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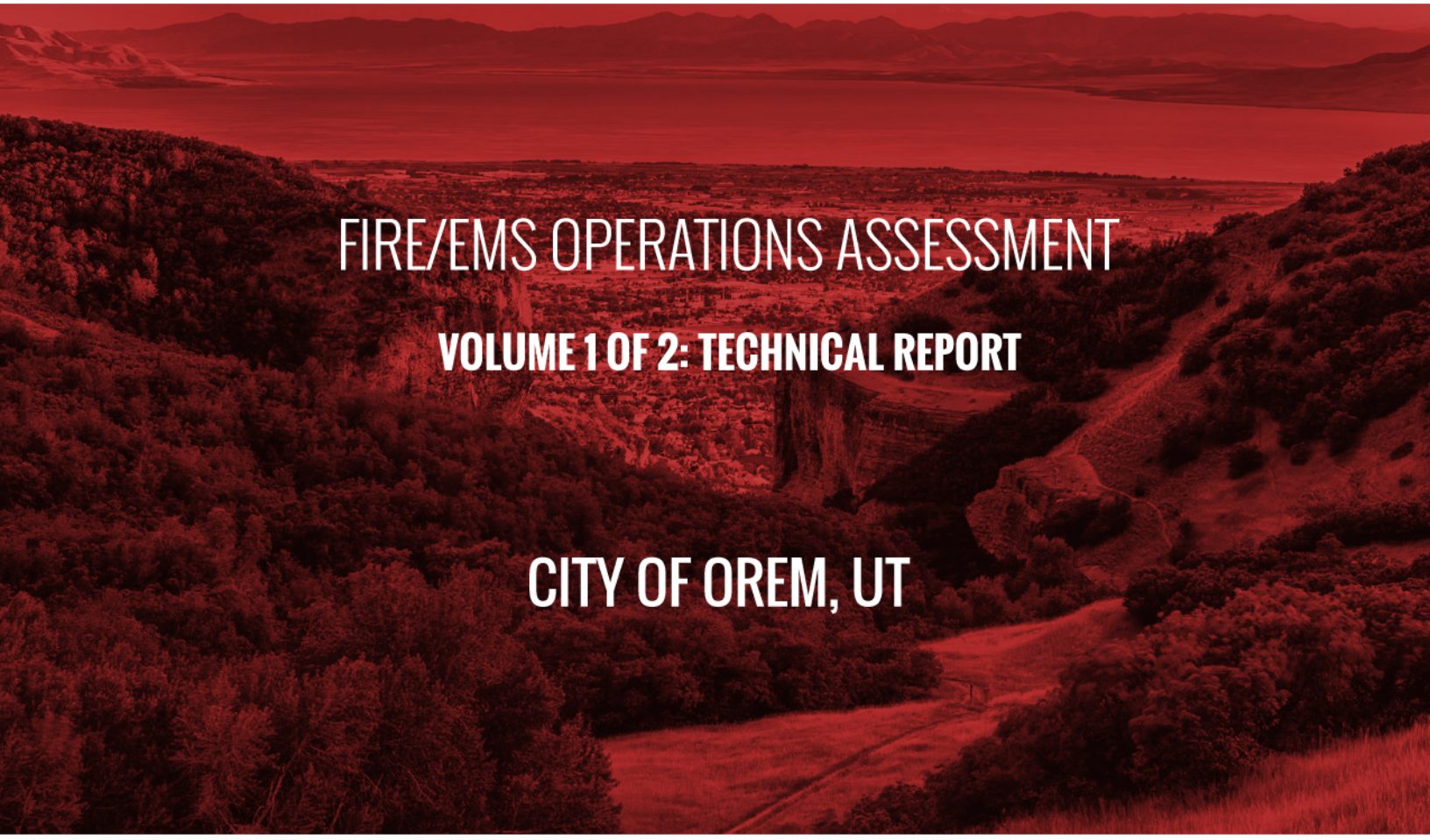
PUBLIC SAFETY SERVICES



FIRE/EMS OPERATIONS ASSESSMENT

VOLUME 1 OF 2: TECHNICAL REPORT

CITY OF OREM, UT

FEBRUARY 24, 2021

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EXECUTIVE SUMMARY

The City of Orem (City) retained Citygate Associates, LLC (Citygate) to conduct a Public Safety Operations Assessment for the Fire Department (Department) and the Police Department. This report is the fire and emergency medical services (EMS) operational assessment, known as a Standards of Coverage (SOC) assessment.

An SOC study provides an ongoing foundation for fire services planning. The goal of this assessment is to identify both current services and desired service levels and then to assess the City's ability to provide them. Citygate provides recommendations to improve Department field deployment operations.

This fire/EMS operational assessment report is presented in several parts, including this Executive Summary outlining the findings and recommendations; the fire station/crew deployment analysis supported by maps, response statistics, and a risk assessment; and the analysis of headquarters staffing. A separate Map Atlas (**Volume 2**) contains all the maps referenced throughout this report. Overall, there are 25 Fire Department findings with 15 actionable recommendations.

POLICY CHOICES FRAMEWORK

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

CITYGATE'S ASSESSMENT GENERAL SUMMARY

The City should be proud of its fire and ambulance services. Citygate found the employees to be positive and committed to their community. They have the equipment and tools they need and look forward to the Department becoming even better as some improvements can be funded over several years. City leadership and the community should view this study as a best practices tune-up that the Department and its new Fire Chief can use as a prescriptive plan. No agency is ever 100 percent meeting best practices, but with a plan and set of priorities to which City leadership commits, everyone can continue to pull together in the direction necessary. All levels of City government that Citygate engaged with were impressive, and the evidence of that starts with the commissioning of this review.

FIRE CREW DEPLOYMENT SUMMARY

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

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

If desired outcomes include limiting building fire damage to only part of the inside of an effected building and/or minimizing permanent impairment resulting from a medical emergency, then initial units should arrive within 8:30 minutes from 9-1-1 notification, and a multiple-unit ERF should arrive within 11:30 minutes of 9-1-1 notification, all at 90 percent or better reliability. Total response time to emergency incidents includes three distinct components: (1) 9-1-1 call processing/dispatch time; (2) crew turnout time; and (3) travel time. Citygate's recommendations for these response components in the City are 1:30 minutes, 2:00 minutes, and 5:00/8:00 minutes respectively for first-due and multiple-unit ERF responses in the Department's three-city service area, which includes the partner cities of Lindon and Vineyard.

The Department's current deployment system with four fire stations provides the following first-due unit response times across a variety of population density/risk areas for emergency medical and fire incident types. As the following table shows, no station area receives service by 7:30 minutes, a best practice goal for an urban area with mostly flat terrain.

Table 1—Call to Arrival Analysis – *Emergencies Only*

Station	2019
Department-wide	**11:59**
Station 1	12:22
Station 2	11:22
Station 3	11:45
Station 5	12:34

The Orem Police Department's Emergency Communications Center's call processing time to 90 percent of the fire/EMS incidents is 2:44 minutes, significantly longer than a national best practice recommendation of 1:30 minutes. At 3:27 minutes, the fire crew turnout times are *also* significantly over a Citygate recommendation of 2:00 minutes. While these two measures can be improved upon with a focused effort by staff, the fire and ambulance unit travel times in the following table are almost double a best practices recommendation of 4:00 minutes for 90 percent of the incidents in an urban population density.

Table 2—Travel Time Analysis

Station	2019
Department-wide	**7:44**
Station 1	8:05
Station 2	7:16
Station 3	7:28
Station 5	8:04

The 4:00-minute first-due goal as published in National Fire Protection Association (NFPA) 1710 was developed in an era before advanced geographic information systems (GIS) mapping and statistics could model the challenges of a community with hills and a curvilinear street network.[1] Also, in that era, dispatch processing and crew turnout were thought to only require 1:00 minute each. It is now understood that the complexities of dispatching can take up to 1:30 minutes and crew turnout can take up to 2:00 minutes.

Two Deployment Challenges

There are two primary challenges facing the street-level delivery of fire and ambulance services in the City—travel time and limited staffing. These two challenges are interrelated. The travel time challenge in Orem and its partner cities of Lindon and Vineyard is to cost-effectively provide 4:00- and 8:00-minute travel time coverage for best outcomes when challenged by a mostly non-grid road network design, geography with open spaces, and limited crossings at the highways.

The City is only fielding four fire stations likely placed using the decades-old ISO measure of 1.5 miles distance coverage in each direction. Reaching 90 percent of the calls in 4:00 minutes travel time or less would require additional stations, which is not fiscally prudent based on the number and severity of incidents at this time. While EMS incidents account for about 74 percent of the incidents, typically less than 20 percent of those are life-threatening critical emergencies with a

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

stopped heart or breathing. Offsetting the slow response times is the number of structure fires, modestly averaging 21 per year, and the four-station system can deliver all of the on-duty personnel to at least the core of the City within 8:00 minutes travel time.

The second challenge is the modest staffing level of the City firefighting units at only two personnel each, which is more typical of a rural department. In the prior era of merged public safety departments, patrol officers assisted on firefighting; since the separation of police and fire/EMS functions, that is increasingly rare as the growing technical job demands on both police and firefighting/EMS personnel limit the training, education, and field experience time to be 100 percent effective at both jobs.

While the City has five personnel assigned per fire station (four minimum per shift), four of these personnel are used when an ambulance and fire engine respond first to EMS incidents, so when one or two stations are committed on EMS incidents, there is only about 50 percent of the firefighting force still available for emergency response. A serious building fire requires 100 percent of the on-duty force to have a chance at being effective.

Low staffing per unit with long response times means the incident continues to worsen, and when the team finally arrives it is much further behind the time curve on deescalating the emergency. Some emergencies will have worsened to the point of needing additional units to increase staffing at the emergency. When this happens to modestly severe incidents, even more units are out of service. This is the why speed and weight of the attack are so important. Keeping a small emergency small takes the right staffing in the right time frame.

Deployment Improvements

As revenue sources allow, Orem and its partner cities can improve the response system over time. The greatest demand for services is during daylight hours. The City can consider incrementally adding staffing for peak-hour EMS and then use those personnel outside of peak hours for all types of incidents. Over a longer period, at least each primary firefighting engine apparatus should be staffed with three personnel.

At this time, adding even one firefighter per day to a crew does not always lower the number of other units needed. Adding one firefighter per crew per day actually means adding three personnel to cover the one assignment 24/7/365. Therefore, adding a third firefighter to all four engines would require 12 additional personnel, plus the overtime or extra staff positions to cover the earned leave absences of the third positions.

The best investment to make the most positive impact with a staffing increase would be to add a two-firefighter/paramedic ambulance at peak hours of the day. This unit could handle the peak-hour demand and the out-of-town patient transfers. This would leave other units more available. After peak hours, the two firefighter/paramedics would be available to increase the staffing of one engine and one ladder/quint to three personnel each at Station 1 during overnight hours when the

deadliest building fires typically occur. This staffing also helps increase the effective response force in the southern area of the City, where the multiple-unit response time is the weakest.

A hybrid staffing plan of a peak-hour ambulance, with that staffing moving to engines at night, is an increase of two per day requiring six total personnel for 24/7/365 coverage. This approach would improve the City's two challenges—the speed of the response at daylight peak demand hours and the weight of the attack, especially during overnight hours.

Given the drive-time challenges due to road design, Citygate recommends the City adopt a more realistic travel time goal of 5:00 minutes travel time and use that metric to locate a fifth fire station and other units in the years ahead.

Finally, measuring the coverage for proposed Station 4 (which is the fifth fire station), a more effective location in the west central area of the Department's service area should be found using 5:00-minute travel time spacing from the adjoining stations.

DEPLOYMENT FINDINGS AND RECOMMENDATIONS

The following are findings and recommendations regarding deployment presented throughout this report. The deployment issues relate to the challenges mentioned—response time, staffing, and a location for the next fire station.

Finding #1: The City Council has not adopted response time goals consistent with best practices. Goals must contain specificity for the measure of start time and desired outcomes by type of risks.

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

Finding #3: A deployment system with four fire stations does not allow the Department to provide a best practices 4:00-minute travel time to all the City's major neighborhoods.

Finding #4: The proposed next fire station at 1350 S. 1600 W in Orem does not increase coverage significantly enough (3.1 percent) to justify the expense at that location.

Finding #5: The Department's service demand is consistent, indicating the need for a 24-hours-per-day, seven-days-per-week fire and EMS emergency response system.

Finding #6: The largest impact of simultaneous incidents is felt in Station 1's district, which further shifts workload to other companies at peak hours of the day.

Finding #7: At 2:44 minutes for 90 percent of the fire/EMS incidents, call processing performance is significantly slower than a best practice recommendation of 1:30 minutes.

Finding #8: At 3:27 minutes Department-wide, crew turnout performance is significantly slower than a Citygate-recommended goal of 2:00 minutes or less to 90 percent of fire/EMS incidents.

Finding #9: At 7:44 minutes to 90 percent of fire/EMS incidents Department-wide, first-due unit travel time is significantly slower than a best practice urban/suburban area goal of 4:00 minutes.

Finding #10: At 11:59 minutes, the Department's call to arrival time to 90 percent of the fire/EMS incidents is significantly slower than Citygate's recommended goal of 7:30 minutes. Every component measure of response time for the Department is too slow, from dispatch to turnout to travel.

Finding #11: At 15:08 minutes, the Effective Response Force (First Alarm) travel times are longer than the best practice and Citygate-recommended goal of 8:00 minutes and, as with first-due units, reflects the service area's challenging road network and topography.

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

Recommendation #1: **Adopt Deployment Policies:** The City Council should adopt complete performance measures to aid deployment planning and to monitor performance. The measures of time should be designed to deliver outcomes that will save patients when possible and keep small but serious fires from becoming more serious. With this is mind, Citygate recommends the following measures:

1.1 Distribution of Fire Stations: To treat pre-hospital medical emergencies and control small fires, the first-due unit should arrive within 8:30 minutes, 90 percent of the time from the receipt of the 9-1-1 call at Orem Police Department's Emergency Communications Center. This equates to a 90-second dispatch time, a 2:00-minute company turnout time, and a 5:00-minute travel time.

1.2 Multiple-Unit Effective Response Force for Serious Emergencies: To confine building fires near the room of origin, keep vegetation fires under one acre in size, extricate trapped victims within 30:00 minutes, and treat multiple medical patients at a single incident, a multiple-unit Effective Response Force should arrive within 11:30 minutes from the time of 9-1-1 call receipt at Orem Police Department's Emergency Communications Center 90 percent of the time. This equates to a 90-second dispatch time, 2:00-minute company turnout time, and 8:00-minute travel time.

1.3 Hazardous Materials Response: To provide hazardous materials response designed to protect the City from the hazards associated with uncontrolled release of hazardous and toxic materials by isolating the hazard, denying entry into the hazard zone, and notifying appropriate officials/resources to minimize impacts on the community, the first-due unit should have a total response time of 8:30 minutes or less to provide initial hazard evaluation and mitigation actions. After the initial evaluation is completed, a determination can be made whether to request additional resources from the regional hazardous materials team.

1.4 Technical Rescue: To respond to technical rescue emergencies as efficiently and effectively as possible with enough trained personnel to facilitate a successful rescue, the first-due total response time should be 8:30 minutes or less to evaluate the situation and initiate rescue actions. Following the initial evaluation, assemble additional resources as needed within a total response time of 11:30 minutes to safely complete rescue/extrication and delivery of the victim to the appropriate emergency medical care facility.

Recommendation #2: The Department should consider adding a two firefighter/paramedic peak-hour ambulance, seven days a week. After peak EMS demand hours, the two personnel should be located at Station 1 in the southern area of the City to improve multiple-unit staffing.

Recommendation #3: The Department should identify a more northerly, western location for a fifth fire station, and not use the current site identified long ago.

HEADQUARTERS SERVICES SUMMARY

Best practices recommendations indicate that fire services management and headquarters programs should have adequate staffing to provide a properly trained, equipped, and supported response force to ensure prompt response and safe, competent service delivery. Compliance regulations for fire services operation are ever increasing, so the proper hiring, training, and supervision of operational personnel require a significant leadership and general management commitment.

Citygate found highly qualified, professional, and dedicated personnel with a strong commitment to serve the organization. There is a strong work ethic/culture to perform the best they can, given the staff available. There are knowledgeable emergency response personnel who have become subject-matter experts in critical lines of service delivery.

The challenge for the headquarters team is a lack of staffing. Since the split from one merged public safety department, Citygate does not believe a complete assessment and understanding of headquarters workload and regulatory importance has been conducted. The personnel are accomplishing very good work, but there are not enough of them to accomplish what is necessary.

HEADQUARTERS FINDINGS AND RECOMMENDATIONS

The following are findings regarding fire headquarters staffing and programs presented throughout this report.

Finding #12: The workload capacity gaps and potential single points of failure could be significantly narrowed or resolved with the hiring of an additional full-time equivalent non-sworn clerical-level position for tracking accounts payable and receivable and assisting with clerical duties of the Department staff.

Finding #13: Firefighter and officer development and training is a necessity for personnel safety and service delivery. With no dedicated person responsible for firefighter training, the tasks are assigned as a collateral duty and do not have the primary focus on firefighter safety and training.

Finding #14: The workload capacity and serious gaps in fire operations training are a single point of failure in overall firefighter safety and service delivery.

Finding #15: There is a low retention / high turnover rate of firefighters within the organization over a five-year period. Approximately one-third of the firefighters who left the organization did so for other employment in the fire service.

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

Finding #17: The number of plan reviews, annual fire occupancy and permit inspections, and community fire and life safety education hours has reached the maximum the two inspectors can accomplish completely and thoroughly within the allocated work period.

Finding #18: The Department's Emergency Services Manager has no dedicated staff. As such, the City's emergency management policies, procedures, and plans need review and updating.

Finding #19: A review of the Comprehensive Emergency Management Plan and associated policies, guidelines, and documents for the City are outdated and not consistent with national best practices.

Finding #20: The City has a regionally coordinated emergency management program, improving overall safety for the residents of the City.

Finding #21: The City must use several existing work areas in the event of an Emergency Operations Center activation. This requires relocation of employees to work in makeshift arrangements and impedes workflow and normal City operations that must occur, even during a disaster.

Finding #22: The City does not have a long-term strategy and budget for a capital equipment replacement fund for vehicles or stations. When an apparatus or fire station requires replacement, the cost is requested in the budget year of replacement.

Finding #23: Overall, the current fire and EMS apparatus repair and maintenance program appears to be efficient and cost-effective.

Finding #24: Due to size and equipment, the fire stations have limited storage space, as well as limited rooms for fire training and physical fitness for the firefighters.

Finding #25: The interior layout of apparatus bays is cluttered and unorganized.

Based on the technical analysis and findings contained in the Fire Department headquarters services assessment, Citygate offers the following recommendations:

Recommendation #4: The Department should hire one additional headquarters office support position to assist in the overall workload and remove support duties and responsibilities from operations personnel.

Recommendation #5: The Department Training Program and its delivery should be formalized with policies and procedures and lesson plans and monitored for completeness and effectiveness.

Recommendation #6: The Department should add a full-time fire training officer at the command staff level to ensure all personnel are trained to the proper level and have the requisite skills for their positions in the Department.

Recommendation #7: The Department must create a career development and retention plan, including incentives, to ensure fully trained and operationally ready crews for emergency response are always available.

Recommendation #8: The Department and City should perform an analysis of the low retention rate for new firefighters and develop plans to mitigate that turnover.

Recommendation #9: Hire an additional fire inspector to improve the quality of fire inspections, plan reviews, and permit inspections.

Recommendation #10: Hire a half-time public education position to assist in training of community members in fire and life safety education and to assist in the Community Emergency Response Team (CERT) training as well to relieve the fire inspectors in performing this function.

Recommendation #11: The Emergency Management Division needs to update all the City's emergency preparedness policies, procedures, and plans, which include the City's Comprehensive Emergency Management Plan.

Recommendation #12: As the City grows and more space is developed in new facilities such as fire stations, a space for a dedicated Emergency Operations Center should be developed.

Recommendation #13: The City could consider adopting a long-term replacement funding strategy for the timely replacement of fire apparatus instead of waiting until apparatus are overdue and identifying one-time funding sources.

Recommendation #14: The City should identify a long-term funding strategy for replacement of the oldest fire stations in the future to ensure adequate space for training, apparatus, and physical fitness.

Recommendation #15: The Department should review each station's storage capacity and equipment and develop a plan for each station and its needed storage capacity.

NEXT STEPS

The purpose of this assessment is to compare the City's current performance against the local risks to be protected and nationally recognized best practices. This analysis of performance forms the basis from which to make recommendations for changes, if any, in fire station locations, equipment types, and staffing. Recommendations take time and fiscal capacity, more so as the impacts of COVID-19 continue to unfold on local and state economies. Citygate suggests the following steps moving forward.

- Review the content, findings, and recommendations of this report.
- Adopt revised response performance goals as recommended.
- Direct staff to return with a multiple-year, prioritized, deployment improvement and headquarters staffing plan within 90 days and, as needed, modify an upcoming budget to implement the first phase. The following table (1) lists all recommendations in summary form, (2) identifies those that can be implemented at no cost (other than staff time), and (3) for the remaining recommendations requiring a General Fund expense to implement, identifies the funding priority level.

Table 3—Recommendations and Funding Priorities

Recommendation	No Cost	Funding Priority 1	Funding Priority 2	Funding Priority 3
1. Adopt deployment measures	X			
2. Add a two-firefighter/paramedic ambulance (six FTEs)		X		
3. Locate a more northerly site for fifth fire station			X	
4. Add one FTE headquarters office support position		X		
5. Improve training documentation	X			
6. Add one FTE training officer		X		
7. Design a career development and retention plan	X			
8. Analyze and mitigate against new firefighter turnover	X			
9. Add one FTE fire inspector				X
10. Add a .5 FTE public educator			X	
11. Update all procedures and plans in the City's Emergency Management Plan	X			
12. Identify future space for a dedicated Emergency Operations Center				X
13. Adopt a long-term fire apparatus replacement fiscal plan	X			
14. Identify a long-term fire station replacement fiscal plan	X			
15. Identify a long-term fire station storage plan with needed square footage	X			

SECTION 1—INTRODUCTION AND BACKGROUND

The City of Orem (City) retained Citygate Associates, LLC (Citygate) to conduct a Public Safety Operations Assessment for the Fire Department (Department) and the Police Department. This report is the fire and emergency medical services (EMS) operational assessment, known as a Standards of Coverage (SOC) assessment, which provides an ongoing foundation for fire service planning.

The goal of this assessment is to identify both current services and desired service levels and then to assess the City's ability to provide them. Citygate has provided recommendations to improve Department field deployment and headquarters operations. Citygate's scope of work and corresponding Work Plan were developed consistent with Citygate's Project Team members' experience in fire administration and deployment. Citygate utilizes various National Fire Protection Association (NFPA) and Insurance Services Office (ISO) publications as best practice guidelines, along with the self-assessment criteria of the Commission on Fire Accreditation International (CFAI).

1.1 REPORT ORGANIZATION

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

Executive Summary	Summary of current services and significant future challenges along with a list of all findings and recommendations contained in this report.
Section 1	Introduction and Background: An introduction to the study and background facts about the City.
Section 2	Standards of Coverage Assessment: An overview of the SOC process and detailed analysis of existing deployment policies, outcome expectations, community risk, critical tasks, distribution and concentration effectiveness, reliability and historical response effectiveness, and overall deployment evaluation.
Section 3	Headquarters Staffing Assessment: A review of the adequacy of the headquarters staffing and the team's ability to meet regulatory requirements and also deliver external services such as fire prevention.
Appendix A	Risk Assessment

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

1.1.1 Goals of the Report

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

This document provides technical information about how fire services are provided and legally regulated and how 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 sound technical foundation upon which to understand the advantages and disadvantages of the choices facing Department and City leadership regarding the best way to provide fire services and, more specifically, at what level of desired outcome and expense.

1.1.2 Limitations of the Report

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

While this report and technical explanation can provide a framework for the discussion of Department services, neither this report nor the Citygate team can make the final decisions or assess the cost of every alternative in detail. Once final strategic choices receive policy approval, City staff can conduct final cost 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 Research Methods

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

Citygate performed focused interviews of the Department's project team members and other project stakeholders. Citygate reviewed demographic information about the City and the potential for future growth and development. Citygate also obtained map and response data from which to model current and projected fire service deployment, with the goal of identifying the location(s) of stations and crew quantities required to best serve the City and to facilitate deployment planning.

After gaining an understanding of the Department's service area and its fire and non-fire risks, Citygate developed a model of fire services that was tested against the travel time mapping and prior response data to ensure an appropriate fit. Citygate also evaluated future City growth and service demand by risk type and evaluated potential alternative emergency service delivery models. The result is a framework for enhancing Department services while meeting reasonable community expectations and fiscal realities.

1.2.2 Project Scope of Work

Citygate's approach to this SOC assessment involved:

- Reviewing information provided by the Department and City
- Utilizing FireView™, a geographic mapping program, to model fire station travel time coverage
- Using StatsFD™, an incident response time analysis program, to review the statistics of prior incident performance and plot the results on graphs and mapping exhibits
- Reviewing projected City population and related development growth
- Projecting future service demand by risk type
- Identifying and evaluating potential alternate service delivery models
- Recommending appropriate risk-specific response performance goals
- Identifying a long-term strategy, including incremental short- and mid-term goals, to achieve desired response performance objectives.

1.3 CITY OVERVIEW

The City of Orem is located on the eastern shore of Utah Lake and extends on the east to Provo and the foothills of Mount Timpanogos. It shares the general location with Provo, and its history is closely related to that of Provo. The City of Orem was incorporated in 1919. Orem was the tenth city incorporated in Utah County.

Orem is the second-largest city in Utah County by population and has the highest population density of any city in Utah County. Orem may have the second-largest population of any city in

Utah County, but it ranks fifth for land size. Orem covers 18.29 square miles of land, making it smaller than Eagle Mountain, Provo, Lehi, and Cedar Fort.[2]

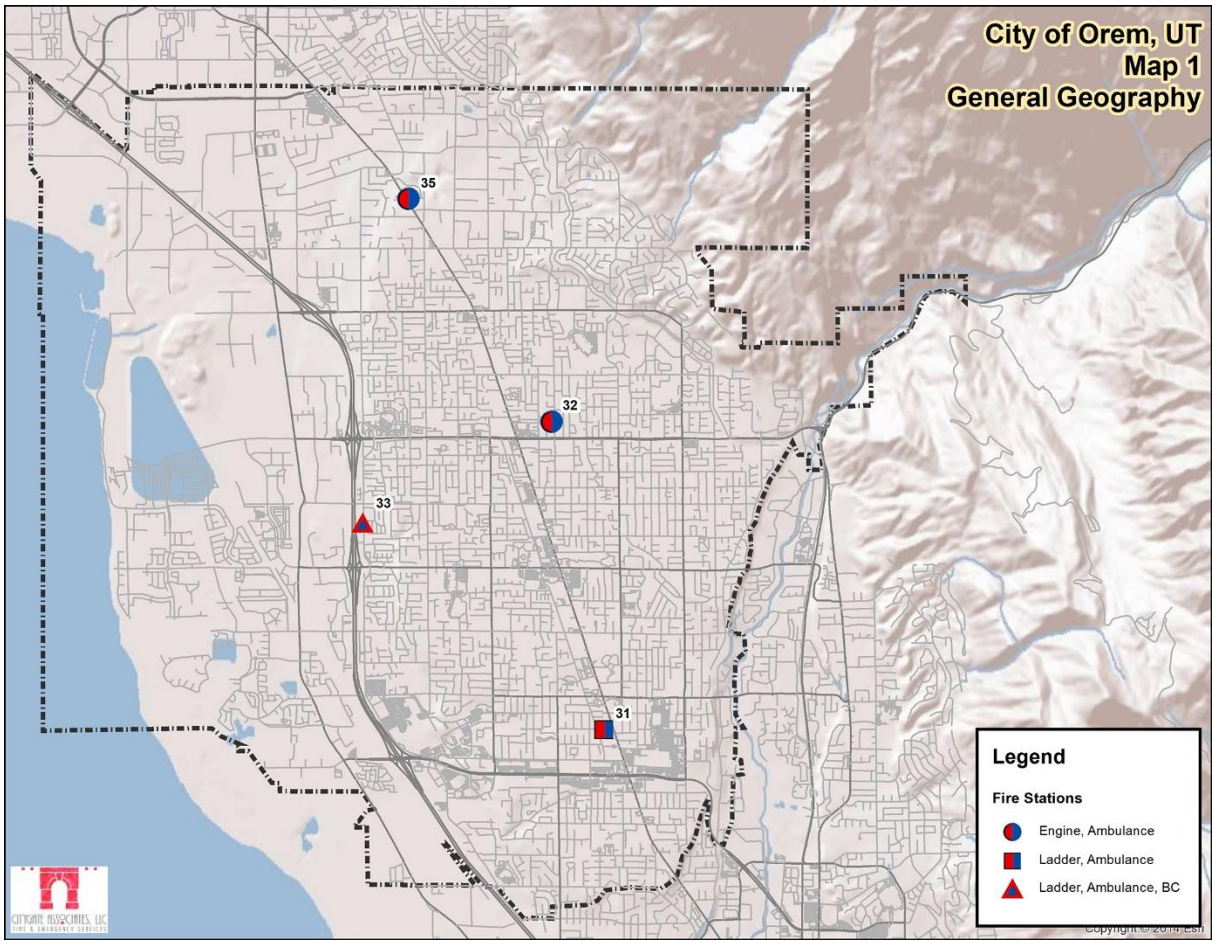
Orem is home to Utah Valley University, the largest public university in the state of Utah. There are also 23 public schools in the City.[3]

The City was set up differently than other cities in Utah County. At the time, most cities were laid out in regular city blocks with homes built closely together. Orem, however, was a farming community with homesteads and it was built along the territorial highway. The homes were scattered along the highway so that farmers could live close to their farms and orchards. As area near the highway was taken, farmers began to settle in other areas of what is now Orem and rural roads were developed, crisscrossing the area to connect the farms.[4]

At present, Orem's road system includes an Interstate highway, US highways, state highways and City-maintained roads. Interstate 15 has four interchanges and runs through the west side of the City. US highway 89 (State Street) runs northwest/southeast through the middle of the City. US highway 189 (University Avenue) passes through a short section of the northeast City. Four state routes also pass through the City—SR-52 (800 North), SR-114 (Geneva Road), SR-241 (1600 North), and SR-265 (University Parkway).[5]

[2] Source: Daily Herald (https://www.heraldextra.com/orem-is-101-years-old/article_91a98820-5b97-5423-9548-0d840d12f16f.html).
[3] Source: City of Orem website
[4] Source: Daily Herald (https://www.heraldextra.com/orem-is-101-years-old/article_91a98820-5b97-5423-9548-0d840d12f16f.html).
[5] Source: City of Orem Transportation Master Plan – 2015 (https://orem.org/wp-content/uploads/2018/06/Transportation-Master-Plan-2015-Final.pdf)

Figure 1—Fire Station Districts and General Geography



The City's population is projected to increase by nearly nine percent to approximately 110,000 people by 2024, for an average annualized growth rate of slightly more than two percent. The service area includes nearly 37,000 housing units and nearly 4,300 businesses to protect.

1.4 FIRE DEPARTMENT OVERVIEW

The Department operates out of four strategically located fire stations. All fire stations deliver fire suppression capabilities and paramedic ambulance level EMS. The Department has a daily constant (minimum/maximum) staffing of 17 firefighting/ambulance personnel on duty operating two fire engines (two firefighters each), two ladder trucks (two firefighters each), and four ambulances (two paramedic/firefighters each), and one Battalion Chief for incident command. In addition, the Department also cross-staffs (using fire engine staff) specialty units for wildland, hazardous materials, and technical rescue responses.

All response personnel are trained to either the Emergency Medical Technician (EMT) level, capable of providing Basic Life Support (BLS) pre-hospital emergency medical care, or paramedic level, capable of providing Advanced Life Support (ALS) pre-hospital emergency medical care. The Department provides ground paramedic ambulance service.

Response personnel are also trained to the United States Department of Transportation Hazardous Material First Responder Operations level to provide initial hazardous material incident assessment, hazard isolation, and support for a hazardous material response team. Response personnel are further trained to the Hazardous Materials Technician or Specialist level for response along with a countywide special response team for specialty rescue and swift water emergencies.

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

1.4.1 Facilities and Resources

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

Table 4—Minimum Daily Staffing

Minimum Per Unit	Staff Type and Number		Total Personnel
2 Engines	2	Firefighters per Day	4
2 Ladder/Quint Trucks	2	Firefighters per Day	4
4 Ambulances	2	Paramedic/Firefighters per Day	8
Battalion Chief	1	Per day for Command	1
Total 24-Hour Personnel			**17**

SECTION 2—STANDARDS OF COVERAGE ASSESSMENT

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

2.1 STANDARDS OF COVERAGE PROCESS OVERVIEW

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

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

In contrast to a one-size-fits-all prescriptive formula, 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 single component. For instance, if only travel time is considered and frequency of multiple calls is not, the analysis could miss over-worked companies. If a risk assessment for deployment is not considered and deployment is based only on travel time, a community could under-deploy to incidents.

The following table describes the eight elements of the SOC process.

Table 5—Standards of Coverage Process Elements

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

Source: CFAI *Standards of Cover*, fifth edition

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

Table 6—Fire Service Deployment Paradigm

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

Thus, smaller fires and less complex emergencies require a single-unit or two-unit response (engine or specialty resource) within a relatively short response time. Larger or more complex incidents require more units and personnel to control. In either case, if the crews arrive too late or the total number of personnel is too few for the emergency, they are drawn into an escalating and more dangerous situation. The science of fire crew deployment is to spread crews out across a community or jurisdiction for quick response to keep emergencies small with positive outcomes without spreading resources so far apart 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 the City's case, when a 9-1-1 call is received by Orem Police Department's Emergency Communications Center, it is first screened to determine if fire or police resources are required. Response time increments include police communications call processing, fire station crew alerting, response unit boarding (commonly called turnout time), and actual driving (travel) time.

At the council level, the City has not adopted formal fire and ambulance response time measures. The Department reports these measures of performance in budget documents or as requested; however, not having adopted goals does not meet the best practice recommendations of the NFPA or the CFAI. Further, goals should be adopted to address all types of response performance to other risks within the City, such as hazardous materials and technical rescue. The response time goals should define the 9-1-1 call receipt as the starting point of the response time measurement.

NFPA 1710, the recommended deployment standard for career fire departments in urban/suburban areas, currently recommends the initial (first-due) intervention unit arrive within a 4:00-minute

travel time and recommends arrival of all resources comprising the multiple-unit First Alarm within an 8:00-minute travel time at 90 percent or better reliability.[6]

The most recent published best practices by the NFPA for dispatching have increased the dispatch processing time to 90 seconds, or 120 seconds if there are language barriers. Further, for crew turnout time, 60 to 80 seconds is recommended depending on the type of protective clothing that must be donned.

If the travel time measures recommended by the NFPA and Citygate are added to dispatch processing and crew turnout times recommended by Citygate and best practices, then a realistic, 90 percent, first-due arrival goal is 7:30 minutes from the time of Orem Police Department's Emergency Communications Center receiving the 9-1-1 call. This is comprised of 90 seconds dispatch, plus 2:00 minutes crew turnout, plus 4:00 minutes travel.

Finding #1:	The City Council has not adopted response time goals consistent with best practices. Goals must contain specificity for the measure of start time and desired outcomes by type of risks.

2.2.1 Current Deployment Model

Resources and Staffing

The Department's current deployment model consists of two engines and two ladder/quint trucks (staffed with a minimum of two personnel each), four ambulances (staffed with two paramedic/firefighters each), and one Battalion Chief, for a total daily minimum year-round continuous staffing of at least 17 personnel operating from the four fire stations. This deployment model only meets the minimum staffing standards for building fires as recommended by NFPA 1710 *if all the ambulance personnel are available to respond.* The 17 personnel also provide the minimum sufficient personnel for an Effective Response Force (ERF or First Alarm) to serious fire incidents. The Department has mutual aid agreements with other fire agencies in Utah County.

Response Plan

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

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

Given these risks, the Department utilizes a tiered response plan calling for different types and numbers of resources depending on incident/risk type. The Orem Police Department's Emergency Communications Center selects and dispatches the closest and most appropriate Department resource types pursuant to the Department's response plan, summarized in the following table.

