone 6	Zone 7	Zone 8
Medical Emergency	***Very High***	***Very High***	***Very High***	***Very High***	***Very High***	***Very High***	***Very High***	***Very High***

Medical Emergency Impact Severity

Table 49 summarizes Citygate's determination of medical emergency impact severity based on evaluation of the following impact severity factors: population density, demography, violence, vehicle traffic, and pre-hospital and hospital emergency medical service capacity.

Table 49—Probable Medical Emergency Impact Severity

Hazard	Planning Zone							
	Zone 1	Zone 2	Zone 3	Zone 4	Zone 5	Zone 6	Zone 7	Zone 8
Medical Emergency	*Moderate*	*Moderate*	*Moderate*	*Moderate*	*Moderate*	*Moderate*	*Moderate*	*Moderate*

Overall Medical Emergency Risk

The following table summarizes Citygate's determination of overall medical emergency risk based on probability of occurrence in combination with probable impact severity.

Table 50—Overall Medical Emergency Risk

Hazard	Planning Zone							
	Zone 1	Zone 2	Zone 3	Zone 4	Zone 5	Zone 6	Zone 7	Zone 8
Medical Emergency	*MODERATE*	*MODERATE*	*MODERATE*	*MODERATE*	*MODERATE*	*MODERATE*	*MODERATE*	*MODERATE*

8.1.16 Hazardous Material Risk

Hazardous Materials Impact Severity Factors

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

The City has 4,988 buildings/facilities classified as hazardous occupancies by the state Building Code, or otherwise requiring a State or County hazardous material operating permit or Hazardous Materials Business Plan (HMBP) as shown in Table 51, Figure 21, and Figure 22.

Table 51—Hazardous Material Sites

Hazard	Zone 1	Zone 2	Zone 3	Zone 4	Zone 5	Zone 6	Zone 7	Zone 8	Total
Hazardous Material Sites	576	991	596	571	1,065	229	620	340	**4,988**
Percentage of Total	**11.55%**	**19.87%**	**11.95%**	**11.45%**	**21.35%**	**4.59%**	**12.43%**	**6.82%**	**100.00%**

Source: City of San Diego Fire-Rescue Department

Figure 21—Hazardous Material Sites (North)

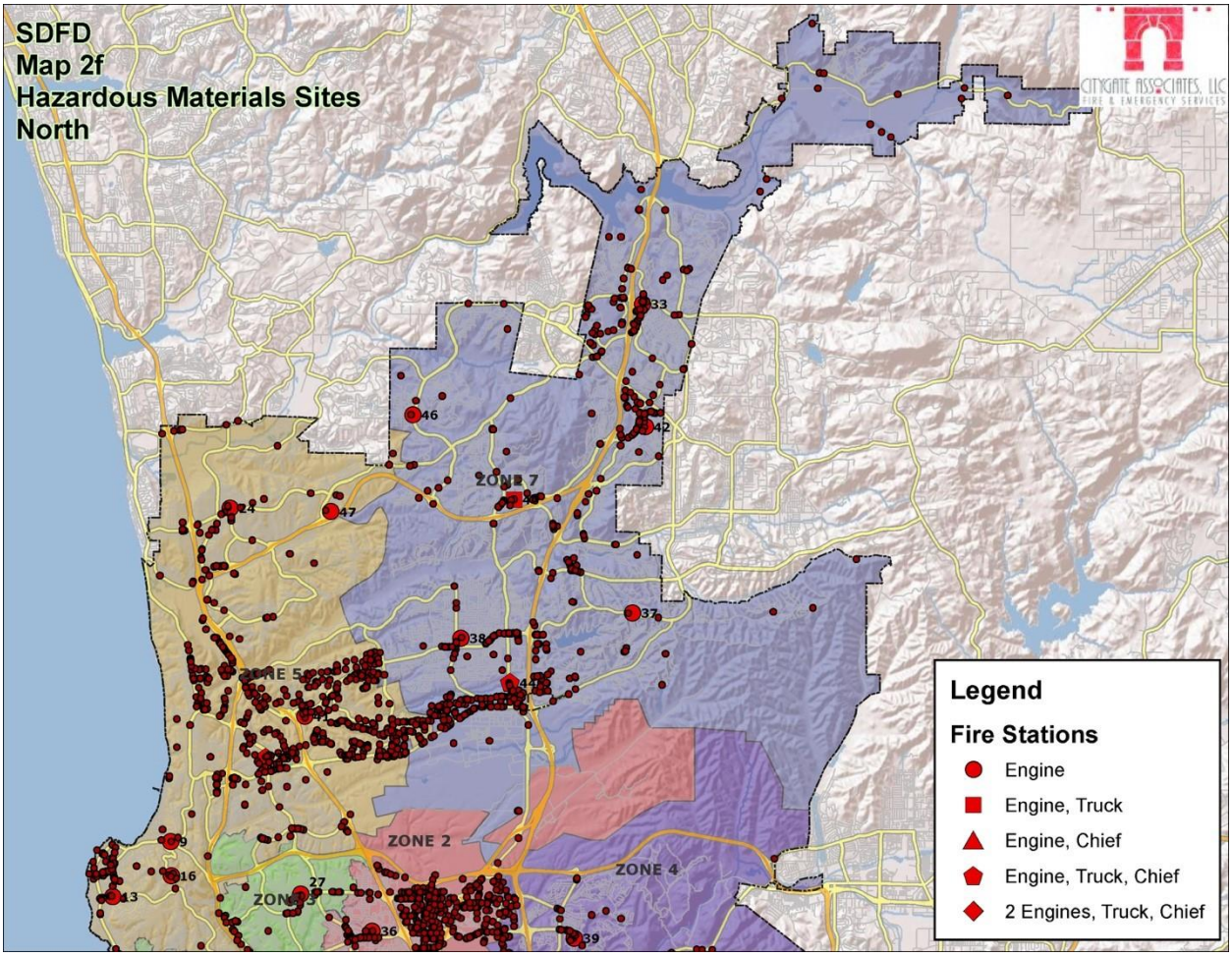
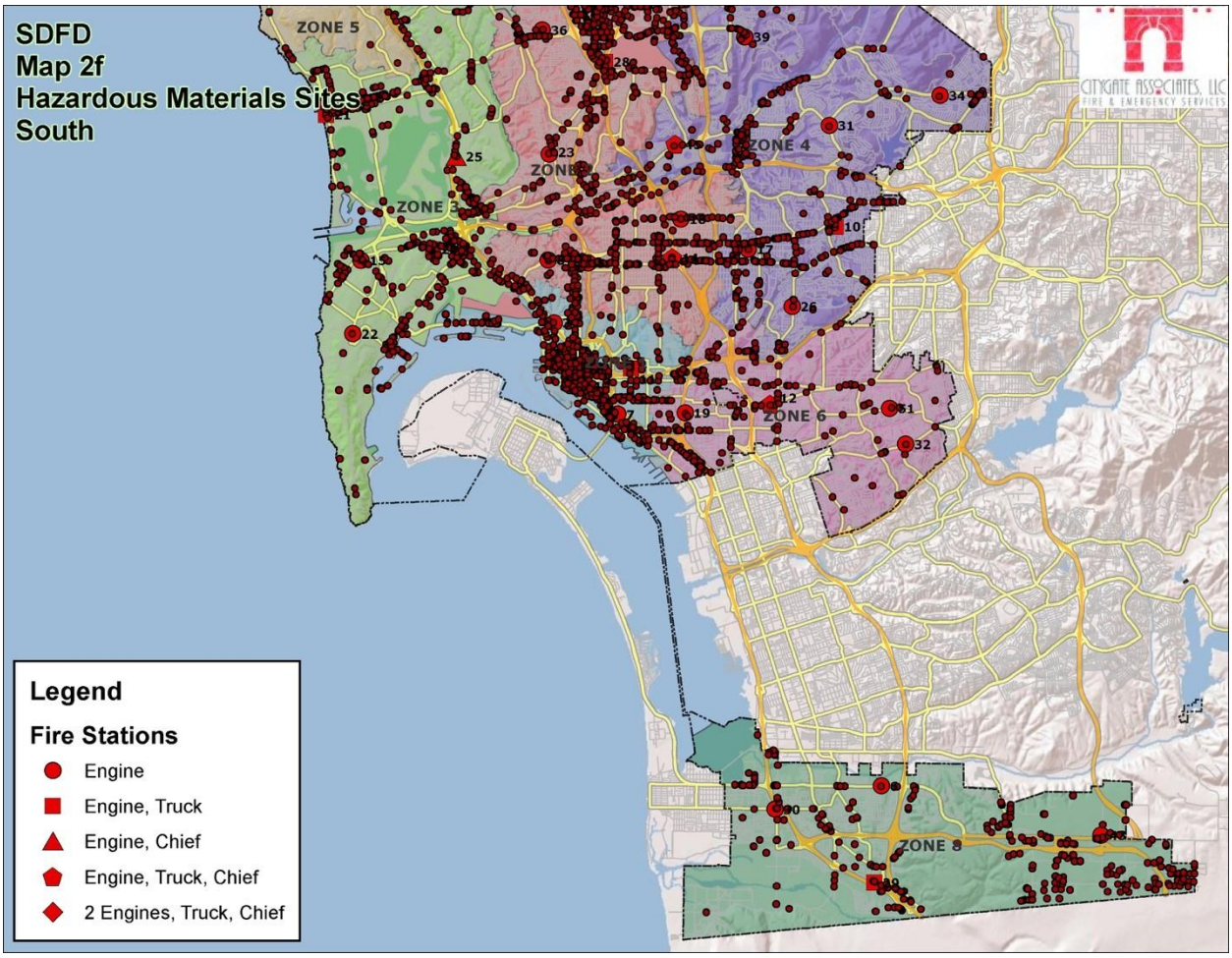


