City of Concord

New Hampshire

Fire Station Location Study

January 2022

Emergency Services Consulting International

Providing Expertise and Guidance that Enhances Community Safety

Acknowledgments

Emergency Services Consulting International (ESCI) would like to acknowledge that without the assistance and support of the staff and elected officials of the City of Concord, New Hampshire and the members of the Concord Fire Department, this project could not have been successfully completed.

The ESCI project team began collecting information regarding the optimization of fire stations in June of 2021. It is ESCI's sincere hope that the information contained in this report is used to its fullest extent and the emergency services provided to the citizens of Concord and the surrounding area will be improved by its implementation.

The ESCI team members recognize this report contains a large amount of information and ESCI would like to thank the City Council, staff members, and fire department for their hospitality and tireless efforts in bringing this project to fruition. ESCI would also like to thank the citizens of Concord, various external organizations, and other stakeholders for their input, opinions, and candid conversations throughout this process.

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Executive Summary

Background

ESCI was engaged by Concord Fire Department to provide a station location study. This report serves as the culmination of the project and is configured as a station location study that evaluates current conditions; projects future growth, development, and service demands; and provides recommendations to enhance current services or provide an equal level of service for the future by examining current or future need for an additional fire station.

Using organizational, operational, staffing, and geographic information system (GIS) models, an evaluation of existing fire and rescue operations and recommendations for improvement in current services delivered to the community. The evaluation and analysis of data and other information is based on National Fire Protection Association (NFPA) standards, the Center for Public Safety Excellence/Commission on Fire Accreditation International (CPSE/CFAI) *Standards of Cover*, 6th edition, health and safety requirements, federal and state mandates relative to emergency services, and generally accepted best practices within the emergency services community; where applicable.

Each section in the following report provides the reader with general information about that element, as well as observations and analyses of any significant issues or conditions. Observations are supported by data provided by Concord Fire Department and collected as part of the review and interview process. Finally, specific recommendations are included to address identified issues or to take advantage of opportunities that may exist.

It is important to bear in mind that these were the current conditions at the time of the data collection and on-site visit. The agency is continuing to change and improve over the time required to author the report, therefore not every current condition remains as stated here.

Major Findings

The Concord Fire Department Fire Station Location Study determined that the City of Concord has several options available regarding the placement and number of fire stations within the City. The decision on where, when, and how many fire stations will ultimately be needed will impact which option is best suited for the department and the City of Concord. The following table provides an overview of these findings.

Decision Point	Description	% of 2020 Incidents within a 4-Minute Travel Time	Net Improvement
How many fire stations does the City of Concord plan to operate during the next 30-50 years?	**4 Stations** ***Option A:*** Continue to operate 4 fire stations in their existing locations. ***Impact:*** No change to current deployment with all facilities requiring rehabilitation/ reconstruction at current locations. ***Option B:*** Optimize the locations of all 4 fire stations. ***Impact:*** Projected improvement to current service delivery performance. Higher costs associated with land acquisition. Similar benefit can be achieved by adding 5th station to current configuration with rehabilitation/ reconstruction required at current locations. **Note: Optimizing the locations of between 1 and 3 stations will also result in a net improvement; however, it will be less of an improvement.*	69.8% 78.7%	No Change 8.9%
	5 Stations ***Option A:*** Add a 5th fire station in the area west of Langley Parkway and Pleasant Street and maintain the locations of the existing 4 fire stations. ***Impact:*** Lower capital costs than acquiring new land and relocating current four stations. Increased personnel costs for additional facility. Improvement to resiliency and effective response force with rehabilitation/ reconstruction required at current locations. ***Option B:*** Optimize the location of the existing 4 fire stations and add a 5th station. ***Impact:*** Projected improvement to current service delivery performance. Higher costs associated with land acquisition and ongoing personnel costs. Significant improvement to current deployment model.	78.9% 86.5%	9.1% 16.7%

Decision Point	Description	% of 2020 Incidents within a 4-Minute Travel Time	Net Improvement
	Rehabilitation costs absorbed through new construction. *Note: Optimizing the locations of between 1 and 3 stations will also result in a net improvement, however it will be less of an improvement.* ***Option C:*** Maintain or slightly relocate stations 1, 5, and 7. Relocate Station 4 near the area of Route 13 and Langley Parkway and plan for a future 5th station near the commercial area of Manchester Street and Interstate 93. ***Impact:*** Reduced land acquisition costs for three stations, maintain current staffing levels while new location for Station 4 is under construction. Fifth station can be added with needed staffing in the future. Rehabilitation/reconstruction required at stations 1, 5, and 7.	85.7%	15.9%

In addition to the station location results, the following deficiencies were noted, and recommendations provided for their future improvement.

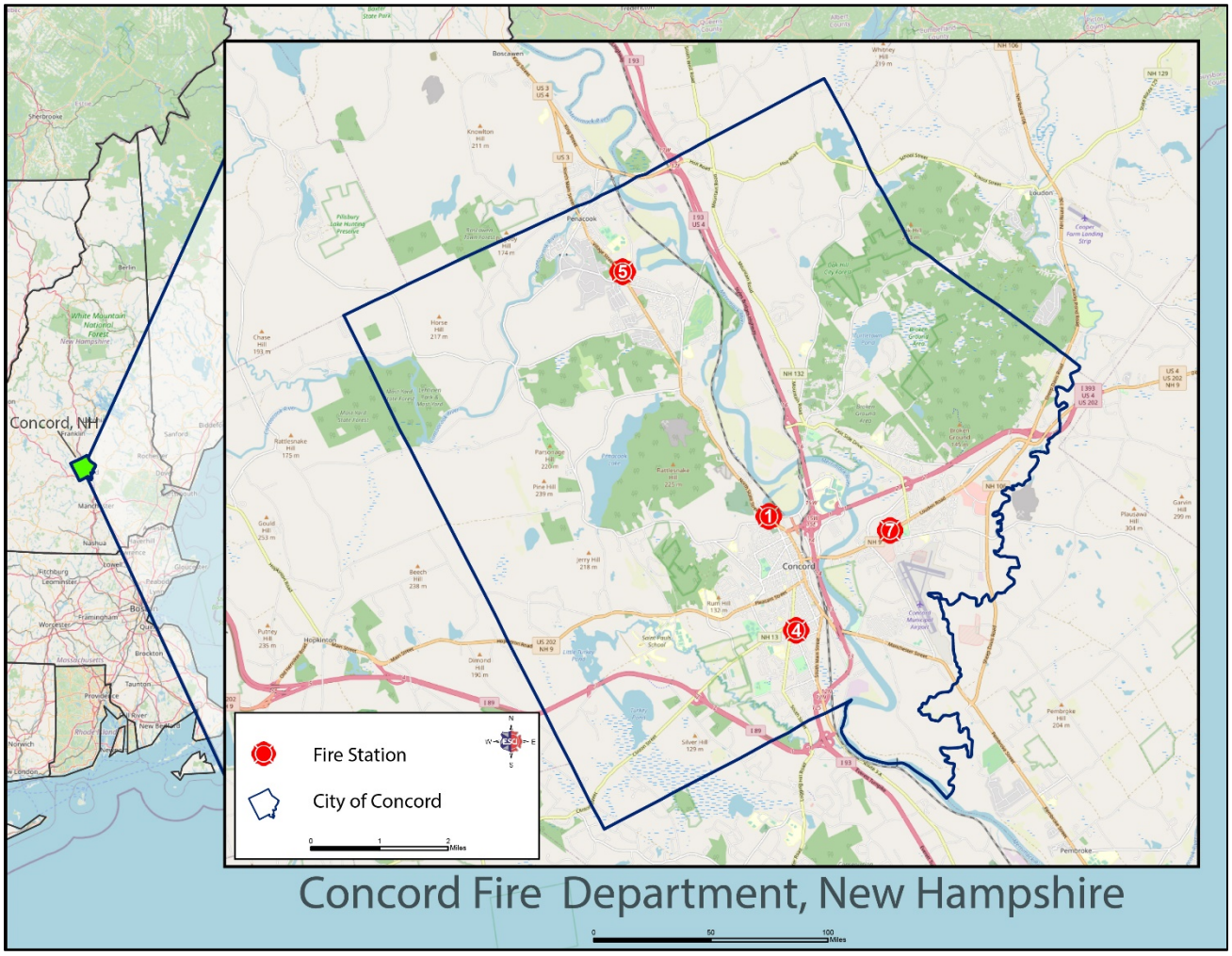
- All fire stations should be renovated or rebuilt due to physical and structural deficiencies.
- A suppression unit should be staffed at Central Station 1. The lack of a suppression unit capable of providing a fire water flow, equivalent for the building types contained within that district, at Central Station 1 allows for a substantial risk within the historic downtown area.
- An ambulance and its required staffing should be added at Central Station to ensure appropriate coverage for the downtown area and its residents. This unit will also provide needed overlapping coverage for all other districts within the City as it is centrally located.
- The Central Station, Administration, and Communications Center campus may be better suited in a new location. This campus contains several historic buildings that are retrofitted to meet the needs of the department. Space is limited for each division and future expansions or renovations are not possible without affecting the historic nature of many of these buildings. The location of Central Station 1, or somewhere nearby, provides the best option to Concord Fire Department for deployment and options for other locations nearby should be considered and evaluated.
- Administrative staffing should be increased. Administrative staffing for Concord Fire Department is approximately one third the staffing levels that would ordinarily be anticipated. When this occurs, communication issues are often cited as the number one challenge within the organization as administrators cannot fulfill tasks in a timely manner, if at all.

Evaluation of Current Conditions

The City of Concord

The City of Concord is located in south-central New Hampshire on the Merrimack River in Merrimack County approximately 70 miles north of Boston, Massachusetts. The City covers an area of approximately 64 square miles and based on U.S. Census 2019 estimates, hosts a population of 43,627.[1] Rich with history, the area was settled in 1659, incorporated in 1733, established as the state capital in 1808, and home to numerous historic buildings that reside within its boundaries.

Figure 1: Overview of Concord, New Hampshire



[1] *American Fact Finder, https://factfinder.census.gov/faces/nav/jsf/pages/community_facts.xhtml, 2020.*

Concord Fire Department

Concord Fire Department is responsible for protecting the New Hampshire State Capitol Building and Legislative Offices as well as the State Emergency Operations Center and the New Hampshire Department of Homeland Security. The department provides a full range of emergency response services for residential, commercial, manufacturing, wildland areas, and waterways.

Concord Fire Department Headquarters and Central Station 1 are co-located on a campus at 24 Horseshoe Pond Lane, and 150 North State Street respectively, in downtown Concord. Also located at this campus is the Fire Prevention Bureau and Communications Center. This campus contains several historic buildings that were originally used by the water department. Three additional stations provide fire rescue coverage throughout the City, with the Broadway Station 4 located at 15 Broadway, the Manor Station 5 located at 46 Village Street, and the Heights Station 7 at 127 Loudon Road. A training facility with a burn tower, classroom, and additional storage is located at 109 Old Turnpike Road.

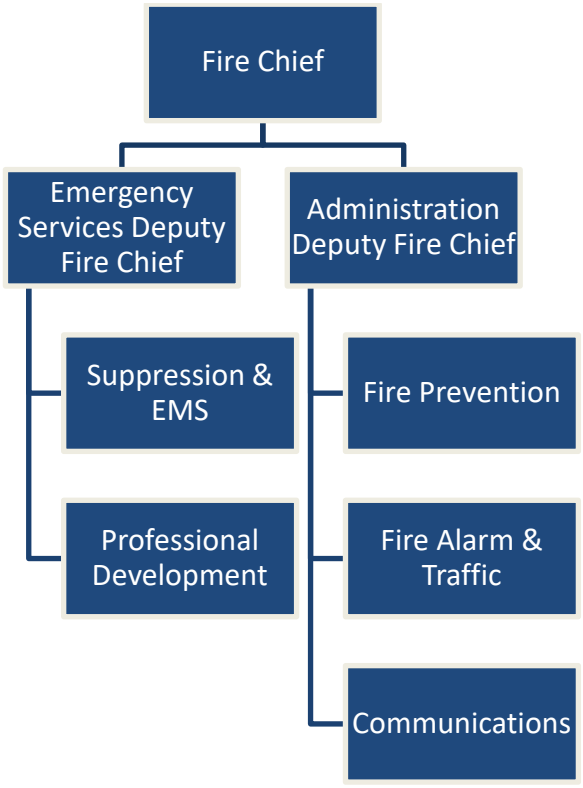
Concord Fire Department provides services for fire suppression, advanced life support (ALS) and basic life support (BLS) response, water/swift water rescue, technical rescue, and hazardous materials operation level response. In 2013, the Concord Fire Department received an Insurance Services Office rating of Class 2/8B.

Fire Department Organizational Structure

To effectively operate, the structure of a fire department needs to be clearly defined in the form of an organizational chart. The chart institutionalizes the agency's hierarchy, identifies roles, and most importantly, reporting authority. It also helps to assure that communication flows appropriately, as well as limiting opportunities to circumvent the reporting structure.

Concord Fire Department has a well-defined organizational chart that achieves this purpose and operates in a traditional top-down manner. Lines of authority are clear and depicted. The next figure illustrates the organizational chart for the Concord Fire Department.

Figure 2: Concord Fire Department Organizational Chart



Staffing

The size of an organization's staffing is dependent upon the specific needs of the organization. These needs must directly correlate to the needs of the City of Concord as a structure that works for one agency may not necessarily work for another. This section provides an overview of the Concord Fire Department's staffing configuration.

Concord Fire Department is staffed by 100 full time employees who hold the following positions:

Figure 3: Staffing

Position	Quantity
Fire Chief	1
Deputy Fire Chief	2
EMS Captain	1
Training / Safety Captain	1
Fire Marshal	1
Assistant Fire Marshal	1
Communications Captain	1
Fire Alarm and Traffic Superintendent	1
Administrative Specialist II	1
Fiscal Supervisor	1
EMS Lieutenant	1
Lead Dispatcher	4
Dispatcher	4
Battalion Chief	4
Captain	4
Lieutenant	12
Firefighter / Paramedics	16
Firefighter / EMTs	44

Fire department staffing can be divided into two distinct groups. The first group is typically recognized by the citizens and is commonly known as the operations section, it can be generally classified as the emergency response personnel. The second group works behind the scenes to provide the support needed by the operation's personnel to deliver an effective emergency response and is commonly known as the administrative section or support services section. Like many fire departments, Concord Fire Department has distinct staff personnel, Chief Officers, who perform specific administrative functions but are also required to perform operationally if the need arises.

While a fire department's evaluation focuses on several factors, staffing is one of the most important. When reviewing staffing, one must define the expectations of each work unit in addition to the organization's overall performance. Once the work product (output or outcome) is defined, and performance metrics are established, senior leadership assumes responsibility in determining appropriate staffing necessary to accomplish goals and meet performance objectives.

Administration

One of the primary responsibilities of the administrative team is to ensure that the operations segment of the organization has the ability and means to respond to and mitigate emergencies safely and efficiently. An effective administration and support services system is critical to the success of the Department.

Typical responsibilities of the administration staff include budget management, planning, organizing, directing, coordinating, and evaluating the various programs within the Concord Fire Department This list of

functions is not exhaustive, and other functions may be added. It is also important to understand these functions do not occur linearly and can more often occur simultaneously. This requires the Fire Chief and administrative support staff to focus on many different areas concurrently.

Concord Fire Department staffs five full-time administration positions. These positions include the Fire Chief and two Deputy Chiefs, a Fiscal Supervisor, and an Administrative Specialist. This represents 5% of the Department's total combined staffing of 100 positions. It is ESCI's experience that effective administrative staffing totals for municipal fire department operations typically range from 12 to 15% of agency totals. After reviewing the functions and responsibilities assigned to the workgroup, ESCI concluded that the number of full-time equivalents (FTEs) assigned resides in the extreme lower range of the normally experienced administrative levels to support the responsibilities of the Concord Fire Department's administration appropriately.

Operations

Concord Fire Department staffs a minimum of 19 personnel with full staffing at 20 personnel around the clock to respond to emergency calls. These firefighters are deployed from four stations as follows:

Figure 4: Stations, Apparatus and Staffing

Station	Apparatus / Staffing
Broadway	Engine 4: 1 Officer and 2 FF/EMTs Ambulance 4: 1 FF/Paramedic and 1 FF/EMT Forestry 4 Reserve Apparatus: Boat 4
Central	Tower 1: 1 Officer and 2 FF/EMTs Battalion Chief: 1 Battalion Chief Reserve Apparatus: Tower 2, Rescue 1, and UTV 1
Heights	Engine 7: 1 Officer and 2 FF/EMTs Ambulance 7: 1 FF/Paramedic and 1 FF/EMT Forestry Truck Reserve Apparatus: Engine 6
Manor	Engine 5: Officer and 2 FF/EMTs Ambulance 5: 1 FF/Paramedic and 1 FF/EMT Reserve Apparatus: Forestry 5, Tanker 1, Boat 5, Spare Engine 3, Spare Ambulance 2 Spare Ambulance 3

Fire Prevention Bureau

The Fire Prevention Bureau is staffed by the fire marshal, assistant fire marshal, and an administrative specialist who is shared with Fire Administration. The bureau is responsible for code enforcement, fire investigations, and public education.

Emergency Medical Services Bureau

The EMS Bureau is staffed by the EMS Officer/Captain. This Captain oversees Health Insurance Portability and Accountability Act (HIPAA) Compliance, EMS regulation compliance, and budgetary oversight.

Additionally, the Paramedic Lieutenant assigned to Medic 1 is also assigned to the EMS Bureau and charged with the responsibility of conducting the continuing EMS training, Quality Assurance, and field EMS Supervision/Support.

Communications Center

The Concord Fire Department Communications Center is commonly referred to as "Concord Fire Alarm." This communications center is the regional dispatch center for fire and EMS in the Greater Concord area. Concord Fire Alarm dispatches for 23 communities, two additional EMS providers, the regional hazardous materials team, and is the contact point for the Statewide Fire Mobilization Plan.

Concord Fire Alarm is staffed with nine full-time employees: one Supervisor Captain, four Lead Dispatchers and four Dispatchers. The center operates with two dispatchers on duty around the clock. In 2020, a year where activity was lessened because of the impacts of the global COVID-19 pandemic, Concord Fire Alarm managed 24,938 incidents in an area encompassing 817 square miles with an estimated population in 2020 of 135,716 residents.

Approximately two thirds of the Communications Center expenses are funded through the Capital Area Mutual Fire Aid Compact.

Fire Alarm and Traffic Division

The Fire Alarm and Traffic Division is staffed by the Fire Alarm Superintendent who is responsible for maintaining the Municipal Fire Alarm System and city-owned traffic signals. The Fire Alarm and Traffic Division maintains:

- The Municipal Fire Alarm Cable Plant which consists of approximately 30 miles of aerial and underground cable, 1,400 utility poles, and 650 master boxes and street boxes as well as the City Radio master box system.
- Intersection Lights, including both signalized and flashing beacons.
- Opticom Intersection Control System which consists of emitters that are located in emergency vehicles and receivers that are located in all traffic signals.
- School Zone Beacons
- Radar Speed Advisory Signs
- Standby Power Systems which include stationary generators at each fire station and the Communications Center, Headquarters, and the Emergency Operations Center Complex. The Communications Center also has a battery-powered universal power supply system.
- Knox Box Key Secure System which is used to securely store the department's Knox Box Keys when they are not in use.
- City Owned Streetlights: the City owns and maintains about 100 ornamental and traditional streetlights that are located on several bridges, at some intersections, and in downtown Concord.
- Fiber Optic Cable Plant which provides fiber optic connectivity to all City buildings.