Table 7—Response Plan by Incident Type

Incident Type	Resources Dispatched	Total Personnel
Single-Patient EMS	1 Engine or Ladder/Quint and 1 Ambulance	4
Vehicle Fire	1 Engine or Ladder/Quint and 1 Ambulance	4
Building Fire Residential	2 Engines, 2 Ladders/Quints, 4 Ambulances, and 1 Battalion Chief	17
Wildland Fire	1 Engine or Ladder/Quint, 1 Ambulance, and 2 Brush Units	8
Rescue	1 Engine or Ladder/Quint, 1 Ambulance, and Regional Specialty Team	Varies
Hazardous Material	1 Engine or Ladder/Quint, 1 Ambulance, and Regional Specialty Team	Varies

Source: Orem Fire Department

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

2.3 Outcome Expectations

SOC Element 2 of 8
Community Outcome Expectations

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

Current national best practice is to measure percent completion of a goal (e.g., 90 percent of responses) instead of an average measure. Mathematically, this is called a fractile measure.[7] Measuring the average only identifies the central or middle point of response time performance for all calls for service in the data set, making it impossible to know how many incidents had response times that were far above or just above the average.

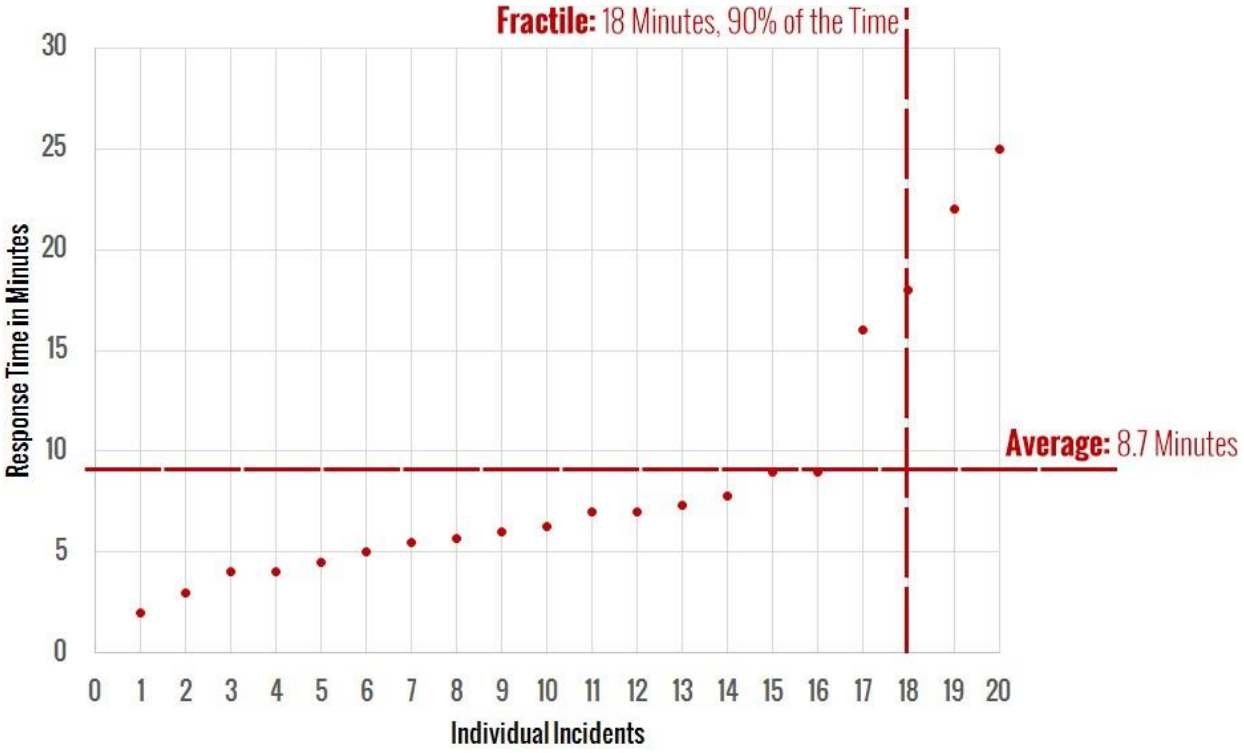
For example, Figure 2 shows response times for a fictitious fire department. This agency is small and receives 20 calls for service each month. Each response time has been plotted on the graph from shortest to longest response time.

Figure 2 shows that the average response time is 8.7 minutes. However, the average response time fails to properly account for four calls for service with response times far greater than a threshold in which positive outcomes could be expected. In fact, it is evident in Figure 2 that 20 percent of responses are far too slow and that this jurisdiction has a potential life-threatening service delivery problem. Average response time as a measurement tool for fire services is simply not sufficient. This is a significant issue in larger cities if hundreds or thousands of calls are answered far beyond the average.

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

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

Figure 2—Fractile versus Average Response Time Measurements



More importantly, within the SOC process, positive outcomes are the goal. From that, crew size and response time can be calculated to allow appropriate fire station spacing (distribution and concentration). Emergency medical incidents include situations with the most severe time constraints. The brain can only survive 4:00 to 6:00 minutes without oxygen. Cardiac arrest, drowning, choking, trauma constrictions, or other similar events can cause oxygen deprivation to the brain. In a building fire, a small incipient fire can grow to involve the entire room in a 6:00- to 8:00-minute time frame. If fire service response is to achieve positive outcomes in severe emergency medical situations and incipient fire situations, *all* responding crews must arrive, assess the situation, and deploy effective measures before brain death occurs or the fire spreads beyond the room of origin.

Thus, from the time of 9-1-1 receiving the call, an effective deployment system is *beginning* to manage the problem within a 7:00- to 8:00-minute total response time. This is right at the point that brain death is becoming irreversible and the fire has grown to the point of leaving the room of origin and becoming very serious. Thus, the City needs a first-due response goal that is within a range to give hope for a positive outcome. It is important to note that the fire or medical emergency continues to deteriorate from the time of inception, not from the time the fire engine starts to drive the response route. Ideally, the emergency is noticed immediately and the 9-1-1 system is activated promptly. This step of awareness—calling 9-1-1 and giving the dispatcher accurate information—

takes, in the best of circumstances, 1:30 minutes. Crew notification and travel time take up to an additional 2:00 minutes. After the unit travels across the road network, upon arrival, the crew must approach the patient or emergency, assess the situation, and appropriately deploy its skills and tools. Even in easy-to-access situations, this step can take 2:00 minutes or more. This time frame may be increased considerably due to long driveways, apartment buildings with limited access, multiple-story apartments or office complexes, or shopping center buildings.

Unfortunately, there are times when the emergency has become too severe, even before the 9-1-1 notification 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 people in the City the hope of a positive outcome for their tax-dollar expenditure.

For this report, total response time is the sum of the call processing, fire crew turnout, and road travel time steps. This is consistent with CFAI best practice recommendations. Calls to 9-1-1 should be answered within 15 seconds 95 percent of the time.

2.4 COMMUNITY RISK ASSESSMENT

SOC ELEMENT 3 OF 8
COMMUNITY RISK ASSESSMENT

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

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

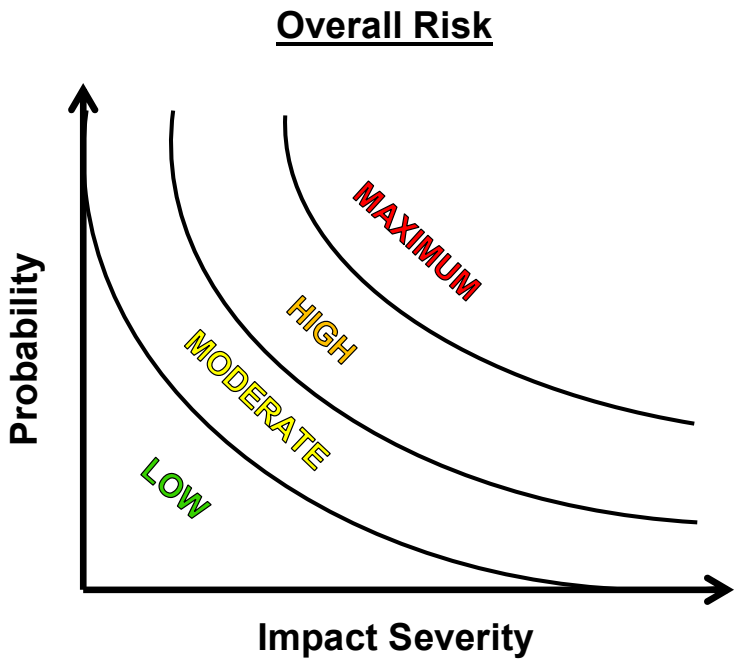
A *hazard* is broadly defined as a situation or condition that can cause or contribute to harm. Examples include fire, medical emergency, vehicle collision, earthquake, flood, etc. *Risk* is broadly defined as the probability of hazard occurrence in combination with the likely severity of resultant impacts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

2.4.1 Risk Assessment Methodology

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

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

Figure 3—Overall Risk



2.4.2 Values at Risk to Be Protected

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

People

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

1. The Department serves an urban/suburban population with densities ranging from less than 1,000 to 12,000 people per square mile, over a varied land-use pattern.
2. Orem's population is projected to increase by nearly nine percent to approximately 110,000 people by 2024.
3. The service area includes nearly 37,000 housing units and nearly 4,300 businesses to protect.
4. The service area includes significant economic and other resource values as identified in this assessment.

Critical Infrastructure / Key Resources

The U.S. Department of Homeland Security defines Critical Infrastructure / Key Resources as those physical assets essential to the public health and safety, economic vitality, and resilience of a community, such as lifeline utilities infrastructure, telecommunications infrastructure, essential government services facilities, public safety facilities, schools, hospitals, airports, etc. The Department has identified 63 critical facilities and infrastructure as listed in Table 5 (**Appendix A – Risk Assessment**) and shown in Map #2c (**Volume 2 – Map Atlas**). A hazard occurrence with significant impact severity affecting one or more of these facilities would likely adversely impact critical public or community services.

Buildings

The Department's service area includes nearly 37,000 housing units and nearly 4,300 businesses as described in **Appendix A**.[8]

2.4.3 Hazard Identification

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

[8] Source: Esri Community Business Summary (2019).

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

- Building fire
- Vegetation/wildland fire
- Medical emergency
- Hazardous material release/spill
- Technical rescue

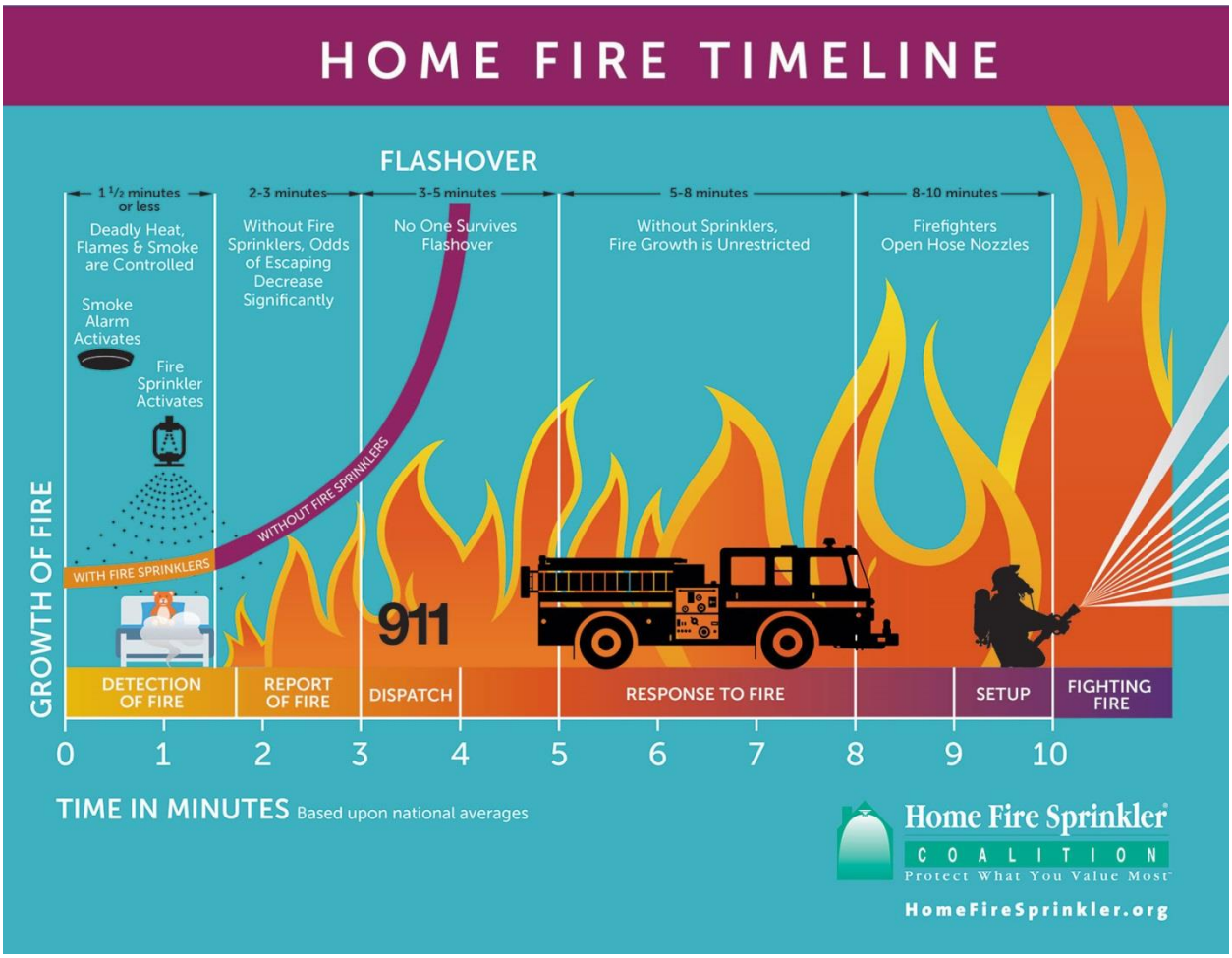
Because building fires and medical emergencies have the most severe time constraints if positive outcomes are to be achieved, the following is a brief overview of building fire and medical emergency risk. **Appendix A** contains the full risk assessment for all five hazards.

Building Fire Risk

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

Figure 4 illustrates the building fire progression timeline and shows that flashover, which is the point at which the entire room erupts into fire after all the combustible objects in that room reach their ignition temperature, can occur as early as 3:00 to 5:00 minutes from the initial ignition. Human survival in a room after flashover is extremely improbable.

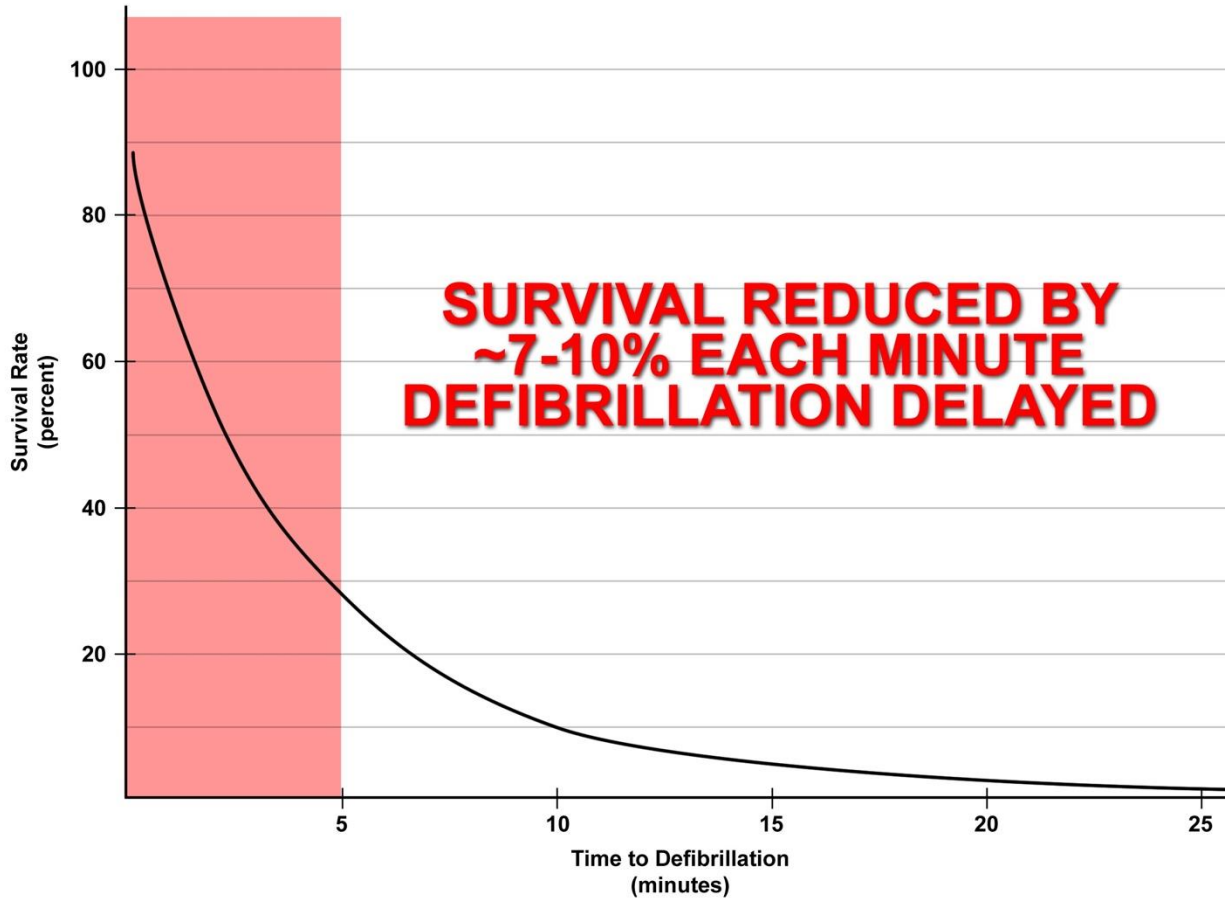
Figure 4—Building Fire Progression Timeline



Medical Emergency Risk

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

Figure 5—Survival Rate versus Time to Defibrillation



Source: www.suddencardiacarrest.org

The Department currently provides ALS ambulance transport emergency medical services, with operational personnel almost completely trained to the EMT-Paramedic level.

2.4.4 Risk Assessment Summary

The City's overall risk for the five hazards related to emergency services presented in this report range from **Low** to **High**, as summarized in the following table. See **Appendix A** for the full risk assessment.

Table 8—Overall Risk by Hazard

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

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

SOC Element 4 of 8
Critical Task Time Study

SOC studies use critical task information to determine the number of firefighters needed within a time frame to achieve desired objectives on fire and emergency medical incidents. Table 9 and Table 10 illustrate critical tasks typical of building fire and medical emergency incidents, including the minimum number of personnel required to complete each task. These tables are composites from Citygate clients in urban/suburban departments similar to the City, with units staffed with two personnel per engine or ladder truck. It is important to understand the following relative to these tables:

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

2.5.1 Critical Firefighting Tasks

Table 9 illustrates the critical tasks required to control a typical single-family dwelling fire with nine response units (two engines, two ladder/quint trucks, four ambulances, and one Battalion Chief) from the City, for a total ERF of 17 personnel. This is **100 percent** of the on-duty force,

and delivering them all means no other incidents are already open and using resources. The tasks in the following table are taken from typical fire departments' operational procedures, which are consistent with the customary findings of other agencies using the SOC process. No conditions exist to override the Occupational Safety and Health Administration (OSHA) two-in/two-out safety policy, which requires that firefighters who enter atmospheres immediately dangerous to life and health, such as building fires, do so in teams of two while two more firefighters are outside, immediately ready to rescue them should trouble arise.

Scenario: Simulated approximately 2,000 square foot, two-story, *residential* single-family house 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 9—First Alarm Residential Fire Critical Tasks – 17 Personnel

	Critical Task Description	Personnel Required
First-Due Engine + Ambulance (4 personnel)		
1	Conditions report / establish command.	1
2	Establish supply line to hydrant / operate pump.	1
3	Deploy initial fire attack line to point of building access.	2
4	Conduct primary search if conditions dictate.	0
Second-Due Engine + Ambulance (4 personnel)		
1	If necessary, establish supply line to hydrant.	1–2
2	Deploy a backup attack line.	0
3	Establish Initial Rapid Intervention Crew for OSHA 2-in/2-out.	2
4	Conduct primary search if conditions dictate.	0
First-Due Truck/Quint + Ambulance (4 personnel)		
1	Deploy ground ladders to roof.	0
2	Establish horizontal or vertical building ventilation.	2
3	Open concealed spaces as required.	2
Chief Officer		
1	Transfer of incident command from First Unit Officer.	1
2	Establish exterior command and scene safety.	0
Second-Due Truck/Quint + Ambulance (4 personnel)		
1	Establish Rapid Intervention Crew.	3
2	Secure utilities.	1
3	Deploy additional attack line(s) as needed.	0
4	Conduct secondary search.	0

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 keeps running.

Fire in a building can double in size during its free-burn period before fire suppression is initiated. Many studies have shown that a small fire can spread to engulf an entire room in less than 4:00 to 5:00 minutes after free burning has started. Once the room is completely superheated and involved in fire (known as flashover), the fire will spread quickly throughout the structure and into the attic and walls. For this reason, it is imperative that fire suppression and search/rescue operations commence before the flashover point occurs if the outcome goal is to keep the fire damage in or

near the room of origin. In addition, flashover presents a life-threatening situation to both firefighters and any occupants of the building.

2.5.2 Critical Medical Emergency Tasks

The Department responded to 4,826 EMS incidents in 2019, including cardiac arrests, 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. Many of these tasks require paramedic intervention and, for that reason, the Department strives to maintain two paramedics per company per day.

Table 10—Cardiac Arrest Critical Tasks – Two Engine Personnel + Two Ambulance Personnel

Critical Task		Personnel Required	Critical Task Description
1	Chest compressions	1–2	Compression of chest to circulate blood
2	Ventilate/oxygenate	1–2	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	Interpret ECG	2	Identify type and treat dysrhythmia
7	Administer drugs	2	Administer appropriate pharmacological agents
8	Patient charting	1–2	Record vitals, treatments administered, etc.
9	Hospital communication	1–2	Receive treatment orders from physician
10	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 must be compared to outcomes. As shown in nationally published fire service time versus temperature tables, after approximately 4:00 to 5:00 minutes of free burning in a room, fire will escalate to the point of flashover. At this point, the entire room is engulfed in fire, the entire building becomes threatened, and human survival near or in the room of fire origin becomes impossible. Additionally, brain death begins to occur within 4:00 to 6:00 minutes of the heart stopping. Thus, the ERF must arrive in time to prevent these emergency events from becoming worse.

The Department's daily staffing is minimally sufficient to deliver one ERF of 17 personnel (a minimum of two engines, two ladder/quint trucks, four ambulances, and one Battalion Chief) to a building fire, if they are all available to respond and can arrive in time, which the statistical analysis of this report will review in depth. Mitigating an emergency event is a team effort once the units have arrived. This refers to the *weight* of response; if too few personnel arrive too slowly, the emergency will escalate instead of improving. The outcome times, of course, will be longer and yield less-desirable results if the arriving force is later or smaller. Thus, controlling a modest building fire in the City requires 100 percent of the on-duty force.

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

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

Previous critical task studies conducted by Citygate, the National Institute of Standards and Technology, and NFPA Standard 1710 find that all units must arrive with 17 or more firefighters within 11:30 minutes from the time of call at a residential room-and-contents structure fire to be able to *simultaneously and effectively* perform the tasks of rescue, fire suppression, and ventilation.[9]

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

Seventeen initial personnel could handle a moderate risk, confined residential fire; however, even an ERF of 17 personnel will be seriously slowed if the fire is above the first floor in a low-rise

[9] Report on Residential Fireground Field Experiments, National Institute of Standards and Technology Technical Note #1661, April 2010.

apartment building or commercial/industrial building. This is where the capability to add additional personnel and resources to the standard response becomes critical.

Given that the Department's ERF plan delivers 17 personnel to a moderate-risk single family home fire, it reflects a goal to confine serious building fires to or near the room of origin and to prevent the spread of fire to adjoining buildings. This is a typical desired outcome in urban/suburban areas and requires more firefighters more quickly than the typical rural outcome of keeping the fire contained to the building, rather than room, of origin.

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

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

SOC Element 5 of 8
Distribution Study

SOC Element 6 of 8
Concentration Study

The City is served today by four fire stations deploying four firefighting units, four ambulances, and one Battalion Chief as the duty Incident Commander and Safety Officer. Using geographic mapping tools, it is appropriate to understand what the existing stations do and do not cover within travel time goals, if there are any coverage gaps needing one or more stations, and what, if anything, to do about them.

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

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

To analyze first-due fire unit travel time coverage, Citygate used FireView™, a geographic mapping tool that can measure theoretical travel time over a street network. For this calculation, Citygate used the base map and street travel speeds calibrated to actual fire apparatus travel times from previous responses to simulate real-world travel time coverage. Using these tools, Citygate ran several deployment tests and measured their impact on various parts of the City. A 4:00-minute

first-due and 8:00-minute ERF *travel* time were used consistent with best practice response performance goals for positive outcomes in urban areas.

2.6.1 Deployment Baselines

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

Map #1 shows the Department's service area 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, ladder/quint trucks, and ambulances are staffed with a minimum of two personnel daily.

Map #2a – Risk Assessment: Planning Zones

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

Map #2b – Risk Assessment: Population Density

Map #2b shows the population density across the Department for *resident* population. People drive EMS incident demand, and the highest population density areas are typically the locations with the highest EMS demand. It is therefore reasonable to expect any significant increases in residential density will result, to some degree, in an increase in EMS call volume.

Map #2c – Critical Facilities

Map #2c displays the locations of the critical infrastructure sites in the Department's service area as reviewed in the risk assessment found in **Appendix A**. These sites support the functioning of a modern urban society.

Map #2d – Risk Assessment: High Risk Occupancies

Map #2d displays the locations of the higher-risk building occupancies within the Department's service area, as defined by the CFAI. These building occupancies typically require a larger initial ERF due to the higher risks associated with these specific occupancies. While there are high- or maximum-risk occupancies in every planning zone, most are located by zoning closer to the I-15 corridor areas.

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

Map #2e displays the locations of 808 buildings within the Department's service area with needed fire flow (NFF) equal to or greater than 1,000 gallons per minute, as determined by the ISO. As the map illustrates, these buildings are predominantly located in the commercial and industrial zoned areas of the Department's service area along the two highway corridors.

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

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

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

The purpose of response time modeling is to determine response time coverage across a jurisdiction's geography and station locations. This geo-mapping design is then validated against dispatch time data to reflect actual response times. There should be some overlap between station areas so that a second-due unit can have a chance of an acceptable response time when it responds to a call in a different station's first-due response area. As can be seen, coverage is weak in that the road network is larger than four fire stations can cover. Another factor constraining travel time is that much of the service area is not comprised of a right-angle "grid" street network. There are many curvilinear street areas, and the two highways and other major roads without over or under crossings limit the route choices an emergency unit has.

As detailed later in this section, the *travel* time to 90 percent of fire and EMS incidents is 7:44 minutes Department-wide in 2019. This is supported by the GIS model that shows 4:00-minute coverage does not extend out past each fire station's primary service area.

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

Map #4 displays the ISO recommendation that urban stations cover a 1.5-mile *distance* response area. Depending on a jurisdiction's road network, the 1.5-mile measure usually equates to a 3:30- to 4:00-minute travel time. However, given the road network design in the City, a 1.5-mile measure is too aggressive of an indicator for station spacing and overlap. The 1.5-mile ISO coverage in Map #4 is much larger than the 4:00-minute first-due coverage in Map #3 and the actual travel time results to serious emergency incidents.

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

Map #5 shows, in green, the streets where the Department's current response plan *should* deliver the initial ERF of two engines, two ladder/quint trucks, and one Battalion Chief within 8:00 minutes' travel time. The ERF coverage is primarily in the core areas of the City both before and during periods of traffic congestion. The coverage *with* traffic congestion (orange) is very small

given that all four stations must reach a location and that can only happen in the center by the eighth minute of travel.

Map #5a – Concentration: Three-Engine Coverage at 8:00-Minute Travel Time

This measure only uses three of the fire stations for a multiple-unit force. This coverage is much larger for both uncongested and congested traffic periods. This measure shows that the limiting factor to the four-station coverage at 8:00 minutes travel is the more southerly location of Station 1 (shown as 31 on map).

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

Map #6 shows 8:00-minute travel time coverage for *either one* of the two ladder/quint trucks with and without traffic congestion. Much of the Department's service area can be reached by one ladder/quint truck, with only a slight reduction during traffic congestion hours.

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

Map #7 displays 8:00-minute travel time coverage for the one Battalion Chief, with and without traffic congestion. The single Battalion Chief travel time coverage includes all but the northeast areas of the Department's service area during normal traffic hours, and during congested periods one Battalion Chief cannot reach eastern areas of the Department's service area in 8:00 minutes or less due to the unit's west central location at Station 3 (shown as 33 on map).

Map #8 – All Incident Locations

Map #8 shows the location of all incidents from 2017 through 2019. It is apparent that incidents occur in all neighborhoods within the Department's service area.

Map #9 – Emergency Medical Services and Rescue Incident Locations

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

Map #10 – All Fire Locations

Map #10 identifies the location of all fires within the Department's service area from 2017–2019. All fires include any type of fire call, from vehicle to dumpster to building. There are obviously fewer fires than medical or rescue calls. Even given this fact, it is evident that fires occur in all fire station areas, but also more frequently in some of the central and highest-population-density areas of the Department's service area.

Map #11 – Structure Fire Locations

Map #11 displays the location of the structure fire incidents from 2017–2019. While the number of structure fires is a smaller subset of total fires, there are two meaningful findings from this map. First, there are structure fires in every fire station area, and second, there are a relatively small number of building fires in the City overall in a three-year period. In Citygate's experience, this is consistent with other similar cities in the western United States.

As with the previous map of all fire types, there are more building fires in some of the central and highest-population-density areas of the City. These locations receive a minimum ERF from four stations, including one Battalion Chief, in less than 8:00 minutes of travel time. This meets national best practice recommendations.

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

Map #12 shows, by mathematical density, where clusters of emergency medical services incident activity occurred. In this set, the darker density color plots the highest concentration of EMS/rescue incidents. This type of map makes the location of frequent workload more meaningful than simply mapping the locations of all EMS incidents, as 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. Much of the density is in Station 2's and Station 3's area (shown as 32 and 33 on map, respectively).

Map #13 – All Fire Location Densities

Map #13 is similar to Map #11 but shows the hot spots of activity for all types of fires from 2017–2019. Fire density is greater in the areas of the City with higher population density.

Map #14 – All Structure Fire Location Densities

Map #14 is like Map #13 but shows the hot spots for structure fire activity from 2017–2019. Given the greatest densities in the center of the City, the multiple-unit coverage is closest to the greatest number of building fires.

2.6.2 Road Mile Coverage Measures

In addition to the visual displays of coverage that maps provide, the GIS software allows for the measurement of the miles of public streets covered at 4:00 or 8:00 minutes. The following table provides these metrics for the coverage versus the impacts of traffic congestion.

Table 11—Service Area Road Mile Coverage Comparison (No Mutual Aid)

Measure	Total Road Miles	Miles Reached by Open Fire Stations / Percent of Total Public Miles Covered	Difference in Miles Covered
4:00-Minute First-Due	535.7	236.1 *44.1% of total public miles*	**299.6**
4:00-Minute First-Due – Traffic Congestion	535.7	126.2 *23.6% of total public miles*	**409.5**
8:00-Minute ERF	535.7	163.3 *30.5% of total public miles*	**372.4**
8:00-Minute ERF – Traffic Congestion	535.7	22.3 *4.2% of total public miles*	**513.4**

The existing 4:00-minute first-due unit coverage is reduced by 20.5 percent during traffic congestion. The ERF with traffic congestion drops significantly to four percent.

The City's shape and road network is difficult to serve efficiently from four fire stations. Traffic congestion travel time reductions further hurt the peripheral Department service areas. This means that when simultaneous incidents occur during peak hours of traffic congestion in the center of the City, peripheral station areas cannot receive a second unit quickly if needed.

Finding #3: A deployment system with four fire stations does not allow the Department to provide a best practices 4:00-minute travel time to all the City's major neighborhoods.

2.6.3 Analysis of Adding Proposed Station 4

Over a decade ago, the Department was offered a fifth fire station site in the far southwest corner of the service area at 1350 S. 1600 W in Orem. Before looking at the mapping results, Citygate offers these three points of advice for adding fire stations:

- A station should service a 360-degree section of the public road network.
- A station should not be placed against a permanent natural barrier, such as a canyon or lake.
- A station should serve the most people in the fewest minutes, not expend valuable coverage crossing open space.

Scenario Maps #1, #1a, and #1b display the coverage at 4:00 minutes, the ISO 1.5-mile distance measure, and the multiple-unit coverage. The location at the corner of the road network provides very little added coverage for either 4:00 minutes or 1.5 miles given the cost of staffing and operating a fifth station. For multiple-unit coverage, the station is too far to improve coverage anywhere in the southern City when compared to Map #5.

For road miles covered, adding a station at this site only increases first unit coverage to 47.2 percent, or an increase of 3.1 percent. The ERF coverage increase is zero. Thus, this location is just not efficient in terms of service or cost.

Finding #4: The proposed next fire station at 1350 S. 1600 W in Orem does not increase coverage significantly enough (3.1 percent) to justify the expense at that location.

2.7 STATISTICAL ANALYSIS

SOC ELEMENT 7 OF 8
RELIABILITY & HISTORICAL RESPONSE EFFECTIVENESS STUDIES

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

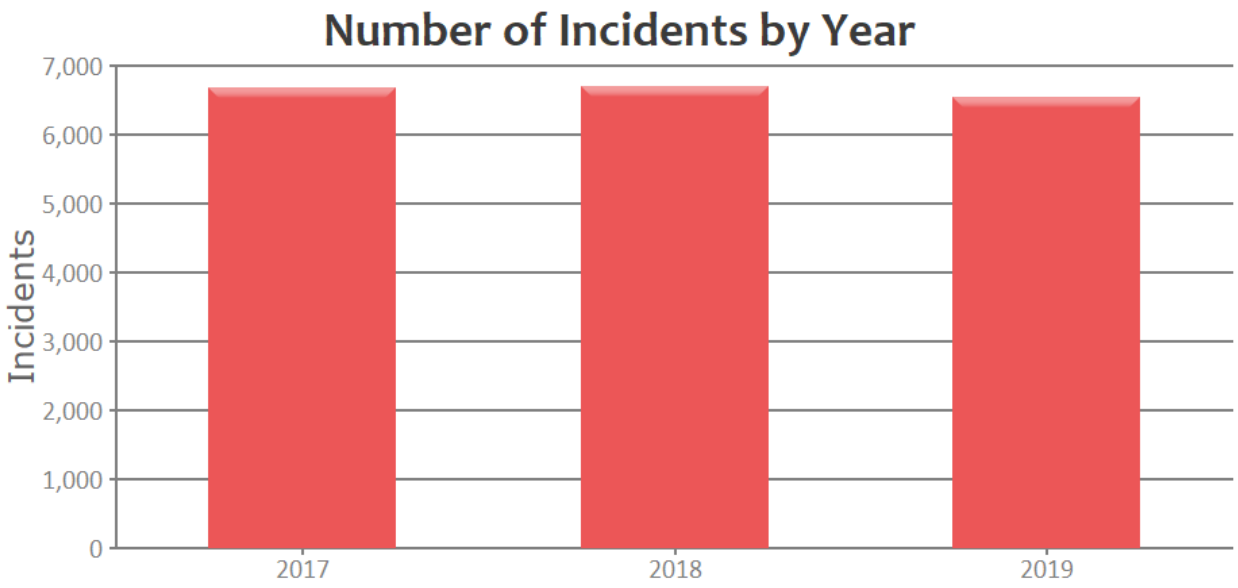
The following subsections provide summary statistical information regarding the Department and its services.

2.7.1 Demand for Service

The Department provided National Fire Incident Reporting System (NFIRS) 5 text files, as well as the output of the Emergency Reporting records management system export for StatsFD. After data merging, there were 19,928 incidents and 38,550 apparatus response records available for the three-year analysis from 2017–2019.