Figure 22—Hazardous Material Sites (South)



As Figure 21 and Figure 22 illustrate, hazardous material sites are located throughout the City, but are most prevalent in Planning Zones 2 and 5.

In addition to fixed hazardous materials facilities, the City also has significant transportation-related hazardous material risk as a result of its extensive road transportation network, including multiple highways and expressways with heavy daily truck traffic volume, and multiple railway routes with heavy daily cargo traffic. Table 52 summarizes the average annual daily truck traffic for the City's 13 highways.

Table 52—Average Annual Daily Truck Traffic

Highway	Crossing	AADT[1]	Truck AADT by Axles				% Truck AADT by Axles			
			2	3	4	5+	2	3	4	5+
Interstate 5	Junction Route 15	9,700	4,918	1,552	514	2,716	50.70%	16.00%	5.30%	28.00%
Interstate 8	Junction Route 15	7,315	4,682	841	329	1,463	64.00%	11.50%	4.50%	20.00%
Interstate 15	Miramar Way	11,129	6,838	801	307	3,183	61.44%	7.20%	2.76%	28.60%
Interstate 805	Junction Route 905	6,904	1,989	692	298	3,925	28.81%	10.02%	4.32%	56.85%
52	Genesee Avenue	2,607	1,775	378	63	391	68.10%	14.50%	2.40%	15.00%
54	Reo Drive	2,489	1,951	314	45	179	78.40%	12.60%	1.80%	7.20%
56	Carmel Country Road	No Data	No Data	No Data	No Data	No Data	No Data	No Data	No Data	No Data
75	Junction Route 5	2,010	1,548	245	46	171	77.00%	12.20%	2.30%	8.50%
78	Bandy Canyon	847	424	135	52	236	50.10%	15.90%	6.10%	27.90%
94	Route 805	6,981	5,075	677	168	1,061	72.70%	9.70%	2.40%	15.20%
125	Junction Route 94	7,216	4,250	1,025	281	1,660	58.90%	14.20%	3.90%	23.00%
163	Junction Route 805	6,784	3,744	1,045	231	1,764	55.20%	15.40%	3.40%	26.00%
905	Beyer Blvd.	4,293	2,224	670	133	1,266	51.80%	15.60%	3.10%	29.50%
Total		**68,275**	**39,418**	**8,375**	**2,467**	**18,015**	**57.73%**	**12.27%**	**3.61%**	**26.39%**

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

The City also has hazardous material risk exposure at the Unified Port of San Diego, with more than 2.7 million metric tons of cargo annually.

Population Density

Because hazardous material emergencies have the potential to adversely impact people's health, it is logical that the higher the population density, the greater the potential population exposed to a hazardous material release or spill. As previously illustrated in Figure 9 and Figure 10, the City's population density ranges from less than 1,000 per square mile to more than 56,000 per square mile.

Vulnerable Populations

Persons vulnerable to a hazardous material release/spill include those individuals or groups unable to self-evacuate, generally including children under the age of 10, the elderly, and persons confined to an institution or other setting where they either cannot or are unable to leave voluntarily. As cited earlier, 23.35% of the City's population is under age 10 or age 65 and older.

Emergency Evacuation Planning, Training, Implementation, and Effectiveness[10]

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

The City of San Diego has established emergency evacuation protocols, procedures, and resources as referenced in Annex Q (Evacuation) of the City's Emergency Operations Plan, San Diego Police Department Procedure 8.20 (Critical Incidents – Evacuation), Fire-Rescue Tsunami Response Procedure, and all-hazard evacuation maps for each of the 17 Police Department service areas of the City.

As needed during actual emergencies, the City's emergency response organization(s) utilizes these references and resources to develop real-time, incident-specific evacuation plans conforming to FEMA ICS and Incident Action Planning principles. Evacuation needs and instructions are communicated to the public using multiple simultaneous methods, including television/radio emergency announcements/broadcasts; Alert San Diego, a mass emergency telephone notification system; Commercial Mobile Alert System mass emergency telephone notification system; text and email notifications; public, non-profit, and private organization websites; web applications; social media; and door-to-door notification by the Police Department.

The City's emergency planners and public safety departments routinely utilize and validate these evacuation protocols, processes, and procedures as part of department-level, Citywide, and regional emergency exercises and training events, including quarterly City Emergency Operations Center tabletop and functional exercises, U.S. Coast Guard's Exercise Bay Shield series, and the statewide Golden Guardian exercise series.

