Round Rock Fire Department

GEOGRAPHIC INFORMATION SYSTEM (GIS) FIRE SUPPRESSION AND EMERGENCY MEDICAL SERVICES RESPONSE CAPABILITIES ANALYSIS

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ABSTRACT

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In August of 2004, the International Association of Fire Fighters (IAFF) was contacted by the Round Rock Association of Professional Firefighters, IAFF Local 3082, to perform a Geographic Information System (GIS) analysis of the Round Rock Fire Department. Local 3082 requested that the GIS study evaluate the 4- and 8-minute response capabilities of fire department units deploying from existing and proposed, under the 5-Year Plan, fire station locations, and an examination of staffing conditions that prevail in the department. The Round Rock Association of Professional Firefighters requested that the results of the GIS mapping be assessed against existing National Fire Protection Association (NFPA) professional standards and Occupational Safety & Health Administration (OSHA) safety regulations, including compliance with NFPA 1710 staffing performance objectives and the OSHA "2 In/2 Out" regulation. The procedures involved in this analysis consisted of the generation of GIS mapping response scenarios under existing and planned staffing and deployment configurations, a statistical analysis of fire department response capabilities, and an evaluation of GIS outcomes measured against NFPA standards and OSHA regulations.

Findings

Analysis of the Round Rock Fire Department reveals that, all fire suppression (engine, brush, and truck) companies are designated to deploy with three fire fighters, **out of compliance** with industry standards. Apparatus not staffed with four firefighters **do not** meet compliance with the company staffing objectives outlined in NFPA 1500, *Standard on Fire Department Occupational Safety and Health Program*, and 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*.

The Round Rock Fire Department's Battalion Chief is not currently deployed with sufficient resources to perform incident oversight in the most efficient manner. Currently, the Battalion Chief deploys without the assistance of a Chief's Aide. The aide plays a critical role in ensuring emergency incident oversight, including fire fighter accountability, and their absence contributes to the likelihood of fire fighter injuries.

Recommendations

The IAFF's GIS-based recommendations include staffing **all** engine and truck companies with ***at least*** **four multi-role fire fighters**, in compliance with NFPA 1710 and NFPA 1500. Furthermore, a Chief's Aide should be assigned to accompany and assist each Battalion Chief. At minimum, an additional fire station staffed with an engine company and a truck company, is necessary for increased emergency response coverage.

EXECUTIVE SUMMARY

EXECUTIVE SUMMARY

This report summarizes the results of a station location, staffing, and emergency vehicle response time analysis for the Round Rock Fire Department and IAFF Local 3082. This computer-based analytical study examines predicted response times and geographic coverage areas for emergency response units deployed from existing fire stations in the Round Rock Fire Department's response jurisdiction.

The Round Rock Fire Department- the primary provider of fire, rescue, disaster and initial emergency medical response services in the City of Round Rock, Texas and portions of the surrounding area- does not currently meet the company staffing objectives of national industry standards. Industry standards require all fire suppression companies (i.e., engines and trucks) to deploy with *at least* four-person crews. Currently, all Engines in the Round Rock Fire Department are staffed with only three firefighters. The practice of staffing fire companies with *less than* four fire fighters puts public safety at a greater risk for the loss of life and property. Assessment of the critical tasks required for an interior fire attack establishes the impact that reduced staffing has on the effectiveness of fireground operations involving a single-family residential structure. Table 1 below describes the impact of crew size on fire attack for residential structures.

TABLE 1:

IMPACT OF CREW SIZE ON FIRE ATTACK IN A RESIDENTIAL STRUCTURE[1]
(First Alarm Assignment)

Apparatus	1st Engine Company		2nd Engine Company		Ladder Company		
Fireground Tasks	Charge Initial Interior Line and Advance	Locate and Rescue Victim	Charge Interior Support Line and Advance	Charge Exterior Line and Advance	Roof Ventilation	Search & Rescue	Check Exposures for Fire Extension
5 Firefighters	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%
4 Firefighters	**84.7%**	**96.1%**	**77.9%**	**72.9%**	**79.0%**	**90.3%**	**80.2%**
3 Firefighters	71.3%	82.8%	0.0%	0.0%	0.0%	79.6%	0.0%

Any decrease in emergency unit response capabilities correlates directly with an increase in expected life, property, and economic losses. Fire growth- the rate of spread and the intensity of the fire- is directly linked to the time it takes to initiate fire suppression operations. As rule, a fire doubles in size for every minute that passes without the application of aggressive fire suppression measures. In less than 30 seconds a small flame can rage completely out of control and turn into a major fire. In five minutes a room can get so hot that everything in it ignites at once, a condition known as "flashover." At this point, the odds of survival for individuals inside the structure- both victim and rescuer- are virtually non-existent.

The unavailability of fire department units, or inadequate staffing levels on those units, exposes citizens to increased risk, drains limited fire department resources, and stresses the emergency response system by requiring additional apparatus to respond with an additional number of

[1] McManis Associates and John T. O'Hagan & Associates, Dallas Fire Department Staffing Level Study, (June 1984); pp. 1-2 and II-1 through II-7; Richard C. Morrison, Manning Levels for Engine and Ladder Companies in Small Fire Departments, (1990)

personnel. Independent studies performed by private consultants, industry trade groups, emergency service associations and individual fire departments across the United States and Canada all validate similar findings: adequately staffed fire suppression companies responding in a timely fashion are able to initiate and perform emergency scene operations more safely, more effectively, and with greater success than under-staffed companies. Due to the staffing of all Engines with only three firefighters, the initial conclusion drawn from analysis of the Round Rock Fire Department's staffing and deployment arrangement is that the fire department does not meet compliance with existing national standards and federal health and safety regulations.

Specific recommendations begin on Page 11 of this report.

RECOMMENDATIONS

RECOMMENDATIONS

Based on the findings discussed in this document, the following recommendations are made:

- **It is the recommendation of this analysis that the Round Rock Fire Department should make efforts to staff all engine companies on a 24-hour basis with *at least* four multi-role fire fighters cross-trained as emergency medical service (EMS) providers.**[2] NFPA Standard 1710 recommends "fire companies, whose primary functions are to pump and deliver water and perform basic fire fighting at fires, including search and rescue... shall be staffed with a minimum of four on-duty personnel."[3] Recent studies indicate that four fire fighters are capable of performing the rescue of potential victims 80% faster than a crew of three fire fighters. *Currently, not all engine companies are staffed in compliance with NFPA 1710 company staffing objectives.*

- **It is the recommendation of this analysis that the Round Rock Fire Department should deploy a dedicated Ladder Company assigned to a full service ladder apparatus from Station 4, staffed on a 24-hour basis with *at least* four multi-role fire fighters cross-trained as emergency medical service (EMS) providers.**

- **It is the recommendation of this analysis that the Round Rock Fire Department should incorporate, at minimum, one additional fire station in the northwest portion of the Round Rock Fire District along the Route 1431 corridor west of Interstate 35. The additional fire station should house one engine company and one truck company.**

- **It is the recommendation of this study that fire department Battalion Chief deploy with a Chief's Aide.** NFPA Standard 1710, Section 5.2.1.2.5, states that, "supervisory chief officers shall have staff aides deployed to them for purposes of incident management and accountability at emergency incidents." *Currently, Battalion Chiefs provide incident oversight without the critical assistance of a Chief's Aide to ensure firefighter accountability, communications, and other logistical and support.*

These measures will work to ensure that the Round Rock Fire Department remains in compliance with established OSHA regulations and NFPA industry standards. Furthermore, it promotes safer and more effective fire suppression and disaster incident mitigation, while expediting the delivery of initial emergency medical services to those residing in and visiting the Round Rock area.

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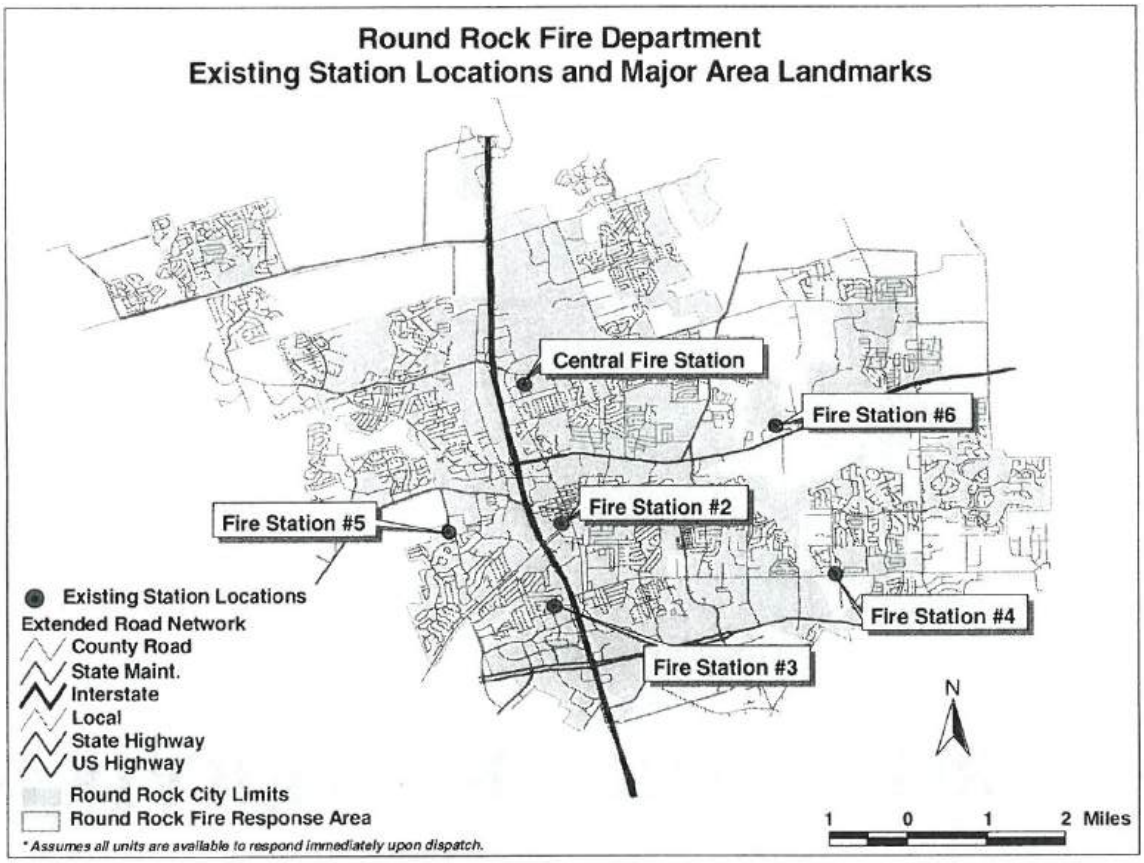
[2] NFPA Standard 1710, §5.2.2.1.2 and §5.2.2.2.2, recommends that, "In jurisdictions with tactical hazards, high hazard occupancies, high incident frequencies, geographical restrictions, or other pertinent factors as identified by the authority having jurisdiction, these companies shall be staffed with a minimum of five or six on-duty members."

[3] NFPA 1710, §5.2.2.1 and §5.2.2.1.1

ROUND ROCK OVERVIEW

MAP 1



Map 1 indicates the Round Rock Fire Department Response Area and the City of Round Rock, Texas, noting major roads and highways, railways, waterways, and the locations of significant area landmarks and existing fire stations. Round Rock is located in Williamson and Travis Counties of Texas.

GEOGRAPHY

Round Rock is located 709 feet above sea level.[4] According to the United States Census Bureau, the City of Round Rock, Texas has a total area of 26.3 square miles, 26.1 square miles of which is land, and 0.1 square miles of which is water. The population was approximately 80,000 in 2004, 61,136 in 2000 and 30,923 in 1990[5].

DEMOGRAPHICS[6]

As of the census of 2000, there are 61,136 people, 21,076 households, and 15,933 families residing in the city. The population density is 2,339.1 per square mile. There are 21,766 housing units at an average density of 832.8 per square mile. The racial makeup of the city is

[4] Round Rock, Texas, Frequently Asked Questions For Community Services <http://www.ci.round-rock.tx.us/links/faq.html>; site visited May 6, 2005.

[5] Wikipedia.org < http://en.wikipedia.org/wiki/Round_Rock%2C_Texas>; site visited May 5, 2005.

[6] Ibid.

76.76% White, 7.72% African American, 0.5% Native American, 2.89% Asian, 0.1% Pacific Islander, 9.47% from other races, and 2.56% from two or more races. Approximately 22.1% of the population is Hispanic or Latino of any race.

There are 21,076 households out of which 47.5% have children under the age of 18 living with them, 60.5% are married couples living together, 11% have a female householder with no husband present, and 24.4% are non-families. Eighteen percent of all households are made up of individuals and 3% have someone living alone who is 65 years of age or older. The average household size is 2.87 and the average family size is 3.29.

In the city the population is spread out with 31.9% under the age of 18, 8.5% from 18 to 24, 38.8% from 25 to 44, 16.3% from 45 to 64, and 4.5% who are 65 years of age or older. The median age is 30 years. For every 100 females there are 99.1 males, and for every 100 females age 18 and over, there are 96.3 males.

The median income for a household in the city is $60,354, and the median income for a family is $65,471. Males have a median income of $41,971 versus $30,807 for females. The per capita income for the city is $24,911. Four percent of the population and 2.8% of families are below the poverty line. Out of the total population, 4.3% of those under the age of 18 and 6.7% of those 65 and older are living below the poverty line.

FIRE DEPARTMENT OVERVIEW

OVERVIEW OF FIRE DEPARTMENT OPERATIONS

The fire service's wide range of capabilities enables fire department personnel to respond effectively to diverse incidents, including victim search and rescue, extrication, hazardous materials releases, and natural disasters, as well as patient stabilization and transport. Fire fighters are uniquely trained and equipped to effectively handle the most time critical emergency on scene. The Round Rock Fire Department consists of 81 active firefighters and captains, 4 Battalion Chiefs, 1 Deputy Chief and a Fire Chief. There are 7 front line fire suppression apparatus (i.e., engines and a ladder truck), which are staffed by a minimum of three firefighters each. Fire suppression units are stationed at 6 fire houses around the Round Rock Fire District. The members of the Round Rock Fire Department who staff these emergency response units provide fire suppression, disaster incident mitigation, technical rescue and initial emergency medical services to the community of Round Rock 24 hours a day, 7 days a week.

The primary emergency services provided by the Round Rock Fire Department include:

1. Fire Suppression
2. Fire Prevention & Fire Investigation
3. Initial Emergency Medical Services
4. Special Operations (*Domestic preparedness, technical rescue, hazardous materials response, and urban search and rescue*)

Each operational program, as described below, has unique responsibilities that support the overall function of the Round Rock Fire Department.

FIRE SUPPRESSION

According to the U.S. Fire Administration, on average, fire departments in the United States respond to 2 million fire calls each year. On a per capita basis, the American fire problem is one of the worst in the industrial world. Table 2 below details the problem. Each year, thousands of Americans die, tens of thousands more are injured, and property losses reach into the billions of dollars. The indirect costs of fire are equally as significant, and include temporary lodging, lost business, medical expenses, psychological damage, and more. The USFA puts this into context by noting that **"the annual losses from floods, hurricanes, tornadoes, earthquakes, and other natural disasters combined in the United States average just a fraction of the casualties from fires."**[7]

[7] U.S. Fire Administration, A Profile of Fire in the United States: 1989-1998, 12th Ed. (Washington, D.C.: 1999)

TABLE 2:
"THE U.S. FIRE PROBLEM"[8]

YEAR	TOTAL FIRES	CIVILIAN DEATHS	CIVILIAN INJURIES	FIREFIGHTER DEATHS	FIREFIGHTER INJURIES	DIRECT PROPERTY DAMAGE[9]
1977	3,264,000	7,395	31,190	157	112,540	$4,709,000,000
1978	2,817,500	7,710	29,825	172	101,100	$4,498,000,000
1979	2,845,500	7,575	31,325	125	95,780	$5,750,000,000
1980	2,988,000	6,505	30,200	138	98,070	$6,254,000,000
1981	2,893,500	6,700	30,450	136	103,340	$6,676,000,000
1982	2,538,000	6,020	30,525	127	98,150	$6,432,000,000
1983	2,326,500	5,920	31,275	113	103,150	$6,598,000,000
1984	2,343,000	5,240	28,125	119	102,300	$6,707,000,000
1985	2,371,000	6,185	28,425	128	100,900	$7,324,000,000
1986	2,271,500	5,850	26,825	120	96,450	$6,709,000,000
1987	2,330,000	5,810	28,215	131	102,600	$7,159,000,000
1988	2,436,500	6,215	30,800	136	102,900	$8,352,000,000
1989	2,115,000	5,410	28,250	118	100,700	$8,655,000,000
1990	2,019,000	5,195	28,600	107	100,300	$7,818,000,000
1991	2,041,500	4,465	29,375	108	103,300	$9,467,000,000
1992	1,964,500	4,730	28,700	75	97,700	$8,295,000,000
1993	1,952,500	4,635	30,475	79	101,500	$8,546,000,000
1994	2,054,500	4,275	27,250	104	95,400	$8,151,000,000
1995	1,965,500	4,585	25,775	97	94,500	$8,918,000,000
1996	1,975,000	4,990	25,550	96	87,150	$9,406,000,000
1997	1,795,000	4,050	23,750	98	85,400	$8,525,000,000
1998	1,755,500	4,035	23,100	91	87,500	$8,629,000,000
1999	1,823,000	3,570	21,875	112	88,500	$10,024,000,000
2000	1,708,000	4,045	22,350	103	84,550	$11,207,000,000
2001	1,734,500	6,196[10]	21,100[11]	439[12]	82,250	$44,023,000,000
2002	1,687,500	3,380	18,425	97		$10,337,000,000
2003	*Data not yet available*	*Data not yet available*	*Data not yet available*	105[13]	*Data not yet available*	*Data not yet available*

Every year, fires injure more than 20,000 people, and every year more than 3,000 Americans die in building fires. According to the NFPA, "Every 20 seconds, a fire department responds to a fire somewhere in the nation. A fire occurs in a structure at the rate of one every 61 seconds, and in particular a residential fire occurs every 79 seconds. Fires occur in vehicles at the rate of 1 every 101 seconds, and there's a fire in an outside property every 42 seconds."[14]

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[8] NFPA survey, NFPA's Fire Incident Data Organization (FIDO).

[9] Direct property damage figures do not include indirect losses, like business interruption, and have not been adjusted for inflation.

[10] This includes 2,451 civilian deaths that occurred from the events of 9/11/01.

[11] This includes 800 civilian injuries that occurred from the events of 9/11/01.

[12] Includes 340 firefighters at the World Trade Center, September 11, 2001.

[13] Paul R. LeBlanc and Rita F. Fahy, "Firefighter Fatalities in the United States - 2003," National Fire Protection Association (Quincy, MA: 2004).

[14] Michael J. Karter Jr., Fire Loss in the United States During 2003, National Fire Protection Association (Quincy, MA: October 2004), i.

There occurred 18,125 civilian fire injuries in 2003, a decrease of 1.6% from the previous year. It should be noted, however, that this only an estimation. According to the NFPA, the figure for civilian injuries is on the low side due to under-reporting of civilian injuries to the fire service. Of these injuries, 14,075 occurred in residential properties, while 1,525 occurred in nonresidential structure fires. **Nationwide, there was a civilian fire injury every 29 minutes.**[15]

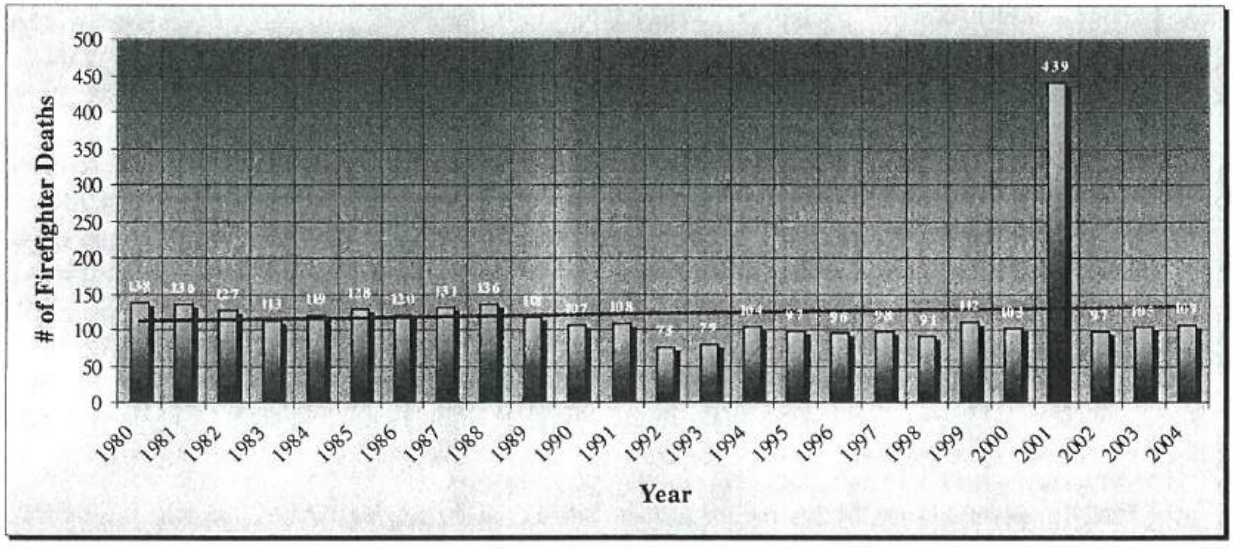
There occurred 3,925 civilian fire deaths in 2003, an *increase* of 16.1% from a year ago. Of these, 3,145 (about 80% of all fire deaths) occurred in the home – an *increase* of 17.8%, and back to the 2000 and 2001 levels. An additional 220 civilians died in nonresidential structure fires. This includes 100 civilians that died in the Station Nightclub Fire in Rhode Island, and 31 civilians who died in nursing home fires in Connecticut and Tennessee. **Nationwide, there was a civilian fire death every 134 minutes.**[16]

Furthermore, each year in the United States and its protectorates, approximately 100 firefighters are killed while on-duty, and tens of thousands more are injured. According to the Federal Emergency Management Agency:

> **Despite a downward dip in the early 1990s, the level of firefighter fatalities is back up to the same levels experienced in the 1980s. If the firefighter deaths at the World Trade Center are included in the 2001 data, the number rises to 23.1 firefighter fatalities per 100,000 fires.**[17]

Figure 1 details the yearly count of on-duty fire fighter fatalities between the years of 1980 and 2004.