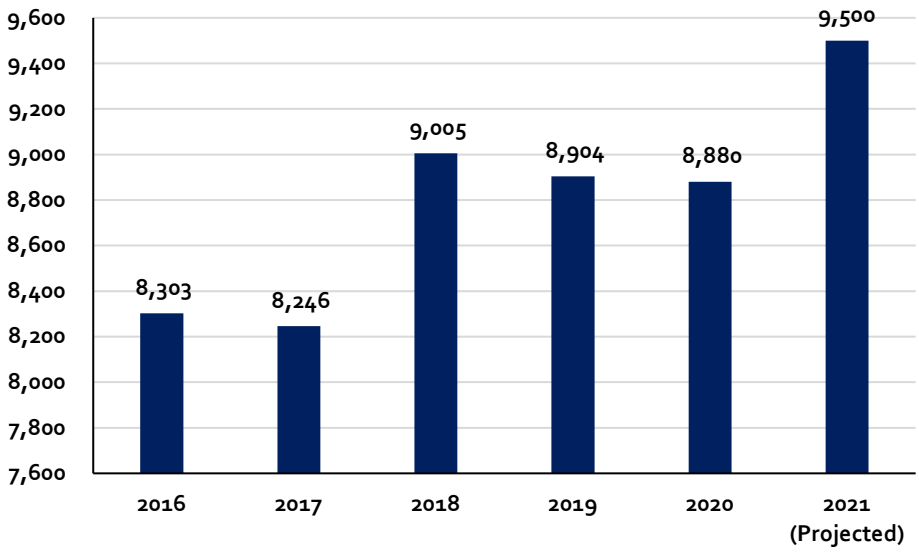
Service Delivery and Performance

Service delivery is the foundation of any service-oriented organization. Without an understanding of how services are organized, deployed, and managed, efficiency and effectiveness cannot be quantified. This section of the report will analyze multiple facets of the current delivery of fire services in Concord, including the identification of incidents by type and frequency, population demographics, deployment analysis, system reliability, and a summary of performance. By understanding current performance and how the system functions, goals and objectives for future performance improvements can be established and implemented.

Service Demand Review

Annual calls for service provide a foundation for discussion on service demand trends within Concord. Increases or decreases may superficially suggest growth or declines in population, or these changes may be attributed to other factors which will be explored in detail within this section. Figure 5 provides a description of how the fire department's workload has changed during the last five years. In 2020, the COVID-19 global pandemic dramatically affected service demand for most service providers across the world as fear of interaction with those outside of the immediate family created a reluctance to request services. As such, incident totals for 2020 will most likely not follow historic trends and show a decline in demand.

Figure 5: Annual Service Demand (2016-2020 and 2021 Projected Demand)



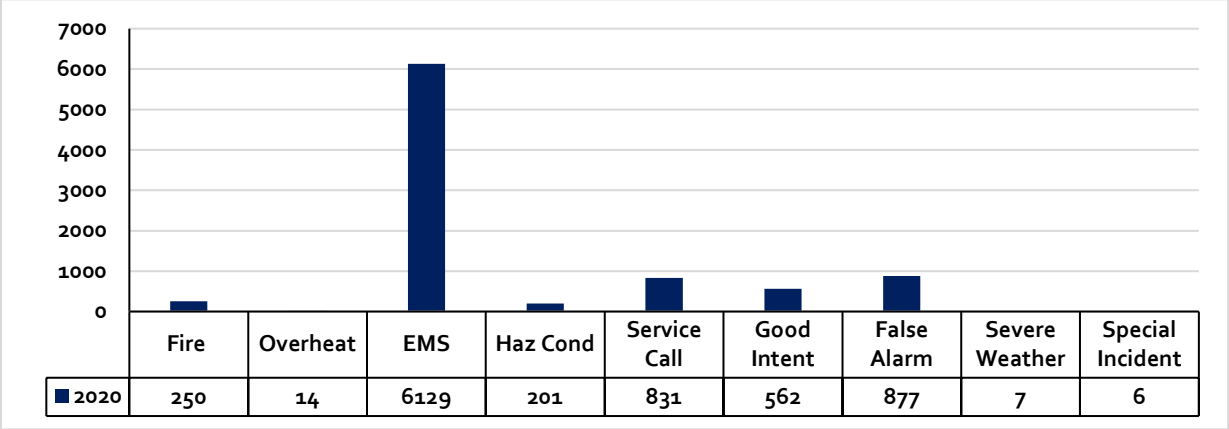
In 2018, service demand increased 9.2% and remained near that level for the next three years. The projected annual demand for 2021 is based on actual totals through early December 2021 and represents a 6.9% increase from the prior year and a 5.5% increase over the previous high in 2018. When projecting how demand for services will change in the future, factors such as changes in population, median age, access to health care, and social demographics can all play a role in how demand will change over time.

Next, service demand by incident type was evaluated. Categories used in this analysis are based upon the National Fire Incident Reporting System (NFIRS) guidelines for grouping of incident types. Within the NFIRS classifications, the following incident types are grouped within the corresponding series:

- 100 Fires
- 200 Overheat/Overpressure
- 300 EMS
- 400 Hazardous Conditions
- 500 Service Call
- 600 Good Intent
- 700 False Alarms
- 800 Severe Weather
- 900 Special Incident

The following figure displays service demand for 2020 by general NFIRS classifications.

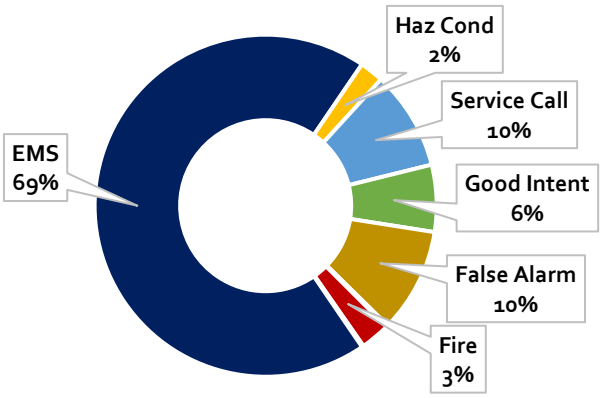
Figure 6: Service Demand by NFIRS Classification (2020)



	Fire	Overheat	EMS	Haz Cond	Service Call	Good Intent	False Alarm	Severe Weather	Special Incident
2020	250	14	6129	201	831	562	877	7	6

Finally, the distribution of call types is presented as a pie chart to provide an understanding of service demand relative to incident categories.

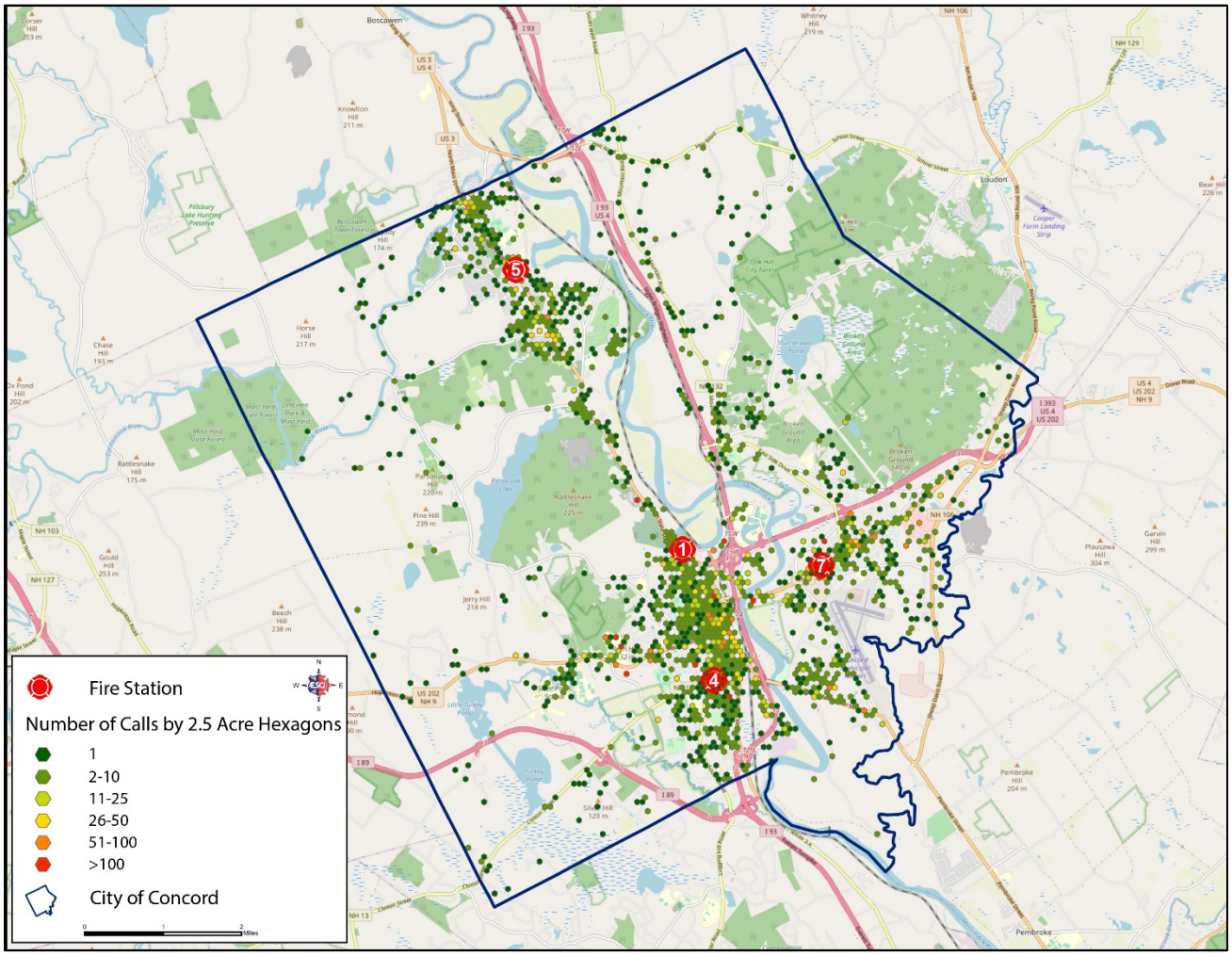
Figure 7: Service Demand by Incident Frequency (2020)



The majority of Concord's fire rescue incidents are EMS in nature (69.0%) followed by False Alarms (9.9%), Service Calls (9.4%), Good Intent (6.3%), Fires (2.8%), and Hazardous Conditions (2.3%). Calls for Overheated Materials, Severe Weather, and Special Incidents were all below 0.2%.

In Figure 8, GIS software was used to create a 2.5-acre hexagon grid across the City of Concord. Geocoded incident locations were added, and the number of incidents that occurred within each hexagon was calculated and presented. Dark green hexagons represent 1 incident occurred within the hexagon while red hexagons represent incident counts that were greater than 100 calls within that hexagon.

Figure 8: Incident Count by 1-Acre Hexagons, 1/1/2020-6/21/2021

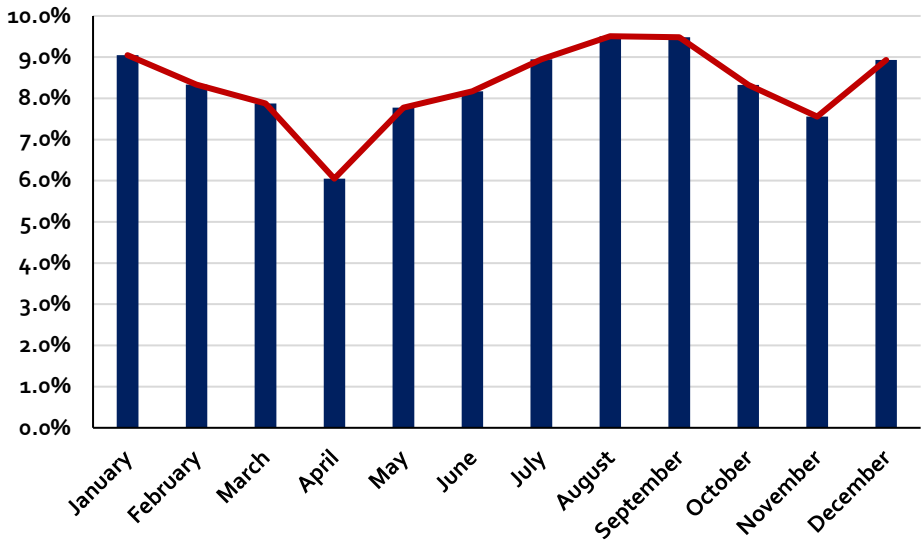


Areas of high incident density typically influence where fire stations are located. Demand for services in Concord is primarily located along US 3 and NH-9 with low demand for services occurring outside of those corridors. In downtown Concord, where NH-9 crosses the Merrimack River towards the State House possesses some of the greatest levels of demand for the City, as well as Concord Hospital to the west. The Steeplegate Mall area east of Station 7 also has higher levels of demand along with the Penacock Village in Station 5's service area.

Incidents by Type and Frequency

The ways in which demand for service occur often follow predictable patterns over time. To identify those patterns occurring in the City of Concord, ESCI conducted an analysis and geographic display of current service demand by incident type and temporal variation using data obtained from the Concord Fire Department. Incident types were selected based on the classification system established by NFIRS and by the data's temporal variation examined by month, day, and by hour. Temporal variation is the way service demand changes over time.

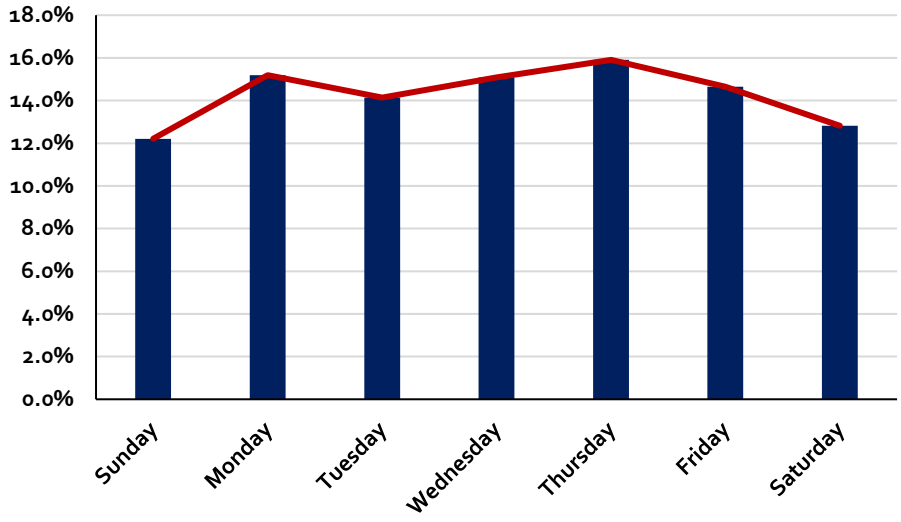
Figure 9: Service Demand by Month (2020)



In the previous figure showing service demand by month, the impact of the COVID-19 pandemic can be observed as call volume dropped sharply in mid-March and continued throughout April. As life began to return to normal, an increase in demand is seen throughout the summer months, which would typically be expected to possess a greater demand for services as people tend to be more active. Finally, a second wave of the pandemic impacted service demand once again in the fall of that year, rebounding in December. Due to the unprecedented nature of the COVID-19 pandemic in 2020, Concord Fire Department should evaluate past trends and observe current data to develop a better understanding of their temporal variation throughout the year.

The next figure continues the temporal analysis with an examination of service demand by the day of the week.

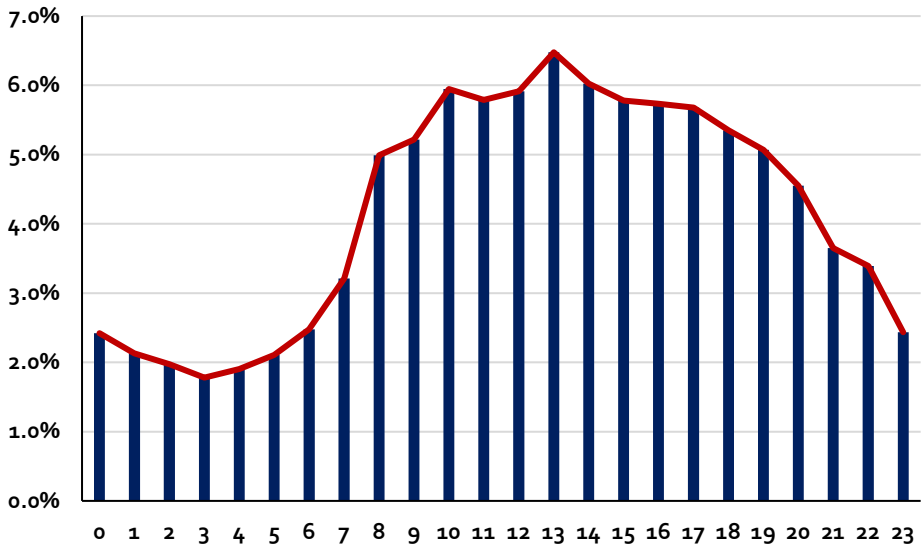
Figure 10: Service Demand by Day of the Week (2020)



Demand for services across the week tended to gradually increase beginning on Mondays and peaked on Thursdays with demand decreasing during the weekends. This pattern suggests that at least some portion of Concord's service demand is related to commerce and workweek activity as people travel to and from work during the week.

The final temporal analysis of service demand examines service demand by the hour of the day.

Figure 11: Service Demand by Hour of Day (2020)



The analysis of service demand by the hour of the day typically mirrors the activities that occur within the community or jurisdiction where more activities (e.g., working, shopping) occur during the daytime hours and decrease in the nighttime and overnight hours. The incident activity for Concord is at its highest between the hours of 8:00 a.m. and 8:00 p.m. with 68.0% of calls for service occurring during these hours. The highest hour for calls for service is 1:00 p.m., with 6.5% of activity occurring at this hour. The slowest hour for calls for service is 3:00 a.m. with 1.8% of activity occurring at this hour.

It is important to note that while demand is lower in the late-night and early morning hours, residential fatal fires occur most frequently late at night or in the early morning. Across the United States, from 2017 to 2019, the time period of 11 pm to 7am accounted for 49% of all civilian fatalities in residential buildings. [2]

The demand for incidents within the City tracks closely with the demand within each individual fire station response district. There is no more than a 0.7% deviation between the districtwide and City demand.