[10] Reference: John Valencia, City of San Diego Office of Homeland Security Program Manager

Finding #24:	The City has established appropriate emergency evacuation protocols, procedures, and resources in its Citywide Emergency Operations Plan, Police Department Procedures, and Fire-Rescue Procedures.
Finding #25:	The City has established multiple effective concurrent methods to communicate emergency evacuation information to the public in a timely manner.
Finding #26:	The City regularly utilizes, validates, and evaluates its emergency evacuation protocols, procedures, and resources to ensure ongoing emergency evacuation readiness and effectiveness.

Hazardous Materials Service Capacity

All Fire-Rescue response personnel are trained to the U.S. Department of Transportation Hazardous Material First Responder Operational level to provide initial hazardous material incident assessment, hazard isolation, and support for a Hazardous Material Response Team. In addition, Fire-Rescue operates a California Office of Emergency Services (CalOES) Type-1 Hazardous Material Response Team from Station 45 adjacent to Qualcomm Stadium. This resource (HAZMAT 1) is cross-staffed, as needed, with a minimum of four personnel trained to the Hazardous Material Specialist or Technician level. This service capacity is minimally adequate to minimize the City's hazardous material impact severity exclusive of a large regional or terrorism incident.

Hazardous Materials Service Demand

The City experienced 1,209 hazardous material incidents for the three-year study period from July 1, 2013 through June 30, 2016, constituting 0.50% of total service demand over the same period as summarized in Table 53.

Table 53—Hazardous Materials Service Demand History

Hazard	Year	Planning Zone								Total	Percent of Total Service Demand
		Zone 1	Zone 2	Zone 3	Zone 4	Zone 5	Zone 6	Zone 7	Zone 8		
Hazardous Material	**2013-14**	30	64	62	71	29	35	43	27	**361**	**0.15%**
	2014-15	19	91	65	77	45	41	50	28	**416**	**0.17%**
	2015-16	34	88	64	84	50	35	45	32	**432**	**0.18%**
Total		**83**	**243**	**191**	**232**	**124**	**111**	**138**	**87**	**1,209**	**0.50%**
Percent of Total Service Demand		**0.21%**	**0.57%**	**0.58%**	**0.56%**	**0.54%**	**0.46%**	**0.65%**	**0.48%**	**0.50%**	

Source: San Diego Fire-Rescue Department incident records

As Table 53 indicates, hazardous material service demand varies by planning zone and is trending upward, with the highest demand in Planning Zones 2, 3, and 4. Overall, the City's hazardous material service demand is low, and similar to other southern California jurisdictions with similar demographics.

Probability of Occurrence

Table 54 summarizes Citygate's determination of probability of a future hazardous material occurrence over the next 12 months based on recent hazardous material service demand history from Table 53.

Table 54—Probability of Hazardous Material Occurrence

Hazard	Planning Zone							
	Zone 1	Zone 2	Zone 3	Zone 4	Zone 5	Zone 6	Zone 7	Zone 8
Hazardous Material	***High***	***High***	***High***	***High***	***High***	***High***	***High***	***High***

Hazardous Materials Impact Severity

Table 55 summarizes Citygate's determination of hazardous material impact severity based on evaluation of the following impact severity factors: fixed hazardous material sites, transportation-related hazardous materials, population density, vulnerable populations, emergency notification and evacuation planning and training, and hazardous material service capacity.

Table 55—Hazardous Material Impact Severity

Hazard	Planning Zone							
	Zone 1	Zone 2	Zone 3	Zone 4	Zone 5	Zone 6	Zone 7	Zone 8
Hazardous Material	*High*	*High*	*High*	*Moderate*	*Moderate*	*High*	*Moderate*	*Moderate*

Overall Hazardous Materials Risk

Table 56 summarizes Citygate's determination of overall hazardous material risk based on probability of occurrence from Table 54 in combination with impact severity from Table 55.

Table 56—Overall Hazardous Material Risk

Hazard	Planning Zone							
	Zone 1	Zone 2	Zone 3	Zone 4	Zone 5	Zone 6	Zone 7	Zone 8
Hazardous Material	*HIGH*	*HIGH*	*HIGH*	*MODERATE*	*MODERATE*	*HIGH*	*MODERATE*	*MODERATE*

8.1.17 Technical Rescue Risk

Technical Rescue Impact Severity Factors

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

Construction Activity

There is continuous ongoing construction activity throughout most areas of the City, particularly given the projected growth and related development.

Confined Spaces

There are many confined spaces within most areas of the City, including tanks, vaults, open trenches, etc.

Water Bodies

There are numerous bodies of water within the City including the Pacific Ocean coastline, Mission Bay and San Diego Bay, Lake Hodges, Lake Miramar, Lake Murray, and numerous streams and smaller bodies of water.

