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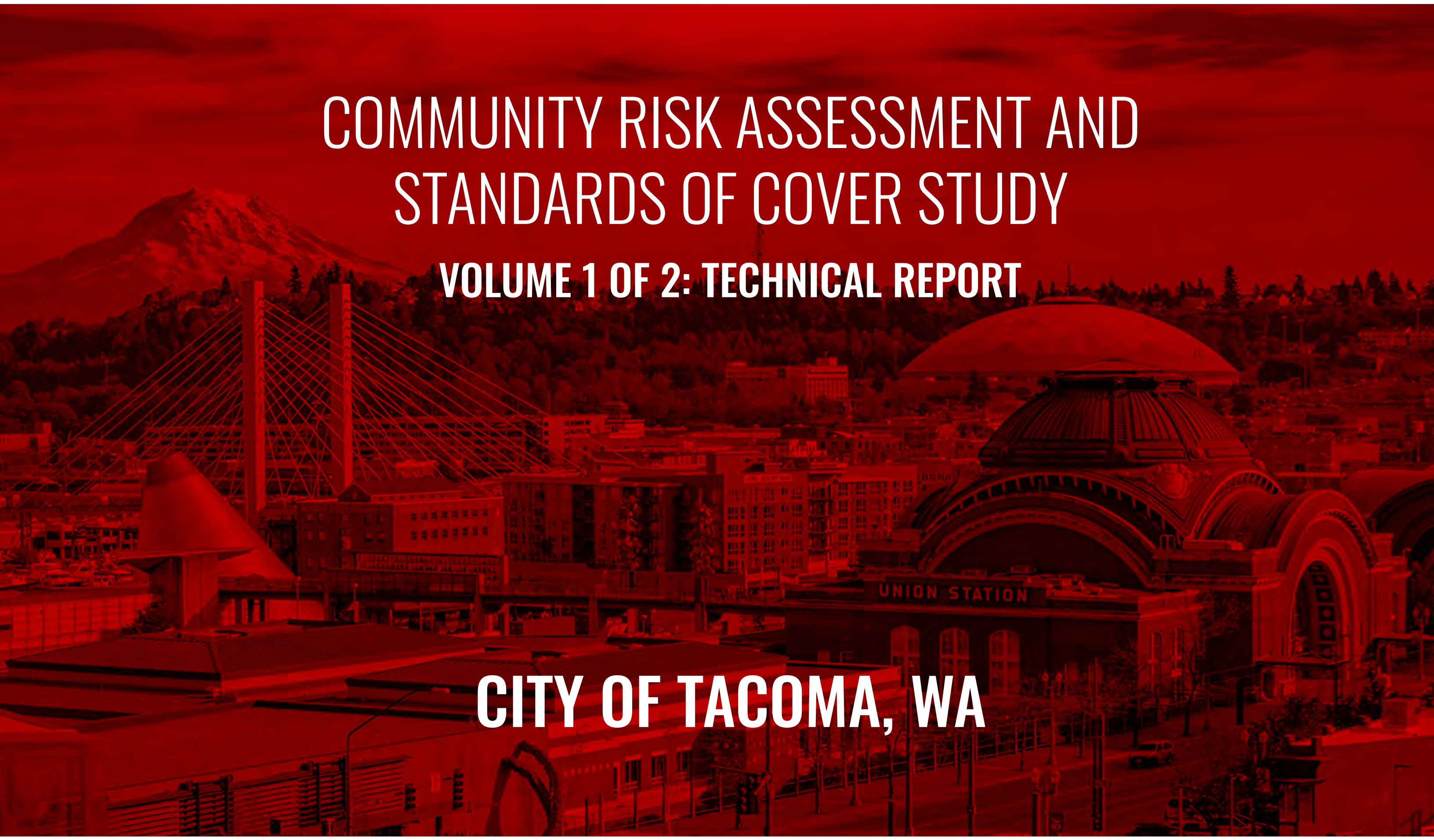

COMMUNITY RISK ASSESSMENT AND STANDARDS OF COVER STUDY

VOLUME 1 OF 2: TECHNICAL REPORT

CITY OF TACOMA, WA

APRIL 18, 2023

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EXECUTIVE SUMMARY

The City of Tacoma (City) Fire Department (Department) retained Citygate Associates, LLC (Citygate) to conduct a data-driven Community Risk Assessment and Standards of Cover (SOC) Study to update its 2009 study and assess the adequacy of the City's fire services facility locations, staffing, apparatus, and equipment. This study reflects the Department's goal to provide a level of service consistent with generally accepted standards and benchmarks for safety, and is also intended to inform key decisions relative to:

- The current and future deployment of emergency response resources to mitigate emergencies.
- The efficiency of current fire station locations and the potential addition of future fire stations based on call volume trends.
- Updating the hazard risk profile for the community to reflect emerging threats and the impacts of population growth.
- Reaffirm emergency response time performance policy goals that meet City Council and community expectations.

This report is presented in two volumes. The Technical Report (**Volume 1**) includes: this Executive Summary, which contains a summary of Citygate's analysis and suggested next steps; sections 1 and 2, which contain the deployment and SOC portions of the study; and a comprehensive Community Risk Assessment provided as **Appendix A**. A Map Atlas of deployment coverage measures is provided in **Volume 2**.

Throughout this report, Citygate makes key findings and, where appropriate, specific action item recommendations. Overall, there are 20 key findings and 8 specific action item recommendations.

POLICY CHOICES FRAMEWORK

As a reminder to the reader, there are no mandatory federal or state regulations directing the level of fire service response times and outcomes. The level of service provided, and any resultant costs, is the choice of local communities in the United States. The body of regulations related to fire services suggests that if fire services are provided, they must be provided with the safety of the firefighters and the pubic in mind. Thus, there is often a constructive tension between the desired level of service and the level that can be funded, and many communities may not have the level of service they desire. The City's investments in fire services over the past decades serve as its baseline commitment today.

This study identifies that additional investment in fire services is still necessary, with expanded and additional services from the Department as the City continues to evolve.

The fundamental policy choices that drive a city's investment in fire services are derived from two key questions:

1. What outcomes are desired for the emergencies to which the Department responds? Is the desire to keep a building fire to the room, building, or block of origin, and to provide emergency medical care in time to lessen the possibility of preventable death and severe disability?
2. Should equitable response time coverage be provided to all neighborhoods with similar risks (building types and population density) to protect? Once desired outcomes are determined, fire and emergency medical services (EMS) first responder and ambulance deployment can then be designed to cover the most geography in the fewest minutes to meet stated outcome goals. In a large city with multiple neighborhoods such as Tacoma, it must be determined whether similarly populated areas should receive similar response time performance from both firefighting and fire department ambulance services units.

RESPONSE PERFORMANCE SUMMARY

Citygate finds that the Department is organized to accomplish "yesterday's mission" and is struggling to meet current EMS workload demand, much less the impending impacts of future growth. Citygate found a caring, committed workforce that is *strongly dedicated* to the City and agency, using best practices where possible to anticipate and meet the risks to be protected in the City. The Department moved during the COVID-19 years to enhance its ambulance program and should be commended for doing so.

In conducting this study, Citygate received outstanding cooperation from the Department. However, the Department is challenged by EMS care growth which, at times, exceeds quality of care and crew workload limits. The growth in population and medical incident demand which has occurred in the City over the past decade, and which is projected to continue, has strained the Department's response times. There are solutions to these issues that will take more than one fiscal year to correct. City leadership can use this study as a master plan to drive policy choices over the next several years.

The Department serves a diversity of populations, from residents to business employees and students. These populations, across a varied land-use pattern combined with topography and road design constraints, place significant restrictions on best practice-based fire and EMS response performance. Population drives service demand, and development brings population. The Department also protects tourism and non-resident population densities. As different areas continue to see infill development with resultant increases in population density, the Department's firefighting and ambulance services will need adjustment just to *recover* timely response capacity, much less *improve* response times equitably across all neighborhoods—more so when simultaneous incidents occur at peak hours of the day.

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

Throughout the City, while the substantial growth in EMS incidents over the past decade seems all-consuming, for the foreseeable future there will always be the need for both a first-due unit and multiple-unit response consistent with current best practices to limit the risk of fire damage to only part of an affected building and keep wildland fires small and within the initial response force's capability to manage. Stated this way, *all neighborhoods need a standby and readily available firefighting force* that can respond when fires break out, regardless of peak-hour EMS workload. As demonstrated by the extreme weather-driven emergencies over the last two years and the pandemic, there is also need for a strong Department during disasters, as the vulnerable members of the City's population will need help from first responders.

INTEGRATED CHALLENGES – RESPONSE TIME, INCIDENT VOLUME, AND GROWTH

The Department serves a diverse urban population with a mixed residential and non-residential land-use pattern around part of the Puget Sound South Basin. While most of the housing and business neighborhoods are typical of this part of the greater Seattle area, Tacoma's setting of being wrapped around a harbor (in addition to hilly terrain in some areas) makes the efficient placement of fire station locations difficult. The Department also protects tourism and other non-resident population densities, and the City also is still evolving and planning to add more residential and commercial buildings.

The intensification of land uses and population growth and density could make several sections of Tacoma very urban to a degree typical of the population densities and traffic seen in the largest metropolitan cities. This will require the City's Fire and Ambulance programs to evolve beyond those of a "suburban" agency to those of a major urban fire department in staffing, unit types, and facility locations. Citygate acknowledges that it will not only be costly, but also difficult to find new locations for infill stations in an essentially built-up City.

While the state fire code allows local agencies to require fire sprinklers in smaller residential dwellings, it will be many more decades before enough residential units are replaced or remodeled with automatic fire sprinklers. If desired outcomes include limiting building fire damage to only part of the inside of an affected building and minimizing permanent impairment resulting from a medical emergency, then the City will need coverage in all neighborhoods that is consistent with Citygate's response performance recommendations for Tacoma. Based on Citygate's study, this response performance recommendation entails *no more than* 8:30 minutes for the arrival of a single first responder, and 11:30 minutes for a multiple-unit arrival to more serious incidents, from the time of 911 call receipt at the Tacoma Fire Communications center—all at 90 percent or better reliability.

The following table summarizes Citygate's benchmarking of the Department's operational response performance for 2021 relative to nationally recognized best practices and Citygate's recommendations. These best practices were compared to the Department's adopted performance measures.

Table 1—Response Performance Summary (2021)

Response Component	Best Practice		90th Percentile Performance	Performance Versus Best Practice and Current Goal
	Time	Reference		
Call Processing / Dispatch	1:30	Citygate	**1:57**	**+ 0:27**
Crew Turnout	2:00	Citygate	**2:10**	**+ 0:10**
First-Unit Travel	4:00	NFPA & Tacoma	**7:45**	**+ 3:45**
First-Unit Call to Arrival	7:30	Citygate	**11:08**	**+ 3:38**
ERF Call to Arrival	11:30	Tacoma & Citygate	**14:51**	**+ 3:21**

Dispatch, turnout, and travel times all need to be reduced to varying degrees. Dispatch time must decrease by 0:27 seconds to meet a 1:30-minutes call-processing goal and turnout time by 0:10 seconds to meet a 2:00-minute goal. Travel time is a much more significant problem. While 4:00 minutes represents a national best practice travel time in *urban* areas, no station area in the City met this goal to 90 percent of the emergent fire and EMS incidents in 2021. Further, no station area met a 5:00-minute goal. In the aggregate for 90 percent travel time by minute:

- Three station districts were in the sixth travel minute (stations 1, 4, and 15).
- 10 more station districts were in the seventh travel minute (stations 2, 7, 8, 9, 10, 11, 12, 14, 16, and 17).

- Three station districts were in the eighth travel minute (stations 3, 6, and 13).
- One station district was at exactly the ninth minute (Station 5).

While there are several factors contributing to long travel times (as discussed in this study), Citygate believes the very high EMS call volume during daylight hours is causing engines to be on or getting back from incidents far too often, leading to a cascading failure where the engine just clearing an incident, or other engines, must then respond from farther away. Most of these engine responses are to low-acuity and moderate-acuity EMS incidents.

Stated this way, Citygate finds that *"Tacoma must get its fire department back"* to offer adequate availability for serious, life-threatening fires and EMS events and to quickly field enough firefighters to serious building fires and other emergencies. The emerging programs intended to manage low-acuity EMS and mental health incidents must be expanded to remove that workload from (very expensive) fire engines and firefighters.

The ongoing intensification of land uses, building heights, and population growth and density will make several sections of the City very urban—typical of the largest metropolitan cities for building fire and rescue/EMS challenges. The cumulative effect of these projects around the City necessitates a shift in staffing and response models as well as an increase in the flexibility of emergency medical resources. The City's Fire and Ambulance programs must evolve to those of a major urban fire department to provided suitable staffing, unit types, and facility locations. Citygate acknowledges this will not only be costly but also very difficult to find new locations for responders.

Overall Summary of Fire Service Deployment

Accomplishing a 5:00-minute travel time goal for first responders entails multiple changes over the next three years to first improve and then maintain response times as growth occurs:

1. Measure the effectiveness of the newly expanded ambulance program to determine if Basic Life Support (BLS) ambulance transports keep more paramedic ambulances in their districts available for the next call.
2. Change dispatch EMS triage systems to allow for greater low-acuity patient identification and then <u>only send a BLS ambulance</u> unless rescue is also needed.
3. Shift responsibility for non-acute EMS calls from the 9-1-1 Fire/Ambulance program to a Mobile Integrated Health / Mental Care program.
4. Engineer traffic systems to give priority access to first responders in addition to providing pedestrian safety.

If these four strategies do not improve acute emergency response times *and lower the unit-hour utilization (UHU) workload for engines to no more than 30 percent hour after hour,* the City should construct infill response units at existing stations or add fire or ambulance-only stations between the busiest station areas. These same areas are also where much of the proposed infill development growth will occur.

Currently, the Department's service capacity for fire and non-fire risk consists of 83 personnel on duty daily. However, engines are very busy providing EMS response and, at present, the firefighters staffing ambulances are not consistently available for firefighting. As both existing buildings age and new buildings are developed, serious structure fires will require a quick weight of response from apparatus and staff in dire emergencies where ladder truck units must conduct search and rescue or ventilation of hot combustion gas so the engine crew can effectively apply water on the fire.

The City only staffs four ladder trucks with three personnel each, while under safety regulations, many urban cities staff ladders with four personnel each to enable two teams of two to conduct simultaneous tasks. Over several fiscal years, the City should add a fourth crew member to each of the four ladder trucks consistent with the National Fire Protection Association (NFPA) Standard 1710 and Citygate best practices for high-density urban core areas. Adding four crew members per day on a four-platoon duty schedule requires a total of 16 firefighters to be newly funded (plus the overtime to cover their leave absences).

FINDINGS AND RECOMMENDATIONS

Following are all findings and recommendations presented throughout this report.

Findings

Finding #1: Depending on source, the City's population is projected to grow by 18 to 57 percent over the next 17 years to 2040. At a current incident-to-1,000-population rate, these growth rates increase incident growth from an added 46 incidents per day up to 70. This demand will further strain department response capacity at peak hours of the day.

Finding #2: The Department's physical response unit *types* are appropriate to protect against the hazards likely to impact the City.

Finding #3: The Department's minimum daily staffing of 83 response personnel is sufficient for multiple simultaneous single-unit incidents and/or multiple-unit responses to more serious incident types.

Finding #4: The Department has established response performance goals mostly consistent with best practice recommendations as published by the Commission on Fire Accreditation International.

Finding #5: The City Council has not adopted a policy resolution with specific response performance goals.

Finding #6: The Department has a standard response plan that considers risk and establishes an appropriate initial response for each incident type; based on Department experience, each type of call for service receives the combination of engines, trucks, ambulances, specialty units, and command officers customarily needed to effectively control that type of incident.

Finding #7: The GIS mapping evaluation of travel time coverage demonstrates that the City's fire stations are not distributed to provide best practice response times equitably to all neighborhoods. As the incident statistics also demonstrate, best practice travel times are further hampered by other factors.

Finding #8: As shown in this study's GIS models, traffic congestion decreases 4:00-minute first-unit travel time road mile coverage by 18 percent, which, in Citygate's experience, is a significant loss. There is an even more significant impact on multiple-unit ERF responses, eroding 8:00-minute travel time coverage by 22 percent.

Finding #9: Overall demand for incidents has increased and surpassed pre-COVID-19 levels.

Finding #10: The annual number of simultaneous incidents is increasing and has significant impacts on response time in the most effected station districts.

Finding #11: Engines 10, 2, 1, 11, 15, 7, 8 were near or above Citygate's recommended 30 percent utilization for long consecutive hours during peak daytime demand periods; ambulances were also approaching maximum utilization during the same period.

Finding #12: The City's call processing / dispatch performance *nearly meets* Citygate's recommended best practice goal of 1:30 minutes to fire and EMS emergencies at 90 percent or better reliability.

Finding #13: At 2:05 minutes, turnout time is slightly over Citygate's recommended performance goal of 2:00-minutes at 90 percent or better reliability.

Finding #14: At 7:45 minutes in 2021, 90^{th} percentile travel time was *significantly slower* than the 4:00-minute best practice goal for urban areas.

Finding #15: At 11:08 minutes in 2021, 90^{th} percentile first-unit call-to-arrival performance is 3:38 minutes *slower* than a Citygate-recommended best practice goal of 7:30 minutes for urban areas.

Finding #16: At 16:25 minutes across the four years of data, 90th percentile ERF (First Alarm) call-to-arrival performance is *4:55 minutes slower* than a best practice goal of 11:30 minutes for urban areas.

Finding #17: To maintain unit availability and response times over time, more units will eventually need to be added; however, current Fire Stations 1, 2, 8, 10, and 11—that will most likely need added units—cannot accommodate more crews without extensive remodeling or enlargement/replacement nearby.

Finding #18: City Planning, Traffic Engineering, and the Department must have an effective set of integrated policies and traffic-calming methods to partially mitigate the impacts of walkable street designs on fire and ambulance response times.

Finding #19: The City's planned expansion of ambulance service is consistent with best practices and will provide needed improvement.

Finding #20: The City's pilot program to expand the Department's CARES program to mental health crisis incidents is reflective of current best practices and deserves full support and expansion as caseloads require.

Recommendations

Recommendation #1: Operate and measure the effects of the enhanced ambulance system.

Recommendation #2: The Department needs to upgrade its dispatch training and software to allow for clinical call triage to send BLS ambulances or alternative care units to low-acuity EMS requests.

Recommendation #3: Design and focus on new strategies to provide for traffic calming and pedestrian safety while not significantly worsening emergency response times or community evacuation times.

Recommendation #4: Increase the staffing on the four aerial ladder trucks from three to four personnel per day.

Recommendation #5: Support the Department's CARES program pilot project for mental health crisis incidents and expand the program as caseloads justify.

Recommendation #6: If ambulance and dispatch improvements do not improve acute emergency response times and lower the UHU workload for engines to no more than 30 percent for long, contiguous hours of the day, the City should add more response units to existing stations or construct infill fire or ambulance-only stations between the station groupings which are currently the busiest.

Recommendation #7: Given the space limitations of the stations that will most need increased response capacity from the near term to 2040, the City should undertake a fire station master facility remodel or replacement plan study to identify its long-term capital facility costs, funding options, and timing.

Recommendation #8: Adopt updated deployment policies. City Council should consider adopting complete performance measures that begin with a 9-1-1 call being answered and end with the Department and/or an ambulance arriving at the emergency incident. The measures of time should be designed to save patients and keep small but serious fires from becoming more complex or damaging. With this in mind, Citygate recommends the following outcome-based measures for the major emergency types:

8.1 **<u>Geographic Distribution of Fire Stations:</u>** To treat medical patients and control small fires, the first-due unit should arrive within 8:30 minutes, 90 percent of the time, from receipt of the 9-1-1 call in the fire dispatch center. This equates to a 90-second dispatch time, a 2:00-minute company turnout time, and a 5:00-minute travel time.

8.2 **<u>Multiple-Unit Effective Response Force for Serious Emergencies:</u>** To confine fires near the room of origin and treat up to five medical patients at once, a multiple-unit response of a minimum of four engines, one ladder truck, one ambulance, and one Battalion Chief—totaling a minimum of 19 personnel—should arrive within 11:30 minutes from the time of 9-1-1 call receipt in fire dispatch, 90 percent of the time. This equates to a 90-second dispatch time, a 2:00-minute company turnout time, and an 8:00-minute travel time.

8.3 **<u>Hazardous Materials Response:</u>** The Department needs to maintain its hazardous materials response as designed to protect the community from hazards associated with uncontrolled release of hazardous and toxic materials. The first-due unit should arrive to investigate a hazmat release at the operations level within 8:30 minutes, 90 percent of the time. This equates to a 90-second dispatch time, a 2:00-minute company turnout time, and a 5:00-minute travel time in urban population areas. After assessment and scene evaluation is completed, a determination can be made whether to request additional resources.

8.4 **Technical Rescue:** To respond to technical rescue emergencies as efficiently and effectively as possible with enough trained personnel to facilitate a successful rescue, the first-due company to arrive for assessment of the rescue should achieve a 5:00-minute travel time in urban to suburban areas, 90 percent of the time. Additional resources capable of initiating a rescue should be assembled within a total response time of 11:30 minutes, 90 percent of the time, with the result being a safe and complete rescue/extrication to ensure delivery of patients to a definitive care facility.

Next Steps

Near Term

- Review and absorb the content, findings, and recommendations of this report.
- As a City Council, adopt revised response performance goals to drive desired improvements in fire services.
- Refocus on balancing traffic safety and emergency response ability.
- Closely monitor the enhanced ambulance program's effect on response times and fire engine crew workloads.
- If ambulance and dispatch improvements do not improve acute emergency response times and lower the UHU workload for engines to no more than 30 percent for long, contiguous hours of the day, the City should begin planning to add more response units to existing stations or construct infill fire or ambulance-only stations between the groupings of stations which are currently the busiest.
- Commission a long-term fire station master facility remodel or replacement plan study for the stations that will not be able to accommodate added units.

SECTION 1—INTRODUCTION AND BACKGROUND

The City of Tacoma (City) Fire Department (Department) retained Citygate Associates, LLC (Citygate) to conduct a data-driven Community Risk Assessment and Standards of Cover (SOC) Study to update its 2009 study and assess the adequacy of the City's fire services facility locations, staffing, apparatus, and equipment. This study reflects the Department's goal to provide a level of service consistent with generally accepted standards and benchmarks for safety, and is also intended to inform key decisions relative to:

- The current and future deployment of emergency response resources to mitigate emergencies.
- The efficiency of current fire station locations and the potential addition of future fire stations based on call volume trends.
- Updating the hazard risk profile for the community to reflect emerging threats and the impacts of population growth.
- Reaffirm emergency response time performance policy goals that meet City Council and community expectations.

Citygate's scope of work conforms with the methodology outlined in *Standards of Response Coverage* (fifth and sixth editions) as published by the Commission on Fire Accreditation International (CFAI) and addresses all elements of the City's requested scope of work. The study also incorporates guidelines and best practices in the field of deployment and risk analysis from the National Fire Protection Association (NFPA), the Insurance Services Office (ISO), the Washington Survey and Ratings Bureau (WSRB), the CFAI, the Occupational Safety and Health Administration (OSHA), relevant federal and state laws and regulations, and other recognized industry best practices.

1.1 REPORT ORGANIZATION

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

Executive Summary	Summarizes fire service policy choices and all findings and recommendations that can be used to strategically guide the City's and Department's efforts.
Section 1	Introduction and Background: Describes Citygate's project approach, methodology, and scope of work and provides an overview of the City and Department.

Section 2	Standards of Cover Analysis: Describes Citygate's updated service demand and response performance analysis in detail, as well as our findings and recommendations for each Standards of Cover element.
Appendix A	Community Risk Assessment: Provides a comprehensive analysis of the fire and non-fire hazards likely to impact the City.

1.1.1 Goals of Report

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

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

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

1.1.2 Limitations of Report

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

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

1.2 PROJECT APPROACH AND SCOPE OF WORK

1.2.1 Project Approach and Methodology

At the beginning of this engagement, Citygate requested and reviewed relevant background data and information to better understand current service levels, costs, and the history of service level decisions, including prior studies.

Citygate subsequently reviewed demographic information about the City and the potential for future growth and development. Citygate also obtained map and response data from which to model current and projected fire service deployment, with the goal to identify the location(s) of stations and crew quantities required to best serve the City as it currently exists and to facilitate future deployment planning.

Once Citygate gained an understanding of the Department's service area and its fire and non-fire risks, the Citygate team then developed a deployment model that was tested against the travel time mapping and prior response data to ensure an appropriate fit. Citygate also evaluated future City growth to model service demand by risk type and evaluate potential alternative emergency service delivery models. This resulted in Citygate proposing an approach to address current and long-term needs with the effective and efficient use of existing resources. The result is a framework for enhancing Department services while meeting reasonable community expectations and fiscal realities.

1.2.2 Scope of Work

Citygate's approach to this study included:

- Reviewing relevant data and information provided by the Department and City.
- Interviewing internal City and Department study team members and stakeholders.
- Receiving a general summary of the City and services provided by the Department.
- Using best practice standards and guidelines as appropriate from the CFAI, the NFPA, the International Code Council, the ISO, OSHA, federal and state laws, and recognized industry best practices.
- Obtaining and analyzing recent historical incident data for the Department.
- Understanding and forecasting the Department's ambulance delivery system needs.
- Conducting a comprehensive Community Risk Assessment.
- Preparing a comprehensive report that includes analysis-based findings and recommendations, including an executive summary presentation of the written report for City stakeholders.

1.3 City Overview

Located 32 miles southwest of Seattle along Washington State's Puget Sound, Tacoma is a port city encompassing 62.4 square miles. With a resident population of 222,500 in 2022, it is the third largest city in the state and the second largest in the Puget Sound area. Incorporated in 1884, it is the county seat of Pierce County, a center of international trade, and Washington's largest port.[1]

The City operates under a council-manager form of government with a nine-member City Council composed of a mayor, five district representatives, and three at-large representatives serving staggered four-year terms. The City provides a full range of municipal services including police and fire protection; electrical generation and distribution; water distribution; wastewater and surface water services; solid waste services; public works (which includes street operations, engineering, facility management, and fleet operations); planning and development services; community and economic development; neighborhood and community services; and others.

The City is home to several international companies with key economic drivers including the military (Joint Base Lewis-McChord), pulp and paper manufacturing, oil refining, retail sales, healthcare, and state and local government services. The City's fiscal year (FY) 2021–22 adopted budget included $182.65 million in expenditures and reserves. The City employs approximately 3,700 full-time equivalent (FTE) employees.

1.3.1 Future Growth and Development

The Puget Sound Regional Safety Council projects that the City's population will grow by 18 percent to 262,068 by 2030, and by a further 38 percent to 306,323 by 2040. The Urban Form element of the One Tacoma Comprehensive Plan envisions 127,000 additional residents by 2040, a 57 percent increase from the current population. At a current incident-to-1,000-population rate, these growth rates increase incident growth from an added 46 incidents per day up to 70.

Finding #1:	Depending on source, the City's population is projected to grow by 18 to 57 percent over the next 17 years to 2040. At a current incident-to-1,000-population rate, these growth rates increase incident growth from an added 46 incidents per day up to 70. This demand will further strain department response capacity at peak hours of the day.

Service Demand by Age of Population

Population drives demand for EMS services; however, it is not easy to account for multiple variables by age group, such as basic access to health care, being fully insured, access to preventive care, cultural and language barriers etc. Over the last 20 or more years, the economic challenges

[1] City of Tacoma 2021–22 Operating and Capital Budget; City of Tacoma 2021 Annual Comprehensive Financial Report.

related to healthcare coverage in many communities have resulted in 9-1-1 EMS and emergency rooms becoming the only heath care service many people utilize.

According to EMS incident data in 2022, 39.6 percent of the patients *transported* in the City are over age 65, which represents only 9.2 percent of the total population according to census data. Patients under 18 years of age account for just 4.1 percent. In total, the most health-sensitive age groups represented 43.7 percent of total patients transported and billed. It is commonly understood that America is "graying," but this generality does not mean that every senior is dependent on EMS for primary health care access. The houseless represent many age groups and most have no routine health care. What can be said is that until there is fundamental economic and health care reform in America, the issues that have dramatically increased ambulance demand over the last two decades show no signs of abating.

The trend in most cities' ambulance billing is that the patients being seen are largely on Medicaid and Medicare. In Tacoma in 2022, 35.25 percent were on Medicaid, 25.55 percent were solely on Medicare, and another 19.64 percent were on Medicaid and Medicare. Thus, 80.45 percent of ambulance bills were billed to state and federal healthcare programs. Of the remaining portion, only 10.77 percent had commercial health insurance. The remainder were "self-pay" or "other."

1.4 FIRE DEPARTMENT OVERVIEW

1.4.1 Organization

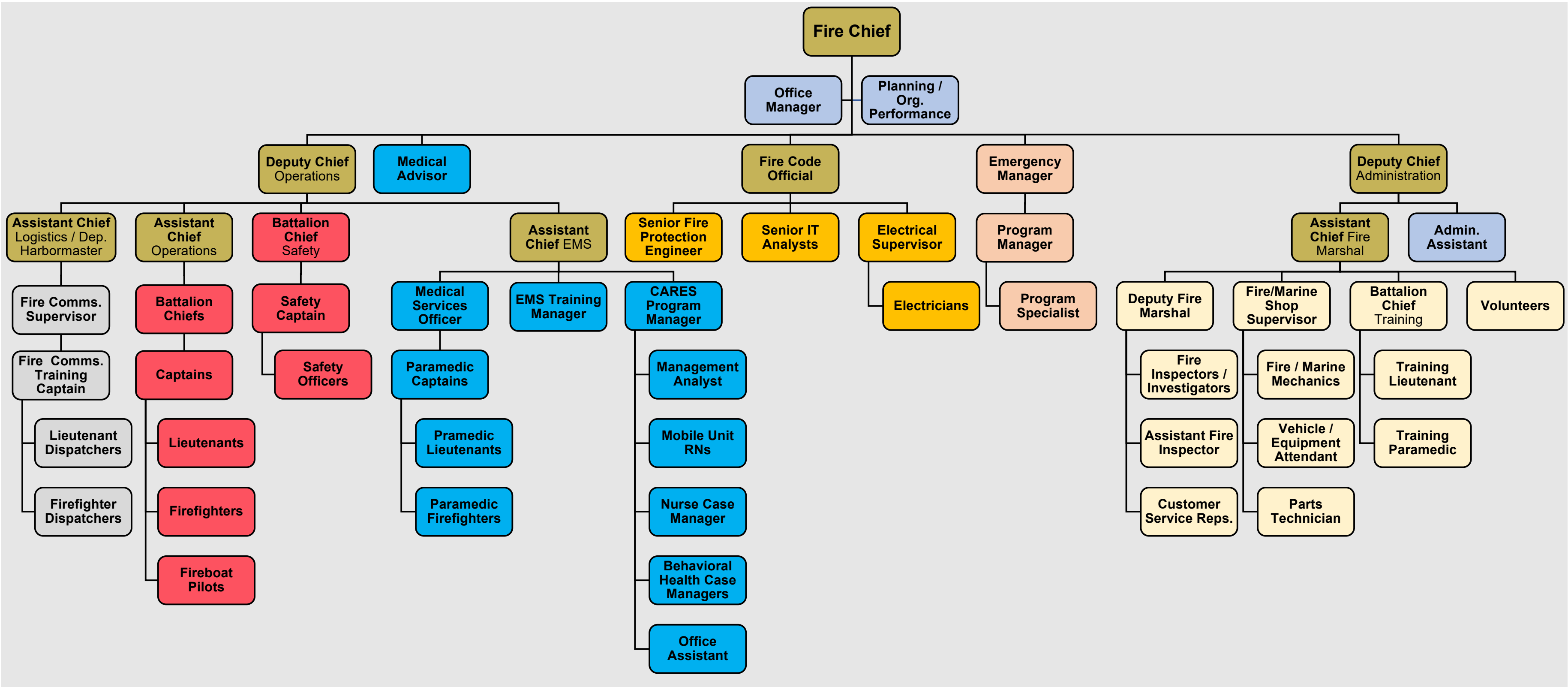
The Department is an all-risk organization providing fire suppression, ground ambulance transportation, Advanced Life Support (ALS) pre-hospital emergency medical, technical rescue, hazardous material release, fire prevention, emergency management, dispatch, community outreach, and related fire and life safety services with a FY 2021–22 staff of 489.3 FTE personnel organized into seven divisions, as summarized in the following table and figure.

Table 2—Tacoma Fire Department Budgeted FTE Personnel

Division	Budgeted FTE
Administration	44.3
Communications	26.2
Emergency Management	3.0
Operations	392
Prevention	10.3
Public Education	9.3
Training	4.2
Total	**489.3**

Source: City of Tacoma Fiscal Year 2021–22 Adopted Budget

Figure 1—Tacoma Fire Department Organizational Chart



1.4.2 Facilities and Resources

The Department provides emergency response services from 17 fire stations, as summarized in the following table.

Table 3—Fire Department Facilities, Response Resources, and Daily Response Staffing

Station	Address	Response Resources	Minimum Daily Staffing
1	901 Fawcett Ave.	**Engine 1** **Ladder 1**	**3** **3**
2	2701 Tacoma Ave S.	**Engine 2** **Battalion 2** **Safety 3** **Medic 3**	**3** **1** **1** **2**
3	206 Browns Point Blvd.	**Engine 3**	**3**
4	1453 Earnest S. Brazill St.	**Engine 4** **Medic 4**	**3** **2**
5	3510 E. 11th St.	**Engine 5**	**3**
6	1015 E. F St.	**Aid 1** **EMS 1**	**2** **1**
7	5448 S. Warner St.	**Engine 7**	**3**
8	4911 S. Alaska St.	**Engine 8** **Truck 2** **Medic 2** **Battalion 3** **Aid 2** **Rescue 8**	**3** **3** **2** **1** **2** **
9	3502 6th Ave.	**Engine 9** **Battalion 1** **Aid 4**	**3** **1** **2**
10	7247 S. Park Ave.	**Engine 10**	**3**
11	3802 E. McKinley Ave.	**Engine 11** **Medic 5** **Aid 5**	**3** **2** *
12	2015 54th Ave. E., Fife	**Engine 12** **Ladder 4** **Aid 3** **HazMat 12**	**3** **3** **2** **
13	3825 N. 25th St.	**Engine 13** **Ladder 3**	**3** **3**
14	4701 N. 41st St.	**Engine 14** **Fireboats**	**3** **
15	6415 E. McKinley Ave.	**Engine 15**	**3**
16	7217 6th Ave.	**Engine 16** **Medic 1**	**3** **2**
17	302 Regents Blvd., Fircrest	**Engine 17** **Aid 7**	**3***
	Wapato Police Substation 1501 S. 72nd St.	**Aid 6**	*
		Total Daily Response Staffing	**83**

* Peak-hour staffing by overtime only 7:30 am – 7:00 pm. Not included in minimum daily staffing
** Cross-staffed as needed by on-duty personnel

1.4.3 Service Capacity

Service capacity refers to the Department's available response force; the size and types of its response fleet and any specialized equipment; core and specialized performance capabilities and competencies; resource distribution and concentration; availability of automatic or mutual aid; and any other agency-specific factors influencing its ability to meet current and prospective future service demand relative to the risks to be protected.

The Department's service capacity for fire and non-fire risks consists of 83 response personnel on duty daily staffing 16 engines, four aerial ladder trucks, five Advanced Life Support (ALS) medic ambulances, four full-time plus three peak-hour Basic Life Support (BLS) aid ambulances, three battalion chiefs, one Safety Officer, and one EMS Supervisor operating from the Department's 17 fire stations. The Department also deploys a Heavy Technical Rescue Unit at Station 8, a Hazardous Materials Response Unit at Station 12, and two fireboats that are cross-staffed as needed by on-duty Station 14 personnel.

All response personnel are trained to either the Emergency Medical Technician (EMT) level, capable of providing BLS pre-hospital emergency medical care, or the EMT-Paramedic (Paramedic) level, capable of providing ALS pre-hospital emergency medical care. Three of the outermost 16 engines are staffed with a minimum of one Paramedic, and the five ALS transport ambulances are staffed with two Paramedics each. The Department also deploys four full-time and three peak-hour BLS transport ambulances staffed with two EMT Firefighters each.

Response personnel are also trained to the U.S. Department of Transportation Hazardous Materials First Responder Operations level to provide initial hazardous material incident assessment, hazard isolation, and support for the Hazardous Materials Response Team. The Department cross-staffs a Hazardous Materials Response Unit at Station 12 as needed with assigned personnel trained to the Hazardous Materials Technician level.

All response personnel are further trained to the Confined Space Awareness level, and most are further trained to the Technical Rescue Operations level. The Heavy Rescue Unit, deployed as needed from Station 8, is assigned personnel trained to the Rescue Technician level.

Marine response capacity is provided by Station 14 personnel cross-staffing one of the Department's two fireboats: Fireboat Destiny, a 30-foot, all-weather MetalCraft with an 1,800-gallons per minute (GPM) fire pump moored at the Tacoma Yacht Club at Point Defiance; and Fireboat Defiance, a 50-foot, all-weather fireboat with twin 3,000-GPM fire pumps moored at Station 18 on Thea Foss Waterway.

The Department also has automatic and mutual aid agreements with adjacent fire agencies.

Finding #2:	The Department's physical response unit *types* are appropriate to protect against the hazards likely to impact the City.
Finding #3:	The Department's minimum daily staffing of 83 response personnel is sufficient for multiple simultaneous single-unit incidents and/or multiple-unit responses to more serious incident types.

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Section 2—Standards of Cover Analysis

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

2.1 Standards of Cover Process Overview

The core methodology used by Citygate in the scope of its deployment analysis work is *Standards of Response Coverage* (fifth and sixth editions), which is a systems-based approach to fire department deployment published by the CFAI. This approach uses local risks and demographics to determine the level of protection best fitting a community's needs.

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

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

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

Table 4—Standards of Coverage Process Elements

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

Source: CFAI, Standards of Cover, fifth edition

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

The following table illustrates this deployment paradigm.