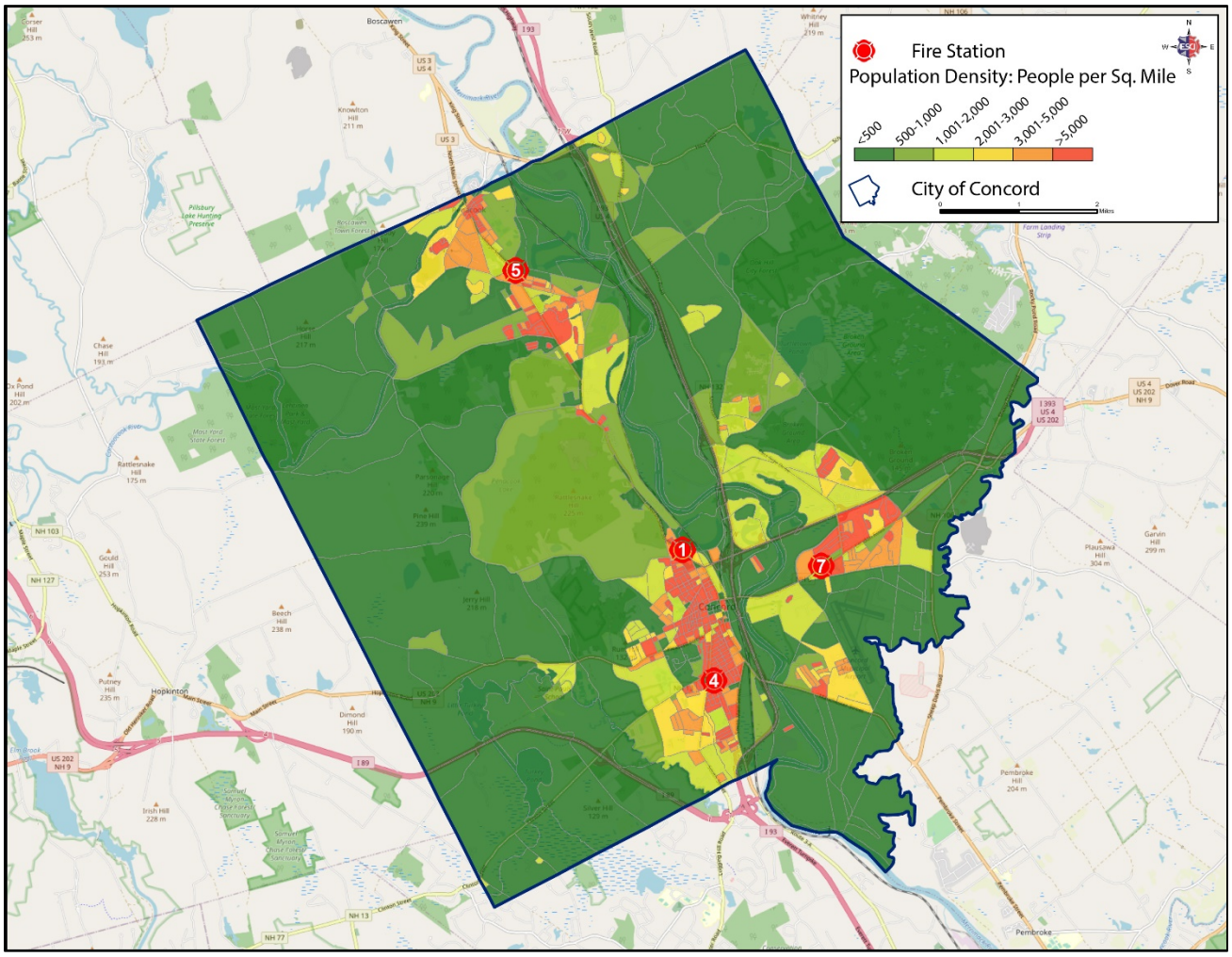
Fatal Fires in Residential Buildings (200917–201119), Topical Fire report Series Volume 14, Issue 3 / May 2013, U.S. Department of Homeland Security, U.S. Fire Administration, National Fire Data Center.

Resource Distribution Analysis

A major contributing factor to the levels of service demand experienced by Concord is the population density of the areas served within its jurisdiction. The City of Concord is an urban municipality along its core areas and rural throughout the rest of the Jurisdiction.

Figure 12 displays population density by U.S. Census blocks, the smallest unit of division available from the census bureau. The population density totals were obtained through the 2019 ACS. Detailed census block information is updated every ten years following the completion of the U.S. Census survey.

Figure 12: Population Density, 2020 Census Blocks

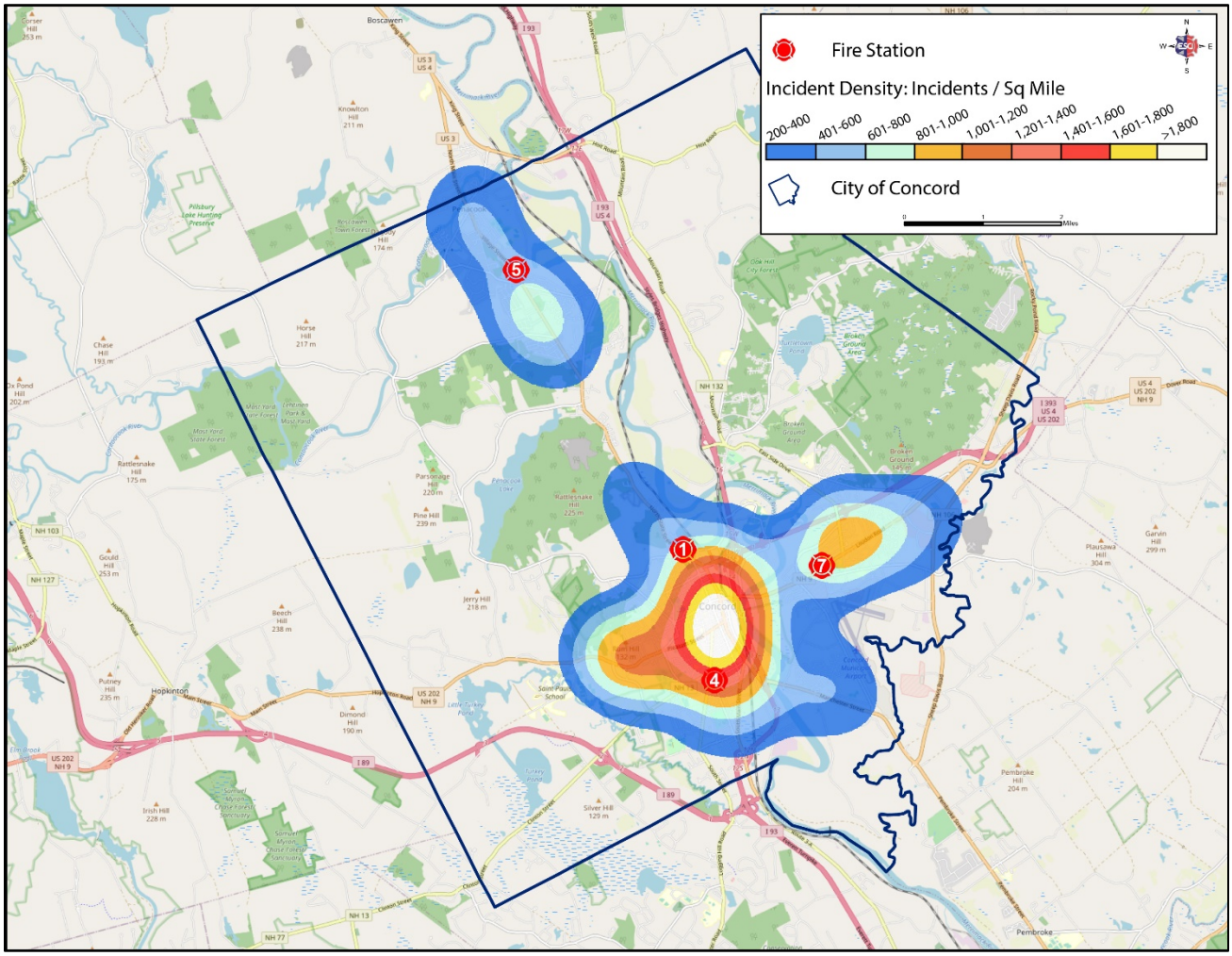


Concord's fire stations are located within or adjacent to areas of higher population density. Since the number of people concentrated within an area generally drives the levels of service demand, the population densities of Census blocks provide an analysis of how demand for services are concentrated within the City.

The next figure provides an analysis of incident density using 2020 fire rescue response data. This analysis, commonly referred to as a Hot Spot Mapping, calculates areas of greatest demand based on the density of incidents within an area. This analysis does not indicate how many calls actually occurred within each ring,

but instead provides a way to compare each area to one another. In this analysis, each ring is calculated to display incidents per square mile and provides a range of how densely located calls for service were to each other.

Figure 13: Incident Density Analysis (2020)



The highest levels of incident density in Concord occur downtown between stations 1 and 4, east of Station 7, and south of Station 5. This analysis provides insights as to why the fire stations were located in their present positions, as well as providing an indication of areas where the fire department is frequently responding to. The blue shades of colored banding across other areas of the City does not indicate that no demand for fire rescue services occurred, but instead suggests that the locations of service demand were less densely clustered than the core of the City.

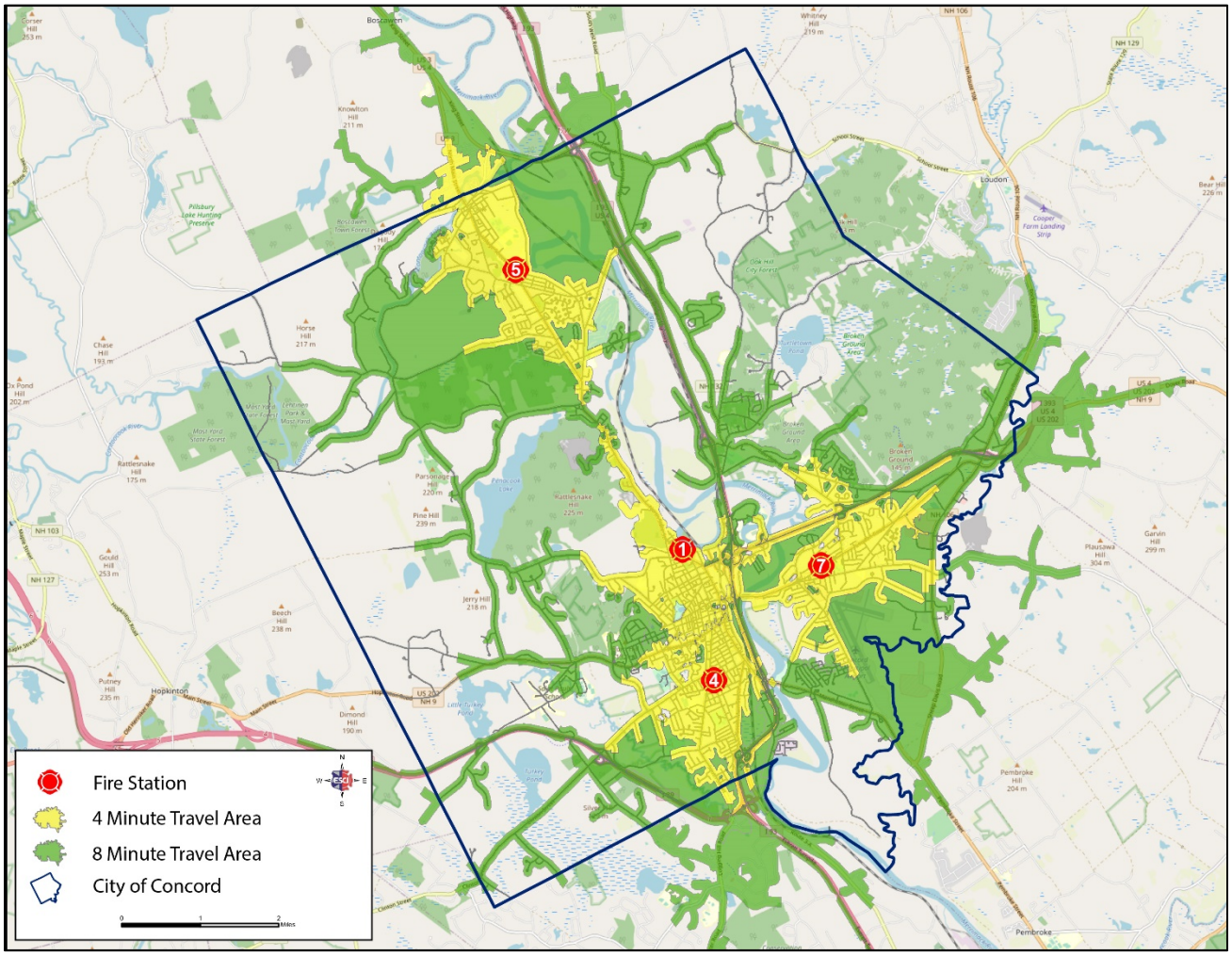
Distribution Study

To determine how the current deployment model of the fire department affects coverage throughout the City, the current performance of the department must first be evaluated. ESCI used fire service industry standards including National Fire Protection Association (NFPA) standards and Insurance Services Office (ISO) criteria, Concord's deployment model and performance were evaluated.

NFPA 1710 Criteria

NFPA is an industry trade association that develops and provides standards and codes for fire department and emergency medical services for use by local governments. One of these standards, 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*, serves as a national consensus standard for career fire department performance, operations, and safety. Within this standard, a travel time of 240 seconds, or 4 minutes, is identified as the benchmark for career departments to reach emergency calls within their jurisdiction with the first arriving unit. Additionally, the balance of the response (called the effective response force) is required to arrive to the incident within 480 seconds, or 8-minutes. Figure 14 provides a synopsis of Concord Fire Department's ability to meet these standards based upon predicted travel times using historical traffic data from Esri for traffic patterns at 8 a.m. on Monday mornings. Unshaded pockets indicate that the area falls outside of the model's maximum extension from the road network.

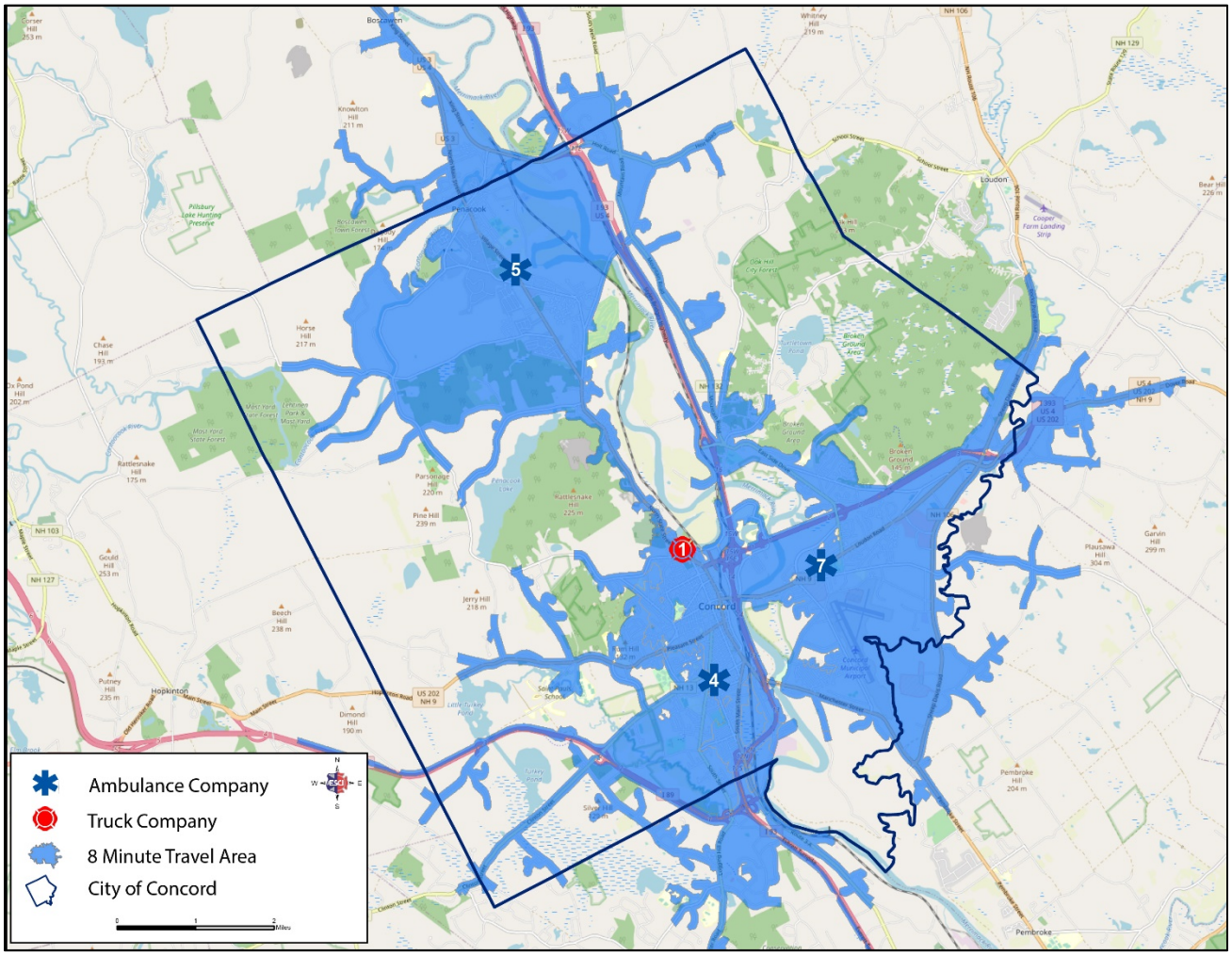
Figure 14: NFPA 1710 4 and 8-Minute Travel



The fire department should have the capability to meet the NFPA 1710 first responding unit requirement of a 4-minute travel to the central core of the City. Nearly all of Concord is within an 8-minute travel time of a fire station and areas outside of the 4-minute travel fall within a 4 to 8-minute travel.

NFPA 1710 also provides criteria for travel times of Advanced Life Support (ALS) transport arrival to EMS incidents requiring this level of care and service. When an ALS provider of transport is needed, NFPA 1710 requires that an ambulance arrive on scene within an 8-minute travel time. In Figure 15, locations of ambulances and their associated 8-minute travel times are displayed.

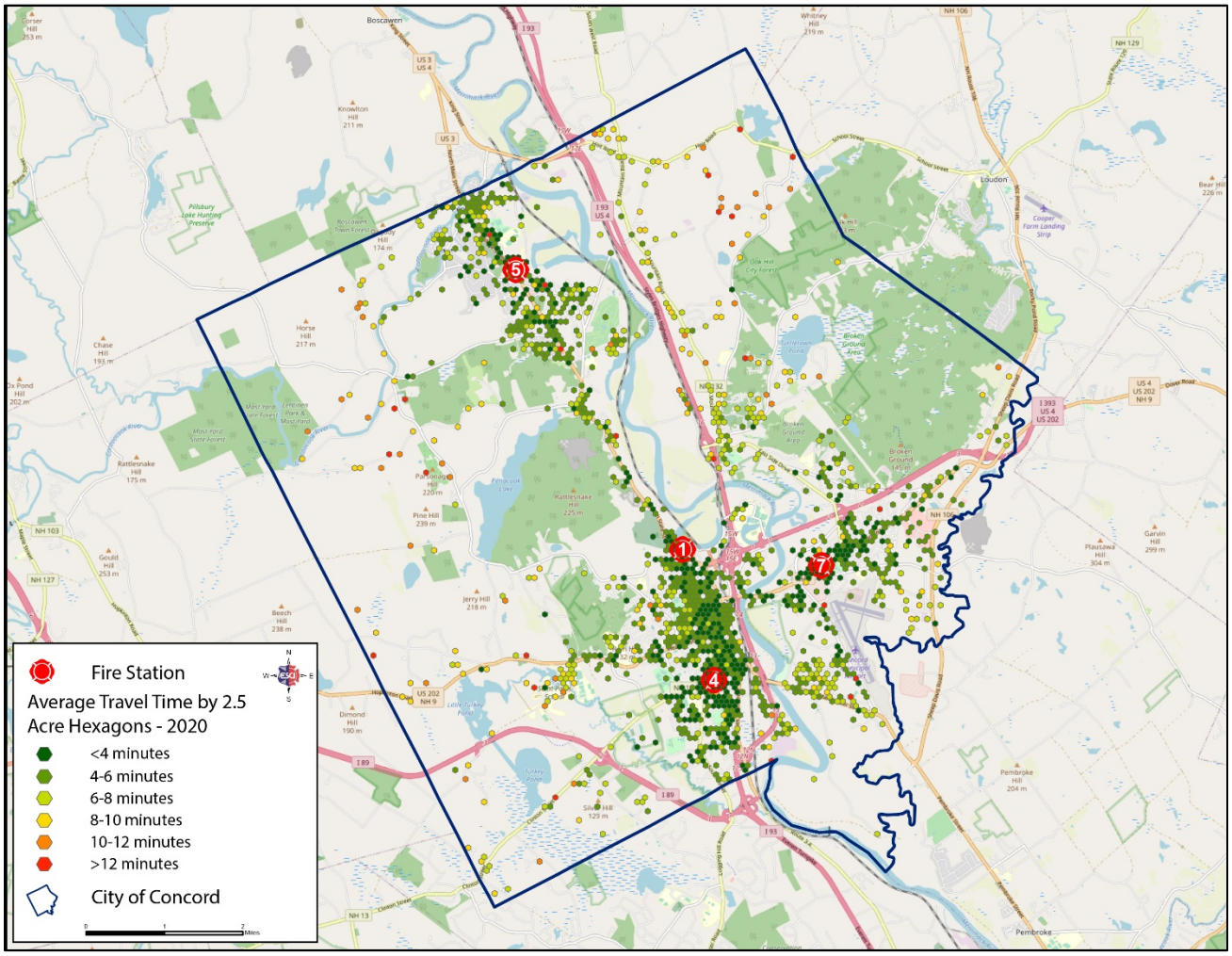
Figure 15: NFPA 1710 Ambulance 8-Minute Travel



For most residents, an ambulance is stationed within an 8-minute travel time from their homes or businesses. When compared with the 4 and 8-minute travel times shown in Figure 14, performance is similar; however, Station 1 does not house an ambulance within that station despite the downtown being an area of greatest demand and population. Overall, the fire department should have the capability to approach or meet NFPA 1710 standards based upon the location of fire stations and apparatus.