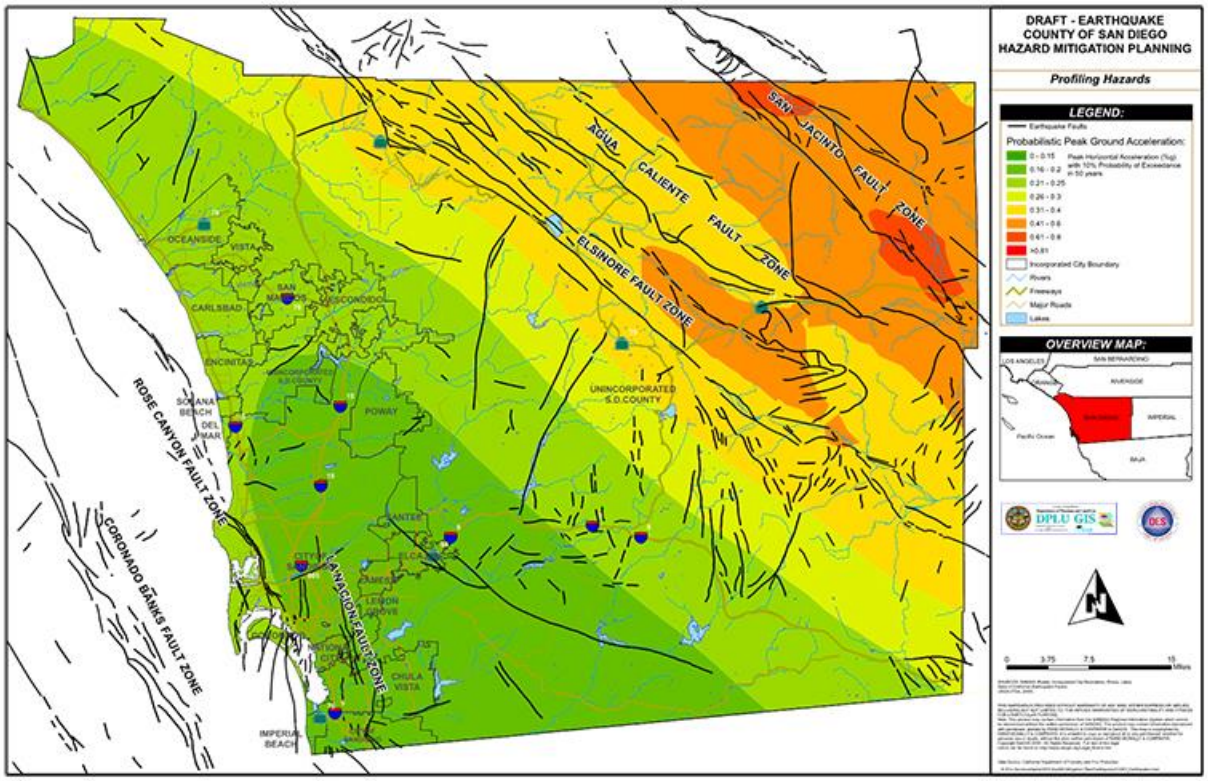
Transportation Volume

Another technical rescue factor is transportation-related incidents requiring technical rescue. This risk factor is primarily a function of vehicle, railway, maritime, and aircraft passenger volume. Vehicle traffic volume is the greatest of these factors in San Diego, with 13 major highways carrying more than 1.9 million vehicles daily.

Earthquake Potential

The 2010 San Diego County Multi-Jurisdictional Hazard Mitigation Plan identifies six active fault zones in San Diego County with earthquake activity doubling over the preceding 50 years. The MJHMP further identifies the likely maximum magnitude of future earthquakes ranging from 6.0 to 7.7 depending on the fault(s) involved. Figure 23 shows the probable Peak Ground Acceleration (PGA) for earthquakes in San Diego County.

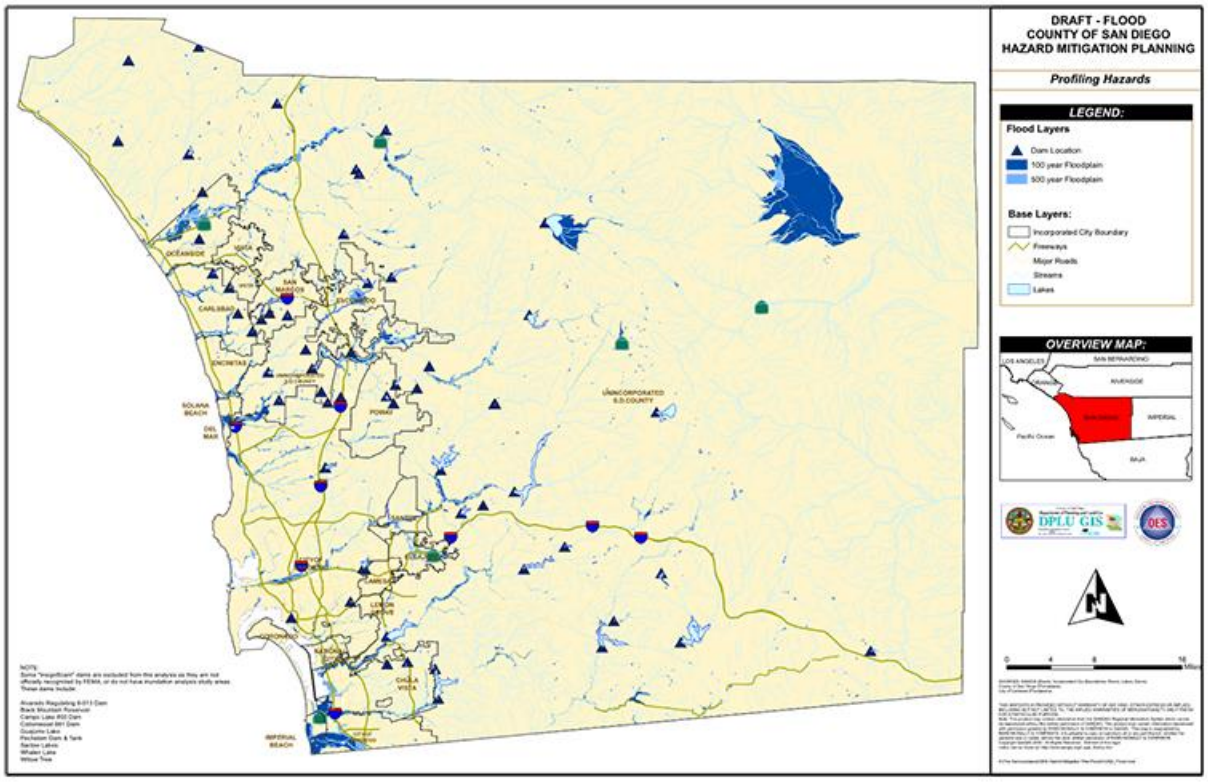
Figure 23—Earthquake Hazard – San Diego County



Flood Potential[11]

San Diego County has an extensive history of serious floods, including ten between 1950 and 1997 that resulted in a proclaimed County State of Emergency. Figure 24 shows the location of flood hazards within San Diego County as determined by the Federal Emergency Management Agency (FEMA).

Figure 24—San Diego County Flood Hazard Zones



San Diego is also potentially susceptible to flood from a tsunami. Figure 25 through Figure 27 illustrate the projected maximum tsunami run-up areas for San Diego.

[11] Source: 2010 San Diego County Multi-Jurisdictional Hazard Mitigation Plan, Section 4.3.4

Figure 25—Projected Maximum Tsunami Run-Up (North)