FIGURE 1:
"ON-DUTY FIRE FIGHTER FATALITIES"
(1980 – 2004)



[15] Michael J. Karter Jr., Fire Loss in the Unites States During 2003, National Fire Protection Association (Quincy, MA: October 2004), ii.
[16] Ibid.
[17] Firefighter Fatalities in the United States in 2002, Federal Emergency Management Agency (Washington, D.C.: July, 2003), 8.

To effectively respond to emergencies occurring in Round Rock, all firefighters are trained in the latest fire suppression techniques, hazardous material recognition, medical first response and basic rescue techniques. A firefighter's base of knowledge must cover the areas of building construction, hydraulics, medical treatment, fire sprinkler design, safe driving practices, vehicle extrication techniques, and more. Each one of these areas is continually changing with new research and technology utilized in the public and private sectors. Rigorous, comprehensive, and continuous training enables the fire department to deliver water rescue, high & low angle rope rescue, heavy rescue, structural collapse rescue, confined space rescue, and trench rescue.

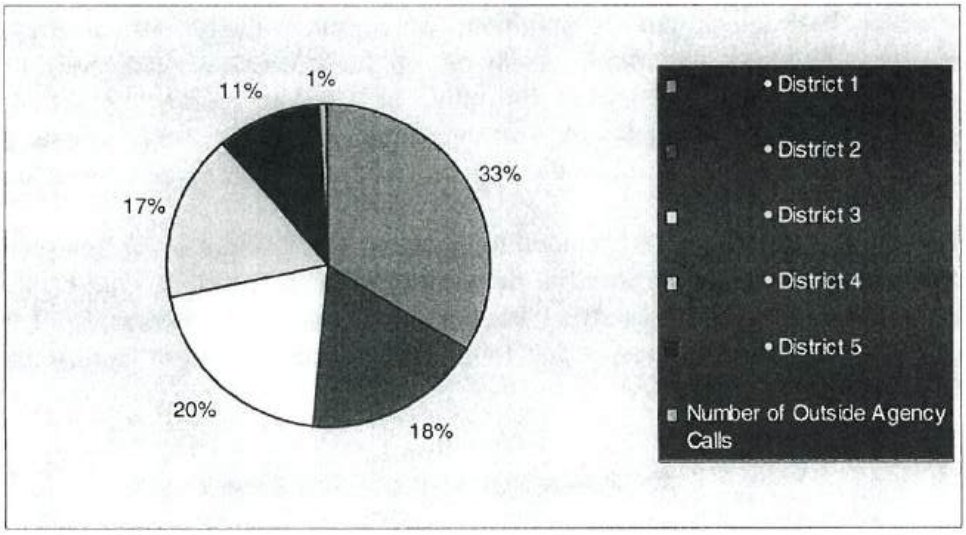
In 2004, the fire department responded to a total of 5,934 requests for emergency assistance. Of these, 5,890 emergencies occurred in the contracted areas of the Round Rock Fire District. An additional 44 emergencies occurring beyond the extent of the Round Rock Fire Department's response jurisdiction were responded to in 2004. Table 3 below details the emergencies by Round Rock Fire Districts.

TABLE 3:
REQUESTS FOR EMERGENCY ASSISTANCE
(2004)

RESPONSE AREA	EMERGENCIES
Number of In-District Calls	**5,890**
• *District 1*	*2,006*
• *District 2*	*1,051*
• *District 3*	*1,190*
• *District 4*	*1,014*
• *District 5*	*629*
Number of Outside Agency Calls	**44**
Total Number of Emergency Requests	**5,934**

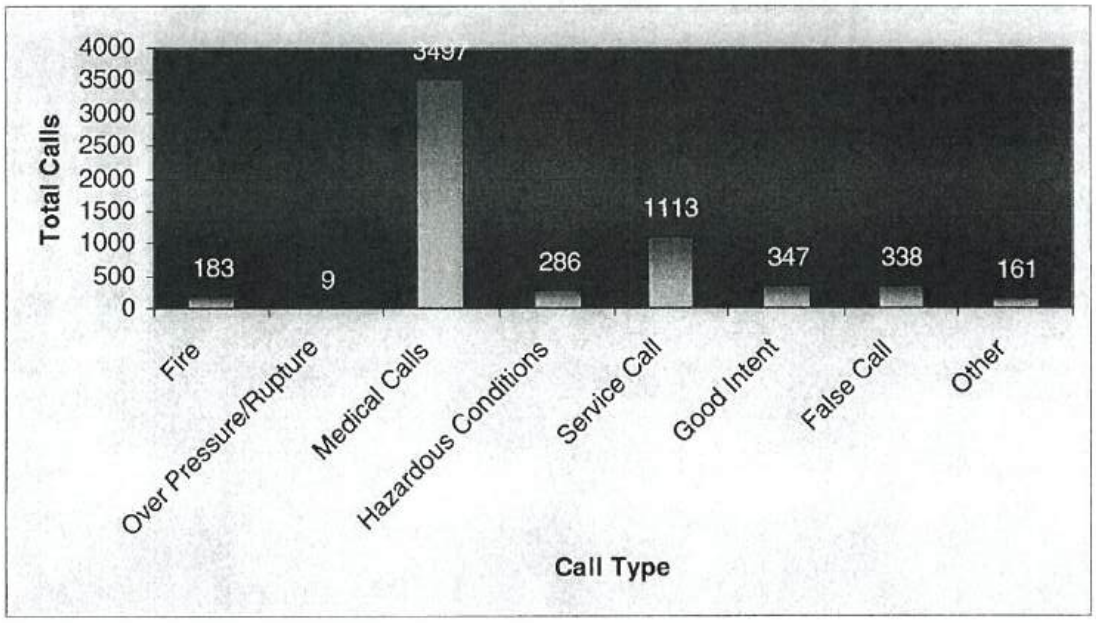
Based on 2004 response statistics, these figures are detailed as percentages in the following figure. Note that 0.74% of all emergency requests occurred beyond the Round Rock Fire District Boundaries.

FIGURE 2:
REQUESTS FOR EMERGENCY ASSISTANCE
(2004)



As is indicated in Figure 2, at nearly 33% of calls, District 1 was the busiest of the fire Districts, followed by District 3 with 20% of calls, District 2 with 18% of calls, District 4 with 17% of calls, District 5 with 11% of call and 1% of calls outside the Round Rock Fire District. The following graphs indicate response activity in the year 2004, by call type.

FIGURE 3:
CALL TYPE EMERGENCY RESPONSE SUMMARY
(2004)



As is indicated in Figure 3, at nearly 3,500 calls, Medical Calls were the most frequent type of call run by the Round Rock Fire Department. **The Medical Calls accounted for 58.9% of the Round Rock Fire Department's total emergency response activity.**

Fire prevention is an important component in all aspects of fire department operations, including education, training, fire cause investigation and determination, support for the preparation of litigation pertaining to arson, and victim assistance. As noted in a recent study, "Some of the greatest value delivered by the U.S. fire service comes in activities that prevent fire and other emergencies from occurring or that moderate their severity when they do occur."[18]

Fire prevention encompasses the performance of mandatory inspections at hospitals, child/adult care facilities, correctional institutions, hotels and motels, foster homes, preschool facilities, health spas and any businesses that, by decree of state law, require inspection. The fire department inspects all new construction, major remodels, and fire protection system revisions to ensure compliance with existing fire codes, the set of fire-safety regulations relating to construction, maintenance of buildings and the use of premises.

Additional fire prevention efforts pursued by the Round Rock Fire Department are aimed at reducing the factors which contribute to the cause and spread of fire. These efforts include consultations with the public, the issuance of permits, and public education programs targeted towards schoolchildren and seniors.

The Value and Purpose of Fire Inspection & Prevention Programs

Fire prevention consists of three elements: codes and code enforcement, fire prevention inspections, and fire education. The American Insurance Association lists the value and purpose of fire department inspections and fire prevention programs as follows:

> 1. *To obtain proper life safety conditions.* Life safety inspections call for attention to the adequacy of exits, obstructions to rapid and orderly egress at time of fire, the adequacy of building evacuation plans, and the determination of the number of occupants permitted in a place of public assembly.
>
> 2. *To keep fires from starting.* Fire inspectors are specifically trained to identify fire hazards and can point out hazardous conditions and explain their seriousness to those who work among materials or situations which are hazardous.
>
> 3. *To keep fires from spreading.* Most people have little appreciation of the value that structural features (stair and elevator enclosures, fire doors and fire partitions) have in preventing the spread of fire. Inspectors educate owners and occupants in the value of proper maintenance of such structural members and have additional features installed, when necessary.
>
> 4. *To determine the adequacy and maintenance of fire protection equipment.* Private fire protection equipment such as extinguishers, standpipes, hose systems, automatic sprinkler systems, private water supplies, and alarm systems are installed to alert and protect building occupants and to aid in fire department operations. Under normal conditions this equipment is seldom used. Frequent

[18] National Fire Protection Association/U.S. Fire Administration, A Needs Assessment of the U.S. Fire Service: A Cooperative Study Authorized by U.S. Public Law 106-938, (Washington, D.C.: December 2002), 49.

inspections therefore are necessary to insure that the equipment will always be in proper working order.

5. *To pre-plan fire fighting procedures.* The "pre-fire plan" of a particular building calls for a knowledge of the building's fire hazards, fire protection equipment, construction features affecting the spread of fire, exposures, and exit facilities. Pre-planning is necessary for the protection of fire fighters as well as the occupants, and aids in efficient extinguishment. Fire department personnel conduct inspections and incident pre-planning on specific residential properties, including triplexes and larger dwellings, in addition to all commercial businesses in the community. Personnel are responsible for checking business licenses in all commercial occupancies during the course of their regular building inspection tours, and for checking permits for hazardous processes, special occupancies and any activity that may produce conditions hazardous to life or property. Regular inspections and pre-planning provide for the systematic inspection of all commercial occupancies, and help to reduce the loss of life and property due to fire and other hazards.

6. *To stimulate cooperation between the fire department and owners and occupants.* Inspectors provide valuable advice on problems of fire protection and prevention. Such advice fosters cooperation between the community and the fire department, and serves to increase the standing of the department within the community.

7. *To assure compliance with fire codes, laws, and regulations.* Inspectors are trained to recognize and correct violations, and are empowered to enforce fire code regulations.[19]

Arson Investigation

According to the United States Fire Administration, arson is the leading cause of fire in the United States. The general public typically views arson as an insurance concern – primarily a "paper" crime of fraud mostly affecting insurance companies. Each year, an estimated 267,000 fires are attributed to arson, which result in $1.4 billion in property loss.

Arsonists, however, injure and kill both civilians and firefighters, causing over 2,000 injuries and nearly 500 deaths per year.[20] Increasingly, set fires motivated by spite and revenge are used as weapons. Such fires tend to be more deadly because they are targeted specifically to inflict personal harm. According to the USFA, "firefighters are 3 times more likely to be injured or killed while responding to arson versus a non-arson fire."[21]

The Round Rock Fire Department pursues investigations should the fire cause be "undetermined" or "suspicious in origin," "incendiary in origin," or result in serious injury or

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[19] James F. Casey, ed., Fire Prevention, Fire Chief's Handbook, 4th ed., (Saddle Brook, N.J., 1987), 530-532.

[20] U.S. Fire Administration, "Arson in the United States," Topical Fire Research Series; vol. 1, issue 8 (Washington, D.C.: January 2001)

[21] USFA Press Release, United States Fire Administration Announces Arson Awareness Week Theme for May 5-11, 2002, (Washington, D.C.: May 3, 2002). < http://www.usfa.fema.gov/inside-usfa/media/2002releases/02-042.shtm >

death. The fire department coordinates with local law enforcement agencies to aggressively prosecute individuals who commit the crime of arson.

Public Education

The Round Rock Fire Department realizes that the most effective way to reduce the tragedies due to fire is to provide the proper fire safety tools to the community. The fire department strives to achieve this by conducting station tours to different groups within the community and by targeting education programs to children in local schools, where educational programs that teach children what to do in a fire situation. In addition, educational programs for school age children address the risks involved in playing with fire and the dangers of playing with matches and lighters,[22] as children are naturally curious about fire. The U.S. Fire Administration characterizes the problem of juvenile fire setting as follows:

> Some studies suggest that interest in fire develops even before age three.[23] However, whether a child actually sets fires depends on a variety of factors, including their exposure to fire and the availability of fire supplies. Although some children who set fires are unaware of the potentially tragic consequences of their actions and are simply curious, others are fully aware of the ramifications of their actions and purposely intend to cause damage. Regardless of the motivations underlying juvenile fire-setting, it is a widespread problem that affects not only those children and their families, but all of society.[24]

According to the NFPA, "in 1999, an estimated 41,900 child-playing fires were reported in the U.S., with associated losses of 165 civilian deaths, 1,901 civilian injuries, and $272 million in direct damage."[25] For the eighth straight year, juvenile fire-setters accounted for at least half (50%) of those arrested for arson in 2001 (the last year for which data is available). Nearly one-third of arrestees were children under the age of 15, and 5% were under the age of 10. According to FBI statistics, only 16% of 2001 arson offenses were solved by arrest. Juvenile offenders accounted for 45% of these arrests.[26] These facts underline the importance of community fire prevention programs, especially in the community's younger population.

Emergency Medical Services

The Round Rock Fire Department provides the citizens of and visitors to Round Rock with initial emergency response. Each apparatus in the fire department is equipped with basic life support equipment, including automatic external defibrillators (AEDs) and oxygen. All firefighters in the Round Rock Fire Department are certified at a minimum, to the level of "Basic" emergency medical technicians (EMT-B). The distinction between the basic level provider and more advanced level of EMS provision (i.e., Paramedic) is that only Paramedics trained in the delivery of advanced life support (ALS) are certified to provide advanced levels of care, such as drug and intravenous (I.V.) therapy.

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[22] These efforts re part of NFPA's *Risk Watch®* curriculum, which incorporates elements from the earlier *Learn Not to Burn® Curriculum*.

[23] D.J. Kolko and A.E. Kazdin, "A Conceptualization of Fire-setting in Children and Adolescents," Journal of Abnormal Child Psychology, 14, (1), 49-61, 1999.

[24] U.S. Fire Administration, "Children and Fire," Topical Fire Research Series, vol. 1, issue 6 (Washington, D.C.: December, 2001).

[25] John R. Hall, Jr., Children Playing with Fire, National Fire Protection Association, (Quincy, MA: November 2003), i.

[26] John R. Hall, Jr., Intentional Fires and Arson, National Fire Protection Association (Quincy, MA: May 2003).

All fire fighters trained as EMT-Bs in Round Rock are also trained and certified in the delivery of automatic external defibrillation and basic airway management. Therefore, an engine company is dispatched on all life-threatening calls, generally arriving before ALS-capable ambulances.

SPECIAL OPERATIONS

Special Operations at the Round Rock Fire Department encompasses the provision and delivery of hazardous materials response, domestic preparedness, urban search and rescue, and specialized/technical rescue.

Hazardous Materials (HazMat)

The fire department is assigned to respond to all hazardous materials incidents in the city that threaten life, property and the environment. Hazardous materials are chemical substances, which if released or misused can pose a threat to the environment or health. These chemicals are used in industry, agriculture, medicine, research, and consumer goods. Hazardous materials come in the form of explosives, flammable and combustible substances, poisons, and radioactive materials. These substances are most often released as a result of transportation accidents or because of chemical accidents in plants.[27]

The importance of a rapid response to a hazardous materials incident cannot be overstated. Responding personnel must arrive as promptly as possible to allow for sufficient time to identify the hazards involved and initiate a plan of action that ensures the safety of the community and the on-scene personnel before attempting to rescue and treat any victims.

A hazardous materials incident involves the intentional or accidental release of toxic, combustible, illegal or dangerous nuclear, biological or chemical agents into the environment. Hazardous materials incidents are generalized under three categories: Intentional Releases, Accidental Releases, and Domestic Terrorism.

Intentional Releases

The intentional release of hazardous materials occurs when "individuals and/or companies knowingly and illegally emit or dump toxic waste into landfills, waterways, the atmosphere and the environment in general. An example of such a release would be the illegal 'cooking' of methamphetamine in clandestine drug labs."[28] Drug labs present a serious health and safety issue to a community. A significant amount of time and resources are required to safely dismantle drug labs, decontaminate the area, and mitigate the incident.

Accidental Releases

Accidental releases are the most common type of hazardous materials incident that fire departments respond to. "These incidents include the release of all types of spills and leaks of

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[27] Federal Emergency Management Agency, Backgrounder: Hazardous Materials, < http://www.fema.gov/hazards/hazardousmaterials/hazmat.shtm > Site visited April 15, 2004.

[28] Seattle Fire Department website: < http://www.ci.seattle.wa.us/fire/text/firefighting/operations/t_hazMat.htm >; site visited September 2, 2004.

toxic agents resulting from collisions, container breakage or failure, fires, floods and simple human error."[29]

Domestic Terrorism

Domestic terrorism involving hazardous materials can be defined as the intentional and malicious release of deadly biological or chemical agents into the general population. Terrorist activities that have occurred in past years– the bombing of Murrah Federal Building in Oklahoma City, the release of a deadly nerve gas (sarin) in a Tokyo subway system, terrorist attacks in New York City and Washington, DC, anthrax attacks along the eastern seaboard, and, most recently, the delivery of ricin to the U.S. Capitol– have prompted the expansion of hazardous materials preparedness and response capabilities, both nationally and internationally.

[29] Seattle Fire Department website: < http://www.ci.seattle.wa.us/fire/text/firefighting/operations/t_hazMat.htm >; site visited September 2, 2004.

GIS ANALYSIS METHODOLOGY

METHODOLOGY

OVERVIEW

Once the domain of cartographers, computer-assisted drawing technicians, mainframes, and workstations, geographic information systems (GIS) mapping has migrated to the desktop. With ArcView, a user can create intelligent, dynamic maps, using data from virtually any source and across most popular computing platforms to display information that has a geographic aspect. The ArcView GIS software, a product of ESRI, Inc., allows desktop users to work simultaneously with maps, database tables, charts, and graphics, and is an effective tool for conducting computerized system analysis and management.

Geographic information systems are used by government agencies, nonprofit organizations, and businesses to describe and analyze the physical world. Simply put, a GIS combines layers of information about a geographic region to give you a better understanding of that region. Layers of information can be combined depending on the purpose of the study, forming a computer model of a jurisdiction on which many types of analysis can be made. In the public safety sector, and for the purposes of this analysis, GIS software uses geography and computer-generated maps as an interface for integrating and accessing location-based information. For example, the location of fire stations can be layered on a jurisdiction's geography including the road network, water features, building footprints, or any other feature that has been digitized and assigned a location. In this manner, GIS allows public safety personnel to effectively plan for emergency response, determine mitigation priorities, analyze historical events, and predict future events. GIS can also be used to provide critical information to emergency responders upon dispatch or while en route to an incident to assist in tactical planning.

NFPA 1710 AND GIS ANALYSIS

While modern science has been well integrated into many areas of emergency response, it has been glaringly absent in the area of fire-rescue organization and deployment. Fire growth and behavior are scientifically measurable, as are the expected outcomes associated with untreated cardiac arrest, and the specific resource requirements to control fires, reduce fire-related injuries, and prevent deaths. Despite these facts, many communities maintain an *ad hoc* approach fire-rescue organization and deployment.

The Role of the National Fire Protection Association (NFPA)

The mission of the NFPA is to reduce the worldwide burden of fire and other hazards on the quality of life by providing and advocating scientifically-based consensus codes and standards, research, training, and education, and recommends that all fire departments establish a policy of providing and operating with "the highest possible levels of safety and health for all members."[30]

The recommendations and analysis contained in this study are guided by NFPA standards for two important reasons. First, NFPA standards provide fire departments with a measure of "interoperability." Interoperability enables fire service personnel in the chain of command to speak the same language and conform to the same operational guidelines. NFPA standards provide the fire service with a common language, common definitions, and common requirements that are meant to foster the *safe* and *effective* delivery of fire suppression, rescue,

[30] NFPA Mission Statement

EMS, and special services to a given community. Second, NFPA standards are formulated via consensus development. Development of NFPA standards are the result of scientific research, empirical studies, and consensus among technical experts and the organizations they are affiliated with. Combined, these factors legitimate NFPA standards as the yardstick by which fire departments are measured internationally.