In Figure 16, GIS software was used to divide the City into 2.5 acre hexagons and incident data summarized within each hexagon. The result is the average travel time within each subdivision to provide a visual of actual performance in 2020.

Figure 16: Average Travel Time Performance by 2.5 Acre Hexagons (2020)



Concord Fire Department displays strong performance in the populated areas of the City but has extended travel times to outlying areas. Since these outlying areas produce little demand for services relative to those that are densely populated, the majority of Concord Fire Department's service demand can be provided through these locations. Underserved areas of the City appear to occur between Airport Road and US 3 and near the western portion of the Pleasant Street medical corridor. With extended travel times and moderate demand, these sites may benefit from additional fire rescue coverage.

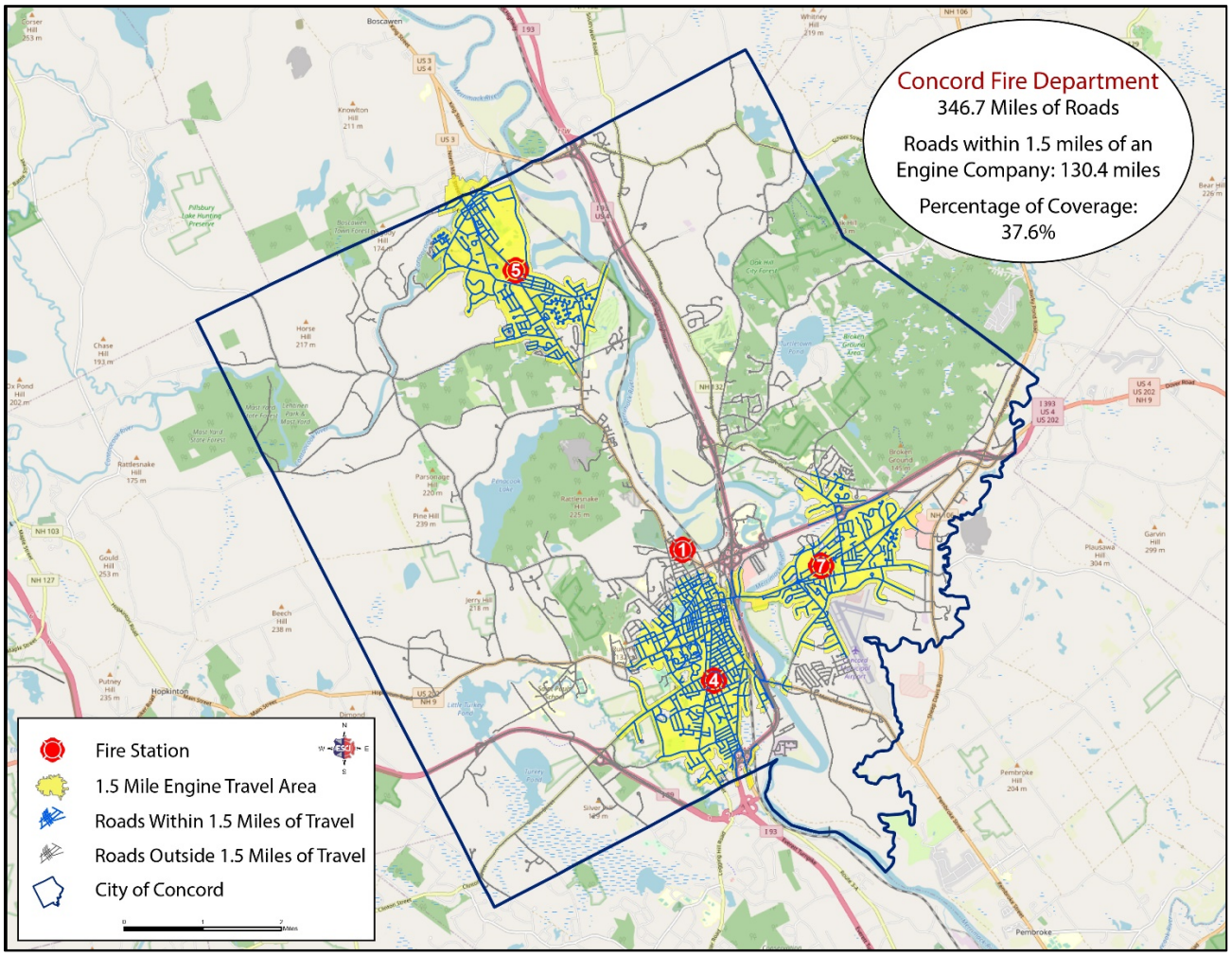
ISO Distribution

ISO is a New Jersey-based advisory organization that provides insurance carriers with a classification rating of a local community's fire protection. The Property Protection Class (PPC®) score or rating classifies communities based upon an overall scale of 1 (best protection) to 10 (no protection) and assesses all areas related to fire protection. These areas are broken into 4 major categories which include: emergency dispatch and communications (10 percent of the rating), water supply system and distribution capabilities (40 percent), the fire department (50 percent), and Community Risk Reduction efforts (an additional 5.5 percent credit is available above 100 percent).

Engine Company Performance

A key area of credit towards a jurisdiction's PPC® score is the degree to which structures protected by the fire department fall within a 1.5 road mile service area of a fire station. This 1.5 road-mile standard is used to estimate a 4-minute travel time for first responding units as required by NFPA 1710. In Figure 17, an analysis was completed for current fire stations housing apparatus capable of pumping at a fire with areas in yellow indicating those structures within a 1.5-mile drive. Based on the ISO engine company travel criteria, approximately 38% of Concord is included within the 1.5-mile travel distance.

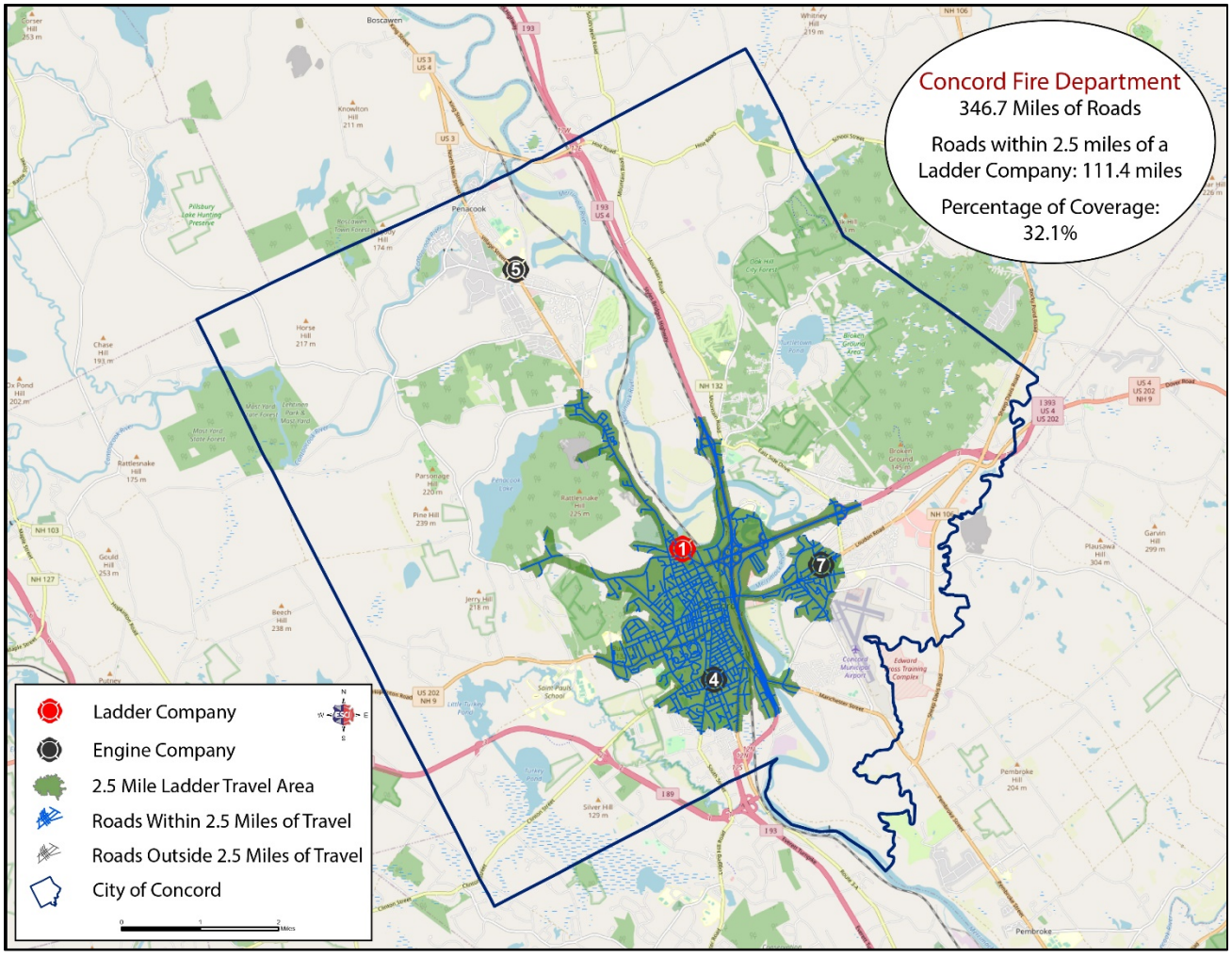
Figure 17: ISO 1.5-Mile Engine Company Service Area



Ladder Company Performance

In many jurisdictions across the country, ladder companies are deployed only to certain types of incidents and are not necessarily considered as the first due unit for all other incident types. Because of this, ISO uses a 2.5 road-mile travel distance for ladder companies to estimate an 8-minute travel time in urban and suburban areas by ladder companies to provide the balance of personnel and equipment needed for incidents such as working fires. Figure 18 displays Concord's ladder company performance within the City.

Figure 18: Road Miles Credited by ISO 2.5 Mile Ladder Company Service Area

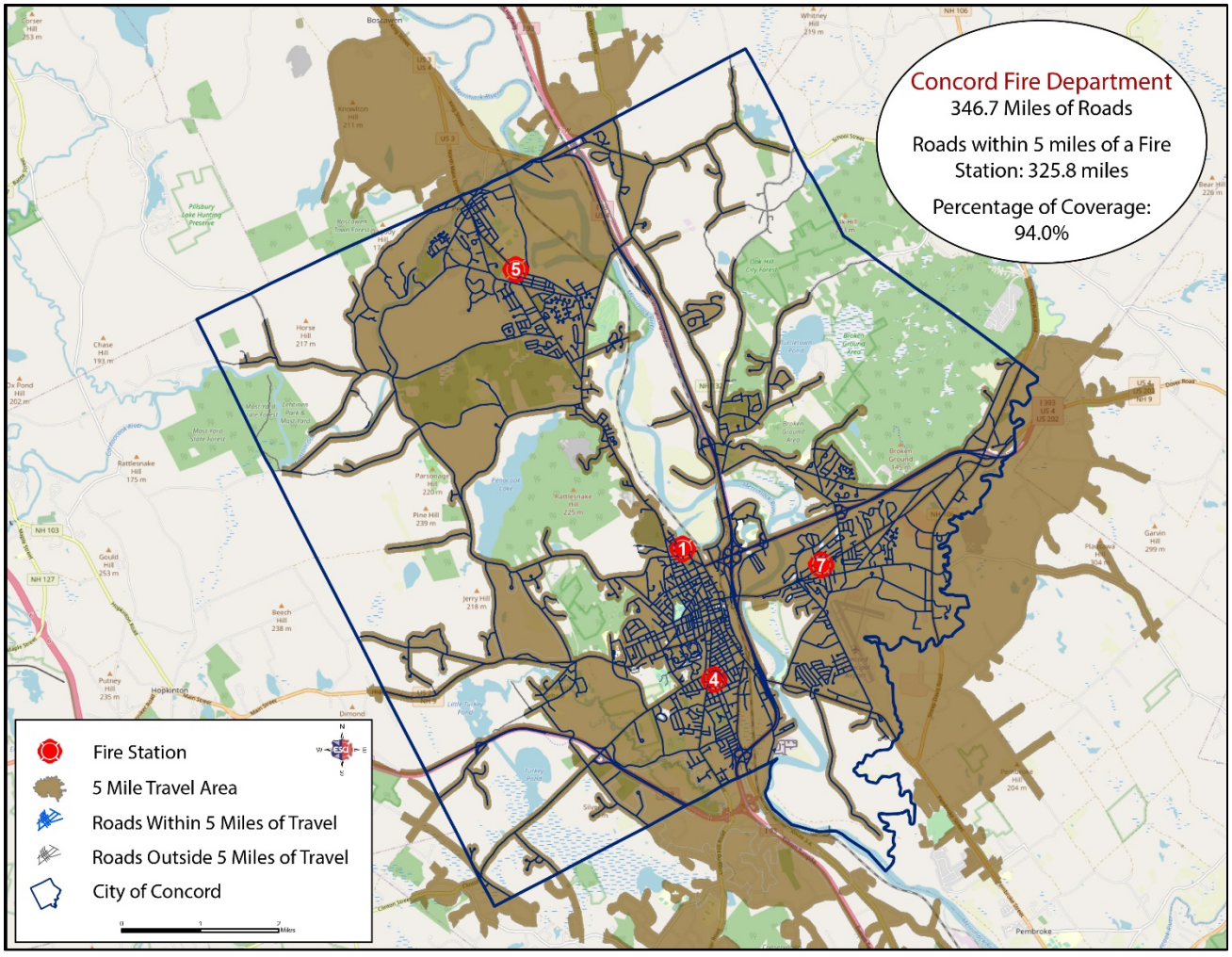


When Concord's ladder company is evaluated, the performance is similar to that of the engine company with 32% coverage across the City. As illustrated in this figure, a substantial portion of potential ladder company coverage extends throughout the core of the City. To determine if any improvements would occur by relocating the ladder company to stations 4, 5, or 7, the same analysis was conducted. However, these locations did not yield an improvement in performance.

ISO Fire Station Coverage

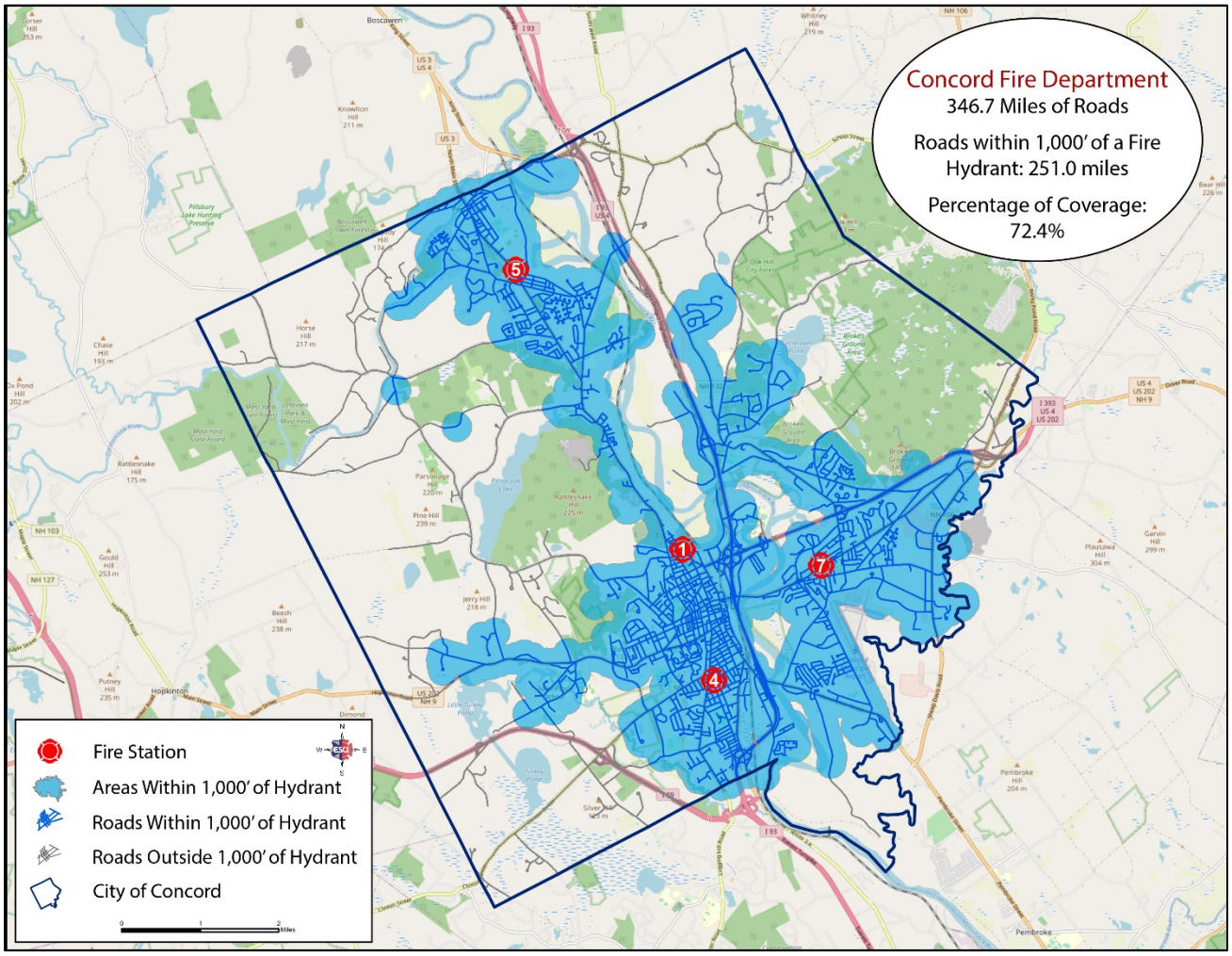
In order to receive a PPC® rating that indicates fire coverage is available from ISO, structures must generally be located within 5-miles of a fire station. Areas outside of 5-miles are subject to receiving a PPC® rating of 10, meaning that no fire department coverage is available. Within the City of Concord, nearly all areas lie within 5-miles of a fire station and are eligible to receive a rating based upon the performance of the fire department.

Figure 19: Road Miles Credited by ISO 5 Mile Fire Station Service Area



The ability of a fire department to arrive on scene of a fire within a given time or distance represents only part of the ISO classification. Other elements include the ability to assemble personnel, resources, and water sufficient to put the fire out. The next figure illustrates the areas that are 1,000 feet from a fire hydrant. Those structures outside of the 1,000-foot radius are subject to receive an ISO Class 10 rating, signifying that no fire protection capabilities exist, unless the fire department can demonstrate a suitable tanker shuttle operation and transport a sufficient volume of water to a fire for suppression activities to the incident scene within a specified period of time.