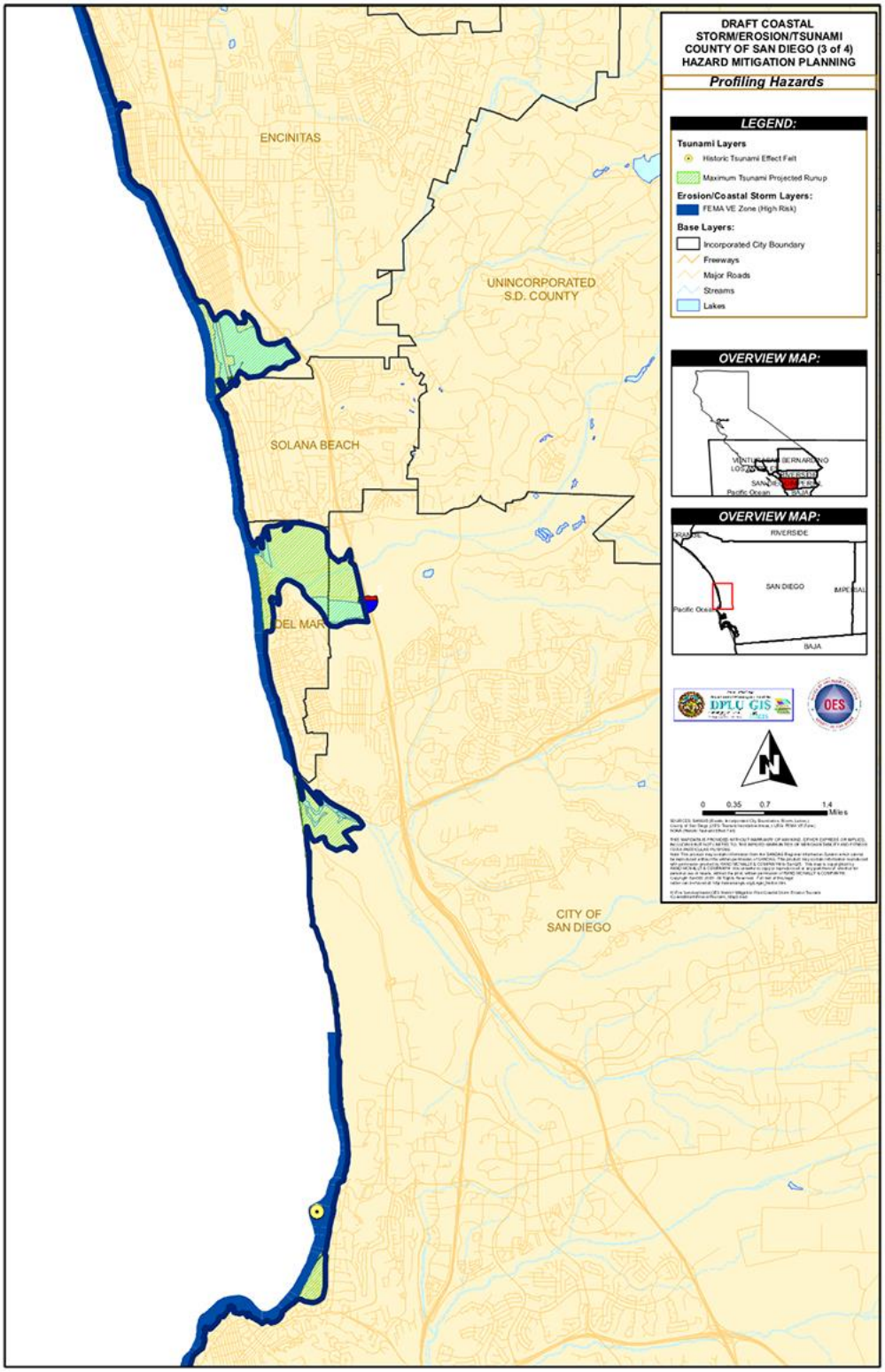


Figure 26—Projected Maximum Tsunami Run-Up (Central)

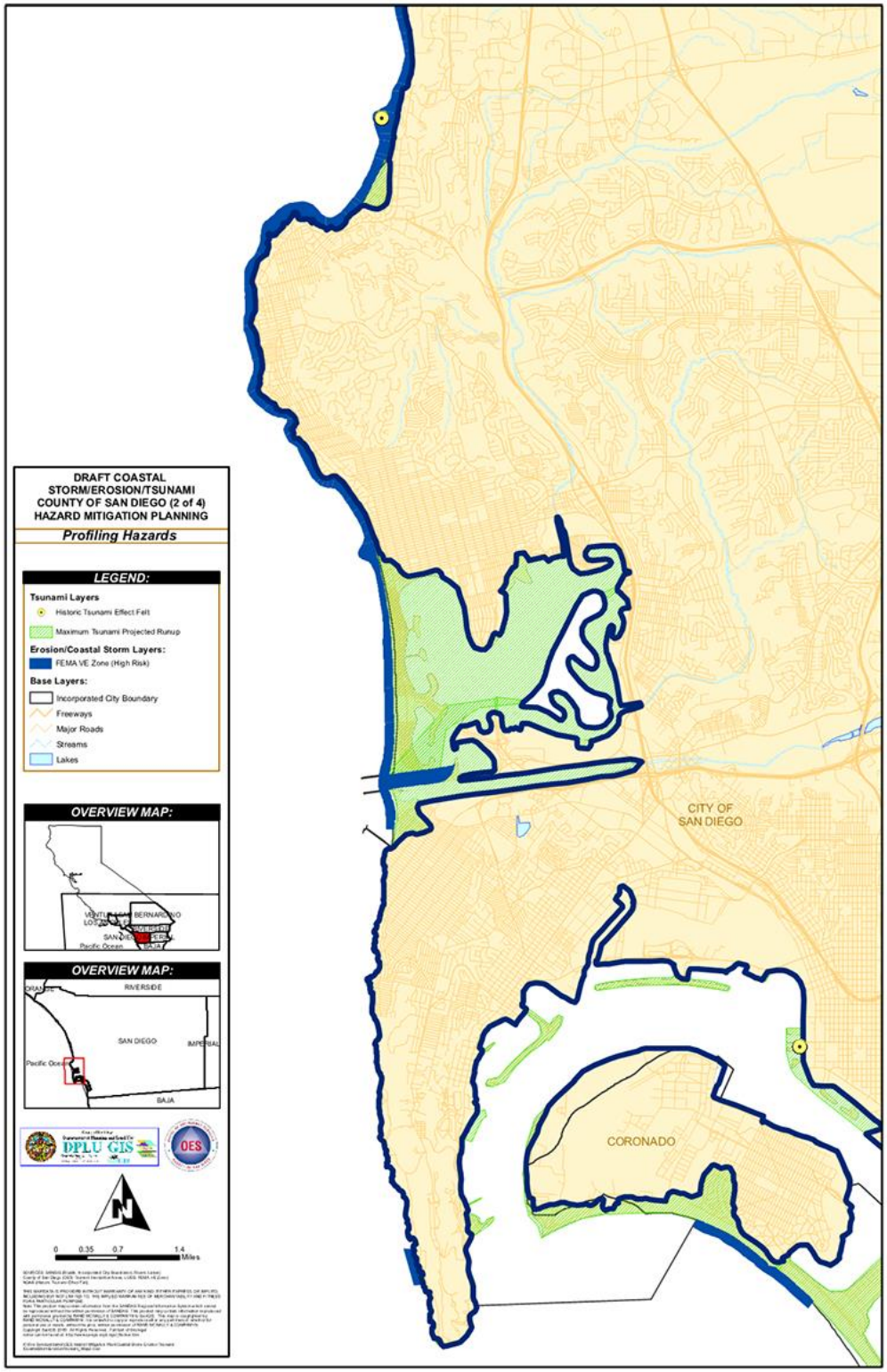
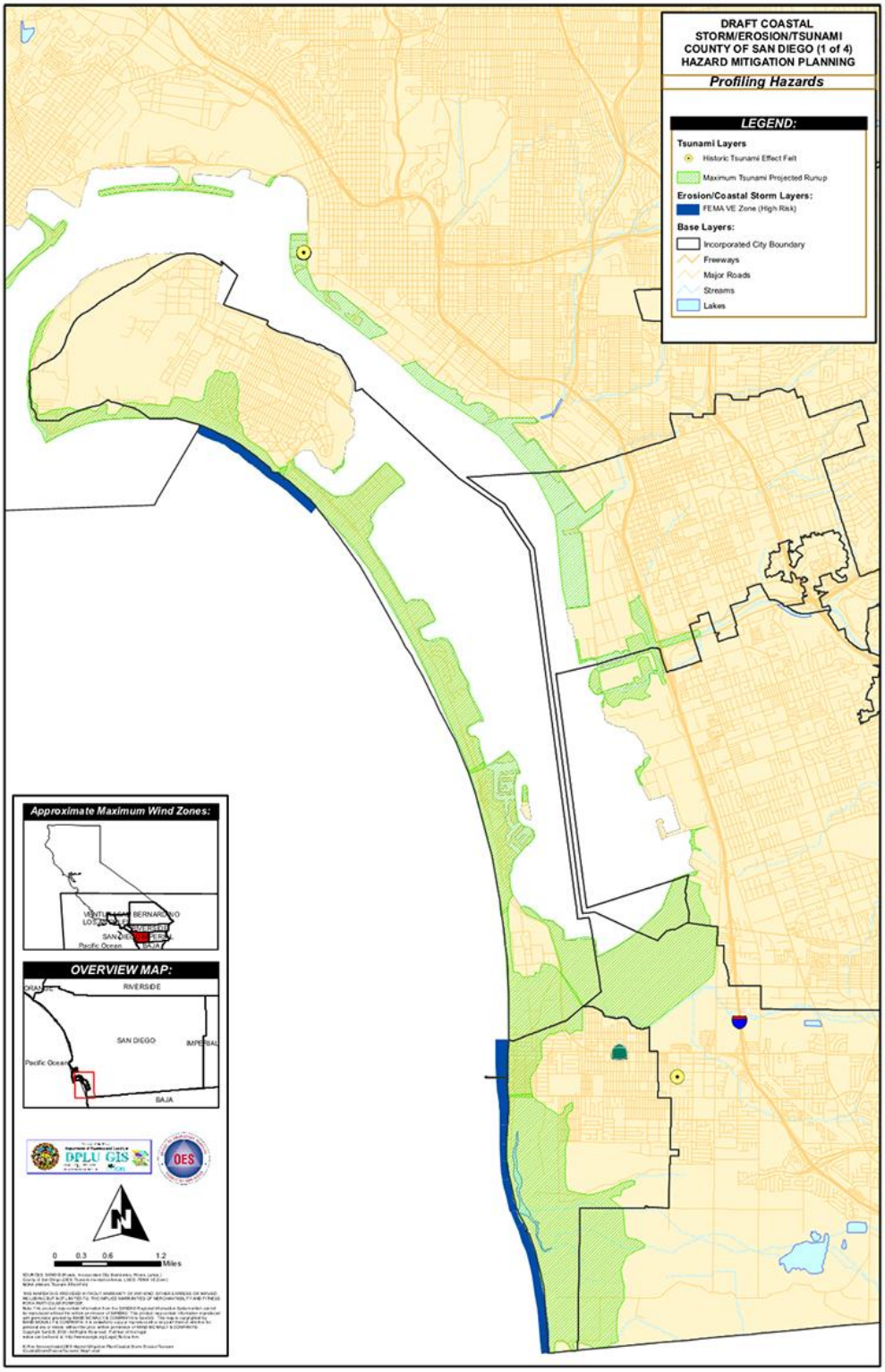