In 2019, the Department responded to 6,546 incidents. During this period, the Department had a daily demand of 17.93 incidents, of which 2.34 percent were to fire incidents, 73.72 percent were to EMS incidents, and 23.94 percent were to other incident types.

Figure 6—Annual Service Demand by Year



The following figure illustrates the number of incidents by incident type for the three years of the study. The number of EMS incidents is declining slightly each year. The number of fires remained relatively flat but with a slight decline in 2019.

Figure 7—Number of Incidents by Year by Incident Type

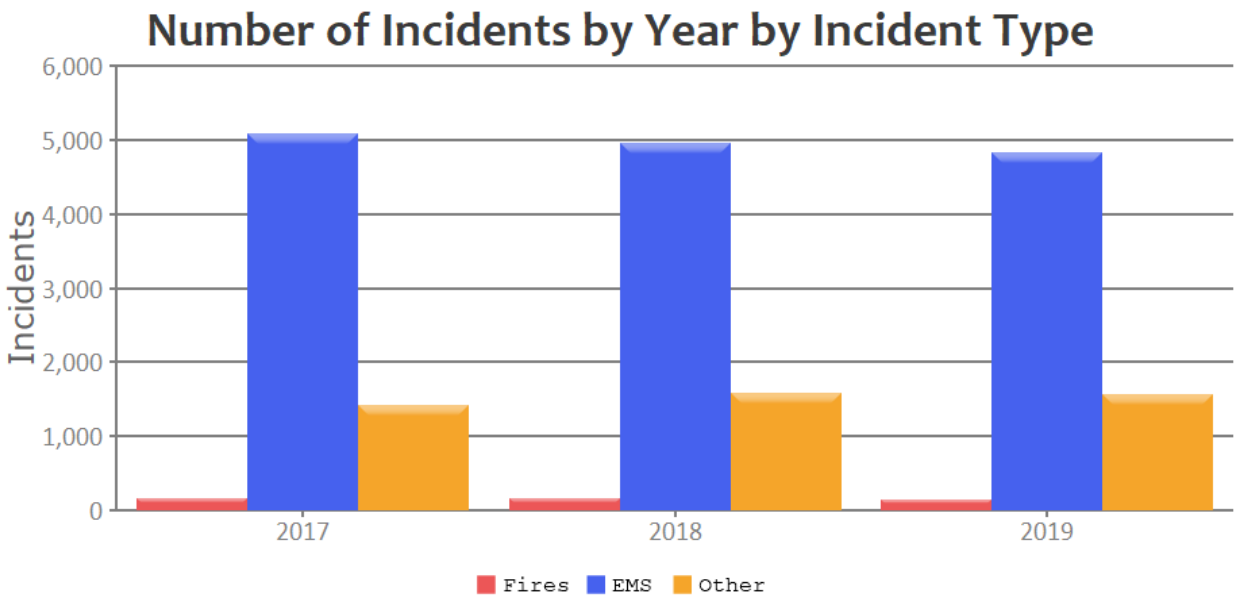
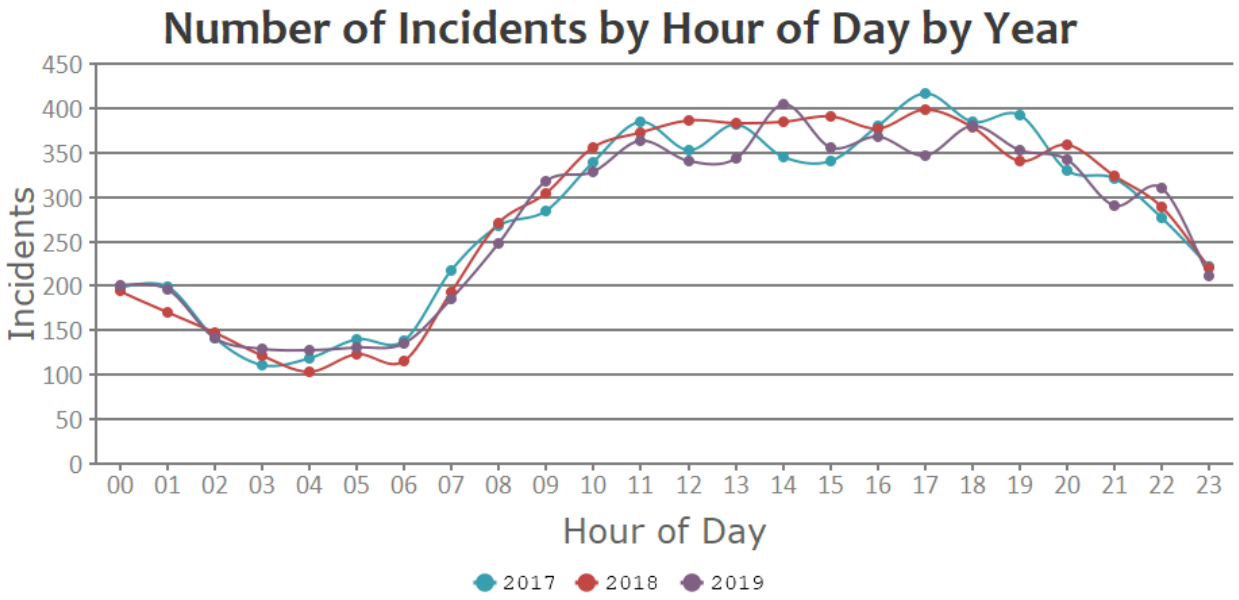


Figure 8 shows service demand by hour of day by year, illustrating that calls for service occur at every hour of the day and night, requiring fire suppression and EMS response capability 24 hours per day, every day of the year. There is a slight annual variance in hourly volume during the afternoon and early evening hours.

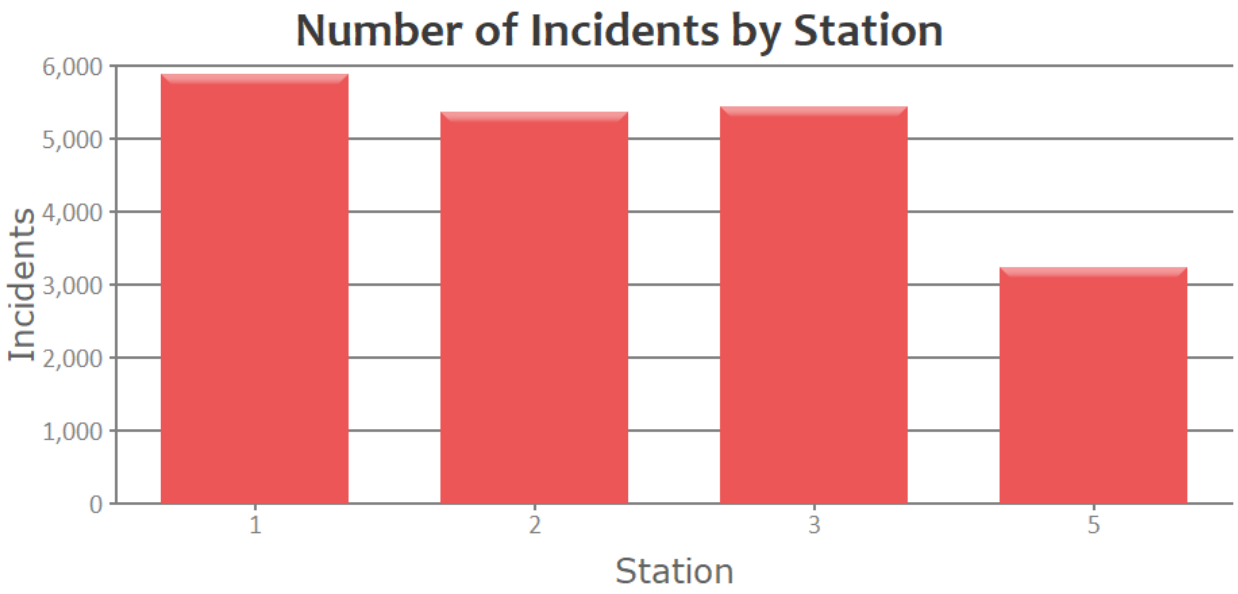
Figure 8—Service Demand by Hour of Day and Year



Finding #5: The Department's service demand is consistent, indicating the need for a 24-hours-per-day, seven-days-per-week fire and EMS emergency response system.

The following figure illustrates the number of incidents by station area during the three-year analysis period. Station 5 has the fewest number of incidents.

Figure 9—Number of Incidents by Station



The following table lists the more significant incidents by incident quantity in 2019. EMS incidents far outnumber all other incident types.

Table 12—Incidents: Quantity by Incident Type – 2019

Federal NFIRS # / Incident Type	2019
321 EMS call, excluding vehicle accident with injury	4,178
611 Dispatched and canceled en route	478
322 Vehicle accident with injuries	282
324 Motor vehicle accident no injuries	193
700 False alarm or false call, other	120
320 Emergency medical service, other	83
551 Assist police or other governmental agency	61
554 Assist invalid	65
550 Public service assistance, other	44
622 No incident found on arrival of incident address	52
412 Gas leak (natural gas or LPG)	64
745 Alarm system sounded, no fire - unintentional	58
323 Motor vehicle/pedestrian accident (MV Ped)	34
500 Service call, other	41
743 Smoke detector activation, no fire – unintentional	56
736 CO detector activation due to malfunction	44
553 Public service	40
111 Building fire	20

The following table illustrates the more significant types of incident property use in 2019. The highest rankings for incidents by property use are residential dwellings.

Table 13—Incidents: Quantity by Property Use – 2019

Federal NFIRS #/ Property Use	2019
419 1 or 2 family dwelling	2,104
331 Hospital – medical or psychiatric	636
311 24-hour care nursing homes, 4 or more persons	558
429 Multi-family dwellings	544
960 Street, other	358
963 Street or road in commercial area	184
961 Highway or divided highway	190
400 Residential, other	257
500 Mercantile, business, other	140
965 Vehicle parking area	117
241 Adult education center, college classroom	100
962 Residential street, road, or residential driveway	97
900 Outside or special property, other	81
519 Food and beverage sales, grocery store	97
365 Police station	7
340 Clinics, doctors offices, hemodialysis centers	44
321 Mental retardation/development disability facility	52
131 Church, mosque, synagogue, temple, chapel	50
599 Business office	44
449 Hotel/motel, commercial	38
300 Health care, detention, and correction, other	34
700 Manufacturing, processing	38
215 High school/junior high school/middle school	38
161 Restaurant or cafeteria	34

2.7.2 Simultaneous Incident Activity

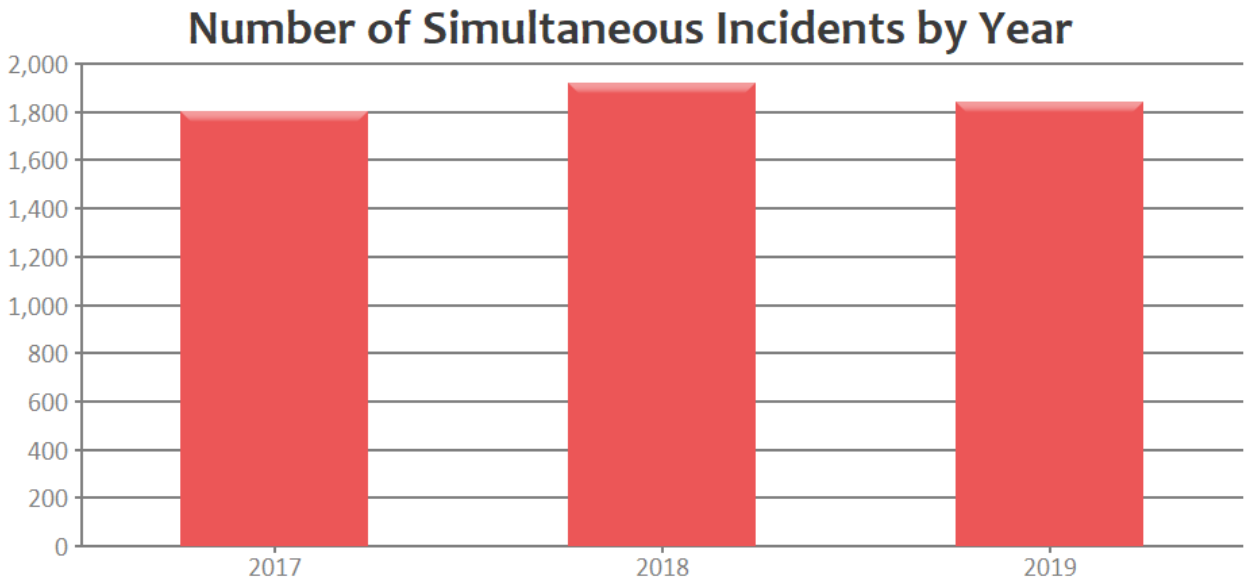
Simultaneous incidents occur when other incidents are underway at the time a new incident develops. During 2019, 28.17 percent of incidents occurred while one or more other incidents were underway. The following is the percentage of simultaneous incidents broken down by the number of simultaneous incidents.

- 28.17 percent for 1 or more simultaneous incidents

- 04.84 percent for 2 or more simultaneous incidents
- 00.55 percent for 3 or more simultaneous incidents

The following figure shows that the number of simultaneous incidents peaked in 2018.

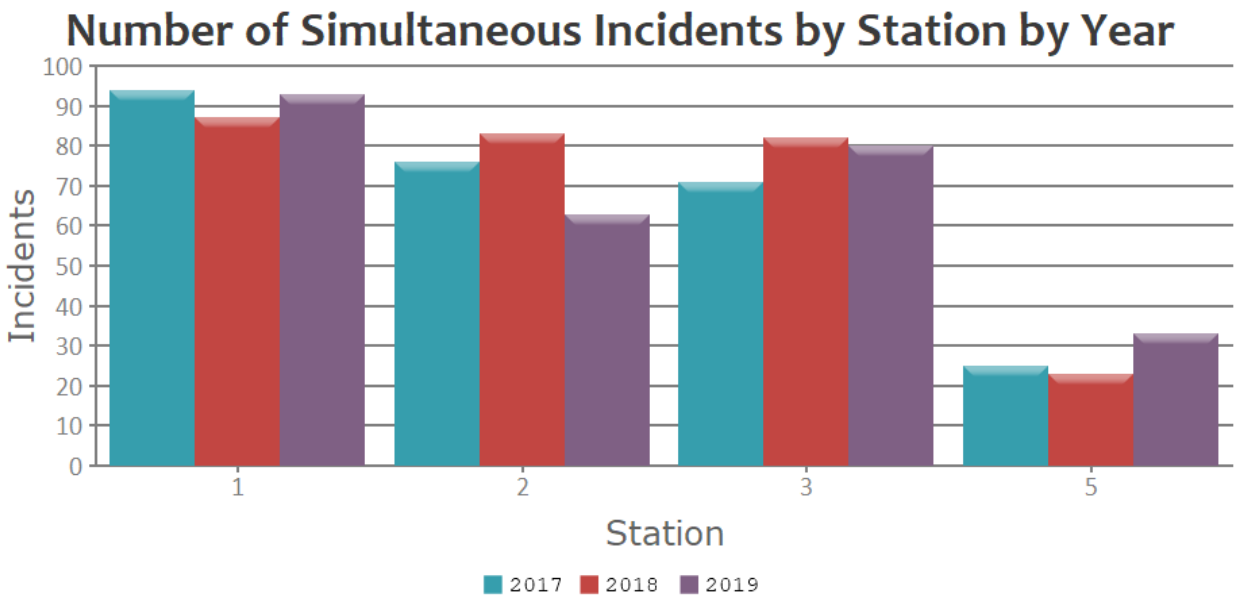
Figure 10—Number of Simultaneous Incidents by Year



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

The following figure illustrates the number of single-station simultaneous incidents by station area by reporting year. Station 1 has the greatest number of single-station simultaneous incidents, followed by Stations 3 and 2.

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



Finding #6:	The largest impact of simultaneous incidents is felt in Station 1's district, which further shifts workload to other companies at peak hours of the day.

2.7.3 Workload by Unit-Hour Utilization

Maintaining response time performance is a function of three interdependent issues—time over distance, rate of simultaneous incidents, and the workload per unit at peak demand hours of the day. The following tables show the percent of time per hour, across 12 months, that units are committed to 9-1-1 incidents. This time does not include returning to the unit's response area, maintenance, training, inspections, public relations activities, refueling, etc.

The utilization percentage for apparatus is calculated by two primary factors—the number of responses and the duration of responses. The following table is a unit-hour utilization summary for Department engine companies. The engines are listed in descending order from busiest in the farthest left column to least-busy in the farthest right column. This table is based on 2,760 apparatus response records in 2019.

Table 14—Unit-Hour Utilization – Engine Companies – 2019

Hour	E-32	E-35
00:00	4.52%	3.50%
01:00	3.52%	2.22%
02:00	3.28%	1.79%
03:00	4.17%	4.48%
04:00	1.73%	1.52%
05:00	3.91%	1.88%
06:00	2.90%	1.50%
07:00	5.11%	3.18%
08:00	6.26%	4.21%
09:00	6.74%	6.96%
10:00	7.26%	6.07%
11:00	8.50%	7.96%
12:00	7.14%	5.65%
13:00	7.43%	6.65%
14:00	10.17%	6.99%
15:00	8.33%	7.31%
16:00	6.86%	4.76%
17:00	5.75%	6.27%
18:00	6.02%	6.82%
19:00	6.39%	5.88%
20:00	6.76%	5.93%
21:00	5.79%	2.50%
22:00	6.00%	4.23%
23:00	3.67%	2.77%

The following table illustrates unit-hour utilization for the Department's ladder companies. This table is based on 3,231 apparatus response records in 2019.

Table 15—Unit-Hour Utilization – Ladder Companies – 2019

Hour	L-31	L-33
00:00	3.70%	4.18%
01:00	2.92%	4.37%
02:00	3.44%	2.90%
03:00	3.64%	6.06%
04:00	5.24%	2.98%
05:00	2.93%	2.45%
06:00	4.58%	4.25%
07:00	3.80%	4.03%
08:00	5.63%	4.30%
09:00	5.90%	8.21%
10:00	8.02%	5.77%
11:00	11.02%	9.82%
12:00	9.70%	5.83%
13:00	9.43%	5.94%
14:00	7.96%	9.00%
15:00	8.06%	6.78%
16:00	8.95%	7.04%
17:00	10.61%	7.56%
18:00	7.92%	9.13%
19:00	8.77%	7.34%
20:00	8.97%	7.12%
21:00	7.27%	6.92%
22:00	6.59%	6.78%
23:00	4.03%	4.66%

The following table illustrates unit-hour utilization for the Department's ambulance units. This table is based on 6,080 apparatus response records in 2019.

Table 16—Unit-Hour Utilization – EMS Companies – 2019

Hour	A-31	A-33	A-32	A-35
00:00	6.33%	4.13%	5.07%	3.83%
01:00	5.03%	5.85%	4.34%	3.78%
02:00	5.34%	3.38%	3.80%	1.70%
03:00	5.78%	6.22%	5.40%	3.58%
04:00	4.60%	3.85%	1.95%	1.67%
05:00	3.33%	3.20%	3.71%	1.70%
06:00	4.62%	3.97%	3.65%	1.79%
07:00	4.29%	4.56%	4.33%	3.45%
08:00	5.66%	6.40%	5.73%	4.23%
09:00	11.43%	8.26%	7.31%	7.02%
10:00	9.66%	7.61%	7.72%	5.07%
11:00	9.76%	11.14%	8.30%	7.69%
12:00	10.08%	7.19%	7.51%	5.70%
13:00	10.36%	8.10%	9.68%	6.26%
14:00	10.25%	9.33%	10.78%	7.21%
15:00	11.13%	9.79%	9.63%	7.32%
16:00	9.48%	8.86%	7.59%	5.22%
17:00	10.37%	9.39%	7.49%	5.50%
18:00	7.75%	8.84%	7.71%	5.80%
19:00	10.22%	9.09%	6.04%	6.51%
20:00	9.21%	7.52%	6.86%	6.12%
21:00	7.87%	6.41%	6.58%	2.96%
22:00	8.26%	7.82%	6.85%	5.08%
23:00	5.42%	4.75%	3.93%	4.21%

During the nine-hour daytime work period, when crews on a 24-hour shift must also pay attention to apparatus checkout, station duties, training, fire prevention inspections, public education, and paperwork, plus required physical training and meal breaks, Citygate recommends the maximum commitment unit-hour utilization percentage per hour should not exceed **30 percent**. Beyond that, the most important duties to suffer will be training hours and fire prevention inspections.

The Department's unit-hour utilization rates do not yet approach saturation levels of 30 percent *hour over hour*, even if an engine and ambulance crew unit-hour utilization at the same station is

added together. (Some of that time they are on the same incident, so adding is not totally accurate.) Stated this way, the Department's units have a significant margin to add incident workload. However, given only four station crews, the peak daylight hours of the day simultaneous demand is hampering prompt response times in the busiest station areas.

2.7.4 Operational Performance

Performance for the first apparatus to arrive on the scene of emergency incidents (fire and EMS incidents in NFIRS) is measured by the time necessary for 90 percent completion of the following components:

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

2.7.5 Call Processing

Call processing measures the time from the first incident time stamp in Orem Police Department's Emergency Communications Center until fire and ambulance crews are notified of the request for assistance.

The following table shows that call processing is 2:44 minutes for 90 percent compliance Department-wide.

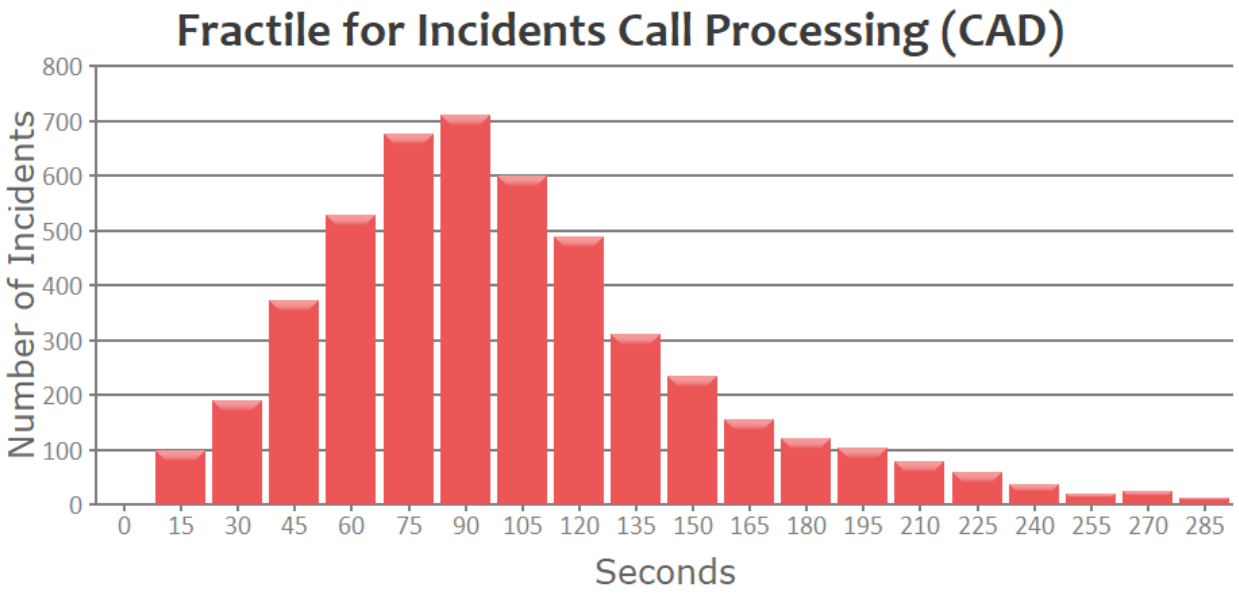
Table 17—Call Processing Performance to 90 Percent of Fire and EMS Incidents – 2019

Station	2019
Department-wide	**02:44**
Station 1	02:39
Station 2	02:49
Station 3	02:42
Station 5	02:49

Finding #7: At 2:44 minutes for 90 percent of the fire/EMS incidents, call processing performance is significantly slower than a best practice recommendation of 1:30 minutes.

The following figure illustrates a peak of requests being processed at 90 seconds. There are a rather large number of incidents with call processing times greater than 90 seconds causing poorer call processing performance.

Figure 12—Fractile for Incidents Call Processing (CAD)



2.7.6 Turnout

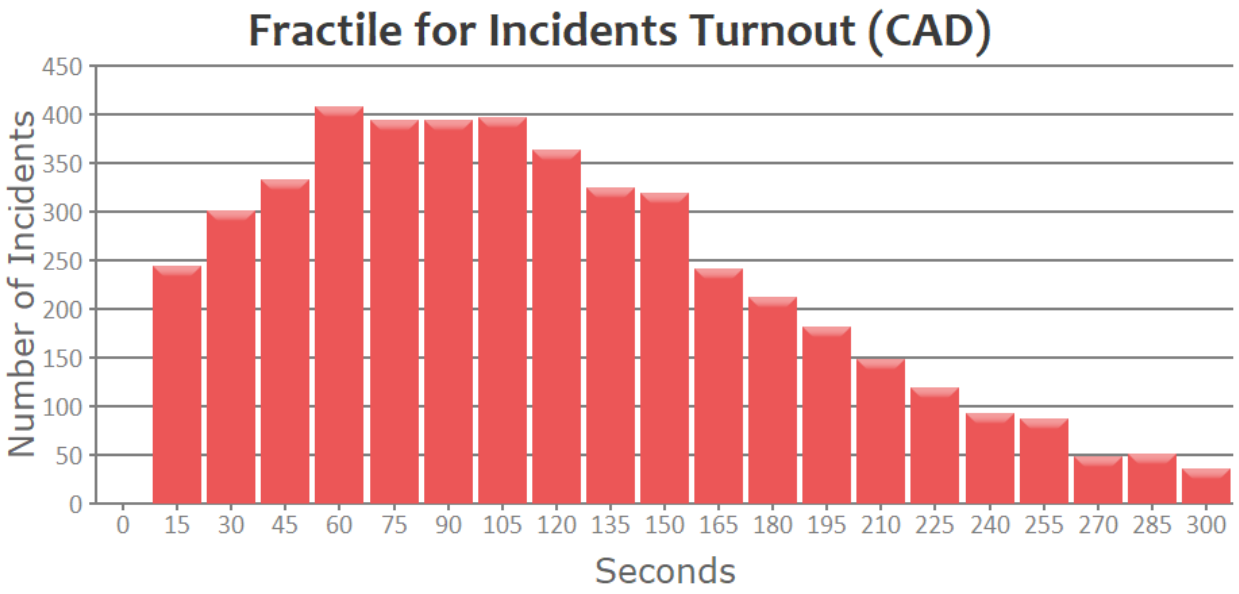
Turnout measures the time from apparatus notification until the apparatus starts traveling to the scene. Based on best practices, Citygate's recommended goal for turnout is 2:00 minutes. The City's fire crews significantly miss the 2:00-minute turnout goal.

Table 18—Turnout Performance to 90 Percent of Fire and EMS Incidents – 2019

Station	2019
Department-wide	**03:27**
Station 1	03:27
Station 2	03:16
Station 3	03:31
Station 5	03:28

The following figure illustrates fractile turnout performance, which shows that many of the incident responses receive turnout performance beyond 2:00 minutes.

Figure 13—Fractile for Incidents Turnout (CAD)



Finding #8: At 3:27 minutes Department-wide, crew turnout performance is significantly slower than a Citygate-recommended goal of 2:00 minutes or less to 90 percent of fire/EMS incidents.

2.7.7 Travel

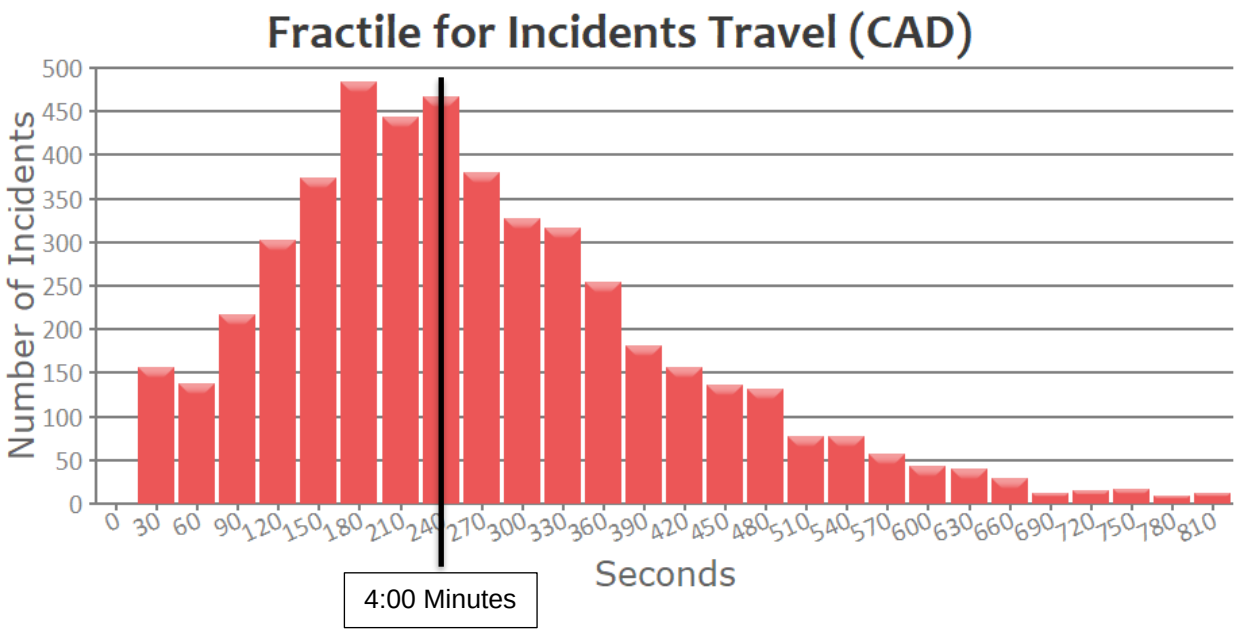
Travel measures the time to travel to the scene of the emergency. In most urban and suburban fire departments, 4:00-minute travel 90 percent of the time would be considered highly desirable. Table 19 shows that no stations achieve that goal.

Table 19—Travel Performance to 90 Percent of Fire and EMS Incidents – 2019

Station	2019
Department-wide	**07:44**
Station 1	08:05
Station 2	07:16
Station 3	07:28
Station 5	08:04

The following figure shows fractile travel time performance. The peak segment for travel time performance is 180 seconds, or 3:00 minutes. The figure is severely right shifted, with fewer travel times less than 3:00 minutes and many more travel times greater than 3:00 minutes.

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



Finding #9: At 7:44 minutes to 90 percent of fire/EMS incidents Department-wide, first-due unit travel time is significantly slower than a best practice urban/suburban area goal of 4:00 minutes.

2.7.8 Call to Arrival

Call to arrival measures time from receipt of the request for assistance until the apparatus arrives on the scene. A best practice goal is 1:30 minutes for call processing, 2:00 minutes for turnout, and 4:00 minutes for travel. This equates to 7:30 minutes overall.

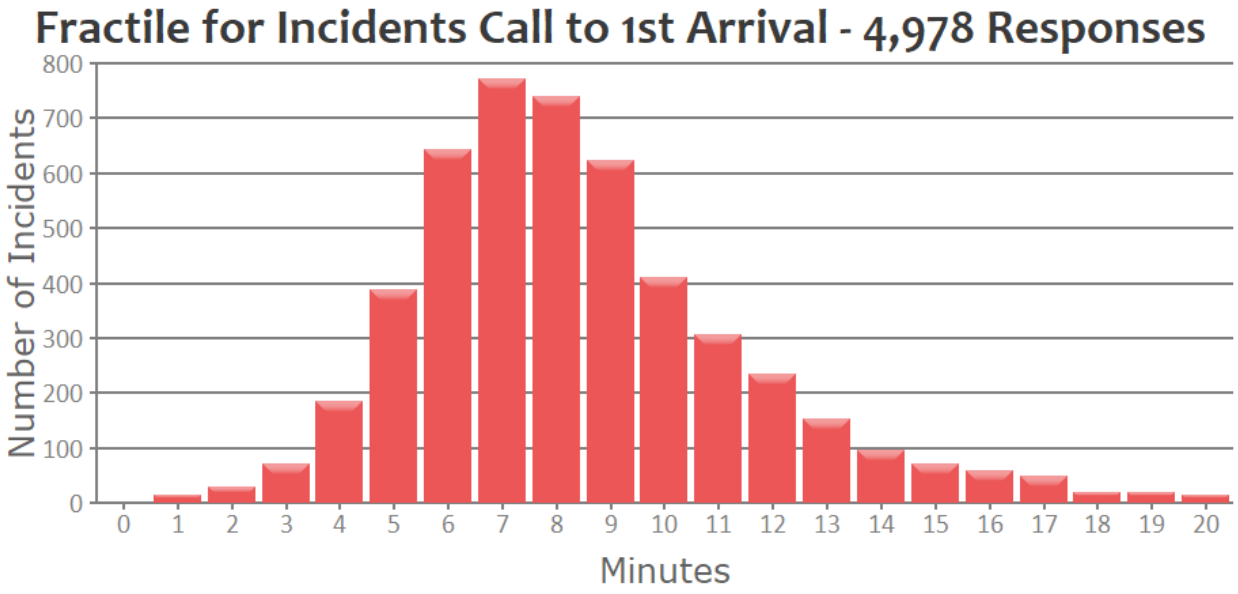
The City fails to meet this goal, with a 2019 Department-wide 90 percent performance of nearly 12:00 minutes. In 2019, Station 2 had the best call to arrival performance at 11:22 minutes, while Station 5 took the longest to reach 90 percent compliance at 12:34 minutes.

Table 20—Call to Arrival Performance to 90 Percent of Fire and EMS Incidents – 2019

Station	2019
Department-wide	11:59
Station 1	12:22
Station 2	11:22
Station 3	11:45
Station 5	12:34

The following figure illustrates fractile call to arrival performance. The peak segment is 7:00 minutes. There is, however, a severe right shifting, which illustrates many incidents take longer.

Figure 15—Fractile for Incidents Call to First Arrival



Finding #10: At 11:59 minutes, the Department's call to arrival time to 90 percent of the fire/EMS incidents is significantly slower than Citygate's recommended goal of 7:30 minutes. Every component measure of response time for the Department is too slow, from dispatch to turnout to travel.

2.7.9 Effective Response Force (First Alarm) Concentration Measurements

The desired ERF for structure fires from the Department is two engines, two ladder/quint trucks, and four ambulances, plus one Battalion Chief for a total of 17 personnel. This is 100 percent of the daily on-duty force.

A best practice goal for the ERF (First Alarm) is that the last arriving unit should take no longer than 8:00 minutes travel time. There are very few incidents in one year that need all the units to arrive within 8:00 minutes travel time. Thus, the following times also show the quantities.

Table 21—Distribution – Effective Response Force (First Alarm) – Travel Time Performance to 90 Percent of Fire and EMS Incidents – 2019

Station	2019 Time/Quantity
Department-wide	**15:08** (3)
Station 1	
Station 2	07:53 (1)
Station 3	15:08 (2)
Station 5	

Finding #11: At 15:08 minutes, the Effective Response Force (First Alarm) travel times are longer than the best practice and Citygate-recommended goal of 8:00 minutes and, as with first-due units, reflects the service area's challenging road network and topography.

2.8 Overall Deployment Evaluation

SOC Element 8 of 8
Deployment Evaluation

The Department serves a diverse urban population with a mixed residential and non-residential land-use pattern typical of a city in Utah south of Salt Lake City.

If desired outcomes include limiting building fire damage to only part of the inside of an affected building and/or minimizing permanent impairment resulting from a medical emergency, the City and its partner cities will need both first-due unit and multiple-unit ERF coverage in all neighborhoods, consistent with service goals, to limit fire severity and to provide paramedic-level first responder care to life-threatening emergencies.

There are two primary challenges facing the street-level delivery of fire and ambulance services in the City—travel time and limited staffing. These two challenges are interrelated. The travel time challenge in the City and its partner cities of Lindon and Vineyard is to cost-effectively provide

4:00- and 8:00-minute travel time coverage for best outcomes when challenged by a mostly non-grid road network design, geography with open spaces, and limited crossings at the highways.

The following table shows the travel time challenge a different way. Yellow highlights show the point at which 80 percent travel time compliance is reached. Green highlights show the point at which 90 percent travel time compliance is reached. At 4:00 minutes, only a little over 50 percent of the incidents are reached.