Table 5—Fire Service Deployment Paradigm

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

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

2.2 Current Deployment

SOC Element 1 of 8
Existing Deployment Policies

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

The following table summarizes the Department's current response performance goals; however, City Council has not, by separate Council policy, adopted response performance goals. The General Plan does not contain specific response measures, but rather strategies reflecting the need to protect the community from fire and other hazards. Industry best practices recommend the adoption, by governing body resolution, of performance measures by which to govern fire and emergency medical services.

Table 6—Fire Department Response Performance Standards

Response Component	Current Performance Goal (Minutes)	Percentage Reliability Goal
Call Processing / Dispatch	**1:30**	90%
Crew Turnout	**1:20**	90%
First-Unit Travel	**4:00**	90%
First-Due Call to Arrival (Distribution)	**6:30**	90%
Multiple-Unit ERF Travel	**8:00**	90%
Multiple-Unit ERF Call to Arrival (Concentration)	**10:30**	90%

The most recently published NFPA best practices have *decreased* recommended dispatch / call processing time to 1:00 minute for events with an imminent threat to life or significant property damage and 1:30 minutes for hazardous materials or technical rescue incidents, for joint response with law enforcement involving weapons, or for incidents involving language barriers.[2] However, the prior edition of NFPA Standard 1221—and Citygate's experience across many systems—finds 1:30 minutes for dispatch to be a safe and effective goal to all serious events that are not identified as life or death in the first few seconds of listening to the call.

As for crew turnout time, the Department's current response performance goal of 80 seconds mostly mirrors the NFPA 1710[3] recommendation for a turnout time of 60 seconds for EMS incidents and up to 80 seconds for fire and special operations incidents, both at 90 percent reliability.

While industry-recognized best practices are useful benchmarks, in Citygate's wide experience, few agencies can reach these crew turnout times as they are unrealistic given the design of many fire stations and the need to don the proper and mandated protective clothing and be seated with seat belt fastened before the apparatus moves. Based on this experience, Citygate recommends a 2:00-minute turnout goal across the 24-hour day to be safe and effective. During high-demand daylight hours, the turnout goal should be closer to 1:30 minutes.

If the travel time measures recommended by the NFPA and Citygate are added to dispatch processing and crew turnout times as recommended by Citygate based on NFPA best practices and practicality, then a <u>realistic</u> 90 percent first-due unit response performance goal is 7:30 minutes (or 8:30 minutes if a 5:00-minute *travel* time is used) from the time the Tacoma Fire

[2] NFPA 1221 – Standard for the Installation, Maintenance, and Use of Emergency Services Communications Systems (2019 Edition).
[3] NFPA 1710 – Standard for the Organization and Deployment of Fire Suppression Operations, Emergency Medical Operations, and Special Operations to the Public by Career Fire Departments (2020 Edition).

Communications center receives the call. This includes 1:30 minutes for call processing / dispatch, 2:00 minutes for crew turnout, and 4:00–5:00 minutes for travel time.

Finding #4:	The Department has established response performance goals mostly consistent with best practice recommendations as published by the Commission on Fire Accreditation International.
Finding #5:	The City Council has not adopted a policy resolution with specific response performance goals.

2.2.1 Current Deployment Model

Resources and Staffing

The Department's current deployment model meets minimum staffing standards for building fires as recommended by NFPA 1710, providing sufficient personnel for serious fire incidents or other emergencies requiring a multiple-unit response to effectively resolve, along with providing additional response capacity for simultaneous incidents.

The ambulance program has grown in service type during the COVID-19 years to best meet the City's EMS demands. By early 2023, the number of Paramedic-level ALS ambulances remains at five, one of which was relocated to a station area with higher incident volumes. After two BLS ambulances began operation in May 2021, two additional 24/7 BLS ambulances and three peak-hour ambulances were added to transport non-acute patients. This expansion will be reviewed in more detail in the deployment recommendations section of this report.

Response Plan

The Department is an all-risk fire agency providing the population it protects with services that include fire suppression; pre-hospital (ALS/BLS) emergency medical services; ambulance transport; hazardous material and technical rescue response; dispatch; open water safety/response; and other non-emergency services, including fire prevention, emergency management, community outreach, and other related services.

Given these risks, the Department utilizes a tiered response plan calling for different types and numbers of resources depending on incident/risk type. The City's 9-1-1 dispatch CAD system selects and dispatches the closest and most appropriate resource(s) pursuant to the Department's response plan, as summarized in the following table.

Table 7—Response Plan by Type of Emergency

Incident Type	Response	Total Staffing
Structure Fire – Residential	4 Engines, 2 Ladders, 2 Aid Transport Units, 2 BCs	**24**
Structure Fire – Commercial	5 Engines, 2 Ladders, 2 Aid Transport Units, 2 BCs	**27**
Medical Emergency (BLS)	1 Engine, 1 Aid Transport Unit	**5**
Medical Emergency (ALS)	1 Engine, 1 Medic Unit	**5**
Vegetation/Wildland Fire (small)	1 Engine	**3**
Vegetation/Wildland Fire (large)	4 Engines, 1 Ladder, 1 Medic Unit, 1 Brush Truck, 1 Safety Officer, 2 BC's, 1 Water Tender	**20**
Vehicle Fire	1 Engine	**3**
Commercial Vehicle Fire	2 Engines	**6**
Vehicle Collision (BLS)	1 Engine	**3**
Vehicle Collision (ALS)	1 Engine, 1 Ladder, 1 Medic Unit, 1 BC, 1 Safety Officer	**10**
Hazardous Materials	4 Engines, 1 Ladder, 1 Medic Unit, 1 BC, HM 12 (E12/L04), 1 Safety Officer, 1 Mobile Air Unit	**25**
Technical Rescue	2 Engines, 1 Ladder, 1 Medic Unit, 1 BC, 1 Safety Officer, TR08 (E8/TWR2)	**19**
Aircraft Crash	4 Engines, 1 Ladder, 1 Medic Unit, 2 BCs, 1 Safety Officer, 1 Fire Investigator	**21**
Railcar Incident	5 Engines, 1 Ladder, 1 Medic Unit, 2 BCs, 1 Safety Officer, HM-12 (E12/L04)	**29**
Water Rescue	1 Engine, 1 Ladder, 1 Medic Unit, 1 BC, 1 Safety Officer, 1 Fireboat (E14)	**13**
Boat Fire (Pleasure Craft)	1 Fireboat (E14)	**3**
Shipboard Firefighting	4 Engines, 1 Ladder, 1 Medic Unit, 1 Fireboat (E14), 2 BCs, 1 Safety Officer	**23**

Finding #6:	The Department has a standard response plan that considers risk and establishes an appropriate initial response for each incident type; based on Department experience, each type of call for service receives the combination of engines, trucks, ambulances, specialty units, and command officers customarily needed to effectively control that type of incident.

2.3 OUTCOME EXPECTATIONS

SOC ELEMENT 2 OF 8
COMMUNITY OUTCOME EXPECTATIONS

The SOC process begins by reviewing existing emergency services outcome expectations. This includes determining for what purpose the response system exists and whether the governing body has adopted specific response performance measures. If it has, the time measures used must be understood and reliable data must be available.

Current national best practice is to measure percent completion of a goal (e.g., 90 percent of responses) instead of an average measure. Mathematically, this is called a fractile measure.[4] This is because measuring the average only identifies the central or middle point of response time performance for all calls for service in the data set. Using an average makes it impossible to know how many incidents had response times that were far above the average or just above.

For example, the following figure shows response times for a hypothetical small fire department that receives 20 calls for service each month. Each response time has been plotted on the graph from shortest response time to longest response time.

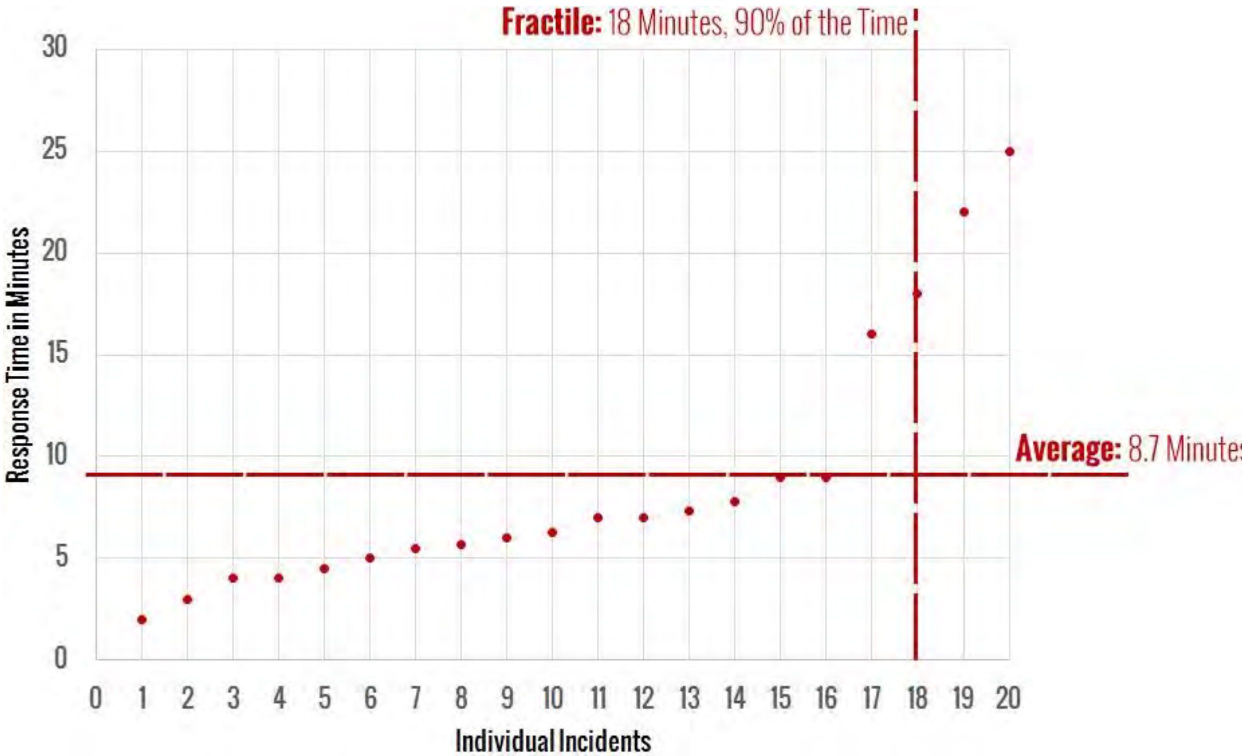
The following figure shows that the average response time is 8.7 minutes. However, the average response time fails to properly account for four calls for service with response times far exceeding a threshold in which positive outcomes could be expected. In fact, it is evident in the figure that 20 percent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

By using the fractile measurement with 90 percent of all responses, this small jurisdiction has a response time of 18:00 minutes, 90 percent of the time. Stated another way, 90 percent of all

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

responses are 18:00 minutes or less. This fractile measurement is far more accurate at reflecting the service delivery situation of this small agency.

Figure 2—Fractile versus Average Response Time Measurements



More importantly, within the SOC process, positive outcomes are the goal. From that, crew size and response time can be calculated to provide appropriate fire station spacing (distribution and concentration) to achieve the desired goal. Emergency medical incidents include situations with the most severe time constraints. The brain can only survive 4:00 to 6:00 minutes without oxygen. Cardiac arrest and other events can cause oxygen deprivation to the brain. Cardiac arrests make up a small percentage, with drowning, choking, trauma constrictions, or other similar events having the same effect. In a building fire, a small incipient fire can grow to involve the entire room in a 3:00- to 5:00-minute time frame. If fire service response is to achieve positive outcomes in severe emergency medical situations and incipient fire situations, *all* responding crews must arrive, assess the situation, and deploy effective measures before brain death occurs or the fire spreads beyond the room of origin.

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

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

For this report, total response time is the sum of the Tacoma Fire Communications center call processing / dispatch, fire crew turnout, and road travel time intervals, which is consistent with CFAI and NFPA best practice recommendations.

2.4 Community Risk Assessment

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

SOC ELEMENT 3 OF 8
COMMUNITY RISK ASSESSMENT

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

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

2.4.1 Risk Assessment Methodology

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

- Identification of geographic planning sub-zones (risk zones) appropriate to the community or jurisdiction.
- Identification and quantification, to the extent data is available, of the specific values at risk to various hazards within the community or service area.
- Identification of the fire and non-fire hazards to be evaluated.
- Determination of the probability of occurrence for each hazard.
- Evaluation of *probable* impact severity for each hazard by planning zone using agency- and jurisdiction-specific data and information.
- Determination of overall risk by hazard using the following template.

Table 8—Overall Risk Template

Probability of Occurrence	Probable Impact Severity				
	Insignificant	Minor	Moderate	Major	Catastrophic
Rare	*Low*	*Low*	*Low*	*Moderate*	*High*
Unlikely	*Low*	*Low*	*Low*	*Moderate*	*High*
Possible	*Low*	*Low*	*Moderate*	*High*	*Extreme*
Probable	*Low*	*Low*	*Moderate*	*High*	*Extreme*
Frequent	*Low*	*Moderate*	*High*	*Extreme*	*Extreme*

2.4.2 Values to Be Protected

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

People

Residents, employees, visitors, and travelers in a community or jurisdiction are vulnerable to harm from a hazard occurrence. Particularly vulnerable are specific at-risk populations, including those unable to care for themselves or self-evacuate in the event of an emergency. At-risk populations typically include children younger than 10 years, the elderly, and people housed in institutional settings. Key demographic data for the City includes the following:[5]

- 28 percent of the population is under 10 years of age or 65 years of age and older.
- The City's daytime population is 14 percent greater than its resident population.
- The City's population is predominantly White (57 percent), followed by Other (23 percent), Black / African American (10 percent), and Asian (9 percent), with those of Hispanic or Latino ethnicity representing 13 percent.
- Of the population over 24 years of age, nearly 91 percent have a high school or equivalent education.
- Nearly 45 percent of the population over 24 years of age has an undergraduate, graduate, or professional degree.
- Of the population older than 15 years of age, slightly more than 96 percent are in the workforce.
- Median household income is nearly $76,000.
- The population below the federal poverty level is nearly 14 percent.
- The population without health insurance coverage is 7.5 percent.

Buildings

The City has more than 93,000 housing units and nearly 8,000 businesses, including offices, professional services, retail sales, restaurants/bars, motels, churches, schools, government facilities, healthcare facilities, and other business types as described in **Appendix A**.[6]

Critical Infrastructure / Key Resources

The City has identified 366 critical facilities as described in **Appendix A**. A hazard occurrence with significant impact severity affecting one or more of these facilities would likely adversely impact critical public or community services.

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[5] Source: Esri Community Profile (2022).

[6] Source: Esri Community Analyst Business Summary (2022).

Cultural, Economic, Historic, and Natural Resources

Of the nearly 8,000 businesses employing more than 117,000 people in the City, top industries include services and retail trade, followed by finance, insurance, real estate, construction, government, wholesale trade, transportation, and manufacturing.[7] Principal employers include:[8]

- Joint Base Lewis McChord
- MultiCare Health System
- State of Washington
- CHI Franciscan Health
- Tacoma Public Schools
- City of Tacoma
- Pierce County Government
- Safeway and Albertson's

Natural Resources

Key natural resources to be protected within the City include:

- Puget Sound / Commencement Bay
- Thea Foss Waterway
- Middle Waterway
- Saint Paul Waterway
- Puyallup River
- Milwaukee Waterway
- Sitcum Waterway
- Blair Waterway
- Hylebos Creek Waterway
- Snake Lake
- Titlow Beach Marine Preserve

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[7] Source: Esri Community Business Summary (2022).
[8] Source: City of Tacoma 2021 Annual Comprehensive Financial Report.

- Point Defiance Park
- Wapato Park

Cultural/Historic Resources

Key cultural/historic resources within Berkeley include:

- The Museum of Glass
- America's Car Museum
- Tacoma Art Museum
- Washington State History Museum
- Tacoma Arts Live
- Fort Nisqually

Special/Unique Resources

Following are special/unique resources to be protected within the City:

- University of Washington – Tacoma Campus
- University of Puget Sound
- Tacoma Community College
- University of Seattle–Tacoma
- Evergreen State College-Tacoma
- Tacoma Dome
- Cheney Stadium
- Tacoma Convention Center

2.4.3 Hazard Identification

Citygate utilized prior risk studies where available, fire and non-fire hazards as identified by the CFAI, and agency- and jurisdiction-specific data and information to identify the hazards to be evaluated for this study. The Pierce County Region 5 All Hazard Mitigation Plan (AHMP)[9] identifies the following 20 hazards with potential to impact the County.

[9] Pierce County Emergency Management, Region 5 All Hazard Mitigation Plan, July 2020–2025 Edition.

1. Avalanche
2. Earthquake
3. Landslide
4. Tsunami
5. Volcanic Activity
6. Climate Change
7. Drought
8. Flood
9. Severe Weather
10. Wildland Urban Interface Fire
11. Abandoned Underground Mines
12. Active Technological Threat
13. Civil Disturbance
14. Cyber Attack
15. Dam Failure
16. Energy Emergency
17. Epidemic/Pandemic
18. Hazardous Material
19. Terrorism
20. Transportation Accident

Although the Fire Department has no legal authority or responsibility to mitigate any of these hazards other than perhaps wildland-urban interface fire risk, it does provide services related to all hazards, including fire suppression, emergency medical services, technical rescue, and hazardous materials response.

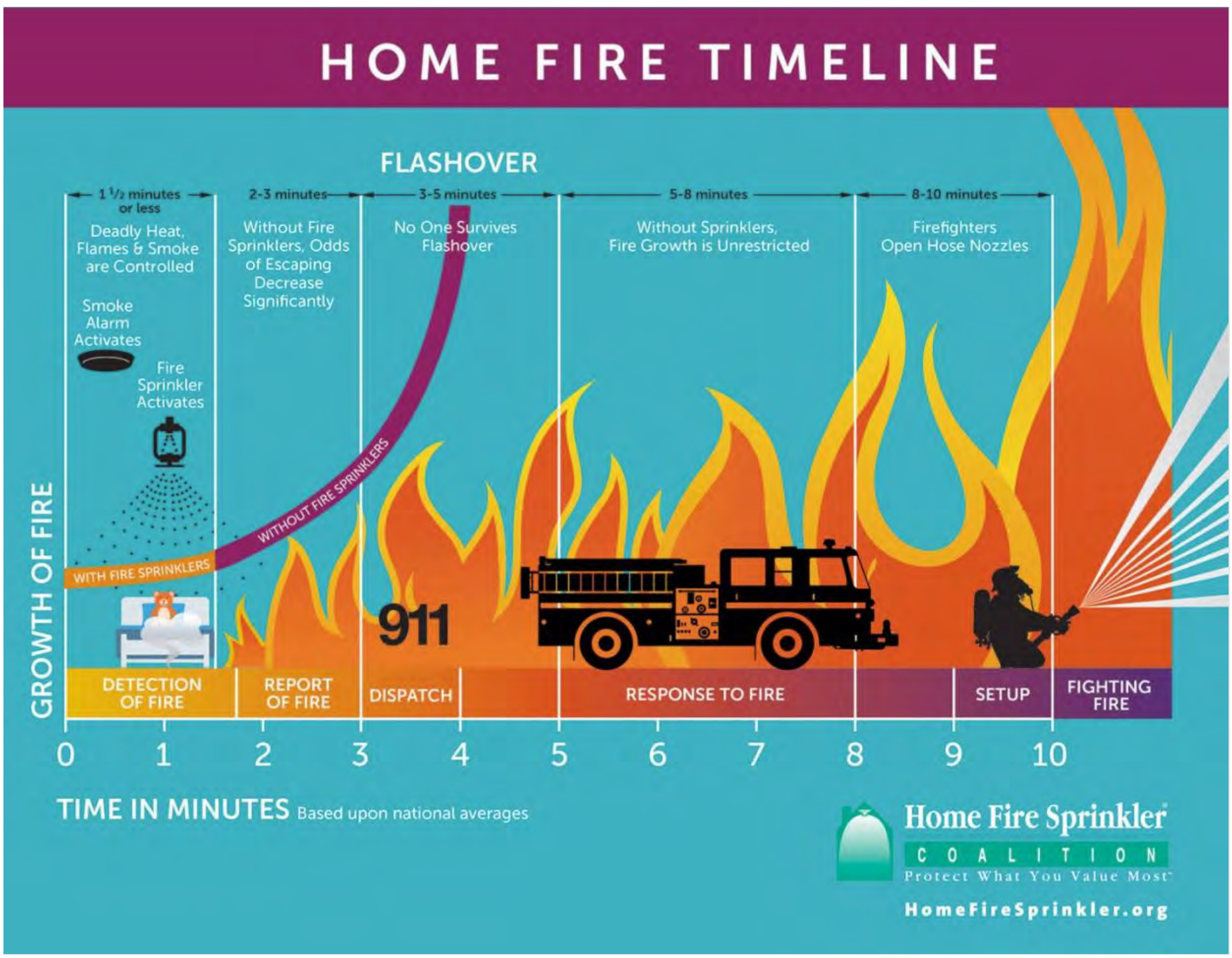
The following is a brief overview of building fire and medical emergency risk. **Appendix A** contains the full risk assessment for all six hazards Citygate focused on for the purposes of this study.

Building Fire Risk

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

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

Figure 3—Building Fire Progression Timeline

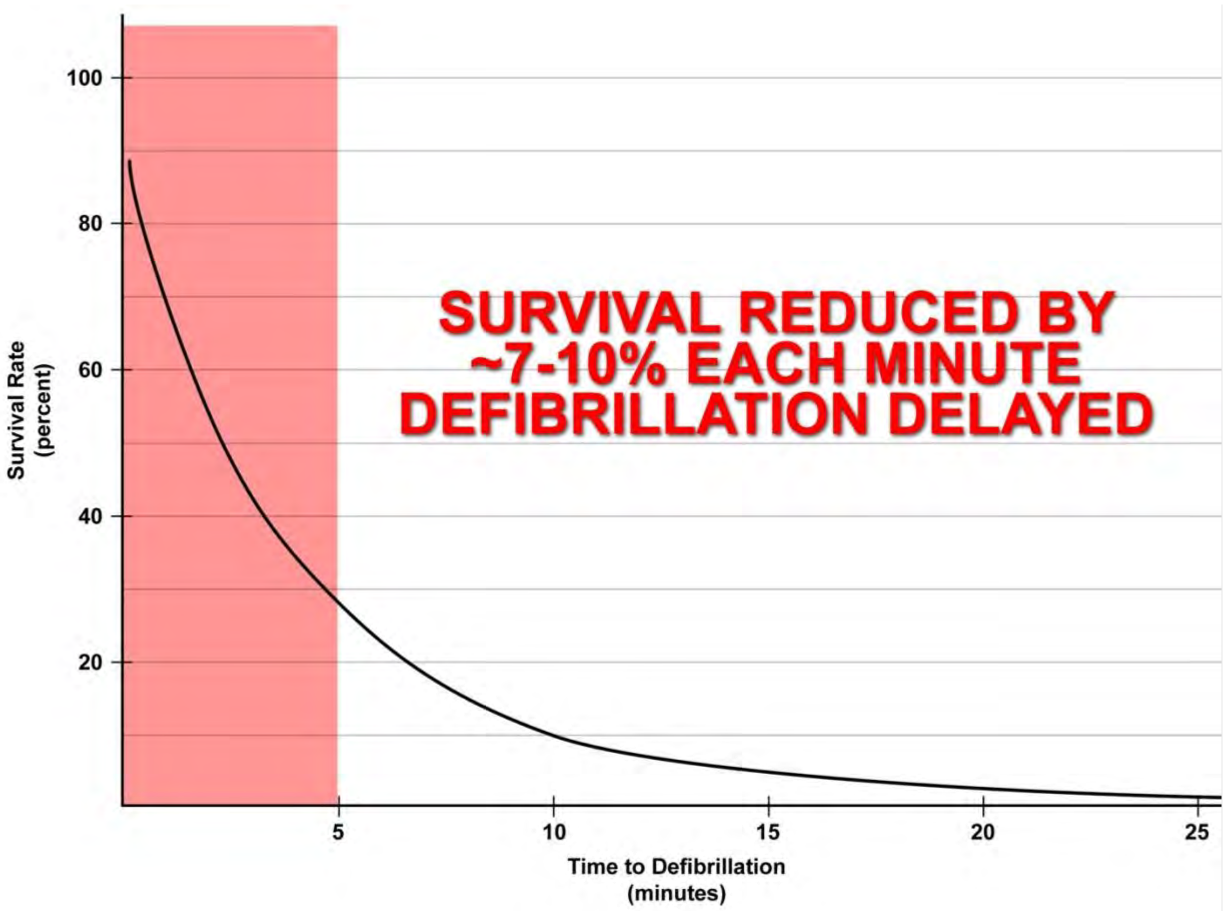


Source: http://www.firesprinklerassoc.org

Medical Emergency Risk

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

Figure 4—Survival Rate versus Time of Defibrillation



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

2.4.4 Risk Assessment Summary

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

- The Fire Department serves a diverse urban/suburban population, with densities ranging from less than 1,000 to more than 10,000 people per square mile over a varied land-use pattern.

- The City's population is projected to increase significantly over the next 18 years to 2040.
- The service area includes a large inventory of residential and non-residential buildings to protect, as identified in this assessment.
- The service area also has significant economic and other resource values to be protected, as identified in this assessment.
- The City has a mass emergency notification system to effectively communicate emergency notifications and information to the public in a timely manner.
- The City's overall risk for six hazards related to emergency services provided by the Fire Department range from Low to High, as summarized in the following table.

Table 9—Overall Risk by Hazard

Hazard	Risk Planning Zone								
	Sta. 1	Sta. 2	Sta. 3	Sta. 4	Sta. 5	Sta. 6	Sta. 7	Sta. 8	Sta. 9
Building Fire	Moderate	Moderate	Moderate	Moderate	Moderate	Moderate	Moderate	Moderate	Moderate
Vegetation/Wildland Fire	Low	Low	Moderate	Low	Moderate	Low	Moderate	Moderate	Moderate
Medical Emergency	High	High	High	High	High	Moderate	High	High	High
Hazardous Material	High	Moderate	Low	Low	High	Moderate	Moderate	Moderate	Low
Technical Rescue	Moderate	Moderate	Moderate	Moderate	Moderate	Moderate	Moderate	Moderate	Moderate
Marine Incident	Moderate	Moderate	Low	Low	Low	Low	Low	Low	Low

Hazard	Risk Planning Zone (Cont.)							
	Sta. 10	Sta. 11	Sta. 12	Sta. 13	Sta. 14	Sta. 15	Sta. 16	Sta. 17
Building Fire	Moderate	Moderate	Moderate	Moderate	Moderate	Moderate	Moderate	Moderate
Vegetation/Wildland Fire	Moderate	Moderate	Moderate	Low	Moderate	Moderate	Moderate	Moderate
Medical Emergency	High	High	High	High	High	High	High	High
Hazardous Material	Moderate	Moderate	High	Moderate	Moderate	Low	Moderate	Moderate
Technical Rescue	Moderate	Moderate	Moderate	Moderate	Moderate	Moderate	Moderate	Moderate
Marine Incident	Low	Low	Low	Low	Moderate	Low	Moderate	Low

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

SOC Element 4 of 8
Critical Task Time Study

SOC studies use critical task information to determine the number of firefighters needed within a time frame to achieve desired objectives on fire and emergency medical incidents. The following tables illustrate critical tasks typical of building fire and medical emergency incidents, including the minimum number of personnel required to complete each task. These tables are composites from Citygate clients in urban/suburban departments like Tacoma, with units staffed with three personnel per engine or ladder truck. It is important to understand the following relative to these tables:

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

2.5.1 Critical Firefighting Tasks

The following table illustrates the critical tasks required to control a typical single-family dwelling fire with nine response units for a total ERF of 24 personnel (four engines, two ladder trucks, two aid transport units, and two Battalion Chiefs). These tasks are taken from typical fire departments' operational procedures, which are consistent with the customary findings of other agencies using the SOC process. No conditions exist to override OSHA's two-in/two-out safety policy, which requires that firefighters enter atmospheres that are immediately dangerous to life and health, such as building fires, in teams of two while two more firefighters are outside and immediately ready to rescue them should trouble arise.

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

Table 10—First Alarm Residential Fire Critical Tasks – 24 Personnel

Critical Task Description		Personnel Required
First-Due Engine (3 Personnel)		
1	Conditions report	**1**
2	Establish supply line to hydrant	**2**
3	Deploy initial fire attack line to point of building access	**1–2**
4	Operate pump and charge attack line	**1**
5	Or skip the above and establish incident command	**1**
6	Or conduct primary search within OSHA regulations	**2**
Second-Due Engine (3 Personnel)		
1	If necessary, establish supply line to hydrant	**1–2**
2	Deploy an attack or backup attack line	**1–2**
3	Or establish Initial Rapid Intervention Team (IRIT)	**2**
First and Second Due Trucks (3 Personnel)		
1	Conduct initial search and rescue, if not already completed	**2**
2	Deploy ground ladders to roof	**1–2**
3	Establish horizontal or vertical building ventilation	**1–2**
4	Open concealed spaces as required	**2**
Battalion Chiefs		
1	Transfer of incident command from first- or second-in Captain	**1**
2	Establish exterior command and scene safety	
Third- and Fourth-Due Engines (6 Personnel)		
1	Establish full Rapid Intervention Crew	**4**
2	Secure utilities	**1**
3	Or deploy second attack line(s) as needed	**2**
Aid Transport Units		
1	Establish incident rehab	**4**

Grouped together, the duties in the previous table form an ERF, or First Alarm Assignment. These distinct tasks must be performed to effectively achieve the desired outcome; arriving on scene does not stop the emergency from escalating. While firefighters accomplish these tasks, the incident progression clock continues to run.

Fire in a building can double in size during its free-burn period before fire suppression is initiated. Many studies have shown that a small fire can spread to engulf an entire room in less than 3:00 to 5:00 minutes after free burning has started. Once the room is completely superheated and involved in fire (known as flashover), the fire will spread quickly throughout the structure and into the attic and walls. For this reason, it is imperative that fire suppression and search/rescue operations commence before the flashover point occurs *if* the outcome goal is to keep the fire damage in or near the room of origin. In addition, flashover presents a life-threatening situation to both firefighters and any building occupants.

2.5.2 Critical Medical Emergency Tasks

The Department responds to approximately 32,000 EMS incidents annually, including vehicle accidents, strokes, heart attacks, difficulty breathing, falls, childbirths, and other medical emergencies. For comparison, the following table summarizes the critical tasks required for a cardiac arrest patient.

Table 11—Cardiac Arrest Critical Tasks – Three Engine or Truck Personnel + ALS Medic Unit

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

2.5.3 Critical Task Analysis and Effective Response Force Size

The time required to complete the critical tasks necessary to stop the escalation of an emergency (as shown in Table 10 and Table 11) must be compared to outcomes. As shown in nationally published fire service time-versus-temperature tables, a building fire will escalate to the point of flashover after approximately 4:00 to 5:00 minutes of free burning in an enclosed room. At this point, the entire room is engulfed in fire, the fire extends rapidly both horizontally and vertically, and human survival near or in the room of fire origin becomes impossible. Additionally, brain death begins to occur within 4:00 to 6:00 minutes of the heart stopping. Thus, the ERF must arrive in time to prevent these emergency events from becoming worse.

The Department's daily staffing provides an ERF of 24 personnel to a residential building fire and 27 to a commercial building fire, if they can arrive in time, which the statistical analysis of this report will discuss in depth. Mitigating an emergency event is a team effort once the units have arrived. This refers to the *weight* of response analogy: if too few personnel arrive too slowly, the emergency will escalate instead of improving. The outcome times, of course, will be longer and yield less-desirable results if the arriving force is smaller or arrives later.

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

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

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

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

An initial response of 24 personnel can handle a moderate risk confined building fire; however, even this ERF will be seriously slowed if the fire is above the first floor in a low-rise apartment building or commercial/industrial building. This is where the capability to add additional personnel and resources to the standard response becomes critical.

The Department's ERF plan delivering 24 personnel to a building fire and 27 to a commercial building fire reflects a goal to confine serious building fires to or near the room of origin and prevent the spread of fire to adjoining buildings. This is a typical desired outcome in urban/suburban areas and requires more firefighters more quickly than the typical rural outcome of keeping the fire contained to the building, not room, of origin.

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

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

SOC Element 5 of 8
Distribution Study

SOC Element 6 of 8
Concentration Study

The Department's service area is served today by 17 fire stations deploying the resources and staffing identified in Table 3. It is appropriate to understand, using geographic mapping tools, what the existing stations do and do not cover within specified travel time goals, if there are any coverage gaps needing one or more stations, and what, if anything, to do about them.

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

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

To analyze first-due fire unit travel time coverage, Citygate used a geographic mapping tool that can measure theoretical travel time over a street network. For this calculation, Citygate used the base map and street travel speeds calibrated to actual fire apparatus travel times from previous responses to simulate real-world travel time coverage. A second model of traffic congestion limitations is used to show realistic negative impacts on travel times. Geographic modeling of travel time for fire units now has available data for the actual throughput traffic speeds on every road segment for every hour of the day—peak and off-peak periods. Where communities also use significant traffic calming devices that slow fire and ambulance apparatus, these constrictions can also be added to the response time models.

Using all these tools, Citygate ran several deployment tests and measured their impact in various parts of the City. A 4:00-minute first-due and 8:00-minute ERF *travel* time were used consistent with national best practice response performance goals for positive outcomes in urban areas.

2.6.1 Deployment Baselines

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

Note: *All maps in this section (with the exception of Map #2 – Population Density) were prepared in the spring of 2020, just before COVID-19 caused the City to suspend this project. As such, some of the apparatus symbols per station are slightly different for EMS units due to proactive changes made by the Department in 2022. The use of these maps for measuring travel time coverage and density of incident demand is still appropriate for benchmarking, however, as these measures change very slowly over the years.*

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

Map #1 shows the City boundary and fire station locations. This is a reference map for other maps that follow. Station symbols denote the type of staffed fire apparatus at each station. All engines and trucks are staffed with a minimum of three personnel each, and ambulance units are each staffed with either two firefighter/paramedics or firefighter/EMTs.

Map #2 – Risk Assessment: Population Density

Map #2 shows population densities in the City. EMS incidents are principally driven by population density. It is apparent the highest-density areas are in the center of the City, from Station 14 south past Station 10. Any areas with resident population density of greater than 5,000 people per square are considered dense urban areas. If, for example, one fire station area served a distance of 1.5 miles from the center of a square, that becomes a 9-square-mile zone. At a population density of 5,000 people per square, that one fire station is protecting 45,000 residents, which is larger than the entire population covered by the departments of many suburban cities.

Map #2a – Risk Assessment: High Risk Building Occupancies

This map displays the locations of the City's identified higher-risk buildings as quantified in the Community Risk Assessment (**Appendix A**). Many represent critical infrastructure, health care facilities, and buildings housing large population densities.

Map #2b – Risk Assessment: High Fire Flow Sites

This map displays locations the insurance industry has identified that would require a high Needed Fire Flow (NFF) should the building become heavily involved in fire. This calculation considers size, height, type of construction, use of the building, and whether or not fire sprinklers are present. These sites should be protected by an ERF (or First Alarm) response and are in areas of the City are where multiple-unit coverage should be the best.

Map #3a – Distribution: 4:00-Minute First-Due Travel Time Coverage With Traffic Congestion

Map #3a shows the City's public road miles that should be expected to be reached within 4:00 minutes of travel time from the City's fire station locations with and without *traffic congestion*, assuming the responding resource is in-station.

The purpose of response time modeling is to determine response time coverage across a jurisdiction's geography and station locations. This geo-mapping design is then validated against actual response data to reflect actual travel times. There should be some overlap between station areas so that a second-due unit can have a chance of an acceptable response time when it responds to a call in a different station's first-due response area.

As can be seen, only the core, most urban areas of the City are within 4:00 minutes' travel time of a station and, given the adequate station spacing, traffic congestion only slows the units at the edges of the urban areas.

Map #3b – Distribution: 8:00-Minute Travel Paramedic Ambulance Coverage with Traffic Congestion

Ambulances serve larger areas with multiple fire engines. Given a faster, neighborhood-based engine response, it is reasonable for ambulances to be spaced with an 8:00-minute travel time. This map shows the 8:00-minute travel coverage from five locations. As 8:00 minutes of travel represents a large coverage footprint, the urban core is substantially covered—though it requires four units to achieve that level of coverage, and there are remaining edge areas that are beyond 8:00 minutes' travel.

Map #4 – Insurance Services Office 1.5-Mile Coverage

Map #4 displays the older ISO recommendation that urban stations cover a 1.5-mile *distance* response area. Depending on a jurisdiction's road network, the 1.5-mile measure usually equates to a 3:30- to 4:00-minute travel time. However, a 1.5-mile measure is a reasonable indicator of station spacing and overlap. As can be seen, the 1.5-mile ISO coverage is weaker outside of the core neighborhoods. This is tight measure that is all but impossible for most agencies to achieve unless they are covering a grid street network with efficient fire station locations.

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

This map shows the City's public road miles that *should* be reachable within a travel time of 8:00 minutes for a <u>minimum</u> initial ERF of four engines, one ladder truck, one medic ambulance and one Battalion Chief with and without *traffic congestion*. This quantity of units is a challenging number to deliver to the entire City as the last unit must arrive within a *travel* time of 8:00 minutes and, for edge areas, getting this many units to arrive quickly is difficult. As with other measures where there are multiple stations to draw from into the center of an area, even with traffic congestion, the core most populated areas are covered within a travel time of 8:00 minutes.

Map #5b – Concentration: 8:00-Minute ERF Travel Time – Four Engines

This version of the ERF measure only looks at the coverage for the four-engine component of the ERF response. As can be seen, the coverage area at 8:00-minutes improves as there are more engines than ladder trucks.