Figure 20: ISO Fire Hydrant Coverage



As illustrated, approximately a quarter of the City lies outside of the 1,000-foot radius from a fire hydrant. Due to the gap in hydrant coverage, it is anticipated that ISO would provide a split rating for the entire City, as opposed to a single rating. If the fire department can demonstrate tanker shuttle operations sufficient to fulfill NFPA 1710 and ISO flow requirements, the City could potentially achieve a single ISO class rating.

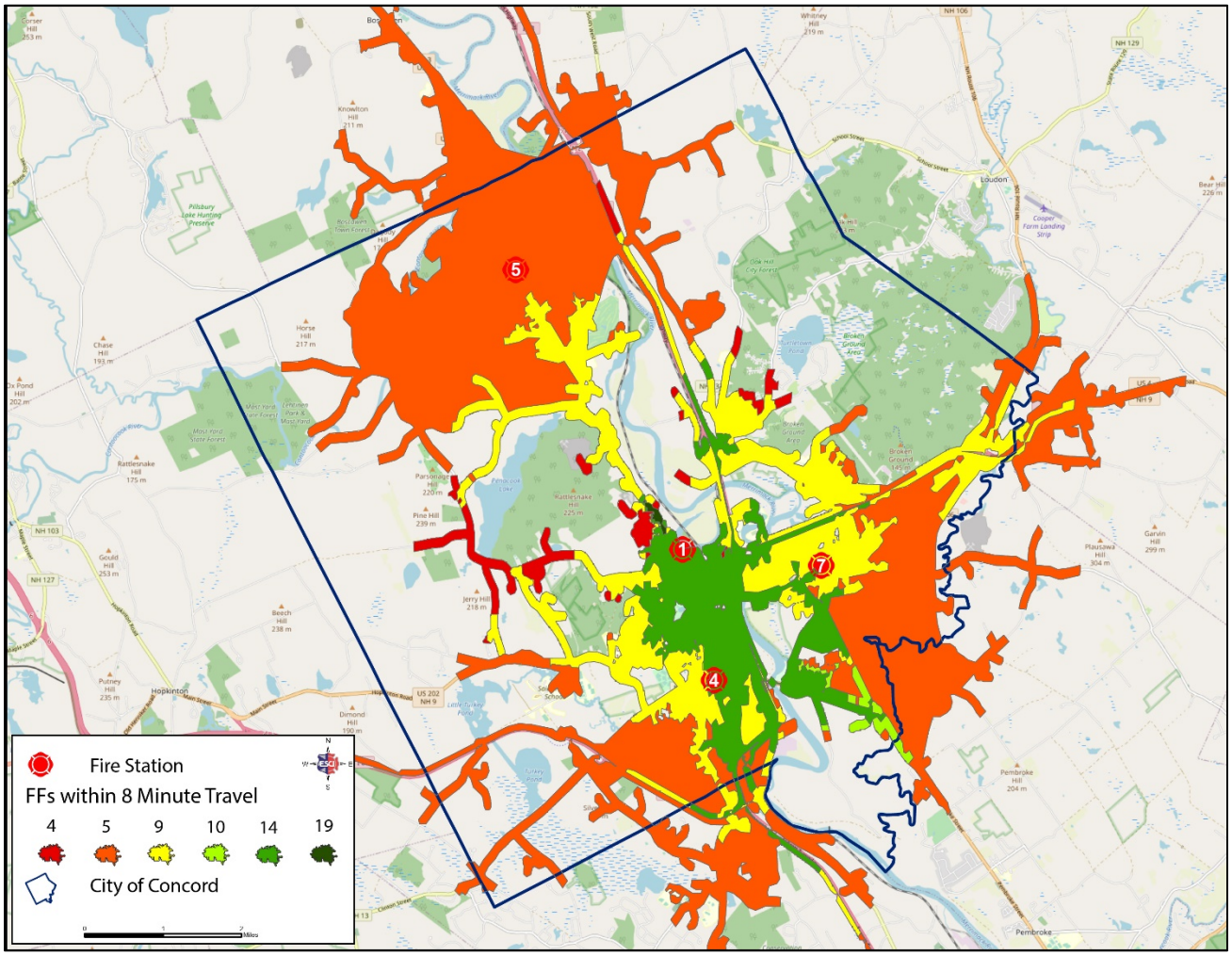
In closing, it bears mentioning again that the addition of fire stations or changes to type of apparatus deployed can have negative impacts to the overall ISO rating if personnel are insufficient to staff those locations based on ISO minimum criteria. A key factor identified during the City's 2013 PPC rating is the importance of documentation and maintaining accuracy in the data the City collects and maintains. Finally, prior to implementing new deployment strategies, the ISO regional representative should be consulted to assess the potential impacts of changes to the deployment strategy.

Resource Concentration Study

Accepted firefighting procedures call for the arrival of the entire initial assignment—sufficient apparatus and personnel to effectively deal with an emergency based on its level of risk—within a reasonable amount of time. This is to ensure that enough people and equipment arrive soon enough to safely control a fire or mitigate any emergency before there is substantial additional damage or injury.

Concentration of resources is defined as "spacing of multiple resources arranged so that an initial 'effective response force' can arrive on scene within the time frames outlined in the on-scene performance expectations." An effective response force (ERF) is defined as "the minimum amount of staffing and equipment that must reach a specific emergency zone location within a maximum prescribed total response time and is capable of initial fire suppression, EMS, and/or mitigation. The ERF is the result of the critical tasking analysis conducted as part of a community risk assessment."

Figure 21: Effective Response Force – 8-Minute Travel at Minimum Staffing



For working moderate-risk fires, such as a 2,000' residential building, NFPA 1710 calls for a minimum of 17 firefighters arrive on scene within an 8-minute travel time. As illustrated in the previous figure, within the core of Concord, Concord Fire Department can come close to meeting this requirement with 14 firefighters within an 8-minute travel time. However, for other highly populated areas of the City, only 5 firefighters would be capable of arriving on scene within that 8-minute travel time, significantly reducing the effectiveness and safety of operations. Although NFPA 1710 is a consensus standard and the City of Concord has no requirements to fully comply, the City should weigh the costs, risks, and benefits of meeting the national standard for the assembly of an effective response force.

Resource Reliability Review

In this section, resource reliability is evaluated using several metrics to establish a global perspective on Concord's ability to provide sufficient responding resources to meet service demand within the City. When all units are available and in quarters, supplying sufficient resources is typically not a problem; however, when multiple calls occur simultaneously, units are committed to incidents for extended periods of time, or when insufficient resources exist to mitigate an emergency, further preparation and planning safely and effectively must be completed.

Call Concurrency

First, call concurrency was evaluated. Call concurrency is a comparison of how often multiple calls are occurring and placing additional demand on resources. In Figure 22, a concurrent call is identified when a second unit is dispatched to a separate incident prior to the first unit clearing the scene and becoming available. When two incidents are occurring simultaneously and a third separate incident is dispatched, three concurrent calls are present and so on.

Figure 22: Call Concurrency (2020)

Call Concurrency	
Single Incident	46.8%
2	33.2%
3	14.0%
4	4.5%
5 or more	1.5%

Nearly half of the time that a unit is committed to an incident, no other calls are occurring leaving multiple resources available for response; however, 53.2% of the time multiple units are committed to two or more incidents which will dramatically affect the fire department's ability to assemble an effective response force if a major incident occurs during that time.

Unit Hour Utilization

Another component that must be considered when evaluating Resource Reliability is Unit Hour Utilization (UHU). UHU provides an expression of the workload placed on the crew assigned to that unit and can also describe the amount of time that a unit is not available for response because it is already committed to another incident. The larger the percentage, the greater its utilization, and the less available it is for assignment to subsequent calls for service, training, and ancillary duties. UHU rates are expressed as a percentage of the total hours in a year.

In Figure 23, the UHUs of Concord Fire Department units are displayed with their relative workloads calendar year 2020. While other units responded to incidents within the City during this time, only units identified by Concord Fire Department for inclusion are displayed.

Figure 23: Unit Hour Utilization (2020)

Unit	Number of Calls	Sum	UHU
AM4	3301	1692:51:53	19.3%
AM5	1698	1097:01:37	12.5%
AM7	2785	1529:44:29	17.5%
CR4	1135	445:31:37	5.1%
EN4	2913	888:06:49	10.1%
EN5	1481	581:50:34	6.6%
EN7	2548	844:26:20	9.6%
TW1	2391	781:45:56	8.9%

UHU analysis is also important in understanding why units may or may not meet NFPA 1710 goals. For example, nearly 70% of fire rescue incidents in Concord are medical in nature. The primary units for response are ambulances to treat and transport sick or injured patients. For example, if Ambulance 4 is unavailable approximately 20% of the time and available only 80% of the time, then 10% of the performance within that district will be attributed to other units responding in from other distant locations to reach the 90th percentile performance metric. Additionally, should Concord Fire Department's demand for services experience a spike in demand, as seen in 2018, this additionally demand will dramatically impact the ambulance crews. Since 70% of that new volume will most likely be attributed to EMS, it can be anticipated that call volume will directly impact the ambulances and increase their annual UHU levels. Given that the City anticipates continued growth, the City should consider adding an ambulance immediately to the Central Station 1 as UHU levels will almost certainly continue to rise and because the downtown is not currently serviced by an ambulance company from this location, despite being one of the areas of greatest demand within the City.

Engine 4, Engine 7, and Tower 1 are the busiest suppression units respectively and possess a UHU in the range anticipated for a fire rescue department that provides transport services. Ambulances 4 and 7 possess UHU ranges suggesting that an additional transport unit could be needed at some point in the future; however, although Ambulance 5 has some remaining capacity for additional call volume, the lack of an ambulance in the downtown area is problematic for the entire system and should be addressed. While the pandemic of 2020 almost certainly influenced these findings, this analysis provides a foundation for monitoring crew activity levels within the department.

Performance Summary

The most visible element of the Concord Fire Department is its response performance. How quickly units arrive on scene and the efficiency with which they resolve an emergency situation are typically the only interaction most residents will have with the fire department. To evaluate the fire department's performance, NFPA 1710 was used as this is the applicable standards for career fire departments.

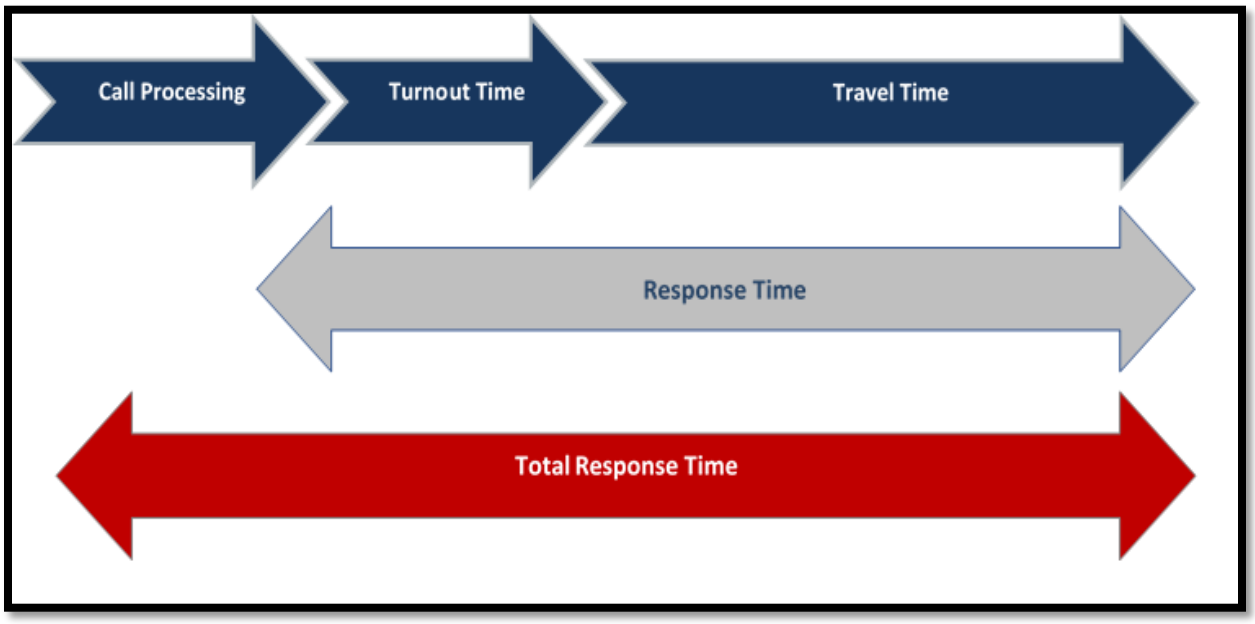
Response time performance is comprised of the following components:

- Call-Processing Time: The amount of time between when a call is answered by the 911 Primary Public Safety Answering Point, or dispatch center, and when resources are dispatched.
- Turnout Time: The time interval between when units are notified of the incident and when the apparatus responds.
- Travel Time: The amount of time the responding unit actually spends on the road traveling to the incident until arrival at the scene. This is a function of speed and distance.
- Response Time: This time is calculated from the time the fire department is dispatched to the arrival of the first apparatus. Response Time equals the sum of "Turnout Time" and "Travel Time."
- Total Response Time: This is the most apparent time to the caller requesting emergency services. Total response time is the amount of time that occurs from the time they place the emergency call until the first unit arrives. This time often includes factors both within and outside the control of the fire department, particularly when another agency provides dispatch services.

Tracking the individual components of response time will enable Concord to identify deficiencies and areas for improvement. Once department leadership understand the current performance for Call Processing, Turnout Time, and Travel Time, this information can be used to develop response goals and standards that are both relevant and achievable. Fire service best practices recommend that fire service organizations monitor and report the components of Total Response Time.

The Time Continuum is comprised of the three elements described above—Call-Processing, Turnout Time, and Travel Time. Total Response Time is the sum of all of the times starting with the call-processing time, turnout time, and travel time. The components of the Concord Fire Department Response Time Continuum will each be evaluated in further detail in the next sections. The following figure is an illustration of the total response time continuum.

Figure 24: Total Response Time Continuum



Historically, fire rescue service providers have used the performance measurement of average response to describe the levels of performance. The average is a commonly used descriptive statistic, also called the mean of a data set. Averages may not accurately reflect the performance for the entire data set because the average can be significantly skewed by data outliers, especially in small data sets. One extremely good or bad value can skew the "average" for the entire data set. Percentile measurements are a better measure of performance since they show that most of the data set has achieved a particular level of performance. The 90th percentile means that 90% of responses were equal to or better than the performance identified, and that the other 10% can be attributed to data outliers, inaccurate data, or situations outside of normal operations that delayed performance. This can be compared to the desired performance objective to determine the degree of success in achieving the goal.

An important consideration when evaluating fractile performance is that the results of each category are not additive, meaning that the sum of two or more constituent metrics cannot be simply added together to find the sum. This is because each dataset is discrete and as such must be observed individually, particularly when data quality is an issue. If a metric, such as response time possesses the majority of its data points, while turnout time is not accurately documented, a significant difference can exist between the response time calculated using the fractile descriptive and the sum of turn out time and travel.

To provide an analysis of performance for emergency calls within Concord, the following assumptions were made:

- Non-emergency incident types were removed
- Mutual and auto aid given were removed
- Other aid given were removed
- NFIRS call types within the 500, 600, 800, and 900 series were removed
- Cells containing zeros or no value were removed

Call Processing Performance

The industry standard for call processing (or alarm handling) is NFPA 1221: *Standard for the Installation, Maintenance, and Use of Emergency Services Communications Systems*. This standard provides for communication centers to have processing times of not more than 64 seconds, 90% of the time. For special operations, calls requiring translation, or other factors described in the standard, times should not exceed 90 seconds at the 90th percentile.

Concord Fire Alarm provides emergency dispatching for 23 neighboring communities, two third party EMS organizations, and a regional hazmat team. The Concord Fire Department Communications Center does not have direct supervision over the initial processing and transferring of emergency calls, so these performance measures are not within its control. This component of the process is performed at the state level by the New Hampshire Bureau of Emergency Communications (NHBECC). ESCI recommends that the Concord Fire Department actively work with the state of New Hampshire to ensure compliance with NFPA 1221.

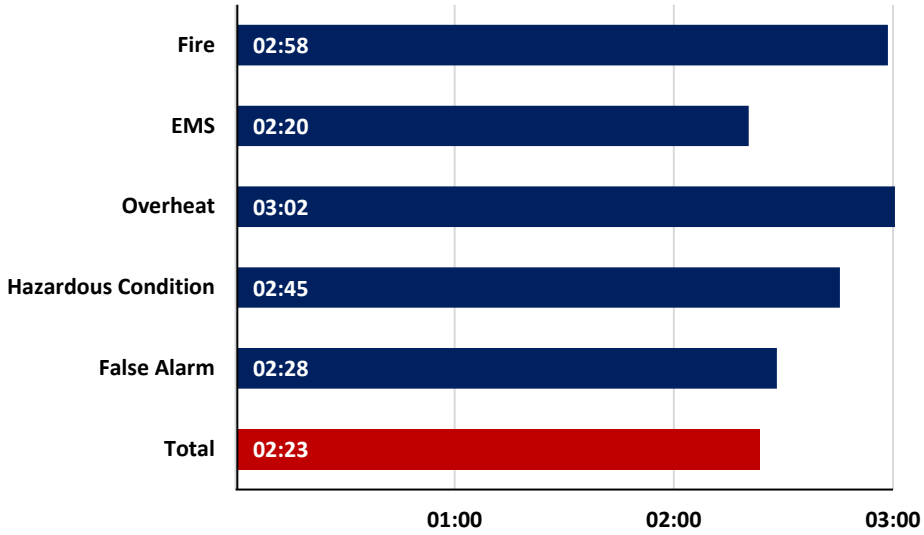
At the time of this evaluation, call processing data was not available.

Turnout Performance

The second component of the response continuum, and one that is directly affected by response personnel, is turnout performance. Turnout is the time it takes personnel to receive the dispatch information, move to the appropriate apparatus, and begin responding to the incident.

NFPA 1710 calls for a 90th percentile turnout performance of 80 seconds for fire and special operations calls and 60 seconds for EMS incidents. The following figure illustrates the turnout performance for the Concord Fire Department.

Figure 25: Turnout Performance 2020



For the year 2020, Concord exceeded the benchmark in all categories. However, this performance is reflective of the impacts of the COVID-19 pandemic and most likely does not represent normal operations. During and after the pandemic, the State of New Hampshire required additional Personal Protective

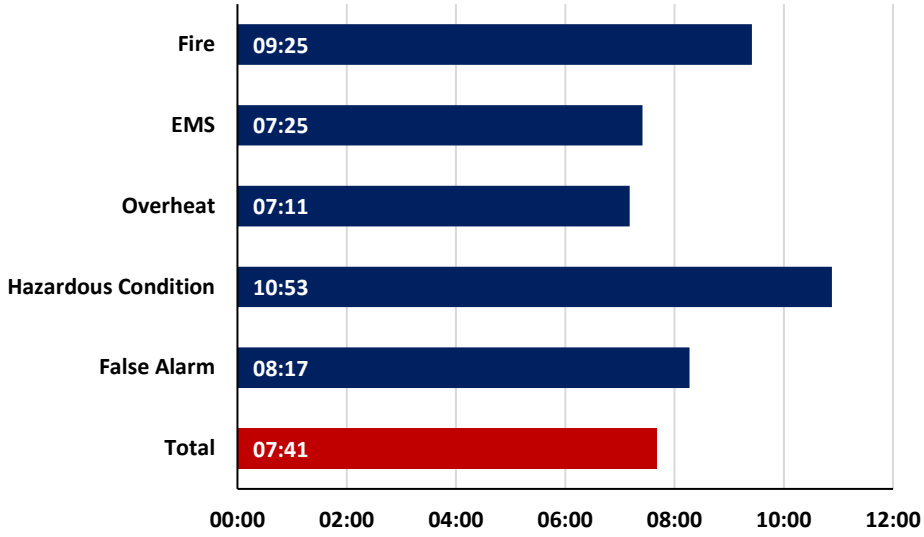
Equipment (PPE) for firefighters prior to responding to an incident. Since then, state protocol has changed, and PPE requirements returned to normal conditions.