On account of their emphasis on safe and effective fire suppression and rescue operations, the two standards that will be referenced most often throughout this analysis are NFPA 1500 and NFPA 1710. NFPA 1500, *Standard on Fire Department Occupational Safety and Health Program*, specifies (1) the minimum requirements for a fire department's occupational safety and health program, and (2) the safety procedures for members involved in rescue, fire suppression, and related activities. This standard addresses organization, training and education, vehicles, equipment, protective clothing, emergency operations, facilities, medical and physical criteria, and member assistance programs. NFPA 1500 recommends that a "**minimum acceptable fire company staffing level should be four members responding on or arriving with each engine and each ladder company responding to any type of fire.**"

The purpose of 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*, is "to specify the minimum criteria addressing the effectiveness and efficiency of the career public fire suppression operations, emergency medical service, and special operations delivery in protecting the public of the jurisdiction and the occupational safety and health of fire department employees."[31] The standard recommends "fire companies, whose primary functions are to pump and deliver water and perform basic fire fighting at fires, including search and rescue... shall be staffed with a **minimum of four on-duty personnel**.[32] Fire companies whose primary functions are to perform the variety of services associated with truck work, such as forcible entry, ventilation, search and rescue, aerial operations for water delivery and rescue, utility control, illumination, overhaul and salvage work... shall [also] be staffed with a **minimum of four on-duty personnel**.[33] In jurisdictions with tactical hazards, high hazard occupancies, high incident frequencies, geographical restrictions, or other pertinent factors as identified by the authority having jurisdiction, these companies shall be staffed with a minimum of five or six on-duty members."[34]

The NFPA 1710 Standard is important because it applies the documented and proven science of fire behavior and emergency medicine to the basic resource requirements for effective fire and emergency service deployment. Coupled with GIS analysis, this application allows a community to determine if the resources allocated for the different types of fires, emergencies, medical calls and other incidents are sufficient to effectively control the incident and protect lives and property. NFPA 1710 sets forth in concise terms the recommended resource requirements for fires, emergencies and other incidents. The standard requires, and GIS analysis facilitates, the emergency response organization to evaluate its performance and report it to the authority having jurisdiction. The approach embodied by NFPA 1710, and supported by GIS analysis, makes communities and fire fighters safer and responders more effective and enhances efficiency.

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[31] NFPA 1710, § 1.2.1
[32] NFPA 1710, § 5.2.2.1 and § 5.2.2.1.1
[33] NFPA 1710, § 5.2.2.2 and § 5.2.2.2.1
[34] NFPA 1710, § 5.2.2.1.2 and § 5.2.2.2.2

NFPA 1710 and the Law

NFPA standards protect communities against liability. In the United States, by law- specifically, the General Duties clause of the Occupational Safety and Health Administration Act- if Congress fails to pass legislation setting industry safety standards, municipal governments nationwide are mandated to follow standards promulgated by an industry-wide trade group, such as the NFPA. Many NFPA standards have been enacted into law at the federal, state, provincial and local levels. Although jurisdictions having authority are not required to automatically enact a particular NFPA standard, courts frequently rely upon NFPA standards to determine the "industry standard" for fire protection and safety measures. Judicial reliance on NFPA doctrines is most frequently found in common law negligence claims. To prevail in a common law negligence claim, the plaintiff must show that the defendant owed a duty of care to the plaintiff, that the defendant breached this duty of care and that this breach was the cause of the plaintiff's injury. Hence, **the NFPA 1710 standard could be found highly relevant to the question of whether a jurisdiction has negligently failed to provide adequate fire or emergency medical protection to an individual harmed in a fire or medical emergency. Furthermore, any local government that fails to follow the NFPA 1710 Standard is subject to liability claims in the event of fire fighter injuries or death.**

ARCVIEW 3.2a AND NETWORK ANALYST GEOGRAPHIC INFORMATION SYSTEMS

ArcView's Network Analyst is an extension, or software tool, that manipulates the network data incorporated into a GIS. Networks are interconnected line features, visually represented as roads, rivers, pipelines, or trails. From this data, it is possible to determine the best route between two spots or amongst several points, calculate travel cost in distance or time, find the closest facility to an address, or model service areas.

Travel speed throughout the Round Rock Fire District is set to 30 mile per hour (MPH) for all roads. The vector road data obtained from the City of Round Rock GIS Information Center was used in this analysis.

ASSUMPTIONS

Several key assumptions must be addressed prior to drawing any conclusions from this analysis:

- Modeled travel speeds are based on reasonable and prudent road speeds. **Actual response speeds may be slower, and the associated travel times greater, with any traffic congestion or any other unpredictable impedances including, but not limited to:**

  ✓ ***Traffic Incidents***: collisions and vehicle breakdowns causing lane blockages and driver distractions.

  ✓ ***Work Zones***: construction and maintenance activity that can cause added travel time in locations and times where congestion is not normally present.

  ✓ ***Weather***: reduced visibility, road surface problems and uncertain waiting conditions result in extra travel time and altered trip patterns.

✓ ***Demand Changes***: traffic volume varies from hour-to-hour and day-to-day and this causes travel time, crowding and congestion patterns to disappear or to significantly worsen for no apparent reason in some locations.

✓ ***Special Events***: an identifiable case of demand changes where the volume and pattern of the change can frequently be predicted or anticipated.

✓ ***Traffic Control Devices***: poorly timed or inoperable traffic signals, drawbridges, railroad grade crossing signals or traveler information systems contribute to irregularities in travel time.

✓ ***Inadequate Road or Transit Capacity***: the interaction of capacity problems with the aforementioned sources causes travel time to expand much faster than demand.[35]

- In addition, it is reasonable to suggest that because larger emergency vehicles are generally more cumbersome and require greater skill to maneuver, their response may be also be negatively affected by their weight, size, and, in some cases, inability to travel narrow surface streets.

- The scenarios depicted herein assume all apparatus are staffed and available to respond from their assigned stations immediately upon dispatch, as indicated in the following tables.

Table 4 below details the location, apparatus, and personnel for each of the Fire Stations in the Round Rock Fire Department.

TABLE 4:
"EXISTING STATION LOCATION & DEPLOYMENT CONFIGURATION"

STATION	ADDRESS	APPARATUS	PERSONNEL
1	203 Commerce Boulevard	**Engine 1** **Truck 1** **Battalion 1**	**3 Firefighter/EMT-Bs** **3 Firefighter/EMT-Bs** **1 Battalion Chief**
2	201 Florence Street	**Engine 2** **Brush 1**	**3 Firefighter/EMT-Bs** *Cross-staffed*
3	1991 Rawhide	**Engine 3**	**3 Firefighter/EMT-Bs**
4	3300 Gattis School Road	**Engine 4**	**3 Firefighter/EMT-Bs**
5	350 Deepwood Drive	**Engine 5**	**3 Firefighter/EMT-Bs**
6	2919 Joe DiMaggio Way	**Engine 6**	**3 Firefighter/EMT-Bs**

Existing On-duty Staffing: 22

- **If any unit is unavailable for any reason** (e.g., simultaneous emergencies, scheduled training, or as a result of mutual aid obligations) **travel times will be greater as more distant apparatus will be required to respond to an emergency with potential delays.**

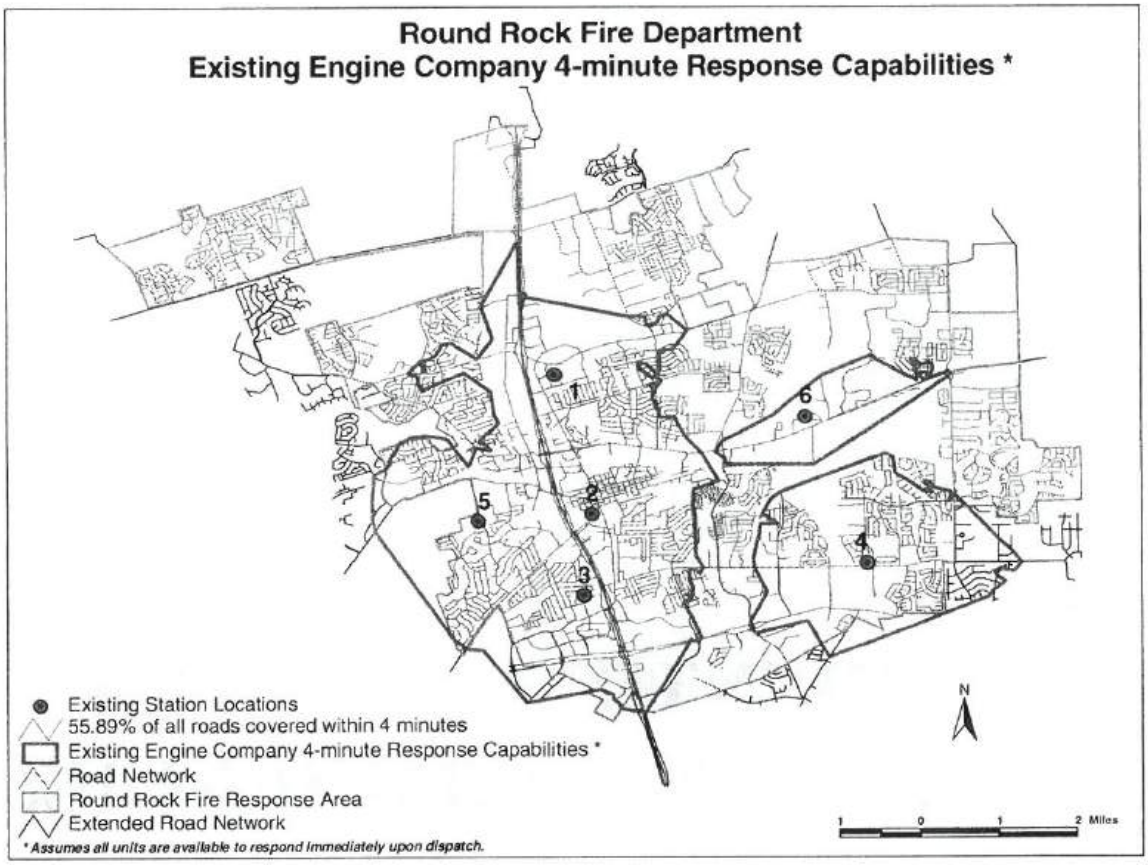
[35] David Schrank and Tim Lomax, The 2003 Urban Mobility Report, (Texas Transportation Institute, Texas A&M University: September 2003).

- **The time from arrival of the apparatus to the onset of interior fire suppression operations and/or initiation of critical emergency medical interventions by that crew** (access interval) **must be considered when analyzing response system capabilities.** In reality, the access interval is dependent upon factors including, but not limited to, distance from the apparatus to the task location and the elevation of the fire or EMS location (i.e., high rise structures). Locked doors or security bars which must be breached also act as impediments to access. Impediments like these may add to the delay between the discovery of a fire and implementation of an actual fire attack, and to the delay between the discovery of an individual in medical distress and the initiation of emergency medical care.

Input information including station locations, apparatus deployment, incident data, and staffing minimums, were provided by the Round Rock Fire Fighter's Association, IAFF Local 3082. The report that follows is a "best estimate" response time model of those roads expected to receive coverage by the Round Rock Fire Department.

IDENTIFICATION OF EXISTING DEFICIENCIES

MAP 2



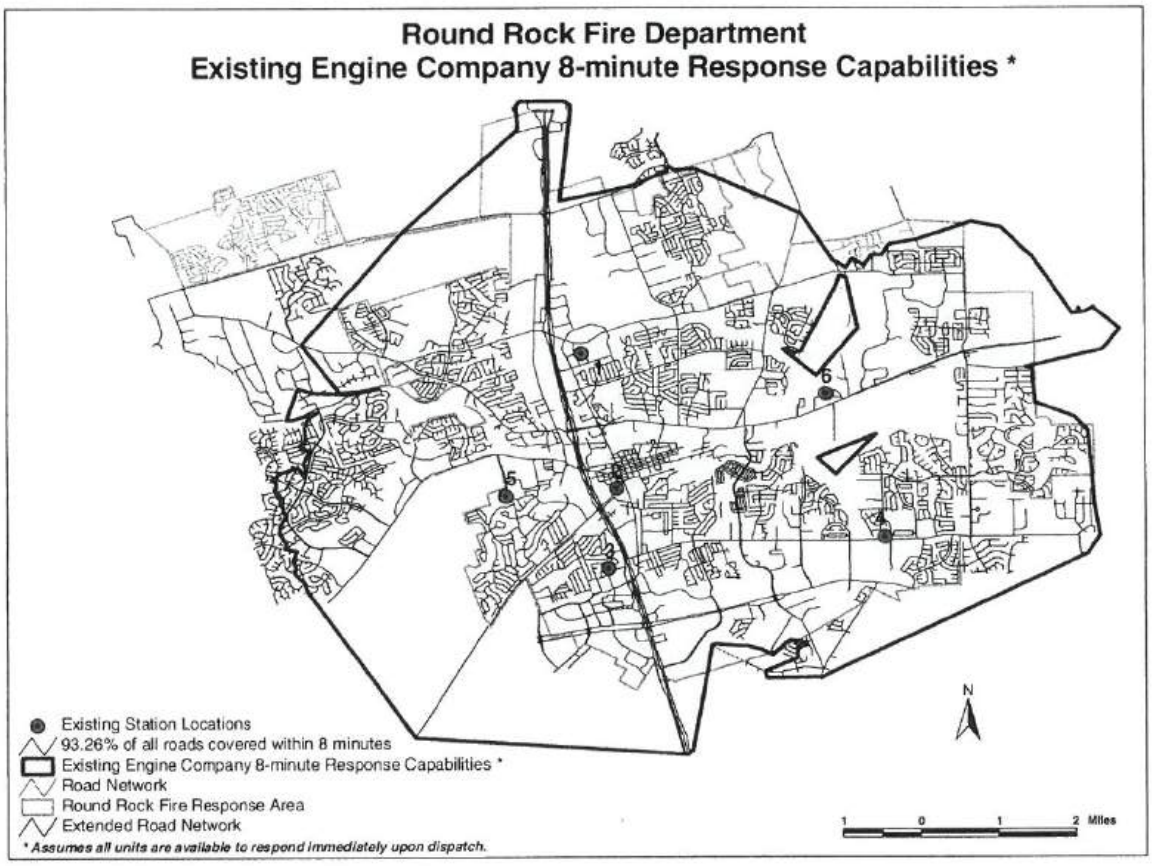
Map 2 indicates the existing 4-minute response areas for engine companies responding from all existing fire stations. Currently, engines that deploy from these six stations are capable of responding to **55.89% of all roads located within the Round Rock Fire District in 4 minutes or less,** *assuming all units are available to respond immediately upon dispatch.* NFPA Standard 1710 recommends "fire companies whose primary functions are to pump and deliver water and perform basic fire fighting at fires, including search and rescue... shall be staffed with **a minimum of four on-duty personnel.**[36] Currently, however, not a single fire department engine company is staffed with four fire fighters, out of compliance with existing national standards. As such, engine companies are limited in their ability to rescue an individual (or individuals) trapped by fire in a residence in a manner that is both *safe* and *effective* until additional personnel arrive on the incident scene.

The largest impediment to fire department response capabilities for this alarm is the assignment of the Battalion Chief (BC) to respond on this alarm type. Under existing conditions, the fire department Battalion Chief, responding from Central Station, is required to respond to a destination within 8 minutes of leaving their station. Upon arrival at the incident scene, the BC assumes operational command as the incident commander (IC), and the role of Safety Officer. While both roles are essential to assuring safe and effective fireground operations, the practice of requiring one BC to respond restricts the ability of the fire department to assemble the units assigned to this alarm type within acceptable time frames. Therefore, **it is the**

[36] NFPA 1710, Section 5.2.2.1 and 5.2.2.1.1

recommendation of this analysis that the Round Rock Fire Department considers the deployment of additional Battalion Chiefs and dedicated chief's aide to the command vehicle. The deployment of an aide to each battalion chief will have the effect of broadening response capabilities for this and similar alarm types. Under such conditions, the deployment of two fire department personnel from a single vehicle - one to establish and direct incident command, and the other to ensure fire fighter accountability.

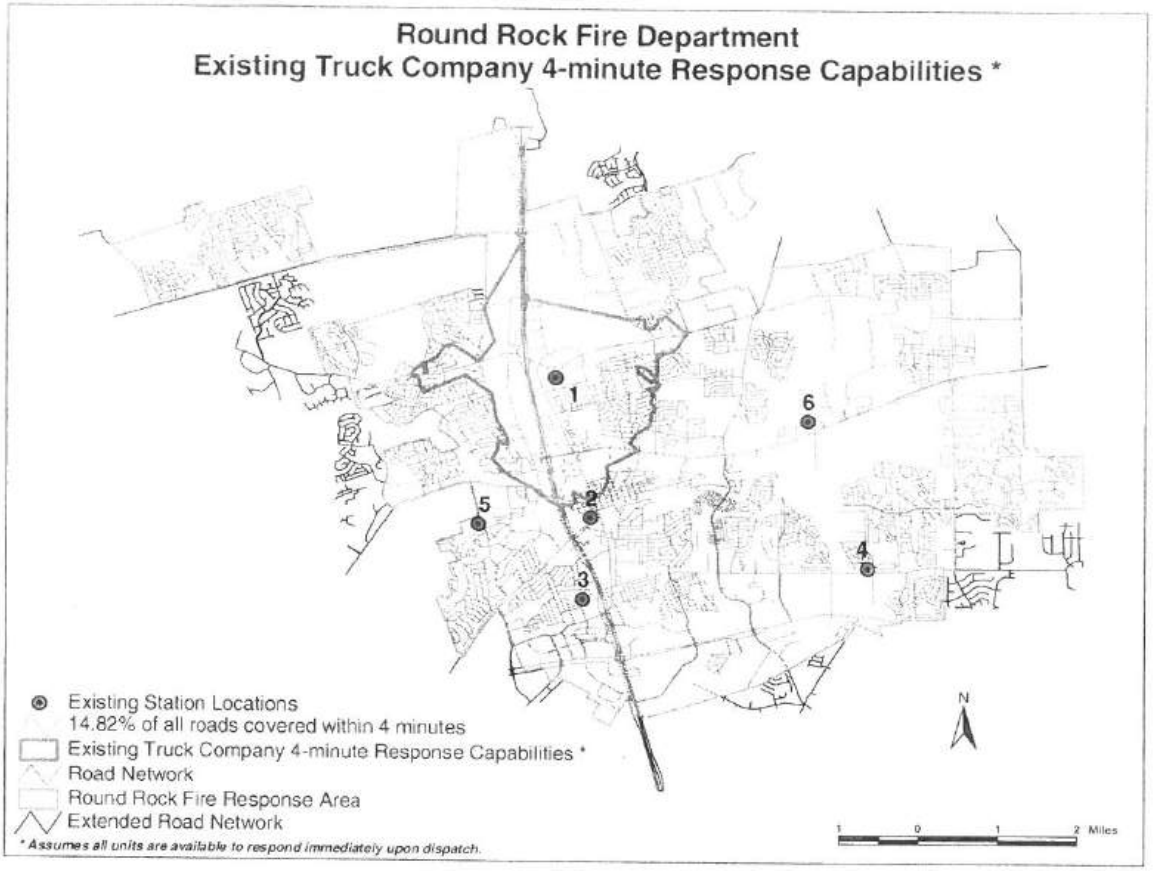
MAP 3



Map 3 indicates the existing 8-minute response areas for engine companies responding from all existing fire stations. Currently, engines deploying from these six stations are capable of responding to **93.26% of all roads located within the Round Rock Fire District in 8 minutes or less,** *assuming all units are available to respond immediately upon dispatch.* NFPA 1710 recommends that all fire suppression units operating in the capacity of engine companies shall be staffed with **a minimum of four on-duty personnel.**[37] Currently, however, not a single fire department engine company is staffed with four fire fighters. It is therefore recommended that **all fire suppression apparatus be staffed on a 24-hour basis with four multi-role, EMS cross-trained fire fighters, at least two of which are certified in the delivery of advanced life support.**

[37] NFPA 1710, Section 5.2.2.1 and 5.2.2.1.1

MAP 4

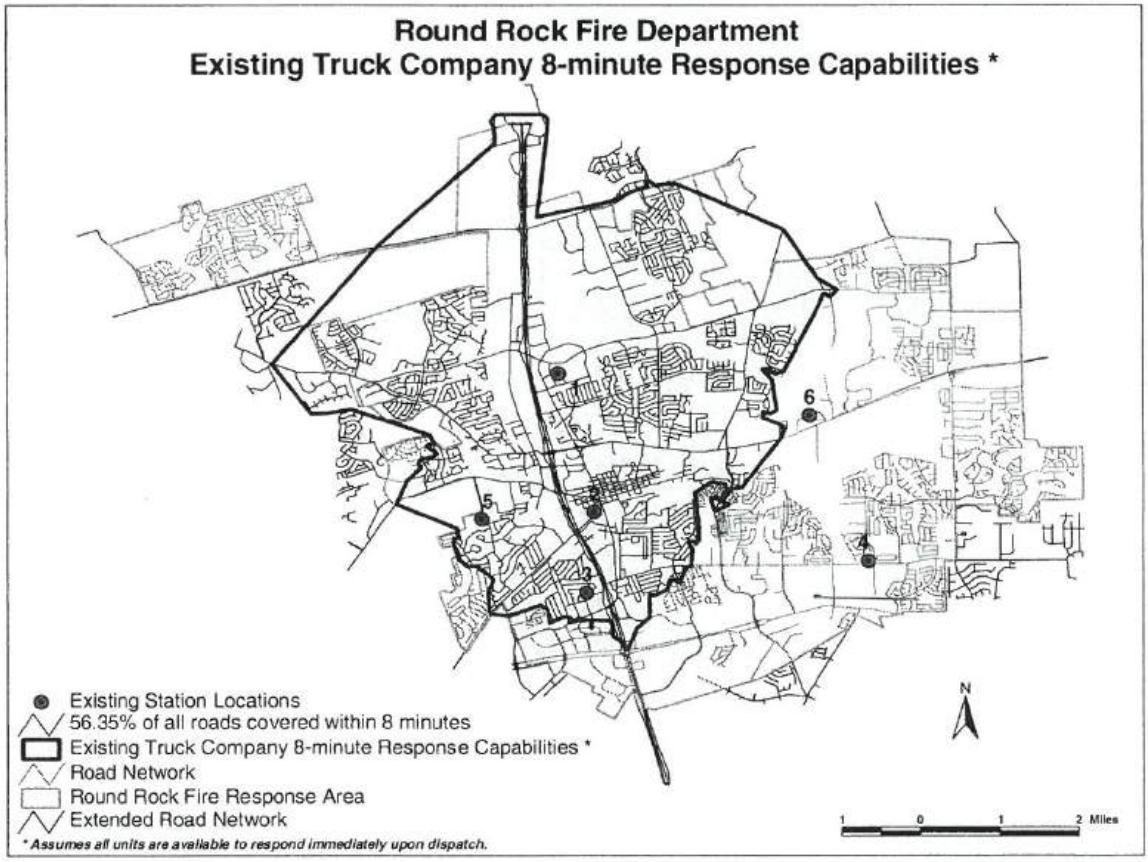


Map 4 indicates the existing 4-minute response area for the ladder company when responding from its assigned station. Currently, the ladder company are capable of responding to **14.82% of all roads located within the Round Rock Fire District in 4 minutes or less,** *assuming the company is available to respond immediately upon dispatch.*