Table 22—Time and Goal Percentage Changes

Travel (CAD) in Seconds	Station 1	Station 2	Station 3	Station 5
000	0.00%	0.00%	0.00%	0.00%
015	1.90%	2.40%	1.30%	2.70%
030	3.10%	3.80%	2.10%	4.30%
045	4.10%	4.80%	2.80%	5.50%
1:00 Minute	6.40%	6.20%	4.20%	8.10%
075	8.10%	8.00%	6.00%	10.20%
090	10.50%	10.80%	8.40%	13.20%
105	12.50%	14.20%	11.00%	16.50%
2:00 Minutes	16.20%	17.50%	13.80%	20.60%
135	19.80%	21.10%	17.10%	24.60%
150	23.60%	26.20%	21.00%	27.90%
165	28.00%	31.50%	26.00%	32.70%
3:00 Minutes	32.30%	37.30%	31.40%	37.50%
195	37.60%	42.90%	36.70%	40.50%
210	40.40%	47.10%	42.30%	44.30%
225	44.90%	51.90%	48.20%	48.20%
4:00 Minutes	*49.30%*	*56.30%*	*53.70%*	*52.70%*
255	53.50%	61.10%	57.30%	56.10%
270	56.60%	65.00%	61.00%	60.70%
285	60.70%	68.70%	64.00%	63.00%
5:00 Minutes	63.60%	72.40%	67.30%	66.40%
315	67.00%	75.10%	70.90%	69.40%
330	70.40%	78.30%	74.10%	72.60%
345	73.60%	80.60%	77.20%	75.60%
6:00 Minutes	76.30%	82.80%	79.50%	77.40%

Travel (CAD) in Seconds	Station 1	Station 2	Station 3	Station 5
375	78.30%	83.90%	81.70%	80.30%
390	79.60%	85.80%	84.10%	81.70%
405	81.10%	87.10%	86.00%	83.40%
7:00 Minutes	82.90%	88.50%	87.60%	85.10%
435	84.60%	89.90%	89.10%	87.00%
450	85.60%	91.20%	90.40%	88.20%
465	87.50%	92.40%	91.60%	89.00%
8:00 Minutes	89.40%	93.40%	93.00%	89.90%
495	90.70%	93.90%	93.50%	90.60%
510	91.80%	94.60%	94.00%	91.70%
525	92.80%	95.30%	95.00%	92.40%
9:00 Minutes	93.60%	95.70%	95.60%	93.70%
555	94.50%	96.10%	96.00%	94.60%
570	95.10%	96.50%	96.40%	95.30%
585	95.80%	96.90%	96.80%	95.80%
10:00 Minutes	96.40%	97.10%	97.40%	96.00%
615	96.80%	97.20%	97.80%	96.80%
630	97.30%	97.90%	97.90%	97.00%
645	97.60%	98.20%	98.60%	97.10%
11:00 Minutes	97.90%	98.50%	98.80%	97.30%
675	98.10%	98.50%	99.00%	97.50%
690	98.30%	98.50%	99.00%	97.80%
705	98.30%	98.70%	99.00%	98.00%
12:00 Minutes	98.60%	99.00%	99.00%	98.40%
735	98.80%	99.20%	99.20%	98.70%
750	99.10%	99.20%	99.20%	98.80%
765	99.30%	99.30%	99.20%	99.10%
13:00 Minutes	99.40%	99.40%	99.30%	99.20%
795	99.50%	99.40%	99.50%	99.30%
810	99.60%	99.50%	99.80%	99.40%
825	99.70%	99.50%	99.80%	99.50%
14:00 Minutes	99.90%	99.70%	100.00%	99.80%

Travel (CAD) in Seconds	Station 1	Station 2	Station 3	Station 5
855	99.90%	99.70%	100.00%	100.00%
870	99.90%	99.80%	100.00%	100.00%
885	99.90%	99.90%	100.00%	100.00%
15:00 Minutes	100.00%	100.00%	100.00%	100.00%
Time to 80%	**390 (6:30)**	**345 (5:45)**	**375 (6:15)**	**375 (6:15)**
Time to 90%	**495 (8:15)**	**435 (7:15)**	**450 (7:30)**	**480 (8:00)**

The 4:00-minute first-due unit goal as published in NFPA 1710 was developed in an era before advanced GIS mapping and statistics could model the challenges of a community like Orem and its partners with a curvilinear street network. Also, in that era, dispatch processing and crew turnout were thought to only require 1:00 minute each. It is now understood that the complexities of dispatching can take up to 1:30 minutes and crew turnout can take up to 2:00 minutes.

The City is only fielding four fire stations likely placed using the decades-old ISO measure of 1.5 miles distance reach in each direction. Reaching 90 percent of the calls in 4:00 minutes travel time or less would require additional stations, which is not fiscally prudent based on the number and severity of incidents at this time. While EMS accounts for about 74 percent of the incidents, typically less than 20 percent of those are life-threatening critical emergencies with a stopped heart or breathing. Offsetting the slow response times is the number of structure fires, modestly averaging 21 per year, and the four-station system can deliver all of the four-station on-duty personnel to at least the core of the City within 8:00 minutes travel time.

The second challenge is the modest staffing level of the City firefighting units at only two personnel each, which is more typical of a rural department. In the prior era of merged public safety departments, patrol officers assisted on firefighting; since the separation of police and fire/EMS functions, that is increasingly rare as the growing technical job demands on both police and firefighting/EMS personnel limit the training, education, and field experience time to be 100 percent effective at both jobs.

While the City has five personnel assigned per fire station (four minimum per shift), four of these personnel are used when an ambulance and fire engine respond first to EMS incidents, so when one or two stations are committed on EMS incidents, there is only about 50 percent of the firefighting force still available for emergency response. A serious building fire requires 100 percent of the on-duty force to have a chance at being effective.

Low staffing per unit with long response times means the incident continues to worsen, and when the team finally arrives it is much further behind the time curve on deescalating the emergency. Some emergencies will have worsened to the point of needing additional units to increase staffing

at the emergency. When this happens to modestly severe incidents, even more units are out of service. This is the why speed and weight of the attack are so important. Keeping a small emergency small takes the right staffing in the right time frame.

2.8.1 Deployment Improvements

As revenue sources allow, Orem and its partner cities can improve the response system over time. The greatest demand for services is during daylight hours. The City can consider incrementally adding staffing for peak-hour EMS and then use those personnel outside of peak hours for all types of incidents. Over a longer period, at least each primary firefighting engine apparatus should be staffed with three personnel.

At this time, adding even one firefighter per day to a crew does not always lower the number of other units needed. Adding one firefighter per crew per day actually means adding three personnel to cover the one assignment 24/7/365. Therefore, adding a third firefighter to all four engines would require 12 additional personnel, plus the overtime or extra staff positions to cover the earned leave absences of the third positions.

The best investment to make the most positive impact with a staffing increase would be to add a two-firefighter/paramedic ambulance at peak hours of the day. This unit could handle the peak-hour demand and the out-of-town patient transfers. This would leave other units more available. After peak hours, the two firefighter/paramedics would be available to increase the staffing of one engine and one ladder/quint to three personnel each at Station 1 during overnight hours when the deadliest building fires typically occur. This staffing also helps increase the effective response force in the southern area of the City, where the multiple-unit response time is the weakest.

A hybrid staffing plan of a peak-hour ambulance, with that staffing moving to engines at night, is an increase of two per day requiring six total personnel for 24/7/365 coverage. This approach would improve the City's two challenges—the speed of the response at daylight peak demand hours and the weight of the attack, especially during overnight hours.

Given the drive-time challenges due to road design, Citygate recommends the City adopt a more realistic travel time goal of 5:00 minutes travel time and use that metric to locate a fifth fire station and other units in the years ahead.

Finally, the road mile coverage measures for proposed Station 4 (which is the fifth fire station at 1350 S. 1600 W in Orem), indicate the need for a more effective location in the west central area of the Department's service area should be found using 5:00-minute travel time spacing from the adjoining stations.

2.8.2 Deployment Recommendations

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

Recommendation #1: **Adopt Deployment Policies:** The City Council should adopt complete performance measures to aid deployment planning and to monitor performance. The measures of time should be designed to deliver outcomes that will save patients when possible and keep small but serious fires from becoming more serious. With this is mind, Citygate recommends the following measures:

1.1 Distribution of Fire Stations: To treat pre-hospital medical emergencies and control small fires, the first-due unit should arrive within 8:30 minutes, 90 percent of the time from the receipt of the 9-1-1 call at Orem Police Department's Emergency Communications Center. This equates to a 90-second dispatch time, a 2:00-minute company turnout time, and a 5:00-minute travel time.

1.2 Multiple-Unit Effective Response Force for Serious Emergencies: To confine building fires near the room of origin, keep vegetation fires under one acre in size, extricate trapped victims within 30:00 minutes, and treat multiple medical patients at a single incident, a multiple-unit Effective Response Force should arrive within 11:30 minutes from the time of 9-1-1 call receipt at Orem Police Department's Emergency Communications Center 90 percent of the time. This equates to a 90-second dispatch time, 2:00-minute company turnout time, and 8:00-minute travel time.

1.3 Hazardous Materials Response: To provide hazardous materials response designed to protect the City from the hazards associated with uncontrolled release of hazardous and toxic materials by isolating the hazard, denying entry into the hazard zone, and notifying appropriate officials/resources to minimize impacts on the community, the first-due unit should have a total response time of 8:30 minutes or less to provide initial hazard evaluation and mitigation actions. After the initial evaluation is completed, a determination can be made whether to request additional resources from the regional hazardous materials team.

1.4 Technical Rescue: To respond to technical rescue emergencies as efficiently and effectively as possible with enough trained personnel to facilitate a successful rescue, the first-due total response time should be 8:30 minutes or less to evaluate the situation and initiate rescue actions. Following the initial evaluation, assemble additional resources as needed within a total response time of 11:30 minutes to safely complete rescue/extrication and delivery of the victim to the appropriate emergency medical care facility.

Recommendation #2: The Department should consider adding a two firefighter/paramedic peak-hour ambulance, seven days a week. After peak EMS demand hours, the two personnel should be located at Station 1 in the southern area of the City to improve multiple-unit staffing.

Recommendation #3: The Department should identify a more northerly, western location for a fifth fire station, and not use the current site identified long ago.

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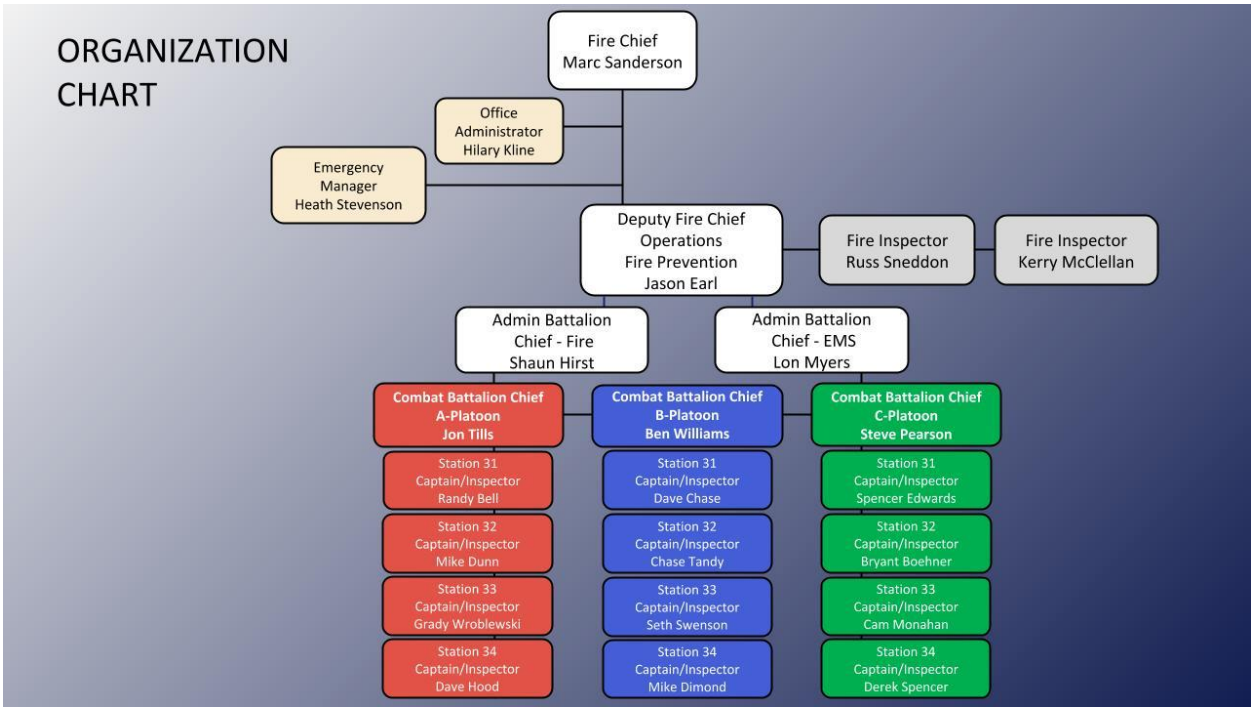
SECTION 3—HEADQUARTERS SERVICES ASSESSMENT

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

- General Department administration
- Administrative support staffing
- Emergency/disaster preparedness
- Fire prevention

NFPA 1201 states, in part, "the [Department] shall have a leader and organizational structure that facilitates efficient and effective management of its resources to carry out its mandate as required [in its mission statement]."[10] Best practices call for a management organization and headquarters programs with adequate staffing to provide a properly trained, equipped, and supported response force to ensure prompt response and safe, competent service delivery. Compliance regulations for fire services operation are increasing, so the proper hiring, training, and supervision of operational personnel require a significant leadership and general management commitment.

Figure 1—Orem Fire Department Organization



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

3.1 Assessment Methodology

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

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

3.2 Headquarters Services Strengths, Weaknesses, Opportunities, and Threats Assessment Summary

Citygate administered a strengths, weaknesses, opportunities, and threats (SWOT) assessment for the Department. The assessment yielded the following summary results:

3.2.1 Strengths

- Very highly qualified, professional, and dedicated personnel with a strong commitment to serve the organization and the community.
- Strong work ethic/culture.
- Knowledgeable emergency response personnel who have become subject-matter experts in critical lines of service delivery.
- High-quality customer service and pride in serving the community.
- Productive and respectful labor-management relationships.
- Positive relationship with City Council, the local EMS agency, and regional fire department partners.

3.2.2 Weaknesses/Concerns

- Insufficient clerical-level support for the administration, suppression, and training/EMS functions.
- Heavy administrative workload for non-clerical staff.

- Lack of a thorough, adopted, durable equipment replacement plan and budgets.
- Limited delivery of public information and education plan.
- Heavy workload for fire inspectors.

3.2.3 Opportunities

- Review if opportunities are available for a more regional approach for public education.
- Empower Department committees to make recommendations to the command staff.

3.2.4 Threats

- Potential single points of failure in each program, such as only one person with critical knowledge.
- Battalion Chief officer burnout due to heavy administrative workloads.
- Significant ongoing administrative workload capacity gaps and inadequate clerical support.

3.3 Orem Fire Department Organization

The City's Fiscal Year 2018/2019 Department budget authorizes two full-time equivalent employees and one half-time administrative support position dedicated to supporting the Fire Department. An additional half-time administrative support position serves the City Office of Emergency Management. This staff is responsible for the overall administration, management, and clerical support of all Department programs and services and most administrative support functions, including general Department administration, fire prevention, training, health and safety, public education/information, policies and procedures, and other related administrative and program support responsibilities. Department divisions include:

- Administration
- Operations
- Fire Prevention
- Emergency Management

3.4 ADMINISTRATION DIVISION

The Administration Division consists of the one Deputy Chief and Fire Marshal, one Administrative Secretary, and an administration Battalion Chief under direct supervision of the Fire Chief.

3.4.1 Key Program Responsibilities

Key Administration Division program responsibilities include:

- Providing overall leadership for the Department.
- Managing administrative systems and procedures.
- Developing and managing the budget and establishing fiscal policy.
- Maintaining and developing labor-management relations and resolving issues.
- Performing strategic planning.
- Managing Fire Department training.
- Implementing best practices in all areas of service.
- Complying with federal, state, and local laws, as well as regulations, codes, ordinances, rules, and professional standards.
- Connecting the Department with the City community and key stakeholders.

3.4.2 Key Fire Chief Responsibilities

- Planning, organizing, directing, and coordinating all Department functions and services.
- Providing highly responsible and technical staff assistance to the City Manager and City Council.
- Directing development and implementation of Department goals, objectives, priorities, policies, procedures, and operating guidelines.
- Developing and managing the Department budget.
- Ensuring the development and execution of a fire protection plan suited for the community.
- Representing the City in relationships with the public, community groups, professional organizations, and outside agencies.

3.4.3 Key Deputy Fire Chief Responsibilities

- Planning, organizing, directing, and coordinating all fire suppression, rescue, and emergency medical services.
- Providing highly responsible and technical staff assistance to the Fire Chief, City Manager, and City Council.
- Directing development and implementation of Division goals, objectives, priorities, policies, procedures, and operating guidelines.
- Directing the forecasting of the funds needed for staffing, equipment, materials, and supplies in assisting with the development and management of the Department budget.
- Directing the monitoring and approval of expenditures.
- Conducting organizational and operational studies and investigations and creating reports and recommendations, including implementation of discipline procedures, as necessary.
- Representing the City in relationships with the public, community groups, professional organizations, and outside agencies.
- Responding to emergencies as needed to provide high-level chief officer support.

3.4.4 Key Fire Marshal Responsibilities

- Planning, organizing, directing, and evaluating all Fire Prevention Division functions and services.
- Providing responsive technical and administrative management of a comprehensive program of fire prevention, loss management, and hazardous materials/environmental protection.
- Reviewing building and fire protection system plans and specifications and advising builders and developers.
- Overseeing public relations and education programs.
- Managing the City's weed abatement program.
- Managing the City's wildland urban interface program.

3.4.5 Administration Division Assessment

Citygate reviewed the job descriptions with Administrative Support personnel prior to administering a SWOT analysis and conducting personal interviews with each member. Citygate's

assessment of Administrative Division administrative workload yielded the following findings and recommendations.

Finding #12: The workload capacity gaps and potential single points of failure could be significantly narrowed or resolved with the hiring of an additional full-time equivalent non-sworn clerical-level position for tracking accounts payable and receivable and assisting with clerical duties of the Department staff.

Finding #13: Firefighter and officer development and training is a necessity for personnel safety and service delivery. With no dedicated person responsible for firefighter training, the tasks are assigned as a collateral duty and do not have the primary focus on firefighter safety and training.

Finding #14: The workload capacity and serious gaps in fire operations training are a single point of failure in overall firefighter safety and service delivery.

Recommendation #4: The Department should hire one additional headquarters office support position to assist in the overall workload and remove support duties and responsibilities from operations personnel.

Recommendation #5: The Department Training Program and its delivery should be formalized with policies and procedures and lesson plans and monitored for completeness and effectiveness.

Recommendation #6: The Department should add a full-time fire training officer at the command staff level to ensure all personnel are trained to the proper level and have the requisite skills for their positions in the Department.

3.5 OPERATIONS DIVISION

The Operations Division administrative staff, serving under the direction of the Deputy Fire Chief, consists of an Operations Administrative Battalion Chief and three shift Battalion Chiefs assigned to a 56-hour shift schedule. Each shift Battalion Chief has assigned collateral operational and administrative program responsibilities. Each of the 24-hour shifts is staffed with 16 personnel staffing two fire engines, two ladder/quint trucks, and four ALS ambulances. Each unit is staffed with two personnel each. The Division has no dedicated administrative clerical support.

Staffing qualified and trained personnel is critical to good outcomes and firefighter safety and fire and EMS delivery. Staffing levels and training are key elements in providing those services to ensure rapid control of a fire or EMS incident, as well as ensuring adequate staffing to complete all tasks necessary on the emergency scene. That staffing is developed based on the number of personnel required to perform critical tasks in a timely manner to bring the incident to a safe conclusion.

Over the years, the Operations Division has had high turnover in its firefighter ranks. In the past five years, 10 personnel retired and 21 left for other reasons. Of those other reasons for leaving, nine left for positions in other local fire departments. This means that in the past five years approximately one-third of the Orem Fire Department's personnel who resigned did so to take other positions in the fire service. This high turnover results in expenses and time to train replacement personnel and overtime costs to fill those temporary vacancies.

3.5.1 Key Program Responsibilities

Key Operations Division responsibilities include:

- Providing firefighting services.
- Delivering emergency medical services, including ambulance transport services, to the community and regionally as required.
- Performing interfacility ambulance transport services regionally.
- Providing technical rescue and hazardous materials responses as a regional partner.
- Performing employee training for fire, rescue, and emergency medical service skills.
- Maintaining and developing good labor-management relations.
- Providing strategic planning for the organization.
- Implementing national best practices for fire and emergency medical services.

3.5.2 Key Administrative Battalion Chief Responsibilities

- Processing and inputting data to create various Department reports.
- Maintaining Department records.
- Providing the main point of contact for individuals and agencies contacting the Department through walk-in, phone, email, and online.
- Assisting with meeting management by assembling agendas, producing support materials, and capturing minutes.
- Assisting with the preparation of the Department annual budget.
- Managing the Department's Fire Training Program.
- Overseeing the Emergency Management Program.

3.5.3 Key Operations Battalion Chiefs Responsibilities

- Performing direct management of on-shift personnel in planning and coordinating fire- and EMS-related duties.
- Planning, coordinating, and managing activities during multiple-company emergency responses, including fire, EMS, technical rescue, and mass casualty incidents.
- Performing professional administrative and managerial duties for assigned shift.
- Ensuring operational readiness of fire crews by managing a platoon to ensure all positions are filled and available resources are best deployed for Citywide coverage in response for both fire and EMS incidents.
- Serving as the Incident Command chief officer for all emergencies as needed on their assigned platoon.
- Monitoring daily fire/EMS crew productivity, including equipment and station maintenance, company drills and training, company fire inspections, and other operational and administrative functions.
- Overseeing and participating in the training and development of assigned company personnel to meet the goals and objectives of individuals and the overall goals of the Department, including those related to health and fitness.
- Working with other management staff to maintain, revise, and improve overall Department operations.
- Supervising, training, scheduling, and evaluating assigned staff.

- Managing sub-Department program(s) as assigned.
- Assisting with and working on special projects as assigned.

3.5.4 Operations Division Assessment

Citygate's assessment of the Operations Division yielded the following findings and recommendations.

Finding #15: There is a low retention / high turnover rate of firefighters within the organization over a five-year period. Approximately one-third of the firefighters who left the organization did so for other employment in the fire service.

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

Recommendation #7: The Department must create a career development and retention plan, including incentives, to ensure fully trained and operationally ready crews for emergency response are always available.

Recommendation #8: The Department and City should perform an analysis of the low retention rate for new firefighters and develop plans to mitigate that turnover.

3.6 Fire Prevention Division

The Fire Prevention Division consists of one Fire Marshal and two fire inspectors.

3.6.1 Key Program Responsibilities

Key Fire Prevention Division program responsibilities include:

- Adopting and enforcing the Utah Fire Code.
- Reviewing all new development projects and building permits for conformance with applicable fire and life safety codes, ordinances, and regulations.

- Inspecting new building construction for conformance with applicable fire and life safety codes, ordinances, and regulations. This also includes the cities of Lindon and Vineyard.
- Reviewing plans and inspecting fire protection and detection systems for conformance with applicable codes, ordinances, and regulations, as well as appropriate design, installation, and operation for the City.
- Regularly inspecting designated building occupancies for conformance with applicable fire and life safety codes, ordinances, and regulations for the City.
- Managing the City's vegetation, weed abatement, and wildland urban interface issues.
- Performing code enforcement and hazard abatement.
- Providing public fire safety education in cooperation with the City of Provo.
- Performing fire investigations to determine cause and origin.

3.6.2 Key Fire Prevention Inspector Responsibilities

- Performing technical inspections and investigative work to enforce compliance with applicable laws, ordinances, and regulations pertaining to the prevention and control of fires.
- Performing hazardous materials inspections.
- Performing fire investigations, as necessary.
- Reviewing the building fire safety and fire system plan.
- Providing community and public education in fire and life safety.

3.6.3 Fire Prevention Division Assessment

The Fire Prevention Division consists of a Fire Marshal and two fire inspectors. There are approximately 3,000 buildings that require a fire inspection annually, and these are divided between the two inspectors. These inspections are rotated every other year between the two inspectors. In addition, there are approximately 1,000 occupancies that require operating fire safety permits under the state and local fire codes, which require inspections and monitoring for compliance. Finally, each inspector spends approximately two to three hours per week on building and fire protection plan reviews.

As an illustration, if there are 4,100 inspections per year, including new construction, and assuming they are evenly divided by both inspectors, that totals almost eight inspections per day, per inspector, not accounting for holidays, earned leave time off, and training time. While some

inspections are quicker than others, and some can be bundled on a single driving loop, it is very possible that two inspectors will not be able to complete all the annual work. In departments with this workload situation, the triage of work goes to new construction then permits before annual maintenance inspections of older commercial buildings occur.

The Department's fire and life safety public education is performed in conjunction with the City of Provo for a regional approach. The Orem Fire Department has a dedicated public education room where tours for the community and different service groups and children are conducted and fire safety education is given to the community members as needed. On average, the number of hours expended by each inspector in educating the public is approximately four hours per week. Each inspector rotates in performing public fire education and assists with the education for Community Emergency Response Team (CERT) training as well.

Citygate's assessment of the Fire Prevention Division yielded the following finding and recommendations.

Finding #17: The number of plan reviews, annual fire occupancy and permit inspections, and community fire and life safety education hours has reached the maximum the two inspectors can accomplish completely and thoroughly within the allocated work period.

Recommendation #9: Hire an additional fire inspector to improve the quality of fire inspections, plan reviews, and permit inspections.

Recommendation #10: Hire a half-time public education position to assist in training of community members in fire and life safety education and to assist in the Community Emergency Response Team (CERT) training as well to relieve the fire inspectors in performing this function.

3.7 EMERGENCY MANAGEMENT DIVISION

The Emergency Management Division consists of the Emergency Services Manager, partially funded through a federal grant. The program is funded through Utah County and is coordinated with other jurisdictions as well. This improves and helps foster the regional relationships and emergency preparedness.

In the event of a disaster or emergency, the Emergency Operations Center (EOC) will be opened and operated in existing City facilities and rooms, not all located in proximity of each other. The rooms must be rearranged, and staff are usually relocated to perform normal duties during the emergency.

3.7.1 Key Program Responsibilities

Key Emergency Management Division program responsibilities include:

- Developing and maintaining the City's Comprehensive Emergency Management Plan.
- Ensuring the City's adherence to federal and state management systems.
- Coordinating public emergency alert and warning systems.
- Conducting training for City staff in the operations of the EOC during an event.
- Managing grant programs for emergency management.
- Coordinating disaster recovery efforts.
- Coordinating disaster response training for City staff and ensuring National Incident Management System compliance.
- Maintaining operational readiness of the City's EOC.
- Coordinating and maintaining operational awareness with the Utah County Emergency Management Department, as well as the State of Utah emergency management.
- Coordinating the City's CERT program with the City of Provo's CERT program to enhance area effectiveness and responses.

3.7.2 Key Emergency Services Manager Responsibilities

- Planning, developing, and implementing all disaster response and training activities for the City, including staff training, exercises, and community education programs such as CERT.
- Maintaining the City's Local Hazard Mitigation Plan and ensuring it complies with and supplants Utah County's Hazard Mitigation Plan.
- Maintaining and evaluating the Comprehensive Emergency Management Plan specific for the City of Orem.
- Ensuring EOC policies, procedures, and checklists for key positions are available during an EOC activation.

- Planning, maintaining, and coordinating the maintenance and activation of the EOC, including tests of telecommunications equipment.
- Designing and conducting employee training and exercises for EOC activations.
- Serving as a liaison between City, County, and state governmental agencies regarding emergency management and disaster preparedness.

3.7.3 Emergency Management Division Assessment

The Division is compliant with best practices for emergency management, including the National Incident Management System and the Federal Emergency Management Agency's guidelines.

The City works collaboratively with the Utah County Emergency Management Office and coordinates with the neighboring cities and agencies.

Citygate's assessment of the Emergency Management Division yielded the following findings and recommendations.

Finding #18: The Department's Emergency Services Manager has no dedicated staff. As such, the City's emergency management policies, procedures, and plans need review and updating.

Finding #19: A review of the Comprehensive Emergency Management Plan and associated policies, guidelines, and documents for the City are outdated and not consistent with national best practices.

Finding #20: The City has a regionally coordinated emergency management program, improving overall safety for the residents of the City.

Finding #21: The City must use several existing work areas in the event of an Emergency Operations Center activation. This requires relocation of employees to work in makeshift arrangements and impedes workflow and normal City operations that must occur, even during a disaster.

Recommendation #11: The Emergency Management Division needs to update all the City's emergency preparedness policies, procedures, and plans, which include the City's Comprehensive Emergency Management Plan.

Recommendation #12: As the City grows and more space is developed in new facilities such as fire stations, a space for a dedicated Emergency Operations Center should be developed.

3.8 FLEET AND FIRE STATIONS

3.8.1 Fleet

The Department's emergency response fleet is standardized between the engines and ambulances. The City tries to use the same manufacturer for engines and ambulances to ensure ease of repair and maintenance and familiarity for the firefighters, as well as training, operations, and use on the emergency scene and during ambulance transportation responses to local hospitals.

Table 23—Fire and EMS Apparatus

Radio Number	Chassis	Build-up Make	Year	Location	Purchase Cost
A-31	Chevrolet	Wheeled Coach	2019	Station 1 Primary	$185,000
A-32	Chevrolet	Wheeled Coach	2018	Station 2 Primary	$185,000
A-33	Chevrolet	Wheeled Coach	2015	Station 3 Reserve	$185,000
A-34	Chevrolet	Wheeled Coach	2011	Station 3 Primary	$185,000
A-35	Chevrolet	Wheeled Coach	2016	Station 5 Primary	$185,000
A-36	Chevrolet	Wheeled Coach	2013	Station 1 Reserve	$185,000
A-37	Chevrolet	Wheeled Coach	2012	Station 3 Reserve	$185,000
A-Rehab	Ford	Wheeled Coach	2007	Station 1 Reserve	$185,000
L-31	Pierce	Lance	2004	Station 1 Primary	$1,240,000
E-32	Pierce	Enforcer	2019	Station 2 Primary	$850,000
L-33	Pierce	Velocity	2017	Station 3 Primary	$1,100,000
E-35	Pierce	Velocity	2012	Station 5 Primary	$850,000
E-36	Pierce	Velocity	2008	Station 2 Reserve	$850,000
E-37	Pierce	Lance	2000	Station 1 Reserve	$850,000
R-33	International	490	1996	Station 3 Primary	$650,000
HR-35	International	490	1992	Station 5 Primary	$650,000
BR-33	Ford	F-550	2006	Station 3 Primary	$120,000
BR-35	Ford	F-350	1989	Station 5 Primary	$120,000
BC-OPS	Chevrolet	Suburban	2013	Station 3 Primary	$50,000
BC-32	Chevrolet	Silverado	2016	HQ	$40,000
DC-31	Ford	Explorer	2017	HQ	$41,000
C-31	Ford	Explorer	2017	HQ	$41,000
EM-31	Ford	Crown Victoria	2003	HQ	$33,000
FM-31	Chevrolet	Silverado	2016	HQ	$40,000
INSP-38	Ford	F-150	2019	HQ	$35,000
INSP-39	Ford	F-150	2020	HQ	$35,000
BC-OPS	Ford	Expedition	2003	Station 3 Reserve	$45,000

The City's Fleet Services Division performs the usual ongoing preventative maintenance to keep the fleet operating smoothly. The City continues to use in-house personnel for the majority of maintenance and repairs of apparatus. Many of the City's Fleet Services personnel are certified in fire pump repair and are also Emergency Vehicle Technicians able and certified to work on fire

apparatus and ambulances. Citygate performed a visual inspection of apparatus and finds they are overall in good operating condition.

Capital equipment and replacements are budgeted and accomplished as needed in that specific time frame. There are no capital equipment replacement fund accounts for tools or apparatus. Any replacement or additional/new equipment must be requested and budgeted during the annual budget process.

Citygate's assessment of the fleet yielded the following findings and recommendation.

Finding #22: The City does not have a long-term strategy and budget for a capital equipment replacement fund for vehicles or stations. When an apparatus or fire station requires replacement, the cost is requested in the budget year of replacement.

Finding #23: Overall, the current fire and EMS apparatus repair and maintenance program appears to be efficient and cost-effective.

Recommendation #13: The City could consider adopting a long-term replacement funding strategy for the timely replacement of fire apparatus instead of waiting until apparatus are overdue and identifying one-time funding sources.

3.8.2 Fire Stations

The City has four fire stations strategically located throughout the response area. Two of the fire stations have been renovated in the last 15 years. Of the other two, one is older, having been in service for 24 years, and one is relatively new and in good condition with four years of service.

Table 24—Fire Stations

Station Number	Address	Year Built	Fire Apparatus Equipment ID	Staffing (Minimum/ Maximum)
Station 1	300 E. 1000 S., Orem, UT	Built in 1972 Renovated in 2006	L-31 #3810, A-31 #3715, A-Rehab #3706, A-36 #3711, E-37 #3820	4/5
Station 2	911 N. Main Street, Orem, UT	Built in 1976 Renovated in 2008	E-32 #3832, A-32 #3714, E-36 #3830	4/5
Station 3	225 N. 1200 W., Orem, UT	Built in 1996	L-33 #3811, A-33 #3712, R-33 #21, BR-33 #3900, BC-OPS #3054, A-37 #3710, A-34 #3709	5/6
Station 5	90 N State Street, Lindon, UT	Built in 2016	E-35 #3830, A-35 #3713, BR-35 #10, HR-35 #20	4/5

Citygate conducted a virtual review and tour of all Fire Department facilities. The tour illustrated stations where there was inadequate room and space for training rooms and physical fitness for the firefighters. Additionally, storage space is not well designed or maintained.

Finding #24: Due to size and equipment, the fire stations have limited storage space, as well as limited rooms for fire training and physical fitness for the firefighters.

Finding #25: The interior layout of apparatus bays is cluttered and unorganized.

Recommendation #14: The City should identify a long-term funding strategy for replacement of the oldest fire stations in the future to ensure adequate space for training, apparatus, and physical fitness.

Recommendation #15: The Department should review each station's storage capacity and equipment and develop a plan for each station and its needed storage capacity.

APPENDIX A

RISK ASSESSMENT

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APPENDIX A—RISK ASSESSMENT

A.1 COMMUNITY RISK ASSESSMENT

SOC ELEMENT 3 OF 8
COMMUNITY RISK ASSESSMENT

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

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

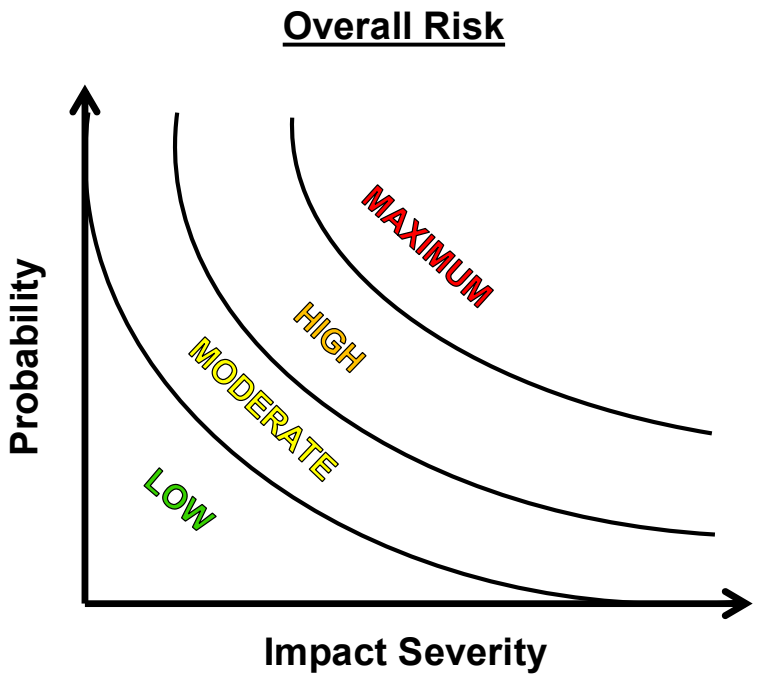
A hazard is broadly defined as a situation or condition that can cause or contribute to harm. Examples include fire, medical emergency, vehicle collision, earthquake, flood, etc. Risk is broadly defined as the *probability of hazard occurrence* in combination with the *likely severity of resultant impacts*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

A.1.1 Risk Assessment Methodology

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

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

Figure 1—Overall Risk



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

- U. S. Census Bureau population and demographic data
- City of Orem geographic information systems (GIS) data
- City General Plan and zoning information
- City and County Hazard Mitigation Plans
- 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 Department's service area yields the following:

1. The Department serves an urban/suburban population with densities ranging from less than 1,000 to 12,000 people per square mile over a varied land use pattern.
2. Orem's population is projected to increase by nearly 9 percent to approximately 110,000 people by 2024.