Map #6a – Concentration: 8:00-Minute ERF Travel Time Coverage – One Ladder Truck

Map #6a shows the ERF coverage for each of the four ladder trucks. As can be seen, the four trucks are well located to provide at least one truck to most of the core City areas.

Map #6b – Concentration: 8:00-Minute ERF Travel Time Coverage – Two Ladder Trucks

This map measures two ladder truck coverage and shows how hard it is—even without traffic congestion—to deliver two ladder trucks in a travel time of 8:00 minutes except in two smaller core areas.

Map #7a – 8:00-Minute One Battalion Chief Travel Time Coverage with Traffic Congestion

This map displays 8:00-minute travel time coverage for each of the two battalion chiefs with and without traffic congestion. It is apparent that the travel time coverage for one of two battalion chiefs in 2020 includes only most of the core City but not the outer edges and hardly any of the Port/Eastside areas.

Map #7b – 8:00-Minute Two Battalion Chief Travel Time Coverage with Traffic Congestion

This measure shows how, in 2020, 8:00-minute coverage for two arriving battalion chiefs was only possible where they overlap in the City center. This map measure, when combined with the coverage from three-ladder trucks, shows why the complete ERF maps show less coverage outside core sections of the City.

Map #8 – All Incident Locations

This map shows the location of all incident responses for four years from January 1, 2016, through December 31, 2019, which occurred on nearly every street segment in the City. Incidents plotted outside the City are due to the City's mutual aid supporting other agencies.

Map #9 – Emergency Medical Services and Rescue Incident Locations

Map #9 illustrates only the emergency medical and rescue incident locations for the four reporting years of data analyzed. With most of the calls for service being medical emergencies, virtually all areas of the City need pre-hospital emergency medical services.

Map #10 – All Fire Locations

This map displays the location of all fires within the City in the four reporting years studied, which includes any type of fire call, from vehicle, to dumpster, to building. There are obviously fewer fires than medical or rescue calls. Even given this fact, it is evident that fires occur in all fire station areas and clustered along major arterials and the more densely populated central core areas.

Map #11 – Building Fire Locations

Map #11 shows the locations of all building fire incidents in the four reporting years studied. While the number of building fires is a smaller subset of total fires, in Citygate's experience, this is consistent with other, similar cities in the western United States. As with the prior map showing all types of fires, there are more building fires in the oldest and most densely populated areas.

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

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

This perspective is important because the deployment system needs an overlap of units to ensure the delivery of multiple units when needed for more serious incidents or to handle simultaneous calls for service, as is evident for the higher population density areas of the City. There is a stronger incident density between Stations 1 and 4 which will show in the incident statistical analysis section to follow in this report.

Map #13 – Fire Incident Location Densities

Map #13 shows the hot spots for all types of fire incidents (shown in Map #10). While this density is also highest in the area of stations 1 and 4, it also spreads further to stations 2 and 11.

Map #14 – Building Fire Incident Location Densities

This map shows the hot spots for building fire incidents (shown in Map #11). The density of structure fire incidents is most pronounced around stations 1, 2 and 4. The multiple-unit ERF coverage should be the strongest in these fire density areas, and it is.

2.6.2 Travel Time Road Mile Coverage Measures

In addition to the visual displays of coverage that maps provide, the following table summarizes non-congested coverage versus the impacts of traffic congestion.

Table 12—First-Due and ERF Travel Time Coverage Summary

Map	Travel Time Measure	Total Public Road Miles	Miles Covered	Percentage of Total Miles Covered
3	4:00-Minute First-Due	1,508	842	**55.8%**
3	4:00-Minute First-Due with Traffic Congestion	1,508	565	**37.5%**
5a	8:00-Minute ERF with Traffic Congestion (4-E, 1-T, 1-M, 1-BC)	1,508	234	**15.5%**
5b	8:00-Minute ERF (4-E) with Traffic Congestion	1,508	17	**1.1%**

As the table shows, 4:00-minute first-due unit coverage is only 56 percent of the City's total public road miles, and is reduced by 18 percent with traffic congestion, which is significant. With 4:00 minutes as a desirable first-due travel time goal, the data in Table 20 for travel time shows the Department's 90th percentile first-due travel time performance was 7:45 minutes Citywide in 2021. Traffic congestion and a street network that is difficult to serve efficiently over the topography is impacting travel time. The 8:00-minute ERF travel time coverage without traffic congestion is also weak at 38 percent of total road miles, and congestion significantly erodes it to 16 percent.

Finding #7: The GIS mapping evaluation of travel time coverage demonstrates that the City's fire stations are not distributed to provide best practice response times equitably to all neighborhoods. As the incident statistics also demonstrate, best practice travel times are further hampered by other factors.

Finding #8: As shown in this study's GIS models, traffic congestion decreases 4:00-minute first-unit travel time road mile coverage by 18 percent, which, in Citygate's experience, is a significant loss. There is an even more significant impact on multiple-unit ERF responses, eroding 8:00-minute travel time coverage by 22 percent.

2.7 STATISTICAL ANALYSIS

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

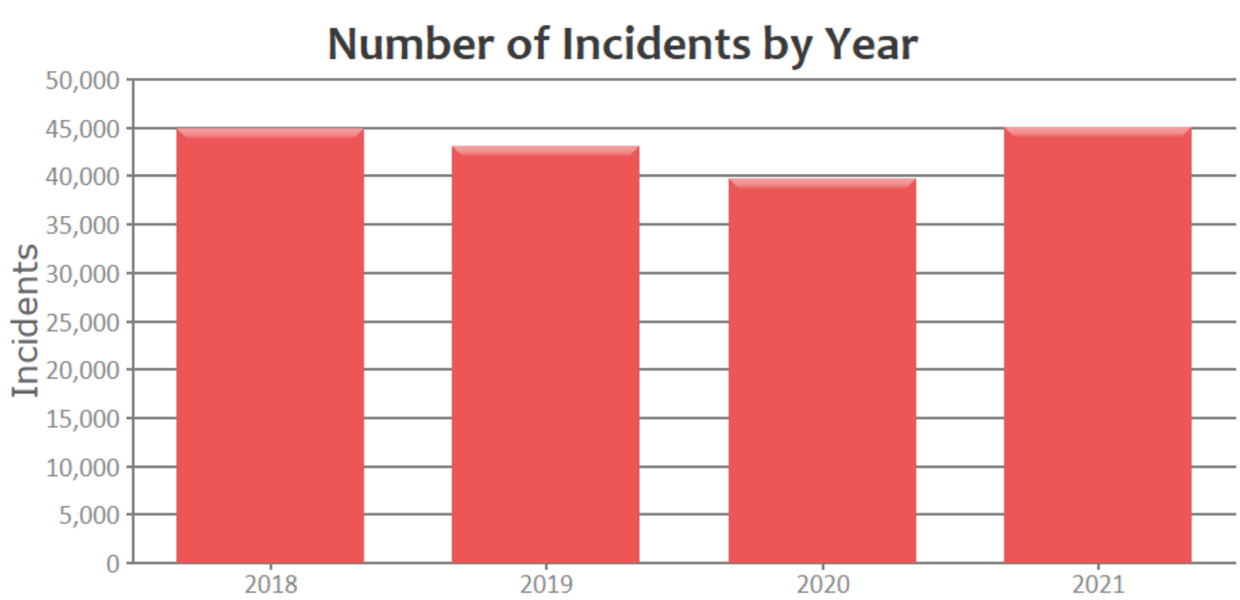
SOC ELEMENT 7 OF 8
RELIABILITY & HISTORICAL RESPONSE EFFECTIVENESS STUDIES

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

2.7.1 Demand for Service

The Department provided NFIRS 5 text files and an Excel spreadsheet with apparatus response data for four years from 01/01/2018 through 12/31/2021. These two data sources were merged by NFIRS 5 incident number into a single analytic database. In total, there were 173,004 incidents and 287,116 apparatus response records available for the four-year analysis period.

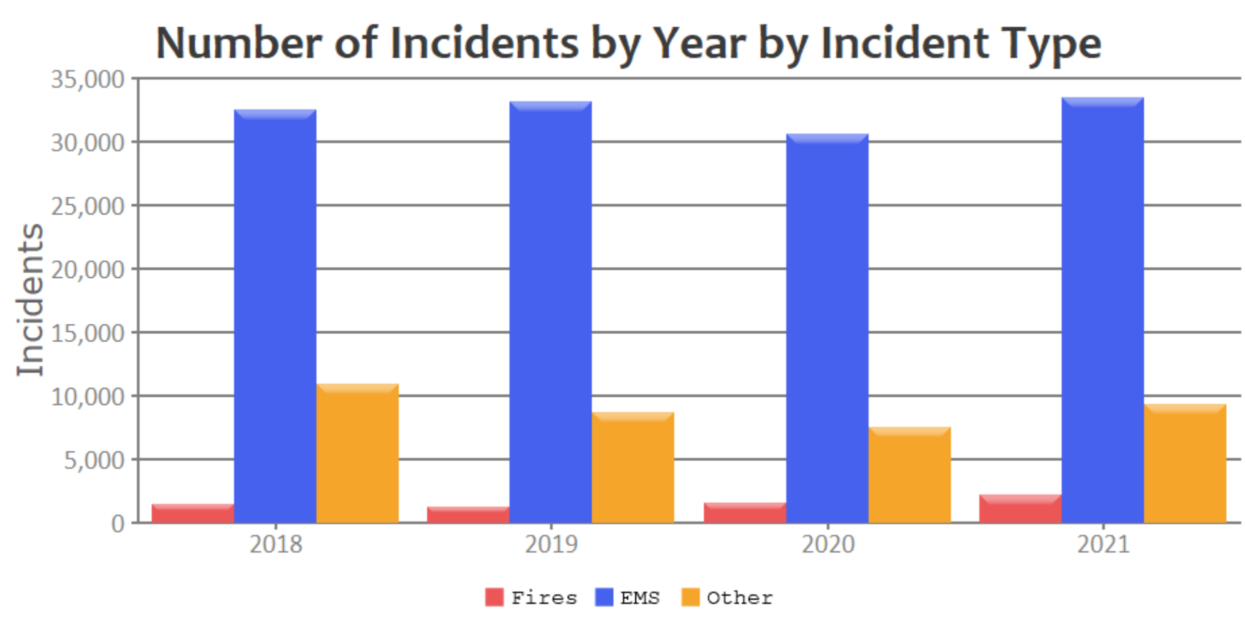
Figure 5—Total Service Demand by Year



As the figure shows, there was a decrease in activity in 2020 (likely due to COVID-19) followed by an increase to normal incident levels in 2021.

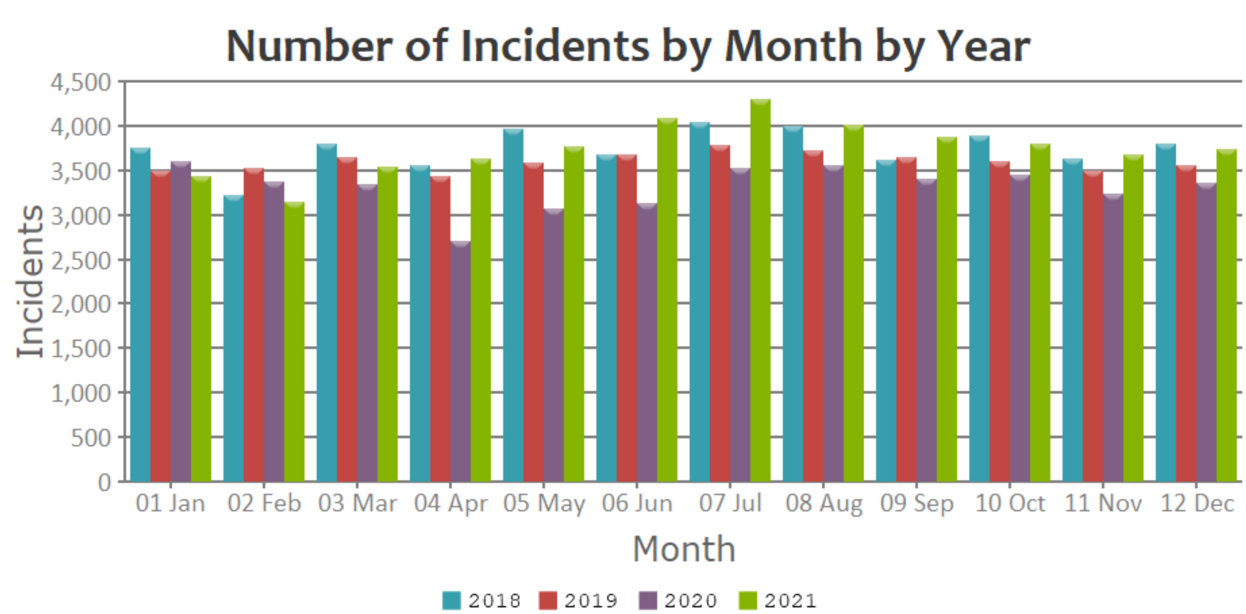
The following figure illustrates the number of incidents by incident type. The number of all types of fires is slowly increasing in recent years. The number of EMS incidents decreased in 2020 but recovered in 2021.

Figure 6—Annual Service Demand by Incident Type



The following figure shows the number of incidents by month for each year of the study period.

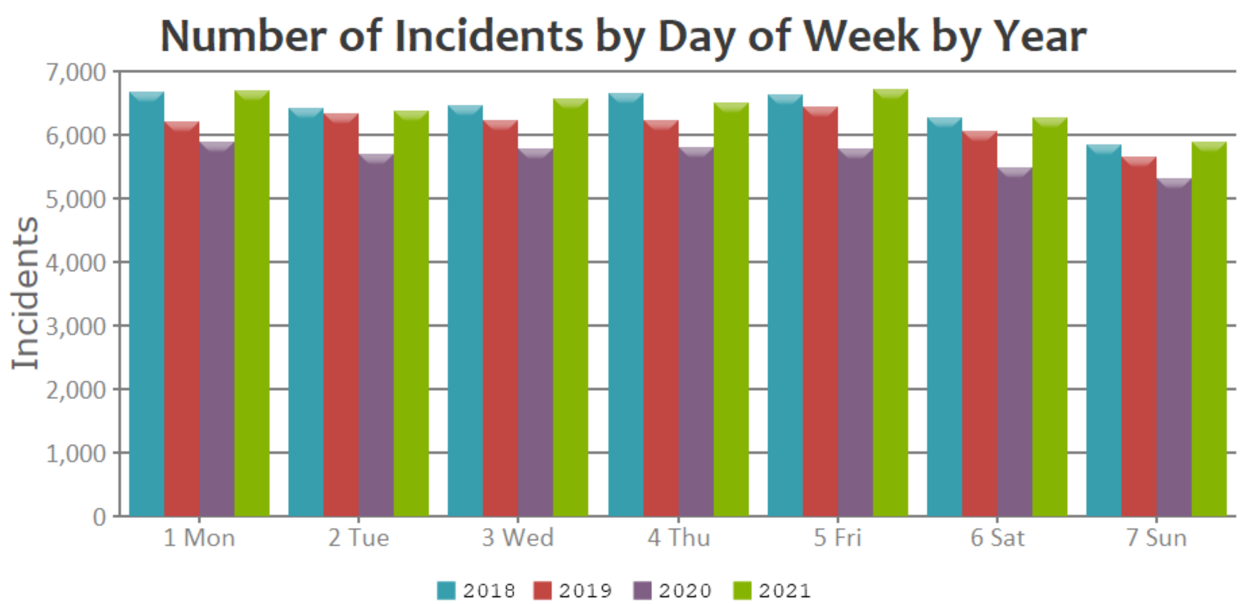
Figure 7—Number of Incidents by Month by Year



As the figure shows, the monthly number of incidents is typically steady, with an increase in activity in mid-summer.

The following figure shows incidents by day of week over the four-year period of analysis.

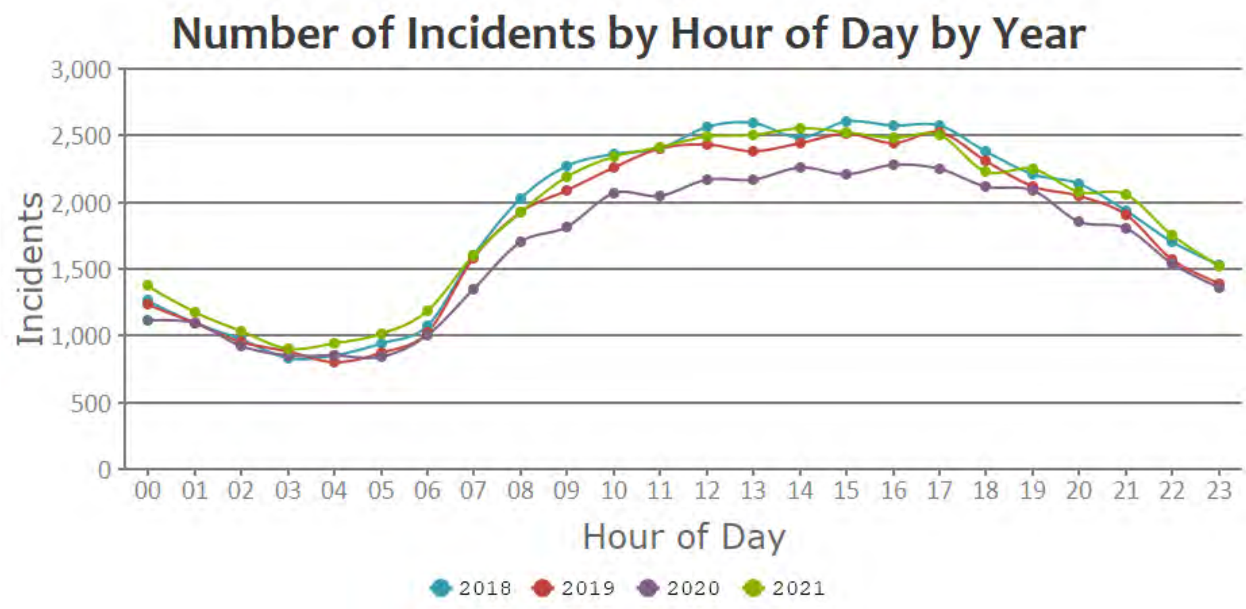
Figure 8—Number of Incidents by Day of Week by Year



As the figure shows, there tends to be a marginally higher number of incidents on Friday and Monday, with slightly lower incident activity on Saturday and Sunday. For deployment purposes, the volume per day is steady, requiring the same level of deployment seven days a week.

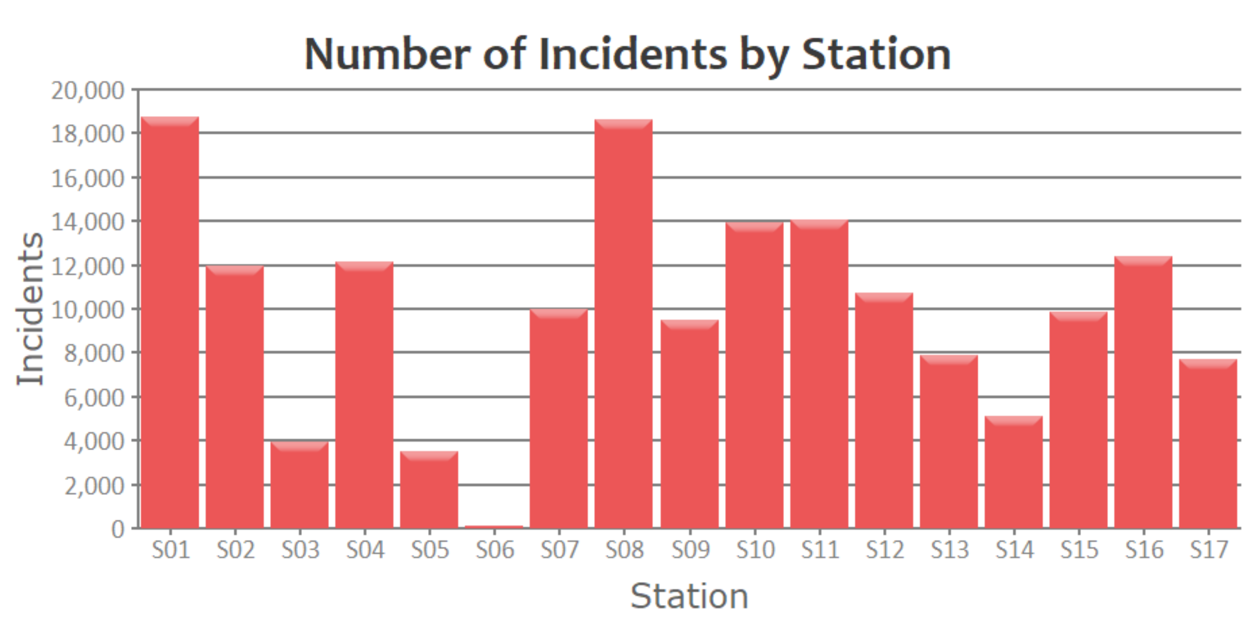
The following figure illustrates the breakdown of incidents by hour of the day by year. Overall, in 2021 there was demand at all hours, with a daily demand increase beginning with morning rush hour and reaching a plateau that runs from roughly 10:00 am to 7:00 pm.

Figure 9—Number of Incidents by Hour of Day by Year



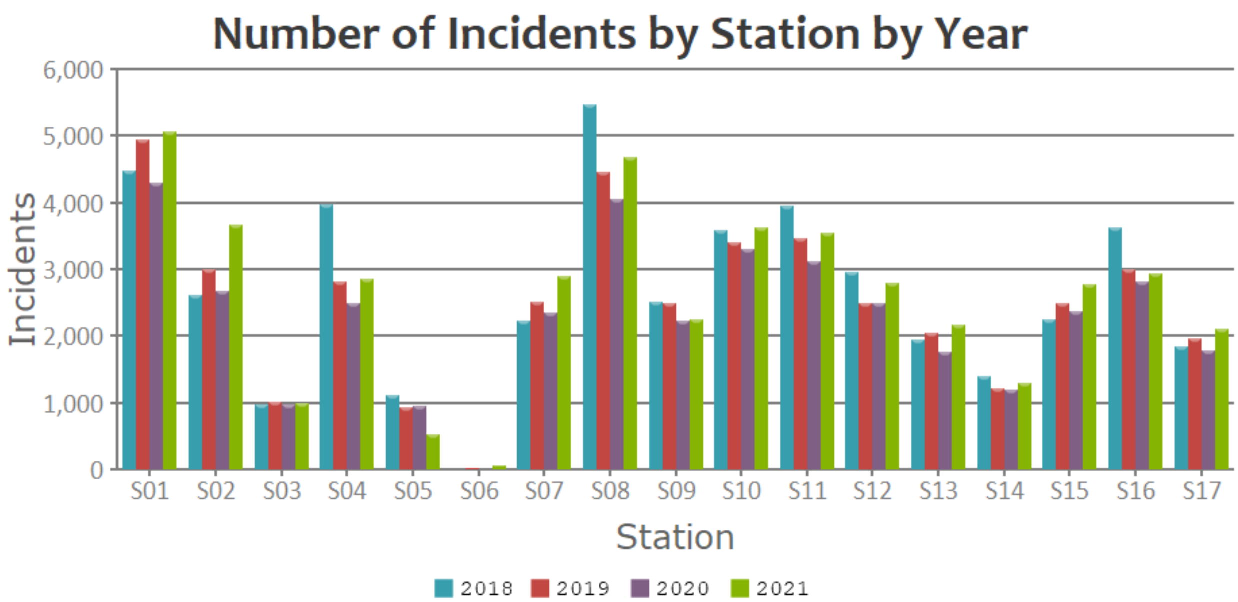
The following figure illustrates the number of incidents by station during the four-year analysis period. Stations 1 and 8 managed the highest volume of incidents, while stations 6 (limited term) and 5 had the lowest volume.

Figure 10—Number of Incidents by Station (Four Years)



The following figure is a breakdown of the number of incidents by station area by year.

Figure 11—Number of Incidents by Station by Year



The volume of incidents responded to from Station 1 increased in 2021. Stations 2 and 8 also recorded a significant increase in activity in 2021 from the prior year.

2.7.2 Incident Quantities by Incident Types

The following table uses the National Fire Incident Reporting System (NFIRS) categories and ranking of incidents by incident type by reporting year. Note the strong ranking for EMS-related incidents. Only incident types with more than **50** calls for service over four years are shown, with building fires ranking thirteenth on the list.

Table 13—Service Demand by Incident Type (2018–2021)

Incident Type	2018	2019	2020	2021	Total
321 **EMS call**, excluding vehicle accident with injury	32,202	32,820	30,443	33,251	128,716
510 Person in distress, other	1,366	1,252	1,098	1,431	5,147
911 Citizen complaint	1,152	1,021	1,031	1,598	4,802
554 Assist invalid	1,151	1,001	1,019	1,245	4,416
600 Good intent call, other	1,491	1,012	741	1,075	4,319
740 Unintentional transmission of alarm, other	1,158	1,046	928	885	4,017
160 Special outside fire, other	495	511	674	1,066	2,746
611 Dispatched & canceled en route	1,518	330	294	420	2,562
732 Extinguishing system activation due to malfunction	538	534	565	538	2,175
142 Brush, or brush and grass mixture fire	458	359	371	470	1,658
460 Accident, potential accident, other	308	300	342	417	1,367
440 Electrical wiring/equipment problem, other	274	348	241	243	1,106
111 **Building fire**	274	263	255	312	1,104
650 Steam, other gas mistaken for smoke, other	257	210	238	293	998
130 Mobile property (vehicle) fire, other	153	138	172	264	727
710 Malicious, mischievous false call, other	179	200	137	210	726
511 Lock-out	176	184	114	117	591
381 Rescue or EMS standby	208	224	34	83	549
550 Public service assistance, other	155	130	97	119	501
671 Hazmat release investigation w/ no hazmat	114	130	121	120	485
551 Assist police or other governmental agency	124	108	83	103	418
154 Dumpster or other outside trash receptacle fire	84	58	108	119	369
353 Removal of victim(s) from stalled elevator	76	68	52	80	276
520 Water problem, other	61	64	67	52	244
521 Water evacuation	55	72	48	50	225
420 Toxic condition, other	61	49	41	41	192
746 Carbon monoxide detector activation, no CO	38	42	48	24	152
360 Water & ice related rescue, other	31	28	34	30	123
652 Steam, vapor, fog, or dust thought to be smoke	29	19	17	22	87
571 Cover assignment, standby, move up	33	19	9	6	67
340 Search, other	13	8	19	15	55
463 Vehicle accident, general cleanup	16	18	6	14	54

2.7.3 Simultaneous Incident Activity

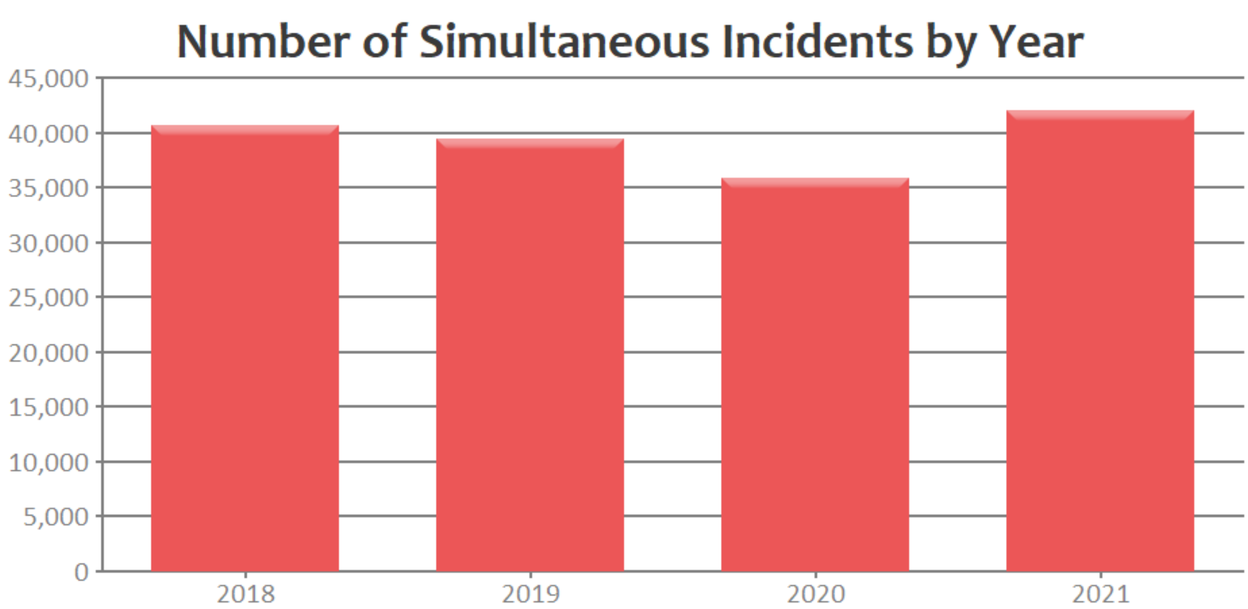
Simultaneous incidents occur when other incidents are underway at the time a new incident begins. During 2021 there were at least two incidents underway 91 percent of the time.

Table 14—Simultaneous Incident Activity (2021)

Number of Simultaneous Incidents	Percentage
1 or more	91.21%
2 or more	78.56%
3 or more	59.12%
4 or more	39.68%
5 or more	23.83%
6 or more	12.93%
7 or more	06.43%
8 or more	02.94%
9 or more	01.29%
10 or more	00.54%

The following figure shows the number of simultaneous incidents by year. There was a downward trend through 2020 (likely due to COVID-19) but the number increased significantly in 2021.

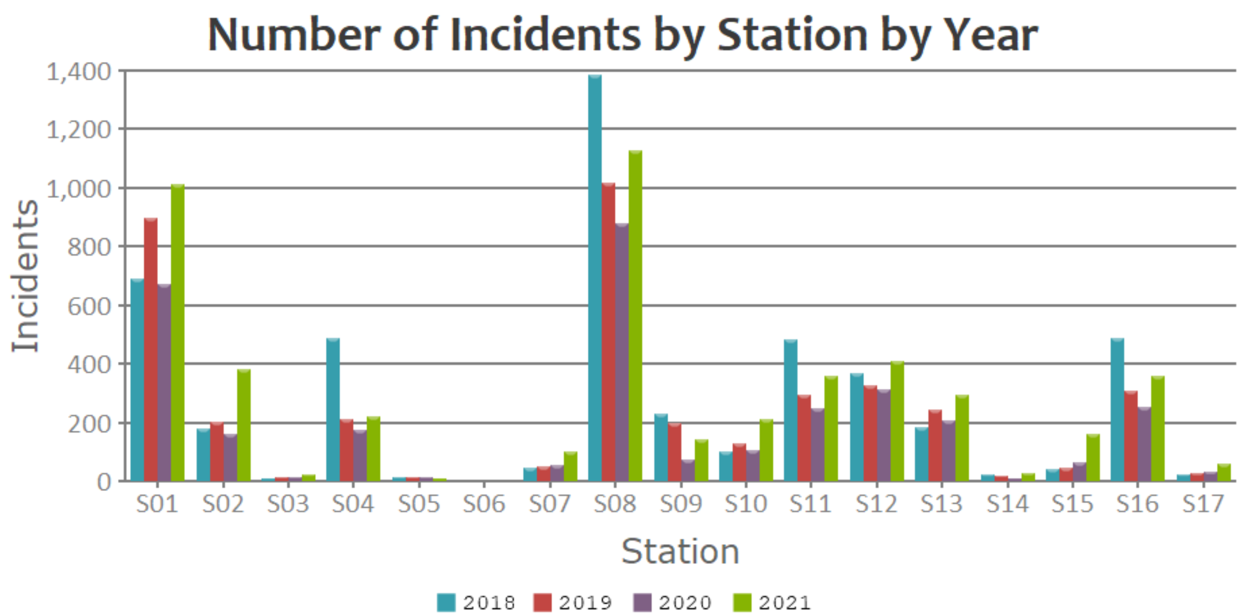
Figure 12—Number of Simultaneous Incidents by Year



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

The following figure illustrates the number of single-station simultaneous incidents by station area by year. Station 8 has the highest number of single-station area simultaneous incidents in 2021.

Figure 13—Number of Single-Station Simultaneous Incidents by Station by Year



Finding #9:	Overall demand for incidents has increased and surpassed pre COVID-19 levels.
Finding #10:	The annual number of simultaneous incidents is increasing and has significant impacts on response time in the most effected station districts.

2.7.4 Unit-Hour Utilization

The unit-hour utilization (UHU) percentage is calculated using the number of responses and duration of the responses to show the percentage of time that a response resource is committed to an active incident during a given hour of the day. In Citygate's experience, a UHU of 30 percent or higher over *multiple* consecutive hours becomes the point at which other responsibilities, such as training, do not get completed. The following table shows a UHU summary for the City's engine companies. The busiest units are listed first on the left. Engines 10 and 2 have the longest run of hours with UHUs over or close to 30 percent. The next *five* engines are in the mid- to high-20th percentiles, which is also problematic.

Table 15—Unit-Hour Utilization – Engines (2021)

Hour	E10	E02	E01	E11	E15	E07	E08	E04	E16	E17
00:00	23.54%	16.74%	20.89%	19.60%	16.55%	17.11%	16.50%	14.29%	12.42%	13.44%
01:00	15.10%	20.30%	17.78%	18.51%	15.16%	19.03%	13.79%	21.50%	11.71%	9.94%
02:00	15.35%	13.27%	19.89%	16.06%	14.74%	15.77%	13.89%	11.53%	12.08%	10.83%
03:00	18.21%	13.41%	12.45%	16.90%	10.84%	9.78%	12.20%	12.78%	10.38%	10.65%
04:00	15.73%	13.14%	14.08%	14.49%	10.01%	14.91%	12.95%	9.22%	12.64%	10.54%
05:00	18.19%	16.34%	14.09%	14.73%	12.10%	15.22%	10.89%	8.90%	8.62%	10.06%
06:00	13.23%	23.12%	20.49%	13.47%	13.49%	12.45%	14.12%	13.07%	12.56%	10.55%
07:00	37.26%	26.40%	30.67%	29.05%	31.43%	28.26%	24.08%	26.08%	20.87%	23.28%
08:00	25.46%	30.66%	20.73%	25.37%	22.80%	20.85%	22.96%	21.39%	17.67%	21.80%
09:00	25.20%	22.06%	24.91%	25.81%	21.26%	17.80%	25.98%	19.44%	23.37%	24.34%
10:00	24.61%	20.58%	23.72%	19.85%	20.79%	22.40%	19.91%	25.12%	21.88%	20.01%
11:00	29.45%	25.51%	24.65%	26.22%	23.18%	24.05%	25.59%	20.81%	18.47%	20.13%
12:00	32.17%	27.10%	26.48%	28.14%	28.17%	30.17%	25.87%	21.40%	24.37%	24.41%
13:00	30.84%	22.98%	25.96%	27.78%	27.05%	26.85%	30.02%	22.27%	22.00%	18.61%
14:00	36.34%	29.75%	29.21%	31.18%	29.22%	29.17%	27.60%	27.16%	20.67%	22.62%
15:00	31.42%	27.26%	27.25%	27.36%	28.51%	28.87%	26.14%	24.72%	20.23%	21.48%
16:00	30.05%	30.45%	27.75%	31.03%	33.08%	25.85%	28.69%	23.85%	22.82%	21.92%
17:00	33.30%	30.42%	25.90%	25.32%	30.24%	28.49%	27.89%	22.92%	23.09%	23.23%
18:00	28.31%	30.14%	27.13%	25.56%	25.46%	25.77%	25.60%	20.38%	19.59%	18.23%
19:00	27.84%	33.04%	23.58%	23.20%	25.19%	22.18%	26.63%	19.03%	22.83%	23.65%
20:00	25.32%	27.81%	28.30%	22.84%	19.67%	24.83%	22.68%	16.54%	21.36%	18.33%
21:00	29.47%	19.79%	25.02%	25.66%	24.09%	22.16%	25.67%	18.88%	17.59%	17.58%
22:00	24.68%	23.05%	25.06%	23.92%	19.85%	20.77%	19.91%	21.54%	20.70%	15.99%
23:00	24.05%	21.03%	20.68%	18.07%	20.25%	17.83%	15.89%	13.86%	18.42%	12.91%
Overall	**25.63%**	**23.51%**	**23.19%**	**22.92%**	**21.80%**	**21.69%**	**21.48%**	**19.03%**	**18.18%**	**17.69%**
Runs	**4,339**	**3,989**	**4,401**	**3,895**	**3,308**	**3,363**	**3,913**	**3,179**	**2,805**	**2,636**

The following table shows UHU for the four truck companies in 2021. Ladder 1 is as busy at peak periods of the day, hour over hour, as the three less busiest engine companies.

Table 16—Unit-Hour Utilization – Ladder Trucks (2021)

Hour	L01	TK02	L04	L03
00:00	10.13%	8.89%	4.62%	6.37%
01:00	10.21%	8.68%	6.06%	4.05%
02:00	14.21%	8.08%	4.71%	4.27%
03:00	8.12%	8.31%	7.80%	5.02%
04:00	10.18%	8.70%	5.50%	3.02%
05:00	7.56%	8.45%	3.85%	1.71%
06:00	10.40%	7.34%	4.05%	6.50%
07:00	18.67%	15.95%	15.29%	10.60%
08:00	15.87%	13.09%	9.27%	6.58%
09:00	16.05%	15.98%	8.62%	8.23%
10:00	17.92%	13.17%	11.32%	10.44%
11:00	17.62%	15.84%	9.41%	7.84%
12:00	19.11%	21.87%	8.42%	11.07%
13:00	18.65%	18.50%	10.44%	9.66%
14:00	20.95%	22.89%	10.44%	10.51%
15:00	18.35%	19.06%	7.28%	11.26%
16:00	21.02%	18.46%	7.98%	11.20%
17:00	18.15%	20.53%	8.28%	10.93%
18:00	16.03%	14.51%	8.07%	6.65%
19:00	12.57%	12.44%	6.91%	6.47%
20:00	16.48%	15.18%	6.60%	8.16%
21:00	15.66%	11.37%	9.84%	4.19%
22:00	16.72%	13.95%	9.48%	3.95%
23:00	9.59%	8.24%	6.27%	4.90%
Overall	**15.01%**	**13.73%**	**7.94%**	**7.23%**
Runs	**2,761**	**2,384**	**1,164**	**1,182**

The following table illustrates a UHU summary for the City's ambulance units in service in 2021. While none are at/over 30 percent UHU for extended periods, the top three units were very busy in the high 20th percentiles from 7 am to 8 pm.