NFPA 1710 states that "fire companies whose primary functions are to perform the variety of services associated with truck work, such as forcible entry, ventilation, search and rescue, aerial operations for water delivery and rescue, utility control, illumination, overhaul and salvage work... shall be staffed with a **minimum of four on-duty personnel.**"[38] Currently, however, the ladder company is staffed with three fire fighters, out of compliance with existing national standards. As such, the ladder company is limited in its ability to rescue an individual (or individuals) trapped by fire in a residence in a manner that is both *safe* and *effective* until additional personnel arrive on the incident scene. **It is therefore the recommendation of this report that the Round Rock Fire Department staff all ladder apparatus with *at least* four multi-role fire fighters, two of which are certified in the delivery of EMS.**

[38] NFPA 1710, Section 5.2.2.2 and 5.2.2.2.1

MAP 5

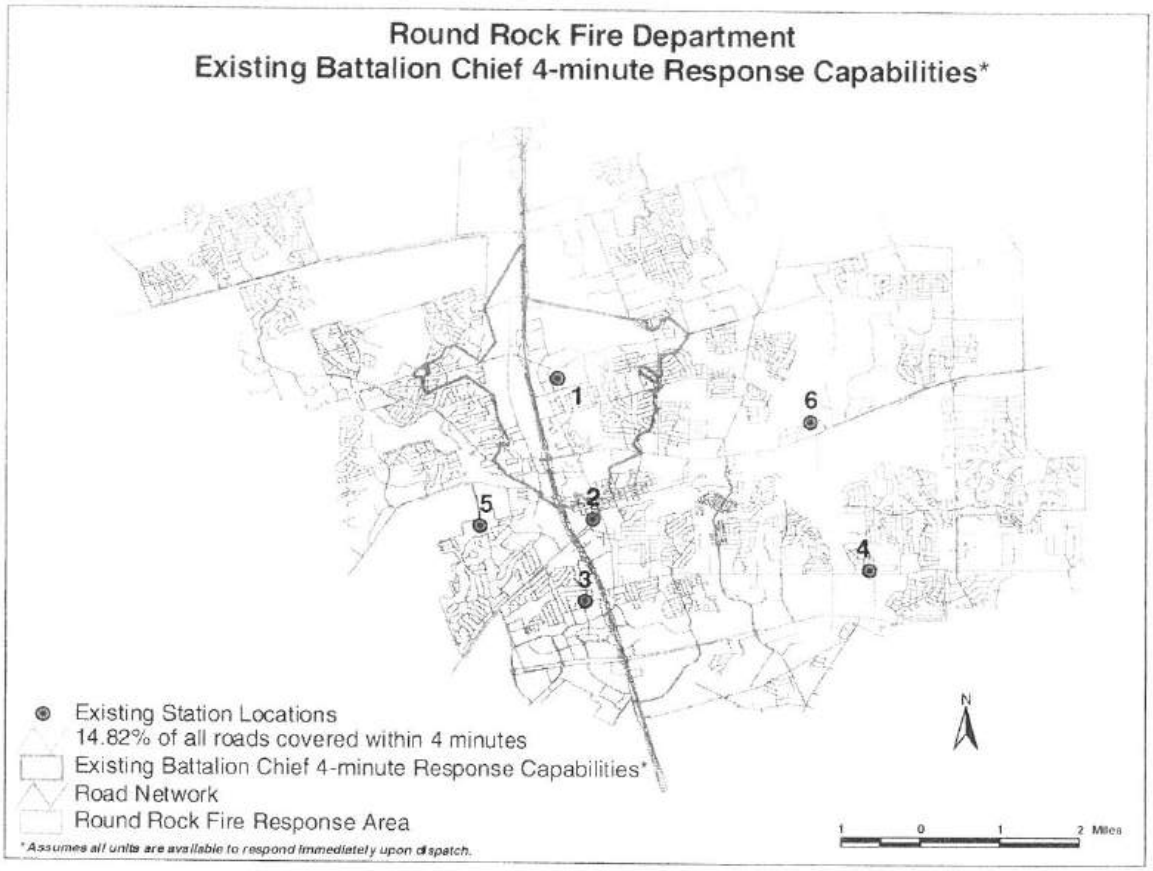


Map 5 indicates the existing 8-minute response area for the ladder company when responding from its assigned station. Currently, the ladder company is capable of responding to **56.35% of all roads located within the Round Rock Fire District in 8 minutes or less,** *assuming all companies are available to respond immediately upon dispatch.*

NFPA 1710 states that "fire companies whose primary functions are to perform the variety of services associated with truck work, such as forcible entry, ventilation, search and rescue, aerial operations for water delivery and rescue, utility control, illumination, overhaul and salvage work... shall be staffed with a **minimum of four on-duty personnel.**"[39] Currently, however, the ladder company is staffed with three fire fighters, out of compliance with existing national standards. As such, the ladder company is limited in its ability to rescue an individual (or individuals) trapped by fire in a residence in a manner that is both *safe* and *effective* until additional personnel arrive on the incident scene. **It is therefore the recommendation of this report that the Round Rock Fire Department staff the current dedicated ladder apparatus with *at least* four multi-role fire fighters, two of which are certified in the delivery of EMS. Additionally, the Round Rock Fire Department should consider deploying a dedicated Ladder Company assigned to a full service ladder apparatus from Station 4.**

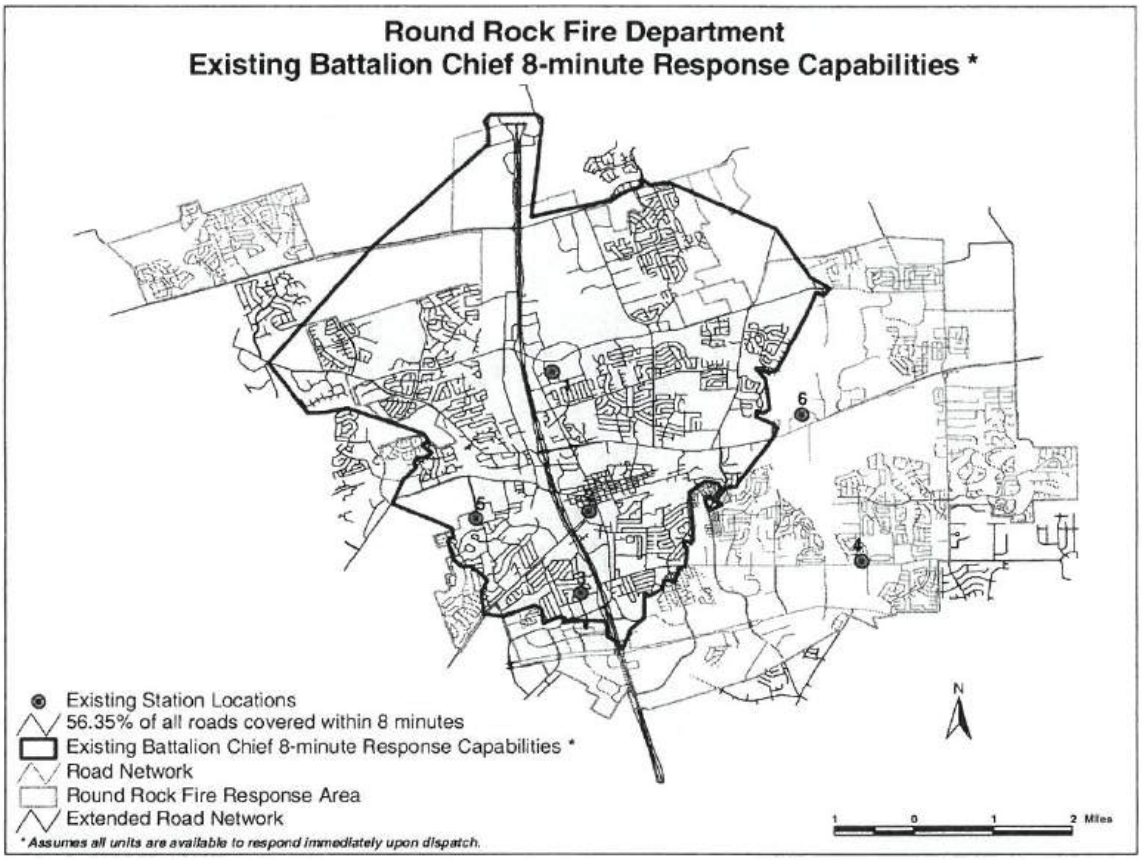
[39] NFPA 1710, Section 5.2.2.2 and 5.2.2.2.1

MAP 6



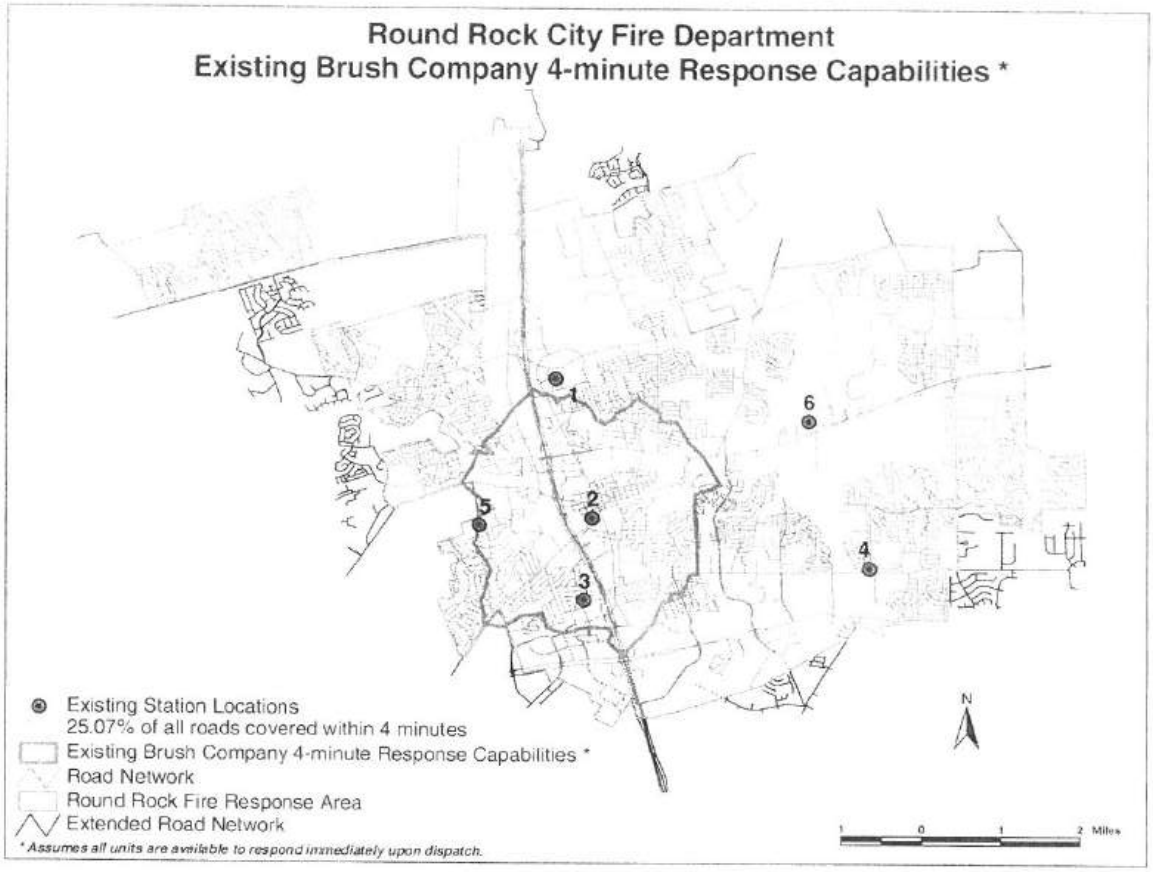
Map 6 indicates the existing Battalion Chief command vehicle 4-minute response capabilities. Currently, the Battalion Chief, when responding from Central Station, is capable of responding to **14.82% of all roads located within the Round Rock Fire District in 4 minutes or less**, *assuming all units are available to respond immediately upon dispatch.* Out of compliance with NFPA Standard 1710, Section 5.2.1.2.5, which states that, "supervisory chief officers shall have staff aides deployed to them for purposes of incident management and accountability at emergency incidents," a staff aide is not currently assigned to any of the command vehicles. **It is therefore the recommendation of this analysis that the Round Rock Fire Department Battalion Chief deploy with a chief's aide to assist in providing critical incident oversight.**

MAP 7



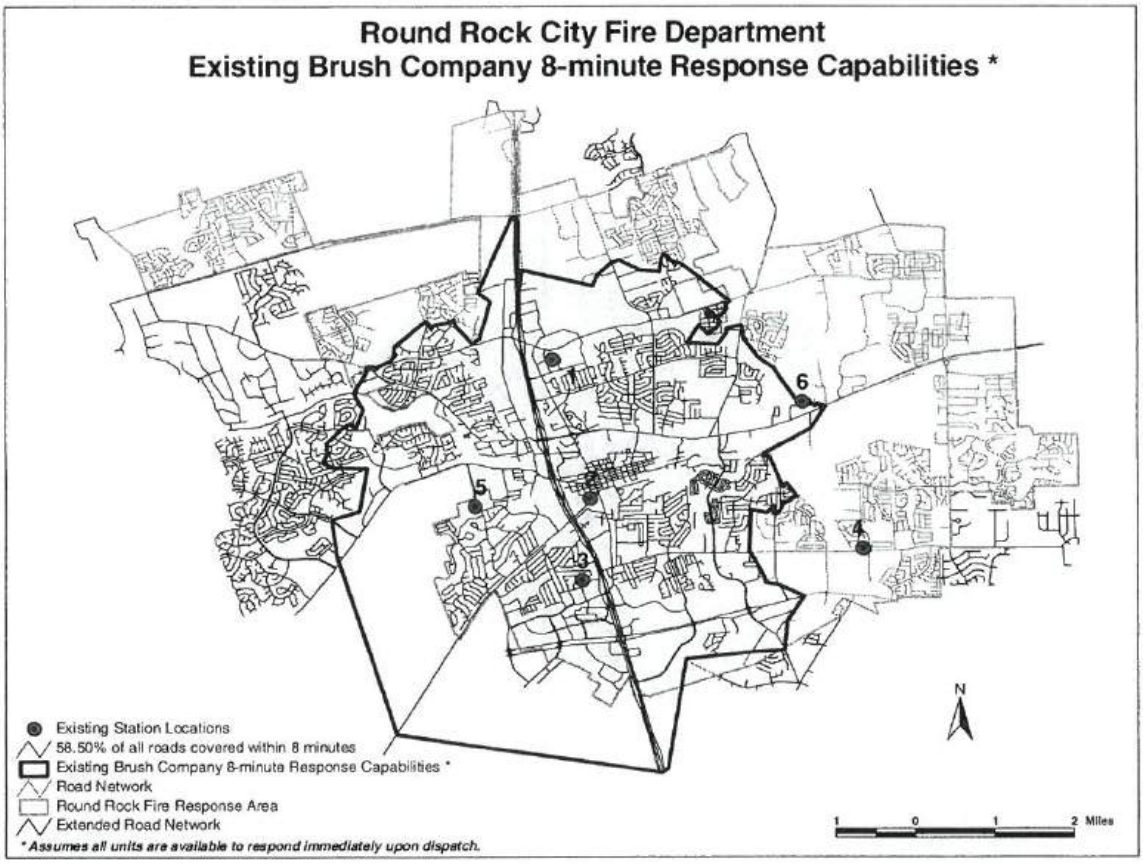
Map 7 indicates the existing Battalion Chief command vehicle 8-minute response capabilities. Currently, the Battalion Chief, when responding from Central Stations, is capable of responding to **56.35% of all roads located within the Round Rock Fire District in 8 minutes or less**, *assuming all units are available to respond immediately upon dispatch.* Out of compliance with NFPA Standard 1710, Section 5.2.1.2.5, which states that, "supervisory chief officers shall have staff aides deployed to them for purposes of incident management and accountability at emergency incidents," a staff aide is not currently assigned to any of the command vehicles. **It is therefore the recommendation of this analysis that Round Rock Fire Department Battalion Chief deploy with a chief's aide to assist in providing critical incident oversight.**

MAP 8



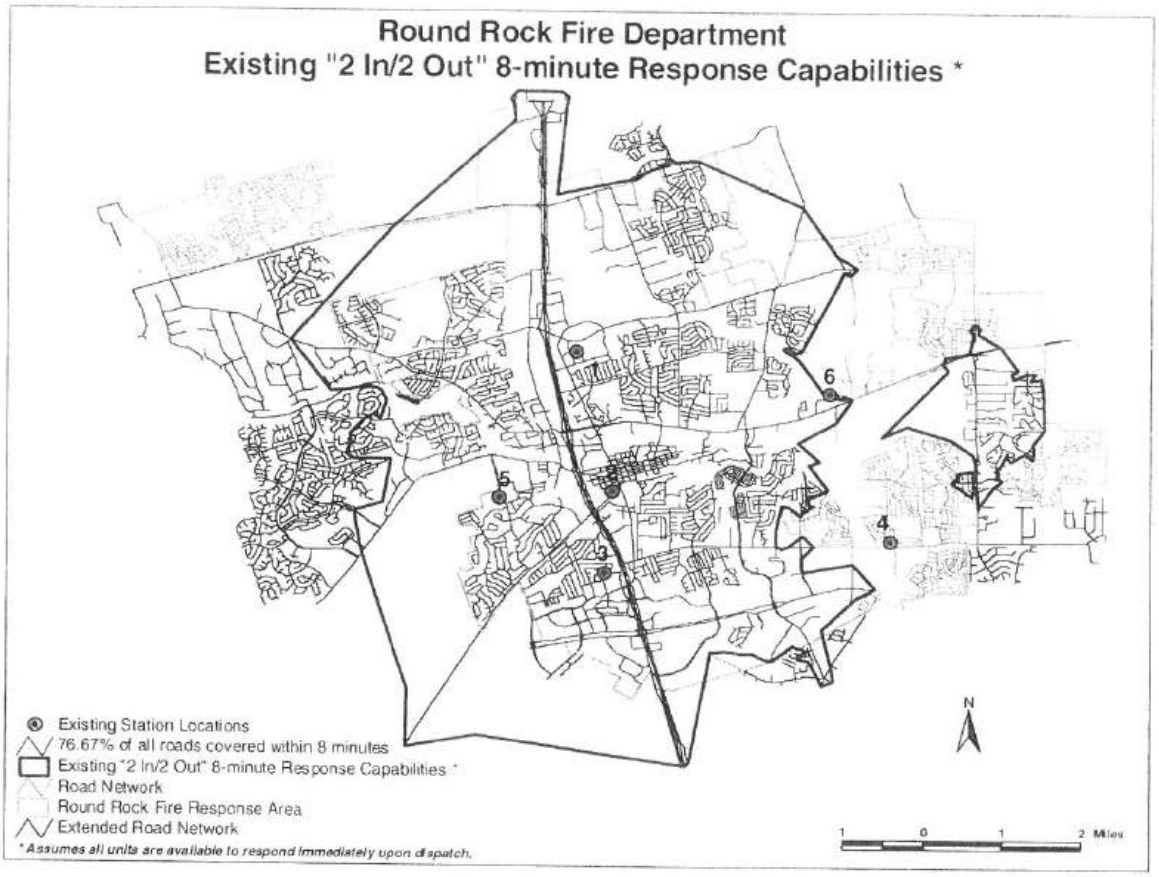
Map 8 indicates the 4-minute response capabilities of fire suppression companies and command units assigned to respond to a brush fire. A typical brush alarm assignment consists of the brush suppression apparatus from Station 2 staffed with the fire suppression personnel from Engine Company 2. Currently, the units assigned to this alarm type are capable of assembling on only **25.07% of all Round Rock Fire District roads within 4 minutes,** *assuming all units are available to respond immediately upon dispatch.* Under the existing deployment configuration, the GIS model is able to predict that **74.93% of all roads in the Round Rock Fire District will not receive the fire suppression resources necessary to initiate *safe* and *effective* brush fire suppression operations within 4 minutes of receiving an alarm**.