3. The service area includes nearly 37,000 housing units and nearly 4,300 businesses to protect.

4. The service area includes significant economic and other resource values as identified in this assessment.

5. The Cities of Orem, Lindon, and Vineyard have a mass emergency notification system to effectively communicate emergency information to the public in a timely manner.

6. The service area's overall risk for five hazards related to emergency services provided by the Department range from **Low** to **High**, as summarized in Table 1.

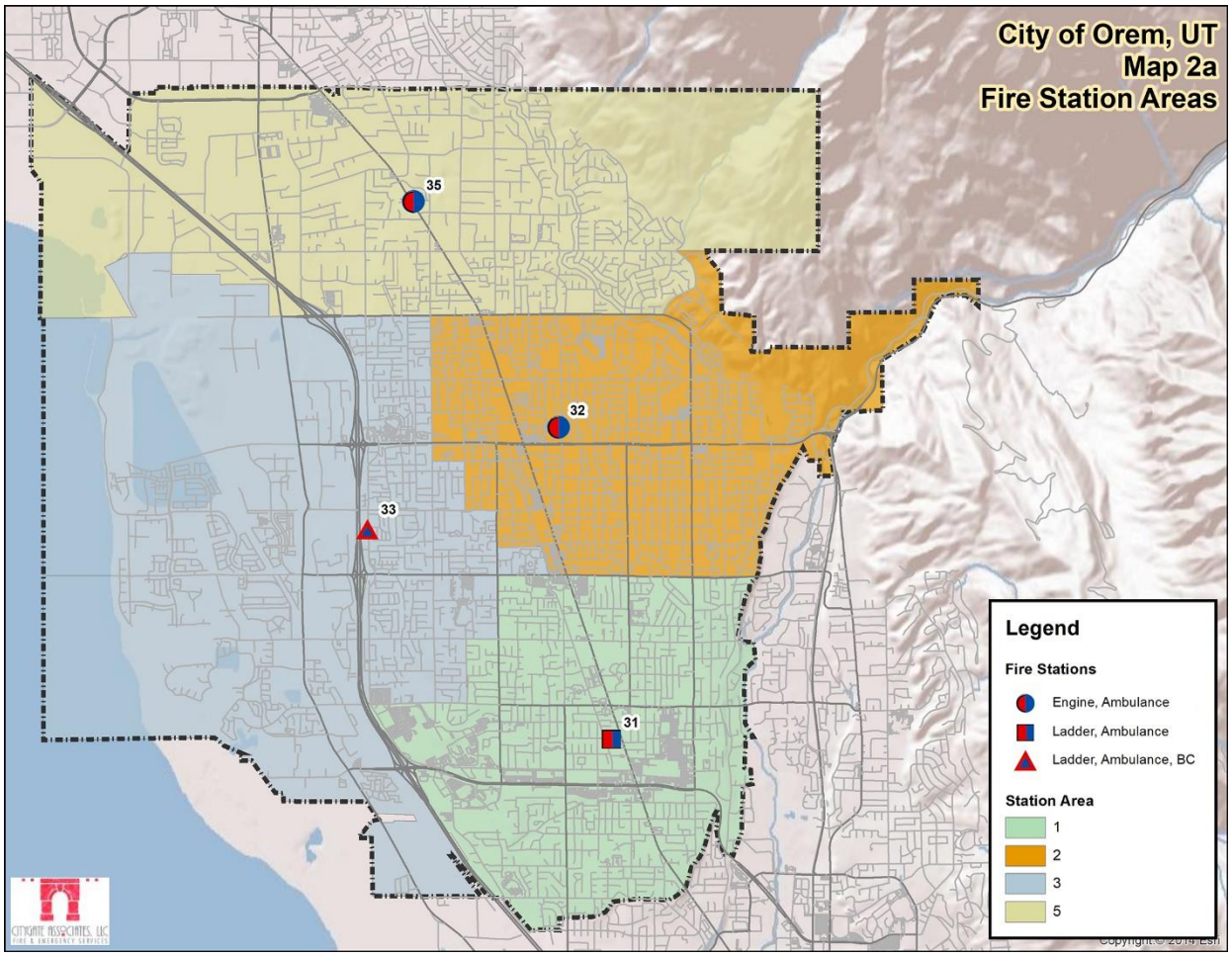
Table 1—Overall Risk by Hazard

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

A.1.3 Planning Zones

The Commission on Fire Accreditation International (CFAI) recommends that jurisdictions establish geographic planning zones to better understand risk at a sub-jurisdictional level. For example, portions of a jurisdiction may contain predominantly moderate risk building occupancies, such as detached single-family residences, while other areas contain high- or maximum-risk occupancies, such as commercial and industrial buildings with a high hazard fire load. If risk were to be evaluated on a jurisdiction-wide basis, the predominant moderate risk could outweigh the high or maximum risk and may not be a significant factor in an overall assessment of risk. If, however, those high- or maximum-risk occupancies are a larger percentage of the risk in a smaller planning zone, then it becomes a more significant risk factor. Another consideration in establishing planning zones is that the jurisdiction's record management system must also track the specific zone for each incident to be able to appropriately evaluate service demand and response performance relative to each specific zone. For this assessment, Citygate utilized four planning zones corresponding with each fire station's first-due response area, as shown in Figure 2.

Figure 2—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, or natural resources.

People

Residents, employees, visitors, and travelers in a community or jurisdiction are vulnerable to harm from a hazard occurrence. Particularly vulnerable are specific at-risk populations, including those unable to care for themselves or self-evacuate in the event of an emergency. At-risk populations typically include children less than 10 years of age, the elderly, and people housed in institutional settings. Table 2 through Table 4 summarize key demographic data for Orem, Lindon, and Vineyard.

Table 2—Key Demographic Data – Orem, UT

Demographic	2019
Population	**101,002**
Under 10 years	18.40%
10–14 years	7.60%
15–64 years	65.60%
65–74 years	4.30%
75 years and older	4.00%
Median age	28.4
Daytime population	103,504
Housing Units	**31,301**
Owner-Occupied	53.30%
Renter-Occupied	42.30%
Vacant	4.30%
Average Household Size	3.31
Median Home Value	$278,210
Education (population over 24 years of age)	**57,101**
High School Graduate	92.50%
Undergraduate Degree	41.70%
Graduate/Professional Degree	13.90%
Employment (population over 15 years of age)	**46,568**
In Labor Force	96.50%
Unemployed	3.50%
Per Capita Income	$25,090
Population below Poverty Level	13.10%
Population without Health Insurance Coverage	11.30%

Source: Esri and U.S. Census Bureau

Table 3—Key Demographic Data – Lindon, UT

Demographic	2019
Population	**11,848**
Under 10 years	19.20%
10–14 years	11.80%
15–64 years	61.80%
65–74 years	4.40%
75 years and older	3.00%
Median age	28.6
Daytime population	16,187
Housing Units	**3,100**
Owner-Occupied	79.10%
Renter-Occupied	17.60%
Vacant	3.30%
Average Household Size	4.17
Median Home Value	$422,404
Education (population over 24 years of age)	**6,575**
High School Graduate	95.90%
Undergraduate Degree	45.60%
Graduate/Professional Degree	16.80%
Employment (population over 15 years of age)	**5,065**
In Labor Force	97.40%
Unemployed	2.60%
Per Capita Income	$29,221
Population below Poverty Level	7.40%
Population without Health Insurance Coverage	7.80%

Source: Esri and U.S. Census Bureau

Table 4—Key Demographic Data – Vineyard, UT

Demographic	2019
Population	**7,376**
Under 10 years	15.90%
10–14 years	7.10%
15–64 years	64.50%
65–74 years	7.10%
75 years and older	5.30%
Median age	30.8
Daytime population	4,461
Housing Units	**2,491**
Owner-Occupied	70.90%
Renter-Occupied	21.10%
Vacant	7.90%
Average Household Size	3.79
Median Home Value	$362,402
Education (population over 24 years of age)	**4,413**
High School Graduate	94.40%
Undergraduate Degree	43.10%
Graduate/Professional Degree	13.70%
Employment (population over 15 years of age)	**3,602**
In Labor Force	97.20%
Unemployed	2.80%
Per Capita Income	$31,811
Population below Poverty Level	6.90%
Population without Health Insurance Coverage	8.70%

Source: Esri and U.S. Census Bureau

Of note from Table 2, Table 3, and Table 4 is the following:

- Nearly 27 percent of the service area population is under 10 years or over 65 years of age.
- Of the service area population over 24 years of age, nearly 93 percent has completed high school or equivalency.

- Of the service area population over 24 years of age, 56 percent has an undergraduate, graduate, or professional degree.
- Nearly 97 percent of the service area population 15 years of age or older is in the workforce; of those, slightly more than 3 percent were unemployed prior to COVID-19 economic impacts.
- Per capita income ranges from $25,000 in Orem to nearly $32,000 in Vineyard.
- Approximately 12 percent of the service area population was below the federal poverty before COVID-19.
- Nearly 11 percent of the service area population did not have health insurance coverage before COVID-19.

The City of Orem Economic Development Department projects the City's population will increase by nearly 9 percent to approximately 110,000 people by 2024.

Buildings

The Department's service area includes nearly 37,000 housing units and nearly 4,300 businesses.[1]

Building Occupancy Risk Categories

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

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

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

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

Maximum Risk – includes buildings or facilities with unusually high risk requiring an Effective Response Force (ERF) involving a significant augmentation of resources and personnel and where

[1] Source: Esri Community Business Summary (2019).

a fire would pose the potential for a catastrophic event involving large loss of life, significant economic impact to the community, or both.

Evaluation of the Department's service area identified 93 multi-family residential buildings as shown in Map #2d (**Volume 2—Map Atlas**). However, data was not available to identify other high- and maximum-risk occupancies as they relate to the CFAI building fire risk categories.

Critical Infrastructure / Key Resources

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 Department has identified 63 critical facilities and infrastructure as shown in Table 5 and Map #2c (**Volume 2—Map Atlas**). A hazard occurrence with significant impact severity affecting one or more of these facilities would likely adversely impact critical public or community services.

Table 5—Critical Facilities

Critical Facility Category	Number of Facilities
Education	46
Government Services	7
Healthcare	3
Public Safety	7
Total	**63**

Source: City of Orem Fire Department

Economic Resources

Principal Orem property tax sources include:[2]

- University Place mall
- TCU Properties
- PacifiCorp
- Timpanogos Regional Hospital
- Dominion Energy

[2] Source: City of Orem FY 2018 Comprehensive Annual Financial Report.

- University Crossing shopping center
- Carillon Square, LLC
- Midtown 360, LLC
- Boyer Lake Pointe shopping center
- Retail Trust III (Walmart)
- U.S. Synthetic Corporation
- Pinnacle Canyon View Apartments

Major Orem employers include:

- Utah Valley University
- Alpine School District
- U.S. Synthetic Corporation
- City of Orem
- Timpanogos Regional Hospital
- Wayfair
- Walmart
- United Parcel Service
- Mity-Lite, Inc.
- Clearlink Technologies, LLC
- Convergys Corporation
- Omniture, Inc.
- Target
- StoresOnline, Inc.

Natural Resources

Natural resources within the Department's service area include:

- Utah Lake
- Powell Slough
- Provo River

- North Union Canal
- Wasatch Range foothills
- Numerous regional and neighborhood parks

Special/Unique Resources

The following facility is a special or unique resource to be protected within the Department's service area:

- Utah Valley University

A.1.5 Hazard Identification

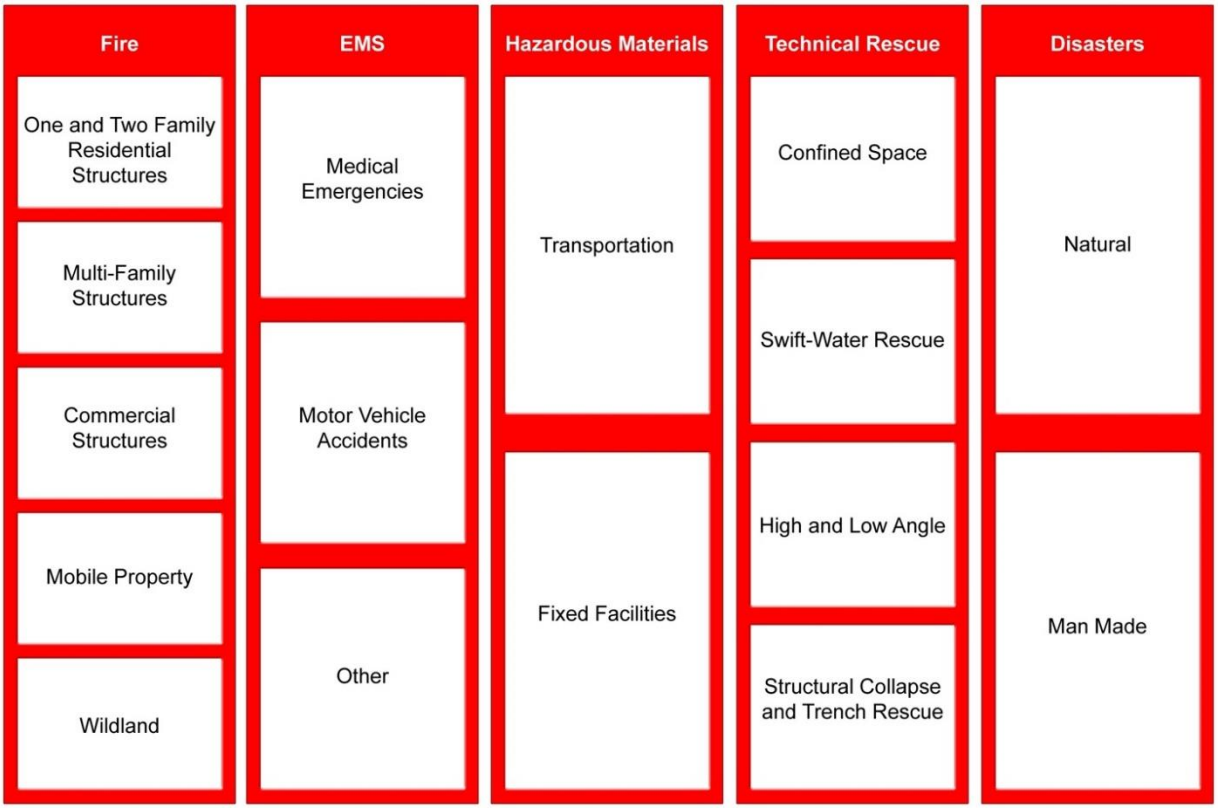
Citygate utilizes prior risk studies where available, fire and non-fire hazards as identified by the CFAI, and agency/jurisdiction-specific data and information to identify the hazards to be evaluated for this study. The Mountainland Pre-Disaster Hazard Mitigation Plan 2016 (Mountainland HMP) identifies the following 16 hazards:

1. Flood
2. Wildland fire
3. Earthquake
4. Drought
5. Mass land movement
6. Avalanche
7. Severe weather
8. Dam failure
9. Infestation
10. Radon gas
11. Tornado
12. Volcano
13. Terrorism
14. Infectious disease
15. Hazardous materials spill
16. Solar flare

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

The CFAI groups hazards into fire and non-fire categories, as shown in Figure 3. 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 3—Commission on Fire Accreditation International Hazard Categories



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

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

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

A.1.6 Service Capacity

Service capacity refers to the Department's available response force; the size, types, and condition of its response fleet and any specialized equipment; core and specialized performance capabilities and competencies; resource distribution and concentration; availability of automatic 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 risk consists of a minimum of 17 personnel on-duty daily staffing two engines, two aerial ladder trucks, and four paramedic ambulances with two personnel each, as well as one Battalion Chief, all operating from the Department's four fire stations.

While the Department strives to have all response personnel trained and certified to the EMT-Paramedic (Paramedic) level to provide Advanced Life Support (ALS) pre-hospital emergency medical care, recent recruitment challenges have resulted in a few newer personnel trained and certified to the Emergency Medical Technician (EMT) level capable of providing Basic Life Support (BLS) pre-hospital emergency medical care. All staffed response units include at least one Paramedic at all times, and in most cases both personnel are EMT-Paramedics. Hospital emergency room services are available in Orem at Timpanogos Regional Hospital and in Provo at Utah Valley Regional Medical Center, which is also a Level II Trauma Center. Intermountain Medical Center in Murray is the nearest Level I Trauma Center.

Response personnel are also trained to the U.S. Department of Transportation Hazardous Material First Responder Operational (FRO) level to provide initial hazardous material incident assessment, hazard isolation, and support for the regional multiple-agency Special Response Team, capable of providing both hazardous materials release mitigation and technical rescue services. Approximately 15 Department personnel are further trained and certified to the Hazardous Materials Specialist level to staff the Special Response Team from Station 5 when needed.

All response personnel are also trained to the Confined Space Awareness level, with personnel assigned to the Special Response Team further trained and certified in low-angle and high-angle rope, confined space, trench, and swift water rescue operations.

A.1.7 Probability of Occurrence

Probability of occurrence refers to the probability of a future hazard occurrence during a specific period. Because the CFAI agency accreditation process requires annual review of an agency's risk assessment and baseline performance measures, Citygate recommends using the 12 months following completion of an SOC study as an appropriate period for the probability of occurrence evaluation. Table 6 describes the five probability of occurrence categories and related scoring criteria used for this analysis.

Table 6—Probability of Occurrence Scoring Criteria

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

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

A.1.8 Impact Severity

Impact severity refers to the extent a hazard occurrence impacts people, buildings, lifeline services, the environment, and the community as a whole. Table 7 describes the five impact severity categories and related scoring criteria used for this analysis.

Table 7—Impact Severity Scoring Criteria

Score	Impact Severity	General Criteria
0–1.0	**Insignificant**	• No serious injuries or fatalities • Few persons displaced for only a short duration • None or inconsequential damage • None or very minimal disruption to community • No measurable environmental impacts • Little or no financial loss
1.25–2.0	**Minor**	• Some minor injuries; no fatalities expected • Some persons displaced for less than 24 hours • Some minor damage • Minor community disruption; no loss of lifeline services • Minimal environmental impacts with no lasting effects • Minor financial loss
2.25–3.0	**Moderate**	• Some hospitalizations; some fatalities possible • Localized displacement of persons for up to 24 hours • Localized damage • Normal community functioning with some inconvenience • Minor loss of critical lifeline services • Some environmental impacts with no lasting effects, or small environmental impact with long-term effect • Moderate financial loss
3.25–4.0	**Major**	• Extensive serious injuries; significant number of persons hospitalized • Many fatalities possible • Significant displacement of many people for more than 24 hours • Significant damage requiring external resources • Community services disrupted; some lifeline services potentially unavailable • Some environmental impacts with long-term effects • Major financial loss
4.25–5.0	**Catastrophic**	• Large number of severe injuries and fatalities • Local/regional hospitals impacted • Large number of persons displaced for an extended duration • Extensive damage • Widespread loss of critical lifeline services • Community unable to function without significant support • Significant environmental impacts and/or permanent environmental damage • Catastrophic financial loss

A.1.9 Overall Risk

Overall hazard risk is determined by multiplying the *probability of occurrence score* by the *impact severity score*. The resultant total determines the overall *risk ranking* as described in Table 8.

Table 8—Overall Risk Score and Rating

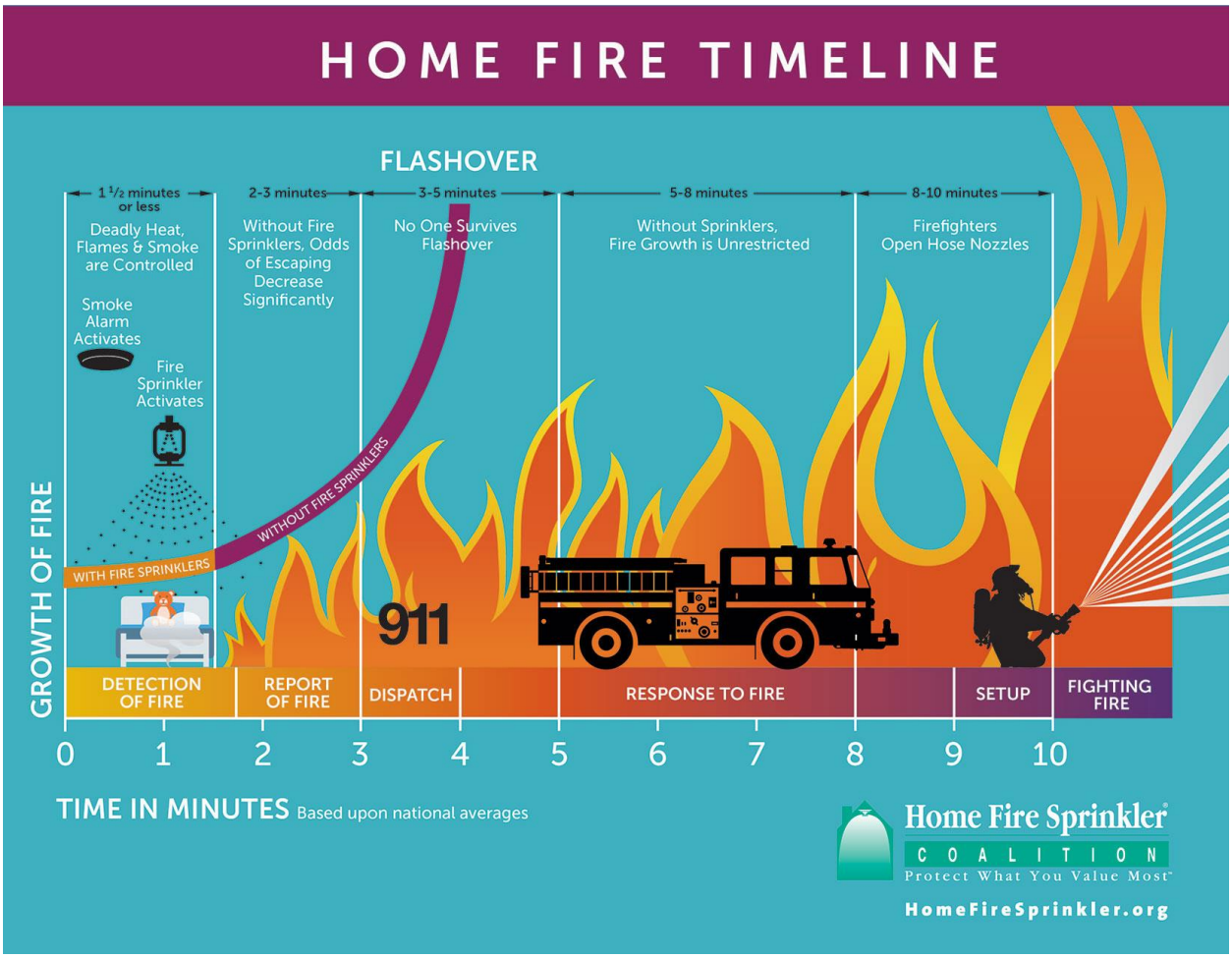
Overall Risk Score	Overall Risk Rating
0–5.99	*LOW*
6.0–11.99	*MODERATE*
12.0–19.99	*HIGH*
20.0–25.0	*MAXIMUM*

A.1.10 Building Fire Risk

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

Figure 4 illustrates the building fire progression timeline and shows that flashover, which is the point at which the entire room erupts into fire after all the combustible objects in that room reach their ignition temperature, can occur as early as three to five minutes from the initial ignition. Human survival in a room after flashover is extremely improbable.

Figure 4—Building Fire Progression Timeline



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

Population Density

Population density within the service area ranges from less than 1,000 to 12,000 people per square mile. Although risk analysis across a wide spectrum of other Citygate clients shows no direct correlation between population density and building fire *occurrence*, it is reasonable to conclude that building fire *risk* relative to potential impact on human life is greater as population density increases, particularly in areas with high density, multiple-story buildings.

Water Supply

A reliable public water system providing adequate volume, pressure, and flow duration in close proximity to all buildings is a critical factor in mitigating the potential impact severity of a community's building fire risk. Potable water in the service area is provided by the City of Orem and City of Lindon and, according to Fire Department staff, firefighting water supply is sufficient

throughout the service area with the exception of the upper eastern area of Lindon where available volume and pressure is less than what is available throughout the rest of the service area.

Building Fire Service Demand

For the three-year period from January 1, 2017, through December 31, 2019, the Department experienced 161 building fire incidents comprising 0.81 percent of total service demand over the same period, as summarized in Table 9.

Table 9—Building Fire Service Demand

Risk	Year	Planning Zone				Total	Percent Total Service Demand
		Sta. 1	Sta. 2	Sta. 3	Sta. 5		
Building Fire	2017	13	6	17	11	47	0.70%
	2018	20	17	17	7	61	0.91%
	2019	21	12	11	9	53	0.81%
Total		54	35	45	27	161	0.81%
Percent of Total Service Demand		0.92%	0.65%	0.83%	0.83%	0.81%	

Source: Orem Fire Department incident data

As Table 9 illustrates, building fire service demand increased nearly 13 percent over the three-year study period, with the highest demand occurring at Station 1 and the lowest at Station 5. Overall building fire service demand is low, comprising less than one percent of all calls for service.

Building Fire Risk Assessment

Table 10 summarizes Citygate's assessment of the Department's building fire risk by planning zone.

Table 10—Building Fire Risk Assessment

Building Fire	Planning Zone			
	Sta. 1	Sta. 2	Sta. 3	Sta. 5
Average Annual Incidents	18	12	15	9
Probability of Occurrence	**2.25**	**2.00**	**2.25**	**1.75**
Probable Impact Severity	**3.00**	**3.00**	**3.00**	**3.00**
Total Risk Score	**6.75**	**6.00**	**6.75**	**5.25**
Overall Risk Rating	***Moderate***	***Moderate***	***Moderate***	***Low***

A.1.11 Vegetation/Wildland Fire Risk

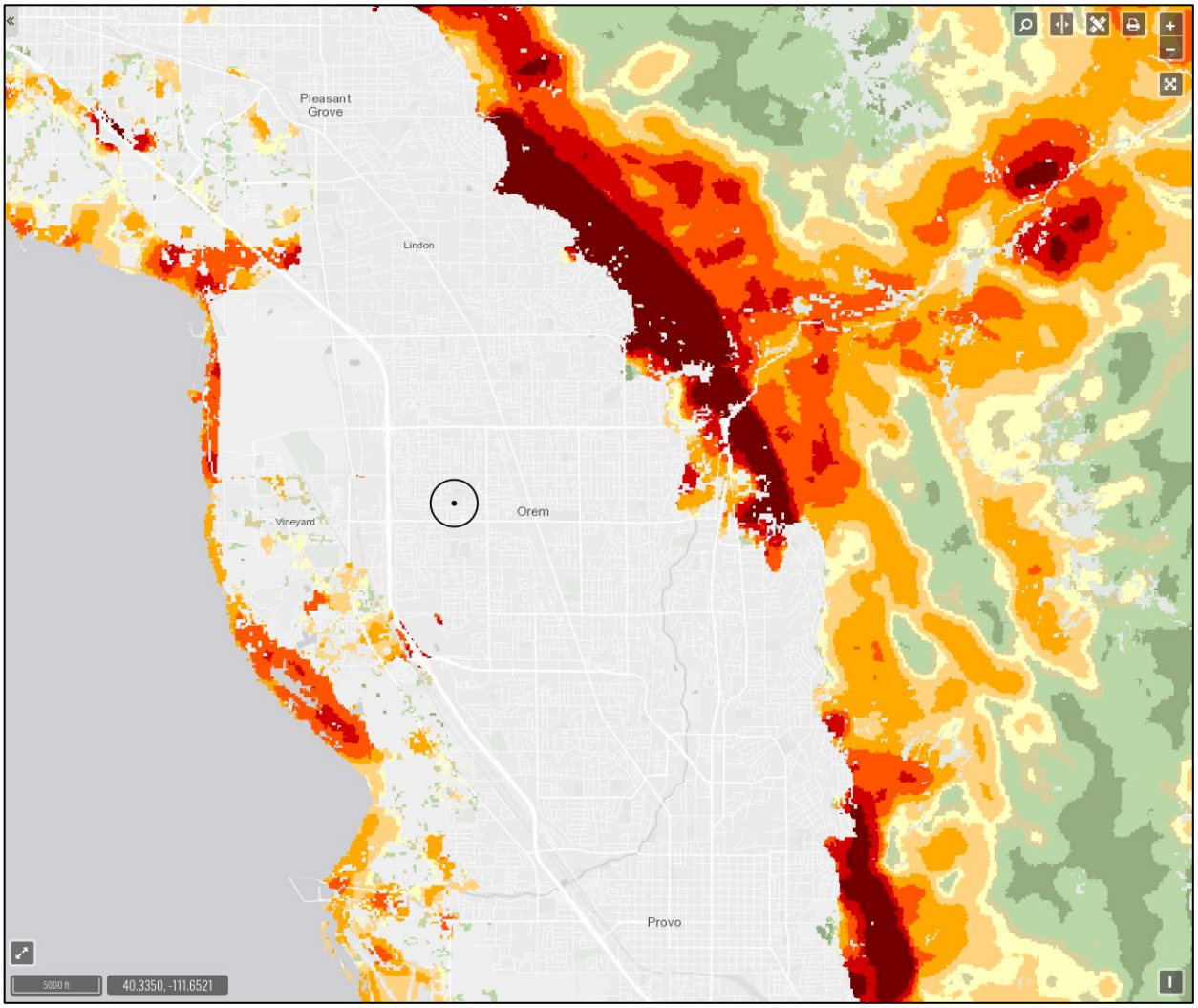
Vegetation fires occur regularly in Utah County, predominantly in the late summer to early fall. While most of the larger fires occur in the high desert or forested areas of the County on federally owned or controlled lands, the eastern area of the Department's service area, north of State Route 189 along the western edge of the Wasatch Range, is also susceptible to vegetation/wildland fires. It poses a particular risk when those fire occur in or threaten wildland–urban interface areas where human habitation is intermingled with naturally occurring wildland vegetative fuels. Vegetation/wildland fire risk factors include vegetative fuel types and configuration, weather, topography, prior service demand, water supply, mitigation measures, and vegetation/wildland fire service capacity.

Wildland Fire Risk Zones

The Utah Department of Natural Resources hosts an online Wildfire Risk Assessment Portal that includes a suite of applications tailored to support specific workflow and information requirements for the public, local community groups, private landowners, government officials, hazard mitigation planners, and wildland fire managers. The following figure shows the likelihood of a wildland fire starting and spreading in and surrounding the Department's service area, ranging from *Very, Very Low* (dark green) to *Extreme* (dark red). A *High* threat (orange) is 12 times greater than a *Moderate* threat (yellow) and 53 times greater than a *Low* threat (light green).[3] Note the *Moderate* to *Extreme* threat zones on both the eastern and western flanks of the Department's service area.

[3] Source: Utah Department of Natural Resources Wildfire Risk Assessment Portal: www.wildfirerisk.utah.gov.

Figure 5—Wildland Fire Risk Zones



Vegetative Fuels

Vegetative fuel factors influencing fire intensity and spread include fuel type (vegetation species), height, arrangement, density, and moisture. Vegetative fuels within the service area consist of a mix of annual grasses and weeds, cheatgrass, sagebrush, phragmites, and cottonwood, maple, and oak trees, in addition to decorative landscape 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/wildland fire potential and behavior. High temperatures and low relative humidity dry

out vegetative fuels, creating a situation where fuels will more readily ignite and burn more intensely. Wind is the most significant weather factor influencing vegetation/wildland fire behavior, with higher wind speeds increasing fire spread and intensity.

Summer temperatures average in the mid to high 90s through early August, and the area receives about 13 inches of precipitation annually. Winds are predominantly westerly, with thermally generated downslope winds from the east in the evenings.

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 Department's service area topography is mostly flat transitioning to hilly terrain on the eastern edge, which can contribute to vegetation/wildland fire behavior and spread in that area.

Water Supply

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

Vegetation/Wildland Fire Hazard Mitigation

Hazard mitigation refers to specific actions or measures taken to prevent a hazard from occurring and to minimize the severity of impacts resulting from a hazard occurrence. While none of the hazards subject to this study can be entirely prevented, measures *can* be taken to minimize the impacts when those hazards do occur. The City of Orem has an annual weed abatement program, and the Department investigates all fire hazard complaints and takes appropriate actions as authorized by ordinances and regulations to eliminate or mitigate identified fire hazards.

Vegetation/Wildland Fire Service Demand

The Department experienced 120 vegetation/wildland fires over the three-year study period comprising 0.60 percent of total service demand over the same period, as summarized in Table 11.

Table 11—Vegetation Fire Service Demand

Risk	Year	Planning Zone				Total	Percent Total Service Demand
		Sta. 1	Sta. 2	Sta. 3	Sta. 5		
Vegetation/Wildland Fire	2017	11	8	19	5	**43**	0.64%
	2018	6	9	12	15	**42**	0.63%
	2019	5	5	16	9	**35**	0.53%
Total		**22**	**22**	**47**	**29**	**120**	0.60%
Percent of Total Service Demand		0.37%	0.41%	0.86%	0.90%	0.60%	

Source: Orem Fire Department incident data

As Table 11 shows, vegetation/wildland fire service demand was consistent over the three-year study period, with the highest demand at Station 3 and the lowest at Stations 1 and 2. Overall, vegetation/wildland fire service demand is low.

Vegetation/Wildland Fire Risk Assessment

Table 12 summarizes Citygate's assessment of the Department's vegetation/wildland fire risk by planning zone.