Table 17—Unit-Hour Utilization – EMS Units (2021)

Hour	M02	M05	M04	M01	M03	M06
00:00	17.56%	19.92%	10.69%	8.79%	8.16%	0.00%
01:00	17.07%	16.59%	10.70%	9.04%	7.22%	0.00%
02:00	13.47%	15.12%	12.93%	8.30%	5.73%	0.02%
03:00	9.72%	12.58%	10.29%	6.02%	5.45%	0.00%
04:00	14.65%	12.38%	11.91%	5.80%	5.59%	0.44%
05:00	13.54%	11.48%	6.74%	7.59%	5.06%	0.01%
06:00	11.11%	14.58%	12.22%	9.07%	8.53%	1.02%
07:00	27.53%	34.78%	26.07%	18.13%	16.67%	14.42%
08:00	27.59%	24.02%	26.93%	21.57%	15.99%	2.70%
09:00	30.10%	29.12%	30.43%	19.49%	14.12%	13.37%
10:00	26.30%	25.09%	26.34%	24.73%	13.16%	8.02%
11:00	25.59%	27.13%	26.26%	18.80%	11.91%	3.65%
12:00	29.19%	27.16%	24.83%	23.19%	14.62%	1.18%
13:00	26.11%	29.37%	25.92%	21.95%	15.07%	4.40%
14:00	32.68%	26.59%	29.18%	21.63%	12.28%	4.69%
15:00	27.03%	24.66%	27.87%	17.81%	12.13%	2.79%
16:00	29.42%	27.16%	24.22%	19.54%	13.11%	3.04%
17:00	27.22%	25.04%	18.21%	20.45%	11.27%	11.30%
18:00	26.98%	24.68%	22.87%	16.47%	10.78%	3.80%
19:00	25.98%	22.30%	15.41%	24.10%	12.88%	0.00%
20:00	20.20%	19.55%	20.43%	22.19%	11.68%	0.00%
21:00	25.90%	25.50%	20.67%	14.92%	11.38%	0.00%
22:00	20.43%	16.25%	17.30%	12.09%	10.95%	0.03%
23:00	17.44%	15.41%	14.93%	11.76%	6.81%	0.05%
Overall	**22.62%**	**21.93%**	**19.72%**	**15.98%**	**10.86%**	**3.12%**
Runs	**3,055**	**2,762**	**2,713**	**1,971**	**1,293**	**79**

Finding #11: Engines 10, 2, 1, 11, 15, 7, 8 were near or above Citygate's recommended 30 percent utilization for long consecutive hours during peak daytime demand periods; ambulances were also approaching maximum utilization during the same period.

2.7.5 Operational Performance

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

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

Call Processing / Dispatch

Call processing measures the time from the first incident timestamp until completion of the dispatch notification. Call processing performance depends on what is being measured. If the first incident timestamp takes place at the time the public-safety answering point (PSAP) physically answers a 9-1-1 call (typically police departments). The City operates a Fire Communications (dispatch) center. In the following time measurements, the call received time is measured when the Fire Communications center receives the 9-1-1 call from Tacoma Police. In the data tables to follow, the time measures are only for incidents recorded as fire and EMS emergencies, not the category of "other" incidents.

In addition, not all requests for assistance are received via landline 9-1-1. Generally, there are numerous ways that requests for assistance are received, including landline telephone, cellular telephone, SMS text message, fire, or police officer-initiated requests, TTY/TDD operator, etc., that each have a separate timestamp at a different point in the processing operation. This is not as much of a factor if most requests are received via 9-1-1 PSAP.

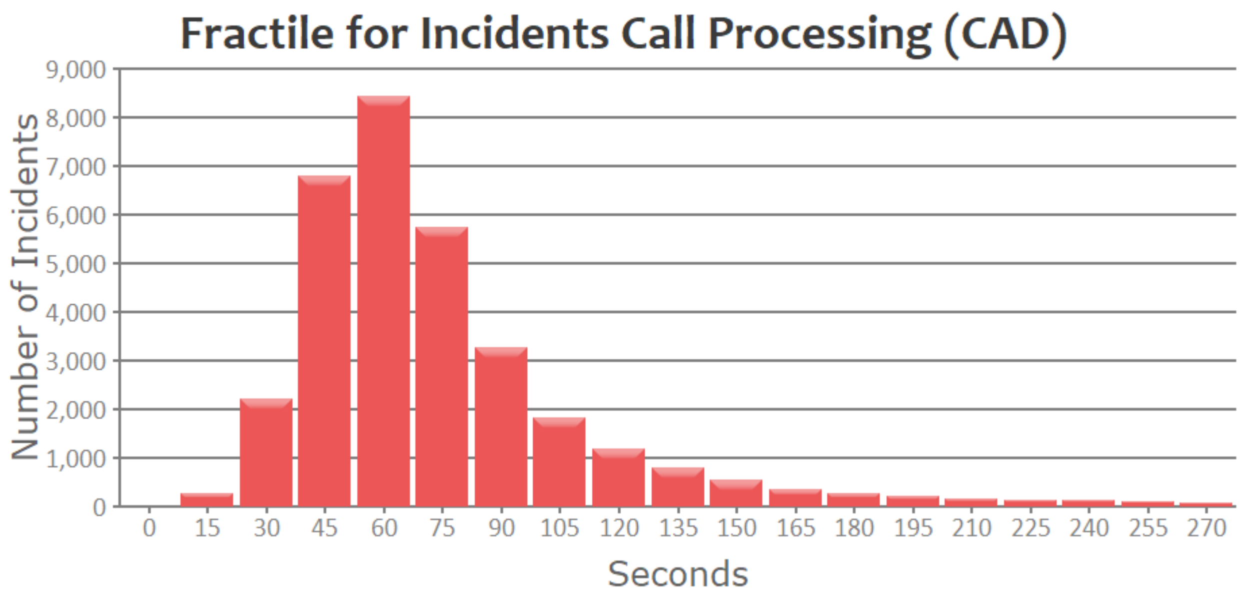
The following table shows call processing / dispatch performance from time of call receipt at the Fire Department. This performance *nearly meets* Citygate's recommended 1:30-minute best practice goal, but not the more aggressive NFPA Standard 1710 recommendation of 65 seconds. Also noteworthy is the consistency of performance across all four reporting years. Stated this way, COVID-19 lengthened dispatch processing time by approximately 31 seconds.

Table 18—90th Percentile Call Processing / Dispatch Performance

Station	Overall	2018	2019	2020	2021
Department-Wide	01:40	01:26	01:26	01:48	01:57

In the following figure, call processing for the highest number of calls for assistance peaks at 60 seconds. This is consistent with a system providing accurate times and ensuring that most calls are answered within 90 seconds.

Figure 14—Fractile Call Processing Performance (2021)



Finding #12:	The City's call processing / dispatch performance *nearly meets* Citygate's recommended best practice goal of 1:30 minutes to fire and EMS emergencies at 90 percent or better reliability.

Crew Turnout

Crew turnout performance measures the time interval from completion of the dispatch notification until the start of apparatus travel to the incident. While the most recent NFPA recommendation for crew turnout performance is 1:00 minute at 90 percent reliability for EMS incidents and 1:20 minutes at 90 percent reliability for fire incidents, Citygate has found over hundreds of fire department studies that few, if any, departments are able to achieve this level of performance when measured across a 24-hour shift.[10] Thus, for many years, Citygate has recommended a 2:00-minute best practice goal for crew turnout at 90 percent or better reliability.

The following table summarizes the City's crew turnout performance over the four reporting years of data, which very nearly meets Citygate's recommendation of 2:00 minutes. Continued focus on this important measure will be needed to reach and maintain a performance of two minutes or less averaged across a 24-hour day.

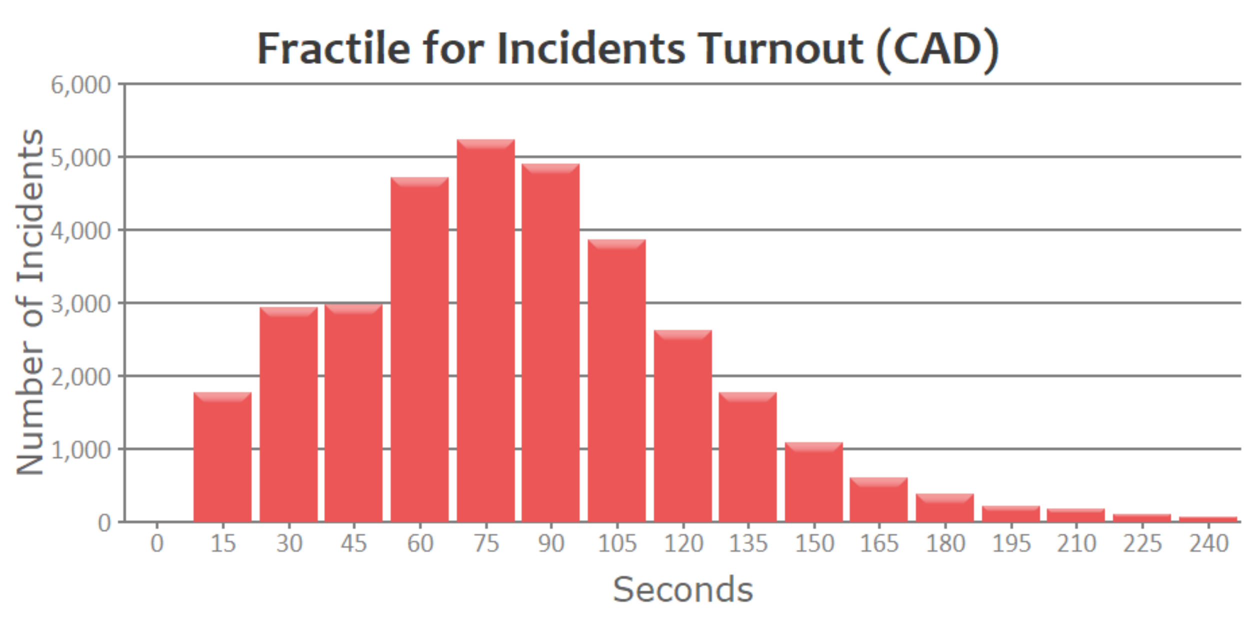
[10] NFPA 1710 – Organization and Deployment of Fire Suppression Operations, Emergency Medical Operations, and Special Operations to the Public by Career Fire Departments (2020 Edition).

Table 19—90th Percentile Crew Turnout Performance

Station	Overall	2018	2019	2020	2021
Department-Wide	02:05	02:06	01:57	02:04	02:10

The following figure illustrates fractile turnout time performance. The 75-second segment reflects the highest number of incidents, and few turnout times are greater than 2:00 minutes.

Figure 15—Fractile Crew Turnout Performance (2021)



Finding #13: At 2:05 minutes, turnout time is slightly over Citygate's recommended performance goal of 2:00-minutes at 90 percent or better reliability.

Fire Station Distribution: First-Unit Travel

Travel performance measures the interval from start of first-due apparatus movement to arrival at the emergency incident. For most urban jurisdictions, a 4:00-minute first-due unit travel time 90 percent of the time would be considered for best practice for positive outcomes.

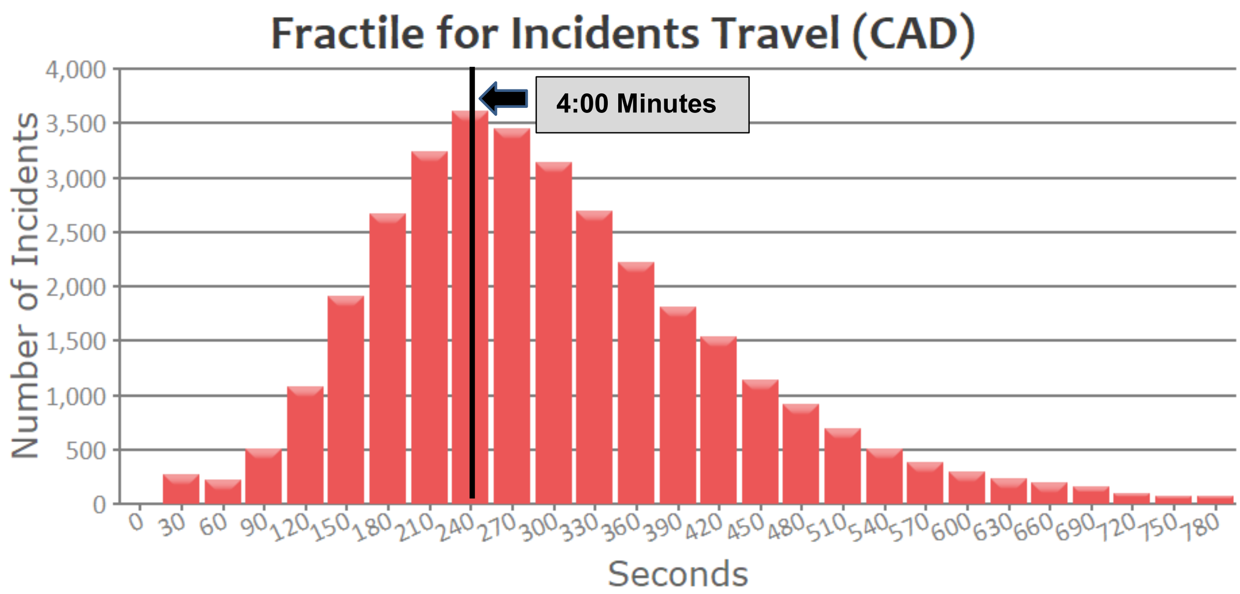
As the following table illustrates, the Department's 90th percentile first-due unit travel time performance in 2021 was 7:45 minutes, which is *3:45 minutes slower* than a best practice outcome goal of 4:00 minutes. In addition, seven stations have overall travel times *greater than 8:00 minutes*.

Table 20—90th Percentile First-Unit Travel Time Performance

Station	Overall	2018	2019	2020	2021
Department-Wide	**07:16**	**07:01**	**07:05**	**07:09**	**07:45**
Station 1	05:58	05:41	05:37	05:26	06:53
Station 2	07:02	06:48	06:40	06:52	07:28
Station 3	08:11	07:58	07:56	08:20	08:35
Station 4	06:36	06:10	06:28	06:41	07:11
Station 5	09:00	08:17	08:37	09:03	10:19
Station 6	07:54	04:56	09:17	07:54	07:06
Station 7	07:03	06:57	06:51	06:58	07:17
Station 8	07:20	06:53	07:05	07:17	08:03
Station 9	06:57	06:47	06:25	06:43	07:50
Station 10	07:30	07:27	07:14	07:18	08:00
Station 11	06:54	06:38	06:54	06:54	07:08
Station 12	07:51	07:47	07:51	07:28	08:08
Station 13	08:19	08:23	08:07	07:55	08:46
Station 14	07:36	07:40	07:34	07:32	07:39
Station 15	06:37	06:19	06:28	06:16	07:03
Station 16	07:14	06:43	07:02	07:14	07:51
Station 17	07:51	07:37	07:37	07:38	08:12

The following figure illustrates fractile travel time performance where 240 seconds (4:00 minutes) is the peak segment for travel time performance. The graph is right shifted, with fewer travel times less than 4:00 minutes and more travel times greater than 4:00 minutes.

Figure 16—Fractile First-Due Travel Performance (2021)



Finding #14:	At 7:45 minutes, the 90th percentile travel time in 2021 is *significantly slower* than the 4:00-minute best practices outcomes goal for urban areas.

Fire Station Distribution: Call to First-Unit Arrival

Call to first-unit arrival performance measures the time interval from receipt of the 9-1-1 call at the Tacoma Fire Communications center until first-unit arrival at the emergency incident. This measure is a fire agency's primary customer service metric. For most urban population areas, Citygate typically recommends a 7:30-minute first-unit call-to-arrival goal at 90 percent compliance.[11] As the following table shows, the Department's overall 90th percentile call-to-arrival performance is weak across all station areas over all four years of data analyzed.

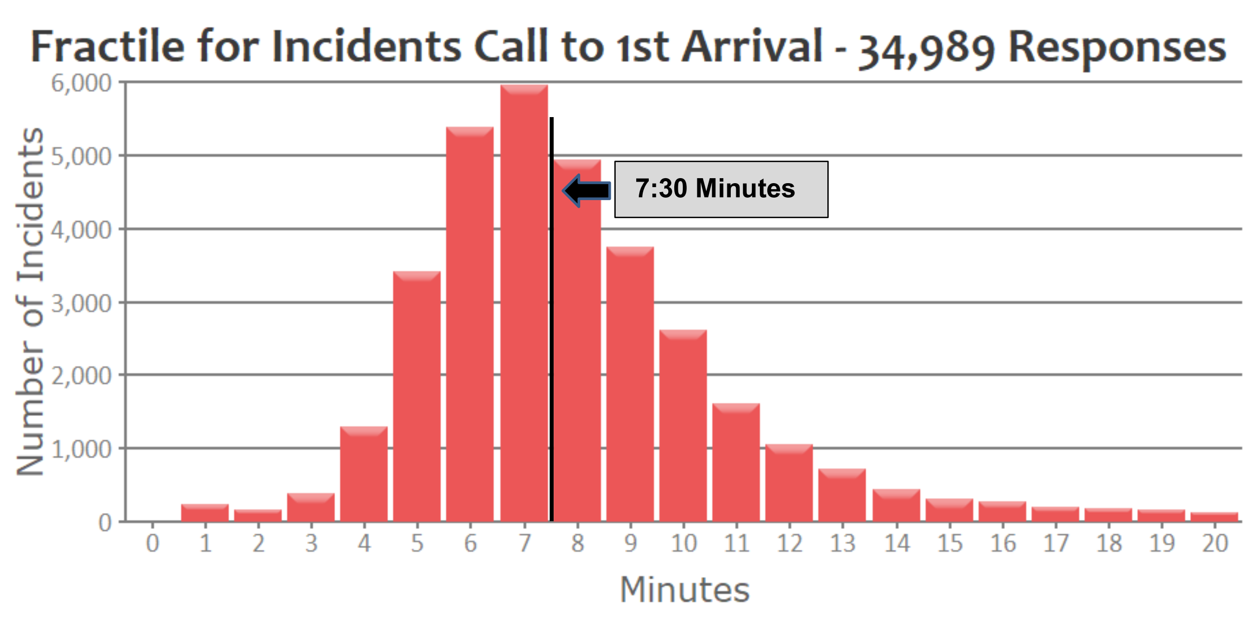
[11] The 7:30-minute call to first-unit arrival goal in urban areas includes 1:30 minutes for call processing / dispatch time, 2:00 minutes for crew turnout time, and 4:00 minutes for travel time.

Table 21—90th Percentile First-Unit Call-to-Arrival Performance

Station	Overall	2018	2019	2020	2021
Department-Wide	**10:07**	**09:38**	**09:25**	**10:08**	**11:08**
Station 1	08:52	08:31	07:51	08:21	10:28
Station 2	10:09	09:24	09:02	10:09	11:29
Station 3	10:48	10:28	09:55	10:59	11:32
Station 4	09:28	08:41	08:48	09:46	10:44
Station 5	12:01	11:23	11:02	12:28	13:48
Station 6	10:33	07:36	11:34	08:12	10:24
Station 7	09:39	09:28	09:09	09:31	10:21
Station 8	10:13	09:25	09:24	10:21	11:40
Station 9	09:38	09:17	08:40	09:33	10:55
Station 10	10:17	09:57	09:34	10:23	11:08
Station 11	09:39	09:16	09:12	09:49	10:19
Station 12	11:03	10:34	10:25	11:00	11:57
Station 13	11:07	10:51	10:20	10:43	11:59
Station 14	10:24	10:04	10:03	10:30	10:47
Station 15	09:27	08:55	08:40	09:24	10:07
Station 16	10:01	09:14	09:28	10:03	10:57
Station 17	10:53	10:27	10:13	10:43	11:47

The following figure illustrates fractile call-to-arrival performance. While 7:00 minutes is the peak segment for call to arrival performance, there is a slight right-shifting which illustrates that many incidents take longer.

Figure 17—Fractile Call to First-Unit Arrival Performance (2021)



Finding #15:	At 11:08 minutes in 2021, 90th percentile first-unit call-to-arrival performance is 3:38 minutes *slower* than a Citygate-recommended best practice goal of 7:30 minutes for urban areas.

Fire Station Concentration: ERF (First Alarm) Call to Arrival

The Department's ERF for building fires includes four engines, one ladder truck, one ambulance, and one Battalion Chief for a total of 18 personnel. Commercial building fires add a second ladder and ambulance unit. In the next table, over the four reporting years studied, there were 125 incidents for which the more rigorous ERF arrived with a 90th percentile call-to-arrival performance of 16:25 minutes, which is 4:55 minutes *slower* than Citygate's recommended 11:30-minute goal for urban areas.

Most of this slower response is due to the longer travel times when several units must cross most of the City to reach an incident. In all fire departments there are fewer ladder trucks and Battalion Chief units to "stop the clock" at 8:00-minutes travel for the full ERF force. In the City, if the ladder and Battalion Chief travel times are removed, and only four engine arrival is measured in the City core (not including the Port and eastern areas), then the 90 percent arrival time for four engines in 2021 was 10:49 minutes—which is still just under 3:00 minutes longer than a goal of 8:00 minutes. However, prior to this point, at least three engines (and perhaps the ladder truck) have arrived. The City's fire stations service areas that are somewhat too large when spread across a challenging topography.

Table 22—90th Percentile ERF Call-to-Arrival Performance

Station	Overall	2018	2019	2020	2021
Department-Wide	16:25	17:55	14:26	17:45	14:51

Finding #16: At 16:25 minutes across the four years of data, 90th percentile ERF (First Alarm) call-to-arrival performance is *4:55 minutes slower* than a best practice outcomes goal of 11:30-minute for urban areas.

Response Performance Summary

The following table summarizes the Department's operational response performance relative to recognized best practices. As the table illustrates, response performance for the most recent data year of 2021 was *slower* than Citygate's and NFPA best practice recommendations to ensure positive outcomes for serious emergencies.

Table 23—Response Performance Summary (2021)

Response Component	Best Practice		90th Percentile Performance (2021)	Performance Versus Best Practice and Current Goal
	Time	Reference		
Call Processing / Dispatch	1:30	Citygate	**1:57**	**+ 0:27**
Crew Turnout	2:00	Citygate	**2:10**	**+ 0:10**
First-Unit Travel	4:00	NFPA & Tacoma	**7:45**	**+ 3:45**
First-Unit Call to Arrival	7:30	Citygate	**11:08**	**+ 3:38**
ERF Call to Arrival	11:30	Tacoma & Citygate	**14:51**	**+ 3:21**

2.8 Special Challenges to Deployment – Traffic Congestion and Street Designs

This study has noted how first-unit travel times to emergency incidents are 3:45 minutes slower than recommended best practice travel times to serious events. This slowness is consistent across the City and by fire station district. Even in 2020, with many shutdowns related to the onset of the COVID-19 pandemic, travel time remained sluggish.

The GIS data measured only a relatively small 19 percent reduction in first-due road mile coverage during traffic congestion periods. In Citygate's experience, cities see peak-hour impacts which decrease the road miles covered by approximately 15–25 percent.

Citygate takes note of the City's street designs, the hills, street parking, buildings at corners and trees affecting sight lines—plus the volume of traffic during most hours of the day, apart from very late evening to pre-morning rush hour. All of these factors combine to negatively impact travel times for emergency vehicles in general. Traffic congestion specifically plays only one part in delaying first-due units; however, traffic congestion also negatively impacts multiple-unit ERF travel times by 13 percent. Even where traffic signal preemption controls are used, there could be nowhere cars and trucks can move to make space for emergency vehicles.

To protect pedestrians and automobile passengers, the City has long used various traffic-calming measures on some streets to slow or stop "cut-through" traffic. Throughout the country, and over the last 20 or more years, traffic engineers have deployed approximately 20 street design elements to slow traffic. Examples include speed humps, lumps, split lumps, intersection bulb-outs, traffic circles, and raised intersections. Most communities have a formal process to consider these tools during development or upon neighborhood request. The more common devices that slow traffic—such as lumps or traffic circles—slow a fire unit by 9–10 seconds *per device encountered.* Thus, if a unit had to encounter and navigate three devices en route to an incident, 27–30 seconds would be lost across the total response time.

Fire departments are typically involved in the approval process for traffic-calming elements to understand the impacts to response time. One strategy to lessen impacts on fire and ambulance response times is to have the department identify "priority response routes" that are the prime arterials and/or main boulevards leaving a fire station, and which allow units to quickly travel across half of a fire station district to the actual residential streets in need of service. Priority response routes would employ few, if any, traffic-calming methods.

There is a constructive tension between preserving public safety travel times and pedestrian and automobile safety. What could worsen the current, congested City response times as measured in this study would be if urban planning adds more street design restrictions to lower traffic volumes, decrease vehicle speeds, and encourage "walkable communities." Additionally, there are likely upcoming increases in development density for mid-rise residential dwelling buildings and ADU units on single-family lots. Even with some limits as to the parking of cars and the use of ride share services, future growth could *increase* street traffic even more. Further, "vertical" high-rise populations mean the time to emergency response is even longer. After a unit reaches an address, it must then ride up several stories to where the patient or fire is.

All of these factors indicate that traditional measures to mitigate the impacts of traffic congestion and safe streets calming on fire/EMS travel times will not materially lower response times to that of a decade ago and will probably barely mitigate the impacts of new growth in traffic. However, it is not Citygate's suggestion that the Department should give up. The Department must be more involved in traffic design approvals, setting forth priority response routes and requesting funding for technological control of traffic signals—e.g., the use of "smart corridor" controls to sync several traffic signals at once along a fire unit route.

The City is facing three choices regarding emergency unit response times:

1. Do nothing and accept sluggish response times that are likely to continue to degrade with infill development and ongoing traffic calming measures and/or streets restricted to bicycles and pedestrians.
2. Implement Department improvements and strictly limit traffic calming on primary and secondary arterials to significantly improve response times.
3. If the changes in #2 do not improve response times, add infill fire/ambulance stations between existing sites to lower travel distances.

Option 3 is essentially the way downtown urban cores such as Manhattan, Chicago, and Los Angeles must provide coverage. In these agencies, fire/EMS stations are almost in sight of each other due to traffic congestion and high-rise building populations.

Finding #18: City Planning, Traffic Engineering, and the Department must have an effective set of integrated policies and traffic-calming methods to partially mitigate the impacts of walkable street designs on fire and ambulance response times.

2.9 PLANNED AMBULANCE SYSTEM IMPROVEMENTS AND ALTERNATIVE CARE RESPONSE

The Department's ambulance program has grown in service type during the COVID-19 years to best meet the City's EMS demands. As of January 2023, the number of Paramedic-level ALS ambulances remains at five, and three full-time BLS ambulances—and three peak-hour BLS ambulances—are in service to transport non-acute patients.

These positive steps will likely keep up with the current demand *for ambulances and transports.* However, as the workload per hour on the engines is borderline excessive and not slowing down, the rate of increase in non-acute EMS demand cannot continue to be staffed by engine crews which are then not available for fires and rescue events.

Currently, the Department responds to approximately 2,500 incidents annually involving individuals experiencing mental health crisis. The Tacoma Police Department (TPD) responds to approximately 9,800 incidents annually that fit this category. While some of these incidents include a response from both TFD and TPD, there are many where only one of the two departments responds. Neither of these emergency response resources have the training or skillset to provide the type or level of psychological support that is required to effectively manage those in mental health crisis. As a proposed alternative, mental and/or behavioral health professionals could be utilized to provide a more appropriate and effective response that would likely result in better immediate and long-term outcomes.

In response to this high demand for non-EMS human care and mental health needs, the Department launched the CARES program under RCW section 35.21.930. Then, in 2022, studies were performed related to expanding alternative care services. The research resulted in a determination that the Tacoma Fire Department (TFD) Community Assistance, Referral, and Education Services (CARES) program would start piloting a mobile behavioral health crisis response. TFD CARES has been licensed as a behavioral health agency with Washington State, allowing the program to independently develop and provide services responsive to those in crisis.

TFD will stand up a pilot Behavioral Health Response Unit by October 2023 that is staffed by two personnel: a registered nurse and a behavioral health provider. The Behavioral Health Response Unit would respond to patients in mental health crisis alone when the circumstances of the individual in crisis indicate that it would be safe to do so, or along with police and/or EMS personnel when safety is a concern. When an assessment for possible involuntary commitment is required, the Behavioral Health Response Unit staff can request assistance from a Designated Crisis Responder (DCR), who will remain housed within TPD.

Finding #19: The City's planned expansion of ambulance service is consistent with best practices and will provide needed improvement.

Finding #20: The City's pilot program to expand the Department's CARES program to mental health crisis incidents is reflective of current best practices and deserves full support and expansion as caseloads require.

2.10 Overall Deployment Evaluation

SOC Element 8 of 8
Overall Evaluation

The Department serves a diverse urban population with a mixed residential and non-residential land-use pattern around part of the Puget Sound South Basin. While most of the housing and business neighborhoods are typical of this part of the greater Seattle area, Tacoma's setting of being wrapped around a harbor (in addition to hilly terrain in some areas) makes the efficient placement of fire station locations difficult. The

Department also protects tourism and other non-resident population densities, and the City also is still evolving and planning to add more residential and commercial buildings.

The intensification of land uses and population growth and density could make several sections of Tacoma very urban to a degree typical of the population densities and traffic seen in the largest metropolitan cities. This will require the City's Fire and Ambulance programs to evolve beyond those of a "suburban" agency to those of a major urban fire department in staffing, unit types, and facility locations. Citygate acknowledges that it will not only be costly, but also difficult to find new locations for infill stations in an essentially built-up City.

While the state fire code allows local agencies to require fire sprinklers in smaller residential dwellings, it will be many more decades before enough residential units are replaced or remodeled with automatic fire sprinklers. If desired outcomes include limiting building fire damage to only part of the inside of an affected building and minimizing permanent impairment resulting from a medical emergency, then the City will need coverage in all neighborhoods that is consistent with Citygate's response performance recommendations for Tacoma. Based on Citygate's study, this response performance recommendation entails *no more than* 8:30 minutes for the arrival of a single first responder, and 11:30 minutes for a multiple-unit arrival to more serious incidents, from the time of 9-1-1 call receipt at the Tacoma Fire Communications center—all at 90 percent or better reliability.

Dispatch, turnout, and travel times all need to be reduced to varying degrees. Dispatch time must decrease by 0:27 seconds to meet a 1:30-minutes call-processing goal and turnout time by 0:10 seconds to meet a 2:00-minute goal. Travel time is a much more significant problem. While 4:00 minutes represents a national best practice travel time in *urban* areas, no station area in the City met this goal to 90 percent of the emergent fire and EMS incidents in 2021. Further, no station area met a 5:00-minute goal. In the aggregate for 90 percent travel time by minute:

- Three station districts were in the sixth travel minute (stations 1, 4, and 15).
- 10 more station districts were in the seventh travel minute (stations 2, 7, 8, 9, 10, 11, 12, 14, 16, and 17).
- Three station districts were in the eighth travel minute (stations 3, 6, and 13).
- One station district was at exactly the ninth minute (Station 5).

While there are several factors contributing to long travel times (as discussed in this study), Citygate believes the very high EMS call volume during daylight hours is causing engines to be on or getting back from incidents far too often, leading to a cascading failure where the engine just clearing an incident, or other engines, must then respond from farther away. Most of these engine responses are to low-acuity and moderate-acuity EMS incidents.

Stated this way, Citygate finds that "Tacoma must get its fire department back" to offer adequate availability for serious, life-threatening fires and EMS events and to quickly field enough firefighters to serious building fires and other emergencies. The emerging programs intended to manage low-acuity EMS and mental health incidents must be expanded to remove that workload from (very expensive) fire engines and firefighters.

Based on our findings, Citygate's recommended first-unit total response time goal would use for physical station spacing a **5:00**-minute travel time, resulting in a first-due unit call-to-arrival time of **8:30** minutes (1:30 + 2:00 + 5:00). The ERF (First Alarm) goal of 8:00 minutes' travel time would remain for an ERF call-to-arrival goal of 11:30 minutes.

Accomplishing a 5:00-minute travel time goal for first responders entails multiple changes over the next three years to first improve and then maintain response times as growth occurs:

1. Measure the effectiveness of the newly expanded ambulance program to determine if Basic Life Support (BLS) ambulance transports keep more paramedic ambulances in their districts, available for the next call.
2. Change dispatch EMS triage systems to allow for greater low-acuity patient identification and then only send a BLS ambulance unless rescue is also needed.
3. Shift responsibility for non-acute EMS calls from the 9-1-1 Fire/Ambulance program to a Mobile Integrated Health / Mental Care program.
4. Engineer traffic systems to give priority access to first responders in addition to providing pedestrian safety.

If these four strategies do not improve acute emergency response times *and lower the unit-hour utilization (UHU) workload for engines to no more than 30 percent hour after hour,* the City should construct infill response units at existing stations or add fire or ambulance-only stations between the busiest station areas. These same areas are also where much of the proposed infill development growth will occur. Citygate acknowledges it will be difficult to find new locations for responders as current Fire Stations 1, 2, 8, 10 and 11—that will most likely need added units—cannot accommodate more crews without extensive remodeling or enlargement/replacement nearby.

Currently, the Department's service capacity for fire and non-fire risk consists of 83 personnel on duty daily. However, engines are very busy providing EMS response and, at present, the firefighters staffing ambulances are not consistently available for firefighting. As both existing buildings age and new buildings are developed, serious structure fires will require a quick weight of response from apparatus and staff in dire emergencies where ladder truck units must conduct search and rescue or ventilation of hot combustion gas so the engine crew can effectively apply water on the fire.

Over several fiscal years, the City and Department should add a fourth crew member to the four ladder trucks, consistent with NFPA Standard 1710 and Citygate's best practices for high-density urban core areas. Adding four crew members per day on a four-platoon duty schedule requires a total of 16 firefighters to be newly funded (plus the overtime to cover their leave absences).

2.10.1 Overall Deployment Recommendations

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

Recommendation #1:	Operate and measure the effects of the enhanced ambulance system.
Recommendation #2:	The Department needs to upgrade its dispatch training and software to allow for clinical call triage to send BLS ambulances or alternative care units to low-acuity EMS requests.
Recommendation #3:	Design and focus on new strategies to provide for traffic calming and pedestrian safety while not significantly worsening emergency response times or community evacuation times.
Recommendation #4:	Increase the staffing on the four aerial ladder trucks from three to four personnel per day.
Recommendation #5:	Support the Department's CARES program pilot project for mental health crisis incidents and expand the program as caseloads justify.
Recommendation #6:	If ambulance and dispatch improvements do not improve acute emergency response times and lower the UHU workload for engines to no more than 30 percent for long, contiguous hours of the day, the City should add more response units to existing stations or construct infill fire or ambulance-only stations between the station groupings which are currently the busiest.

Recommendation #7: Given the space limitations of the stations that will most need increased response capacity from the near term to 2040, the City should undertake a fire station master facility remodel or replacement plan study to identify its long-term capital facility costs, funding options, and timing.

Recommendation #8: Adopt updated deployment policies. City Council should consider adopting complete performance measures that begin with a 9-1-1 call being answered and end with the Department and/or an ambulance arriving at the emergency incident. The measures of time should be designed to save patients and keep small but serious fires from becoming more complex or damaging. With this in mind, Citygate recommends the following outcome-based measures for the major emergency types:

8.1 **Geographic Distribution of Fire Stations:** To treat medical patients and control small fires, the first-due unit should arrive within 8:30 minutes, 90 percent of the time, from receipt of the 9-1-1 call in the fire dispatch center. This equates to a 90-second dispatch time, a 2:00-minute company turnout time, and a 5:00-minute travel time.

8.2 **Multiple-Unit Effective Response Force for Serious Emergencies:** To confine fires near the room of origin and treat up to five medical patients at once, a multiple-unit response of a minimum of four engines, one ladder truck, one ambulance, and one Battalion Chief—totaling a minimum of 19 personnel—should arrive within 11:30 minutes from the time of 9-1-1 call receipt in fire dispatch, 90 percent of the time. This equates to a 90-second dispatch time, a 2:00-minute company turnout time, and an 8:00-minute travel time.

8.3 **Hazardous Materials Response:** The Department needs to maintain its hazardous materials response as designed to protect the community from hazards associated with uncontrolled release of hazardous and toxic materials. The first-due unit should arrive to investigate a hazmat release at the operations level within 8:30 minutes, 90 percent of the time. This equates to a 90-second dispatch time, a 2:00-minute company turnout time, and a 5:00-minute travel time in urban population areas. After assessment and scene evaluation is completed, a determination can be made whether to request additional resources.

8.4 **Technical Rescue:** To respond to technical rescue emergencies as efficiently and effectively as possible with enough trained personnel to facilitate a successful rescue, the first-due company to arrive for assessment of the rescue should achieve a 5:00-minute travel time in urban to suburban areas, 90 percent of the time. Additional resources capable of initiating a rescue should be assembled within a total response time of 11:30 minutes, 90 percent of the time, with the result being a safe and complete rescue/extrication to ensure delivery of patients to a definitive care facility.

APPENDIX A—RISK ASSESSMENT

A.1 COMMUNITY RISK ASSESSMENT

SOC ELEMENT 3 OF 8
COMMUNITY RISK ASSESSMENT

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

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

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

A.1.1 Risk Assessment Methodology

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

- Identification of geographic planning sub-zones (risk zones) appropriate to the community or jurisdiction.
- Identification and quantification, to the extent data is available, of the specific values at risk to various hazards within the community or service area.
- Identification of the fire and non-fire hazards to be evaluated.
- Determination of the probability of occurrence for each hazard.
- Evaluation of *probable* impact severity for each hazard by planning zone using agency- and jurisdiction-specific data and information.
- Determination of overall risk by hazard using the following template.