MAP 9



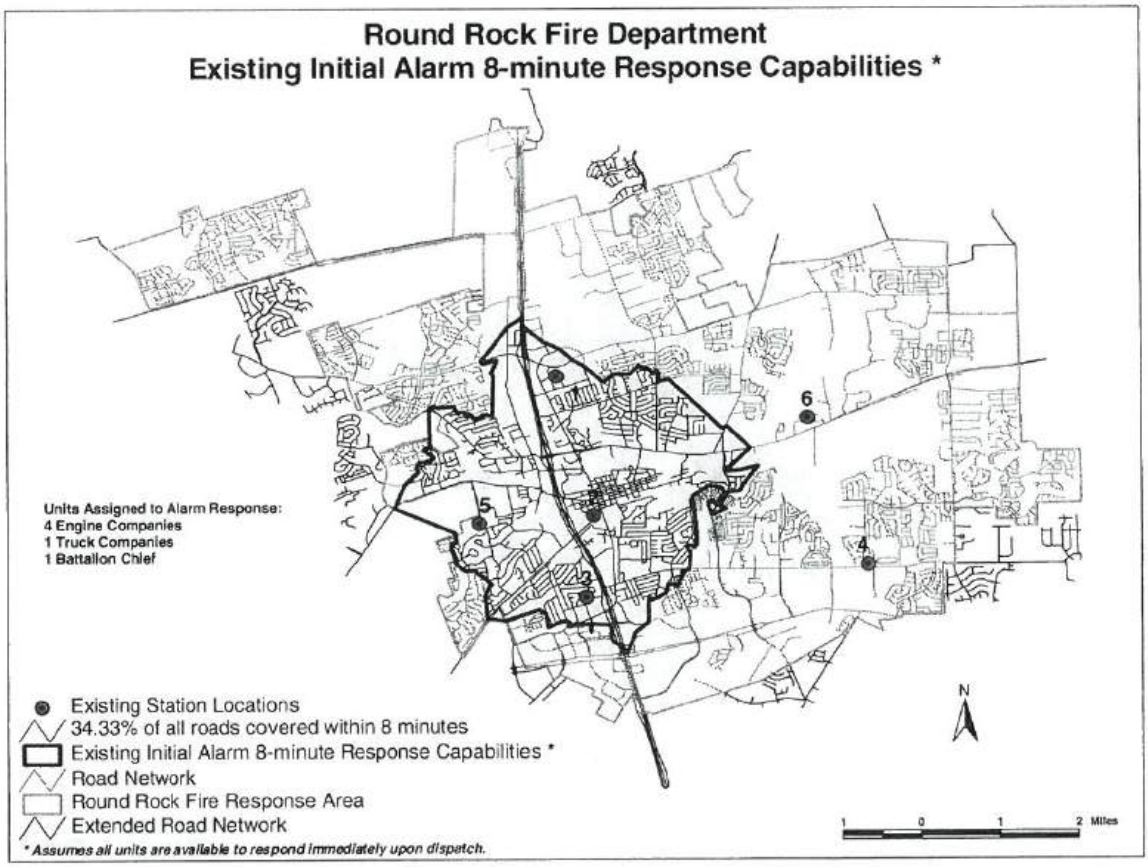
Map 9 indicates the 8-minute response capabilities of fire suppression companies and command units assigned to respond to a brush fire. Currently, the units assigned to this alarm type are capable of assembling on only **58.5% of all Round Rock Fire District roads within 8 minutes,** *assuming all units are available to respond immediately upon dispatch.* Under the existing deployment configuration, the GIS model is able to predict that **41.5% of all roads in the Round Rock Fire District will not receive the fire suppression resources necessary to initiate *safe* and *effective* brush fire suppression operations within 8 minutes of receiving an alarm.**

MAP 10



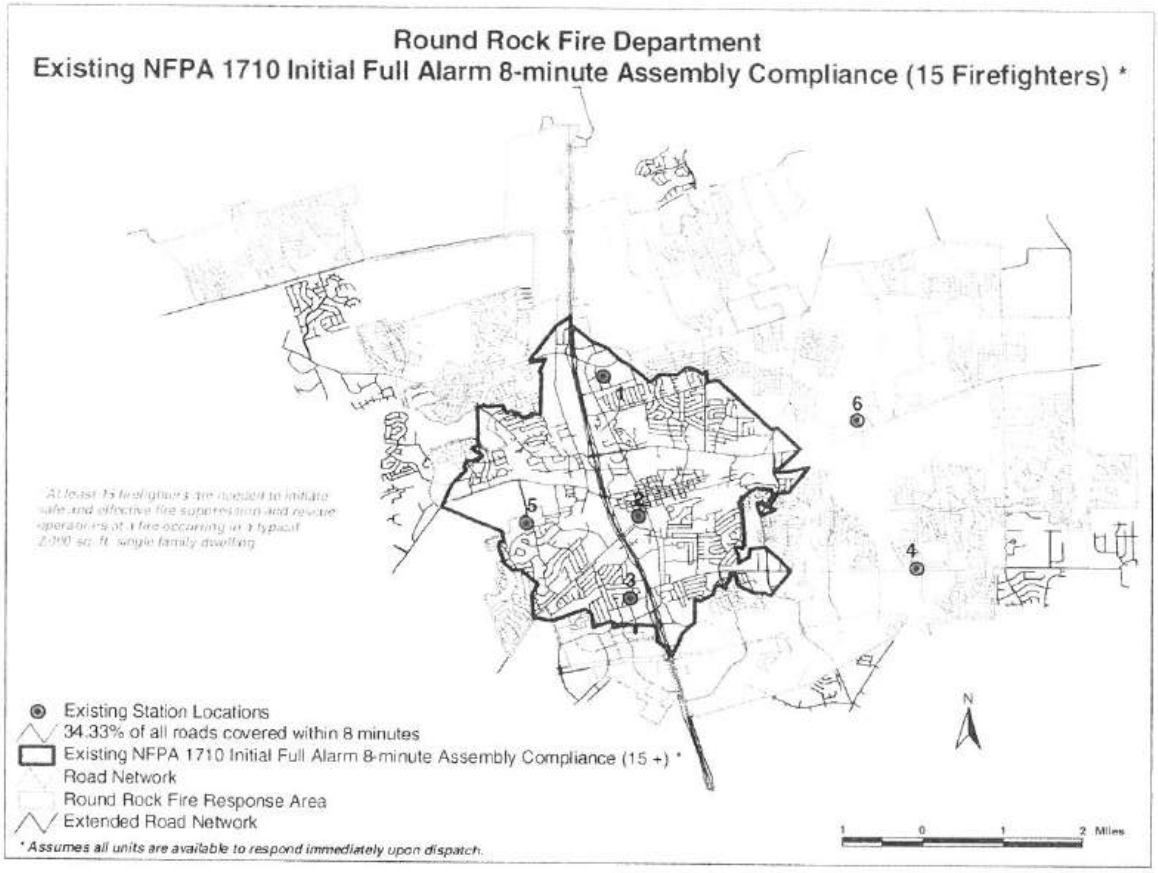
Map 10 indicates those areas where the Round Rock Fire Department is currently capable of initiating *safe* and *effective* fire suppression and rescue operations in accordance with the "2 In/2 Out" regulation (OSHA 29 CFR 1910.134) within 8 minutes. Under these conditions, when fire department units are responding from their assigned stations, it is predicted that **the Round Rock Fire Department is capable of initiating fire suppression and rescue operations in accordance with the "2 In/2 Out" regulation on 76.67% of all Round Rock Fire District roads within 8 minutes,** *assuming all units are fully staffed at existing staffing levels and available to respond immediately upon dispatch.*

MAP 11



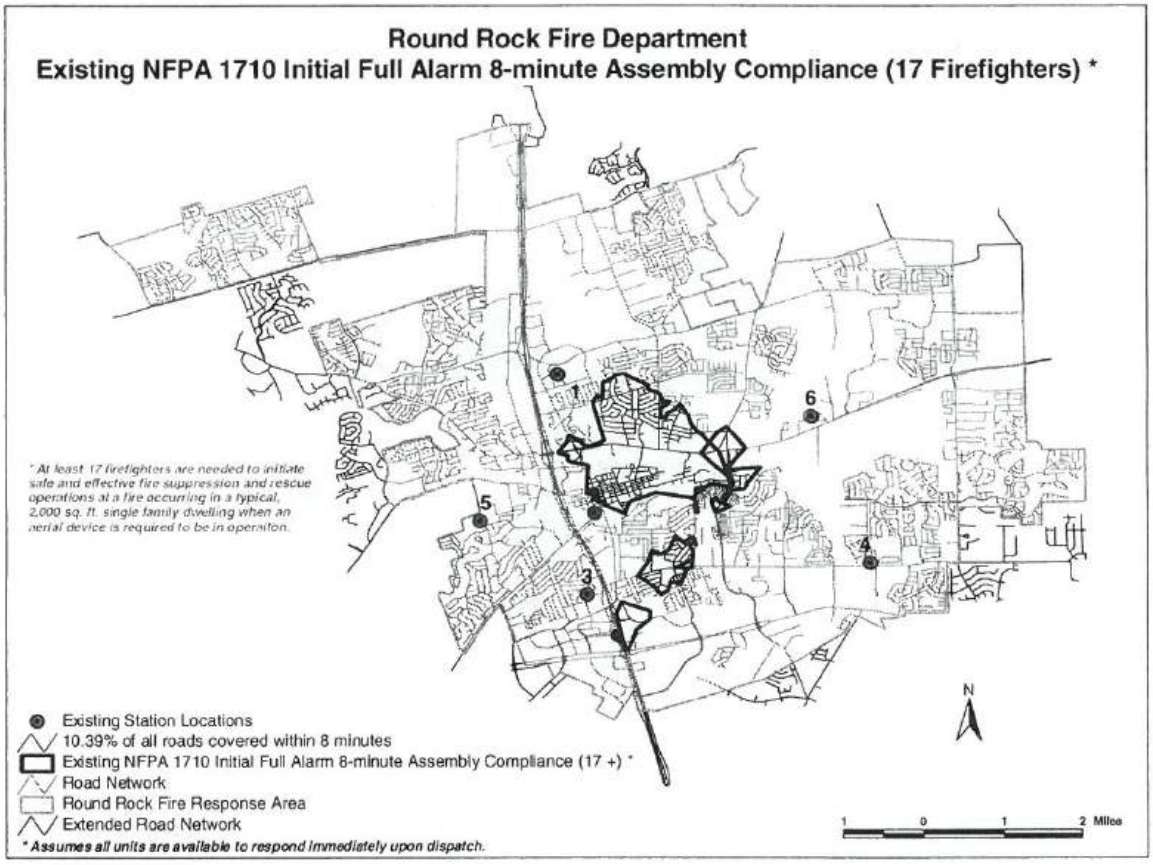
Map 11 indicates the existing 8-minute response capabilities of fire suppression companies and supervisory officers assigned to respond as part of an initial alarm assignment *(i.e., residential structure fire)*. Currently, the units assigned to this alarm type are capable of assembling on **34.33% of all Round Rock Fire District roads within 8 minutes,** *assuming all units are available to respond immediately upon dispatch.* Under the existing deployment configuration, the GIS model is able to predict that **65.67% of all roads in the Round Rock Fire District will not receive the fire suppression resources necessary to initiate *safe* and *effective* fire suppression and rescue operations within 8 minutes of receiving an alarm.**

MAP 12



Map 12 examines the ability of the Round Rock Fire Department to respond to incidents with *at least* fifteen personnel within an 8-minute time frame. Utilizing all apparatus and personnel in all stations, it is predicted that **34.33% of all Round Rock Fire District roads currently receive a sufficient number of fire suppression personnel within 8 minutes of receiving an alarm to comply with NFPA Standard 1710**, *assuming all units are fully staffed at existing staffing levels and available to respond immediately upon dispatch.* NFPA 1710 states that "the fire department's fire suppression resources shall be deployed to provide for the arrival of an engine company within a 4-minute response time and/or **the initial full alarm assignment within an 8-minute response time to 90% of the incidents.**" Under the existing staffing and deployment configuration, then, it may be said the Round Rock Fire Department is unable to assemble an initial full alarm assignment in compliance with NFPA 1710 on 65.67% of all Round Rock Fire District roads within 8 minutes or less. **It is therefore the recommendation of this study that the Round Rock Fire Department increase staffing levels on all fire suppression apparatus to four fighters, in compliance with existing national standards, and deploy a dedicated chief's aide to each command vehicle.** This increase in individual unit staffing will have a positive impact on the ability of the fire department to provide *safe* and *effective* fire suppression and rescue services to the community, and will have the added effect of moving the department closer into compliance with the Initial Full Alarm Assignment Capabilities of NFPA 1710.

MAP 13



Map 13 examines the ability of the Round Rock Fire Department to respond to incidents with *at least* seventeen personnel within an 8-minute time frame when a second pump and an aerial device are in operation at the incident scene. Utilizing all apparatus and personnel in all stations, it is predicted that **10.39% of all Round Rock Fire District roads currently receive a sufficient number of fire suppression personnel within 8 minutes of receiving an alarm to comply with NFPA Standard 1710**, *assuming all units are fully staffed at existing staffing levels and available to respond immediately upon dispatch.* NFPA 1710 states that "the fire department's fire suppression resources shall be deployed to provide for the arrival of an engine company within a 4-minute response time and/or **the initial full alarm assignment within an 8-minute response time to 90% of the incidents.**" Under the existing staffing and deployment configuration, then, it may be said the Round Rock Fire Department is unable to assemble an initial full alarm assignment in compliance with NFPA 1710 on 89.61% of all Round Rock Fire District roads within 8 minutes or less. **It is therefore the recommendation of this study that the Round Rock Fire Department increase staffing levels on all fire suppression apparatus to four fighters, in compliance with existing national standards, and deploy a dedicated chief's aide to each command vehicle.** This increase in individual unit staffing will have a positive impact on the ability of the fire department to provide *safe* and *effective* fire suppression and rescue services to the community, and will have the added effect of moving the department closer into compliance with the Initial Full Alarm Assignment Capabilities of NFPA 1710.

(6) For other than high-rise, 480 seconds or less travel time for the deployment of an initial full alarm assignment at a fire suppression incident.
(7) For high-rise, 610 seconds or less travel time for the deployment of an initial full alarm assignment at a fire suppression incident.
(8) 240 seconds or less travel time for the arrival of a unit with first responder with automatic external defibrillator (AED) or higher-level capability at an emergency medical incident.
(9) 480 seconds or less travel time for the arrival of an advanced life support (ALS) unit at an emergency medical incident, provided that a first responder with an AED or basic life support (BLS) unit arrived in 240 seconds or less travel time.

For purposes of this section, the following definitions apply:

(1) "Alarm" means a signal or message from a person or device indicating the existence of an emergency or other situation that requires action by an emergency response agency.
(2) "Alarm answering time" means the time interval that begins when the alarm is received at the Round Rock public safety dispatch center and ends when the alarm is acknowledged at the dispatch center.
(3) "Alarm processing time" means the time interval that begins when the alarm is acknowledged at the Round Rock public safety dispatch center until the beginning of the transmittal of the response information via voice or electronic means to emergency response facilities and emergency response units.
(4) "Travel time" means the time interval that begins when a unit is en route to the emergency incident and ends when the unit arrives at the scene.
(5) "Turnout time" means the time interval that begins when the emergency response facilities and emergency response units notification process begins by either an audible alarm or visual annunciation or both and ends at the beginning point of travel time.

By January 1, 2027, the Round Rock Fire Department shall meet the NFPA 1710 alarm answering time and alarm processing time performance objectives.

By January 1, 2028, the Round Rock Fire Department shall meet the NFPA 1710 turnout time and travel time performance objectives for 75 percent of alarms received.

By January 1, 2030, the Round Rock Fire Department shall meet the NFPA 1710 turnout time and travel time performance objectives for 90 percent of alarms received.

Units dispatched from other jurisdictions under mutual aid or automatic aid arrangements may be considered for the purposes of meeting the performance objectives only if those units meet the NFPA 1710 minimum company staffing levels for engine companies, ladder/truck companies, or fire companies with quint apparatus, as applicable.

Compliance with performance objectives for alarm answering time, alarm processing time, turnout time, and travel time shall be determined by an analysis conducted by the International Association of Fire Fighters, using public GIS data and computer-aided dispatch data, which must be provided to the Association by the City.

By January 1, 2030, the Round Rock Fire Department shall staff each fire company with personnel sufficient for that fire company to provide an Advanced Life Support (ALS) level of emergency medical care.

Jan

Feb

March 27%

April 8%

May

Jun

July

Aug

Dec 5%

The Round Rock Fire Department shall be governed by the minimum company staffing levels for engine companies, ladder/truck companies, and fire companies with quint apparatus identified in the version of 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*, in effect at the time.

The minimum company staffing levels in effect at the time this provision is enacted are found in Section 5.2.3 of the 2020 version of NFPA 1710 and are as follows:

(1) Fire companies whose primary functions are to pump and deliver water and perform basic fire fighting at fires, including search and rescue, shall be staffed with a minimum of 4 on-duty members.
(2) Fire companies whose primary functions are to perform the variety of services associated with truck work, such as forcible entry, ventilation, search and rescue, aerial operations for water delivery and rescue, utility control, illumination, overhaul, and salvage work, shall be staffed with a minimum of 4 on-duty members.
(3) A fire company that deploys with quint apparatus, designed to operate as either an engine company or a ladder company, shall be staffed with a minimum of 4 on-duty members.

After adoption Outline

~~By January 1, 2026~~, the Round Rock Fire Department shall meet the NFPA 1710 minimum company staffing levels for engine companies, ladder/truck companies, and fire companies with quint apparatus, except that in the event of unforeseen staffing shortages, a company may be staffed by 3 on-duty fire fighters for a period not to exceed 3 hours.

The Round Rock Fire Department shall be governed by the performance objectives for alarm answering time, alarm processing time, turnout time, and travel time identified in the version of 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*, in effect at the time.

The performance objectives in effect at the time this provision is enacted are found in Section 4.1.2 of the 2020 version of NFPA 1710 and are as follows:

(1) An alarm answering time of not more than 15 seconds for at least 95 percent of the alarms received and not more than 40 seconds for at least 99 percent of the alarms received.
(2) An alarm processing time of not more than 64 seconds for at least 90 percent of the alarms and not more than 106 seconds for at least 95 percent of the alarms.
(3) 80 seconds turnout time for fire and special operations response and 60 seconds turnout time for EMS response.
(4) 240 seconds or less travel time for the arrival of the first engine company at a fire suppression incident.
(5) 360 seconds or less travel time for the arrival of the second company with a minimum staffing of 4 personnel at a fire suppression incident.

Sales tax Allocation, increase from prior yr. Standard must be

IDENTIFICATION OF EXISTING EMERGENCY RESOURCE RESPONSE CAPABILITIES

The following series of maps indicate the existing response capabilities of Round Rock Fire Department emergency apparatus when responding from existing station locations (reference p. 10). **The indicated response capabilities for individual units, and the resources designated to respond as part of an alarm assignment, assume that all units and the personnel assigned to staff and respond these units are available to respond immediately upon dispatch.**

Understanding the several components of an emergency response is an important part of understanding how to interpret the following series of maps. To follow are some key terms that the reader should understand.

- ***Alarm Time*** is defined as "The point of receipt of the emergency alarm at the public safety answering point to the point where sufficient information is known to the dispatcher to deploy applicable units to the emergency."[40]

- ***Dispatch Time***, also referred to as *call processing time*, is "The point of receipt of the emergency alarm at the public safety answering point to the point where sufficient information is known to the dispatcher and applicable units are notified of the emergency."[41]

- ***Turnout Time*** is "The time beginning when units acknowledge notification of the emergency to the beginning point of response time."[42] Per NFPA 1710, turnout time should not exceed one minute.[43]

- ***Response Time*** is defined as "The time that begins when units are en route to the emergency incident and ends when units arrive at the scene."[44]

It is critical to understand that the response capabilities indicated in the following series of maps reflect ***response time only***. That is to say, the following series of maps indicate how far an emergency vehicle traveling on the existing road network in Round Rock can travel within 4 and 8 minutes. **Dispatch time and turnout time are not considered as part of this analysis, and may add as much as two minutes to overall call-to-arrival time. Actual response speeds may be slower, and the associated travel times greater, with any traffic congestion or any other unpredictable impedances.**

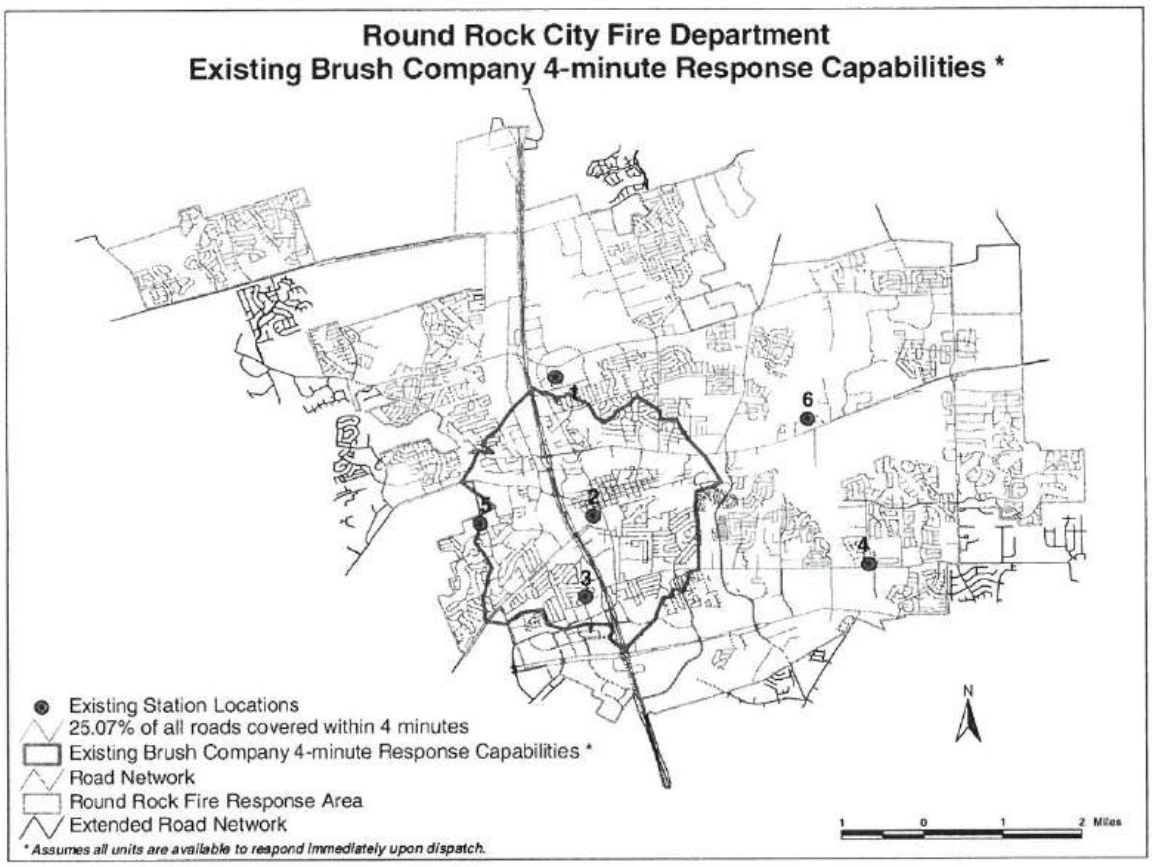
If any unit is unavailable for any reason, travel times will be greater as more distant apparatus will be required to respond, with potential delays. Impediments to access may add to the delay between the discovery of a fire and implementation of an actual fire attack (resulting in *increased* fire growth), **and to the delay between the discovery of an individual in medical distress and the initiation of emergency medical care** (resulting in *decreased* patient survivability).