Concord should evaluate any factors which may be impacting the ability of personnel to deliver the expected performance standard. This may include station design that may delay movement to the apparatus bays, location of safety equipment to be donned prior to response, or other factors. Further investigation may reveal that the documented turnout times may not be an accurate representation of the fire department's actual performance. ESCI recommends that the tracking of times be evaluated and modified as necessary to ensure that the data accurately capture these metrics.

Travel Performance

The third component of the response continuum is travel time. It is important to understand that travel time is not specifically a factor of speed as much as it is the result of proper placement of fire stations from which emergency response begin. Travel time is the amount of time between when the apparatus departs for the call and when it arrives on scene and measured at the 90th percentile. NFPA 1710 requires that the first due fire or EMS unit arrive on scene within a 4-minute, or 240 second, travel time. The following figure provides the travel time performance for Concord Fire Department.

Figure 26: Travel Performance 2020

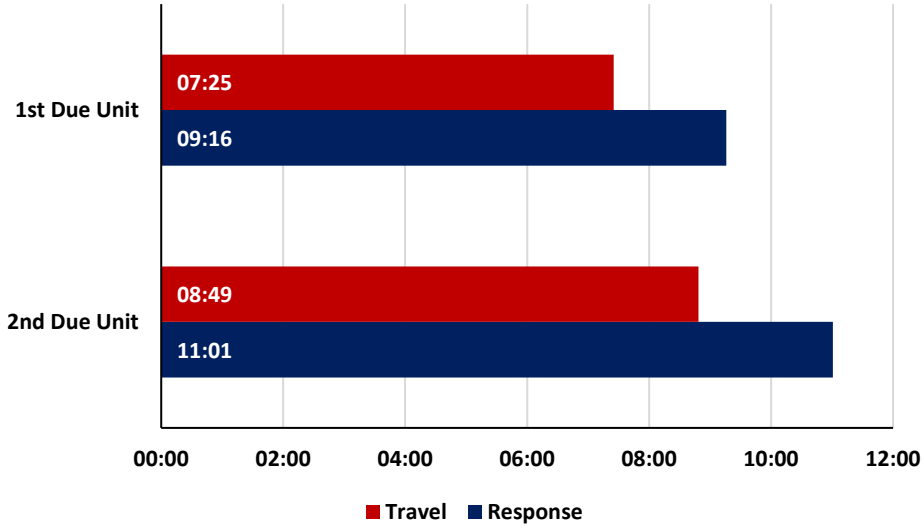


Overall, travel time performance across Concord was approximately double the NFPA standard. Response to overheated or over pressured items performed the best at 7 minutes 11 seconds, while responses to hazardous conditions possessed a 10 minute 53 second travel time at the 90th percentile. While this could potentially be due to a small number of incidents within the dataset, firefighters identifying these calls as lower priority and therefore travel nonemergency, data collection, or some combination thereof, most likely this is a result of the geography of the City. The central spine of the City travel along US 3 and transverse crossing of US 202 contains the majority of service demand; however, several other requests for services occur in relatively remote areas of the City. Concord Fire Department should establish service demand zones

to capture response performance more accurately within the core of the City and performance to outlying areas to convey response performance expectations more accurately.

Due to the unique layout and size of the City, response performance for first due units responding within their districts was compared to second due units responding to other districts when the primary unit is not available. When this occurs, units must travel farther and are less familiar with the area than if they were responding within their primary district.

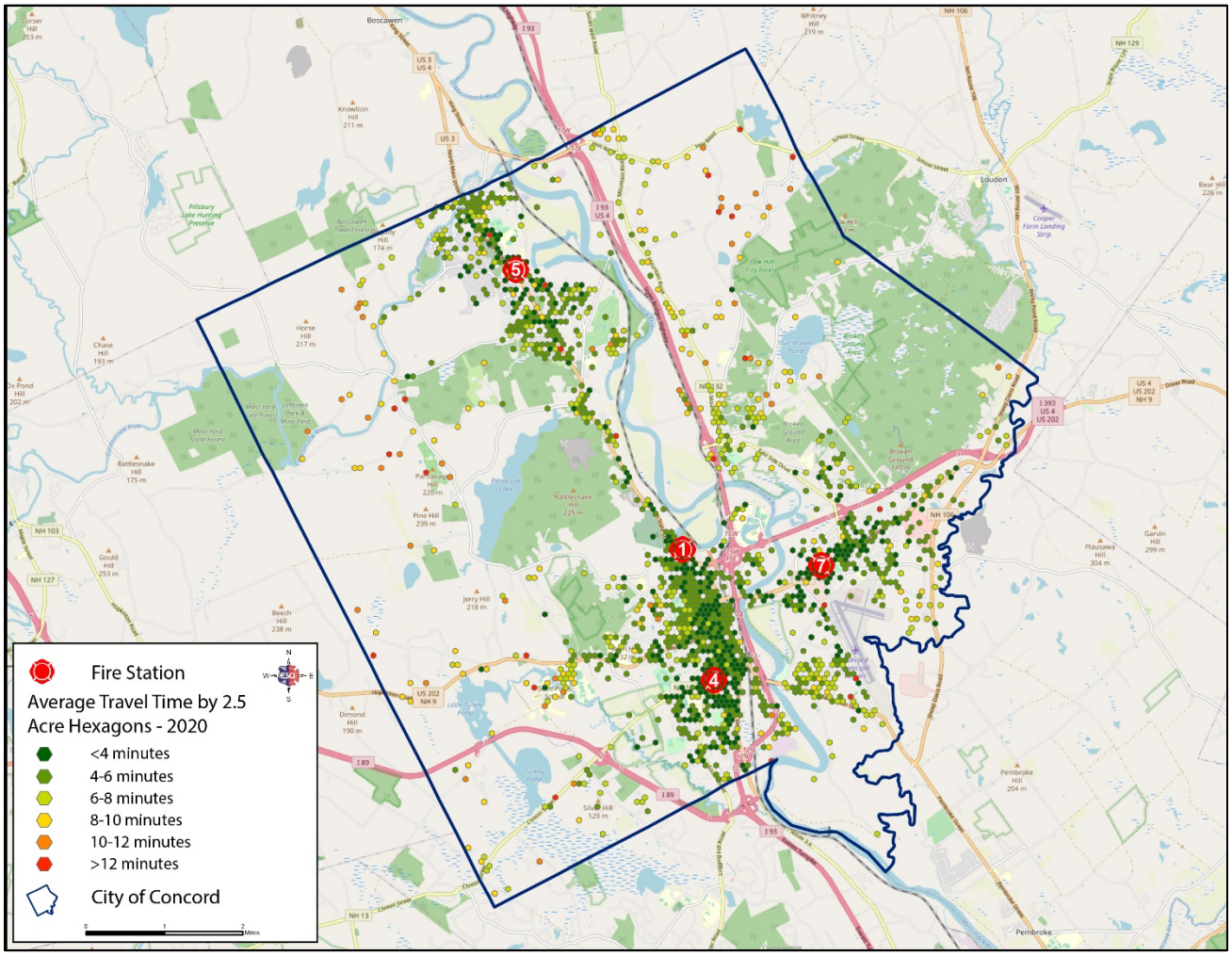
Figure 27: First Due Response Performance vs. Second Due Response Performance (2020)



When travel time performance between first due in district responses are compared with a second due unit responding to an incident out of district when the primary unit is not available, an 18.8% difference in travel performance and 18.9% response performance occurs. As discussed in the call concurrency section, two or more incidents occur within Concord over half of the time and the likelihood of extended travel and response times will occur. This is also true for the assembly of an effective response force. Since units are committed to two or more incidents more than half of the time, Concord Fire Department should anticipate that performance for the assembly of resources will likely be delayed by nearly 20%.

In Figure 28, GIS software was used to create a 2.5-acre hexagon grid across the City of Concord. Geocoded incident locations were added, and the average travel time that occurred within each hexagon) calculated and presented. Dark green hexagons represent travel times of less than 4-minutes while red hexagons represent travel times greater than 12 minutes.

Figure 28: Average Travel by 2.5 Acre Hexagons 2020

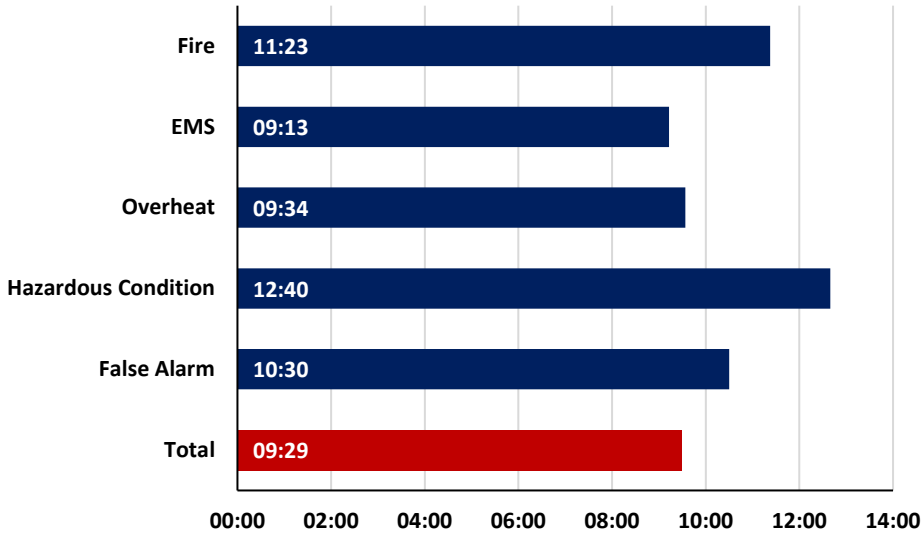


As observed in this figure, travel performance within the core of the City is typically represented by green hexagons while travel to outlying areas experienced greater wait times. Options for establishing service demand zones include Census blocks by population density, proximity to a fire station, or travel corridors to create these zones or urban/suburban and rural demand zones.

Response Time Performance

Response time is the amount of time from initial notification to the fire department until the first unit arrives on-scene. While not specifically addressed by NFPA 1710, it is a combination of turnout and travel time standards or 5 minutes 4 seconds for most responses and 5 minutes 24 seconds for fire and special operations calls.

Figure 29: Response Performance 2020



The response time performance for all emergency calls was 9 minutes 29 seconds at the 90th percentile. The best performance was for EMS calls at just over 9 minutes and the longest response times were related to hazardous conditions responses. EMS incidents possessed the best response times at 9 minutes 13 seconds, followed by special incident calls.

Total Response Time Performance

The culmination of the Response Time Continuum is total response time. When citizens call for emergency assistance, this metric represents what they experience as they place the call and wait for help to arrive. Total response time is the amount of time that elapsed from when the call was initiated at the communications center until the first emergency unit arrived on scene. Like response time performance, NFPA 1710 does not provide a standard for this metric; however, it is presented here for informational purposes at the 90th percentile.

As call processing data was not available at the time of this report, total response time calculations were not possible. Concord Fire Department should regularly collect and evaluate call processing data. This data not only affects the fire department's ISO rating, but the additional element of the NHBECC first receiving the call and conducting their own call processing adds additional time to what caller's experience as the fire department's total response time. It is ESCI's experience from previous New Hampshire projects that the NHBECC's call processing performance at the 90th percentile is near three minutes before the first notification is received by the local communications center.

Mutual and Automatic Aid Systems

Few if any organizations possess all of the resources needed to mitigate all possible types of incidents. Additionally, when mutually beneficial agreements are possible, particularly when they occur at little cost to the organizations, good governance suggests that these opportunities should be seized to provide higher service levels to the communities involved. Two types of agreements are discussed in this section, mutual and automatic aid agreements. In mutual aid agreements, two or more organizations agree that, when requested, they will supply the other agency with the requested resources if available. For emergency services, this request typically occurs through the request on responding or on scene personnel. The other type of agreement, automatic aid, occurs as the name implies, automatically. When an emergency call is received by the dispatch center, all available resources are examined based on the appropriate unit type and their proximity to the call, typically with the closest unit responding regardless of the jurisdiction in which the incident occurred. The following figure presents the locations of Concord Fire Department stations, as well as the locations of automatic aid fire stations within 3 miles of the municipal boundaries of Concord.

These agreements are important as they allow the fire department to plan for low frequency/high risk occurrences that are difficult to staff for, as well as provide a safety net during times of heavy and unexpected service demand. However, many of the departments Concord Fire Department has these agreements with possess minimal fulltime staffing, if stations are staffed at all, particularly on nights and weekends. Additionally, automatic aid agreements are recognized by ISO and additional credit is awarded when automatic aid agreements are in place with organizations that can reach within the service area within an 8-minute travel time.

Fire Department Facilities

An Administrative Headquarters, four fire stations and a Training Center make up the fixed facility capabilities of Concord Fire Department. Appropriately designed facilities provide safe living spaces for personnel and provide an appropriate arrangement for deployment to provide timely service. ESCI visited each of the Concord Fire Department facilities in July 2021. The tour included a building review with a focus on construction, building conditions and amenities, and visible problems or concerns, with input from Concord Fire Department personnel on duty in the fire stations. The Training Center, which was built in 2019, was in excellent condition and the Concord Fire Department stations were in poor condition as categorized according to the following criteria:

Figure 30. Fire Station Condition Classifications

Excellent	Like new condition. No visible structural defects. The facility is clean and well maintained. Interior layout is conducive to function with no unnecessary impediments to the apparatus bays or offices. No significant defect history. Building design and construction match the building's purposes. Age is typically less than 10 years.
Good	The exterior has a good appearance with minor or no defects. Clean lines, good workflow design, and only minor wear of the building interior. Roof and apparatus apron are in good working order, absent any significant full-thickness cracks or crumbling of apron surface or visible roof patches or leaks. Building design and construction match the building's purposes. Age is typically less than 20 years.
Fair	The building appears to be structurally sound with weathered appearance and minor to moderate non-structural defects. The interior condition shows normal wear and tear but flows effectively to the apparatus bay or offices. Mechanical systems are in working order. Building design and construction may not match the building's purposes well. Showing increasing age-related maintenance, but with no critical defects. Age is typically 30 years or more.
Poor	The building appears to be cosmetically weathered and worn with potentially structural defects, although not imminently dangerous or unsafe. Large, multiple full-thickness cracks and crumbling of concrete on apron may exist. The roof has evidence of leaking and/or multiple repairs. The interior is poorly maintained or showing signs of advanced deterioration with moderate to significant non-structural defects. Problematic age-related maintenance and/or major defects are evident. May not be well suited to its intended purpose. Age is typically greater than 40 years.

Figure 31. Concord Fire Department Fire Stations and Facilities

Facility	Picture	Address	Date of Construction	Condition
Fire Headquarters		24 Horseshoe Pond Lane	Late 1890's	Poor
Broadway		15 Broadway Street	1984	Poor
Central		150 North State Street	1977	Poor
Heights		127 Loudon Road	1965	Poor
Manor		46 Village Street	1974	Poor
Training Center		109 Old Turnpike Road	2019	Excellent

All four of the fire stations were evaluated by the architect, engineering, and building scientist firm The H.L. Turner Group in 2020 as part of the City of Concord, New Hampshire Facility Conditions Assessment. The assessment identified significant infrastructure issues at all the stations, including roof problems, heating, ventilation, and air conditioning (HVAC) issues, plumbing, concerns, and fire safety and electrical issues.

In addition to the issues noted by The H.L. Turner Group, ESCI offers the following for consideration as it relates to the usability of the fire stations by the firefighters who occupy them.

Fire Station Layout

Across the city, most of the Concord Fire Department are functioning as they were originally built with only minor modifications. All are in dire need of significant updates to accommodate modern fire apparatus, which are heavier, larger, and taller than apparatus of a generation or more ago.

ESCI found the living conditions within all the Concord Fire Department Stations to be poor. In many cases, firefighters have worked with their crews to perform minor renovations as approved by the fire department to make the stations habitable.

Cancer Prevention Engineering

The occupation of firefighter is recognized as one where those working in the industry are more likely to be diagnosed with cancer than the general public. The danger for firefighters does not stop when the fire is extinguished but returns to the fire stations through their gear, equipment, and vehicles that were exposed and contaminated by smoke or other vapors. When contaminated gear and equipment are returned to the station via their respective response apparatus, the potential for cross-contamination occurs.

Within Concord Fire Department, there are cancer prevention policies in place. Firefighters have been provided with training, a second set of personal protective equipment, wipes, and protocols for both cancer prevention and decontamination. An additional preventative measure that could be taken by the Concord Fire Department is to limit/reduce firefighter exposure to toxic products of combustion which occur *after the fire* (aka, off-gassing). Concord Fire Department should take steps to store turnout gear in a well-ventilated room to prevent additional firefighter exposure to off-gassing of chemicals absorbed into turnout gear during a fire. To that end, the Concord Fire Department should also relocate all current fitness areas that are housed within apparatus bays to locations where firefighters can exercise without exposure to the toxic products of combustion.

Facility Security

Fire departments have typically been open environments where residents and visitors from the community have been allowed access to any part of a fire station with very few limitations. Unfortunately, the current social environment requires emergency services providers to implement specific security measures limiting and controlling access to fire department facilities. This is driven by the need to protect firefighters, expensive equipment, and sensitive data from inadvertently being accessed by individuals desiring to harm the community.

ESCI recommends that the Concord Fire Department implement video monitoring and recording at exterior entry points to ensure increased levels of security and awareness as to who is, or attempting to, enter

Concord Fire Department facilities. The department should also evaluate the implementation of an access card system that identifies each fire department member accessing facilities. This evaluation should also include the ability of Concord Fire Department leadership to change access of a staff member immediately from a central location based upon a member's employment status or operational concern.

Other Considerations

ESCI suggests that as part of planning to renovate or build new fire stations, that consideration be given to the potential operational efficiencies that could be realized by co-locating Fire Headquarters and the Communications Center with a fire station.

While the 1894 Water Works Buildings were renovated in 2000, the historic nature of the buildings is a limiting factor as it comes to future space needs, especially within the Communications Center. Relocating Fire Administration and the Communications Center into a new fire station could provide a more modern infrastructure for the fire department that allows for more convenient collaboration within the fire department.

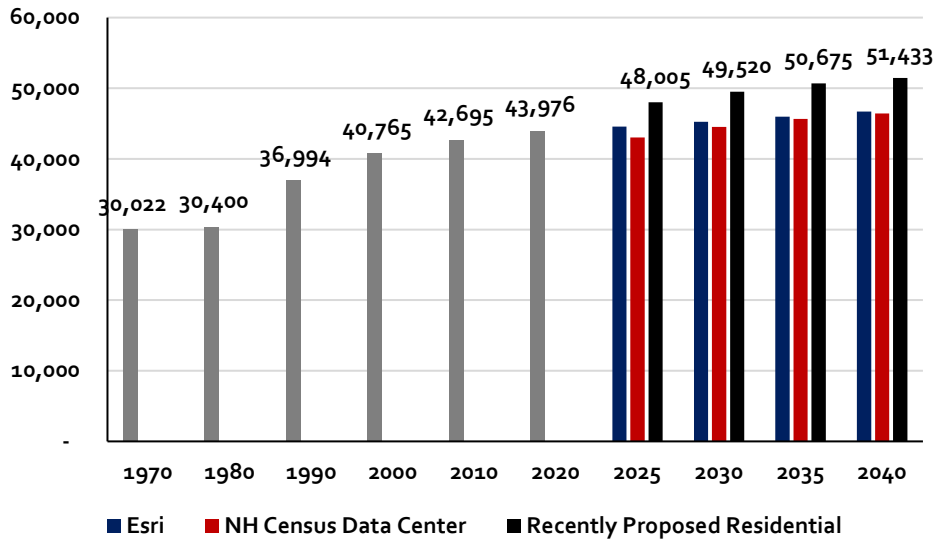
Moving the fire department out of the 1894 Water Works Buildings would make that space available for other city offices, potentially allowing the city to reduce the amount of space it is currently leasing to accommodate its employees.