Figure 27—Projected Maximum Tsunami Run-Up (South)



Technical Rescue Risk Service Capacity

Fire-Rescue's technical rescue capability consists of a CalOES Type-1 Urban Search and Rescue (US&R) Heavy Rescue unit at Station 4 (US&R 4) and Station 41 (US&R 41). US&R 4 is staffed daily with four personnel, and US&R 41 is cross-staffed by Engine 41 personnel as needed. Both units are capable of conducting low angle and high angle rope rescue, building collapse, cave-in, trench collapse, confined space, and other technical rescue operations. Fire-Rescue also hosts Federal Emergency Management Agency (FEMA) US&R Task Force 8 (CA-TF8), one of 28 federal Type-1 US&R Task Forces available to respond to major disasters throughout the country.

Fire-Rescue also has a Lifeguard Division, which is responsible for providing water and boat rescue, limited marine fire suppression, coastal cliff rescue, underwater search and recovery, swiftwater and flood search and rescue, and EMS response on and around beach, bay, and ocean areas. The Lifeguard Services Division has one main headquarters and eight permanent sub-stations strategically located throughout the 17 miles of coastline, and 4,600 acres of Mission Bay consisting of 26 miles of shoreline within the bay. The Division has approximately 43 seasonal towers and outposts that are primarily used for the seasonal staff during high peak summer activity. The Division's staffing consists of 108 permanent and 240 seasonal employees.

The Division operates a fleet of four-wheel drive pickup truck and sport utility vehicles, six personal watercraft, an 18-foot and a 22-foot surf rescue/patrol boat, and a 32-foot and 35-foot fire/rescue boat capable of both limited small boat marine fire suppression and rescue missions.

Additional technical and water rescue capability is available from the San Diego County Fire Authority, and the City of Chula Vista. This service capacity is adequate to minimize the City's technical rescue impact severity exclusive of a significant disaster event.

Technical Rescue Service Demand

Over the most recent three-year period from July 1, 2013 through June 30, 2016, Fire-Rescue responded to 1,625 technical rescue incidents comprising 0.67% of total service demand for the same period as summarized in Table 57.

Table 57—Technical Rescue Service Demand

Hazard	Year	Planning Zone								Total	Percent of Total Service Demand
		Zone 1	Zone 2	Zone 3	Zone 4	Zone 5	Zone 6	Zone 7	Zone 8		
Technical Rescue	**2013-14**	165	75	65	41	56	12	11	7	**432**	**0.18%**
	2014-15	200	115	90	71	70	13	20	16	**595**	**0.25%**
	2015-16	167	118	87	92	84	14	22	14	**598**	**0.25%**
Total		**532**	**308**	**242**	**204**	**210**	**39**	**53**	**37**	**1,625**	**0.67%**
Percent of Total Service Demand		**1.38%**	**0.72%**	**0.74%**	**0.50%**	**0.92%**	**0.16%**	**0.25%**	**0.20%**	**0.67%**	

Source: San Diego Fire-Rescue Department incident records

As Table 57 shows, technical rescue service demand is trending higher, with the greatest demand in Planning Zones 1 and 2, followed by Zones 3, 4, and 5.

Probability of Occurrence

Table 58 summarizes Citygate's determination of probability of a future technical rescue occurrence over the next 12 months based on technical rescue service demand history from Table 57.

Table 58—Probability of Technical Rescue Occurrence

Hazard	Planning Zone							
	Zone 1	Zone 2	Zone 3	Zone 4	Zone 5	Zone 6	Zone 7	Zone 8
Technical Rescue	***Very High***	***Very High***	***Very High***	***Very High***	***Very High***	***High***	***High***	***High***

Technical Rescue Impact Severity

Table 59 summarizes Citygate's determination of technical rescue impact severity based on evaluation of the following impact severity factors: active construction projects, confined spaces, bodies of water, transportation volume, earthquake/flood potential, and technical rescue service capacity.