Additionally, the computer model is unable to accurately portray the response of "callback" fire fighters responding in private vehicles from distant locations to an incident scene. Inasmuch as "callback" personnel are not available on a regular basis to respond emergency units

[40] NFPA 1710, §3.3.42.1
[41] NFPA 1710, §3.3.42.3
[42] NFPA 1710, §3.3.42.5
[43] NFPA 1710, §4.1.2.1.1
[44] NFPA 1710, §3.3.42.4

immediately upon dispatch- and it is impossible to quantify the amount of time it takes for those individuals to respond from their different locations to the station, staff an apparatus, and respond that unit to a given location- the GIS software is also unable to accurately display the predicted response capabilities of apparatus deploying from a fire station when staffed with "callback" personnel. As such, the unpredictable response capabilities of units staffed by off-duty personnel responding as "callback" fire fighters are omitted from this analysis.

MAP 14

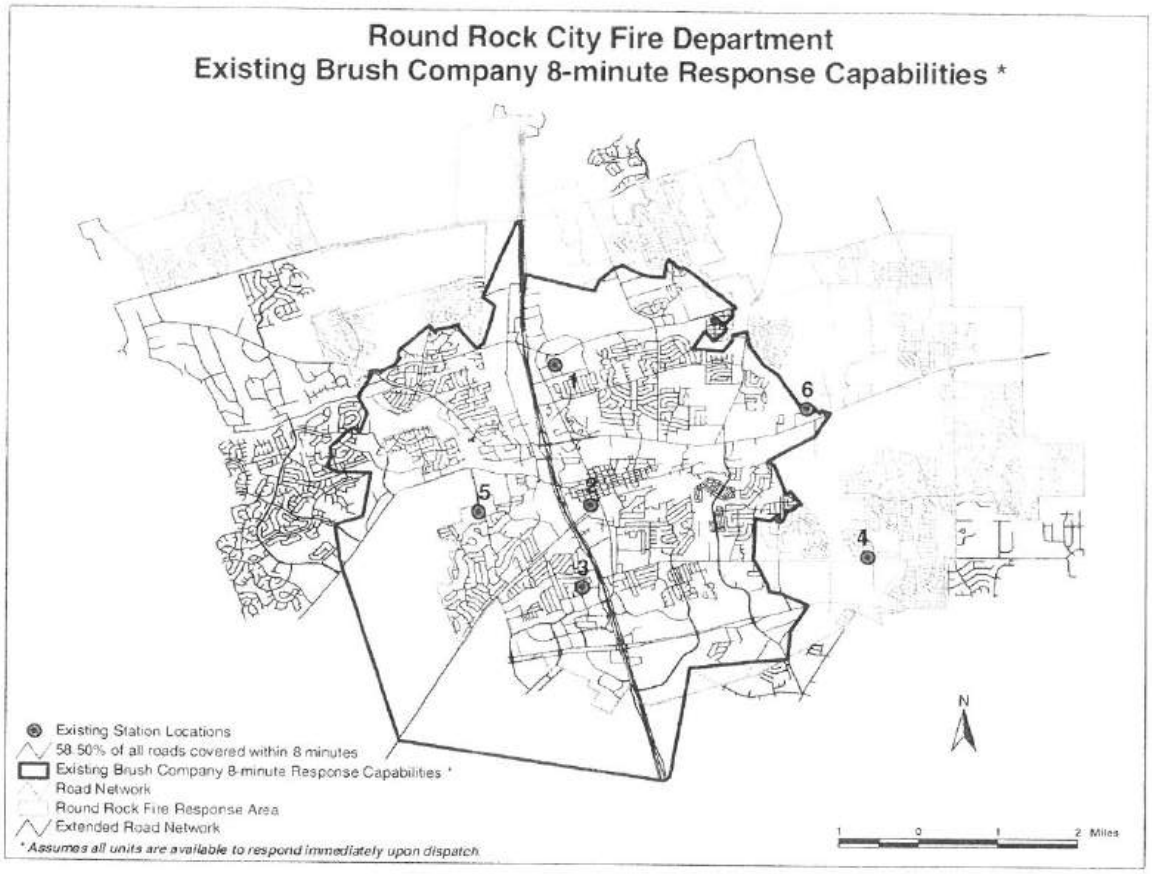


Map 14 indicates the existing Brush 1 4-minute response capabilities from. Currently, Brush 1, when responding from Station 2, is capable of responding to **25.07% of all roads located within the Round Rock Fire District in 4 minutes or less**, *assuming all units are available to respond immediately upon dispatch.*

Current population growth and the expanding development into traditionally non-urban areas have increasingly brought humans into contact with wildfires. Between 1985 and 1994, wildfires destroyed more than 9,000 homes in the United States.[45] Generally, these homes were located in areas "where structures and other human development meet or intermingle with undeveloped wildland or vegetative fuels,"[46] also known as the wildland/urban interface or intermix (WUI). WUI fires pose tremendous challenges to the fire service. Firefighting tactics for wildland fires differ considerably from those in structures, and access to homes and availability of water are often limited in WUI areas.[47]

[45] *The Wildland/Urban Fire Hazard,* Insurances Services Office, Inc., December 1997
[46] *Federal Wildland Fire Policy,* U.S. Department of Agriculture Forest Service, Chartered 1994, Revised 2001.
[47] "Fires in the Wildland/Urban Interface," U.S. Fire Administration Topical Fire Research Series, Volume 2, Issue 16, March 2002

MAP 15



Map 15 indicates the existing Brush 1 8-minute response capabilities. Currently, Brush 1, when responding from Station 2, is capable of responding to **58.5% of all roads located within the Round Rock Fire District in 8 minutes or less**, *assuming the unit is available to respond immediately upon dispatch.*

In effect, 41.5% of all Round Rock Fire District roads do not currently enjoy the range of emergency services provided by the brush unit. As Map 15 illustrates, significant areas in the extreme east and north ends of the Fire District remain beyond the 8-minute reach of the brush unit. Furthermore, it is important to recognize that engine company personnel cross-staff the brush unit, so that **any response by the brush unit necessitates the abandonment of Engine 2, housed at Station 2.** In the event that firefighters are unable to deploy the frontline engine into its primary response district, the community they are charged with protecting will experience delays of the emergency services taxpaying citizens are entitled to (see Figure 4. "Wild Fire Staffing Practices").

The conundrum that is presented by such a staffing arrangement is as follows: the brush unit is only capable of responding to 58.5% of all roads within 8 minutes, and significant portions of the Fire District do not currently enjoy the range of emergency services provided by the brush unit. Moreover, the personnel who staff and respond Engine 2 are unavailable to respond said engine in the event of a simultaneous emergency because they are deployed with the brush unit.

In the event firefighting personnel are unavailable to deploy their frontline (primary) response units, secondary units from neighboring fire districts are required to respond in their stead. The inability of frontline response units to respond creates a decrease in overall response capabilities, as units from neighboring fire districts must be relied upon to answer the alarm. The response of secondary units from neighboring districts into the district where an emergency is occurring requires increased travel distances, resulting in increased response times. Increased response times are directly associated with an increase in the loss of both life and property.

Just as fires occurring in the WUI challenge wildland firefighters because they are not trained in structural firefighting, structural firefighters generally have limited training in wildland fire suppression. Economic constraints have slowed effective cross-training and equipping of all fire fighters to attack these two vastly different types of fire. The areas in which these two types of fires interface can be classified into the following three general types:

The *mixed interface* contains structures scattered throughout undeveloped areas. Usually, there are isolated homes surrounded by areas of undeveloped land. When a fire starts, the individual homes are hard to protect because of the large area that may be burning. While relatively few homes may be at risk, the risk to the individual homes is great.

An *occluded interface* is characterized by isolated areas of wildlands, either large or small, within an urban area. An example would be a city park surrounded by homes, where the goal is to preserve some contact with a natural setting. Many homes and other buildings may be at risk, but these relatively small wildland areas are generally less susceptible to uncontrolled raging.

A *classic interface* is where homes, especially those crowded onto smaller lots in new subdivisions, press against wildland vegetation along a broad front. These vast wildland areas can propagate a massive flame-front during a wildland fire, causing numerous homes to be at risk from a single fire. Because the built-up quality of the subdivision may give a false sense of security, this is where the greatest loss of life is possible.[48]

It goes without saying that preventing fires costs significantly less than suppressing them, and that fire prevention efforts in the WUI are crucial. A Wildland/Urban Interface Fire Protection Program identified four common components of interface fires: (1) low relative humidity, high temperatures, and high winds often are in place before a fire starts; (2) human activity such as arson, debris burning, or downed electrical wires cause many interface fires; (3) many destroyed homes were constructed with combustible material or have especially vulnerable features such as wood shingle roofs; (4) considerable combustible materials surround the home, such as woodpiles and fences.[49]

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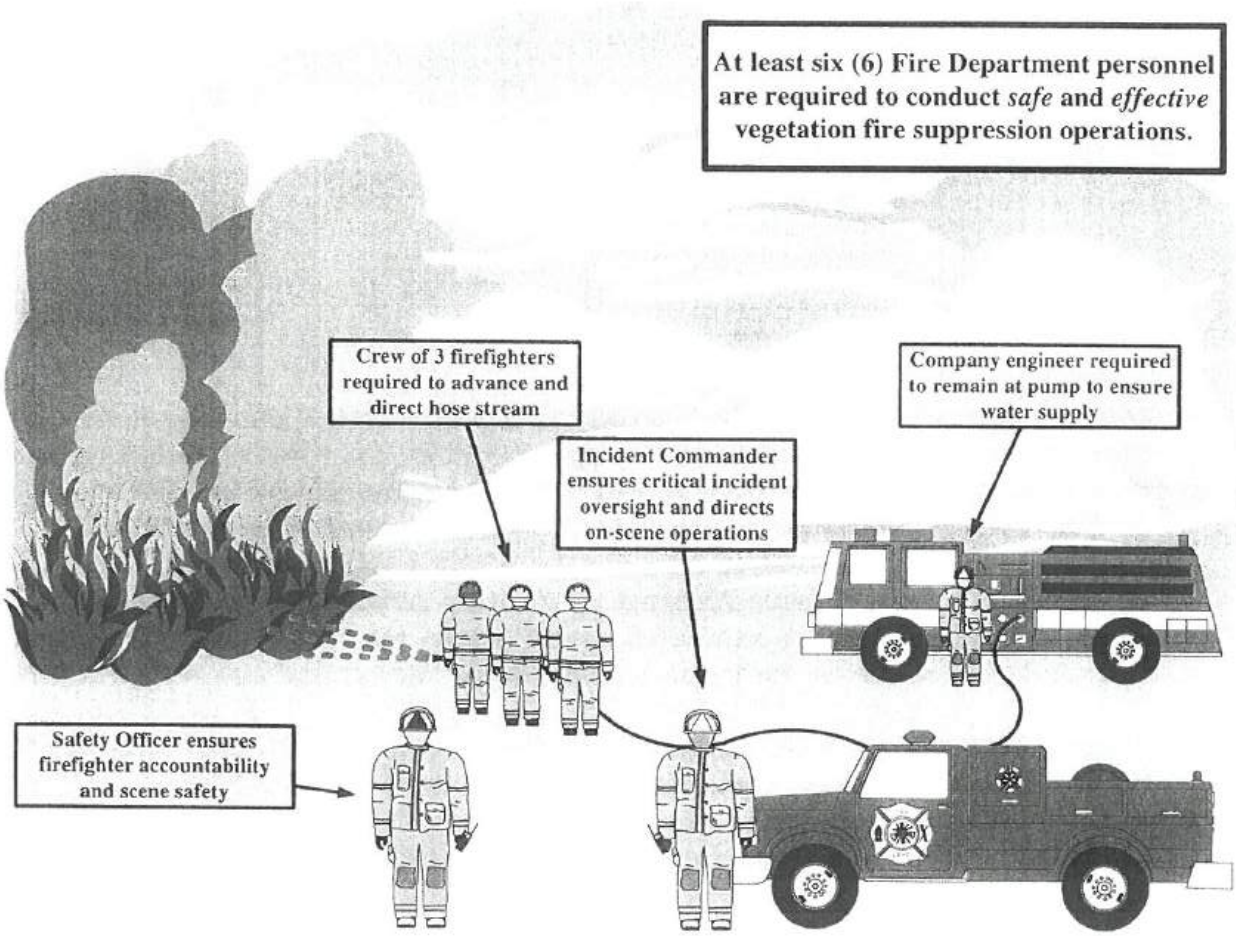
[48] Fire Protection Handbook, 18th Ed., "Wildland Fire Management," © 1997, p. 10-79 and 10-80

[49] *The Wildland/Urban Fire Hazard,* Insurances Services Office, Inc., December 1997

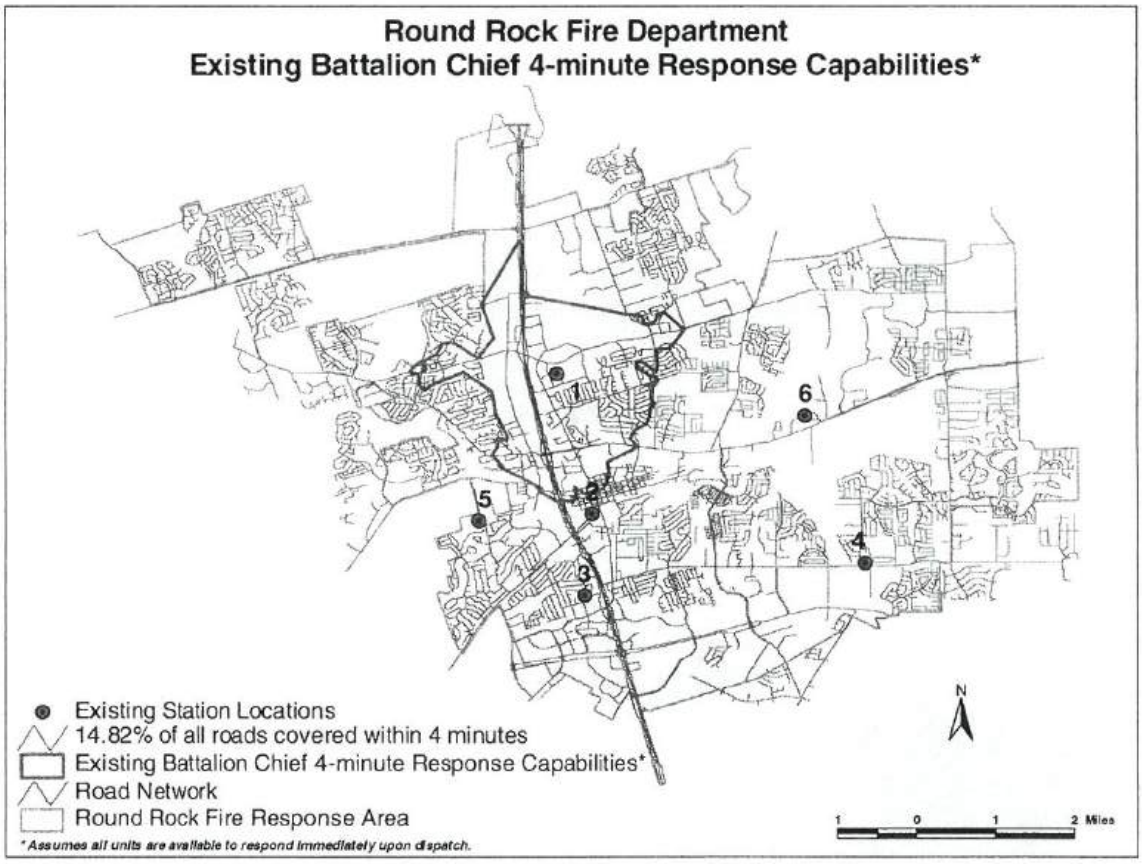
To highlight the importance of fire safety in the WUI, communities throughout the country have codified requirements for homeowners to construct and maintain their homes in a fire-safe manner. Other communities have considered tax credits for homeowners as a means to encourage fire safety in the WUI. The insurance industry also has an important stake in protecting homes in the WUI. The Oakland Hills fires of 1991 alone caused nearly $1.2 billion in insured property losses.[50] As such, the industry has considered adjusting premiums based on the assessed level of wildfire risk for a particular property. Agencies at the local, state, and federal levels need to work together to define areas as being in the WUI and then to find ways to provide services, including fire protection, to developments on these lands. Moreover, individual communities and homeowners must be willing to accept a high degree of responsibility for protecting their homes from wildfire.

Figure 4:
"Wild Fire Staffing Practices"



[50] *Fire in the United States: 1985–1994*, Ninth Edition, U.S. Fire Administration, Federal Emergency Management Agency, p. 195

MAP 16



Map 16 indicates the existing Battalion Chief Command Vehicle 4-minute response capabilities. Currently, the Battalion Chief, when responding from the Central Station, is capable of responding to **14.82% of all roads located within the Round Rock Fire District in 4 minutes or less**, *assuming all units are available to respond immediately upon dispatch.* Out of compliance with NFPA Standard 1710, Section 5.2.1.2.5, which states that, "supervisory chief officers shall have staff aides deployed to them for purposes of incident management and accountability at emergency incidents," a staff aide is not currently assigned to any of the command vehicles to assist the Battalion Chiefs in providing critical incident oversight.

The Importance of the 4-minute Battalion Chief Response In Structural Fire Fighting Operations:

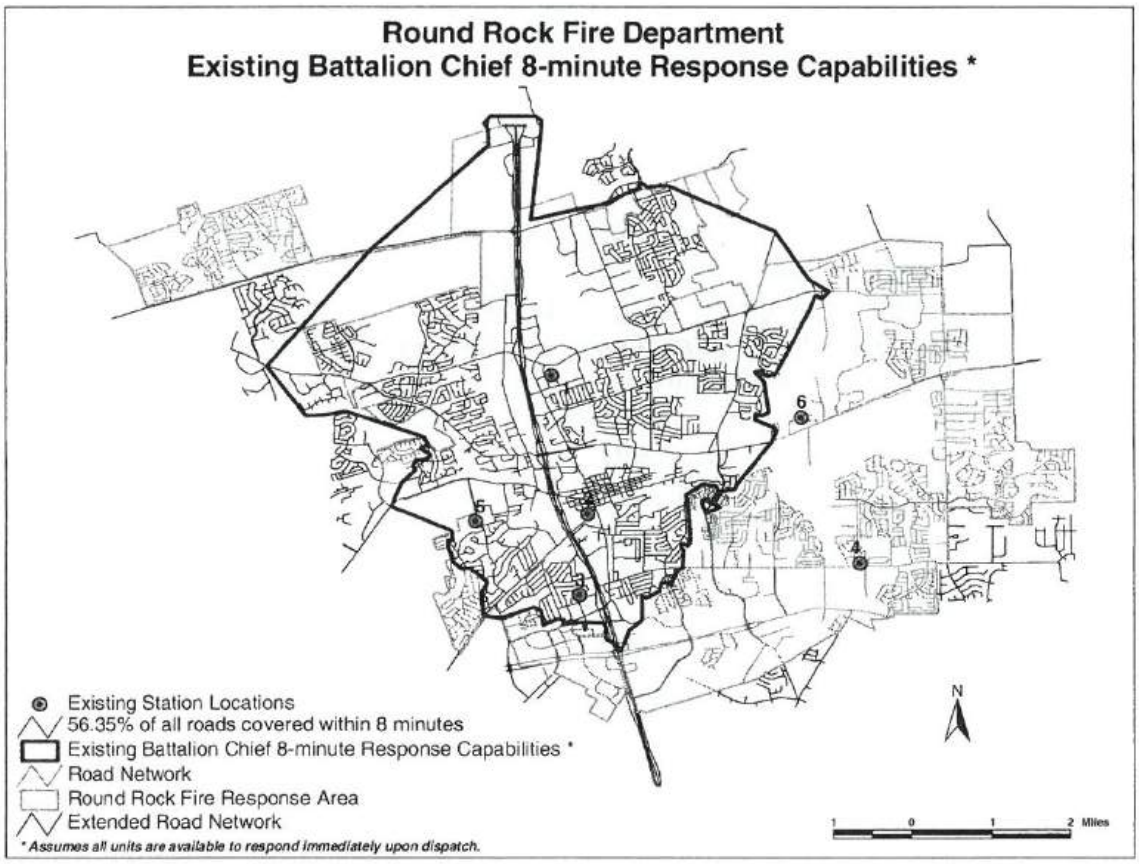
Fire department emergency operations are inherently dangerous. In the early moments of a fire department's arrival at an emergency scene they are also often very confusing, increasing the potential for ineffective operations. Conditions such as these also increase risk. In order to efficiently and effectively deliver emergency services, and to do so in a fashion that minimizes the threat posed to firefighters and civilians, actions must be coordinated by an incident commander (IC) not directly involved in the provision of emergency services. Firefighters arriving at the scene of an emergency from disparate locations, at different times, and trained to perform different emergency tasks require strong, proactive, and immediately-recognizable leadership.