Table 12—Vegetation/Wildland Fire Risk Assessment

Vegetation/Wildland Fire	Planning Zone			
	Sta. 1	Sta. 2	Sta. 3	Sta. 5
Average Annual Incidents	7	7	16	10
Probability of Occurrence	**1.50**	**2.00**	**2.00**	**2.00**
Probable Impact Severity	**2.50**	**3.00**	**3.00**	**3.00**
Total Risk Score	**3.75**	**6.00**	**6.00**	**6.00**
Overall Risk Rating	***Low***	***Moderate***	***Moderate***	***Moderate***

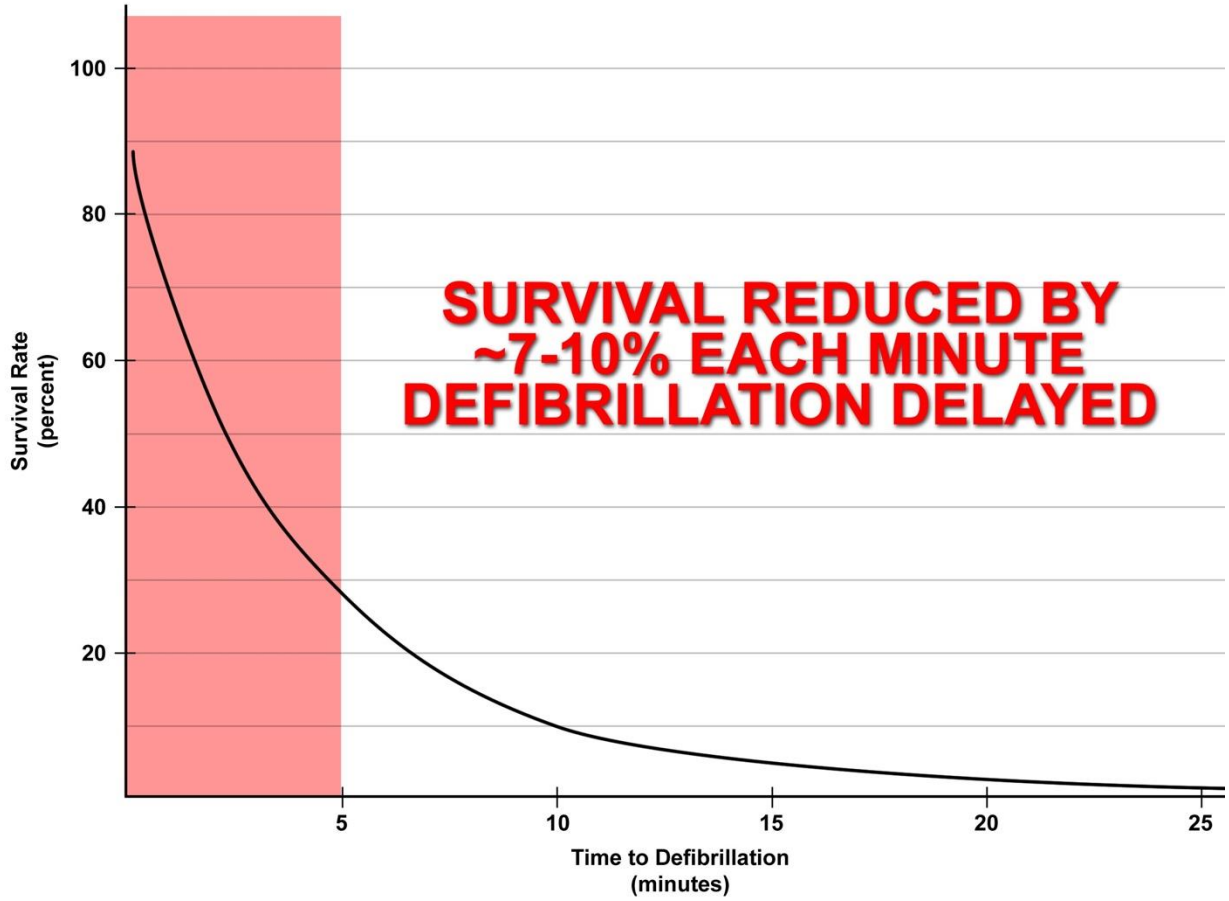
A.1.12 Medical Emergency Risk

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

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

Figure 6 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 6—Survival Rate versus Time to Defibrillation



Source: www.suddencardiacarrest.org.

Population Density

The Department's service area population density ranges from less than 1,000 to 12,000 per square mile, as shown in Map #2b (**Volume 2—Map Atlas**). Risk analysis across a wide spectrum of other Citygate clients shows a direct correlation between population density and the *occurrence* of medical emergencies, particularly in high urban population density zones.

Demographics

Medical emergency risk tends to be higher among older, poorer, less educated, and uninsured populations. As shown in Table 2, Table 3, and Table 4, nearly 27 percent of the service area

population is under 10 years or over 65 years of age; 56 percent of the population over 24 years of age has an undergraduate, graduate, or professional degree; approximately 12 percent of the service area population over 15 years of age was unemployed prior to COVID-19, and nearly 11 percent of the population did not have health insurance coverage prior to COVID-19.[4]

Vehicle Traffic

Medical emergency risk tends to be higher in those areas of a community with high daily vehicle traffic volume, particularly those areas with high traffic volume traveling at high speeds. The service area transportation network includes Interstate 15 and State Routes 52, 89, 114, and 189 carrying an aggregate average annual daily traffic volume of more than 285,000 vehicles.[5]

Medical Emergency Service Demand

Medical emergency service demand over the three-year study period includes nearly 15,000 calls for service comprising slightly more than 74 percent of total service demand over the same period, as summarized in Table 13.

Table 13—Medical Emergency Service Demand

Risk	Year	Planning Zone				Total	Percent Total Service Demand
		Sta. 1	Sta. 2	Sta. 3	Sta. 5		
Medical Emergency	2017	1,464	1,458	1,368	790	**5,080**	76.08%
	2018	1,477	1,360	1,286	807	**4,930**	73.54%
	2019	1,414	1,284	1,263	836	**4,797**	73.28%
Total		**4,355**	**4,102**	**3,917**	**2,433**	**14,807**	74.31%
Percent of Total Service Demand		74.03%	76.50%	71.96%	75.21%	74.31%	

Source: Orem Fire Department incident data

As Table 13 shows, medical emergency service demand varies significantly by planning zone and *decreased* nearly six percent over the three-year study period. Overall, the Department's medical emergency service demand is typical of other jurisdictions with similar demographics.

Medical Emergency Risk Assessment

Table 14 summarizes Citygate's assessment of the Department's medical emergency risk by planning zone.

[4] Source: Esri and U. S. Census Bureau.
[5] Source: Utah Department of Transportation (2017).

Table 14—Medical Emergency Risk Assessment

Medical Emergency	Planning Zone			
	Sta. 1	Sta. 2	Sta. 3	Sta. 5
Average Annual Incidents	1,452	1,367	1,306	811
Probability of Occurrence	**5.00**	**5.00**	**5.00**	**4.75**
Probable Impact Severity	**3.00**	**3.00**	**3.00**	**3.00**
Total Risk Score	**15.00**	**15.00**	**15.00**	**14.25**
Overall Risk Rating	***High***	***High***	***High***	***High***

A.1.13 Hazardous Material Risk

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

Fixed Hazardous Materials Facilities

No data was available to identify facilities within the service area requiring a state or county hazardous material operating permit or a Hazardous Materials Business Plan.

Transportation-Related Hazardous Materials

The Department has transportation-related hazardous material risk as a result of its road transportation network, with Interstate 15 and State Routes 52, 89, 114, and 189 carrying an aggregate average annual daily traffic volume of more than 285,000 vehicles, including trucks carrying hazardous commodities. In addition, there are more than 65 daily train movements into and through Orem, many of which also transport hazardous commodities.[6]

Population Density

Because hazardous material emergencies have the potential to adversely impact human health, it is logical that the higher the population density the greater the potential population exposed to a hazardous material release or spill. As shown in Map #2b (**Volume 2—Map Atlas**), the Department's service area population density ranges from less than less than 1,000 to 12,000 per square mile.

[6] Source: Federal Railroad Administration (2020 data).

Vulnerable Populations

Persons vulnerable to a hazardous material release/spill include those individuals or groups unable to self-evacuate, generally including children under the age of 10, the elderly, and persons confined to an institution or other setting where they are unable to leave voluntarily. As shown in Table 2, Table 3, and Table 4, nearly 27 percent of the service area population is under age 10 or is 65 years of age and older.

Emergency Evacuation Planning, Training, Implementation, and Effectiveness

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

Both Orem and Lindon have 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. This system can also access the federal Integrated Public Alert and Warning System to alert *all* cell phones within a designated emergency notification area. Within each City, emergency notifications can be initiated by designated Fire Department, Police Department, and City management personnel.

Although neither City has a formal emergency evacuation plan, Annex E of the Utah County Emergency Operations Plan provides planning and execution guidelines and evacuation routes for mass evacuations. Orem also conducts one Emergency Operations Center drill annually, with individual Emergency Operations Center section training provided on a rotating monthly schedule.[7]

Hazardous Material Service Demand

The Department experienced 260 hazardous material incidents over the three-year study period comprising 1.3 percent of total service demand over the same period, as summarized in Table 15.

[7] Source: City of Orem Emergency Manager.

Table 15—Hazardous Material Service Demand

Risk	Year	Planning Zone				Total	Percent Total Service Demand
		Sta. 1	Sta. 2	Sta. 3	Sta. 5		
Hazardous Materials	2017	21	13	18	9	**61**	0.91%
	2018	23	20	28	8	**79**	1.18%
	2019	23	29	36	32	**120**	1.83%
Total		**67**	**62**	**82**	**49**	**260**	1.30%
Percent of Total Service Demand		1.14%	1.16%	1.51%	1.51%	1.30%	

Source: Orem Fire Department incident data

As Table 15 shows, hazardous material service demand varies by planning zone and nearly doubled over the three-year study period, with Station 3 having the highest demand and Station 5 the lowest. Overall, the Department's hazardous material service demand is low.

Hazardous Materials Risk Assessment

Table 16 summarizes Citygate's assessment of the Department's hazardous materials risk by planning zone.

Table 16—Hazardous Materials Risk Assessment

Hazardous Materials	Planning Zone			
	Sta. 1	Sta. 2	Sta. 3	Sta. 5
Average Annual Incidents	22	21	27	16
Probability of Occurrence	**2.50**	**2.25**	**2.50**	**2.25**
Probable Impact Severity	**3.00**	**3.00**	**3.00**	**3.00**
Total Risk Score	**7.50**	**6.75**	**7.50**	**6.75**
Overall Risk Rating	***Moderate***	***Moderate***	***Moderate***	***Moderate***

A.1.14 Technical Rescue Risk

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

Construction Activity

There is ongoing residential, commercial, industrial, and infrastructure construction activity within the Department's service area.

Unreinforced Masonry Buildings

No buildings constructed of unreinforced masonry are known to exist within the Department's service area.[8] Such buildings are particularly vulnerable to damage or collapse from a seismic event.

Confined Spaces

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

Bodies of Water

Bodies of water within the service area include Utah Lake and the Provo River.

Transportation Volume

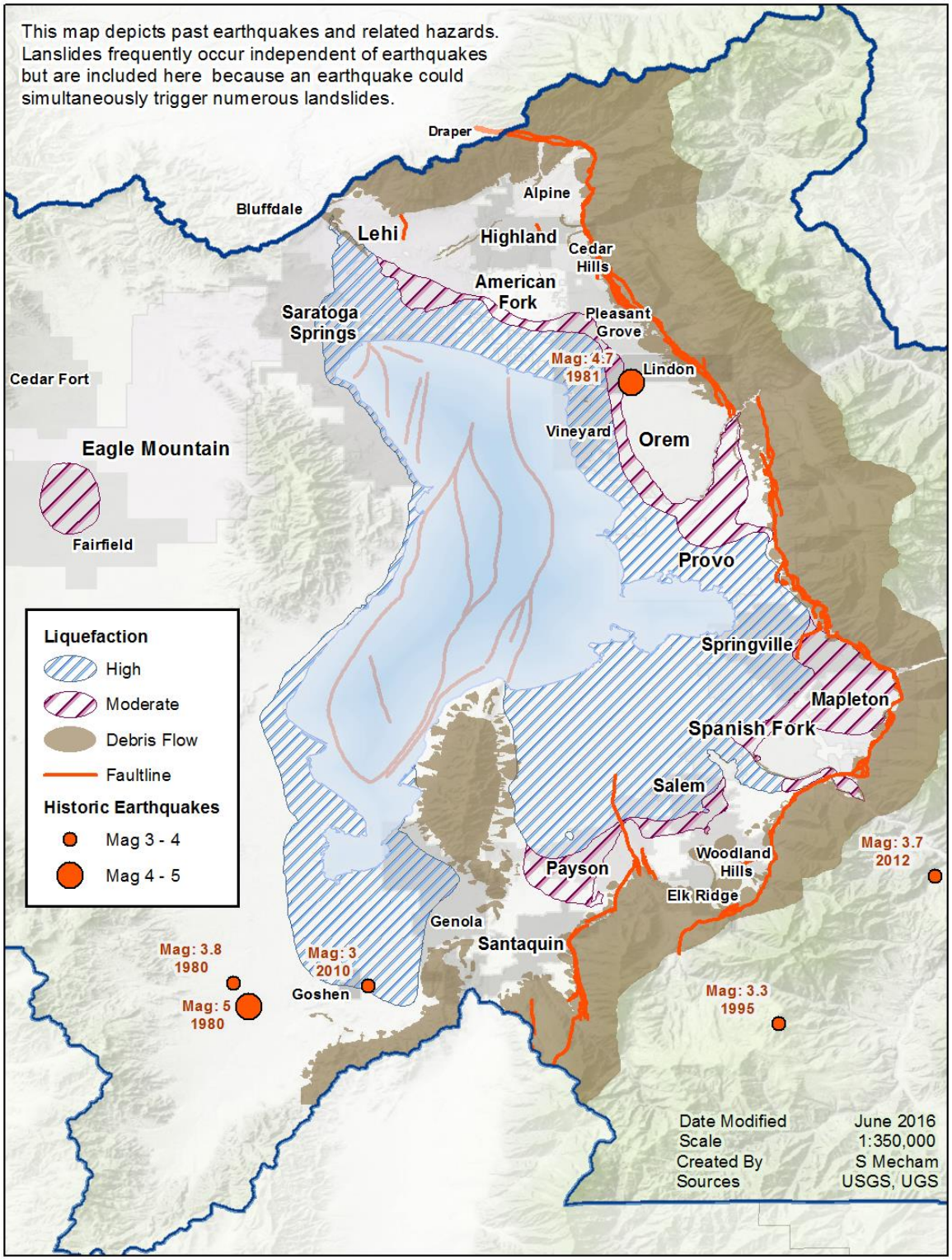
Another technical rescue risk factor is transportation-related incidents requiring technical rescue. This risk factor is primarily a function of vehicle, railway, maritime, and aviation traffic. Vehicle traffic volume is the greatest of these factors within the service area, with Interstate 15 and State Routes 52, 89, 114, and 189 carrying an aggregate average annual daily traffic volume of more than 285,000 vehicles.[9] In addition, there are more than 65 daily train movements into or through Orem.

Earthquake Risk[10]

The Intermountain Seismic Belt is a zone of pronounced seismic activity extending north–south through the center of the state along the Wasatch Range Front. Although severe earthquakes are by their nature rare disasters, Figure 7 shows the location of past earthquakes and earthquake-related hazard zones in Utah County. According to the United States Geological Survey, there is a 75 percent probability of a magnitude 6.0 or greater earthquake occurring along the Wasatch Front in the next 50 years.

[8] Source: Orem Fire Department staff.
[9] Source: Utah Department of Transportation (2017 data).
[10] Source: 2016 Mountainland Pre-Disaster Hazard Mitigation Plan, Part IV.

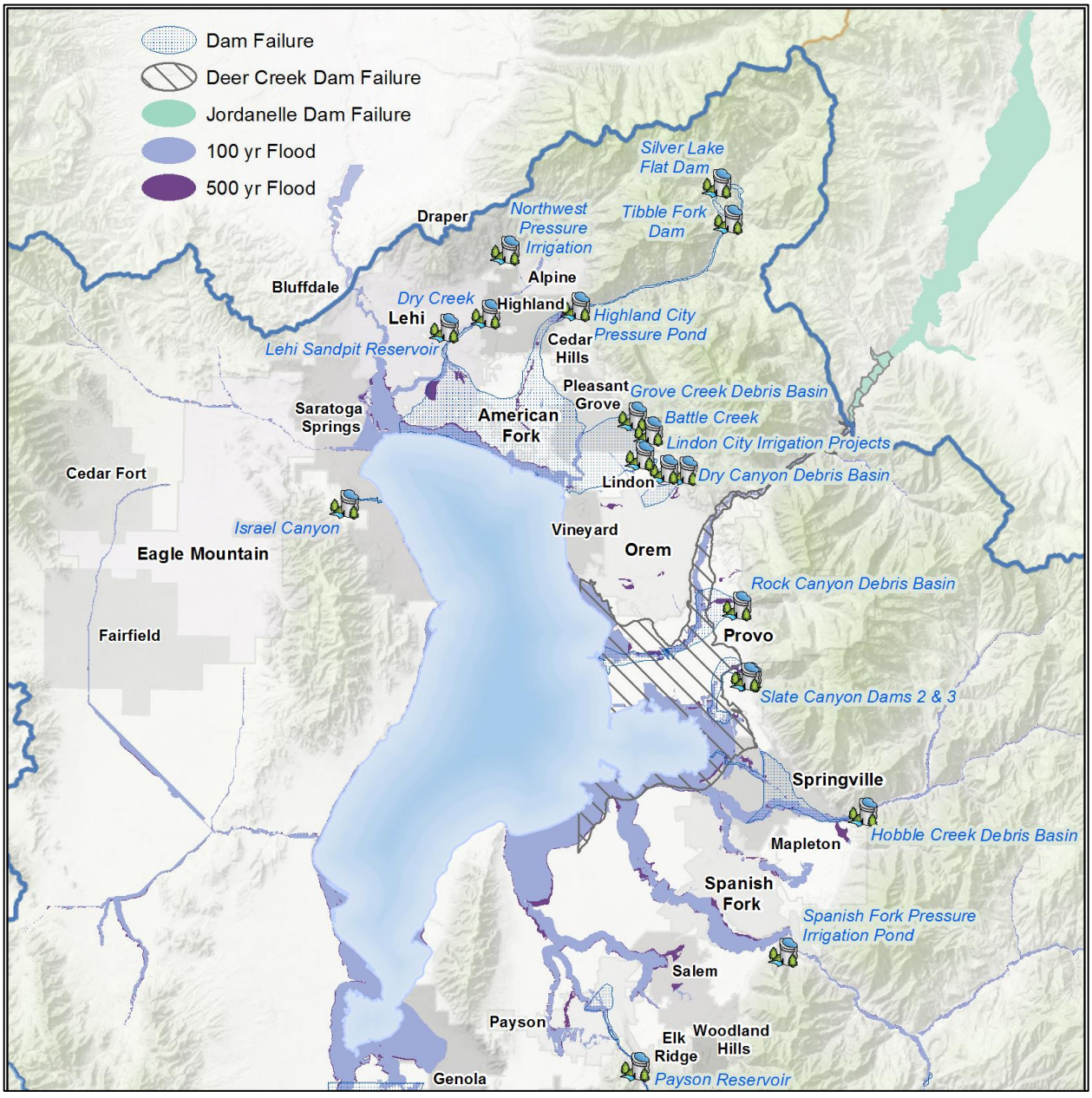
Figure 7—Earthquake Hazard Zones



Flood Risk[11]

Although Utah is considered a dry desert state, the Mountainland region can experience rapid snow melt in the spring, as well as severe summer storms, which results in moderate flooding occurring on a regular basis in Utah County. Figure 8 shows the flood hazard zones in Utah County. There are numerous 100-year and dam failure zones within or adjacent to the Department's service area.

Figure 8—Flood Hazard Zones



[11] Source: 2016 Mountainland Pre-Disaster Hazard Mitigation Plan, Part IV.

Technical Rescue Service Demand

Over the three-year study period, there were 36 technical rescue incidents comprising 0.18 percent of total service demand for the same period, as summarized in Table 17.

Table 17—Technical Rescue Service Demand

Risk	Year	Planning Zone				Total	Percent Total Service Demand
		Sta. 1	Sta, 2	Sta. 3	Sta. 5		
Technical Rescue	2017	1	1	3	1	6	0.09%
	2018	6	2	3	5	16	0.24%
	2019	5	3	2	4	14	0.21%
Total		12	6	8	10	36	0.18%
Percent of Total Service Demand		0.18%	0.11%	0.15%	0.31%	0.18%	

Source: Orem Fire Department incident data

As Table 17 shows, technical rescue service demand is very low, with Station 1 experiencing the highest demand.

Technical Rescue Risk Assessment

Table 18 summarizes Citygate's assessment of the Department's technical rescue risk by planning zone.

Table 18—Technical Rescue Risk Assessment

Technical Rescue	Planning Zone			
	Sta. 1	Sta. 2	Sta. 3	Sta. 5
Average Annual Incidents	4	2	3	3
Probability of Occurrence	**1.25**	**1.25**	**1.25**	**1.25**
Probable Impact Severity	**2.50**	**2.50**	**2.50**	**2.50**
Total Risk Score	**3.13**	**3.13**	**3.13**	**3.13**
Overall Risk Rating	***Low***	***Low***	***Low***	***Low***

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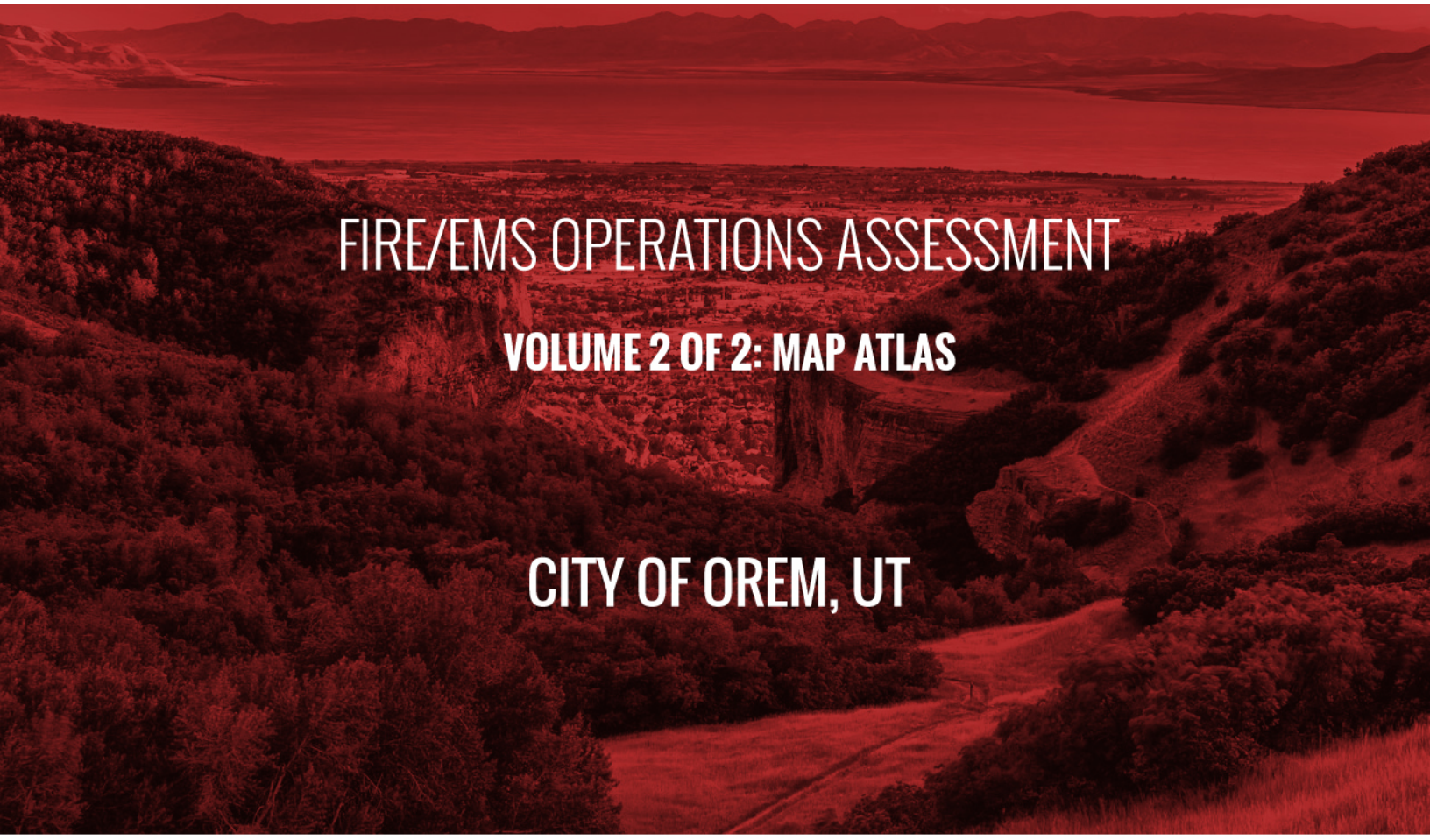

FIRE/EMS OPERATIONS ASSESSMENT

VOLUME 2 OF 2: MAP ATLAS

CITY OF OREM, UT

FEBRUARY 24, 2021

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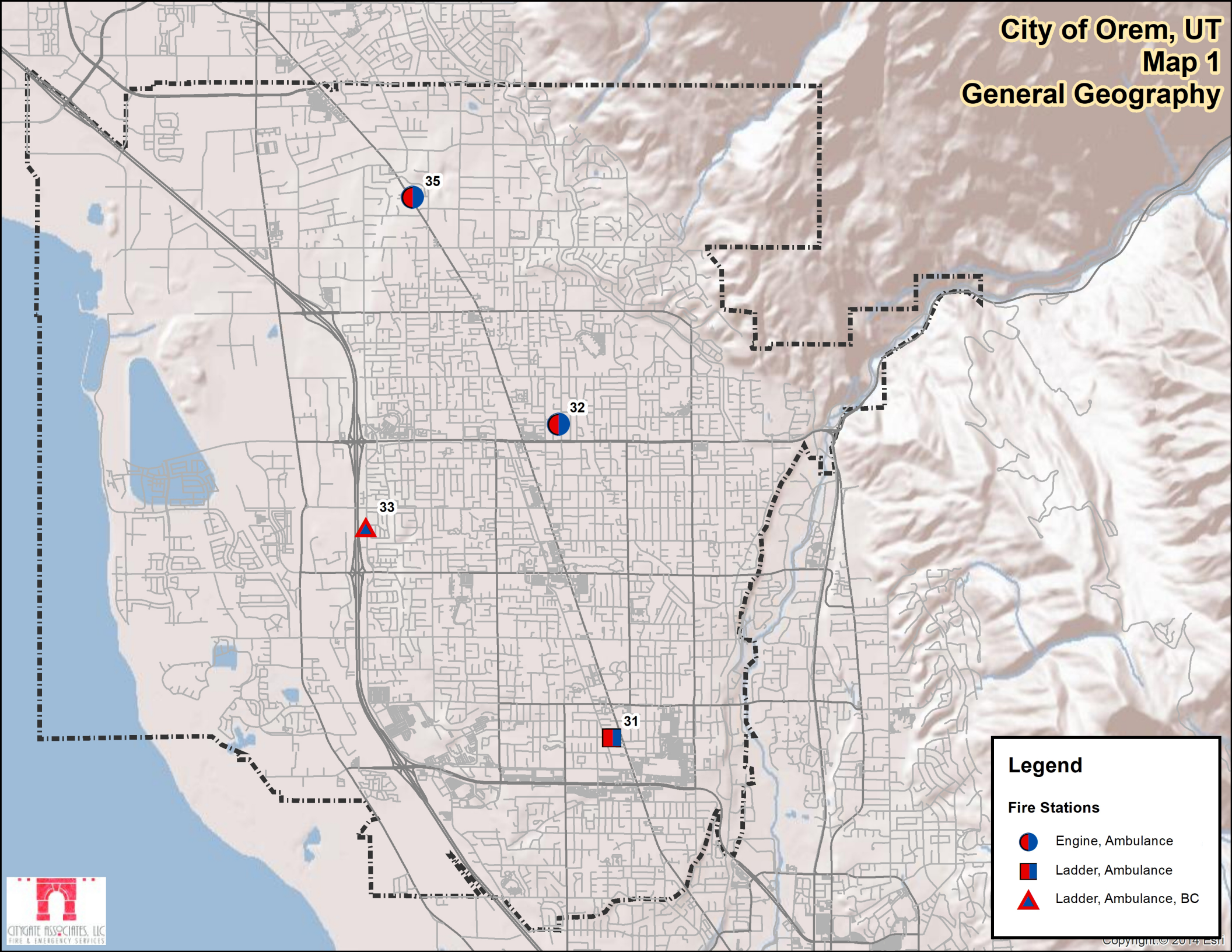
City of Orem, UT
Map 1
General Geography
35
32
33
31
Legend
Fire Stations
Engine, Ambulance
Ladder, Ambulance
Ladder, Ambulance, BC
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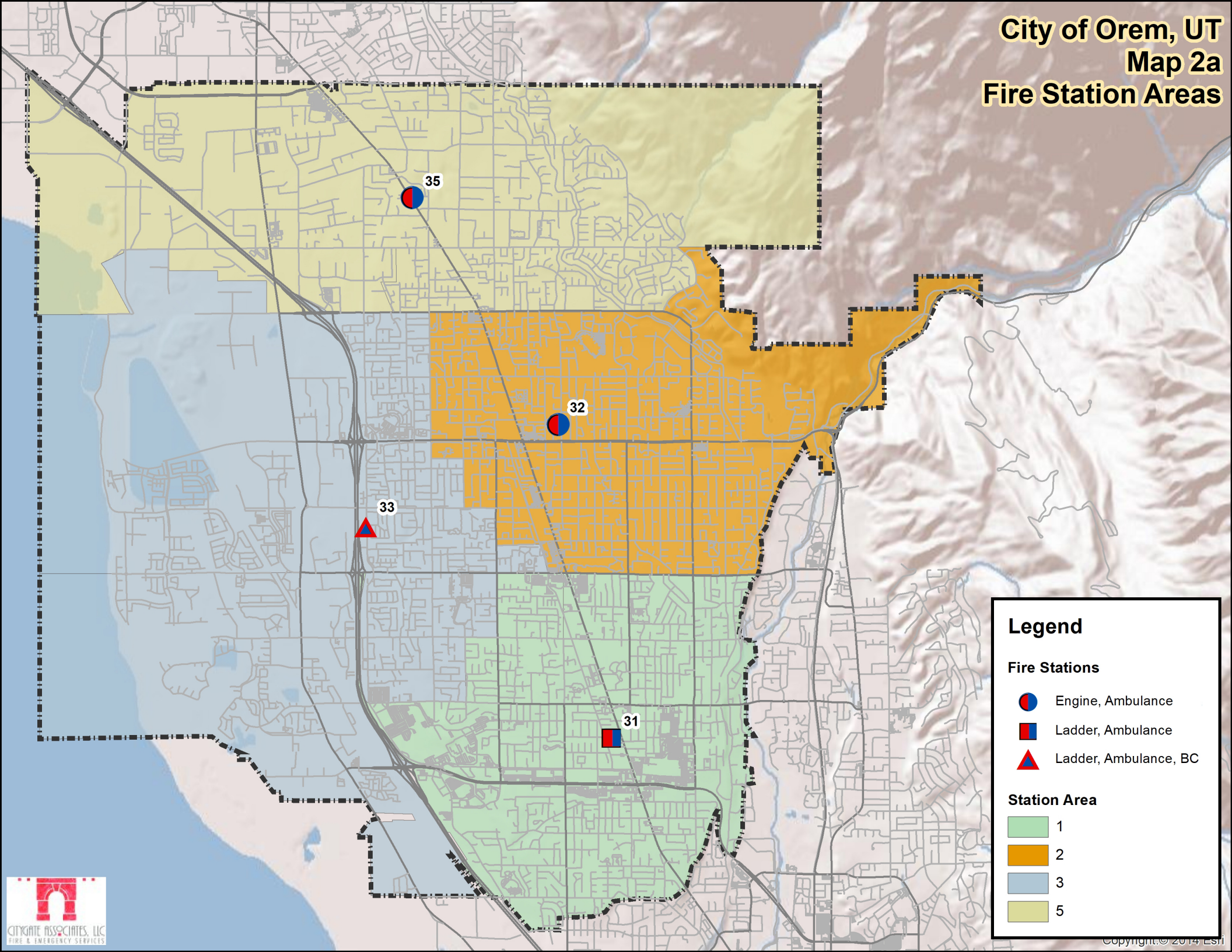
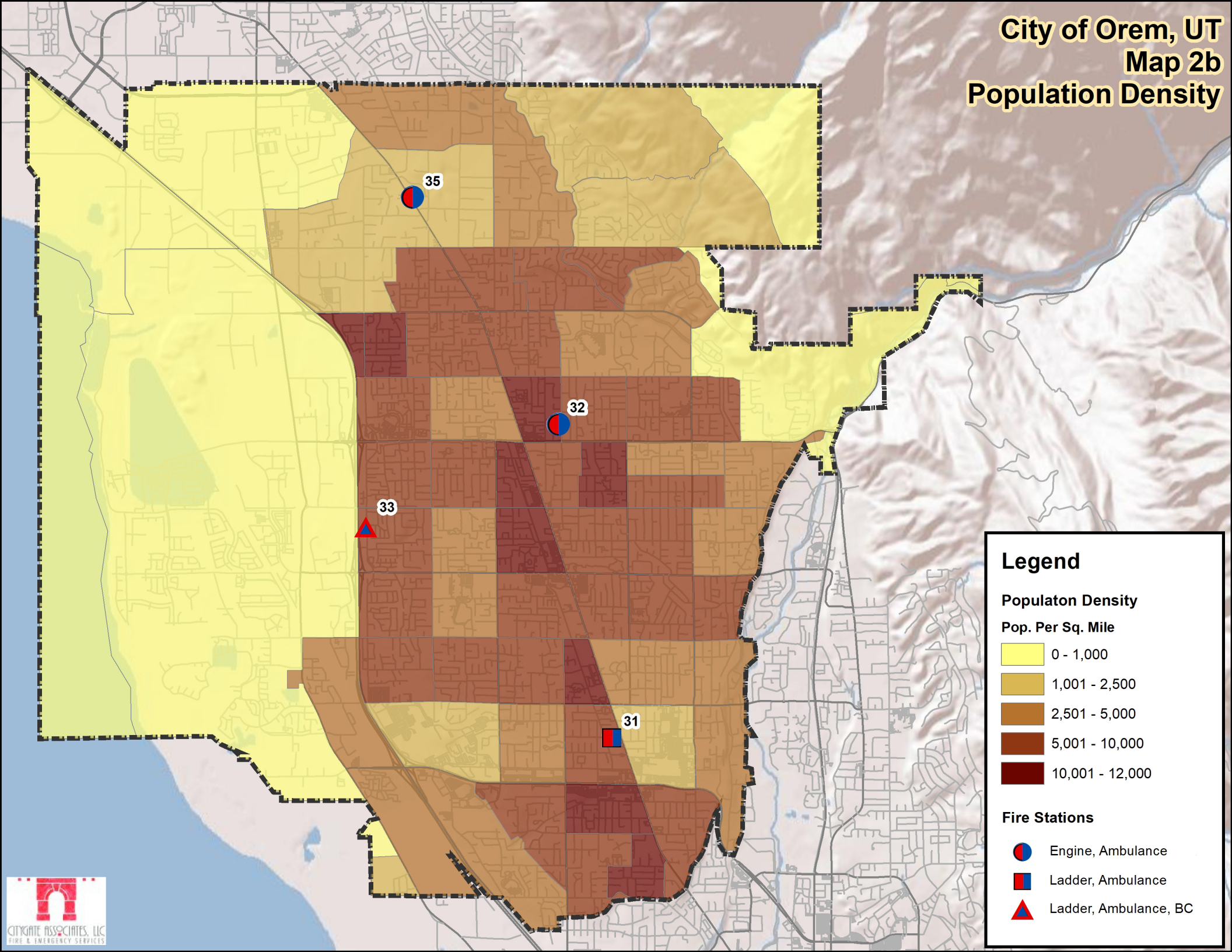
City of Orem, UT
Map 2a
Fire Station Areas