Table 59—Technical Rescue Impact Severity

Hazard	Planning Zone							
	Zone 1	Zone 2	Zone 3	Zone 4	Zone 5	Zone 6	Zone 7	Zone 8
Technical Rescue	***Moderate***	***Moderate***	***Moderate***	***Moderate***	***Moderate***	***Moderate***	***Moderate***	***Moderate***

Overall Technical Rescue Risk

Table 60 summarizes Citygate's determination of overall technical rescue risk based on probability of occurrence from Table 58 in combination with impact severity from Table 59.

Table 60—Overall Technical Rescue Risk

Hazard	Planning Zone							
	Zone 1	Zone 2	Zone 3	Zone 4	Zone 5	Zone 6	Zone 7	Zone 8
Technical Rescue	***MODERATE***	***MODERATE***	***MODERATE***	***MODERATE***	***MODERATE***	***MODERATE***	***MODERATE***	***MODERATE***

8.1.18 Marine Risk

Marine Risk Impact Severity Factors

Marine risk impact severity factors include commercial marine activity and related economy, recreational activity, and watercraft use and storage in San Diego City waterways.

Waterways

Mission Bay, located seven miles northwest of Downtown San Diego, is the largest man-made aquatic park in the country. Encompassing 2,300 acres of water, the adjoining 2,300-acre Mission Bay Park with 27 miles of shoreline, 19 miles of sandy beaches, 14 miles of bike paths, the bay and park are an extremely popular destination for beachgoers and for all types of watersports. The Bay is also the home of SeaWorld San Diego. The Mission Bay area includes numerous hotels and luxury resorts, shops, restaurants, and nightclubs.

San Diego Bay, a natural harbor and deep-water port encompassing 19 square miles, is the third largest protected natural bay in California. The Bay is home to four U.S. Navy facilities including Naval Air Station North Island, Naval Station San Diego, Naval Base Point Loma, and Naval Amphibious Base Coronado. The Bay is also the home of General Dynamics National Steel and Shipbuilding Company, the only shipyard on the west coast capable of building and repairing large ocean-going vessels. The San Diego-Coronado Bridge connects the North Island section of the peninsula with the mainland section of the City. Numerous resorts, hotels, the San

Diego Convention Center, and the San Diego International Airport are adjacent to the Bay. The Bay is also home to the San Diego Maritime Museum with ten museum ships including the aircraft carrier USS Midway. The Bay also has thousands of commercial and recreational boat berths. In addition to military and commercial uses, the Bay is very popular for recreational watersport and watercraft use.

Port of San Diego

The Port of San Diego, the fourth largest port in California, is governed by the San Diego Unified Port District, which governs all uses of San Diego Bay exclusive of military facilities and operations. The Port is a key economic engine for San Diego, handling more than 3 million metric tons of cargo including 615,000 cargo containers, and more than 615,000 cruise ship passengers annually with two container ship facilities and two cruise ship terminals. The Port is the primary port of entry for more than eight foreign automobile manufacturers, as well much of the Country's banana crop.

Marine Risk Service Capacity

Fire-Rescue's service capacity for marine risk includes 32-foot and a 35-foot fire/rescue boats with 1,000 GPM fire pumps on Mission Bay, 18-foot and 22-foot surf rescue/patrol boats, and six personal watercraft. In addition, the Port of San Diego Harbor Police Department operates a fleet of patrol/rescue and small boat firefighting vessels, and all Harbor Police Department officers are cross-trained as marine firefighters. Additional marine risk service capacity support is available from Fire-Rescue's daily on-duty force. This combined service capacity is minimally adequate to mitigate the City's marine risk impact severity exclusive of a large military or commercial ship fire.

Marine Risk Service Demand

During the most recent three-year period from July 1, 2013 through June 30, 2016, the Emergency Operations Branch (not Lifeguards) responded to 195 marine incidents comprising 0.08% of total service demand for the same period, as summarized in Table 61.

Table 61—Marine Service Demand

Hazard	Year	Planning Zone								Total	Percent of Total Service Demand
		Zone 1	Zone 2	Zone 3	Zone 4	Zone 5	Zone 6	Zone 7	Zone 8		
Marine Risk	**2013-14**	6	3	19	2	5	0	3	3	**41**	**0.02%**
	2014-15	7	6	27	6	11	4	2	6	**69**	**0.03%**
	2015-16	5	12	32	8	17	3	3	5	**85**	**0.04%**
Total		**18**	**21**	**78**	**16**	**33**	**7**	**8**	**14**	**195**	**0.08%**
Percent of Total Service Demand		**0.05%**	**0.05%**	**0.24%**	**0.04%**	**0.14%**	**0.03%**	**0.04%**	**0.08%**	**0.08%**	

Source: San Diego Fire-Rescue Department incident records

As Table 61 shows, the highest service demand for marine-related incidents was in Planning Zones 3 and 5.

Probability of Occurrence

Table 62 summarizes Citygate's determination of probability of a future marine-related incident occurrence over the next 12 months based on service demand history from Table 61.

Table 62—Probability of Marine Incident Occurrence

Hazard	Planning Zone							
	Zone 1	Zone 2	Zone 3	Zone 4	Zone 5	Zone 6	Zone 7	Zone 8
Marine Risk	***Moderate***	***Moderate***	***High***	***Moderate***	***High***	***Low***	***Low***	***Moderate***

Marine Risk Impact Severity

Table 63 summarizes Citygate's determination of marine risk impact severity based on evaluation of commercial marine activity and related economy, recreational activity, watercraft use and storage, and marine risk service capacity.

Table 63—Probable Marine Incident Impact Severity

Hazard	Planning Zone							
	Zone 1	Zone 2	Zone 3	Zone 4	Zone 5	Zone 6	Zone 7	Zone 8
Marine Risk	***Major***	***Minor***	***Major***	***Minor***	***Minor***	***Moderate***	***Minor***	***Minor***

Overall Marine Risk

Table 64 summarizes Citygate's determination of overall marine risk based on probability of occurrence from Table 62 in combination with impact severity from Table 63.

Table 64—Overall Marine Risk

Hazard	Planning Zone							
	Zone 1	Zone 2	Zone 3	Zone 4	Zone 5	Zone 6	Zone 7	Zone 8
Marine Risk	*HIGH*	*MODERATE*	*HIGH*	*LOW*	*MODERATE*	*LOW*	*LOW*	*MODERATE*

8.1.19 Aviation Risk

Aviation Risk Impact Severity Factors

Aviation risk impact severity factors include commercial airline passenger and commercial air cargo activity, and commercial airship and general aviation activity into, from, and over the City of San Diego.

Airports

The San Diego International Airport, also known as Lindbergh Field, is located three miles northwest of Downtown San Diego adjacent on the north end of San Diego Bay. Governed and operated by the San Diego County Regional Airport Authority, the airport has approximately 465 scheduled passenger flights daily with 24 airlines from two terminals, carrying more than 20 million passengers annually. In addition, there are more than 9,600 general aviation flights and three air cargo carriers that transport more than 161,000 tons of cargo annually.

Montgomery-Gibbs Executive Airport, located six miles north of downtown and owned and operated by the City of San Diego, is one of the busiest general aviation airports in the nation.

Brown Field Municipal Airport, a former U.S. Navy airfield, now a public airport located 13 miles southeast of Downtown San Diego, is a busy general aviation airport also owned and operated by the City of San Diego.