During incidents involving multiple jurisdictions or agencies, the IC not only coordinates the efforts of many jurisdictions, but provides for and assures joint decisions on objectives, strategies, plans, priorities, and public communications. In short, a standardized approach to emergency or fireground management, under a unified command, ensures a consistent approach to decision-making, incident priorities, and life-safety for responders and the public. The importance of an Incident Commander (usually a supervisory officer) at an incident scene is reflected in NFPA 1710:

> An incident management system shall be provided in accordance with NFPA 1561, *Standard on Emergency Services Incident Management System*, to form the basic structure of **all emergency operations of the fire department, regardless of the scale of the department or the emergency**.[51] An effective incident management system shall be designed to manage incidents of different types, including structure fires, wildland fires, hazardous materials incidents, emergency medical operations, and other types of emergency operations that could be handled by the department *[emphasis added]*.[52]

[51] NFPA 1710, §6.2.1
[52] NFPA 1710, §6.2.2

MAP 17



Map 17 indicates the existing Battalion Chief Command Vehicle 8-minute response capabilities. Currently, the Battalion Chief, when responding from the Central Station, is capable of responding to **56.35% of all roads located within the Round Rock Fire District in 8 minutes or less**, *assuming all units are available to respond immediately upon dispatch.*

NFPA 1710, Section 6.2.1, states that "an incident management system shall be provided in accordance with NFPA 1561, *Standard on Emergency Services Incident Management System*, to form the basic structure of all emergency operations of the fire department, regardless of the scale of the department or the emergency." Section 6.2.2 states that, "an effective incident management system shall be designed to manage incidents of different types, including structure fires, wildland fires, hazardous materials incidents, emergency medical operations, and other types of emergency operations that could be handled by the department."

Current command vehicle staffing does not meet the requirements of NFPA Standard 1710, Section 5.2.1.2.5. This section of NFPA states that, "supervisory chief officers shall have staff aides deployed to them for purposes of incident management and accountability at emergency incidents." Section A.3.3.37 of the standard defines the roles of the staff aide, stating, that "this member is assigned to a supervisory chief officer who assists at incident scene operations, which can include personnel accountability, communications, and other logistical and administrative support. In addition, this member can assist in coordinating training activities, respond to citizen inquiries, coordinate staffing issues and sick leave follow-up, and resource allocations for facilities and apparatus under the supervisory chief officer's jurisdiction. Staff

aides can be known as field incident technicians, staff assistants, battalion fire fighter, or battalion adjutant."

Battalion Chiefs may also function in the capacity of Safety Officer. Every incident that results in a loss is caused by either an unsafe act or condition. The Incident Safety Officer's duties at any incident- fire or EMS- are to support the incident commander and management system to ensure that safety is an important component of the incident action plan and that the responders are operating as safely as conditions allow. The Incident Safety Officer is charged with the duties of identifying, and mitigating, where possible, those "hazardous or careless actions and to assess changing conditions or circumstances that could increase the existing hazard level."[53] The fire department safety officer is the one position that affects all areas of operation within the incident command system. It is the one position that has the authority, under certain conditions, to countermand orders issued by the incident commander.[54] Fire service models for basic safety standards and the role of the safety officer can be found in NFPA 1500, *Fire Department Occupational Safety and Health Program*, and NFPA 1521, *Fire Department Safety Officer*, and in the National Fire Academy courses *Incident Safety Officer* and *Health and Safety Officer*.[55]

It is the recommendation of this analysis that the Round Rock Fire Department considers the deployment of a dedicated chief's aide to each command vehicle. Under existing conditions, fire department Battalion Chiefs, when assigned to respond to a wildland fire or a residential fire alarm, are required to arrive at a common destination within 8 minutes of leaving their respective stations. Upon arrival at the incident scene, one BC assumes operational command as the incident commander, and the other ensures fire fighter accountability. While both roles are essential to assuring safe and effective fireground operations, the practice of requiring two separate supervisory officers to respond in separate vehicles from opposite ends of the Fire District restricts the ability of the fire department to assemble the units assigned to this alarm type within acceptable time frames.

The deployment of an aide to each battalion chief will have the effect of broadening response capabilities while maintaining the existing apparatus deployment configuration. Under such conditions, the deployment of two fire fighters- one that assumes incident command, and the other to ensure fire fighter accountability- from a single vehicle will obviate the need for both battalion chiefs to respond, as is current practice.

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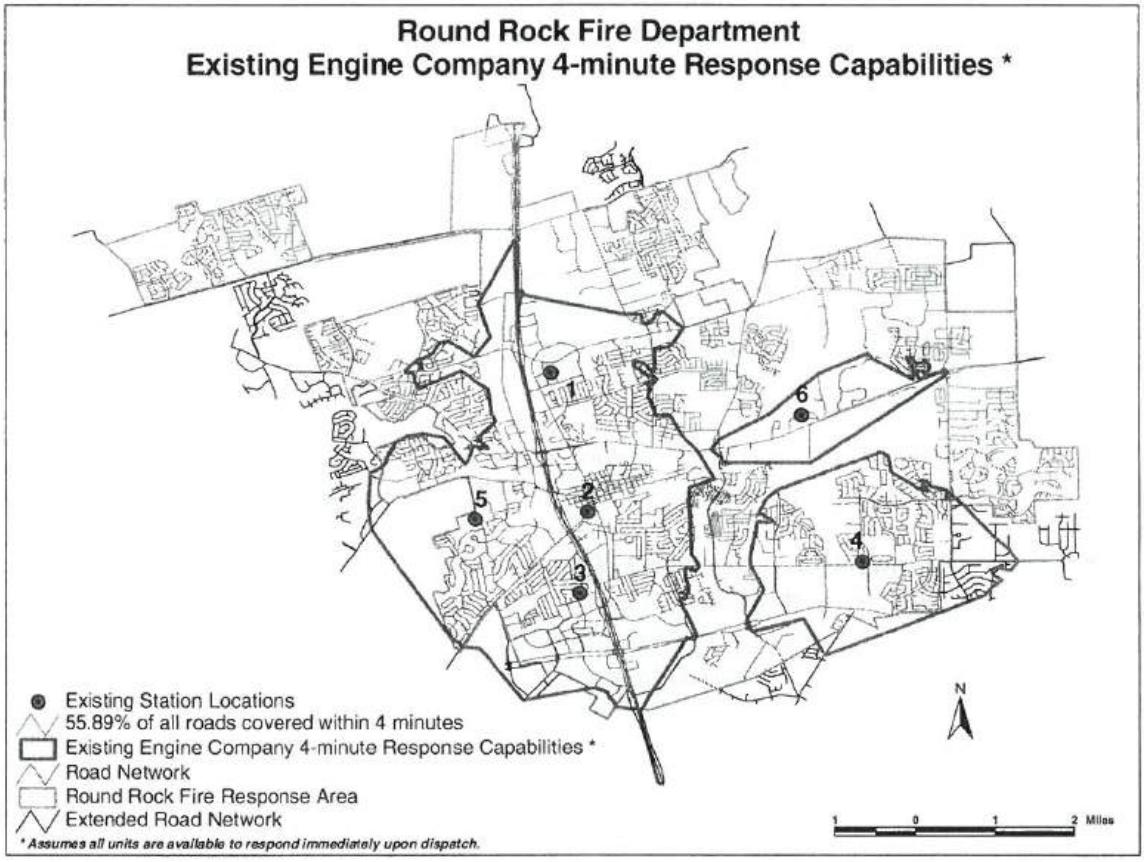
[53] "The Role of the EMS Safety Officer," *EMS: Journal of Emergency Care, Rescue and Transportation* (October 2000), Vol. 29, #10, p. 56

[54] Wilder, Steven S., "Risk Management in the Fire Service," © 1997, p. 66

[55] Ibid, p. 54

MAP 18



Map 18 indicates the existing 4-minute response areas for engine companies responding from all existing fire stations. Currently, engines that deploy from these six stations are capable of responding to **55.89% of all roads located within the Round Rock Fire District in 4 minutes or less,** *assuming all units are available to respond immediately upon dispatch.*

The 4-minute goal for arriving fire suppression companies is critical. NFPA Standard 1710 states that a fire department shall establish the response time objective of "**4 minutes or less** for the arrival of the first arriving engine company at a fire suppression incident."[56] As stated in NFPA 1710, Section 5.2.1.1, "on-duty fire suppression personnel shall be comprised of the numbers necessary for fire-fighting performance relative to the expected fire-fighting conditions. These numbers shall be determined through task analyses that take the following factors into consideration:

(1) Life hazard to the populace protected
(2) Provisions of *safe* and *effective* fire-fighting performance conditions for the fire fighters
(3) Potential property loss
(4) Nature, configuration, hazards, and internal protection of the properties involved
(5) Types of fire ground tactics and evolutions employed as standard procedure, type of apparatus used, and results expected to be attained at the fire scene."

[56] NFPA Standard 1710, Section 4.1.3.1.1 (1)

NFPA Standard 1710 recommends "fire companies whose primary functions are to pump and deliver water and perform basic fire fighting at fires, including search and rescue... shall be staffed with **a minimum of four on-duty personnel**."[57] Fire companies whose primary functions are to perform the variety of services associated with truck work, such as forcible entry, ventilation, search and rescue, aerial operations for water delivery and rescue, utility control, illumination, overhaul and salvage work... shall [also] be staffed with **a minimum of four on-duty personnel**."[58] According to studies performed by the Dallas, Texas and Westerville, Ohio Fire Departments, **four fire fighters are capable of performing the rescue of potential victims 80% faster than a crew of three fire fighters.**[59] Currently, however, not a single fire department engine company is staffed with four fire fighters, out of compliance with existing national standards. As such, engine companies are limited in their ability to rescue an individual (or individuals) trapped by fire in a residence in a manner that is both *safe* and *effective* until additional personnel arrive on the incident scene.

The standard further states that a "fire department shall establish the response time objectives of **4 minutes or less** for the arrival of a unit with first responder or higher capability at an emergency medical incident."[60] Rapid emergency medical response is essential in improving survival rates. For cardiac arrest- one of the most time-critical medical emergencies that can be treated in the field- the highest hospital discharge rate has been achieved in patients in whom CPR was initiated **within 4 minutes** of arrest and ACLS within 8 minutes.[61] The use of an automated external defibrillator (AED) by trained personnel is integral to this treatment and the survival of cardiac arrest. If fire fighters responding within 4 minutes of receiving an alarm initiate CPR, the probability of patient survival quadruples, from 4.6% to 18.2%. If those same fire fighters are equipped and trained to provide defibrillation, the expected survival rate is five times greater at 25.8%. Finally, if those fire fighters are trained and equipped as paramedics, the survival rate is increased to 34.3% - nearly a sevenfold increase.[62]

While patient survivability from cardiac arrest depends upon a series of critical interventions, "rapid defibrillation is the most important single factor in determining survival."[63] If defibrillation is initiated in less than 2 minutes, the survival rate from cardiac arrest can be as high as 90%. But, "if defibrillation is delayed more than 10 minutes, survival rates drop to less than 5%."[64] In accordance with NFPA Standard 1710, Section 4.3.2, the Round Rock Fire Department equips all of its apparatus with AED's and requires all fire fighters to be trained in their use.[65]

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[57] NFPA 1710, Section 5.2.2.1 and 5.2.2.1.1

[58] NFPA 1710, Section 5.2.2.2 and 5.2.2.2.1

[59] McMannin Associates and John T. O'Hagan and Associates, "Dallas Fire Department Satffing Level Study," June 1984; pp. I-2 and II-1 through II-7; Morrison, Richard C., "Manning Levels for Engine and Ladder Companies in Small Fire Departments," 1990.

[60] NFPA Standard 1710, Section 4.1.3.1.1 (2)

[61] The Journal of the American Medical Association, October 28, 1992; p. 2184

[62] "Predicting Survival From Out-of-Hospital Cardiac Arrest: A Graphic Model," *Annals of Emergency Medicine*, November 1993

[63] The Journal of the American Medical Association, October 28, 1992; p. 2289.

[64] American Heart Association (1992)

[65] NFPA Standard 1710, Section 4.3.2 - "The fire department... shall ensure [that] emergency medical response capability includes personnel, equipment, and resources to deploy at the first responder level with automatic external defibrillator (AED) or higher treatment level."

The Importance of the 4-minute Engine Company Response
In the Provision of Emergency Medical Services:

The Round Rock Fire Department responds to all emergencies in the Fire District necessitating the skills, capabilities, and resources of the fire department. Motor vehicle accidents, for example, often times require the fire department to stabilize the incident scene and gain access to the patient before emergency medical care can be rendered. While the extrication is being performed, and before the ambulance arrives at the incident scene, the responsibility of emergency medical care and patient stabilization falls upon the fire department. Likewise, Round Rock fire fighters oversee the medical care of patients beyond the immediate reach of those who provide more advanced levels of EMS. For example, those individuals requiring the technical rescue services that are provided exclusively by the fire department will also receive initial medical attention by the fire department. To this extent, the Round Rock Fire Department plays a critical role in the provision of EMS to the citizens of Round Rock. In this context, it is easy to see that the fire department is truly an "all hazards" provider for the Round Rock.

The prehospital care rendered by the fire department in such instances encompasses the "A.B.C.s" of basic emergency medical care – maintenance of the **a**irway, ensuring the patient can continue **b**reathing, and maintaining **c**irculation. The bandaging of wounds, the realignment of broken limbs, when necessary, and protection of the spine are also priorities for the fire department in the prehospital setting. To the extent that fire fighters are capable of stablizing patients until the arrival of advanced emergency medical resources, the fire department plays a critical role in the provision of EMS to the citizens of Round Rock. A rapid response to traumatic injury or related emergency is therefore critical to saving lives.

In addition, the Round Rock Fire Department responds to cardiovascular accidents (stroke) and myocardial infarctions (heart attacks). The American Heart Association notes that, "Nearly 2,600 Americans die of cardiovascular disease each day, an average of 1 death every 34 seconds. Cardiovascular disease claims more lives each year than the next 5 leading causes of death combined, which are cancer, chronic lower respiratory diseases, accidents, diabetes mellitus, and influenza and pneumonia."[66] A stroke is a sudden loss of brain function. It is caused by the interruption of the flow of blood to the brain or the rupture of blood vessels in the brain. The interruption of the blood flow or the rupture of blood vessels causes brain cells in the affected area to die.

A heart attack occurs when the blood supply to part of the heart muscle itself is severely reduced or stopped. This happens when one of the arteries supplying blood to the heart muscle is blocked. If the blood supply to the heart muscle is cut off for longer than several minutes, muscle cells in the affected area suffer irreversible injury and die. According to the Occupational Safety & Health Administration, there are 300,000 – 400,000 deaths *per year* in the United States from cardiac arrest,[67] making it one of the leading causes of death in the nation. Most cardiac arrest deaths occur outside the hospital, resulting in survival rates ranging between 1% and 5%. In spite of these statistics, cardiac arrest remains one of the most time-critical medical emergencies that can be treated in the field.

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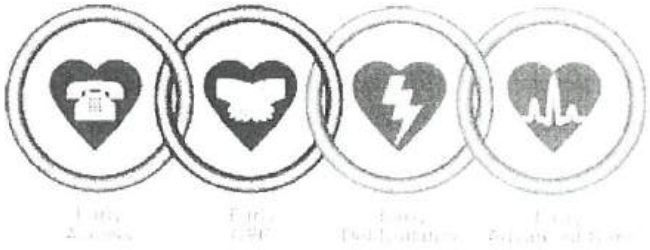
[66] American Heart Association, "Heart Disease and Stroke Statistics – 2004 Update;" AHA website visited September 21, 2004
< http://www.americanheart.org/downloadable/heart/1079736729696HDSStats2004UpdateREV3-19-04.pdf >

[67] U.S. Occupational Safety and Health Administration, Technical Information Bulletin: Cardiac Arrest and Automated External Defibrillators (AEDs), < http://www.osha.gov/dts/tib/tib_data/tib20011217.html >

The fire service's wide range of capabilities enables fire department personnel to respond effectively to diverse incidents, including victim search and rescue, extrication, hazardous materials releases, and natural disasters, to name but a few. Fire fighters are uniquely trained and equipped to effectively handle the most time-critical emergency on scene. Owing to their strategic distribution throughout a given community, the responsibility to respond to medical emergencies is often delegated to multi-role fire fighters cross-trained as emergency medical technicians (EMTs).

Recognizing the importance of a rapid response to increased survivability rates from cardiac arrests and other medical emergencies, the 1710 Standard requires that a "fire department shall establish the response time objectives of **4 minutes or less for the arrival of a unit with first responder or higher capability at an emergency medical incident.**"[68] While patient survivability from cardiac arrest depends upon a series of critical interventions, such as are provided by fire fighter/EMT's, "rapid defibrillation is the most important single factor in determining survival."[69] Abnormal heart rhythms, with ventricular fibrillation (VF) being the most common, cause cardiac arrest. The highest hospital discharge rates have been achieved in cardiac arrest patients in whom CPR was initiated **within 4 minutes of arrest** and ACLS within 8 minutes. A rapid emergency medical response is therefore essential in improving survival rates.[70] Figure 5 depicts the components of the cardiac "Chain of Survival".

FIGURE 5:[71]
"THE CHAIN OF SURVIVAL"



The use of an automated external defibrillator (AED) by trained personnel is integral to the treatment and survival of cardiac arrest. Defibrillation within 2 minutes can produce cardiac arrest survival rates as high as 90%. **If fire fighters responding within 4 minutes of receiving an alarm initiate CPR, the probability of patient survival quadruples, from 4.6% to 18.2%. If those same fire fighters are equipped and trained to provide defibrillation, the expected survival rate is five times greater at 25.8%.**[72] **However, "if defibrillation is delayed more than 10 minutes, survival rates drop to less than 5%."**[73]

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[68] NFPA 1710, § 4.1.3.1.1(2)

[69] Emergency Cardiac Care Committee and Subcommittees of the American Heart Association, "Guidelines for Cardiopulmonary Resuscitation and Emergency Cardiac Care," Journal of the American Medical Association (October 28, 1992): 2289

[70] Emergency Cardiac Care Committee and Subcommittees of the American Heart Association, "Guidelines for Cardiopulmonary Resuscitation and Emergency Cardiac Care," Journal of the American Medical Association (October 28, 1992): 2184.

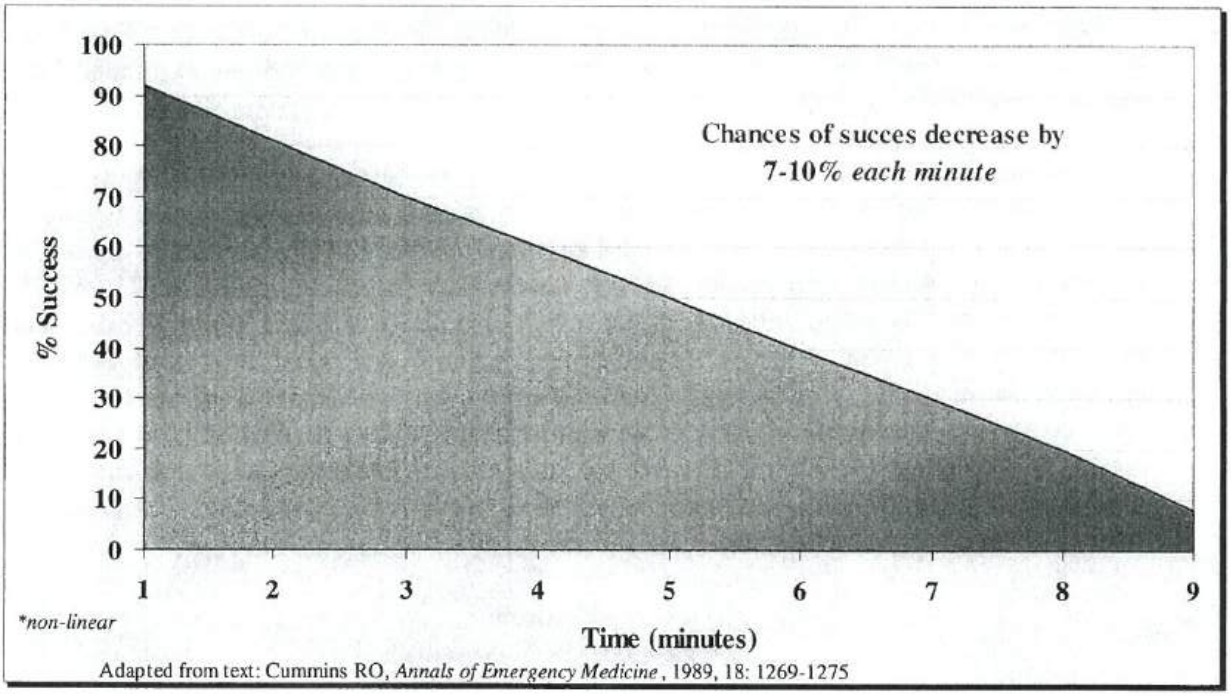
[71] "Chain of Survival" diagram courtesy of "ChainofSurvival.com"
< http://www.chainofsurvival.com/cos/COSOverview_detail.asp >

[72] "Predicting Survival From Out-of-Hospital Cardiac Arrest: A Graphic Model," Annals of Emergency Medicine (November 1993)

[73] American Heart Association, Sudden Deaths from Cardiac Arrest Statistical Fact Sheet (2003)

Figure 6 details the cardiac arrest survival rate based on time.