City of Orem, UT
Map 2b
Population Density
35
32
33
31
Legend
Populaton Density
Pop. Per Sq. Mile
0 - 1,000
1,001 - 2,500
2,501 - 5,000
5,001 - 10,000
10,001 - 12,000
Fire Stations
Engine, Ambulance
Ladder, Ambulance
Ladder, Ambulance, BC
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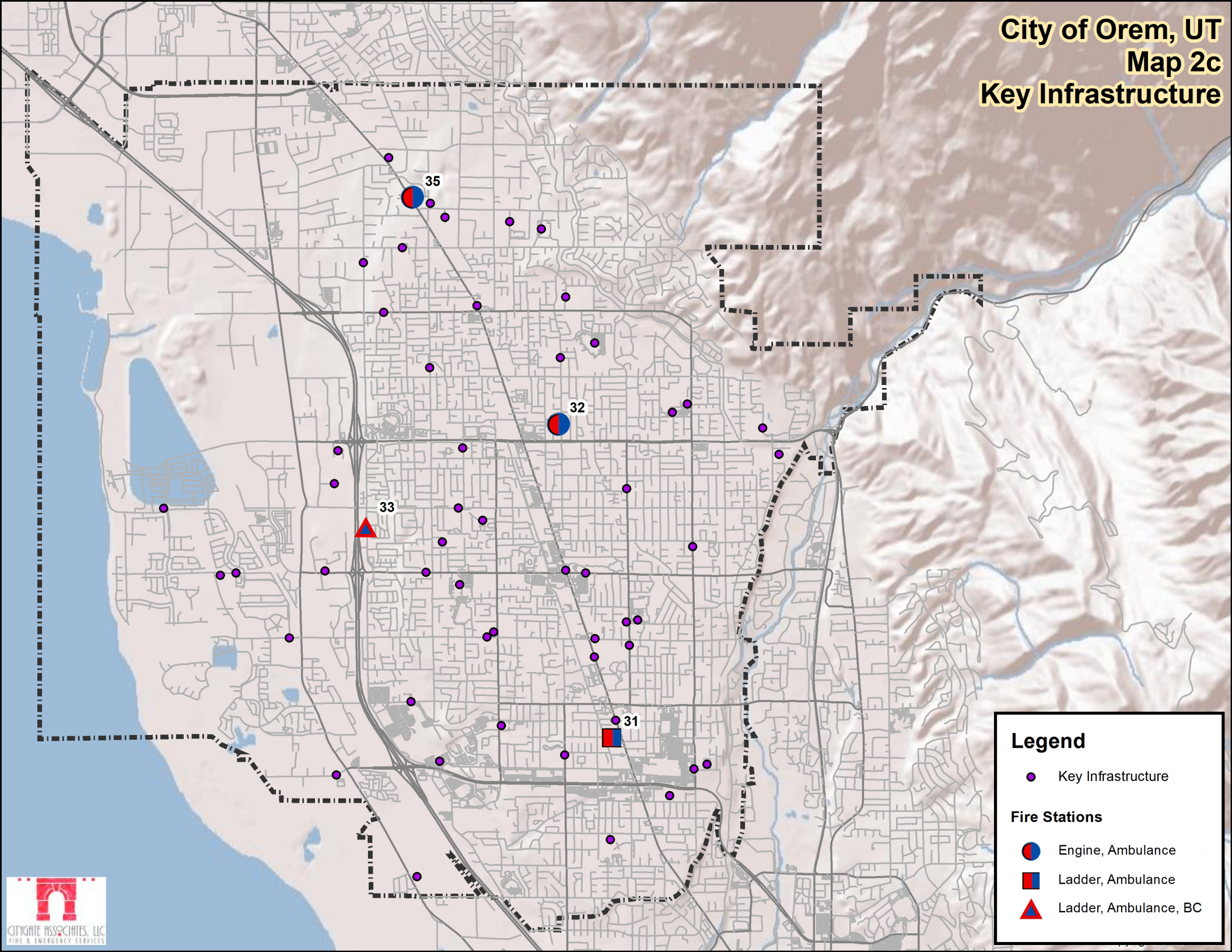
City of Orem, UT
Map 2c
Key Infrastructure
35
32
33
31
Legend
Key Infrastructure
Fire Stations
Engine, Ambulance
Ladder, Ambulance
Ladder, Ambulance, BC
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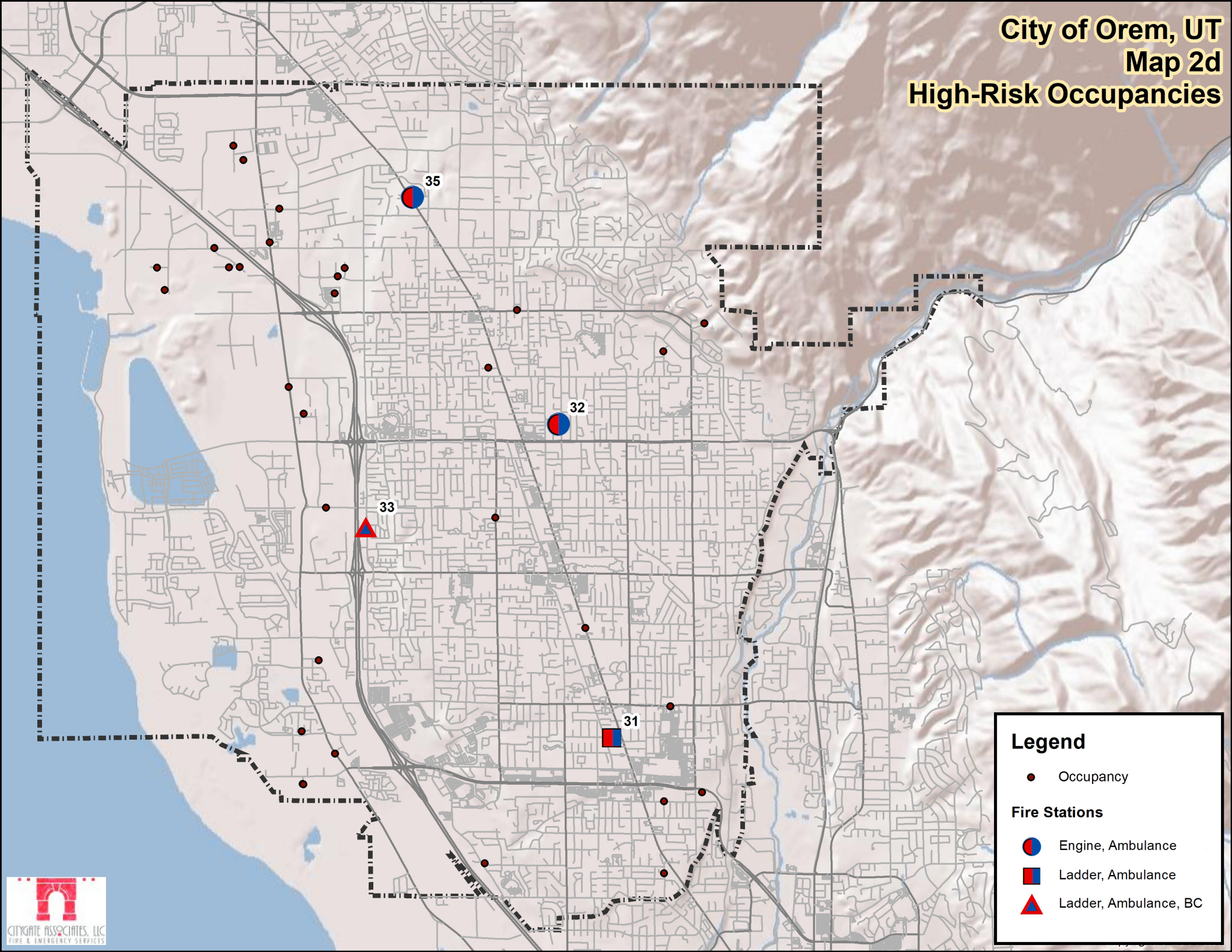
City of Orem, UT
Map 2d
High-Risk Occupancies
35
32
33
31
Legend
Occupancy
Fire Stations
Engine, Ambulance
Ladder, Ambulance
Ladder, Ambulance, BC
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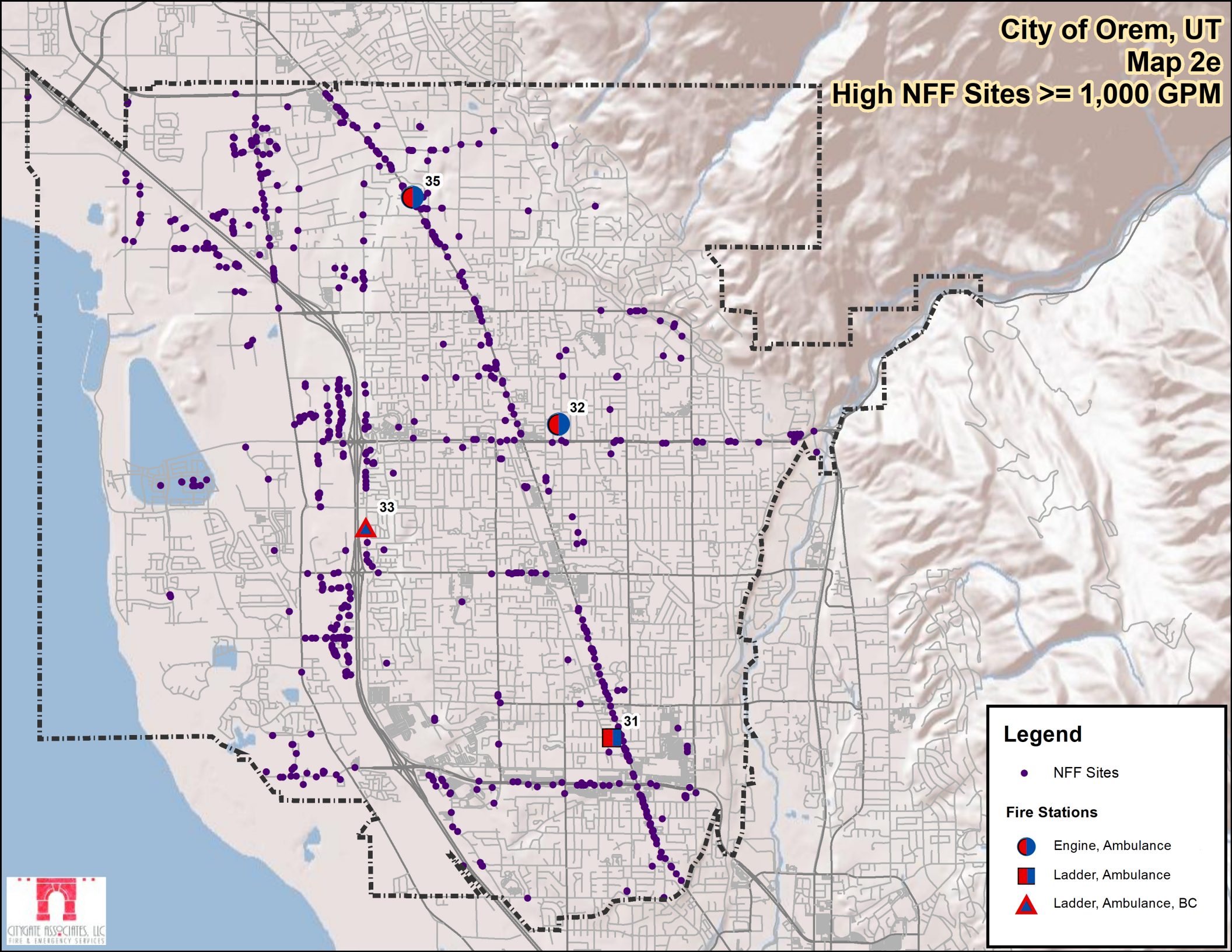
City of Orem, UT
Map 2e
High NFF Sites >= 1,000 GPM
35
32
33
31
Legend
NFF Sites
Fire Stations
Engine, Ambulance
Ladder, Ambulance
Ladder, Ambulance, BC
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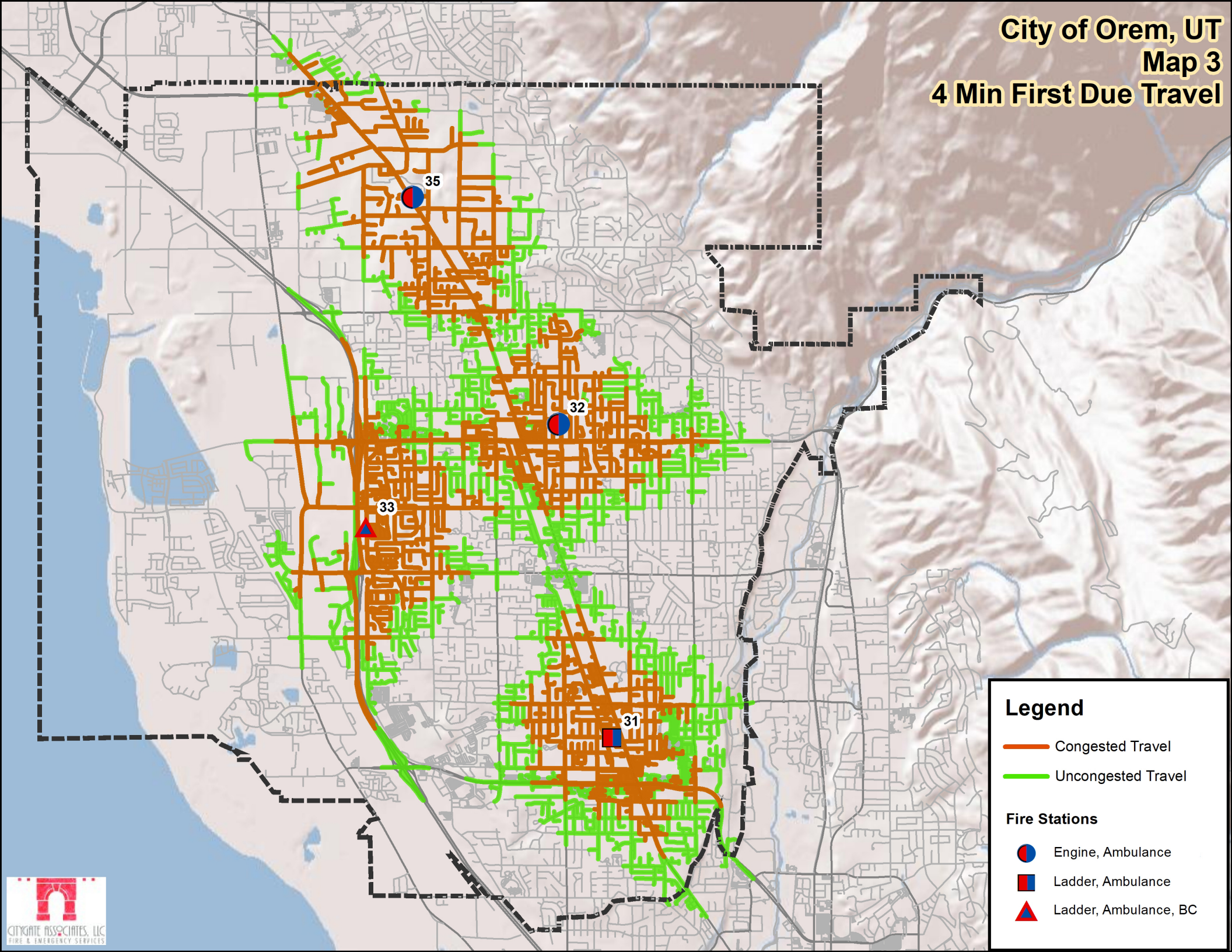
FIRE & EMERGENCY SERVICES


City of Orem, UT
Map 3
4 Min First Due Travel
35
32
33
31
Legend
Congested Travel
Uncongested Travel
Fire Stations
Engine, Ambulance
Ladder, Ambulance
Ladder, Ambulance, BC
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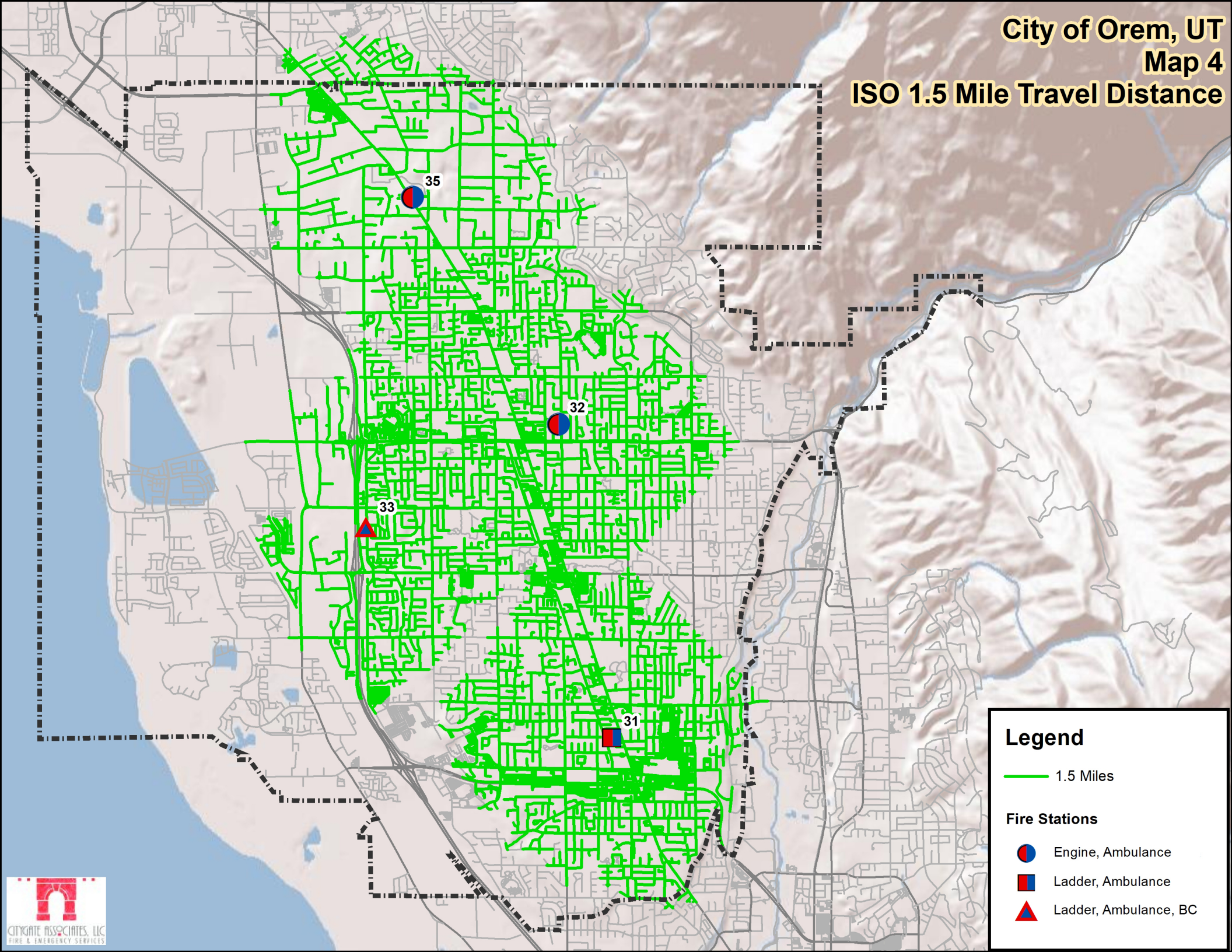
City of Orem, UT
Map 4
ISO 1.5 Mile Travel Distance
35
32
33
31
Legend
1.5 Miles
Fire Stations
Engine, Ambulance
Ladder, Ambulance
Ladder, Ambulance, BC
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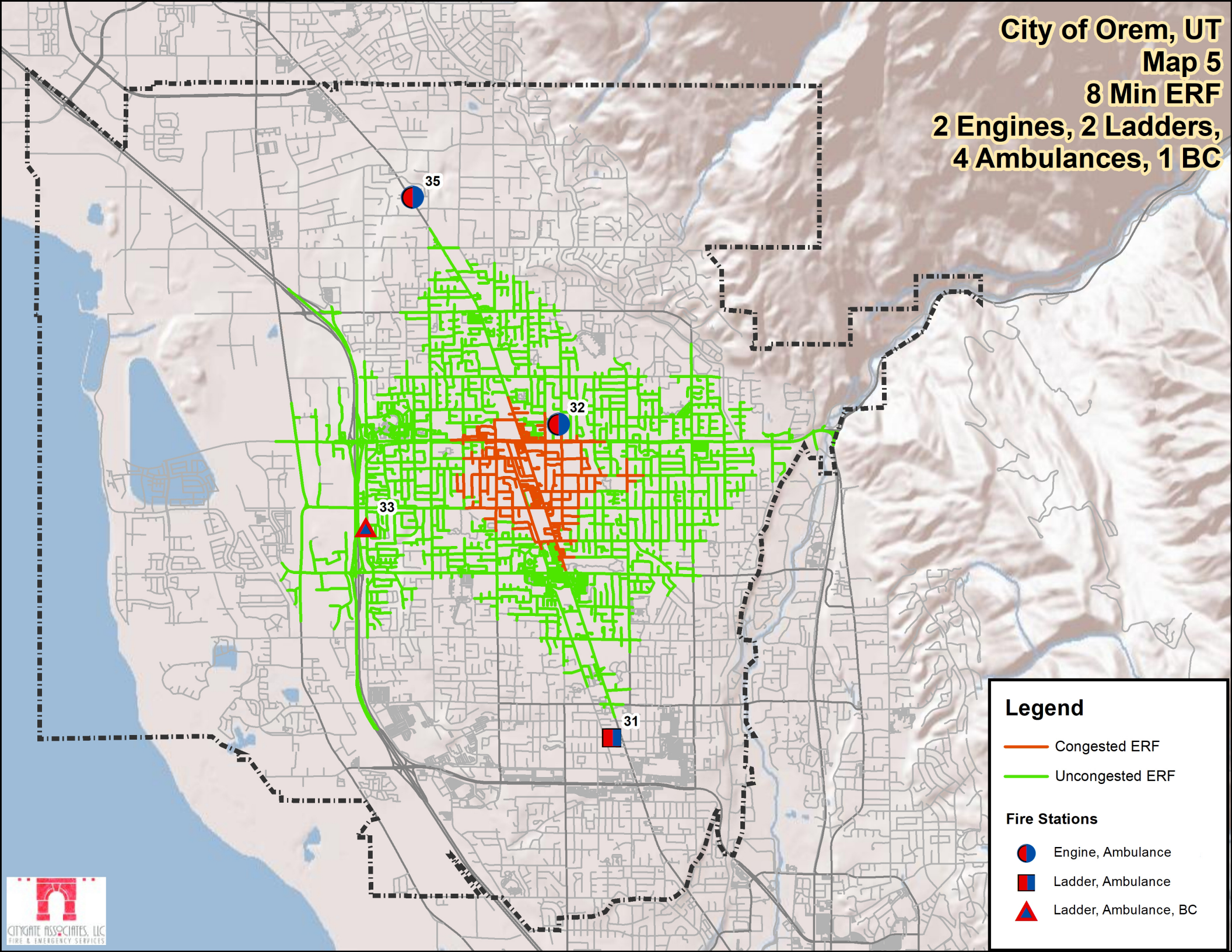
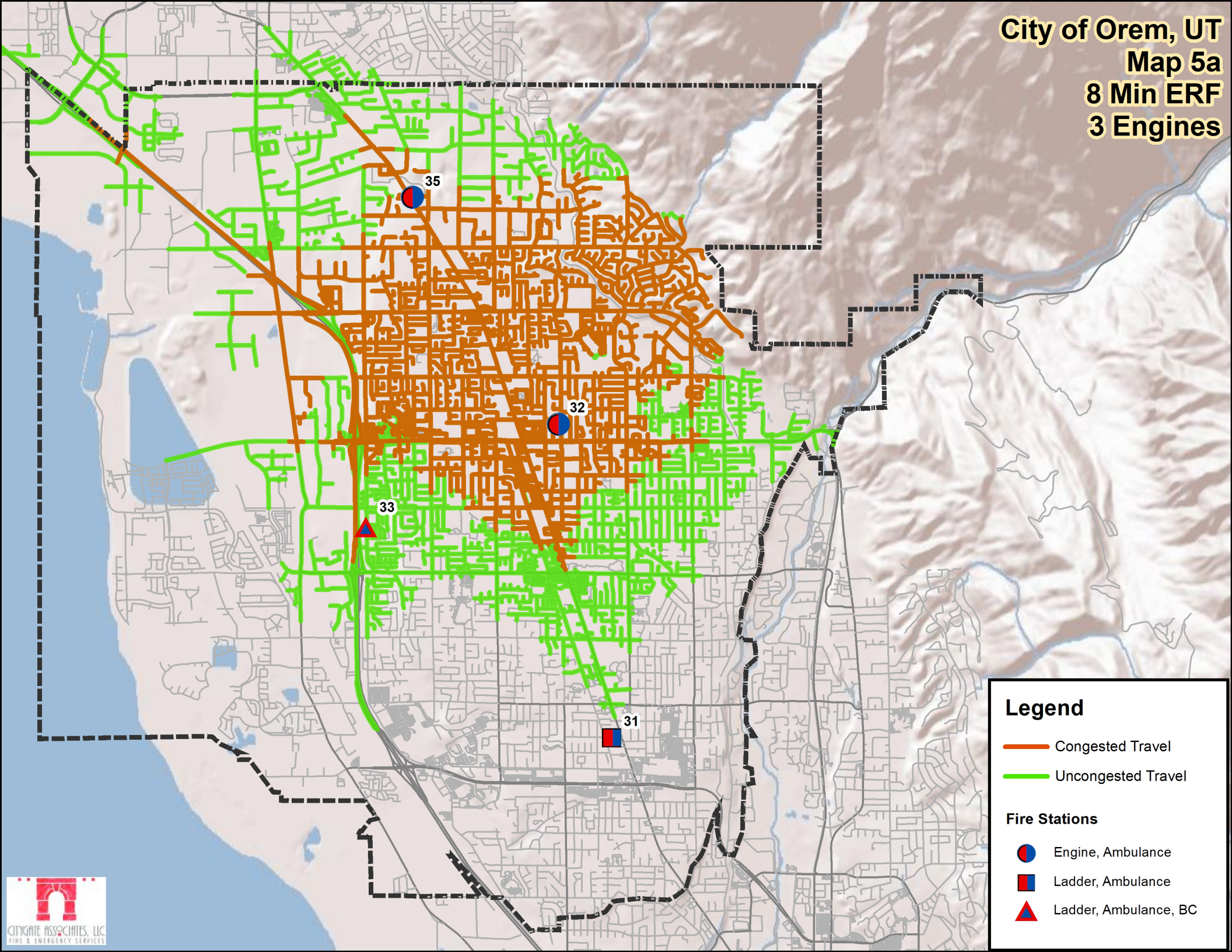
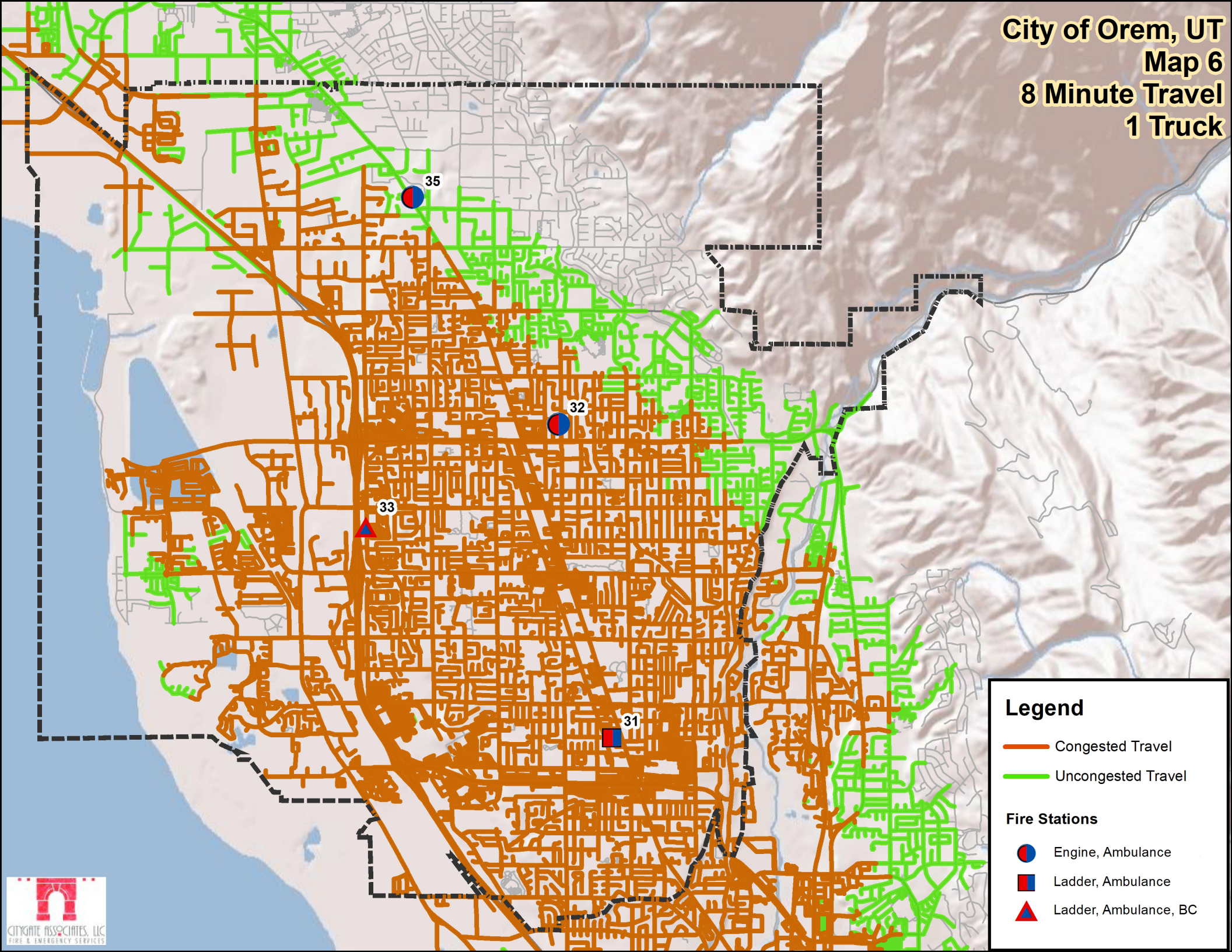
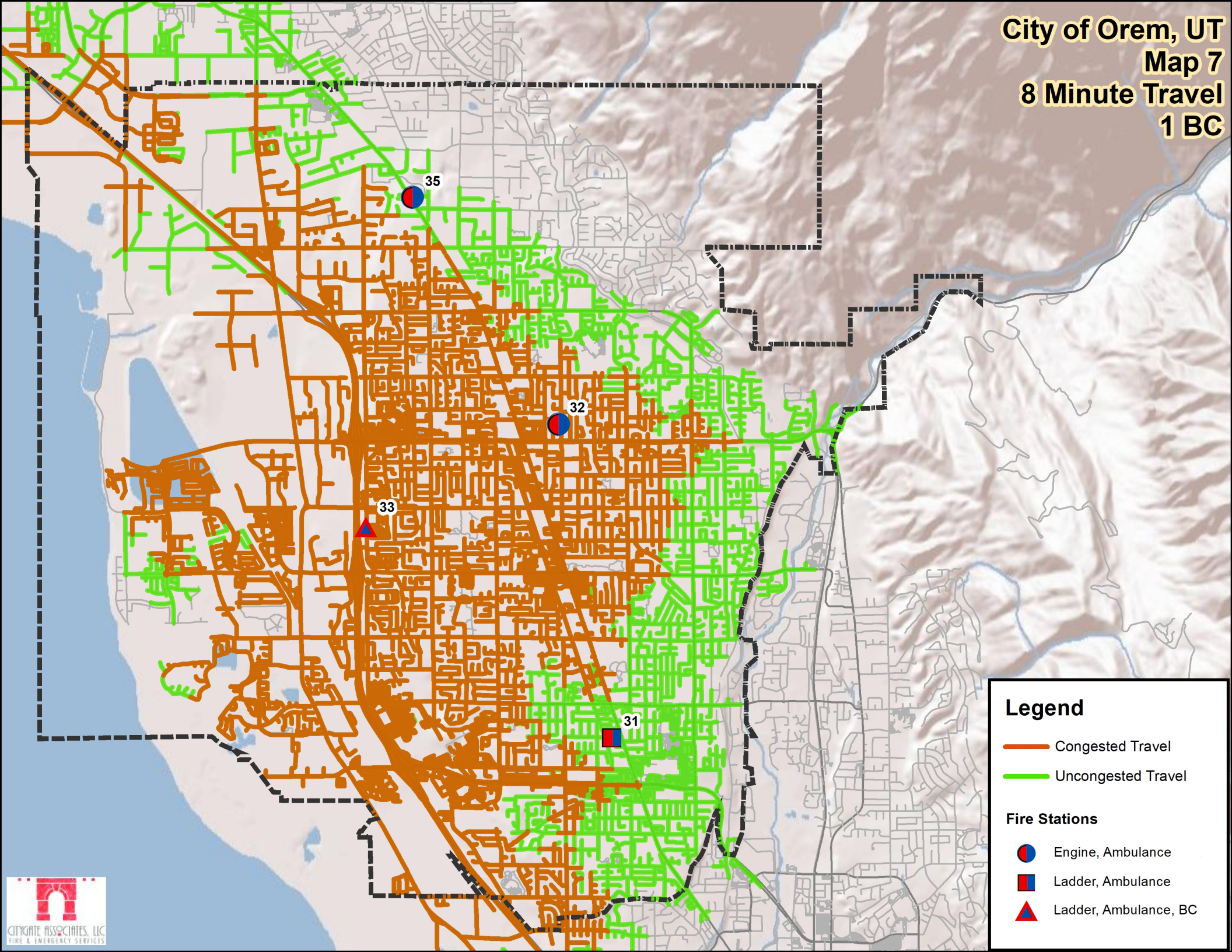
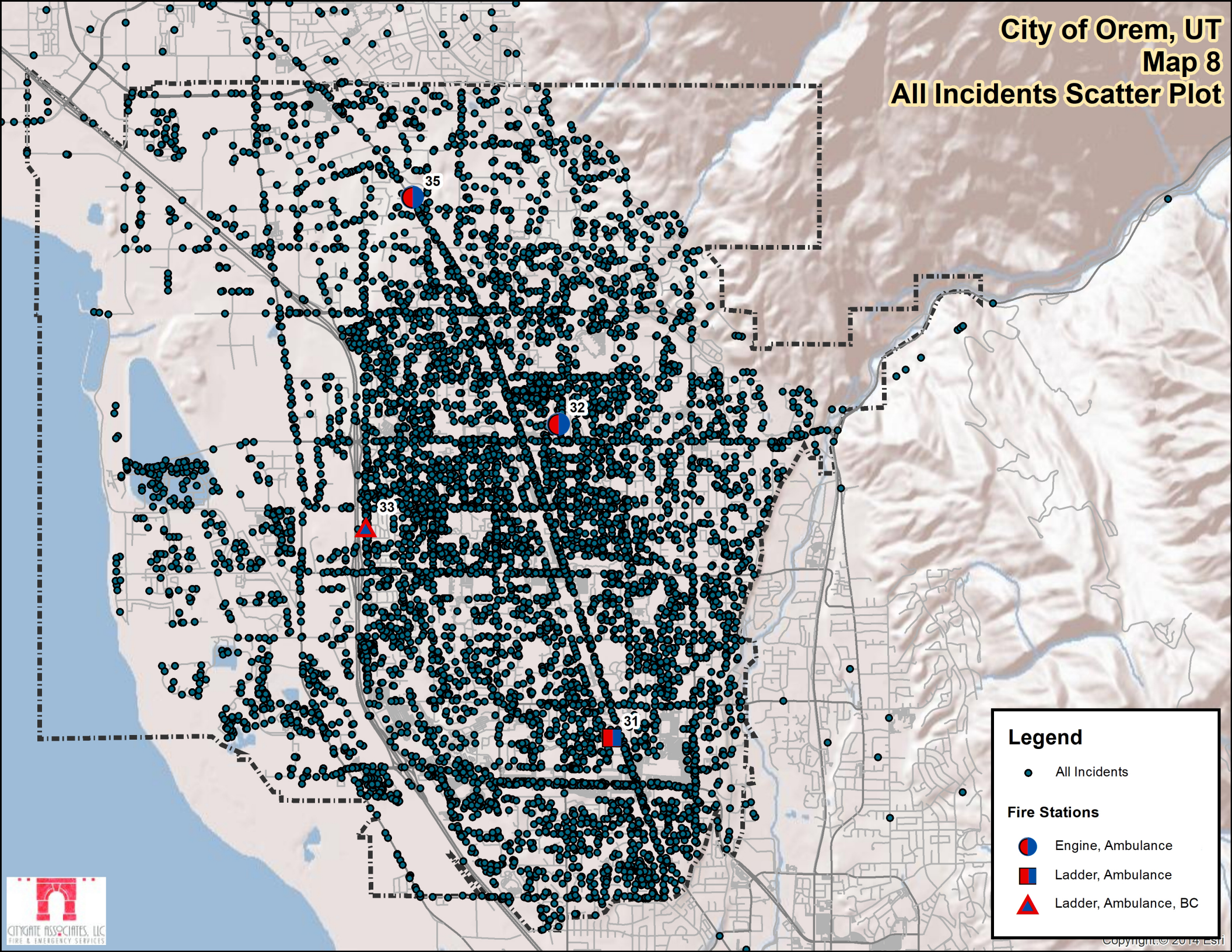
FIRE & EMERGENCY SERVICES


City of Orem, UT
Map 5
8 Min ERF
2 Engines, 2 Ladders,
4 Ambulances, 1 BC
35
32
33
31
Legend
Congested ERF
Uncongested ERF
Fire Stations
Engine, Ambulance
Ladder, Ambulance
Ladder, Ambulance, BC
CITYGATE ASSOCIATES, LLC
FIRE & EMERGENCY SERVICES