Marine Corps Air Station Miramar, located ten miles north of downtown, is an Untied States Marine Corps installation home to the 3rd Marine Aircraft Wing.

Aviation Risk Service Capacity

Aviation Risk service capacity includes Aircraft Rescue Fire Fighting (ARFF) capability at San Diego International Airport Fire Station, Station 28 adjacent to Montgomery-Gibbs Executive Airport, and Station 43 at Brown Field Municipal Airport.

Rescue 1, Rescue 2, Rescue 3, and Rescue 5 are ARFF apparatus stationed at San Diego International Airport. The Fire Station facility and apparatus are owned and maintained by the San Diego Regional Airport Authority, and staffing is provided contractually by the City of San Diego Fire-Rescue Department. Crash 28 and Crash 43 are also ARFF apparatus cross-staffed as needed by on-duty personnel.

Additional aviation risk service capacity support is available from Fire-Rescue's daily on-duty force of 256 personnel staffing 70 response apparatus from 47 fire stations. This combined service capacity is adequate to mitigate the City's aviation risk exclusive of multiple serious concurrent events.

Aviation Risk Service Demand

Over the most recent three-year period from July 1, 2013 through June 30, 2016, Fire-Rescue responded to five aviation-related incidents (not alerts where a standby crew is requested by a pilot but an actual emergency is not realized) comprising less than .01% of total service demand for the same period, as summarized in Table 65.

Table 65—Aviation Risk Service Demand

Hazard	Year	Planning Zone								Total	Percent of Total Service Demand
		Zone 1	Zone 2	Zone 3	Zone 4	Zone 5	Zone 6	Zone 7	Zone 8		
Aviation Risk	**2013-14**	0	0	0	0	0	0	0	0	**0**	**0.00%**
	2014-15	0	1	0	0	0	0	0	0	**1**	**0.00%**
	2015-16	0	3	1	0	0	0	0	0	**4**	**0.00%**
Total		**0**	**4**	**1**	**0**	**0**	**0**	**0**	**0**	**5**	**0.00%**
Percent of Total Service Demand		**0.00%**	**0.01%**	**0.00%**	**0.00%**	**0.00%**	**0.00%**	**0.00%**	**0.00%**	**0.00%**	

Source: San Diego Fire-Rescue Department incident records

As Table 65 shows, there were only five aviation-related incidents: four at San Diego International Airport, and one at Montgomery-Gibbs Executive Airport.

Probability of Occurrence

Table 66 summarizes Citygate's determination of probability of a future aviation incident occurrence over the next 12 months based on maritime incident service demand history from Table 65.

Table 66—Probability of Aviation Incident Occurrence

Hazard	Planning Zone							
	Zone 1	Zone 2	Zone 3	Zone 4	Zone 5	Zone 6	Zone 7	Zone 8
Aviation Risk	*Very Low*	*Low*	*Very Low*	*Very Low*	*Very Low*	*Very Low*	*Very Low*	*Very Low*

Aviation Risk Impact Severity

Table 67 summarizes Citygate's determination of aviation risk impact severity based on evaluation of commercial airline passenger and commercial air cargo activity, commercial airship and general aviation activity, and aviation risk service capacity.

Table 67—Aviation Risk Impact Severity

Hazard	Planning Zone							
	Zone 1	Zone 2	Zone 3	Zone 4	Zone 5	Zone 6	Zone 7	Zone 8
Aviation Risk	*Moderate*	*Major*	*Moderate*	*Moderate*	*Moderate*	*Moderate*	*Moderate*	*Moderate*

Overall Aviation Risk

Table 68 summarizes Citygate's determination of overall aviation risk based on probability of occurrence from Table 66 in combination with impact severity from Table 67.

Table 68—Overall Aviation Risk

Hazard	Planning Zone							
	Zone 1	Zone 2	Zone 3	Zone 4	Zone 5	Zone 6	Zone 7	Zone 8
Aviation Risk	*LOW*	*MODERATE*	*LOW*	*LOW*	*LOW*	*LOW*	*LOW*	*LOW*

APPENDIX A

Status of Fire Station Areas Identified in the 2010 and 2017 Studies

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Appendix A—Status of Fire Station Areas Identified in the 2010 and 2017 Studies

2010 GAP				2017 GAP*			
2010 ID	Council District	Fire Station	Community Planning Area	2017 ID	Council District	Community Planning Area	Current Status
1	4/9		Mid-City: City Heights				Capital Improvement Program (CIP) created; pursuing land purchase at 47th and Fairmount Avenue
2	4	FS54	Skyline-Paradise Hills	Gap 4 N	4	Southwestern Skyline-Paradise Hills	No land identified; CIP created; no funding
3	9		College Area				CIP created; no funding
4	4	FS51	Skyline-Paradise Hills				Station in-service (temporary facility); CIP created; no funding
5	4	SQ55	Encanto	Gap 4 S	4	Northeastern Encanto	Squad in-service; 61st and Imperial Avenue; no CIP
6	1	SQ56	University	Gap 2	1	Southern University	Squad in-service; Governor Drive and Dunant Street; no CIP
7	2		Pacific Beach	Gap 1	2	Pacific Beach	No CIP or activity
8	1		University				UCSD Fire Station project; in negotiations
9	2		Peninsula				No CIP or activity
10	1	FS50	University				Nobel and Shoreline; CIP created; land secured; station in design
11	1		Torrey Hills	Gap 3	1	Torrey Hills/South Carmel Valley	No CIP or activity
12	6/7		Serra Mesa				No CIP or activity
13	6		Mira Mesa				No CIP; possibility future development will build station
14	8		Otay Mesa				No CIP or activity; see “FS49 – Otay Mesa” in bottom row of this table
15	5		Scripps Miramar Ranch				No CIP or activity
16	5	SQ57	San Pasqual				Squad in-service
17	7		Linda Vista				No CIP or activity

2010 GAP				2017 GAP*			
2010 ID	Council District	Fire Station	Community Planning Area	2017 ID	Council District	Community Planning Area	Current Status
18	1	FS48	Black Mountain Ranch				Carmel Valley Road and Winecreek Road; land secured; in negotiations with developer for construction; potential reimbursement agreement; partial Facility Benefit Assessment (FBA) funding to date
19	2		Mission Valley				No CIP or activity
				Gap 5	5	Northeastern Rancho Bernardo	Newly identified
				Gap 6	5	Southern Sabre Springs	Newly identified
Sites Identified by Fire-Rescue After 2010 Study							
	3	FS02	Downtown				Pacific Highway and Cedar; CIP created; fully funded, station under construction ("Bayside")
	3		Downtown				No CIP or activity; north of Broadway between 13th and 14th Street ("East Village")
	8	FS49	Otay Mesa				Named FS49; Ocean View Hills area; CIP created; developer built; FBA funding; no current activity; station is west of 2010 Gap #14

* No priority weight is given to 2017 gaps.

Underway in planning, either with service established or active work being performed. Council Districts 1, 3, 4, 5, and 9 are represented.

There are three gaps that carry over from 2010 to 2017 that have had no activity.