Table 24—Overall Risk Template

Probability of Occurrence	Probable Impact Severity				
	Insignificant	Minor	Moderate	Major	Catastrophic
Rare	*Low*	*Low*	*Low*	*Moderate*	*High*
Unlikely	*Low*	*Low*	*Low*	*Moderate*	*High*
Possible	*Low*	*Low*	*Moderate*	*High*	*Extreme*
Probable	*Low*	*Low*	*Moderate*	*High*	*Extreme*
Frequent	*Low*	*Moderate*	*High*	*Extreme*	*Extreme*

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

- State of Washington, Esri, and U.S. Census Bureau population and demographic data
- City and County geographical information systems (GIS) data
- City Comprehensive Plan and zoning information
- Pierce County Region 5 All Hazard Mitigation Plan
- City of Tacoma All-Hazards Risk Assessment
- City Comprehensive Emergency Management Plan
- Tacoma Fire Department data and information

A.1.2 Risk Assessment Summary

Citygate's evaluation of the values at risk and hazards likely to impact the City of Tacoma service area yields the following:

1. The Fire Department serves a diverse urban/suburban population, with densities ranging from less than 1,000 to more than 10,000 people per square mile over a varied land-use pattern.
2. The City's population is projected to increase significantly over the next 18 years to 2040.
3. The service area includes a large inventory of residential and non-residential buildings to protect, as identified in this assessment.

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

5. The City has a mass emergency notification system to effectively communicate emergency notifications and information to the public in a timely manner.

6. The City's overall risk for six hazards related to emergency services provided by the Fire Department range from **Low** to **High**, as summarized in the following table.

Table 25—Overall Risk by Hazard

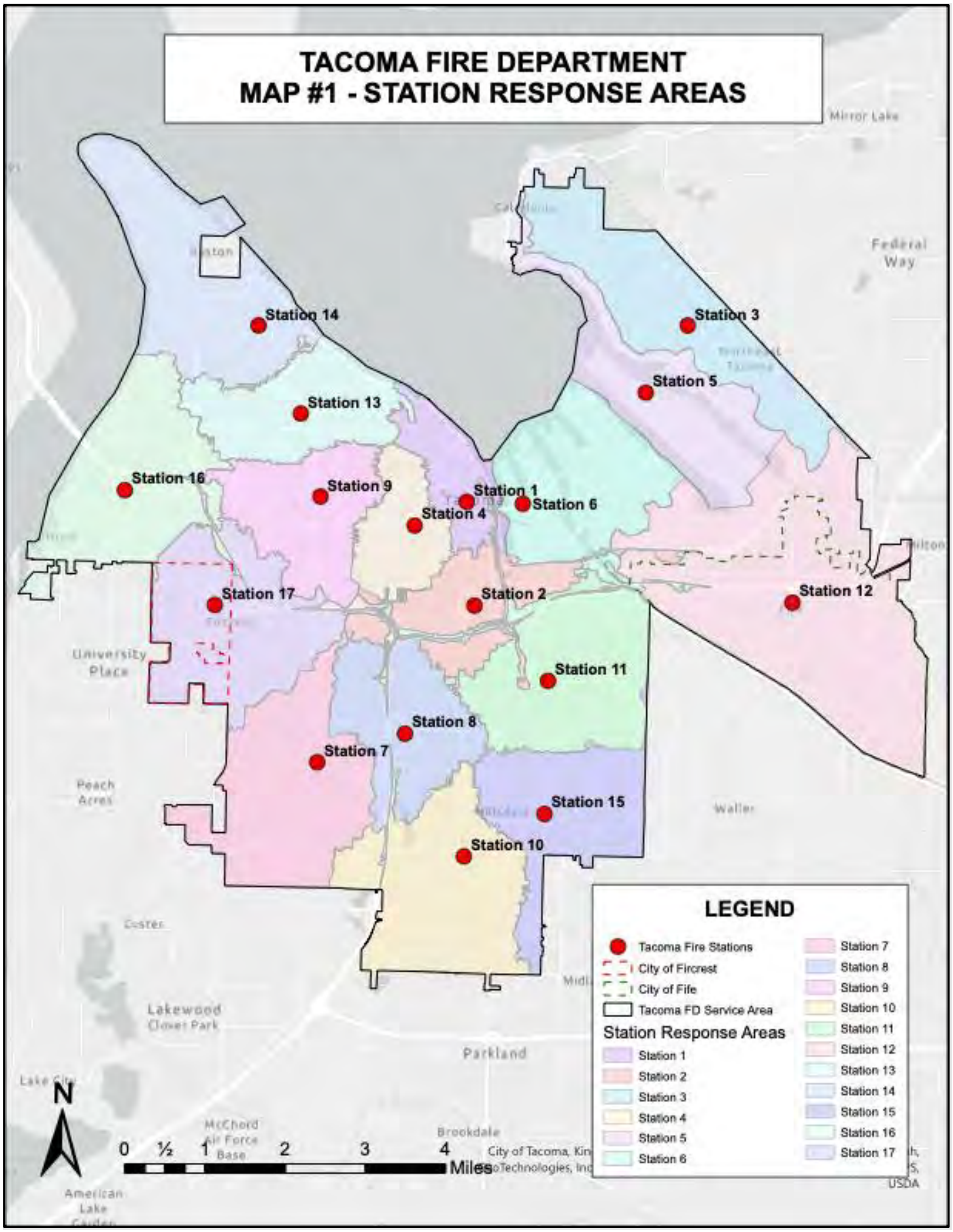
Hazard	Risk Planning Zone								
	Sta. 1	Sta. 2	Sta. 3	Sta. 4	Sta. 5	Sta. 6	Sta. 7	Sta. 8	Sta. 9
Building Fire	Moderate	Moderate	Moderate	Moderate	Moderate	Moderate	Moderate	Moderate	Moderate
Vegetation/Wildland Fire	Low	Low	Moderate	Low	Moderate	Low	Moderate	Moderate	Moderate
Medical Emergency	High	High	High	High	High	Moderate	High	High	High
Hazardous Material	High	Moderate	Low	Low	High	Moderate	Moderate	Moderate	Low
Technical Rescue	Moderate	Moderate	Moderate	Moderate	Moderate	Moderate	Moderate	Moderate	Moderate
Marine Incident	Moderate	Moderate	Low	Low	Low	Low	Low	Low	Low

Hazard	Risk Planning Zone (Cont.)							
	Sta. 10	Sta. 11	Sta. 12	Sta. 13	Sta. 14	Sta. 15	Sta. 16	Sta. 17
Building Fire	Moderate	Moderate	Moderate	Moderate	Moderate	Moderate	Moderate	Moderate
Vegetation/Wildland Fire	Moderate	Moderate	Moderate	Low	Moderate	Moderate	Moderate	Moderate
Medical Emergency	High	High	High	High	High	High	High	High
Hazardous Material	Moderate	Moderate	High	Moderate	Moderate	Low	Moderate	Moderate
Technical Rescue	Moderate	Moderate	Moderate	Moderate	Moderate	Moderate	Moderate	Moderate
Marine Incident	Low	Low	Low	Low	Moderate	Low	Moderate	Low

A.1.3 Risk Planning Zones

The Commission on Fire Accreditation International (CFAI) recommends 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 may 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, high- or maximum-risk occupancies are a larger percentage of the risk in a smaller planning zone, then they become 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 appropriately evaluate service demand and response performance relative to each zone. For this assessment, Citygate utilized 17 planning zones corresponding with the Department's current first-due response areas, as shown in the following map.

Figure 18—Risk Planning Zones



A.1.4 Values at Risk to Be Protected

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

People

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

Table 26—Key Demographic Data – Tacoma

Demographic	2022
Population	**222,535**
Under 10 years	12.20%
10 – 14 years	5.90%
15 – 64 years	66.30%
65 – 74 years	9.20%
75 years and older	6.60%
Median age	37.2
Daytime population	252,598
Housing Units	**93,466**
Owner-Occupied	50.50%
Renter-Occupied	44.10%
Vacant	5.50%
Average Household Size	2.43
Median Home Value	$382,490
Race/Ethnicity	
White	56.90%
Black / African American	10.40%
Asian	9.30%
Other/Two or More Races	23.40%
Hispanic/Latino Origin	13.30%
Diversity Index	71.9
Education (population over 24 yrs. of age)	**153,249**
High School Graduate	90.70%
Undergraduate Degree	32.70%
Graduate/Professional Degree	12.20%
Employment (population over 15 years of age)	**109,877**
In Labor Force	96.10%
Unemployed	3.90%
Median Household Income	$75,796
Population Below Poverty Level	13.80%
Population without Health Insurance Coverage	7.50%

Source: Esri Community Analyst (2022 Tacoma) and U.S. Census Bureau

Of note from the table is the following:

- 28 percent of the population is under 10 years or 65 years of age and older.

- The City's daytime population is 14 percent greater than its resident population.
- The City's population is predominantly White (57 percent), followed by Other (23 percent), Black / African American (10 percent), and Asian (9 percent), with those of Hispanic or Latino ethnicity representing 13 percent.
- Of the population over 24 years of age, nearly 91 percent have a high school or equivalent education.
- Nearly 45 percent of the population over 24 years of age has an undergraduate, graduate, or professional degree.
- Of the population older than 15 years of age, slightly more than 96 percent are in the workforce.
- Median household income is nearly $76,000.
- The population below the federal poverty level is nearly 14 percent.
- The population without health insurance coverage is 7.5 percent.

Projected Growth

The Puget Sound Regional Safety Council projects that the City's population will grow by 18 percent to 262,068 by 2030, and by 38 percent to 306,323 by 2040. The Urban Form element of the One Tacoma Comprehensive Plan envisions 127,000 additional residents by 2040, a 57 percent increase from the current population.

Buildings

The City has more than 93,000 housing units and nearly 8,000 businesses, including offices, professional services, retail sales, restaurants/bars, motels, churches, schools, government facilities, healthcare facilities, and other business types.[12]

Building Occupancy Risk Categories

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

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

Moderate Risk – includes detached single-family or two-family dwellings; mobile homes; commercial and industrial buildings fewer than 10,000 square feet without a high hazard fire load;

[12] Source: Esri Community Analyst Business Summary (2022).

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 or significant economic impact to the community.

No building occupancy data was available to identify high- or maximum-risk building uses as they relate to the CFAI building fire risk categories. Citygate suggests that the City or Department consider maintaining that data as an important risk factor.

Critical Facilities

The U.S. Department of Homeland Security defines critical infrastructure and key resources as those physical assets essential to the public health and safety, economic vitality, and resilience of a community, such as lifeline utilities infrastructure, telecommunications infrastructure, essential government services facilities, public safety facilities, schools, hospitals, airports, etc. The City has identified 366 critical facilities/infrastructure as summarized in the following table. A hazard occurrence with significant impact severity affecting one or more of these facilities would likely adversely impact critical public or community services.

Table 27—Critical Facilities/Infrastructure

Critical Facility Category	Number
Emergency Services	32
Energy	78
Government	24
Telecommunications	11
Transportation	51
Water	170
Total	**366**

Source: City of Tacoma

Economic Resources

The City has a diverse economy, including one of the largest seaports in the Pacific Northwest. The City is also home to several international companies in multiple business sectors. Of the nearly 8,000 businesses employing nearly 120,000 people, top industries include services and retail trade, followed by finance, insurance, and real estate, construction, government, wholesale trade, transportation, and manufacturing.[13] Principal employers include:[14]

- Joint Base Lewis McChord
- MultiCare Health System
- State of Washington
- CHI Franciscan Health
- Tacoma Public Schools
- City of Tacoma
- Pierce County Government
- Safeway and Albertson's

Natural Resources

Key natural resources to be protected within the City include:

- Puget Sound / Commencement Bay
- Thea Foss Waterway
- Middle Waterway
- Saint Paul Waterway
- Puyallup River
- Milwaukee Waterway
- Sitcum Waterway
- Blair Waterway
- Hylebos Creek Waterway

[13] Source: Esri Community Business Summary (2022).
[14] Source: City of Tacoma 2021 Annual Comprehensive Financial Report.

- Snake Lake
- Titlow Beach Marine Preserve
- Point Defiance Park
- Wapato Park

Cultural/Historic Resources

Key cultural/historic resources within the City include:

- The Museum of Glass
- America's Car Museum
- Tacoma Art Museum
- Washington State History Museum
- Tacoma Arts Live
- Fort Nisqually

Special/Unique Resources

Following are special/unique resources to be protected within the City:

- University of Washington – Tacoma Campus
- University of Puget Sound
- Tacoma Community College
- University of Seattle–Tacoma
- Evergreen State College-Tacoma
- Tacoma Dome
- Cheney Stadium
- Tacoma Convention Center

A.1.5 Hazard Identification

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

The Pierce County Region 5 All Hazard Mitigation Plan (AHMP)[15] identifies the following 20 hazards with potential to impact the County.

1. Avalanche
2. Earthquake
3. Landslide
4. Tsunami
5. Volcanic Activity
6. Climate Change
7. Drought
8. Flood
9. Severe Weather
10. Wildland Urban Interface Fire
11. Abandoned Underground Mines
12. Active Technological Threat
13. Civil Disturbance
14. Cyber Attack
15. Dam Failure
16. Energy Emergency
17. Epidemic/Pandemic
18. Hazardous Material
19. Terrorism
20. Transportation Accident

Although the Fire Department has no legal authority or responsibility to mitigate any of these hazards other than perhaps wildland urban interface fire risk, it does provide services related to all hazards, including fire suppression, emergency medical services, technical rescue, and hazardous materials response.

[15] Pierce County Emergency Management, Region 5 All Hazard Mitigation Plan, July 2020–2025 Edition.

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

Figure 19—Commission on Fire Accreditation International Hazard Categories

Fire	EMS	Hazardous Materials	Technical Rescue	Disasters
One and Two Family Residential Structures	Medical Emergencies	Transportation	Confined Space	Natural
Multi-Family Structures	Motor Vehicle Accidents	Fixed Facilities	Swift-Water Rescue	Man Made
Commercial Structures	Other		High and Low Angle	
Mobile Property			Structural Collapse and Trench Rescue	
Wildland				

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

Pursuant to review and evaluation of the hazards identified in the AHMP, and the fire and non-fire hazards identified by the CFAI as they relate to services provided by the Department, Citygate evaluated the following six hazards for this risk assessment:

1. Building fire
2. Vegetation/wildland fire
3. Medical emergency
4. Hazardous material release/spill
5. Technical rescue
6. Marine incident

A.1.6 Service Capacity

Service capacity refers to the Department's available response force; the size, types, and condition of its response fleet and any specialized equipment; core and specialized performance capabilities and competencies; resource distribution and concentration; availability of automatic or mutual aid; and any other agency-specific factors influencing its ability to meet current and prospective future service demand relative to the risks to be protected.

The Department's service capacity for fire and non-fire risks consists of 83 response personnel on duty daily staffing 16 engines, four aerial ladder trucks, five Advanced Life Support (ALS) medic ambulances, four full-time plus three peak-hour Basic Life Support (BLS) aid ambulances, three battalion chiefs, one Safety Officer, and one EMS Supervisor operating from the Department's 17 fire stations. The Department also deploys a Heavy Technical Rescue Unit at Station 8, a Hazardous Materials Response Unit at Station 12, and two fireboats that are cross-staffed as needed by on-duty Station 14 personnel.

All response personnel are trained to either the Emergency Medical Technician (EMT) level, capable of providing BLS pre-hospital emergency medical care, or the EMT-Paramedic (Paramedic) level, capable of providing ALS pre-hospital emergency medical care. Three of the outermost 16 engines are staffed with a minimum of one Paramedic, and the five ALS transport ambulances are staffed with two Paramedics each. The Department also deploys four full-time and three peak-hour BLS transport ambulances staffed with two EMT Firefighters each.

Response personnel are also trained to the U.S. Department of Transportation Hazardous Material First Responder Operations level to provide initial hazardous material incident assessment, hazard isolation, and support for the hazardous material response team. The Department cross-staffs a Hazardous Material Response Unit at Station 12 as needed with assigned personnel trained to the Hazardous Material Technician level.

All response personnel are further trained to the Confined Space Awareness level, and most are further trained to the Technical Rescue Operations level. The heavy rescue unit, deployed as needed from Station 8, is assigned personnel trained to the Rescue Technician level.

Marine response capacity is provided by Station 14 personnel cross-staffing one of the Department's two fireboats: Fireboat Destiny, a 30-foot, all-weather MetalCraft with an 1,800-gallons per minute (GPM) fire pump moored at the Tacoma Yacht Club at Point Defiance; and Fireboat Defiance, a 50-foot, all-weather fireboat with twin, 3,000-GPM fire pumps moored at Station 18 on Thea Foss Waterway.

A.1.7 Probability of Occurrence

Probability of occurrence refers to the probability of a future hazard occurrence during a specific period. Because the CFAI agency accreditation process requires annual review of an agency's risk assessment and baseline performance measures, Citygate recommends using the 12 months following completion of an SOC study as an appropriate period for the probability of occurrence evaluation. The following table describes the five probability of occurrence categories and related characteristics used for this analysis.

Table 28—Probability of Occurrence Categories

Probability	General Characteristics	Expected Frequency of Occurrence
Rare	• Hazard ***may occur*** rarely under unusual conditions.	> 10 years
Unlikely	• Hazard ***could occur*** infrequently. • No recorded or anecdotal evidence of occurrence. • Little opportunity, reason, or means for hazard to occur.	2–10 years
Possible	• Hazard ***should occur*** occasionally. • Infrequent, random recorded or anecdotal evidence of occurrence. • Some opportunity, reason, or means for hazard to occur.	Monthly to Biennially
Probable	• Hazard will ***probably occur*** regularly. • Regular recorded or strong anecdotal evidence of occurrence. • Considerable opportunity, reason, or means for hazard to occur.	Weekly to Monthly
Frequent	• Hazard is ***expected to occur*** frequently. • High level of recorded or anecdotal evidence of regular occurrence. • Strong opportunity, reason, or means for hazard to occur. • Frequent hazard recurrence.	Daily to weekly

Citygate's SOC assessments use recent, multiple-year incident response data to project the probability of hazard occurrence for the ensuing 12-month period.

A.1.8 Impact Severity

Impact severity refers to the *probable* extent a hazard occurrence impacts people, buildings, lifeline services, the environment, and the broader community. The following table summarizes the five impact severity categories and related general criteria used for this assessment.

Table 29—Impact Severity Categories

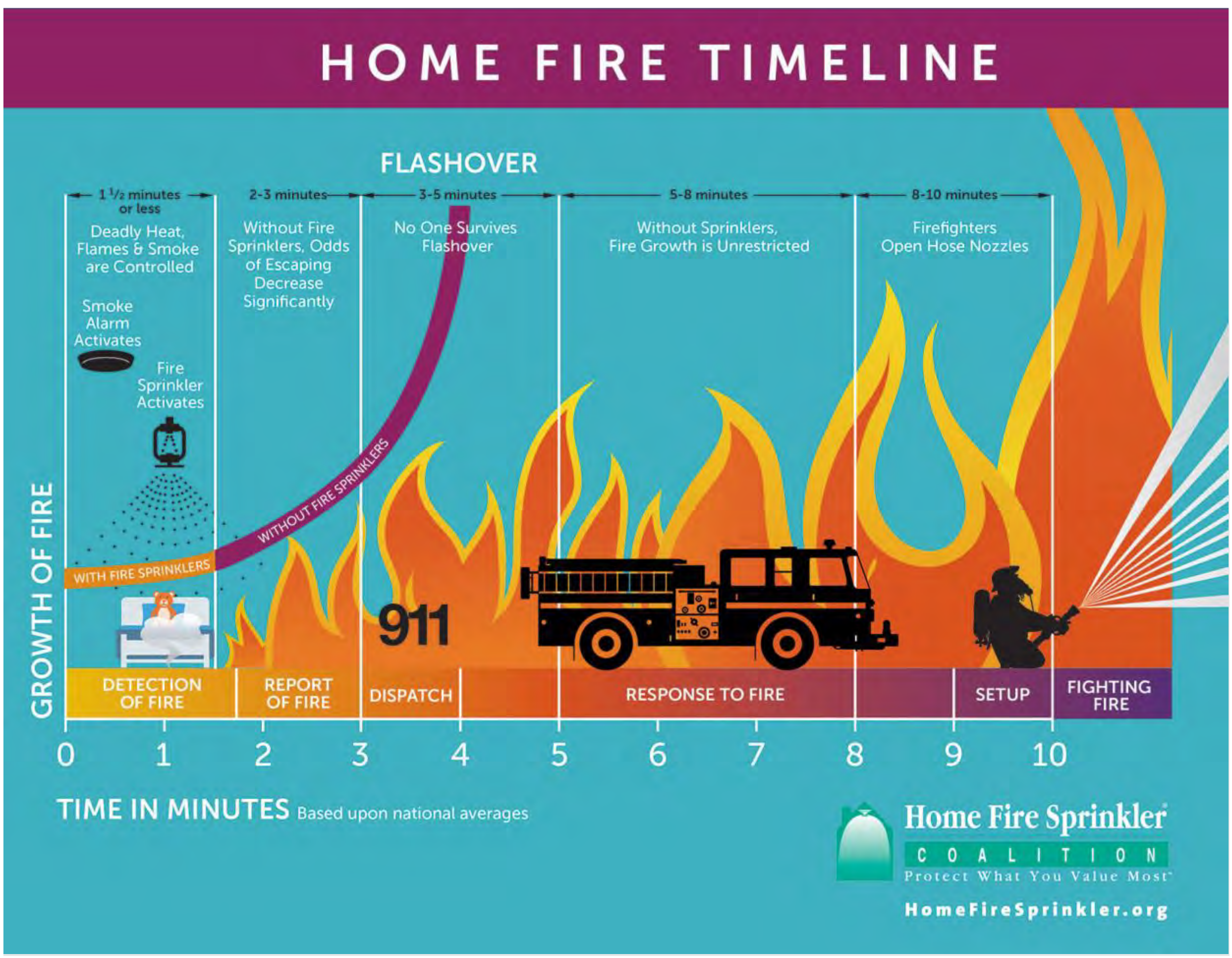
Impact Severity Category	Characteristics
Insignificant	• No injuries or fatalities • None to few persons displaced for short duration • Little or no personal support required • None to inconsequential damage • None to minimal community disruption • No measurable environmental impacts • None to minimal financial loss • No wildland Fire Hazard Severity Zones (FHSZs)
Minor	• Few injuries; no fatalities; minor medical treatment only • Some displacement of persons for less than 24 hours • Some personal support required • Some minor damage • Minor community disruption of short duration • Small environmental impacts with no lasting effects • Minor financial loss • No wildland FHSZs
Moderate	• Medical treatment required; some hospitalizations; few fatalities • Localized displacement of persons for fewer than 24 hours • Personal support satisfied with local resources • Localized damage • Normal community functioning with some inconvenience • No measurable environmental impacts with no long-term effects, or small impacts with long-term effect • Moderate financial loss • Less than 25% of area in *Moderate* or *High* wildland FHSZs
Major	• Extensive injuries; significant hospitalizations; many fatalities • Large number of persons displaced for more than 24 hours • External resources required for personal support • Significant damage • Significant community disruption; some services not available • Some impact to environment with long-term effects • Major financial loss with some financial assistance required • More than 25% of area in *Moderate* or *High* wildland FHSZs; less than 25% in *Very High* wildland FHSZs
Catastrophic	• Large number of severe injuries requiring hospitalization; significant fatalities • General displacement for extended duration • Extensive personal support required • Extensive damage • Community unable to function without significant external support • Significant impact to environment and/or permanent damage • Catastrophic financial loss; unable to function without significant support • More than 50% of area in *High* wildland FHSZs; more than 25% of area in *Very High* wildland FHSZs

A.1.9 Building Fire Risk

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

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

Figure 20—Building Fire Progression Timeline



Source: http://www.firesprinklerassoc.org

Population Density

The population density in the City ranges from less than 1,000 to more than 10,000 people per square mile, as shown in Map #2a (**Volume 2—Map Atlas**). Although risk analysis across a wide spectrum of other Citygate clients shows no direct correlation between population density and building fire *occurrence*, it is reasonable to conclude that building fire *risk* relative to potential impact on human life is greater as population density increases, particularly in areas with high-density, multiple-story buildings.

Water Supply

A reliable public water system providing adequate volume, pressure, and flow duration near all buildings is a critical factor in mitigating the potential impact severity of a community's building fire risk. Potable water is provided by the Tacoma Public Utilities Department, and according to Fire Department staff, fire flow, pressure, and hydrant spacing are adequate throughout the service area.

Building Fire Service Demand

As summarized in the following table, for the four-year study period from January 1, 2018, through December 31, 2021, the Department responded to 1,100 building fire incidents, comprising 0.65 percent of total annual service demand over the same period.

Table 30—Building Fire Service Demand

Hazard	Year	Planning Zone									
		Sta. 1	Sta. 2	Sta. 3	Sta. 4	Sta. 5	Sta. 6	Sta. 7	Sta. 8	Sta. 9	Sta. 10
Building Fire	2018	37	37	5	10	3	0	19	34	20	18
	2019	29	41	6	7	8	0	14	34	28	12
	2020	26	33	9	5	2	0	14	38	21	17
	2021	32	54	9	15	1	1	21	48	21	16
	Total	**124**	**165**	**29**	**37**	**14**	**1**	**68**	**154**	**90**	**63**
Percent Total Station Demand		0.66%	1.38%	0.73%	0.30%	0.40%	1.02%	0.68%	0.82%	0.95%	0.45%

Hazard	Year	Planning Zone							Total	Percent Annual Demand
		Sta. 11	Sta. 12	Sta. 13	Sta. 14	Sta. 15	Sta. 16	Sta. 17		
Building Fire (cont.)	2018	14	18	10	6	16	13	14	**274**	0.61%
	2019	13	17	9	5	19	10	10	**262**	0.62%
	2020	19	20	10	2	19	14	6	**255**	0.66%
	2021	28	7	7	4	24	11	10	**309**	0.70%
	Total	**74**	**62**	**36**	**17**	**78**	**48**	**40**	**1,100**	**0.65%**
Percent Total Station Demand		0.53%	0.58%	0.46%	0.33%	0.79%	0.39%	0.52%		

As the table shows, building fire service demand varies widely by planning zone, with overall demand increasing nearly 13 percent over the four-year period. Overall, building fire service demand is like other western jurisdictions of similar size and demographics.

Building Fire Risk Assessment

The following table summarizes Citygate's assessment of building fire risk by planning zone.

Table 31—Building Fire Risk Assessment

Building Fire Risk	Risk Planning Zone								
	Sta. 1	Sta. 2	Sta. 3	Sta. 4	Sta. 5	Sta. 6	Sta. 7	Sta. 8	Sta. 9
Probability of Occurrence	*Probable*	*Probable*	*Possible*	*Possible*	*Possible*	*Possible*	*Probable*	*Probable*	*Probable*
Probable Impact Severity	*Moderate*	*Moderate*	*Moderate*	*Moderate*	*Moderate*	*Moderate*	*Moderate*	*Moderate*	*Moderate*
Overall Risk	***Moderate***	***Moderate***	***Moderate***	***Moderate***	***Moderate***	***Moderate***	***Moderate***	***Moderate***	***Moderate***

Building Fire Risk	Risk Planning Zone (Cont.)							
	Sta. 10	Sta. 11	Sta. 12	Sta. 13	Sta. 14	Sta. 15	Sta.16	Sta.17
Probability of Occurrence	*Probable*	*Probable*	*Probable*	*Possible*	*Possible*	*Probable*	*Possible*	*Possible*
Probable Impact Severity	*Moderate*	*Moderate*	*Moderate*	*Moderate*	*Moderate*	*Moderate*	*Moderate*	*Moderate*
Overall Risk	***Moderate***	***Moderate***	***Moderate***	***Moderate***	***Moderate***	***Moderate***	***Moderate***	***Moderate***

A.1.10 Vegetation/Wildfire Risk

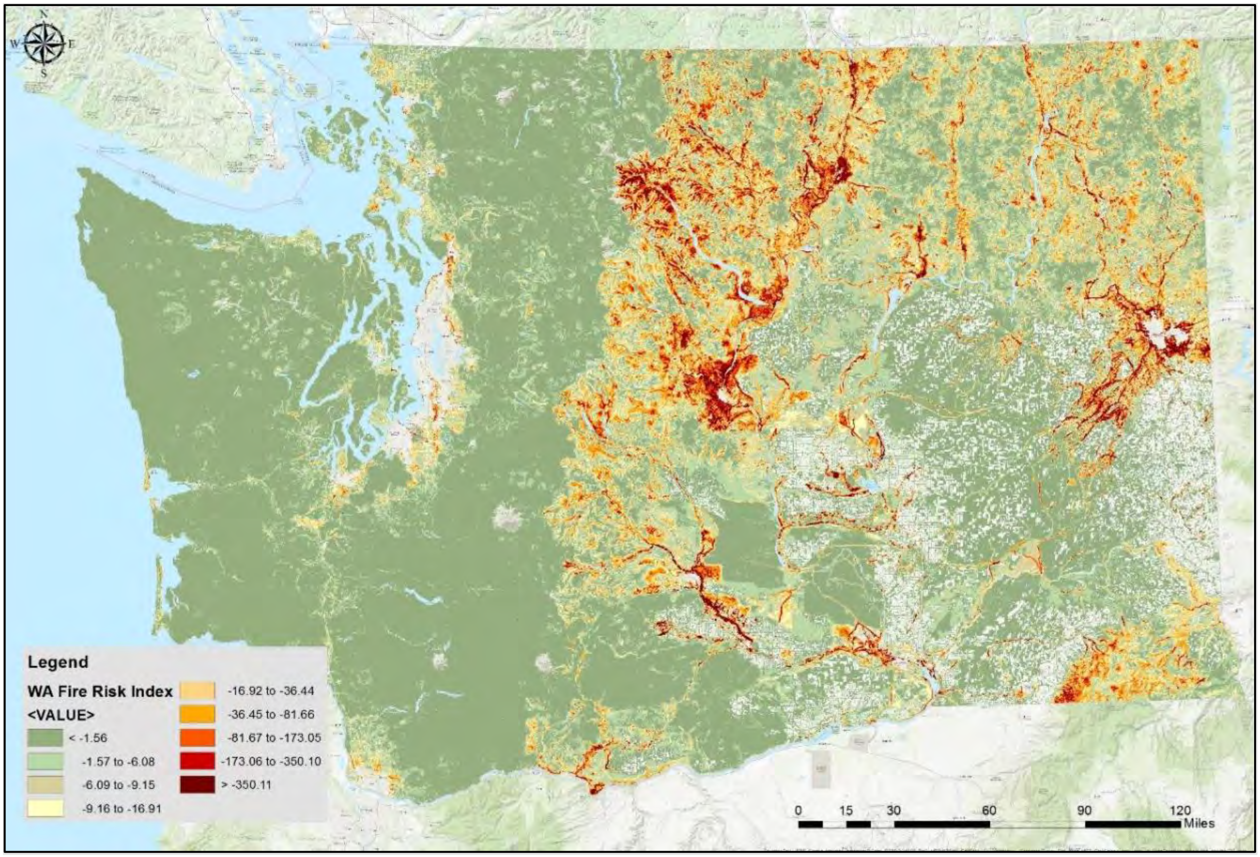
Wildfires occur every year in Pierce County, however few have the potential of developing into a Wildland Urban Interface (WUI) fire. Some areas within the City and surrounding service area are susceptible to vegetation/wildland fire, particularly the Point Defiance Park, Swan Creek Park, West Slope, and Northeast Tacoma areas.[16] Vegetation/wildfire risk factors include vegetative fuel types and configuration, weather, topography, prior fire history, water supply, mitigation measures, and vegetation/wildland fire service response capacity.

Wildfire Risk Zones[17]

The Washington Department of Natural Resources (DNR) identifies wildfire risk throughout the state, as shown in the following map for the western area of the state.

[16] Source: 2016 All Hazards Risk Assessment, Tacoma Fire Department, page 34.
[17] Source: Region 5 All Hazard Mitigation Plan, July 2020–2025 Edition, Section 4.5M.

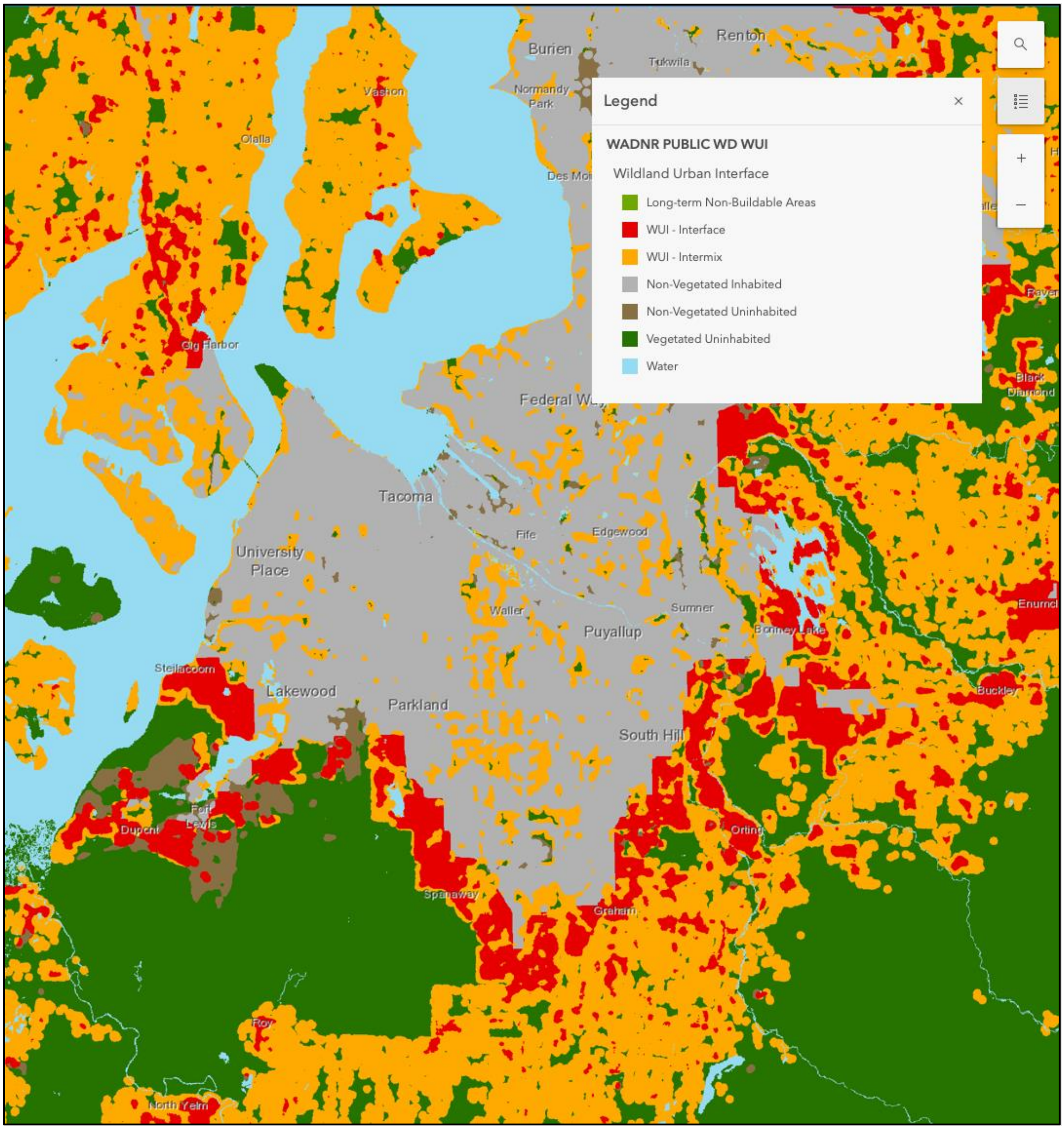
Figure 21—Washington Wildfire Hazard Risk Zones



As the map above illustrates, Pierce County has concentrations of wildfire risk with additional portions scattered around near the Puget Sound.

The DNR also designates WUI areas of the state where urban or suburban development exists within a wildland/vegetation environment prone to fire. These are the areas with at least 20 people per square mile with the most potential for significant damage to life and property. The following figure shows WUI zones within and around the City that contain at least one housing unit per 40 acres with vegetation occupying *less* than 50 percent of the area, and the intermix WUI zones that contain at least one housing unit per 40 acres with vegetation occupying *more* than 50 percent of the area. As the figure shows, there are multiple WUI intermix areas with the service area.

Figure 22—Wildland-Urban Interface/Intermix Areas



Source: Washington Department of Natural Resources Open Data Portal

Vegetative Fuels

Vegetative fuel factors influencing fire intensity and spread include fuel type (vegetation species), height, arrangement, density, and moisture. In addition to decorative landscape species, vegetative fuels within the service area include both native and non-native annual and perennial plant species, including grasses, weeds, brush, and mostly deciduous and mixed hardwood and conifer tree species. Once ignited, vegetation fires can burn intensely and contribute to rapid fire spread under the right fuel, weather, and topographic conditions.

Weather

Weather elements, including temperature, relative humidity, wind, and lightning also affect vegetation/wildfire potential and behavior. High temperatures and low relative humidity dry out vegetative fuels, creating a situation where fuels will more readily ignite and burn more intensely. Wind is the most significant weather factor influencing vegetation/wildfire behavior, with higher wind speeds increasing fire spread and intensity. Wildfire season, when vegetation/wildfires are most likely to occur due to fuel and weather conditions, occurs from approximately mid-May through October in Pierce County. Climate change is also influencing Pierce County, with higher summer daytime temperatures, lower relative humidity, and higher winds that elevate the potential for a wildfire.

Topography

Vegetation/wildland fires tend to burn more intensely and spread faster when burning uphill and up-canyon, except for a wind-driven downhill or down-canyon fire. The service area's generally flat topography minimally influences vegetation/wildfire behavior and spread.