Future System Demand Projections

Population Growth Projections

The population of the City of Concord has remained stable since the 2000 U.S. Census. During the 20 years since the 2000 census, the City experienced a population increase of approximately 2,923 people, or an increase of 7.2%. Based on census population projections and information from regional economic development groups, such as the New Hampshire Employment Security and the New Hampshire Census Data Center, three estimates were developed for future population estimates, an annual growth rate of 0.31% and projections developed by the New Hampshire Data Center. This percentage was selected as the 0.31% rate is representative of historic population data and in line with regional growth projections. However, within the last year, significant development is proposed that could increase Concord's population by as many as 5,000 or more. This growth is anticipated to occur within the next three to five years and could result in Concord's population exceeding 50,000 by 2035.

Figure 32: Population Growth Estimates

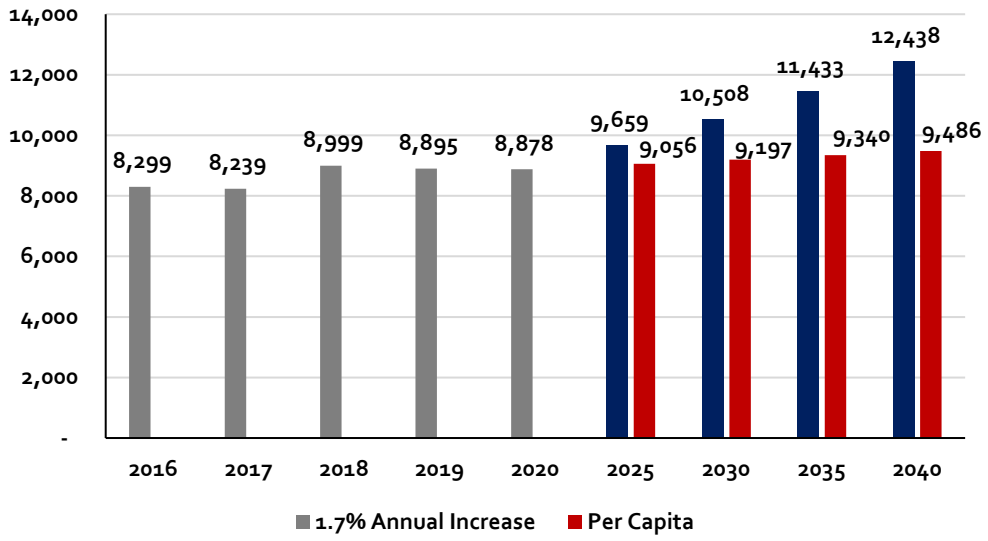


An important consideration to population is its relationship to service demand. Generally speaking, service demand will be greater in areas of high population density than lower population density; however, the demographics of the area also play a significant role in demand. For example, a newly constructed subdivision occupied by young professionals and families would likely be much less dependent upon emergency medical services than a neighborhood occupied primarily by retirees. Although the population densities may be equivalent, the dependence upon emergency responders would differ.

Service Demand Projections

The demand for services is central to the existence of a fire department. Often as the population rises or falls, so too does the demand for services. As discussed in the previous section, the population of Concord has remained relatively constant since 2000. Because of this, it can be anticipated that the demand for service should be consistent year to year as well. An examination of Concord Fire Department's call volume from 2016 through 2020 displayed slight variations in total call volume year to year, with an average annual increase of 1.7% for the period from 2016 and 2020. Using the two projection methodologies, each indicates a gradual increase in service demand through 2040, with the linear 1.7% annual increase indicating approximately 31% greater demand than the per capita model which used the average of the period's service demand by population for a rate of one incident per 20.3 people annually.

Figure 33: Future Service Demand Estimates



Based on this rate of increase, Concord Fire Department could anticipate that annual service demand may increase from 7% to 40% by year 2040. As with any forecast, local and external factors can dramatically impact changes to both population and service demand. Changes in demographics, the median age of a population and other factors also influence the demand for services. New construction in currently rural areas of the City may also impact the rate of change as homes and businesses are established in previously undeveloped areas. Should the proposed developments increase the City's population in the next few years, the result is on par with the 1.7% linear increase.

Station Location Considerations

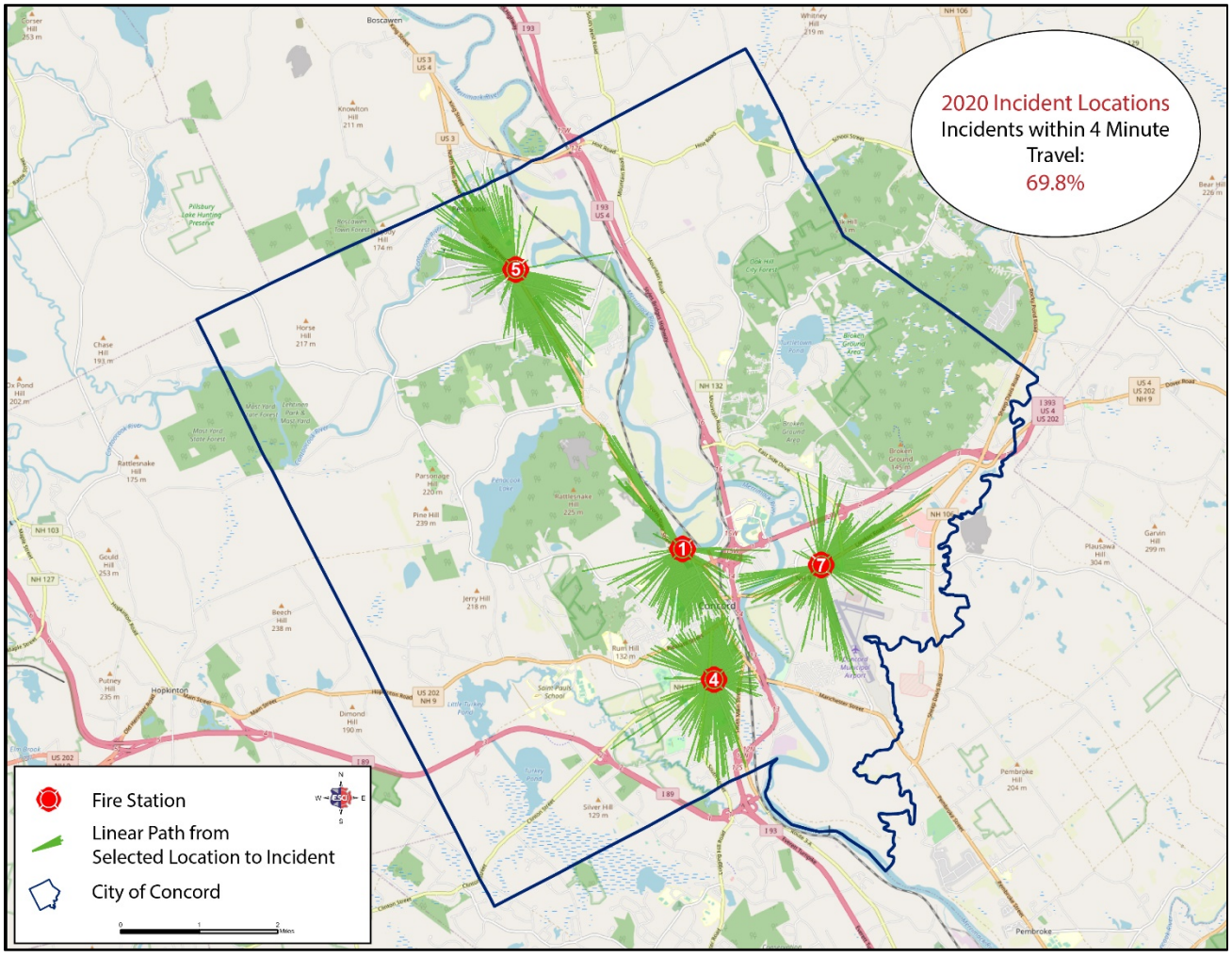
GIS Analysis

To determine the viability of the proposed fire station locations selected by the City of Concord, GIS software was used to conduct a fire station service area analysis. The purpose of this analysis is to select the location that will provide:

1. the largest service area based on travel within the road network; and
2. capture within that service area the greatest number of incidents.

To provide a means of comparison between models, a baseline analysis of the current deployment model was developed, and the results shown in Figure 34. Travel estimates were provided through Esri's proprietary database for historic traffic patterns at 8am on Monday mornings.

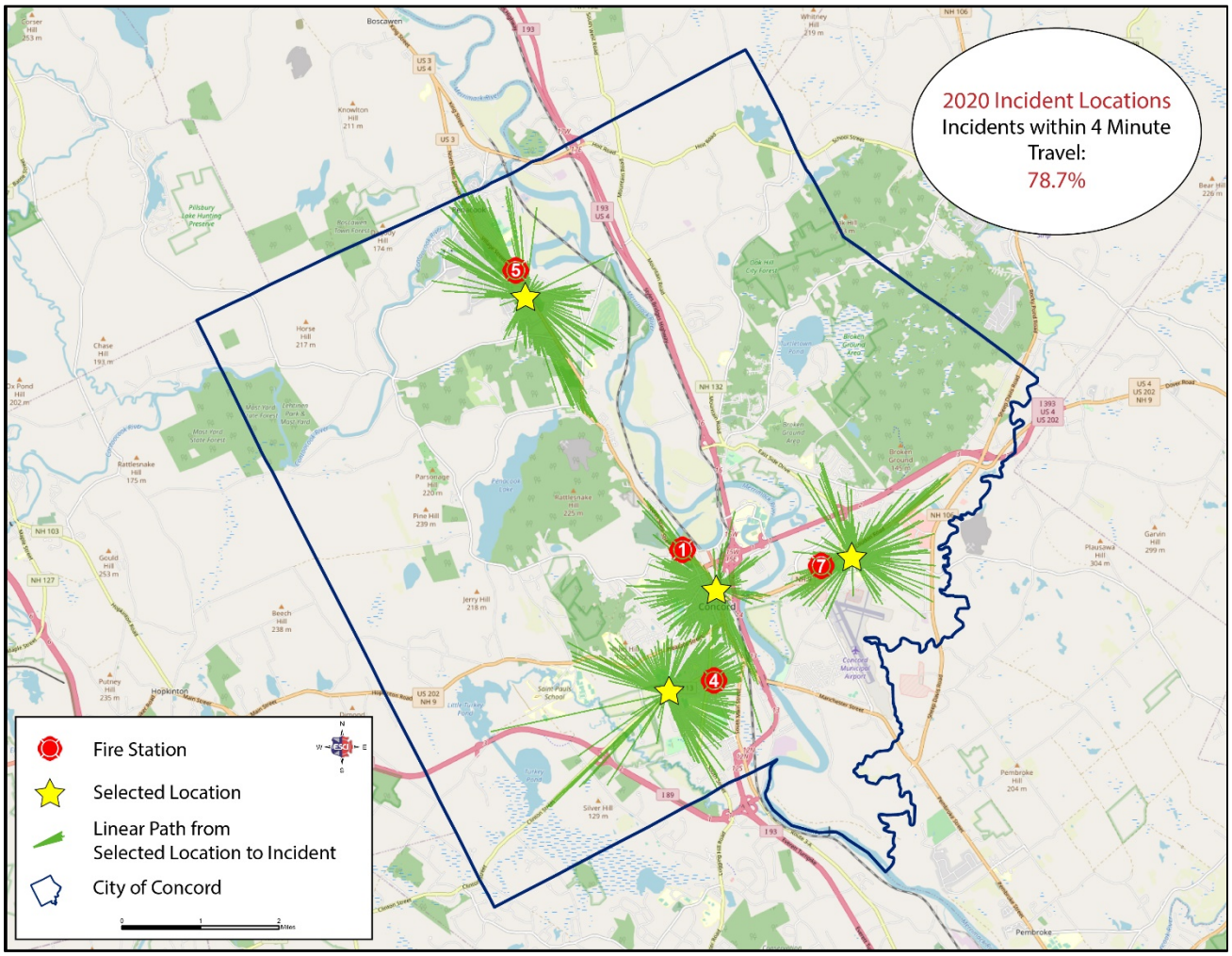
Figure 34: Station Location Analysis Baseline Model



Using 2020 incident locations and a maximum travel time of four minutes, it is projected that Concord Fire Department can reach 69.8% of incidents within NFPA 1710 criteria.

Next, an optimal model was created using 2,500 random points to serve as potential new locations for four relocated fire stations. While it is recognized that actually relocating the current stations to these specific locations is most likely not possible, this model provides insight as to where four stations could be located for comparison.

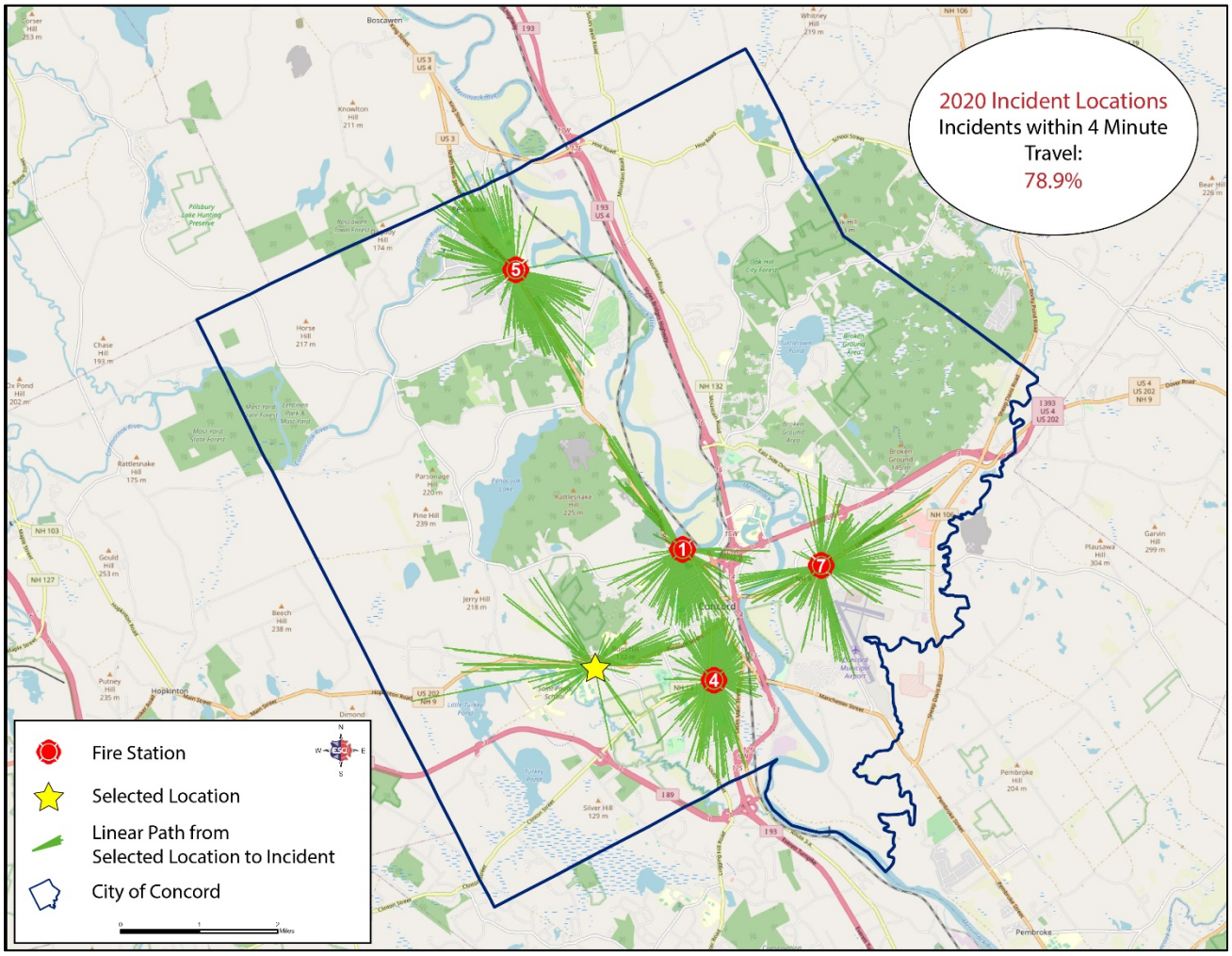
Figure 35: Optimized Four Station Model



The results of the optimization model for four stations suggests that, although each station could be more optimally located and performance increased by as much as 8.9%, each station is generally located fairly close to its optimized location. Additionally, due to the limited variability between current and proposed locations, it can be deduced that the areas between or near the current and optimized locations are suitable to construct new stations. If some stations were relocated and others remain in their current positions, overall performance would fall somewhere between current performance and optimized performance.

As an alternative to relocating all four current stations, a model was created that adds a fifth station to the system while keeping the other four stations in their current locations. This option provides a less costly alternative to acquiring land and relocating every fire station in the system. The results are shown in Figure 36.

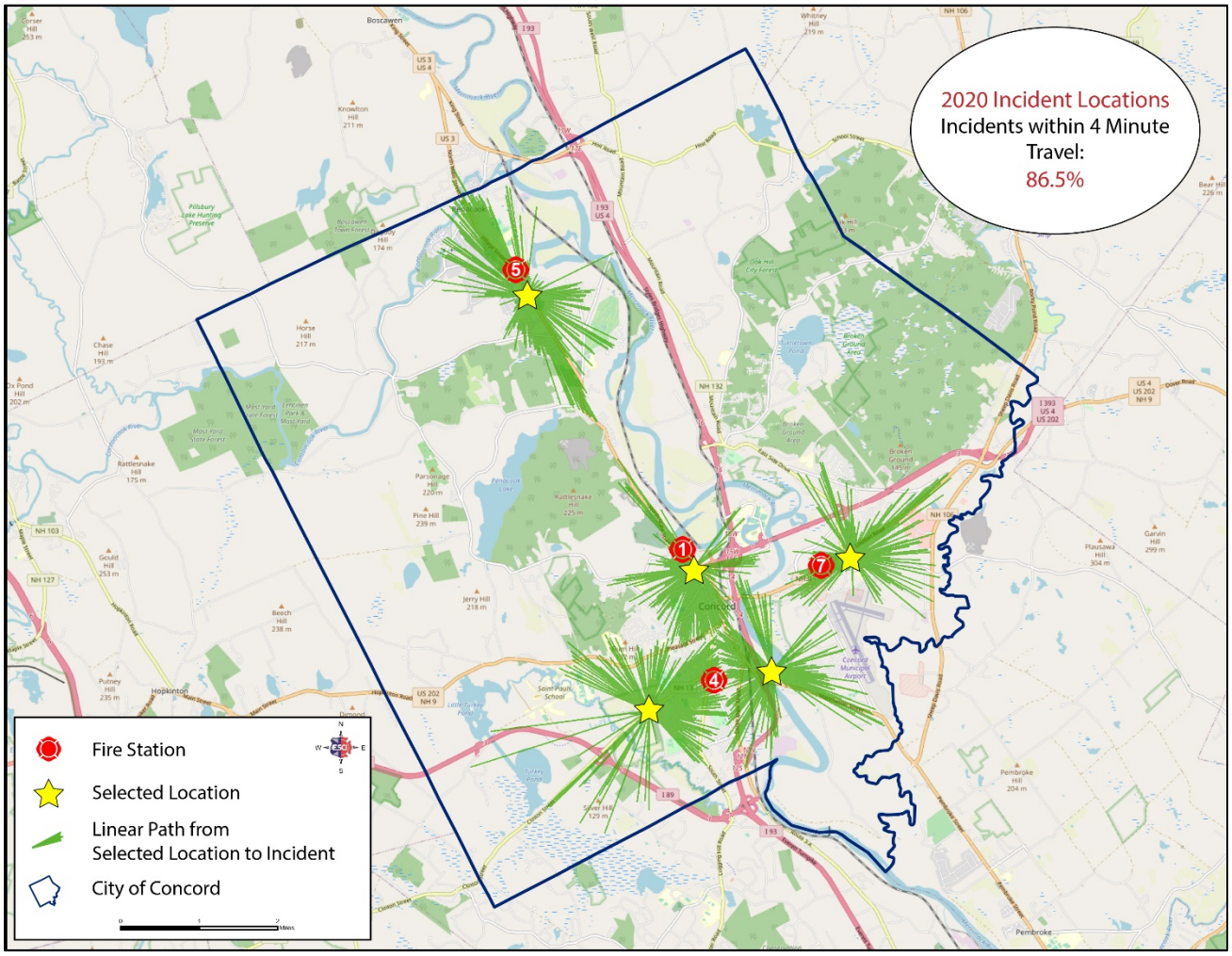
Figure 36: Current Deployment with an Additional Fire Station



The addition of a fifth fire station to the system while the other four remain in their current locations provides a 9.1% increase over the baseline model and 0.2% increase over the optimized four station model. Reconstructing or remodeling fire stations on their current sites provides a cost savings to the City and an investment in staffing and another facility significantly improves upon Concord Fire Department's efficacy of service delivery and effective response force.