City of Orem, UT
Map 5a
8 Min ERF
3 Engines
35
32
33
31
Legend
Congested Travel
Uncongested Travel
Fire Stations
Engine, Ambulance
Ladder, Ambulance
Ladder, Ambulance, BC
CITYGATE ASSOCIATES, LLC
FIRE & EMERGENCY SERVICES


City of Orem, UT
Map 6
8 Minute Travel
1 Truck
35
32
33
31
Legend
Congested Travel
Uncongested Travel
Fire Stations
Engine, Ambulance
Ladder, Ambulance
Ladder, Ambulance, BC
CITYGATE ASSOCIATES, LLC
FIRE & EMERGENCY SERVICES


City of Orem, UT
Map 7
8 Minute Travel
1 BC
35
32
33
31
Legend
Congested Travel
Uncongested Travel
Fire Stations
Engine, Ambulance
Ladder, Ambulance
Ladder, Ambulance, BC
CITYGATE ASSOCIATES, LLC
FIRE & EMERGENCY SERVICES


City of Orem, UT
Map 8
All Incidents Scatter Plot
35
32
33
31
Legend
All Incidents
Fire Stations
Engine, Ambulance
Ladder, Ambulance
Ladder, Ambulance, BC
CITYGATE ASSOCIATES, LLC
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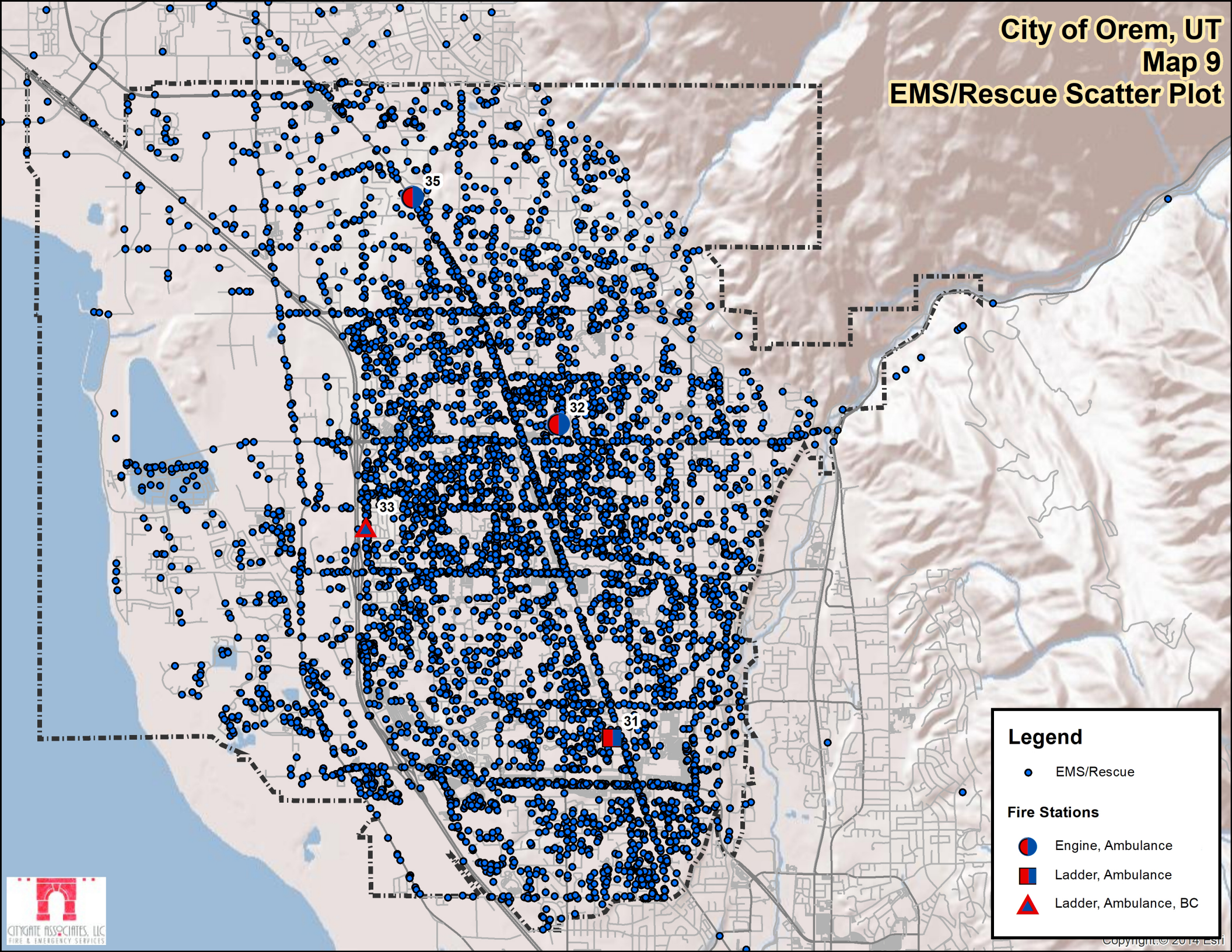
City of Orem, UT
Map 9
EMS/Rescue Scatter Plot
35
32
33
31
Legend
EMS/Rescue
Fire Stations
Engine, Ambulance
Ladder, Ambulance
Ladder, Ambulance, BC
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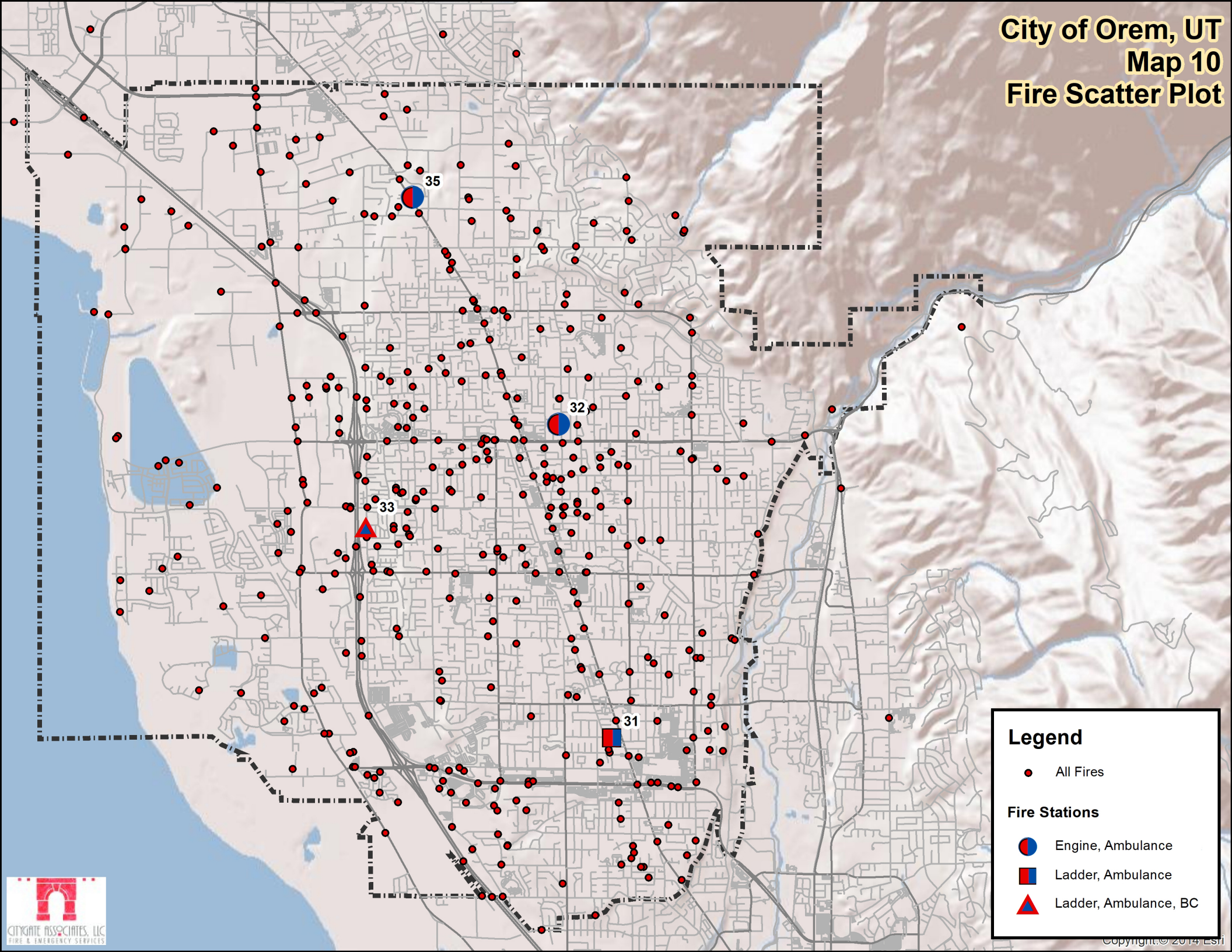
City of Orem, UT
Map 10
Fire Scatter Plot
35
32
33
31
Legend
All Fires
Fire Stations
Engine, Ambulance
Ladder, Ambulance
Ladder, Ambulance, BC
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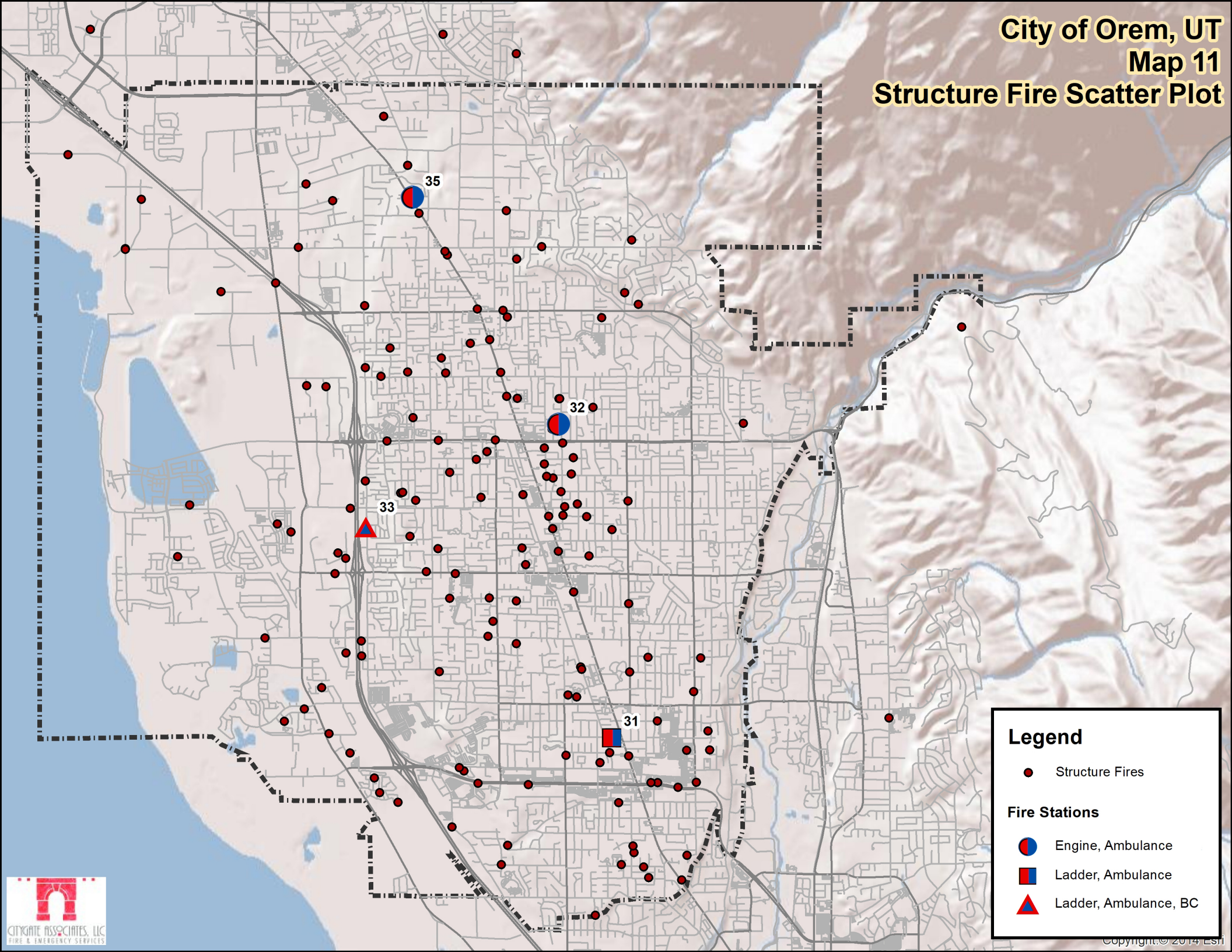
City of Orem, UT
Map 11
Structure Fire Scatter Plot
35
32
33
31
Legend
Structure Fires
Fire Stations
Engine, Ambulance
Ladder, Ambulance
Ladder, Ambulance, BC
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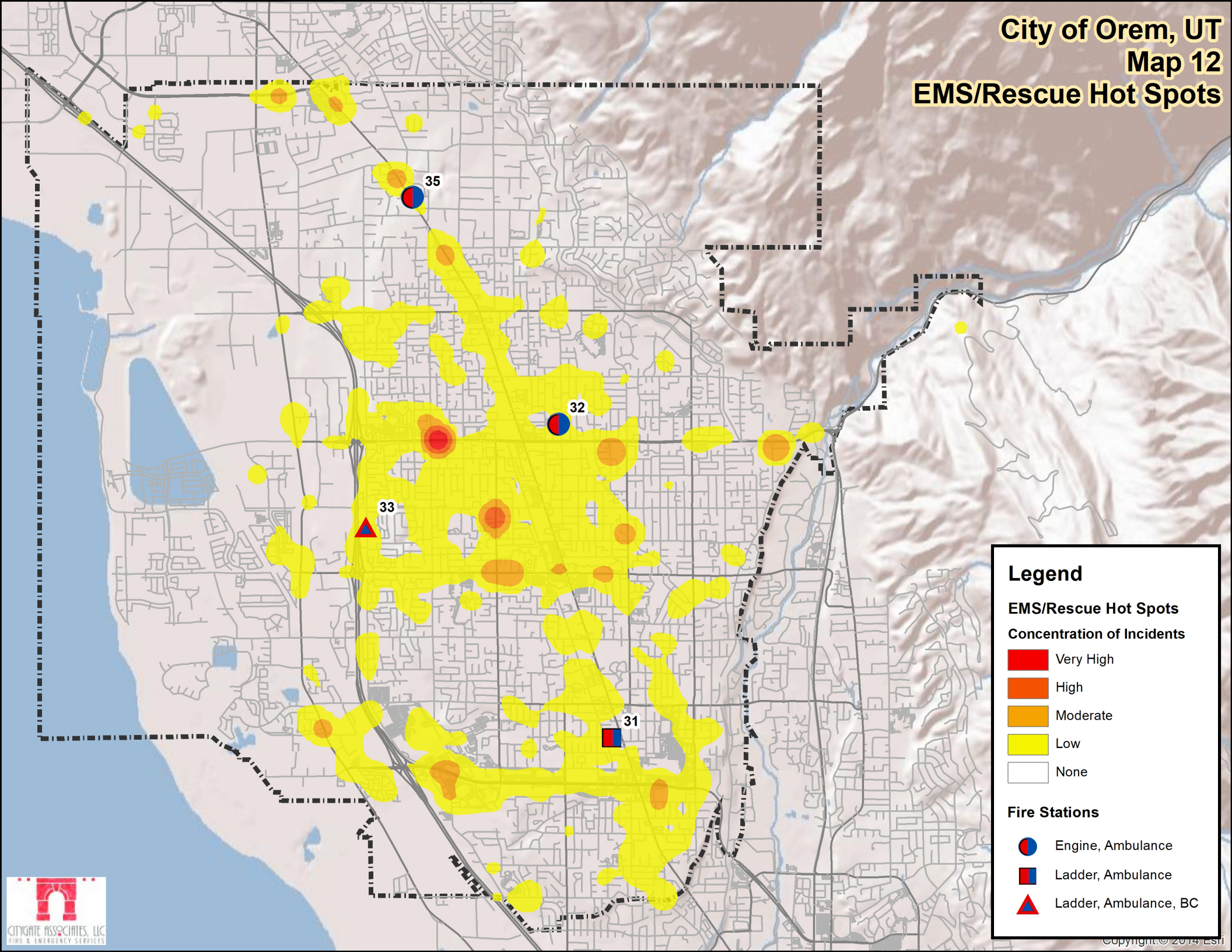
City of Orem, UT
Map 12
EMS/Rescue Hot Spots
35
32
33
31
Legend
EMS/Rescue Hot Spots
Concentration of Incidents
Very High
High
Moderate
Low
None
Fire Stations
Engine, Ambulance
Ladder, Ambulance
Ladder, Ambulance, BC
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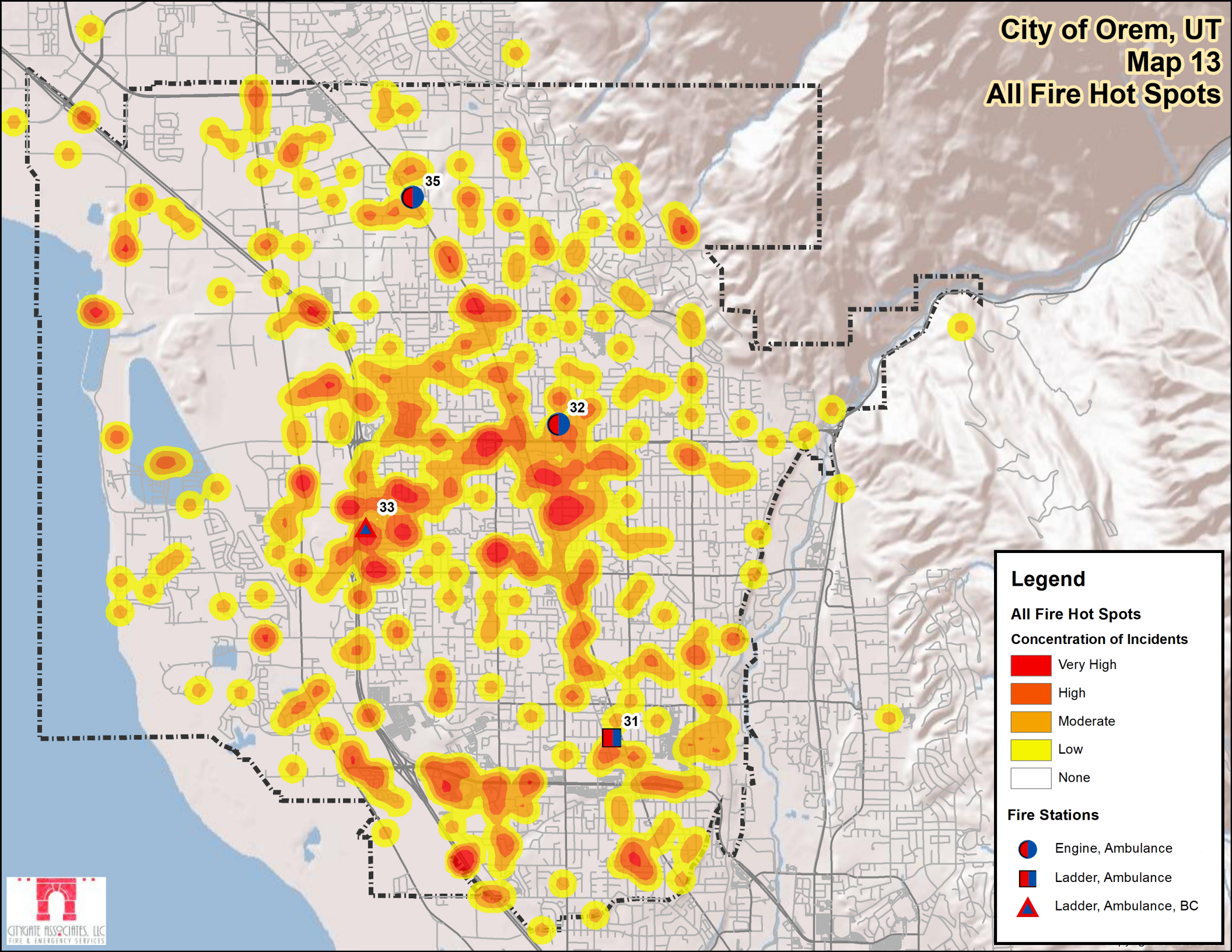
City of Orem, UT
Map 13
All Fire Hot Spots



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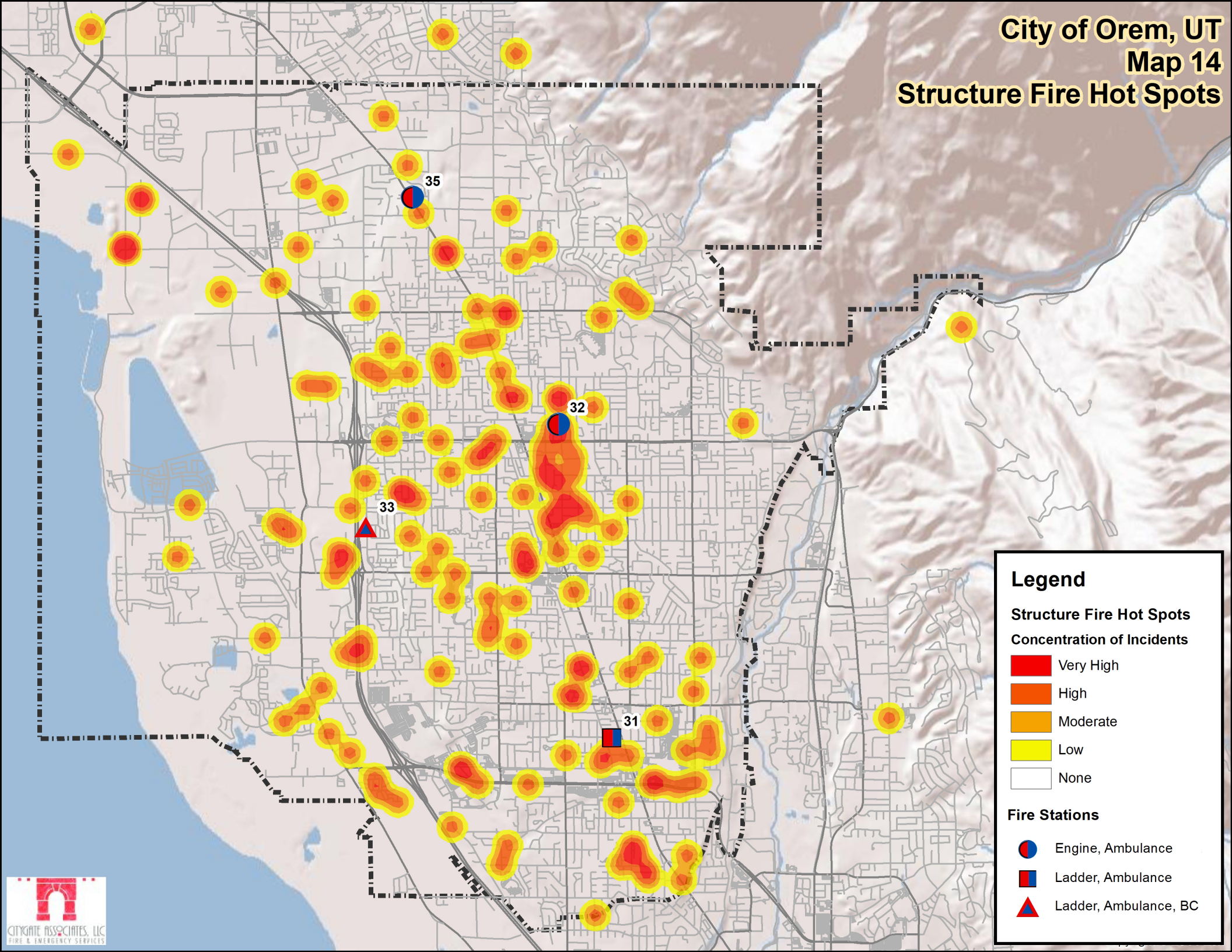
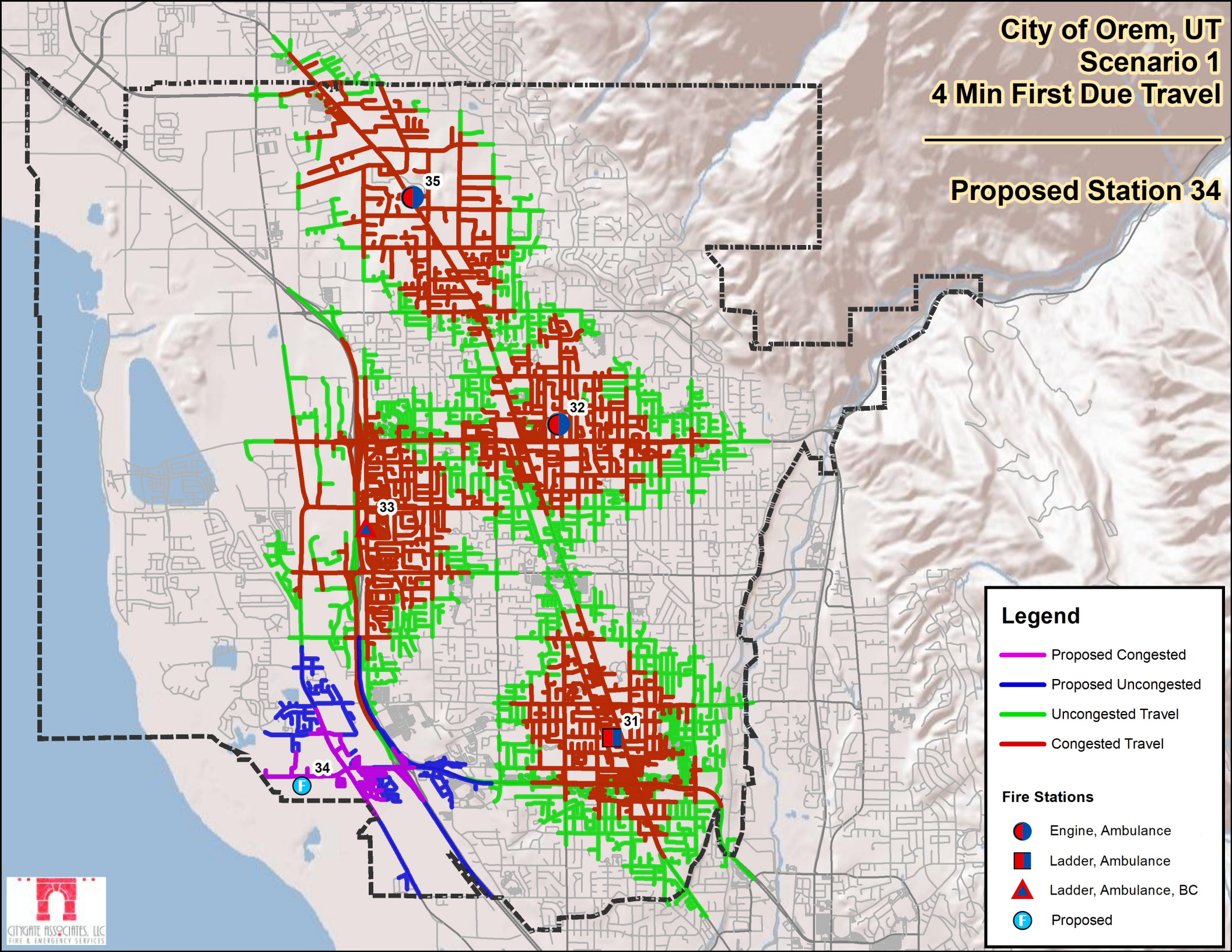
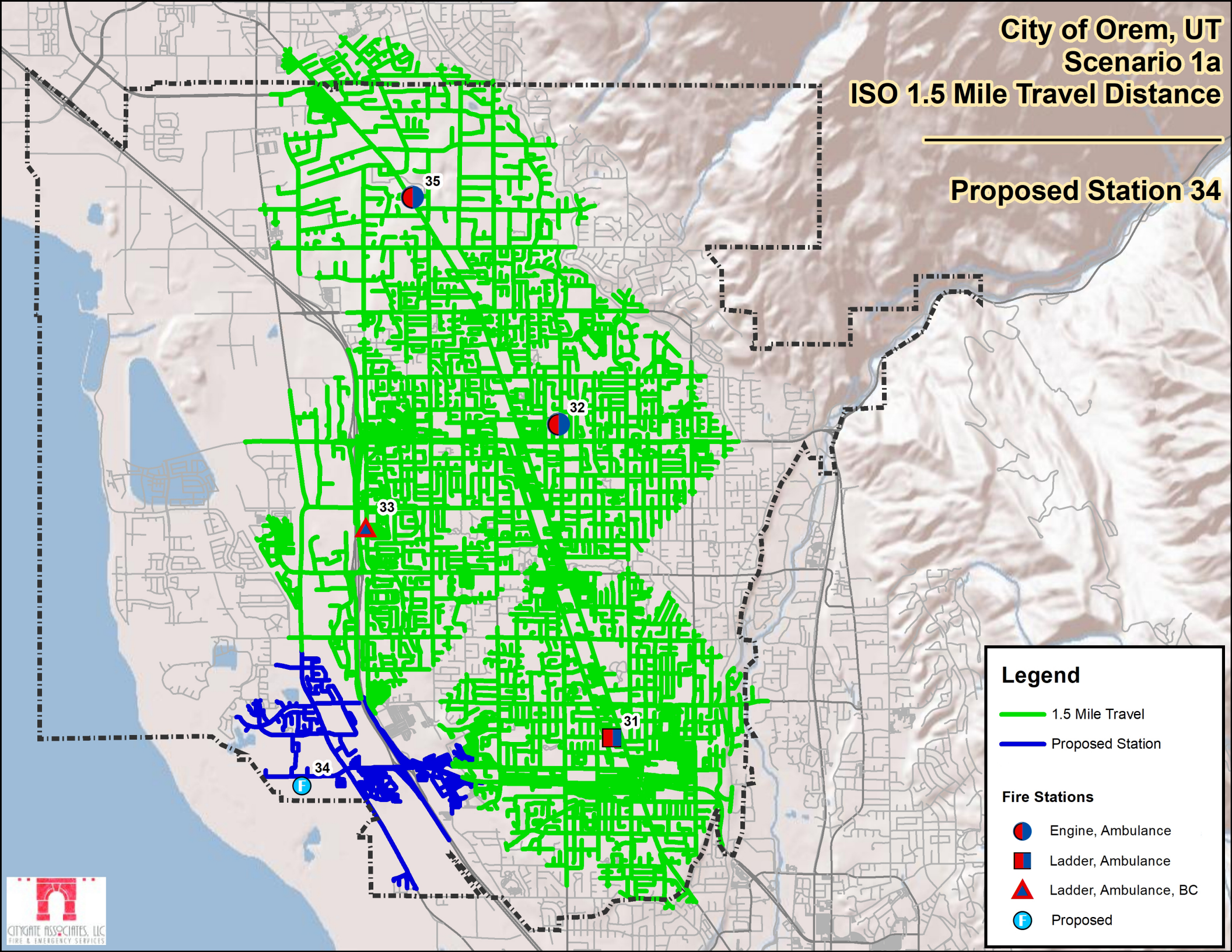
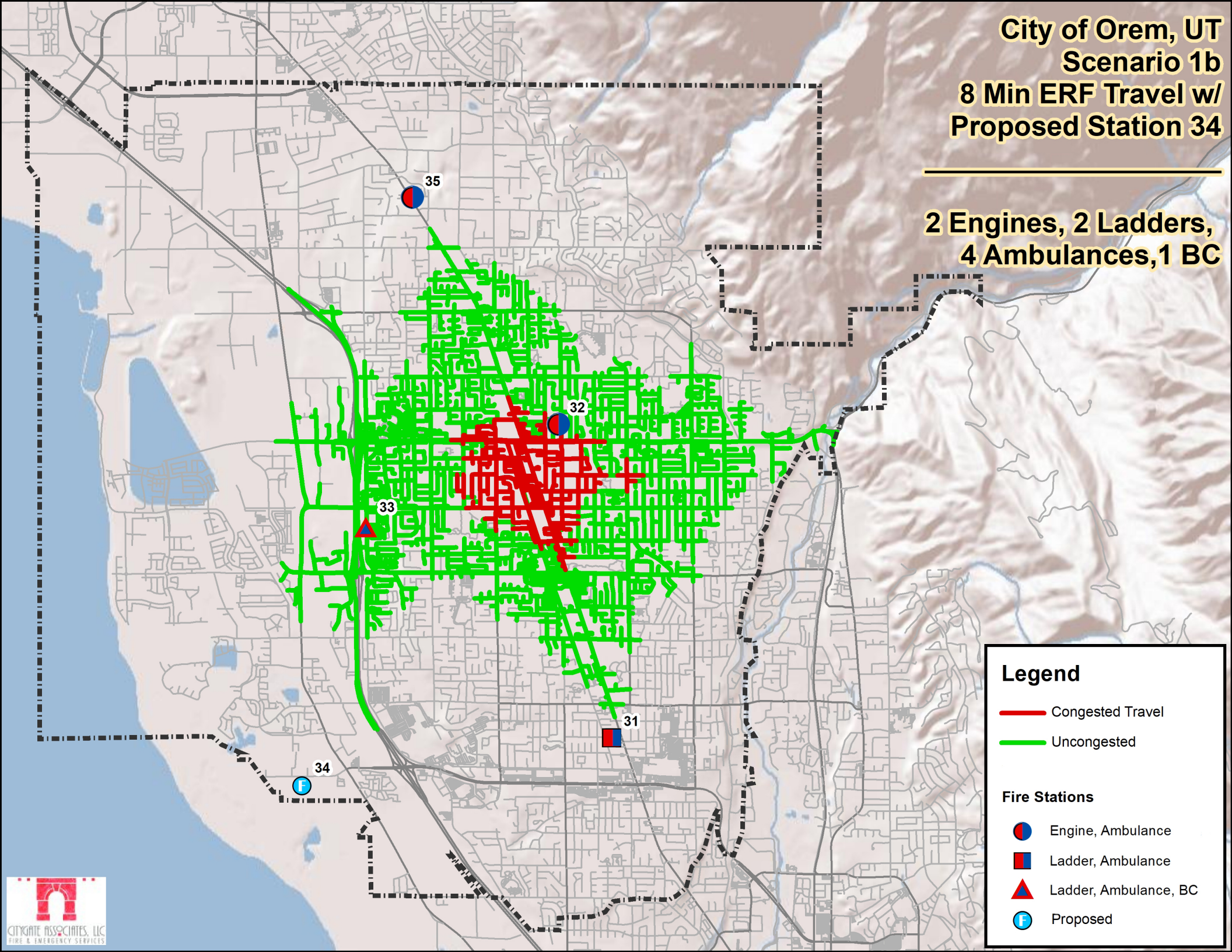

City of Orem, UT
Map 14
Structure Fire Hot Spots
35
32
33
31
Legend
Structure Fire Hot Spots
Concentration of Incidents
Very High
High
Moderate
Low
None
Fire Stations
Engine, Ambulance
Ladder, Ambulance
Ladder, Ambulance, BC
CITYGATE ASSOCIATES, LLC
FIRE & EMERGENCY SERVICES


City of Orem, UT
Scenario 1
4 Min First Due Travel
Proposed Station 34
35
32
33
31
34
Legend
Proposed Congested
Proposed Uncongested
Uncongested Travel
Congested Travel
Fire Stations
Engine, Ambulance
Ladder, Ambulance
Ladder, Ambulance, BC
Proposed
CITYGATE ASSOCIATES, LLC
FIRE & EMERGENCY SERVICES


City of Orem, UT
Scenario 1a
ISO 1.5 Mile Travel Distance
Proposed Station 34
35
32
33
31
34
Legend
1.5 Mile Travel
Proposed Station
Fire Stations
Engine, Ambulance
Ladder, Ambulance
Ladder, Ambulance, BC
Proposed
CITYGATE ASSOCIATES, LLC
FIRE & EMERGENCY SERVICES


City of Orem, UT
Scenario 1b
8 Min ERF Travel w/
Proposed Station 34
2 Engines, 2 Ladders,
4 Ambulances,1 BC
35
32
33
31
34
Legend
Congested Travel
Uncongested
Fire Stations
Engine, Ambulance
Ladder, Ambulance
Ladder, Ambulance, BC
Proposed
CITYGATE ASSOCIATES, LLC
FIRE & EMERGENCY SERVICES