Water Supply

Another significant impact severity factor is the water supply immediately available for fire suppression. According to Fire Department staff, available fire flow, pressure, and hydrant spacing is adequate throughout the City and service area.

Vegetation/Wildfire Service Capacity

The Department's vegetation/wildland fire service consists of 83 response personnel on duty daily staffing 16 engines, four aerial ladder trucks, five ALS medic ambulances, four full-time and three peak-hour BLS transport ambulances, three battalion chiefs, one Safety Officer, and one EMS Supervisor operating from the Department's 17 fire stations.

Vegetation/Wildfire Service Demand

As summarized in the following table, the Department responded to 1,656 vegetation fires over the four-year study period, comprising 0.97 percent of total service demand over the same period.

Table 32—Vegetation/Wildfire Service Demand

Hazard	Year	Planning Zone									
		Sta. 1	Sta. 2	Sta. 3	Sta. 4	Sta. 5	Sta. 6	Sta. 7	Sta. 8	Sta. 9	Sta. 10
Vegetation/Wildland Fire	2018	19	42	22	32	16	2	40	23	19	33
	2019	30	44	9	17	13	0	33	27	15	25
	2020	15	35	9	24	18	0	21	37	29	28
	2021	35	52	5	28	14	2	43	38	20	43
	Total	**99**	**173**	**45**	**101**	**61**	**4**	**137**	**125**	**83**	**129**
Percent Total Station Demand		0.53%	1.45%	1.14%	0.83%	1.73%	4.08%	1.37%	0.67%	0.88%	0.93%

Hazard	Year	Planning Zone							Total	Percent Annual Demand
		Sta. 11	Sta. 12	Sta. 13	Sta. 14	Sta. 15	Sta. 16	Sta. 17		
Vegetation/Wildland Fire (cont.)	2018	48	57	11	21	24	23	26	**458**	1.02%
	2019	32	39	13	5	14	24	19	**359**	0.85%
	2020	27	39	8	9	24	31	17	**371**	0.95%
	2021	50	48	18	7	32	11	22	**468**	1.06%
	Total	**157**	**183**	**50**	**42**	**94**	**89**	**84**	**1,656**	**0.97%**
Percent Total Station Demand		1.11%	1.70%	0.63%	0.82%	0.95%	0.72%	1.09%		

Vegetation/Wildfire Risk Assessment

The following table summarizes Citygate's assessment of vegetation/wildfire risk by planning zone.

Table 33—Vegetation/Wildfire Risk Assessment

Vegetation/Wildfire Risk	Risk Planning Zone								
	Sta. 1	Sta. 2	Sta. 3	Sta. 4	Sta. 5	Sta. 6	Sta. 7	Sta. 8	Sta. 9
Probability of Occurrence	*Probable*	*Probable*	*Possible*	*Probable*	*Probable*	*Possible*	*Probable*	*Probable*	*Probable*
Probable Impact Severity	*Minor*	*Minor*	*Moderate*	*Minor*	*Moderate*	*Minor*	*Moderate*	*Moderate*	*Moderate*
Overall Risk	***Low***	***Low***	***Moderate***	***Low***	***Moderate***	***Low***	***Moderate***	***Moderate***	***Moderate***

Vegetation/Wildfire Risk	Risk Planning Zone (Cont.)							
	Sta. 10	Sta. 11	Sta. 12	Sta. 13	Sta. 14	Sta. 15	Sta.16	Sta.17
Probability of Occurrence	*Probable*	*Probable*	*Probable*	*Probable*	*Possible*	*Probable*	*Probable*	*Probable*
Probable Impact Severity	*Moderate*	*Moderate*	*Moderate*	*Minor*	*Moderate*	*Moderate*	*Moderate*	*Moderate*
Overall Risk	***Moderate***	***Moderate***	***Moderate***	***Low***	***Moderate***	***Moderate***	***Moderate***	***Moderate***

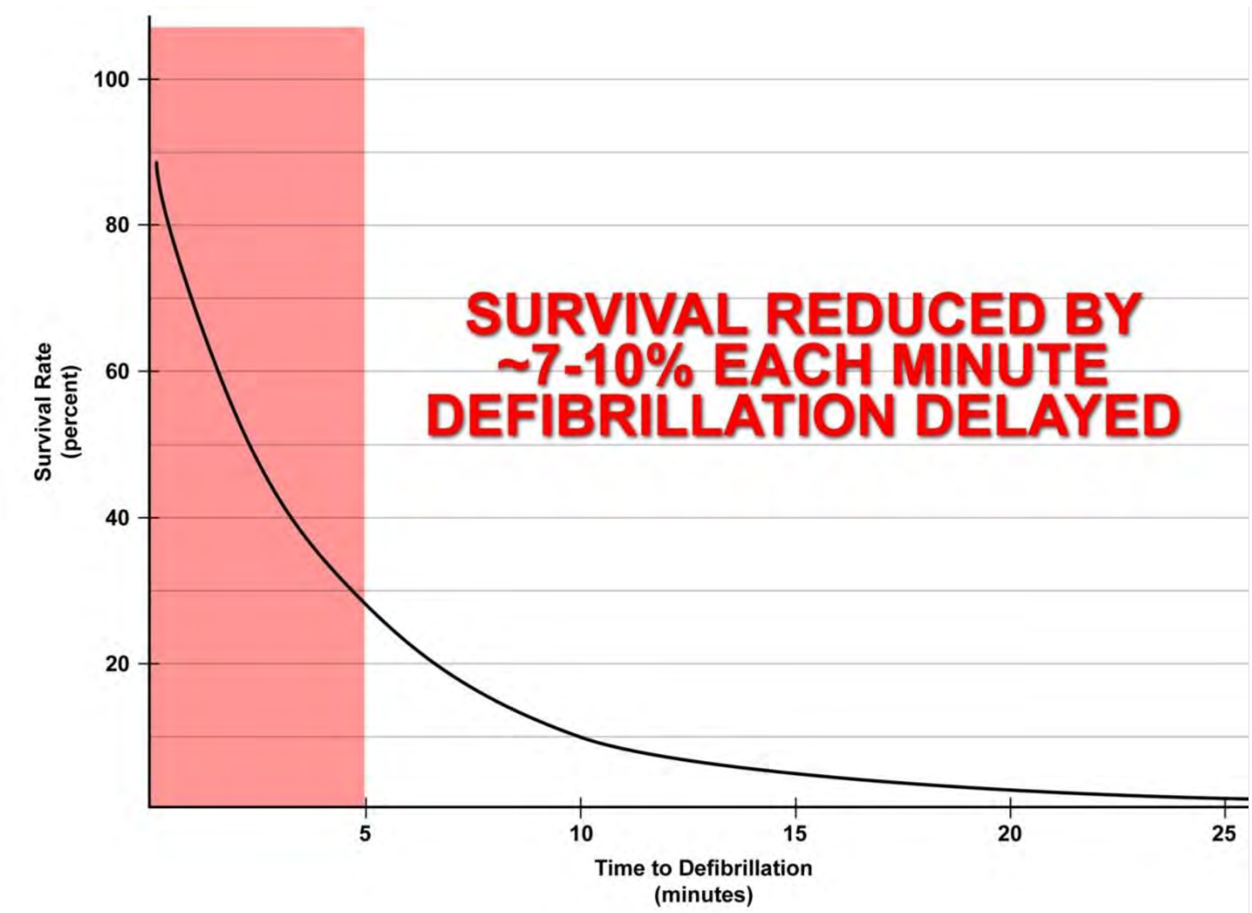
A.1.11 Medical Emergency Risk

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

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

The following figure 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 23—Survival Rate Versus Time to Defibrillation



Population Density

The population density in Tacoma ranges from less than 1,000 to more than 10,000 people per square mile, as shown in Map #2a (**Volume 2—Map Atlas**). Risk analysis across a wide spectrum of other Citygate clients shows a direct correlation between population density and the *occurrence* of medical emergencies, particularly in high urban population density zones.

Demographics

Medical emergency risk tends to be higher among older, poorer, less educated, and uninsured populations. As shown in Table 3, nearly 16 percent of the population is 65 and older, only 9 percent of the population over 24 years of age has less than a high school education or equivalent, nearly 14 percent of the population is at or below poverty level, and 7.5 percent of the population under age 65 does not have health insurance coverage.[18]

Vehicle Traffic

Medical emergency risk tends to be higher in areas of a community with high daily vehicle traffic volume, particularly areas with high traffic volume traveling at high speeds. The City's transportation network includes Interstate 5 and State Routes 7, 16, 163, 509, and 705 carrying an aggregate annual average daily traffic volume of more than 410,000 vehicles.[19]

[18] Source: Esri Community Analyst Community Profile (2022) and U. S. Census Bureau.

[19] Source: Washington Department of Transportation (2021).

Medical Emergency Service Demand

As summarized in the following table, medical emergency service demand over the four-year study period includes more than 126,000 calls for service comprising 74.4 percent of total service demand over the same period.

Table 34—Medical Emergency Service Demand

Hazard	Year	Planning Zone									
		Sta. 1	Sta. 2	Sta. 3	Sta. 4	Sta. 5	Sta. 6	Sta. 7	Sta. 8	Sta. 9	Sta. 10
Medical Emergency	2018	2,954	1,596	656	3,060	690	5	1,564	4,177	1,866	2,382
	2019	3,447	2,096	780	2,154	659	8	2,009	3,399	1,945	2,524
	2020	2,976	1,974	754	1,858	650	3	1,923	3,050	1,734	2,462
	2021	3,304	2,472	788	1,931	339	45	2,301	3,413	1,713	2,505
	Total	**12,681**	**8,138**	**2,978**	**9,003**	**2,338**	**61**	**7,797**	**14,039**	**7,258**	**9,873**
Percent Total Station Demand		67.51%	68.04%	75.43%	74.19%	66.18%	62.24%	78.01%	75.19%	76.55%	70.82%

Hazard	Year	Planning Zone							Total	Percent Annual Demand
		Sta. 11	Sta. 12	Sta. 13	Sta. 14	Sta. 15	Sta. 16	Sta. 17		
Medical Emergency (cont.)	2018	3,114	2,105	1,334	967	1,613	2,961	1,339	**32,383**	72.04%
	2019	2,778	1,818	1,511	966	2,022	2,478	1,582	**32,176**	76.15%
	2020	2,455	1,843	1,326	949	1,918	2,383	1,393	**29,651**	76.22%
	2021	2,643	2,069	1,676	1,077	2,250	2,508	1,590	**32,624**	73.69%
	Total	**10,990**	**7,835**	**5,847**	**3,959**	**7,803**	**10,330**	**5,904**	**126,834**	**74.44%**
Percent Total Station Demand		78.00%	72.97%	74.02%	77.26%	78.78%	83.45%	76.73%		

As the table shows, medical emergency service demand varies significantly by planning zone and was consistent overall annually except for a 12 percent decrease in 2020, most likely due to the COVID-19 pandemic.

Medical Emergency Risk Assessment

The following table summarizes Citygate's assessment of medical emergency risk by planning zone.

Table 35—Medical Emergency Risk Assessment

Medical Emergency Risk	Risk Planning Zone								
	Sta. 1	Sta. 2	Sta. 3	Sta. 4	Sta. 5	Sta. 6	Sta. 7	Sta. 8	Sta. 9
Probability of Occurrence	*Frequent*	*Frequent*	*Frequent*	*Frequent*	*Frequent*	*Probable*	*Frequent*	*Frequent*	*Frequent*
Probable Impact Severity	*Moderate*	*Moderate*	*Moderate*	*Moderate*	*Moderate*	*Moderate*	*Moderate*	*Moderate*	*Moderate*
Overall Risk	***High***	***High***	***High***	***High***	***High***	***Moderate***	***High***	***High***	***High***

Medical Emergency Risk	Risk Planning Zone (Cont.)							
	Sta. 10	Sta. 11	Sta. 12	Sta. 13	Sta. 14	Sta. 15	Sta.16	Sta.17
Probability of Occurrence	*Frequent*	*Frequent*	*Frequent*	*Frequent*	*Frequent*	*Frequent*	*Frequent*	*Frequent*
Probable Impact Severity	*Moderate*	*Moderate*	*Moderate*	*Moderate*	*Moderate*	*Moderate*	*Moderate*	*Moderate*
Overall Risk	***High***	***High***	***High***	***High***	***High***	***High***	***High***	***High***

A.1.12 Hazardous Material Risk

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

Fixed Hazardous Materials Facilities

City staff identified 17 facilities within the City that require a state or local hazardous materials operating permit. There are also three large-diameter pipelines transporting crude oil, gasoline, diesel, and jet fuel in the eastern section of the City.

The Port of Tacoma also has fixed hazardous materials risk, with an 8 million-gallon Liquefied Natural Gas (LNG) facility co-operated by Puget Sound Energy and Puget LNG; and a 136-acre oil refinery operated by US Oil with 42,000 barrels of daily refining capacity, a tank farm with 2.9 million barrels of storage capacity, and 14 miles of pipeline.

Transportation-Related Hazardous Materials

The City also has transportation-related hazardous material risk from its road transportation network, including Interstate 5 and State Routes 7, 16, 163, 509, and 705 carrying an aggregate annual average daily traffic volume of more than 410,000 vehicles, many of which are trucks transporting hazardous commodities.

Burlington Northern Santa Fe (BNSF), Tacoma Municipal Belt Line Railway (TMBL), and Union Pacific (UP) operate cargo rail services within the service area with more than 100 train movements daily, with some railcars transporting hazardous commodities.[20] In addition, more than 204 million barrels of crude oil, including Bakken crude, are transported into the City annually by vessel, pipeline, and rail.[21]

Population Density

Because hazardous material emergencies have the potential to adversely impact human health, it is logical that the higher the population density, the greater the potential population exposed to a hazardous material release or spill. As shown in Map #2a – Population Density by Block Group (**Volume 2—Map Atlas**), the population density within the service area ranges from less than 1,000 to more than 10,000 people per square mile.

Vulnerable Populations

Persons vulnerable to a hazardous material release/spill include individuals or groups unable to self-evacuate, generally including children under the age of 10, the elderly, and persons confined to an institution or other setting where they are unable to leave voluntarily. As shown in Table 26, 28 percent of the population is under age 10 or is 65 years and older.

Emergency Evacuation Planning, Training, Implementation, and Effectiveness

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

Although the City does not have formal, written evacuation plans, it utilizes CodeRED, a free subscription and reverse 9-1-1-based mass emergency notification system that can provide emergency alerts, notifications, and other emergency information to email accounts, cell phones, smartphones, tablets, and landline telephones. The City also utilizes social media, local AM and FM radio stations, and local television outlets to provide timely emergency information and alerts. Emergency notifications can be initiated by designated Fire and Police Department personnel. The

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[20] Source: US Department of Transportation, Federal Railroad Administration; Washington Department of Ecology.

[21] Source: Washington Department of Ecology, Crude Oil Movement by Rail and Pipeline Quarterly Report, January 1, 2022, through March 31, 2022.

Emergency Management Division also conducts ongoing Emergency Operations Center training at least quarterly, with at least one full EOC exercise annually.

Hazardous Material Service Demand

The Department responded to 277 hazardous material incidents over the four-year study period, comprising 0.16 percent of total service demand over the same period, as summarized in the following table.

Table 36—Hazardous Material Service Demand

Hazard	Year	Planning Zone									
		Sta. 1	Sta. 2	Sta. 3	Sta. 4	Sta. 5	Sta. 6	Sta. 7	Sta. 8	Sta. 9	Sta. 10
Hazardous Material	2018	13	9	3	4	1	0	1	11	3	6
	2019	6	9	2	1	0	0	2	13	9	5
	2020	10	9	3	3	3	0	1	6	1	5
	2021	8	7	2	3	0	0	2	9	2	4
	Total	**37**	**34**	**10**	**11**	**4**	**0**	**6**	**39**	**15**	**20**
Percent Total Station Demand		0.20%	0.28%	0.25%	0.09%	0.11%	0.00%	0.06%	0.21%	0.16%	0.14%

Hazard	Year	Planning Zone							Total	Percent Annual Demand
		Sta. 11	Sta. 12	Sta. 13	Sta. 14	Sta. 15	Sta. 16	Sta. 17		
Hazardous Material (cont.)	2018	3	18	3	2	2	0	4	**83**	0.18%
	2019	4	11	7	0	1	3	3	**76**	0.18%
	2020	3	6	9	1	1	3	1	**65**	0.17%
	2021	1	3	5	4	2	1	0	**53**	0.12%
	Total	**11**	**38**	**24**	**7**	**6**	**7**	**8**	**277**	**0.16%**
Percent Total Station Demand		0.08%	0.35%	0.30%	0.14%	0.06%	0.06%	0.10%		

As the table shows, hazardous material service demand varies significantly by planning zone and overall annul demand was generally consistent over the four-year study period.

Hazardous Materials Risk Assessment

The following table summarizes Citygate's assessment of hazardous materials risk by planning zone.

Table 37—Hazardous Materials Risk Assessment

Hazardous Material Risk	Risk Planning Zone								
	Sta. 1	Sta. 2	Sta. 3	Sta. 4	Sta. 5	Sta. 6	Sta. 7	Sta. 8	Sta. 9
Probability of Occurrence	Possible	Possible	Possible	Possible	Possible	Possible	Possible	Possible	Possible
Probable Impact Severity	Major	Moderate	Minor	Minor	Major	Moderate	Moderate	Moderate	Minor
Overall Risk	High	Moderate	Low	Low	High	Moderate	Moderate	Moderate	Low

Hazardous Material Risk	Risk Planning Zone (Cont.)							
	Sta. 10	Sta. 11	Sta. 12	Sta. 13	Sta. 14	Sta. 15	Sta.16	Sta.17
Probability of Occurrence	Possible	Possible	Possible	Possible	Possible	Possible	Possible	Possible
Probable Impact Severity	Moderate	Moderate	Major	Moderate	Moderate	Minor	Moderate	Moderate
Overall Risk	Moderate	Moderate	High	Moderate	Moderate	Low	Moderate	Moderate

A.1.13 Technical Rescue Risk

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

Construction Activity

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

Confined Spaces

There are multiple confined spaces within the service area, including tanks, vaults, and open trenches.

Bodies of Water

Bodies of water within the service area include Puget Sound / Commencement Bay, Blair Waterway, Hylebos Creek Waterway, Middle Waterway, Milwaukee Waterway, Saint Paul Waterway, Thea Foss Waterway, Puyallup River, Sitcum Waterway, Snake Lake, and multiple smaller ponds, creeks, and seasonal waterways.

Transportation Volume

Another technical rescue risk factor is transportation-related incidents requiring technical rescue. This risk factor is primarily a function of vehicle, railway, maritime, and aviation traffic. Vehicle traffic volume is the greatest of these factors within the service area, with Interstate 5 and State Routes 7, 16, 163, 509, and 705 carrying an aggregate annual average daily traffic volume of more than 410,000 vehicles.

Maritime traffic includes the Washington State Ferry traffic to and from the Point Defiance Ferry Terminal, with 20 arrivals/departures daily. Ferries carry 60–200 vehicles and 750–2,000 passengers.[22]

The Port of Tacoma[23]

The 2,600-acre Port of Tacoma served more than 800 vessels in 2021, with cargoes including containerized products, automobiles, bulk commodities, breakbulk, and specialty cargoes. The Port includes seven terminals with a total of 16 berths, including seven international berths that can serve vessels up to 1,100 feet in length. Railroad spurs also serve nearly all terminals and berths. The Port of Tacoma is also a strategic military port.

Earthquake Risk[24]

All areas of Pierce County are affected by earthquakes, either directly or indirectly, with the Seattle, Tacoma, and Rattlesnake Mountain faults posing the greatest risk. Much of the City is also highly susceptible to liquefaction, a secondary risk.

Since 1870, there have been six significant earthquakes in the Puget Sound basin, including the magnitude 6.8 Nisqually in 2001.

Flood Risk[25]

As shown in the following figure, many areas of the City are susceptible to flooding from the Puyallup River, with prior major floods in 2014 and 2015. A 2003 Federal Emergency Management Agency (FEMA) study concluded that moderate-to-severe flooding can be expected every 2–10 years, and severe flooding every 10–25 years.

---

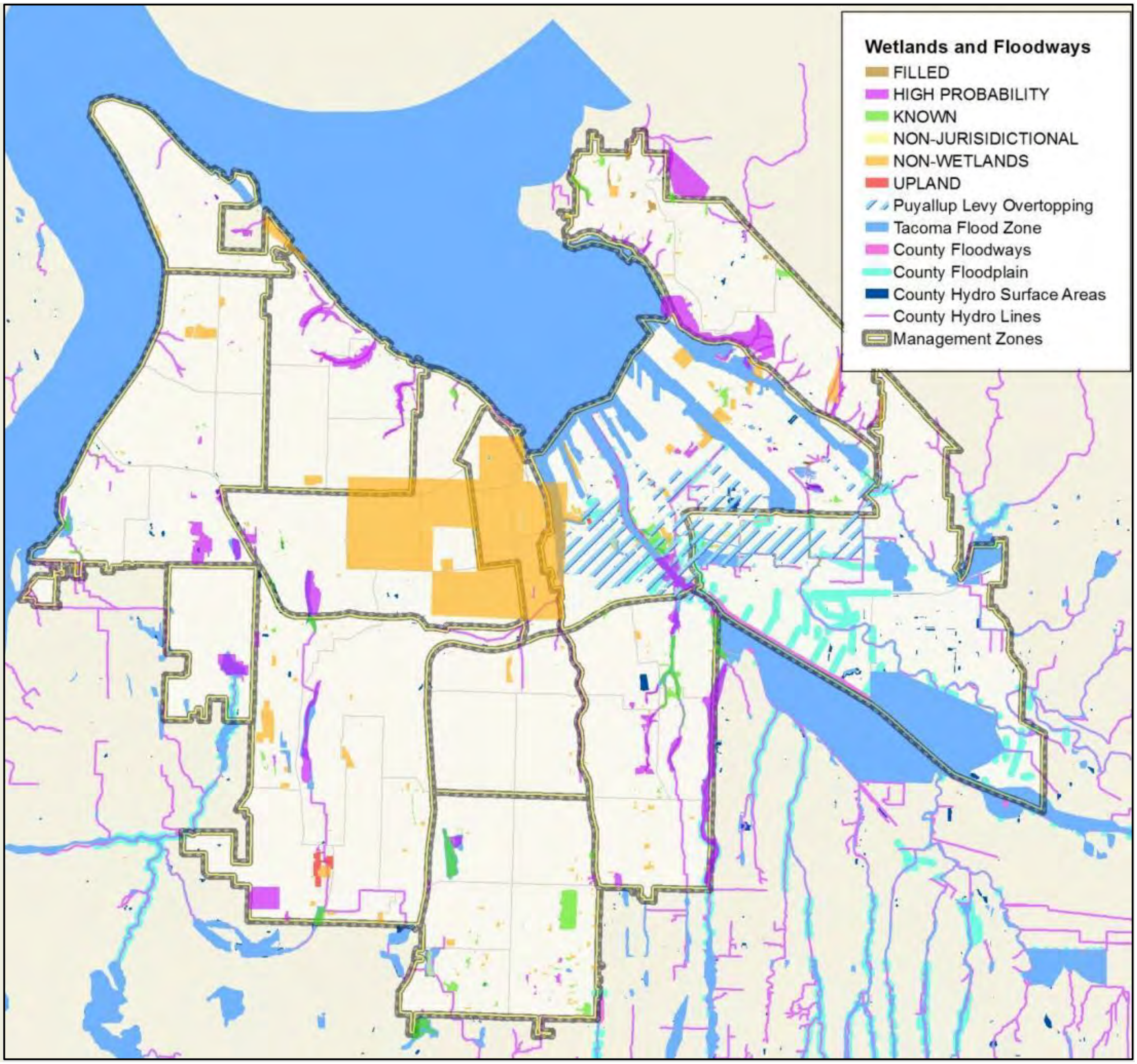
[22] Source: Washington State Department of Transportation website.

[23] Source: Mr. Tim Ebner, Senior Manager of Operations, The Northwest Seaport Alliance.

[24] Source: Region 5 All Hazard Mitigation Plan (2020–2025 Edition), Section 4.2G.

[25] Source: Region 5 All Hazard Mitigation Plan (2020–2025 Edition), Section 4.3M.

Figure 24—Flood Hazard Zones



Tsunami Risk[26]

All of Puget Sound and the Strait of Juan de Fuca are at risk from tsunamis. In addition, Puget Sound south of the Tacoma Narrows could be affected by a seiche. Several tsunamis have occurred in Washington state since the 1820s, most recently in 1980 from the Mount Saint Helens eruption and resultant landslide. The low-lying, relatively flat areas around the Port of Tacoma harbor are

[26] Source: Region 5 All Hazard Mitigation Plan (2020–2025 Edition), Section 4.4G.

the most likely to be affected. Until further research can provide a better estimate, a tentative tsunami recurrence rate of +/- 100 years is being used.

Technical Rescue Service Demand

As summarized in the following table, over the four-year study period, the Department responded to 464 technical rescue incidents comprising 0.27 percent of total service demand.

Table 38—Technical Rescue Service Demand

Hazard	Year	Planning Zone									
		Sta. 1	Sta. 2	Sta. 3	Sta. 4	Sta. 5	Sta. 6	Sta. 7	Sta. 8	Sta. 9	Sta. 10
Technical Rescue	**2018**	56	2	1	2	0	0	1	12	2	1
	2019	49	1	0	2	0	0	0	11	0	1
	2020	35	1	0	0	0	0	0	9	3	1
	2021	60	3	1	2	1	0	1	10	0	0
	Total	**200**	**7**	**2**	**6**	**1**	**0**	**2**	**42**	**5**	**3**
Percent Total Station Demand		1.06%	0.06%	0.05%	0.05%	0.03%	0.00%	0.02%	0.22%	0.05%	0.02%

Hazard	Year	Planning Zone							Total	Percent Annual Demand
		Sta. 11	Sta. 12	Sta. 13	Sta. 14	Sta. 15	Sta. 16	Sta. 17		
Technical Rescue (cont.)	**2018**	0	4	14	31	0	1	1	**128**	0.28%
	2019	0	5	7	32	1	2	2	**113**	0.27%
	2020	2	4	7	33	0	1	0	**96**	0.25%
	2021	0	2	17	23	1	4	2	**127**	0.29%
	Total	**2**	**15**	**45**	**119**	**2**	**8**	**5**	**464**	**0.27%**
Percent Total Station Demand		0.01%	0.14%	0.57%	2.32%	0.02%	0.06%	0.06%		

Technical Rescue Risk Assessment

The following table summarizes Citygate's assessment of technical rescue risk by planning zone.

Table 39—Technical Rescue Risk Assessment

Technical Rescue Risk	Risk Planning Zone								
	Sta. 1	Sta. 2	Sta. 3	Sta. 4	Sta. 5	Sta. 6	Sta. 7	Sta. 8	Sta. 9
Probability of Occurrence	Probable	Possible	Possible	Possible	Possible	Possible	Possible	Possible	Possible
Probable Impact Severity	Moderate	Moderate	Moderate	Moderate	Moderate	Moderate	Moderate	Moderate	Moderate
Overall Risk	Moderate	Moderate	Moderate	Moderate	Moderate	Moderate	Moderate	Moderate	Moderate

Technical Rescue Risk	Risk Planning Zone (Cont.)							
	Sta. 10	Sta. 11	Sta. 12	Sta. 13	Sta. 14	Sta. 15	Sta.16	Sta.17
Probability of Occurrence	Possible	Possible	Possible	Possible	Probable	Possible	Possible	Possible
Probable Impact Severity	Moderate	Moderate	Moderate	Moderate	Moderate	Moderate	Moderate	Moderate
Overall Risk	Moderate	Moderate	Moderate	Moderate	Moderate	Moderate	Moderate	Moderate

A.1.14 Marine Incident Risk

Marine incident risk factors include water and near-shore recreational activity, and watercraft storage and use in or on City waterways. Marine incidents include watercraft fires, searches for person(s) in water, and water and watercraft rescues.

Waterways

The primary bodies of water in Tacoma are Puget Sound / Commencement Bay, Blair Waterway, Hylebos Creek Waterway, Middle Waterway, Milwaukee Waterway, Saint Paul Waterway, Thea Foss Waterway, Puyallup River, and Sitcum Waterway.

Port of Tacoma[27]

The Port of Tacoma is a 2,600-acre facility that served more than 800 vessels in 2021. Facilities include seven terminals with a total of 16 berths, including seven international berths that can serve vessels up to 1,100 feet in length. Railroad spurs also serve nearly all terminals and berths. The Port of Tacoma is also a strategic military port.

Recreational Activity

Near-shore and open water recreational activities include boating, swimming, snorkeling, diving, fishing, etc.

[27] Source: Tim Ebner, Senior Manager of Operations, The Northwest Seaport Alliance.

Marine Incident Service Capacity

Marine incident response capacity is provided by Station 14 personnel cross-staffing one of the Department's two fireboats: Fireboat Destiny, a 30-foot, all-weather MetalCraft with an 1,800-GPM fire pump moored at the Tacoma Yacht Club at Point Defiance; and Fireboat Defiance, a 50-foot, all-weather fireboat with twin, 3,000-GPM fire pumps moored at Station 18 on Thea Foss Waterway.

Marine Incident Service Demand

As shown in the following table, over the four-year study period, the Department responded to 123 marine incidents comprising 0.07 percent of total service demand over the same period.

Table 40—Marine Incident Service Demand

Hazard	Year	Planning Zone									
		Sta. 1	Sta. 2	Sta. 3	Sta. 4	Sta. 5	Sta. 6	Sta. 7	Sta. 8	Sta. 9	Sta. 10
Marine Incident	2018	0	0	0	0	0	0	0	0	0	0
	2019	0	1	0	0	0	0	0	0	0	0
	2020	2	0	0	0	0	0	0	0	1	0
	2021	0	2	0	1	1	0	1	0	0	0
	Total	2	3	0	1	1	0	1	0	1	0
Percent Total Station Demand		0.01%	0.03%	0.00%	0.01%	0.03%	0.00%	0.01%	0.00%	0.01%	0.00%

Hazard	Year	Planning Zone							Total	Percent Annual Demand
		Sta. 11	Sta. 12	Sta. 13	Sta. 14	Sta. 15	Sta. 16	Sta. 17		
Marine Incident (cont.)	2018	0	0	0	31	0	0	0	31	0.07%
	2019	0	0	0	27	0	0	0	28	0.07%
	2020	0	0	0	31	0	0	0	34	0.09%
	2021	0	0	0	22	1	2	0	30	0.07%
	Total	0	0	0	111	1	2	0	123	0.07%
Percent Total Station Demand		0.00%	0.00%	0.00%	2.17%	0.01%	0.02%	0.00%		

Marine Incident Risk Assessment

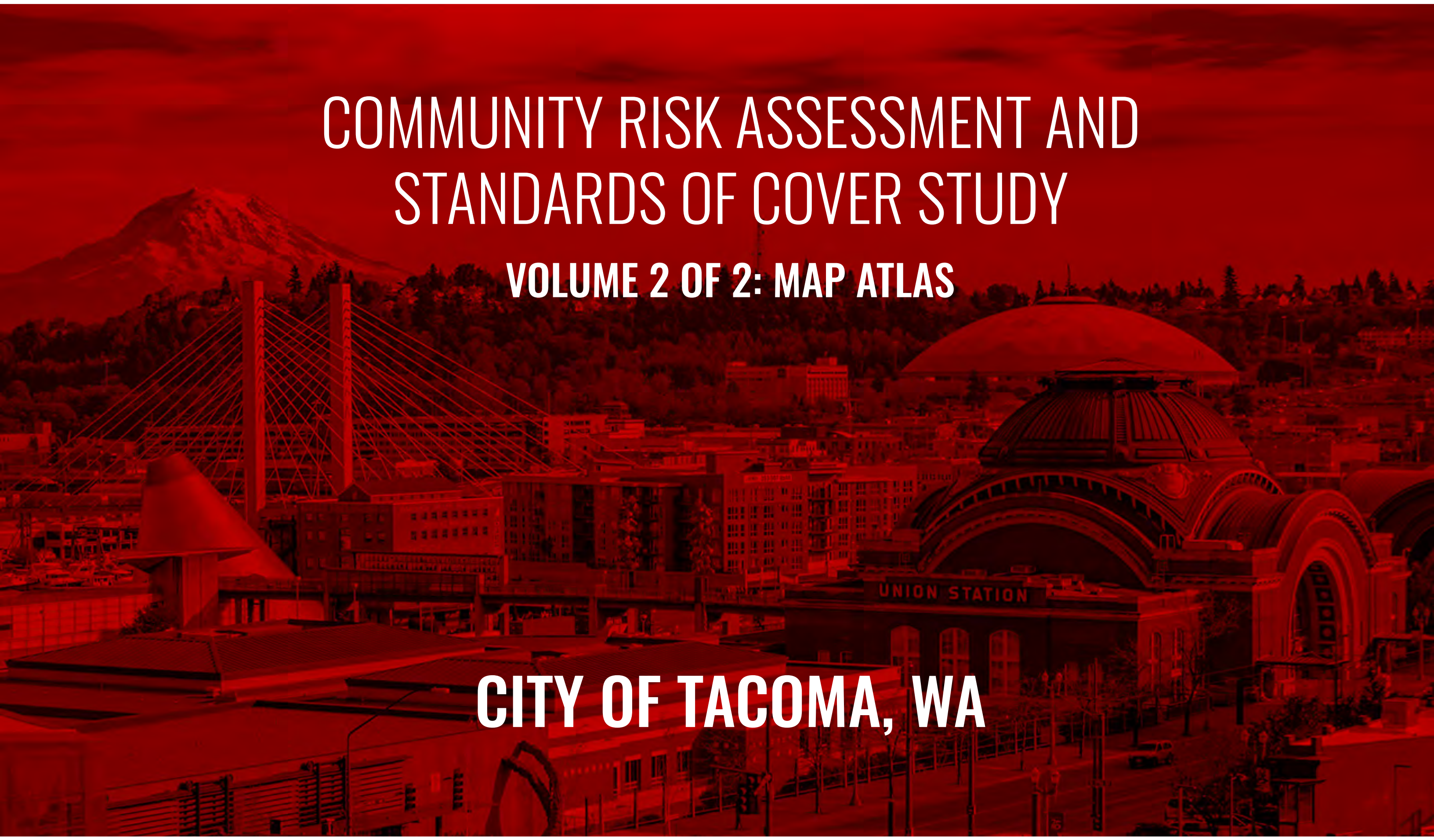
The following table summarizes Citygate's assessment of marine incident risk by planning zone.