Finally, an optimized five station model is illustrated to provide a comparison of where fire stations would be located in optimal conditions.

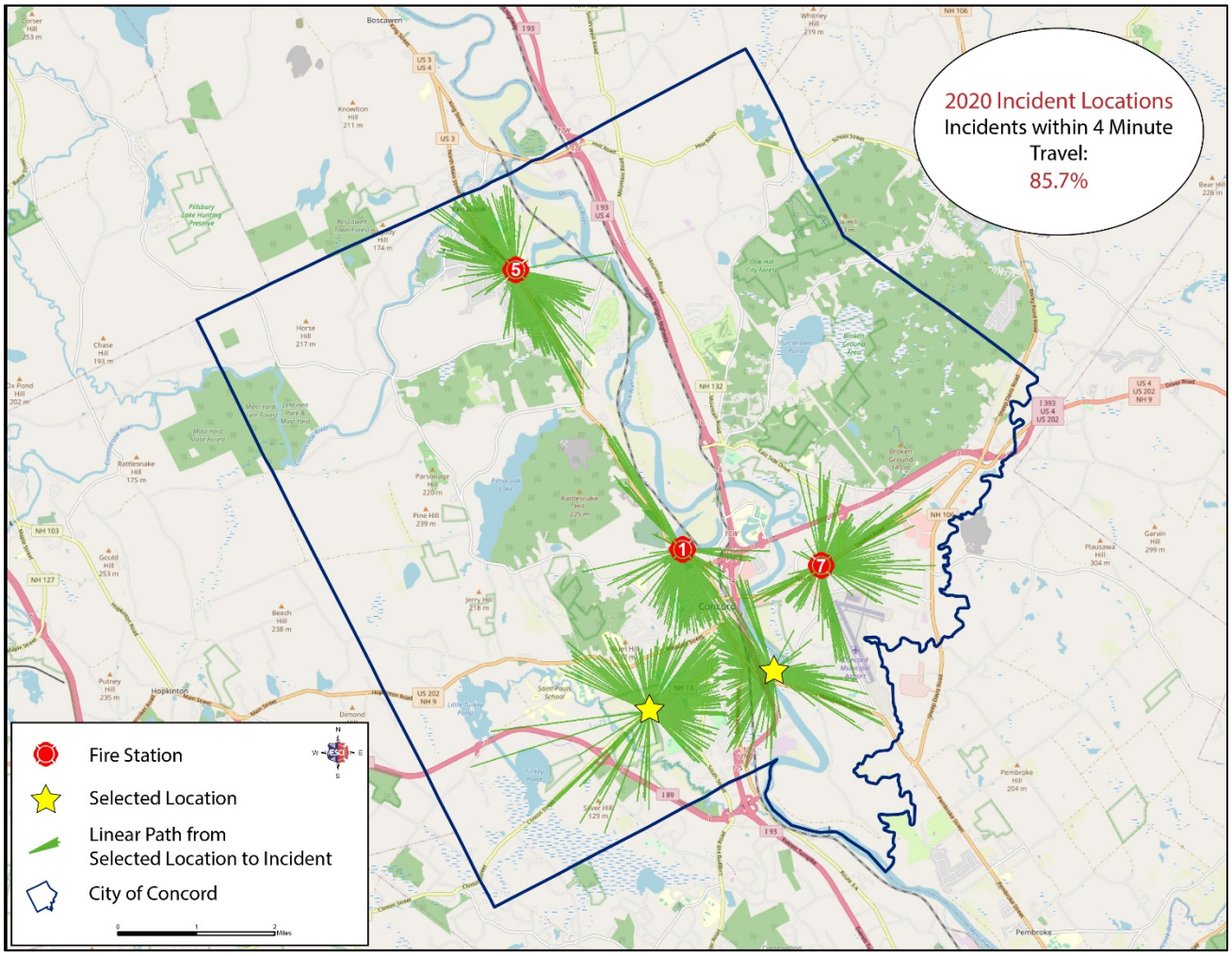
Figure 37: Optimized 5 Station Model



With five optimized locations for fire stations, projected performance once again increases to 86.5%. This is a 16.7% improvement over the baseline model and a 7.6% increase over the model using the four current station locations and adding a fifth station. Additionally, while stations 1, 5, and 7 remain fairly close to the current locations, the other two fall on either side of Station 4.

If the City determines that a fifth fire station will not be needed in the next 30 to 50 years, the location of Station 4, or somewhere nearby, will provide an adequate location; however, if five fire stations are projected to be needed by the middle of the century, the City should strongly consider locating a fire station in the commercial area near Manchester Street and Interstate 93 and the area of Route 13 and Langley Parkway. The following figure provides the impact of maintaining station 1, 5, and 7 at or near their current locations and adding the additional two optimized stations, one replacing Station 4 and the other near Manchester Street and Interstate 93.

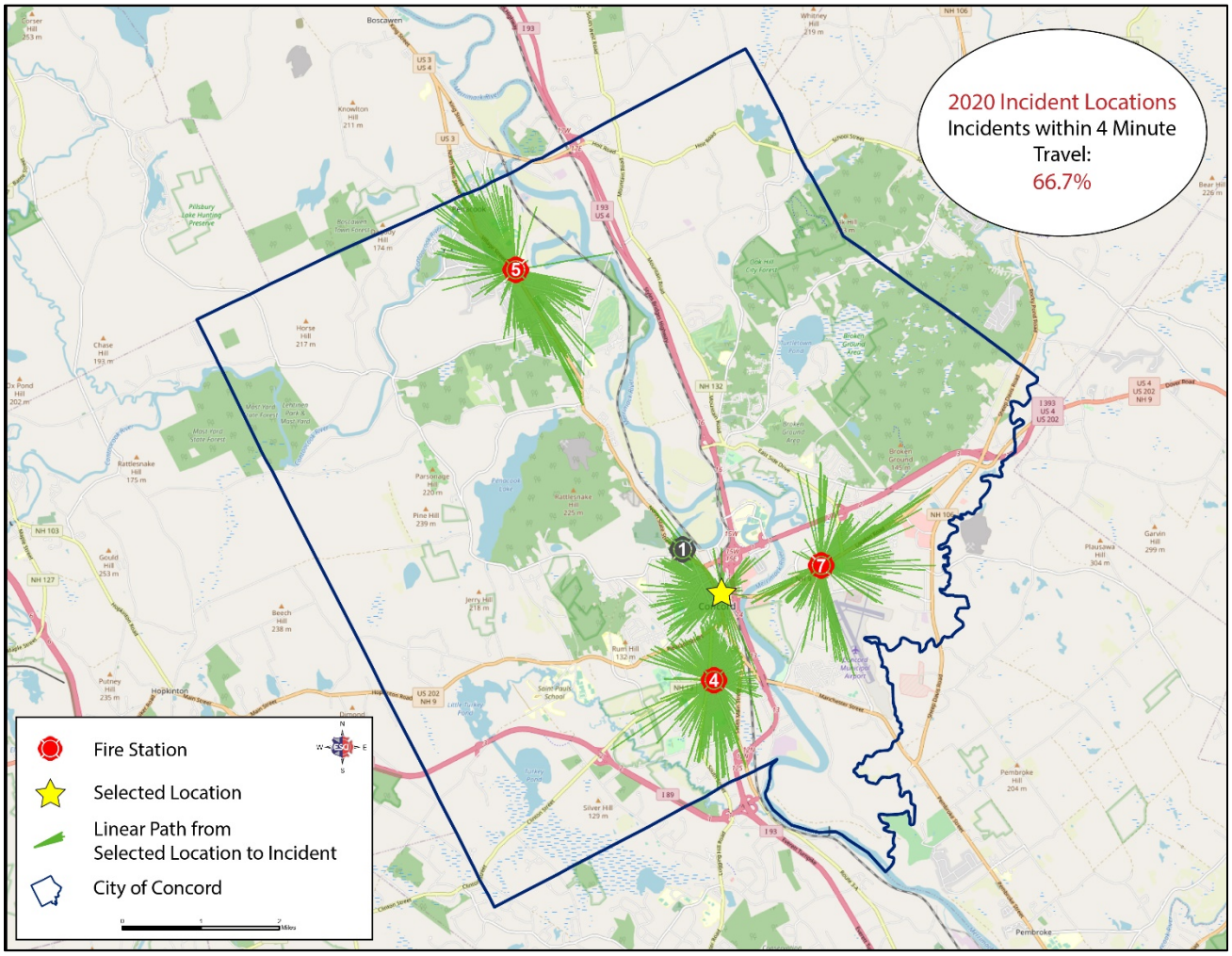
Figure 38: Five Station Optimization with Stations 1, 5, and 7 at Current Locations



Although a slight reduction, 0.8%, in performance is anticipated when compared to the model optimizing all five locations, this option may provide Concord with the best balance of performance with fiscal accountability and allows the City to work in stages toward a long range station location plan. Construction of the new Station 4, near Route 13 and Langley Parkway, can occur with crews remaining in the current facility until construction is completed and the future fifth station planned for and constructed over several fiscal years to provide time to account for additional staffing costs.

Finally, Concord Fire Department has identified potential locations to relocate stations based on land availability and size. First, a location on Storrs Street near the Holiday Inn was evaluated to compare performance with the current and optimized models by moving Central Station.

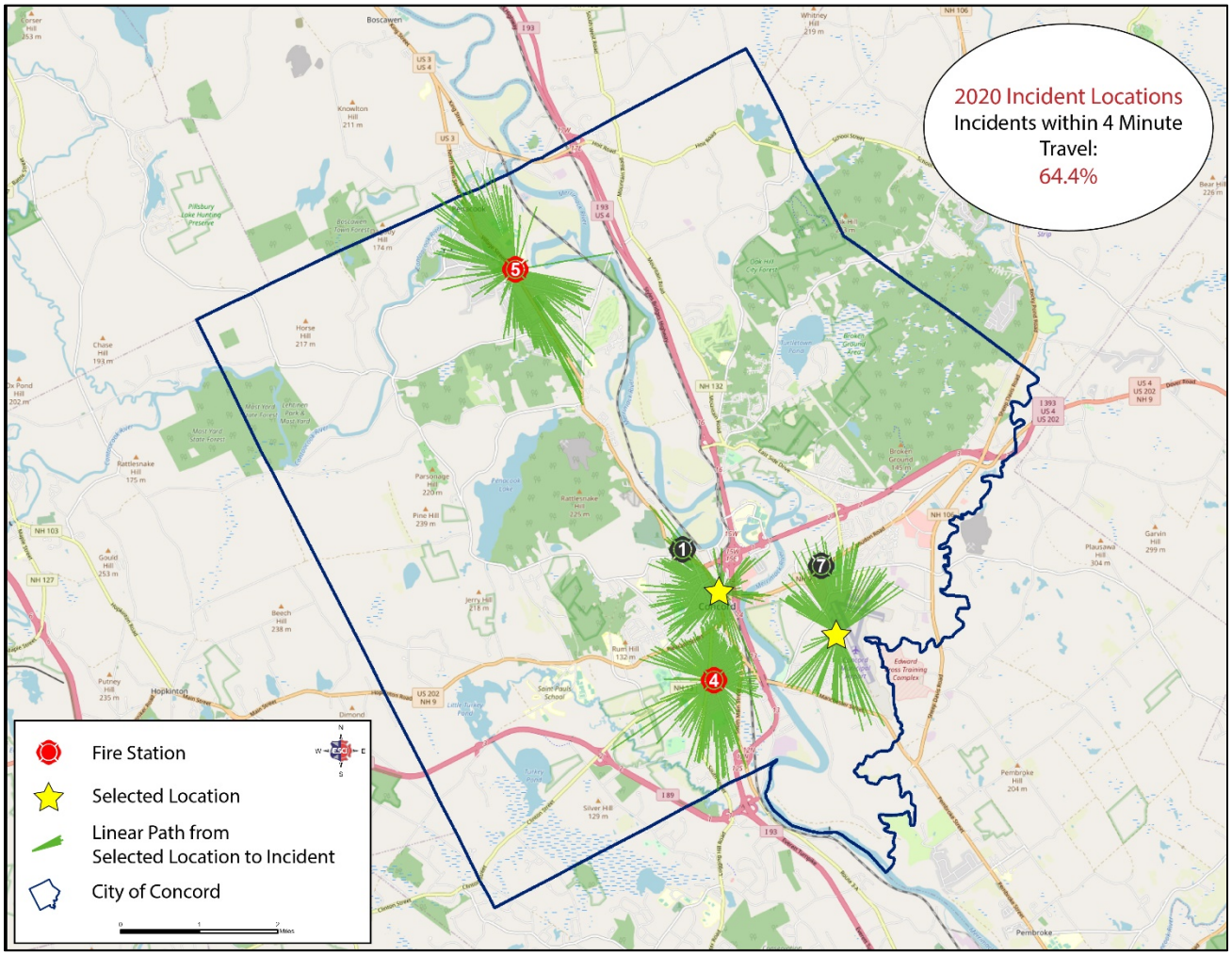
Figure 39: Central Station Relocated to Storrs Street



With Central Station relocated to Storrs Street, performance is reduced slightly by 3.1%. Although this is a minor reduction in performance, the ability for Concord Fire Department to construct a facility of appropriate size and functionality versus the department making sacrifices in space and functionality to the current location may prove more beneficial to the department and City over time.

Next, the same analysis was conducted to determine performance if the Heights Station were also relocated near the northern border of the airport on Regional Drive.

Figure 40: Central Station Relocated to Storrs Street and Heights Station Relocated to Regional Drive



With the combination of relocating Central Station (1) and the Heights Station (7), the model suggests that performance is reduced from the current deployment model by nearly 5%. Although there may exist benefits in relocating the Heights Station, the reduction in performance may not warrant the benefits gained.

There are many options available for consideration by the City of Concord. ESCI suggests that the City and the fire department consider that these buildings typically have a usable life of 30 to 50 years and that the decisions made today should consider the needs of tomorrow. Future development and changes to the road network can also impact traffic flows and optimal station locations. For example, should the City proceed with the Langley Parkway extension, it could have a significant impact on fire department response times. While this proposed extension could not be factored into the data modeling, its construction would most likely improve fire department response times within the most densely populated area of the City, as well as reduce patient transport times to the hospital. Depending on the direction the City chooses to move, stations 1, 5, and 7 could be relocated slightly or remain in their current locations without much impact to the overall delivery of services.

Summary of Decision Points and Options

Figure 41: Decision Point Summary

Decision Point	Description	% of 2020 Incidents within a 4-Minute Travel Time	Net Improvement
How many fire stations does the City of Concord plan to operate during the next 30-50 years?	**4 Stations** ***Option A:*** Continue to operate 4 fire stations in their existing locations. ***Impact:*** No change to current deployment with all facilities requiring rehabilitation/ reconstruction at current locations. ***Option B:*** Optimize the locations of all 4 fire stations. ***Impact:*** Projected improvement to current service delivery performance. Higher costs associated with land acquisition. Similar benefit can be achieved by adding 5th station to current configuration with rehabilitation/ reconstruction required at current locations. **Note: Optimizing the locations of between 1 and 3 stations will also result in a net improvement; however, it will be less of an improvement.*	69.8% 78.7%	No Change 8.9%
	5 Stations ***Option A:*** Add a 5th fire station in the area west of Langley Parkway and Pleasant Street and maintain the locations of the existing 4 fire stations. ***Impact:*** Lower capital costs than acquiring new land and relocating current four stations. Increased personnel costs for additional facility. Improvement to resiliency and effective response force with rehabilitation/ reconstruction required at current locations.	78.9%	9.1%

Decision Point	Description	% of 2020 Incidents within a 4-Minute Travel Time	Net Improvement
	Option B: Optimize the location of the existing 4 fire stations and add a 5th station. ***Impact:*** Projected improvement to current service delivery performance. Higher costs associated with land acquisition and ongoing personnel costs. Significant improvement to current deployment model. Rehabilitation costs absorbed through new construction. *Note: Optimizing the locations of between 1 and 3 stations will also result in a net improvement, however it will be less of an improvement.*	86.5%	16.7%
	Option C: Maintain or slightly relocate stations 1, 5, and 7. Relocate Station 4 near the area of Route 13 and Langley Parkway and plan for a future 5th station near the commercial area of Manchester Street and Interstate 93. ***Impact:*** Reduced land acquisition costs for three stations, maintain current staffing levels while new location for Station 4 is under construction. Fifth station can be added with needed staffing in the future. Rehabilitation/reconstruction required at stations 1, 5, and 7.	85.7%	15.9%

Recommendations

Through the course of this Station Location Study, ESCI noted the following recommendations to improve upon the performance, safety, and efficiency of the Concord Fire Department.

- All fire stations should be renovated or rebuilt due to physical and structural deficiencies.
- A suppression unit should be staffed at Central Station 1. The lack of a suppression unit capable of providing a fire water flow, equivalent for the building types contained within that district, at Central Station 1 allows for a substantial risk within the historic downtown area.
- An ambulance and its required staffing should be added at Central Station to ensure appropriate coverage for the downtown area and its residents. This unit will also provide needed overlapping coverage for all other districts within the City as it is centrally located.
- The Central Station, Administration, and Communications Center campus may be better suited in a new location. This campus contains several historic buildings that are retrofitted to meet the needs of the department. Space is limited for each division and future expansions or renovations are not possible without affecting the historic nature of many of these buildings. The location of Central Station 1, or somewhere nearby, provides the best option to Concord Fire Department for deployment and options for other locations nearby should be considered and evaluated.
- Administrative staffing should be increased. Administrative staffing for Concord Fire Department is approximately one third the staffing levels that would ordinarily be anticipated. When this occurs, communication issues are often cited as the number one challenge within the organization as administrators cannot fulfill tasks in a timely manner, if at all.

Conclusion

The ESCI project team began collecting information for the City of Concord, New Hampshire in the Spring of 2018. The team members recognize this report contains a large amount of information and ESCI would like to thank the chief, leadership, City staff members and employees for their efforts in bringing this project to fruition. ESCI would also like to thank the various individuals and external organizations for their input, opinions, and candid conversations throughout this process. It is ESCI's sincere hope the information contained in this report is used to its fullest extent and that the emergency services provided to the citizens of Concord and the surrounding area will be improved by its implementation.

Appendix A: Table of Figures