Table 41—Marine Incident Risk Assessment

Marine Incident Risk	Risk Planning Zone								
	Sta. 1	Sta. 2	Sta. 3	Sta. 4	Sta. 5	Sta. 6	Sta. 7	Sta. 8	Sta. 9
Probability of Occurrence	*Possible*	*Possible*	*Unlikely*	*Unlikely*	*Unlikely*	*Unlikely*	*Unlikely*	*Unlikely*	*Unlikely*
Probable Impact Severity	*Moderate*	*Moderate*	*Moderate*	*Moderate*	*Moderate*	*Moderate*	*Moderate*	*Moderate*	*Moderate*
Overall Risk	***Moderate***	***Moderate***	***Low***	***Low***	***Low***	***Low***	***Low***	***Low***	***Low***

Marine Incident Risk	Risk Planning Zone (Cont.)							
	Sta. 10	Sta. 11	Sta. 12	Sta. 13	Sta. 14	Sta. 15	Sta.16	Sta.17
Probability of Occurrence	*Unlikely*	*Unlikely*	*Unlikely*	*Unlikely*	*Probable*	*Unlikely*	*Possible*	*Unlikely*
Probable Impact Severity	*Moderate*	*Moderate*	*Moderate*	*Moderate*	*Moderate*	*Moderate*	*Moderate*	*Moderate*
Overall Risk	***Low***	***Low***	***Low***	***Low***	***Moderate***	***Low***	***Moderate***	***Low***

CITYGATE ASSOCIATES, LLC
PUBLIC SAFETY SERVICES



COMMUNITY RISK ASSESSMENT AND STANDARDS OF COVER STUDY

VOLUME 2 OF 2: MAP ATLAS

CITY OF TACOMA, WA

APRIL 18, 2023

CITYGATE ASSOCIATES, LLC
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600 COOLIDGE DRIVE, SUITE 150
FOLSOM, CA 95630
PHONE: (916) 458-5100
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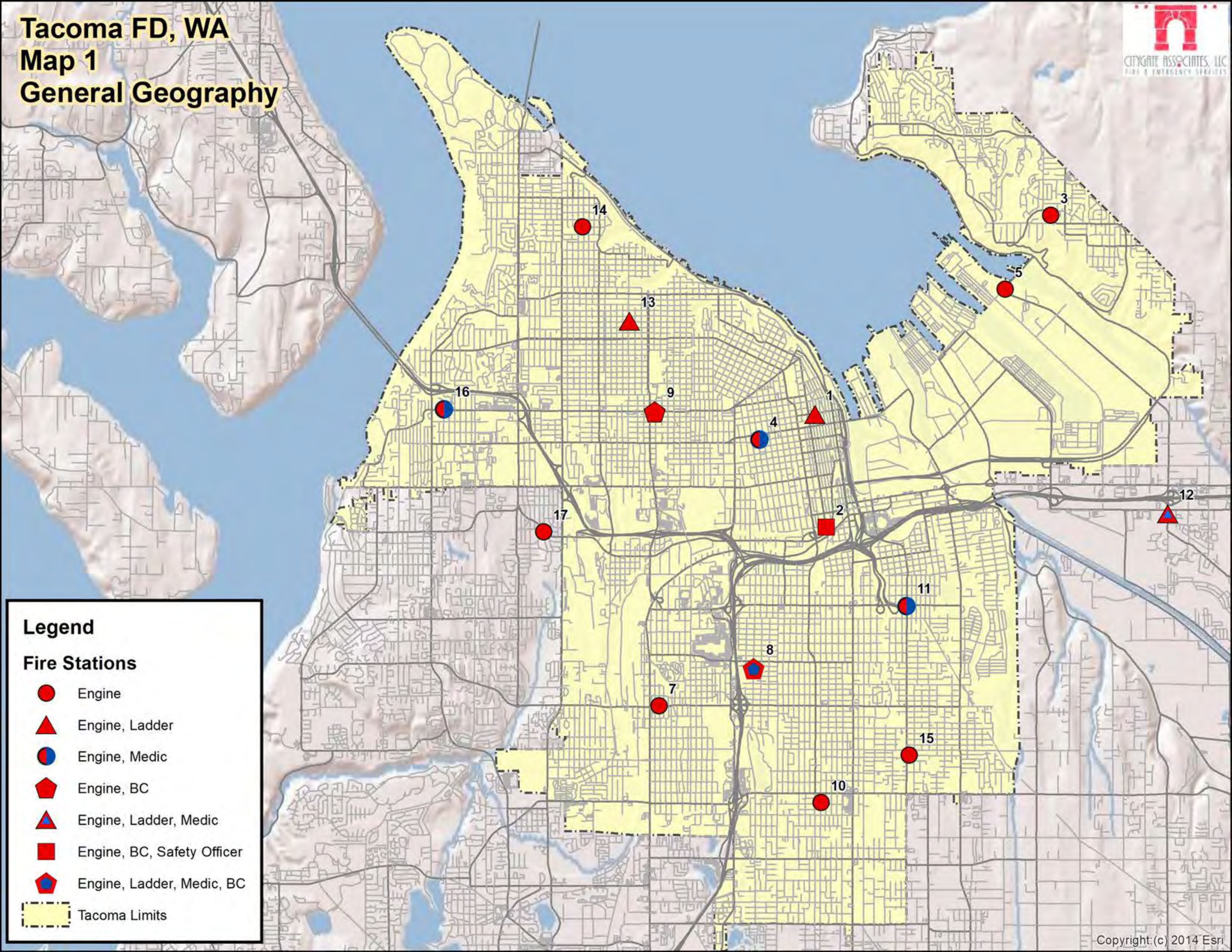

Tacoma FD, WA
Map 1
General Geography
CITIGATE ASSOCIATES, LLC
14
3
5
13
9
1
16
4
2
12
17
11
8
7
15
10
Legend
Fire Stations
Engine
Engine, Ladder
Engine, Medic
Engine, BC
Engine, Ladder, Medic
Engine, BC, Safety Officer
Engine, Ladder, Medic, BC
Tacoma Limits
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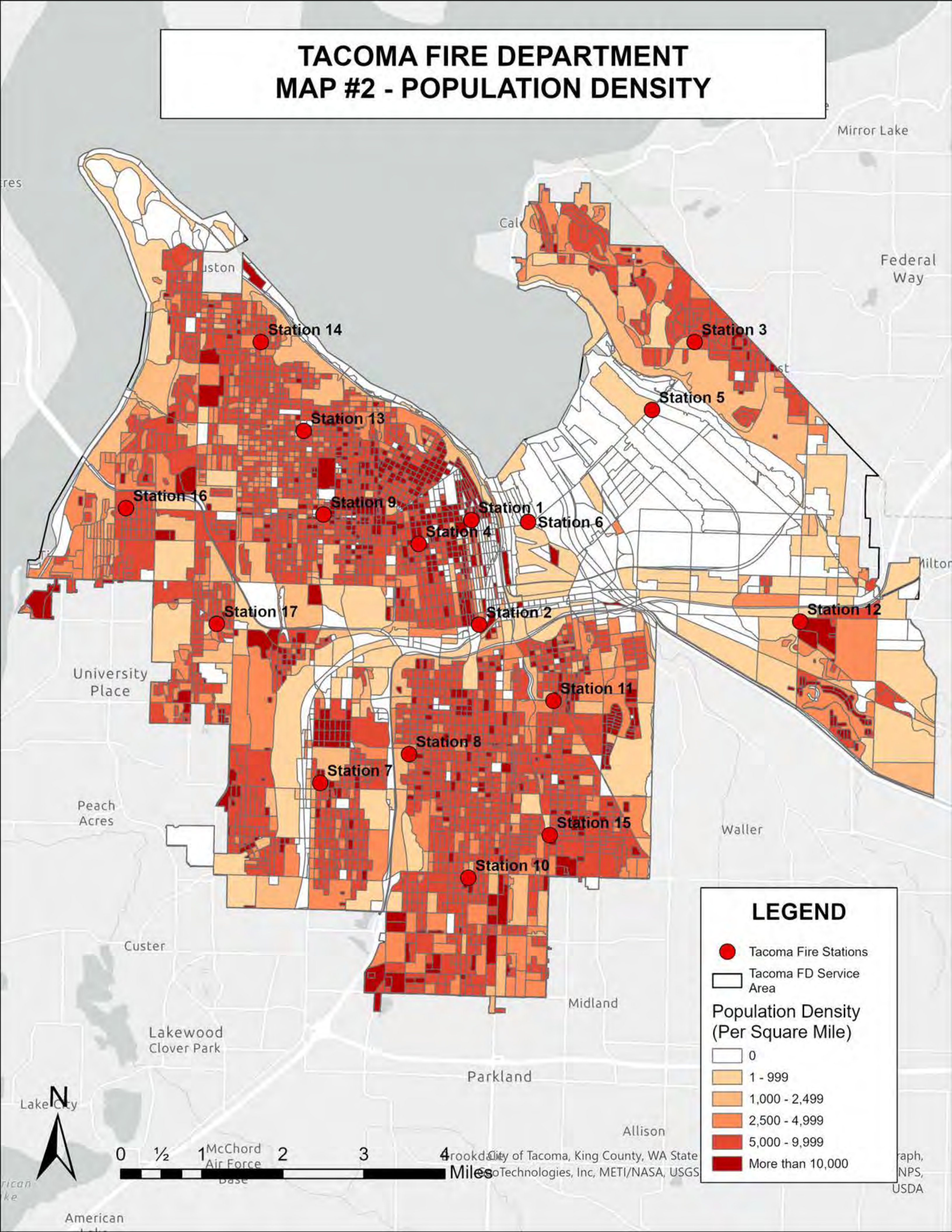
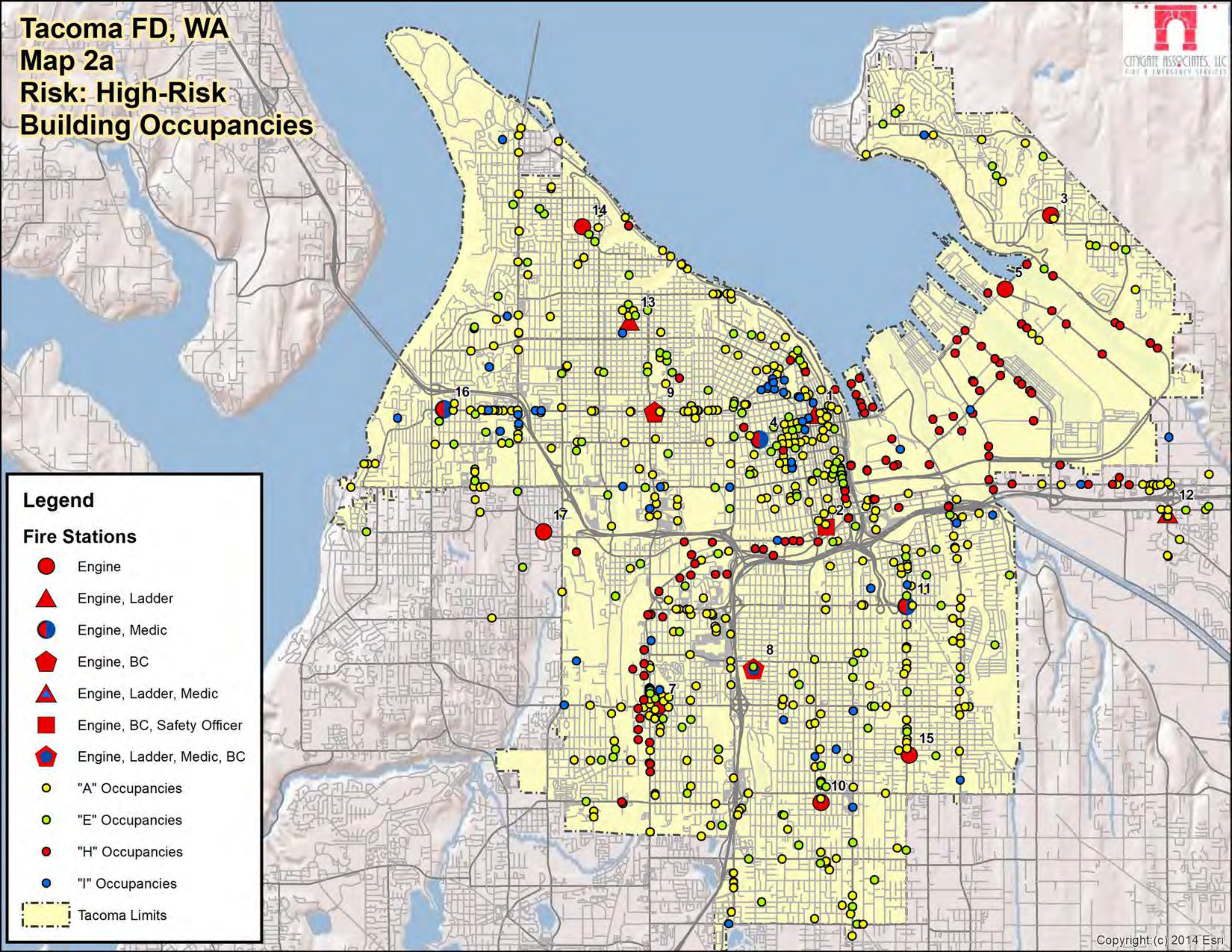

TACOMA FIRE DEPARTMENT
MAP #2 - POPULATION DENSITY
Station 14
Station 3
Station 5
Station 13
Station 16
Station 9
Station 1
Station 6
Station 4
Station 17
Station 2
Station 12
Station 11
Station 8
Station 7
Station 15
Station 10
Mirror Lake
Federal Way
University Place
Peach Acres
Waller
Custer
Midland
Lakewood
Clover Park
Parkland
Lake City
Allison
McChord Air Force Base
American
N
0 ½ 1 2 3 4 Miles
City of Tacoma, King County, WA State
GeoTechnologies, Inc, METI/NASA, USGS
USDA
LEGEND
Tacoma Fire Stations
Tacoma FD Service Area
Population Density (Per Square Mile)
0
1 - 999
1,000 - 2,499
2,500 - 4,999
5,000 - 9,999
More than 10,000



Tacoma FD, WA
Map 2a
Risk: High-Risk
Building Occupancies
Citygate Associates, LLC
Fire & Emergency Services
Legend
Fire Stations
Engine
Engine, Ladder
Engine, Medic
Engine, BC
Engine, Ladder, Medic
Engine, BC, Safety Officer
Engine, Ladder, Medic, BC
"A" Occupancies
"E" Occupancies
"H" Occupancies
"I" Occupancies
Tacoma Limits
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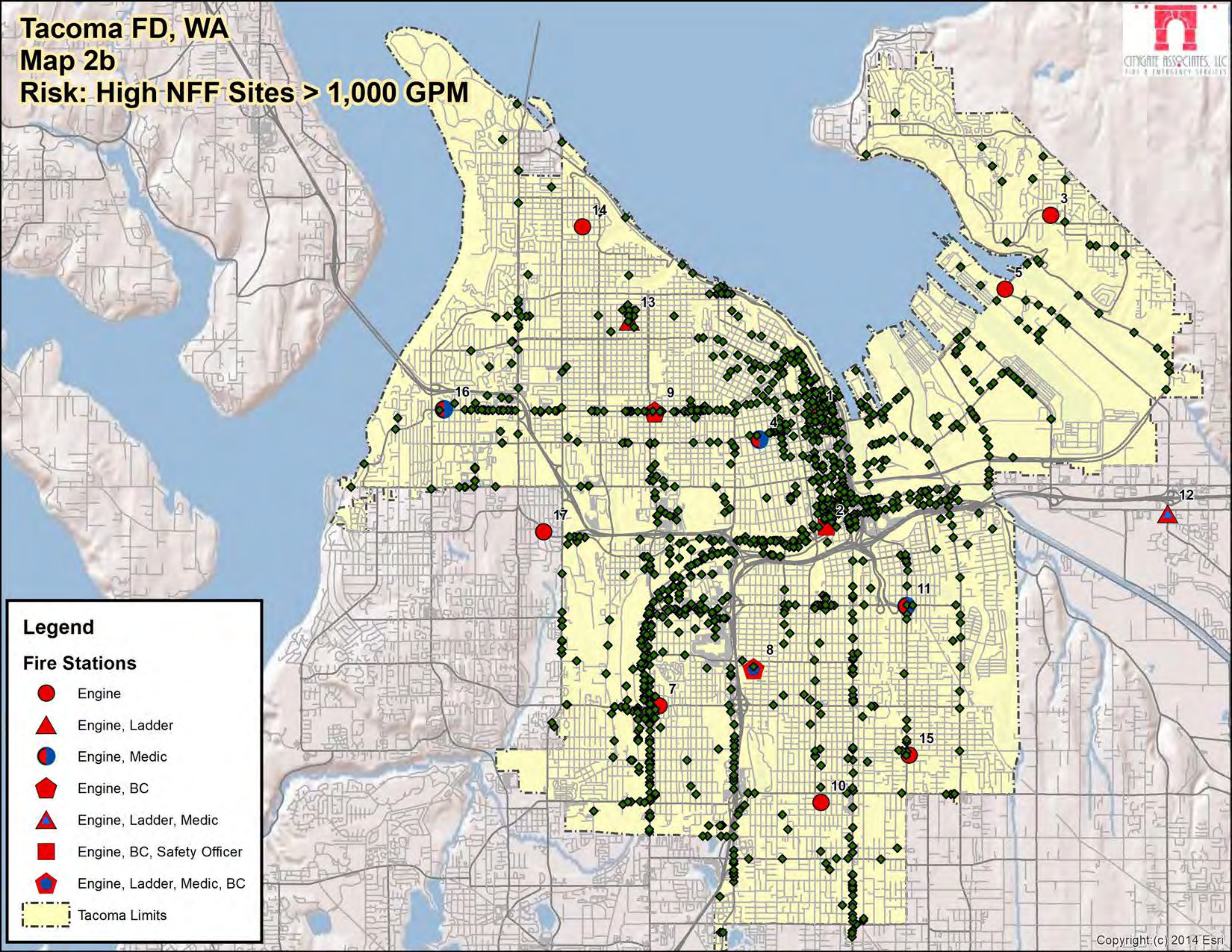
Tacoma FD, WA
Map 2b
Risk: High NFF Sites > 1,000 GPM
CITIGATE ASSOCIATES, LLC
1
2
3
4
5
7
8
9
10
11
12
13
14
15
16
17
Legend
Fire Stations
Engine
Engine, Ladder
Engine, Medic
Engine, BC
Engine, Ladder, Medic
Engine, BC, Safety Officer
Engine, Ladder, Medic, BC
Tacoma Limits
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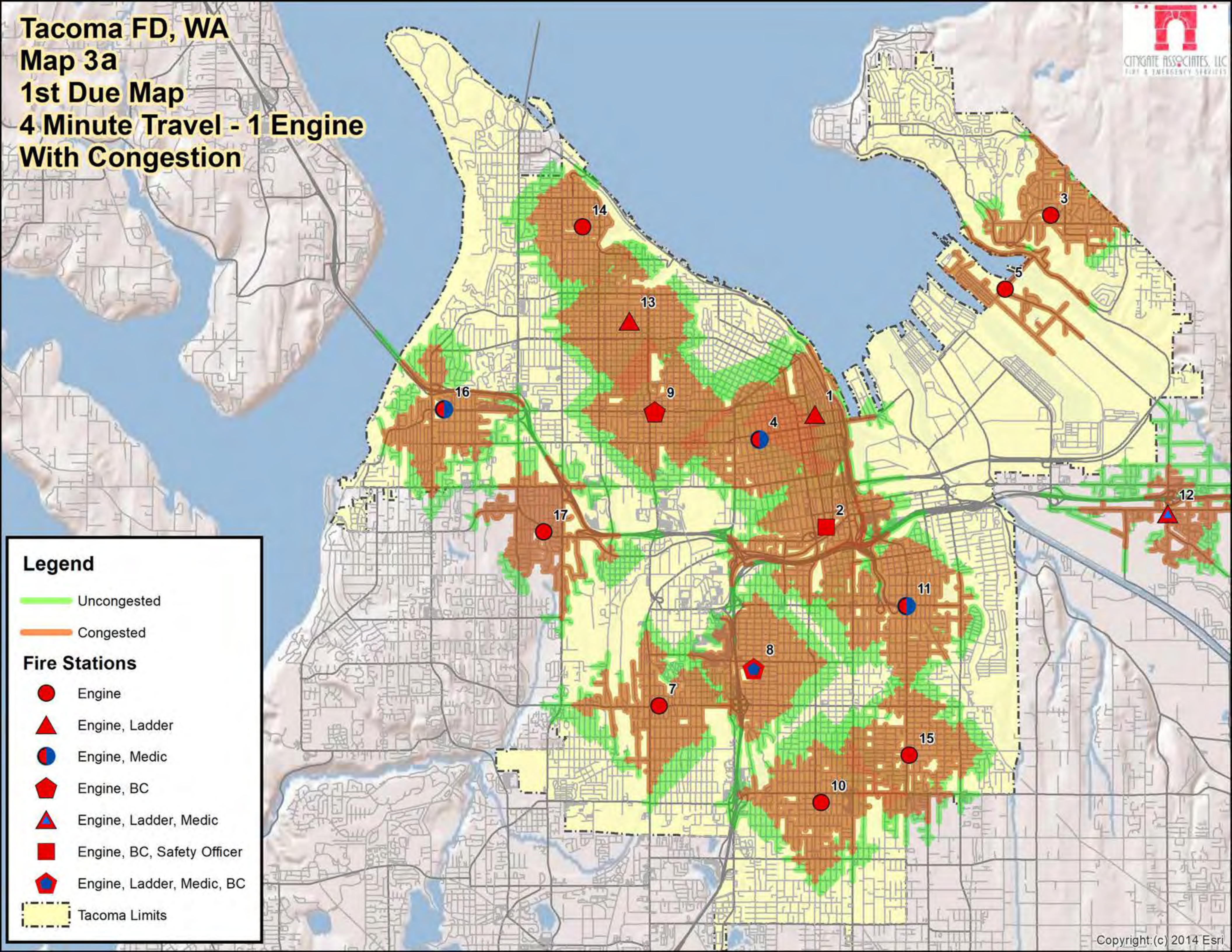

Tacoma FD, WA
Map 3a
1st Due Map
4 Minute Travel - 1 Engine
With Congestion
CITIGATE ASSOCIATES, LLC
Legend
Uncongested
Congested
Fire Stations
Engine
Engine, Ladder
Engine, Medic
Engine, BC
Engine, Ladder, Medic
Engine, BC, Safety Officer
Engine, Ladder, Medic, BC
Tacoma Limits
1
2
3
4
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14
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16
17
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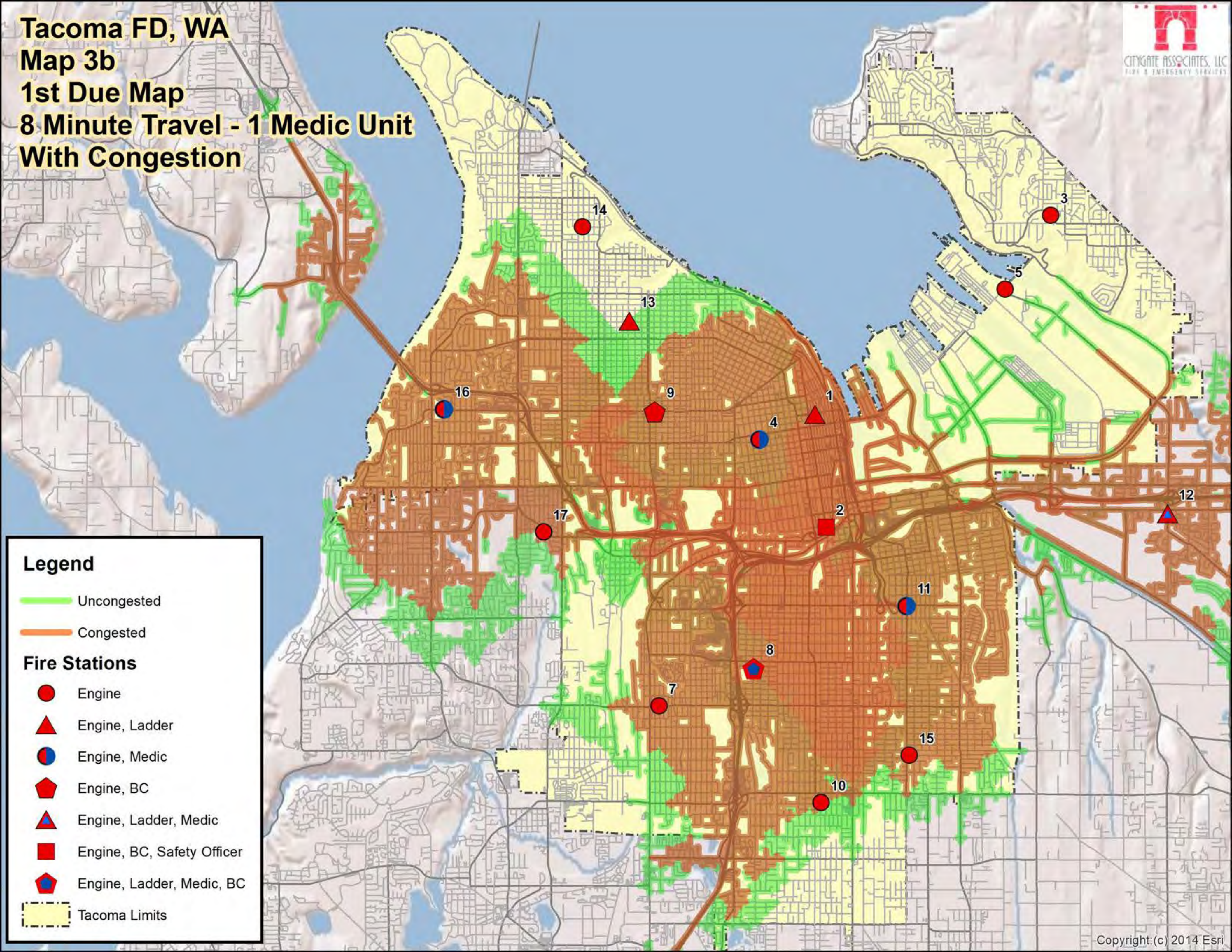

Tacoma FD, WA
Map 3b
1st Due Map
8 Minute Travel - 1 Medic Unit
With Congestion
CITYGATE ASSOCIATES, LLC
Legend
Uncongested
Congested
Fire Stations
Engine
Engine, Ladder
Engine, Medic
Engine, BC
Engine, Ladder, Medic
Engine, BC, Safety Officer
Engine, Ladder, Medic, BC
Tacoma Limits
1
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17
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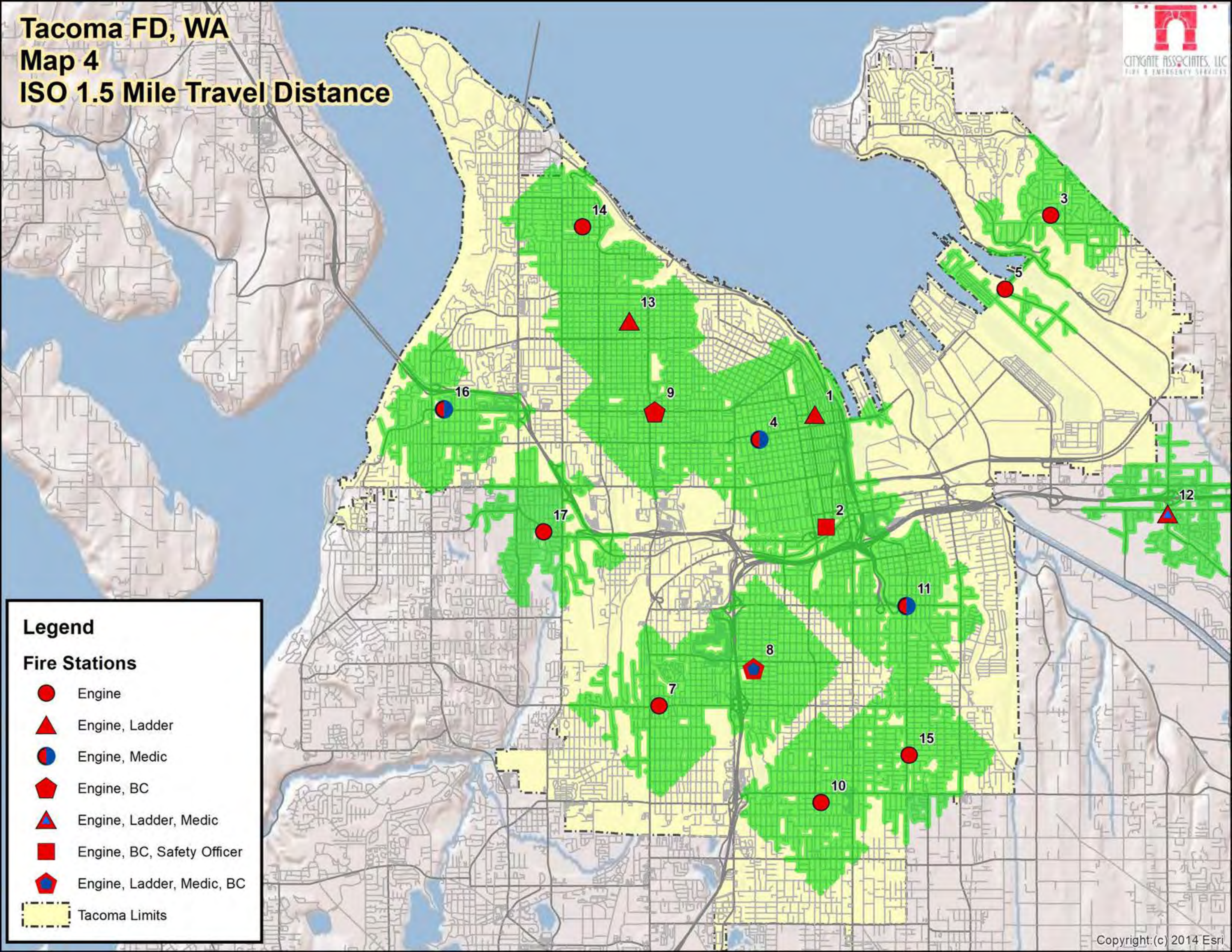
Tacoma FD, WA
Map 4
ISO 1.5 Mile Travel Distance
CITIGATE ASSOCIATES, LLC
14
3
5
13
16
9
1
4
12
2
17
11
8
7
15
10
Legend
Fire Stations
Engine
Engine, Ladder
Engine, Medic
Engine, BC
Engine, Ladder, Medic
Engine, BC, Safety Officer
Engine, Ladder, Medic, BC
Tacoma Limits
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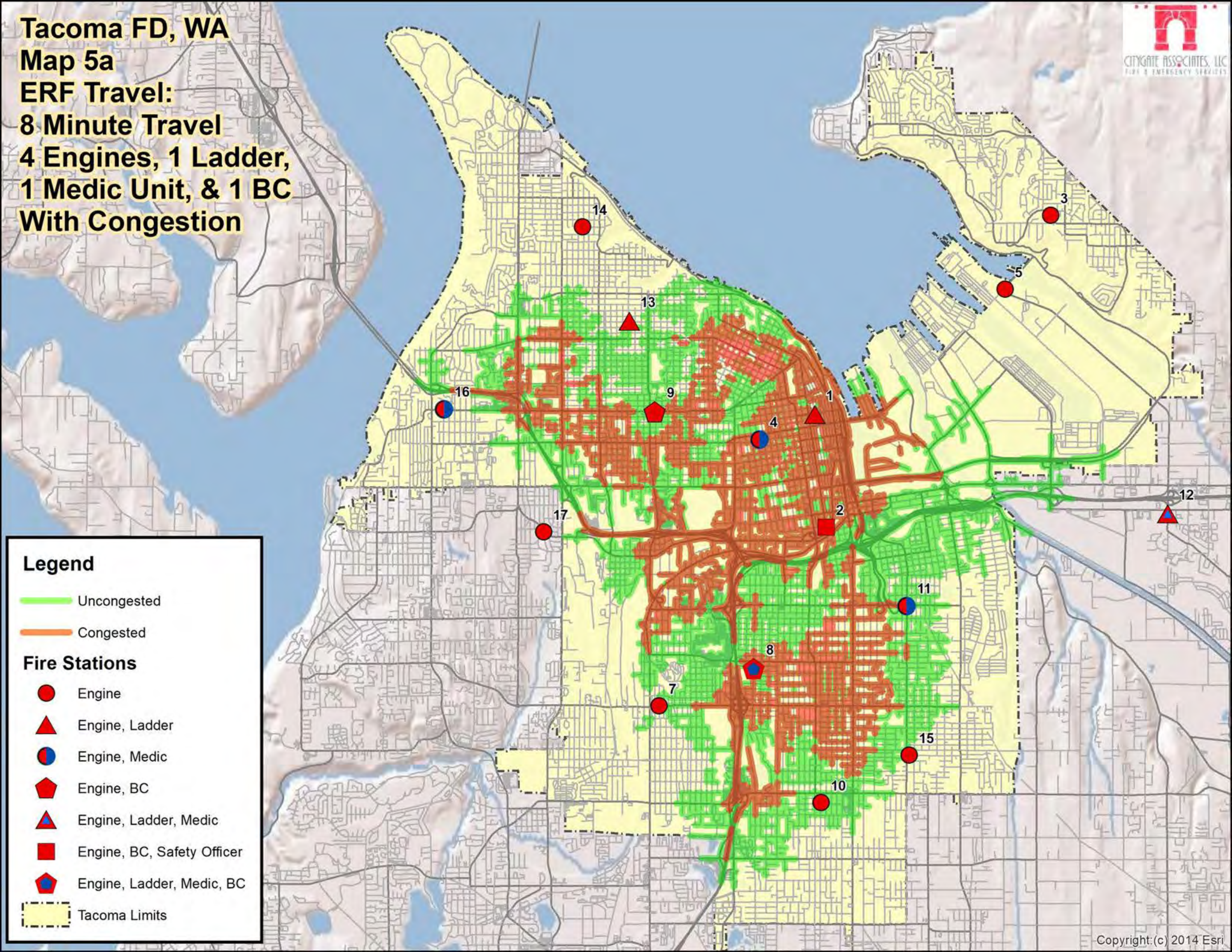

Tacoma FD, WA
Map 5a
ERF Travel:
8 Minute Travel
4 Engines, 1 Ladder,
1 Medic Unit, & 1 BC
With Congestion
Citygate Associates, LLC
Legend
Uncongested
Congested
Fire Stations
Engine
Engine, Ladder
Engine, Medic
Engine, BC
Engine, Ladder, Medic
Engine, BC, Safety Officer
Engine, Ladder, Medic, BC
Tacoma Limits
1
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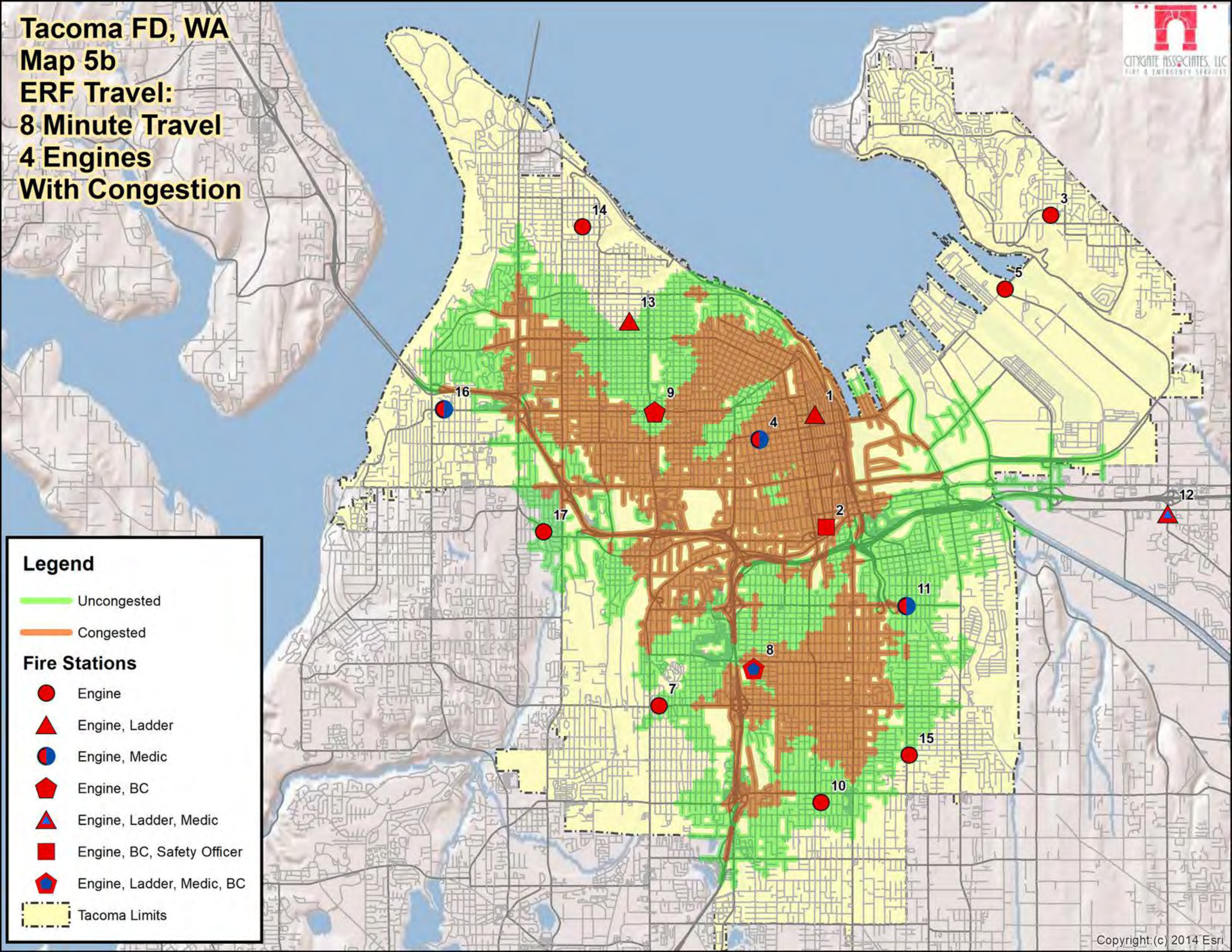
Tacoma FD, WA
Map 5b
ERF Travel:
8 Minute Travel
4 Engines
With Congestion
CITIGATE ASSOCIATES, LLC
14
3
5
13
16
9
1
4
12
17
2
11
8
7
15
10
Legend
Uncongested
Congested
Fire Stations
Engine
Engine, Ladder
Engine, Medic
Engine, BC
Engine, Ladder, Medic
Engine, BC, Safety Officer
Engine, Ladder, Medic, BC
Tacoma Limits
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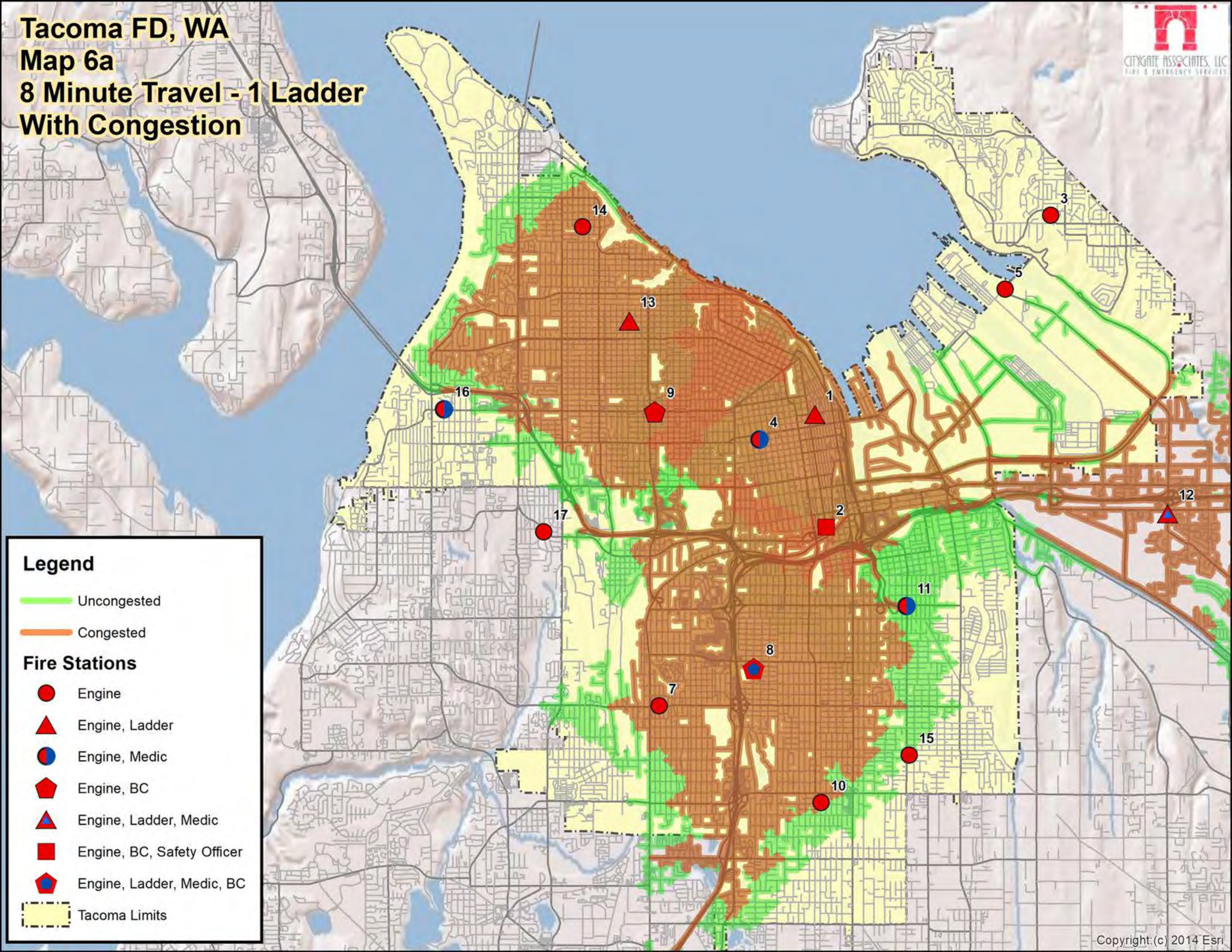
Tacoma FD, WA
Map 6a
8 Minute Travel - 1 Ladder
With Congestion
CITIGATE ASSOCIATES, LLC
FIRE & EMERGENCY SERVICES
Legend
Uncongested
Congested
Fire Stations
Engine
Engine, Ladder
Engine, Medic
Engine, BC
Engine, Ladder, Medic
Engine, BC, Safety Officer
Engine, Ladder, Medic, BC
Tacoma Limits
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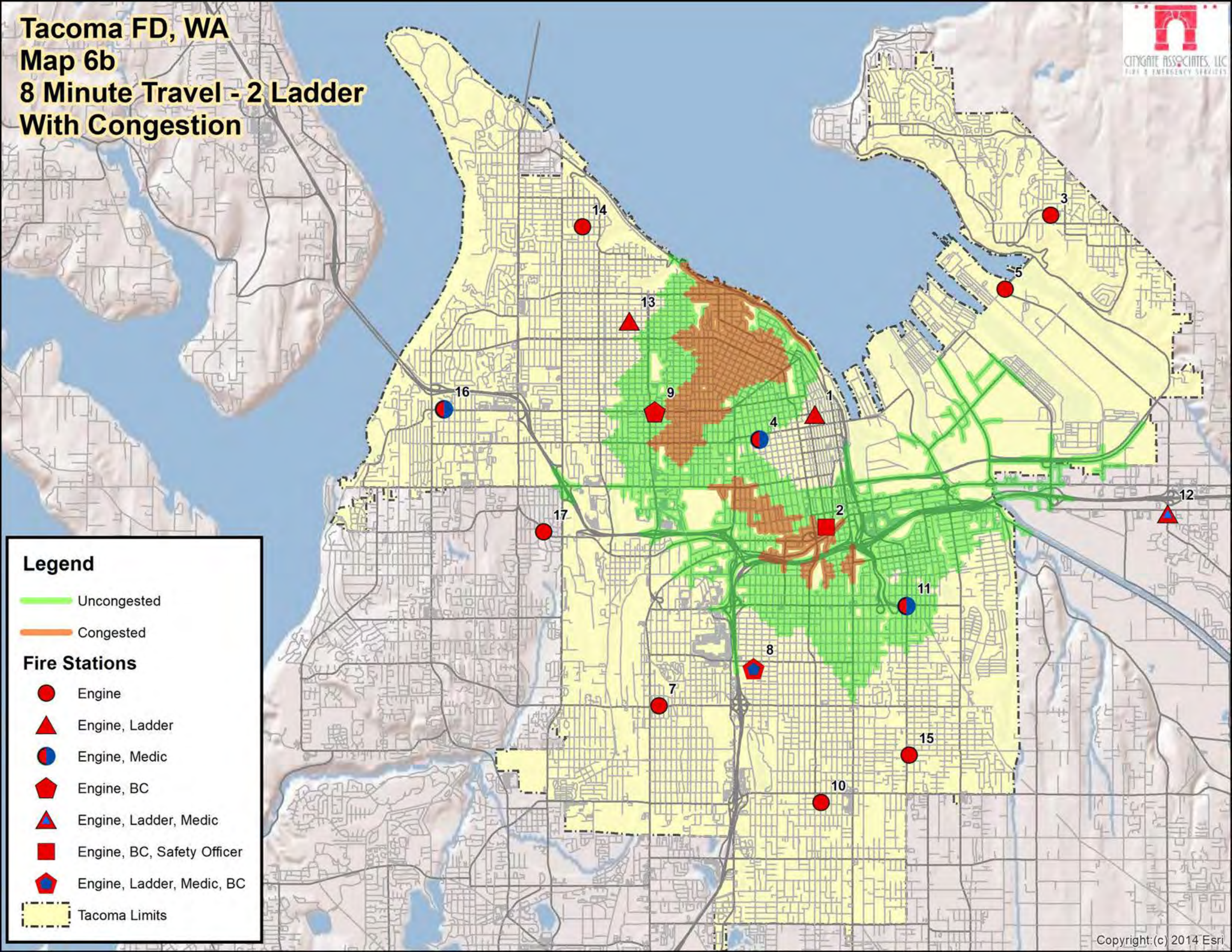

Tacoma FD, WA
Map 6b
8 Minute Travel - 2 Ladder
With Congestion
Citygate Associates, LLC
Legend
Uncongested
Congested
Fire Stations
Engine
Engine, Ladder
Engine, Medic
Engine, BC
Engine, Ladder, Medic
Engine, BC, Safety Officer
Engine, Ladder, Medic, BC
Tacoma Limits
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14
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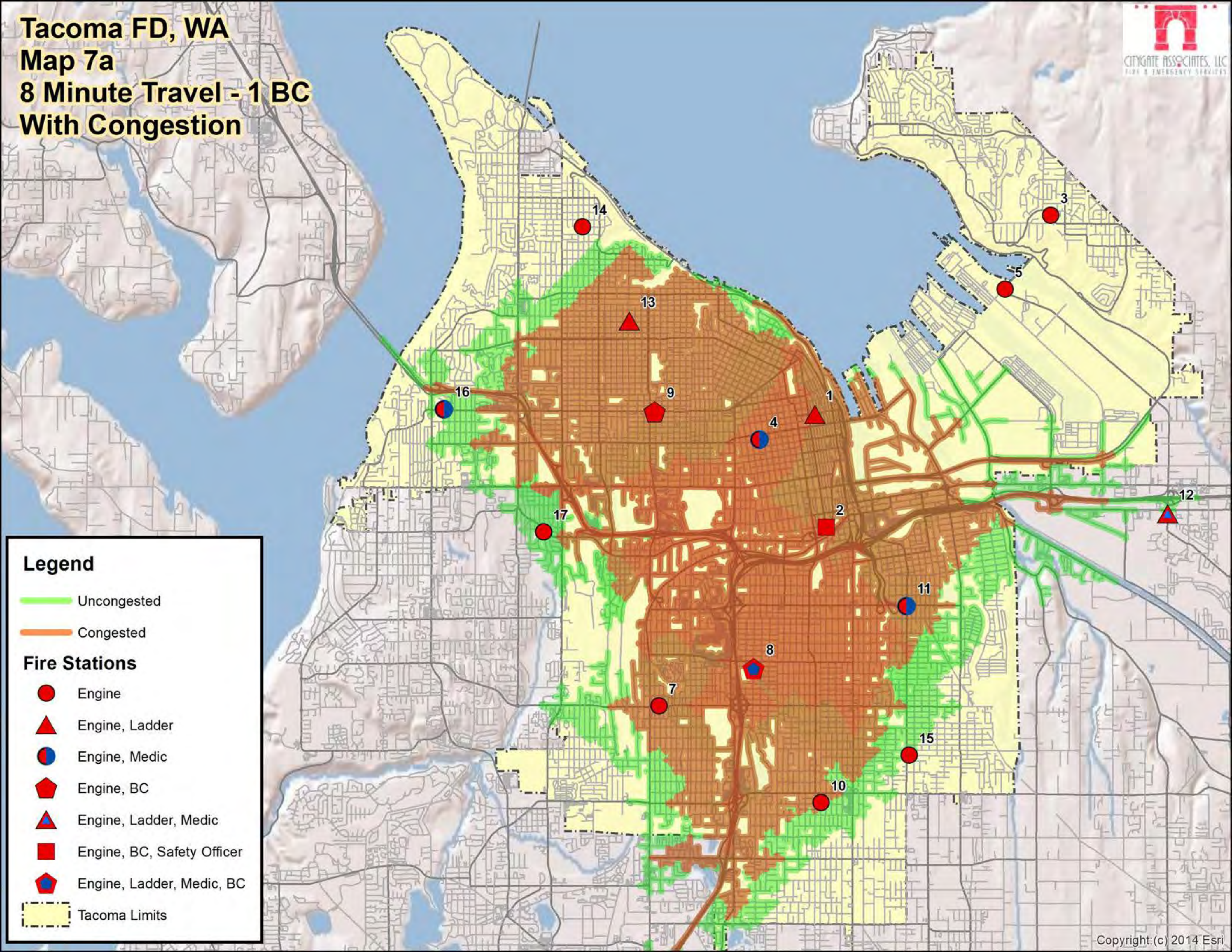

Tacoma FD, WA
Map 7a
8 Minute Travel - 1 BC
With Congestion
CITYGATE ASSOCIATES, LLC
Legend
Uncongested
Congested
Fire Stations
Engine
Engine, Ladder
Engine, Medic
Engine, BC
Engine, Ladder, Medic
Engine, BC, Safety Officer
Engine, Ladder, Medic, BC
Tacoma Limits
1
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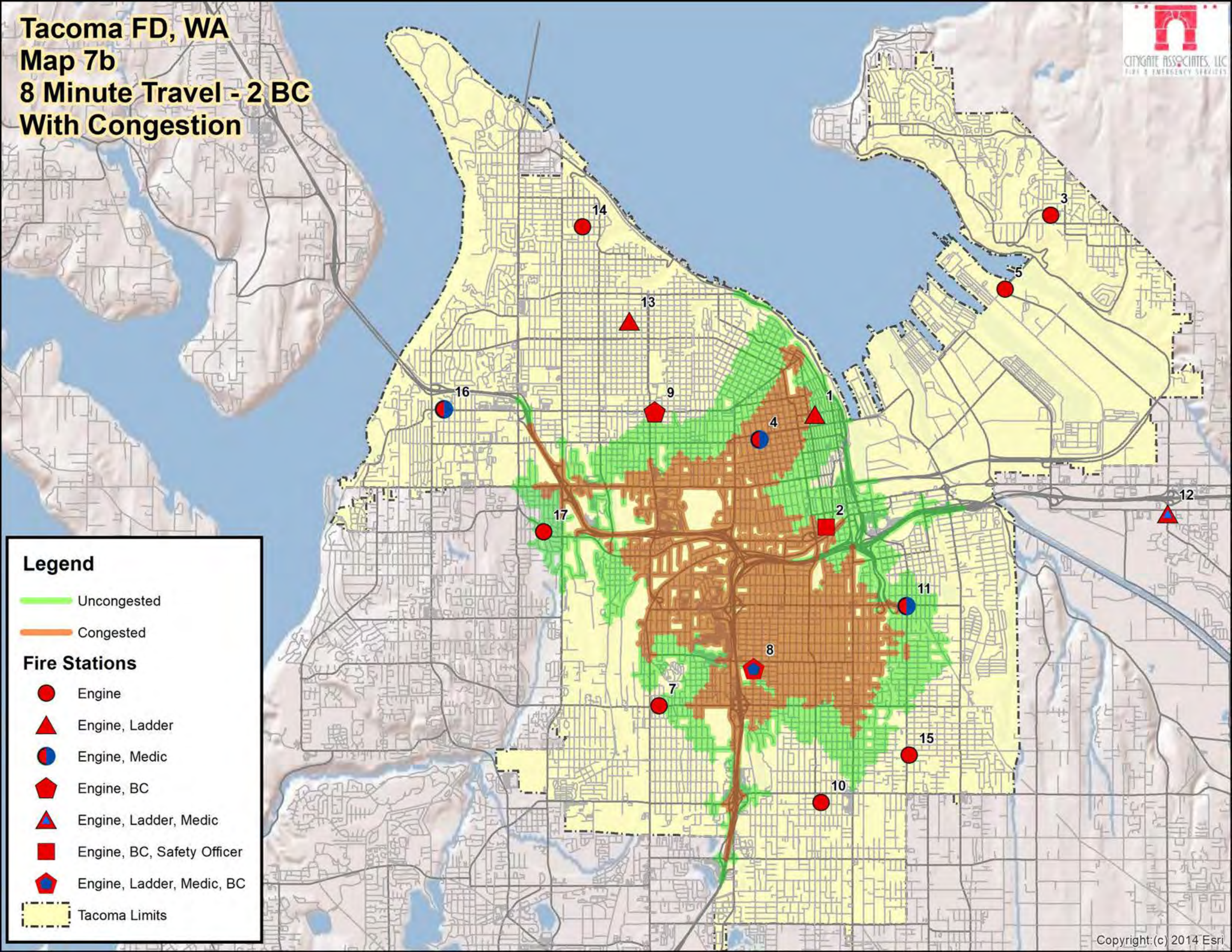
Tacoma FD, WA
Map 7b
8 Minute Travel - 2 BC
With Congestion
CITYGATE ASSOCIATES, LLC
FIRE & EMERGENCY SERVICES
Legend
Uncongested
Congested
Fire Stations
Engine
Engine, Ladder
Engine, Medic
Engine, BC
Engine, Ladder, Medic
Engine, BC, Safety Officer
Engine, Ladder, Medic, BC
Tacoma Limits
1
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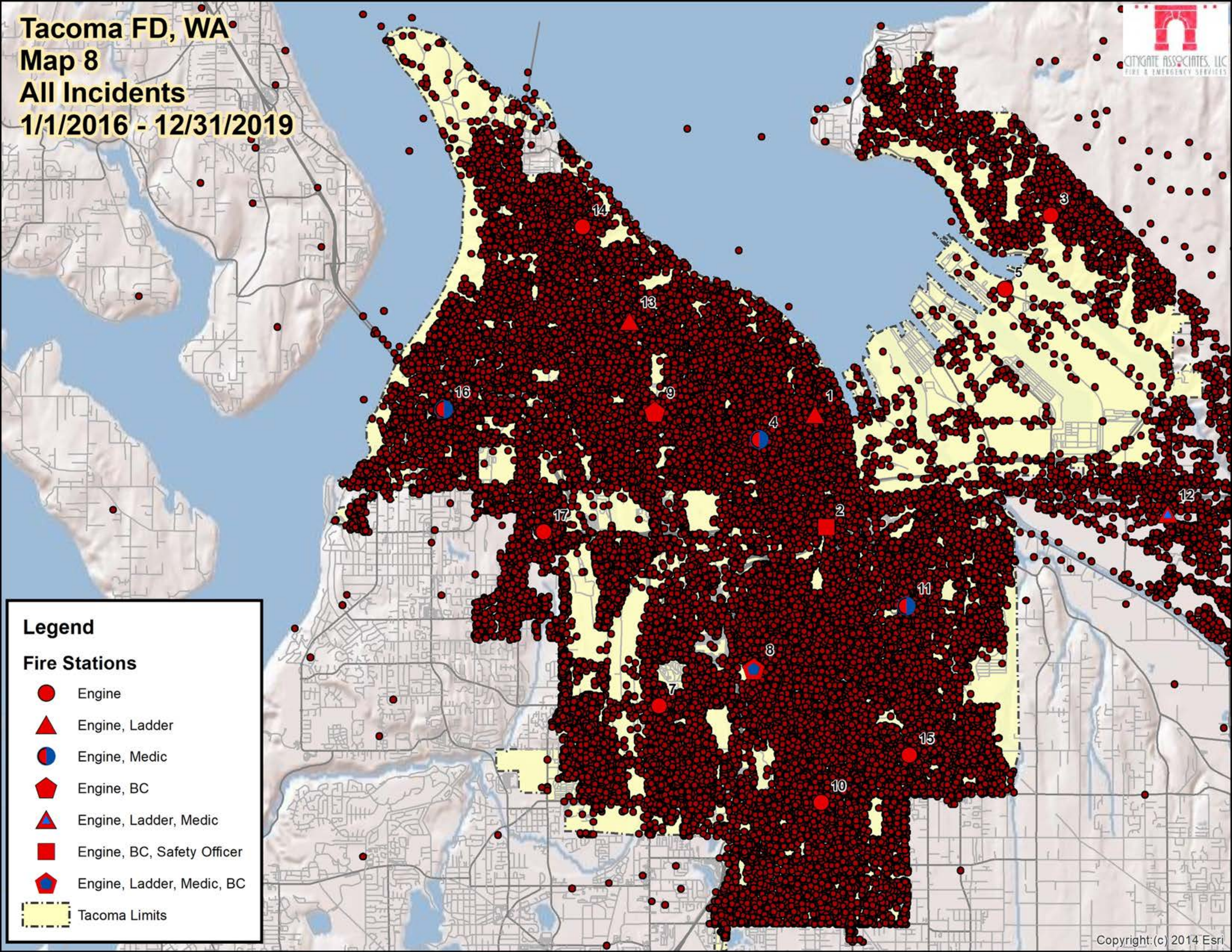

Tacoma FD, WA
Map 8
All Incidents
1/1/2016 - 12/31/2019
CITYGATE ASSOCIATES, LLC
FIRE & EMERGENCY SERVICES
14
13
3
5
16
9
4
1
12
2
17
11
8
7
15
10
Legend
Fire Stations
Engine
Engine, Ladder
Engine, Medic
Engine, BC
Engine, Ladder, Medic
Engine, BC, Safety Officer
Engine, Ladder, Medic, BC
Tacoma Limits
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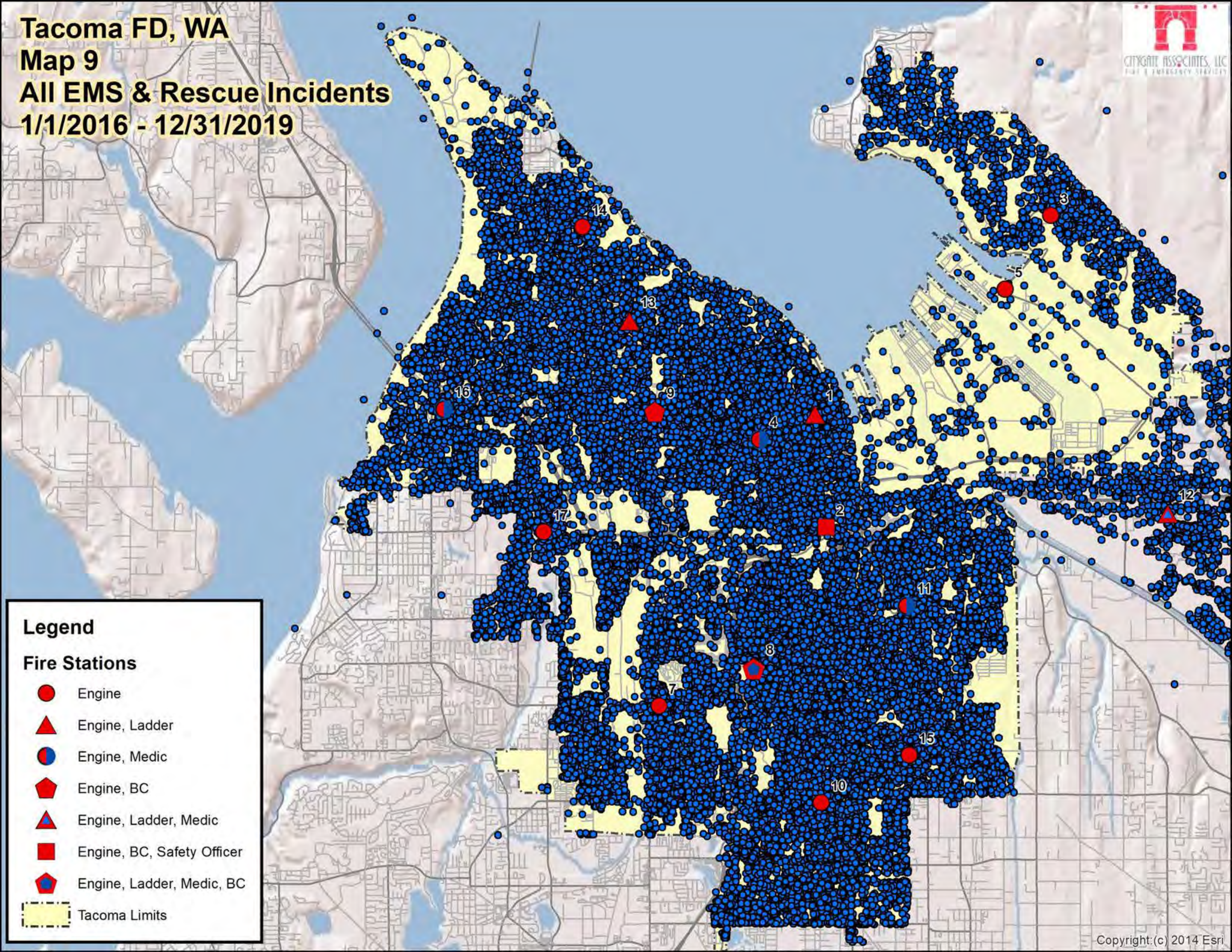
Tacoma FD, WA
Map 9
All EMS & Rescue Incidents
1/1/2016 - 12/31/2019
Citygate Associates, LLC
14
3
5
13
16
9
1
4
12
17
2
11
8
7
15
10
Legend
Fire Stations
Engine
Engine, Ladder
Engine, Medic
Engine, BC
Engine, Ladder, Medic
Engine, BC, Safety Officer
Engine, Ladder, Medic, BC
Tacoma Limits
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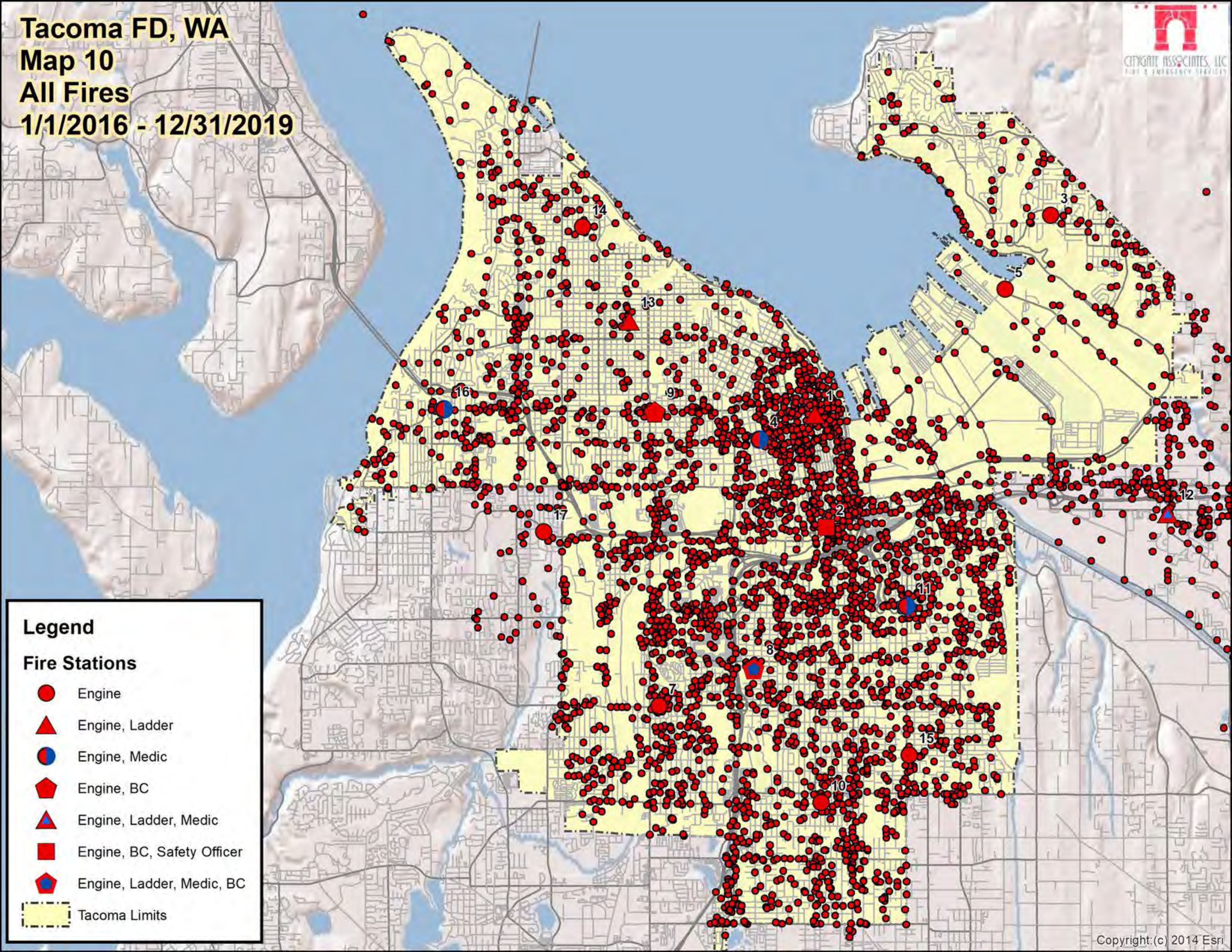
Tacoma FD, WA
Map 10
All Fires
1/1/2016 - 12/31/2019
Citygate Associates, LLC
14
13
16
9
4
1
3
5
12
2
17
11
8
7
15
10
Legend
Fire Stations
Engine
Engine, Ladder
Engine, Medic
Engine, BC
Engine, Ladder, Medic
Engine, BC, Safety Officer
Engine, Ladder, Medic, BC
Tacoma Limits
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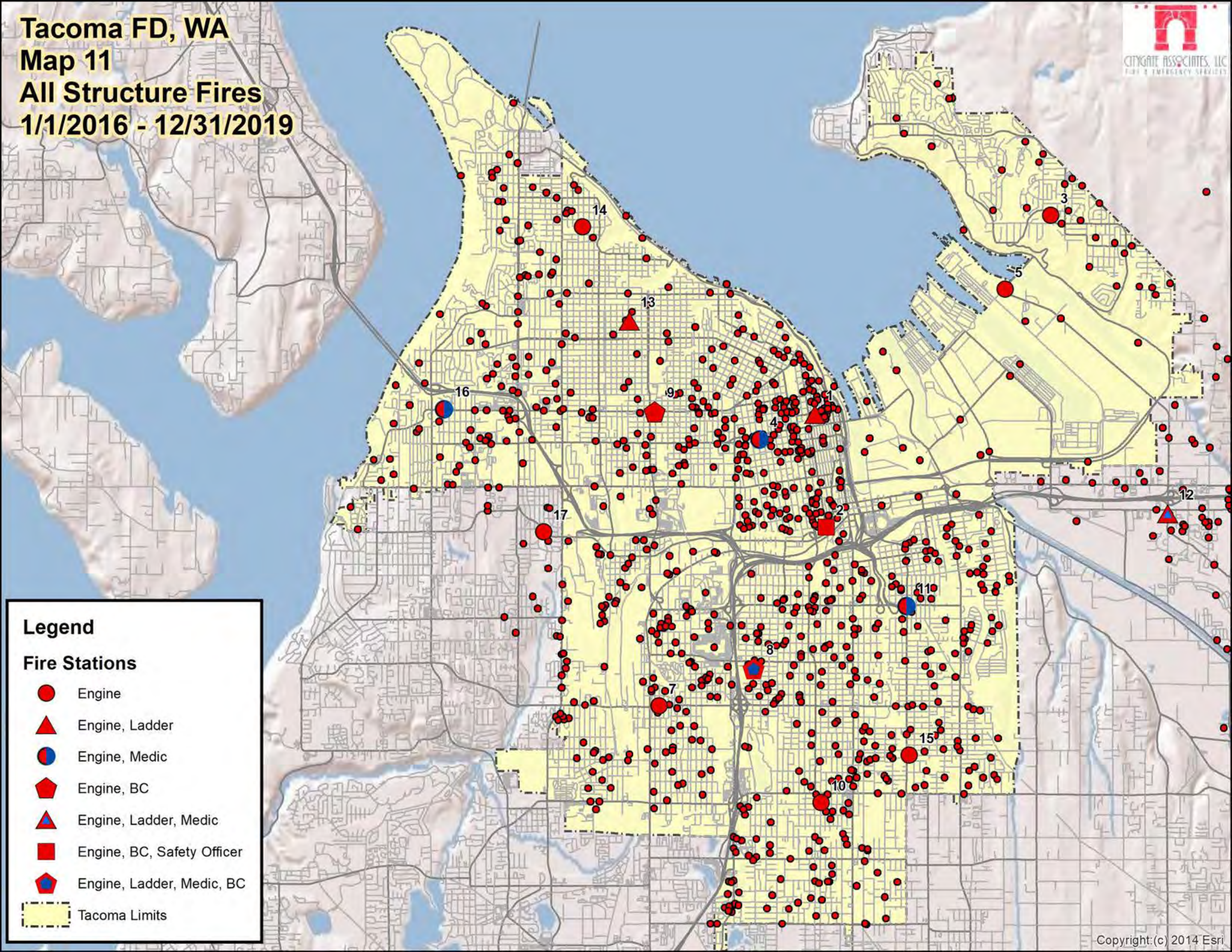
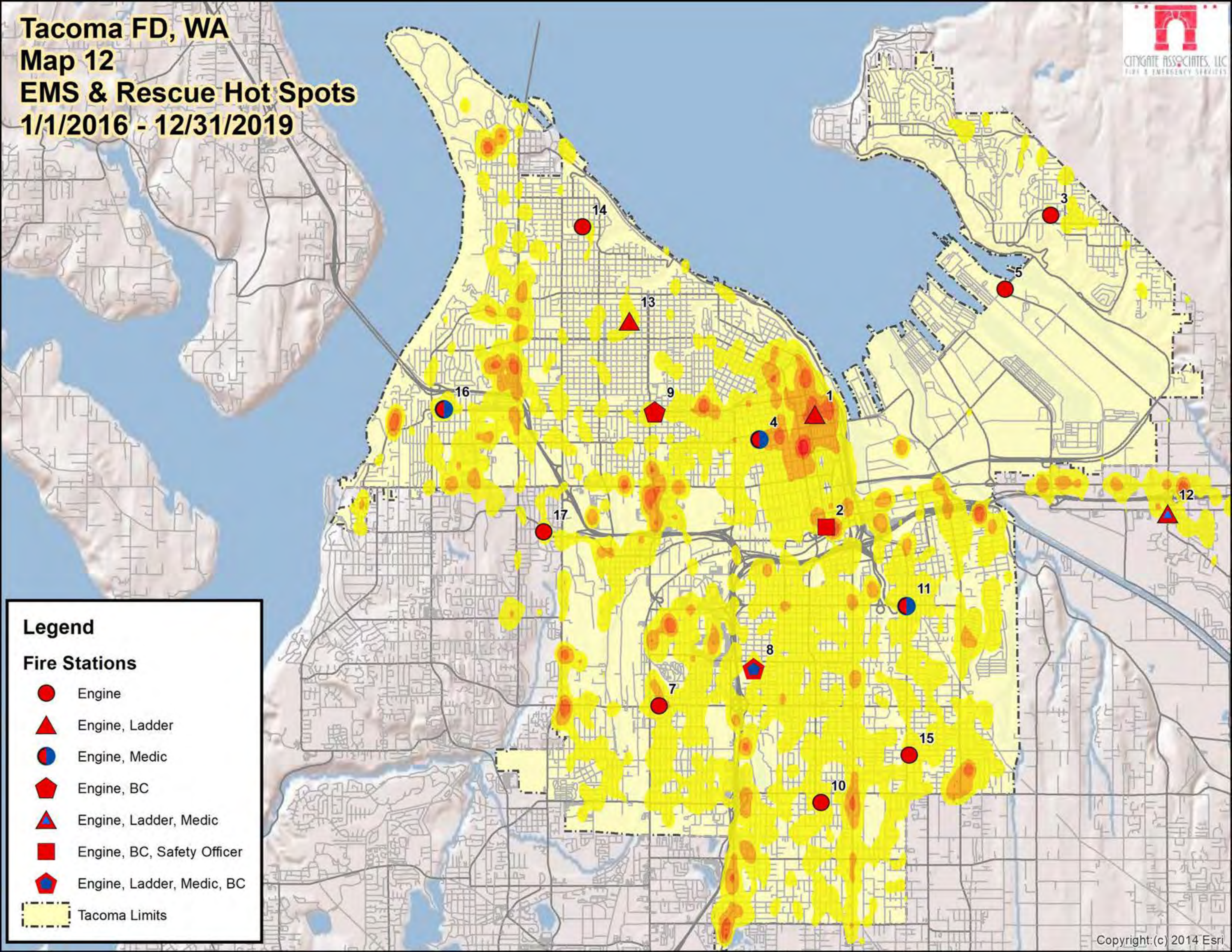

Tacoma FD, WA
Map 11
All Structure Fires
1/1/2016 - 12/31/2019
CITYGATE ASSOCIATES, LLC
FIRE & EMERGENCY SERVICES
Legend
Fire Stations
Engine
Engine, Ladder
Engine, Medic
Engine, BC
Engine, Ladder, Medic
Engine, BC, Safety Officer
Engine, Ladder, Medic, BC
Tacoma Limits
Copyright:(c) 2014 Esri


Tacoma FD, WA
Map 12
EMS & Rescue Hot Spots
1/1/2016 - 12/31/2019
CITYGATE ASSOCIATES, LLC
FIRE & EMERGENCY SERVICES
1
2
3
4
5
7
8
9
10
11
12
13
14
15
16
17
Legend
Fire Stations
Engine
Engine, Ladder
Engine, Medic
Engine, BC
Engine, Ladder, Medic
Engine, BC, Safety Officer
Engine, Ladder, Medic, BC
Tacoma Limits
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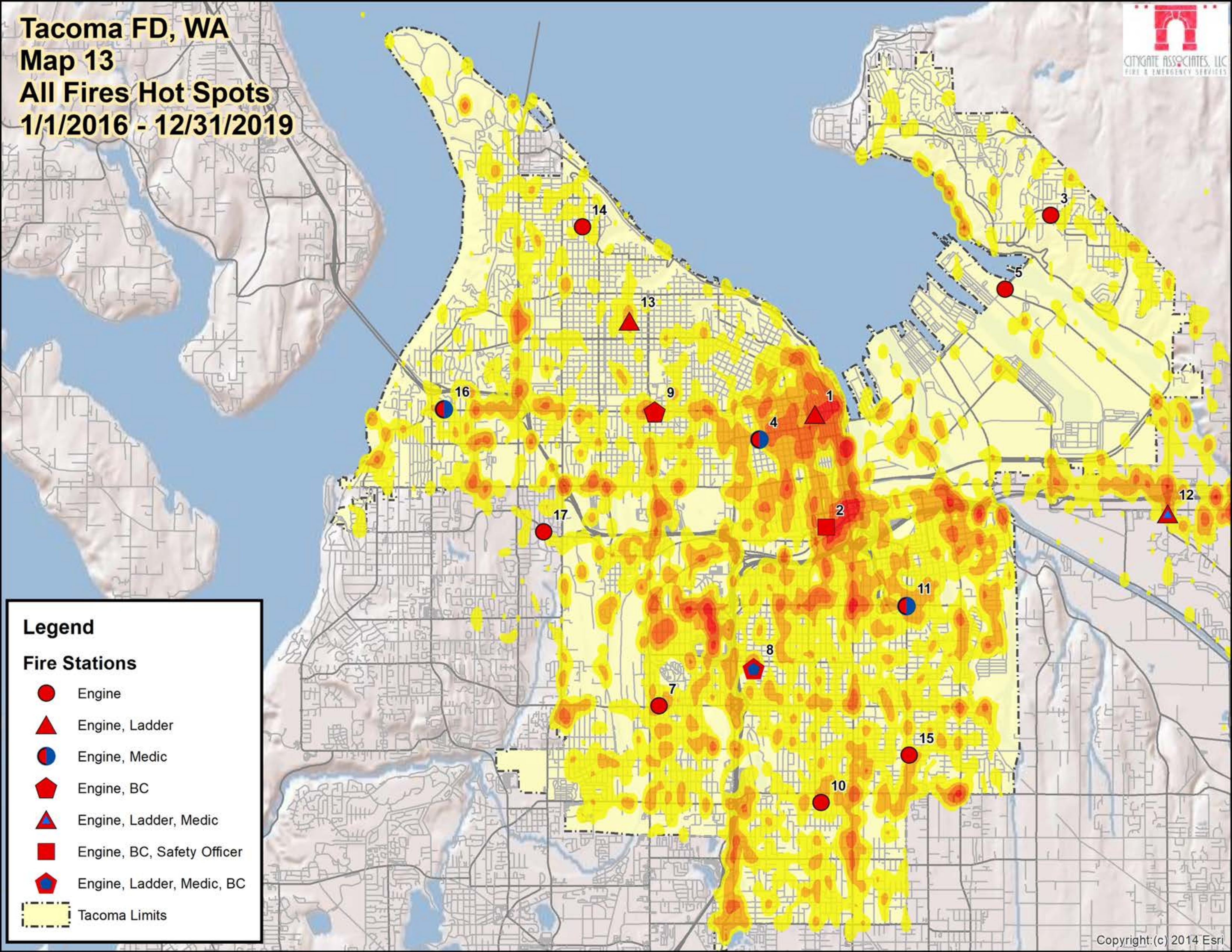

Tacoma FD, WA
Map 13
All Fires Hot Spots
1/1/2016 - 12/31/2019
CITYGATE ASSOCIATES, LLC
FIRE & EMERGENCY SERVICES
14
3
5
13
9
1
16
4
2
12
17
11
8
7
15
10
Legend
Fire Stations
Engine
Engine, Ladder
Engine, Medic
Engine, BC
Engine, Ladder, Medic
Engine, BC, Safety Officer
Engine, Ladder, Medic, BC
Tacoma Limits
Copyright:(c) 2014 Esri

Tacoma FD, WA
Map 14
Structure Fires Hot Spots
1/1/2016 - 12/31/2019