FIGURE 6:
"CARDIAC ARREST SURVIVAL RATE"



So effective is the use of an AED in increasing survivability of cardiac arrest patients, the International Association of Fire Chiefs has endorsed equipping every fire suppression unit in the United States with an automated external defibrillator.[74] Mirroring this recommendation, NFPA 1710 states, "the fire department... shall ensure [that] emergency medical response capability includes personnel, equipment, and resources to deploy at the first responder level with automatic external defibrillator (AED) or higher treatment level."[75] In accordance with NFPA Standard 1710, Section 4.3.2, the Round Rock Fire Department equips all of its apparatus with AED's and ensures all fire fighters are trained in their proper and effective operation.[76]

The Importance of the 4-minute Engine Company Response In Structural Fire Fighting Operations:

Fire growth- the rate of spread and the intensity of the fire- is directly linked to the time it takes to initiate fire suppression operations. As rule, a fire doubles in size for every minute that passes without the application of aggressive fire suppression measures. In less than 30 seconds a small flame can rage completely out of control and turn into a major fire. During fire growth, the temperature of a fire rises to 1,000° to 1,200° F. Flashover (the very rapid spreading of the fire due to super heating of room contents and other combustibles) at 1,100° to 1,200° F. may occur in a burning room in as little as 4 minutes, depending upon its contents.[77] At flashover,

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[74] American Heart Association, Sudden Deaths from Cardiac Arrest Statistical Fact Sheet (2003).

[75] NFPA 1710, § 4.3.2 - "The fire department... shall ensure [that] emergency medical response capability includes personnel, equipment, and resources to deploy at the first responder level with automatic external defibrillator (AED) or higher treatment level."

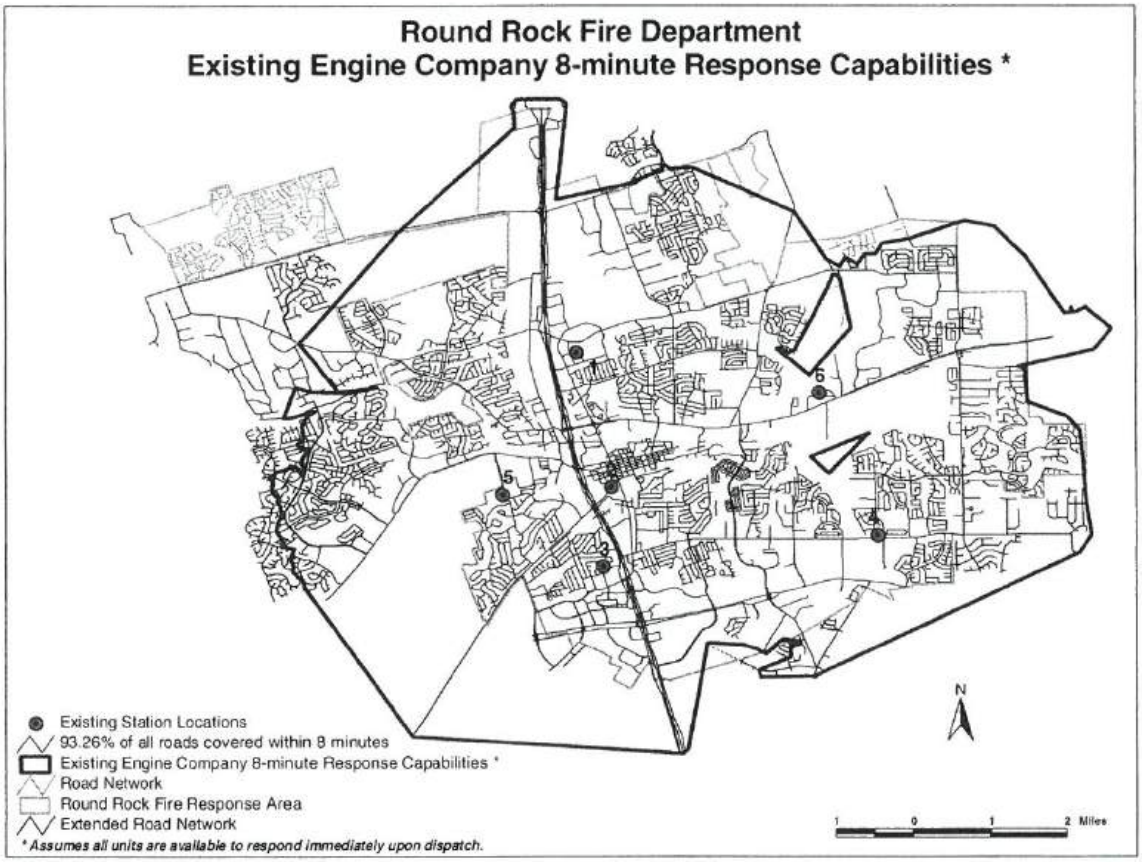
[76] Ibid.

[77] In general, however, flashover is most likely to occur within 10 minutes of fire ignition within a confined space, and with typical contents.

the odds of survival for individuals inside the structure- both victim and rescuer- are virtually non-existent. The 4-minute goal for arriving fire suppression companies is therefore critical. Recognizing the criticality of a rapid fire department response, NFPA Standard 1710 states that a fire department shall establish the response time objective of "**4 minutes or less for the arrival of the first arriving engine company at a fire suppression incident.**"[78]

[78] NFPA 1710, § 4.1.3.1.1 (1)

MAP 19

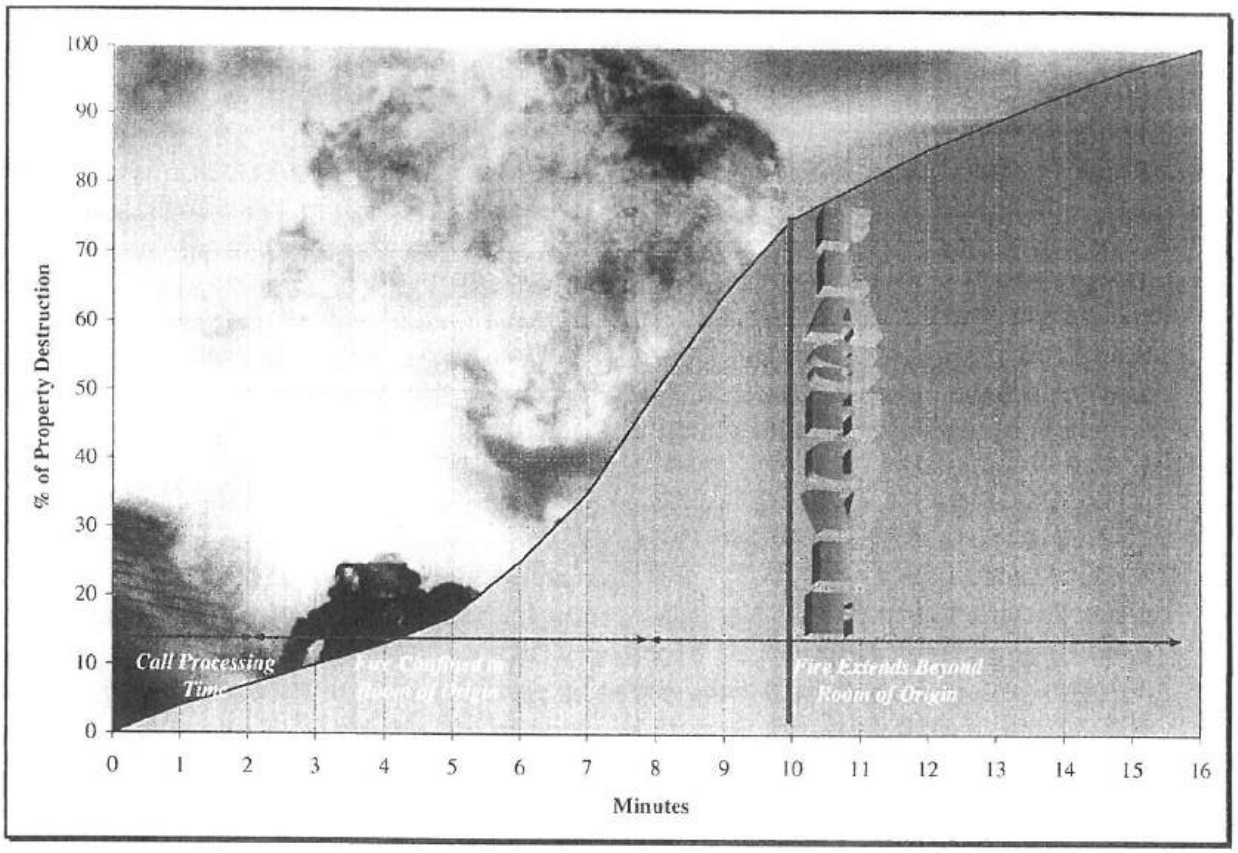


Map 19 indicates the existing 8-minute response areas for engine companies responding from all existing fire stations. Currently, engines deploying from these six stations are capable of responding to **93.26% of all roads located within the Round Rock Fire District in 8 minutes or less,** *assuming all units are available to respond immediately upon dispatch.*

The Importance of the 8-minute Engine Company Response In Structural Fire Fighting Operations:

The 8-minute goal for arriving companies is critical because the progression of a structural fire to the point of "flashover" (the very rapid spreading of the fire due to super heating of room contents and other combustibles) generally occurs in less than 10 minutes. As there is a potential delay between fire ignition, discovery, and the transmission of an alarm it may be said that flashover is likely to occur within 8 minutes of firefighters receiving the alarm. Figure 7 is the fire propagation curve.

FIGURE 7:
"THE FIRE PROPAGATION CURVE"



Minimally, a crew of four is required to make a safe initial attack on a fire, with a crew of two working inside the burning structure and a backup crew of two standing by to assist as necessary. This is known as the "2 In/2 Out" regulation, and is codified as OSHA CFR 1910.134. Currently, the Round Rock Fire Department staffs all engine companies with only three fire fighters, **out of compliance with NFPA 1710**. On the scene of a fire the driver/operator of an engine must remain with the apparatus to operate the pump. This leaves a crew of only two fire fighters from each engine company immediately available to initiate the attack or complete search and rescue activities. A fire attack initiated by a single fire company, then, would not be capable of effecting a safe and effective fire suppression and/or rescue operation in compliance with the "2 In/2 Out" regulation until a second company arrives with sufficient personnel to support the fire attack and/or rescue operation, and to assist the first company in the event of an unexpected emergency. [79, 80, 81] For these reasons, **it is the**

[79] As stated in NFPA 1500, "a rapid intervention team shall consist of at least two members and shall be available for rescue of a member or a team if the need arises. Once a second team is assigned or operating in the hazardous area, the incident shall no longer be considered in the 'initial stage,' and at least one rapid intervention crew shall be required."

[80] An unexpected emergency may include, but is not limited to, extreme fire conditions such as flashover; localized, partial, or complete structural collapse; failure to implement the incident command system, resulting in "freelancing" and a breakdown in fire fighter accountability; flawed tactical strategies; fire fighter disorientation or entrapment; or an injury that incapacitates a fire fighter, from a strained muscle to severe trauma.

[81] Freelancing occurs when firefighters or companies deviate from their assigned duties. What makes freelancing so dangerous is that the IC may give orders to another company that endangers the freelancers, or the freelancers may operate in a manner that endangers other firefighters. Training in ICS and operations may mitigate the occurrence of freelancing.

recommendation of this study that the Round Rock Fire Department make efforts to enhance existing response capabilities by staffing all engine companies with *at least* four multi-role fire fighters.

The Importance of the 8-minute Engine Company Response In the Provision of Emergency Medical Services:

Sudden cardiac arrest- one of the leading causes of death in America- is also one of the most time-critical medical emergencies that can be treated in the field. The eight-minute benchmark is crucial because a rapid fire department response expedites the delivery of more advanced lifesaving interventions, such as defibrillation, advanced airway management, and drug therapy. Two-tiered EMS systems such as these, where the more widely-distributed fire department Basic Life Support (BLS) providers arrive in advance of Advanced Life Support (ALS) providers, have improved survival rates over one-tiered systems, particularly when the first responder provides automated external defibrillation.[82]

According to the Journal of the American Medical Association, "two-tier systems in which the first responders are trained in early defibrillation are most effective in providing rapid Advanced Cardiac Life Support (ACLS)."[83] **Cardiac arrest victims have a 33% higher survival rate when Paramedics arrive within eight minutes**, according to the American Heart Association. After eight minutes, the prospects of recovery decreases rapidly.[84] Hence, by gaining access to the scene and ensuring patient stabilization by providing defibrillation and airway management, if necessary, Round Rock fire fighters set the stage for the arrival of secondary ALS units, the provision of ACLS, and the opportunity for increased patient survivability. A timeline of a typical emergency response to an incident of sudden cardiac arrest is provided in Appendix "C."

The Eisenberg Model

A 1993 University of Washington study of 1,667 cardiac arrests linked survival of cardiac arrest to the time that elapsed before the initiation of three critical interventions: CPR, defibrillation and advanced cardiac life support. From this study, researchers produced a model for predicting cardiac arrest survival rates, known as the *Eisenberg Model.*[85] Because it clearly links response time to the probability of survival, the *Eisenberg Model* has become the standard of performance for measuring effectiveness in the delivery of pre-hospital emergency medical services. Figure 8 details the components of the Eisenberg Formula.

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[82] Analysis of some systems with high survival rates for out-of-hospital cardiac arrest reveals common practices of (1) multi-tiered systems deployed by a 911 priority dispatch system, (2) aggressive use of fire department apparatus for first response and automated defibrillation, (3) intensive medical supervision, and (4) widespread citizen awareness and CPR training.

[83] The Journal of the American Medical Association (October 28, 1992): 2290.

[84] Matthew Cella, "Response Rate of EMS Declines," The Washington Times, 1 April 2003

[85] M.P. Larsen, M.S. Eisenberg, et al., "Predicting Survival from Out-of-Hospital Cardiac Arrest: A Graphic Model," Annals of Emergency Medicine 22, no. 11 (November 1993): 1652 – 8.

FIGURE 8:
"THE EISENBERG FORMULA"

Survival Rate = 67% (*maximum percentage survival rate of out-of-hospital cardiac arrest patients if all three interventions were to occur upon collapse. This figure represents the assumption that only 2/3 of the population can be expected to survive an of out-of-hospital cardiac arrest.* ***One minute is added to the observed response times to allow for dispatch and turnout. An additional minute is added for gaining access to the patient.***)

- Less 2.3% per minute until CPR is started
- Less 1.1% per minute until defibrillation is provided
- Less 2.1% per minute until ACLS is initiated

Table 5 indicates predicted survivability rates for cardiac arrest patients, based upon the Eisenberg formula for predicting cardiac arrest survival rates, following the initiation of CPR, defibrillation, and advanced cardiac life support (ACLS) in 5, 6, and 7 minutes, respectively.

TABLE 5:
"EFFECT OF EMERGENCY CARE RESPONSE TIMES ON CARDIAC PATIENT SURVIVAL RATES"[86]

Fire Dep't. Response Time	Initiation of CPR ♥	Time to Defibrillation ⚡	Time to Advanced Cardiac Life Support (ACLS) 🚑	Predicted Survival Rate/ All Cardiac Arrest *(percentages)*
9 minutes	10 minutes	11 minutes	13 minutes	4.6%
4 minutes	F.D. EMT: 5 minutes	11 minutes	12 minutes	18.2%
4 minutes	F.D. EMT: 5 minutes	F.D. EMT-D: 6 minutes	11 minutes	25.8%
4 minutes	**F.D. EMT: 5 minutes**	**F.D. EMT-D: 6 minutes**	**F.D. Paramedic: 7 minutes**	**34.3%**

This scenario requires two fire fighters to provide CPR, one to prepare the AED and analyze the results of an electrocardiogram (ECG) report, and one to prepare for and initiate advanced cardiac life support measures, such as advanced airway management, I.V. therapy, and pharmacological interventions. This breakdown of the expected capabilities of a medical alarm assignment requires a minimum contingent of four EMS personnel to arrive at the scene of a cardiac arrest within 5 minutes of receiving an alarm. Most experts agree that four responders (at least two trained in ACLS and two trained in BLS) are the minimum required to provide ACLS to cardiac arrest victims[87] (see also "Appendix C," *Timeline of a Typical Emergency Response to an Incident of Cardiac Arrest*).

[86] M.P. Larsen, M.S. Eisenberg, et al., "Predicting Survival from Out-of-Hospital Cardiac Arrest: A Graphic Model," Annals of Emergency Medicine 22, no. 11 (November 1993): 1652 – 8.
[87] The Journal of the American Medical Association (October 28, 1992): 2291.

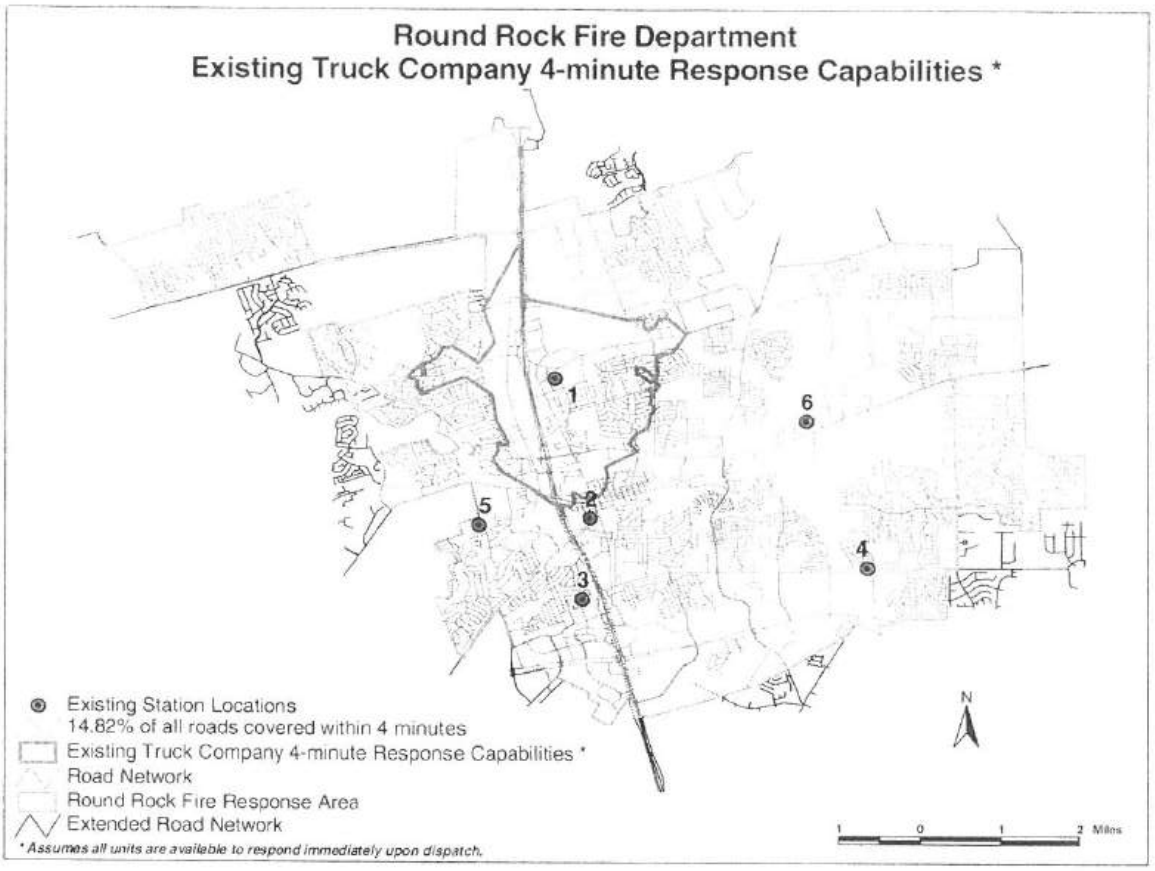
As the table indicates, a 9-minute response time means that CPR is not initiated until at least 10 minutes have elapsed from the time of cardiac arrest; 11 minutes have elapsed before defibrillation; and 13 minutes have elapsed before ACLS care is initiated, resulting in an expected patient survival rate of only 4.6 percent. Conversely, a 4-minute fire department response – with CPR initiated in 5 minutes, defibrillation in 6 minutes, and ACLS in 7 minutes – results in patient survivability rates of over 34%.

In other words, based on Eisenberg's maximum percentage survival rate of 67%, a 9-minute initial arrival time prior to pre-hospital emergency medical intervention gives the patient only a 1 in 15 chance of survival. A 4-minute arrival by fire fighters increases the probability to 1 in 4. Fire fighters delivering defibrillation improve patient survivability to 1 in 3. And fire fighters trained as paramedics improve the odds of patient survival to 1 in 2. The simple reduction of 4 to 5 minutes in the response time through the use of cross-trained fire fighters has a substantial impact of increased patient survival, with improved patient outcomes for each increase in level of pre-hospital training that fire fighters receive. The Eisenberg Model supports the findings published in the *Journal of the American Medical Association*, which concluded that "two-tier systems in which the first responders are trained in early defibrillation are most effective in providing rapid Advanced Cardiac Life Support."[88]

It is clear that the quick arrival of an appropriate number of adequately trained personnel deploying with lifesaving medical resources is critical to increasing survivability from cardiac arrest and traumatic injury. For these reasons, **this analysis recommends every engine company be staffed with four full-time fire fighters, all of which are trained, at a minimum, to the level of EMT-B. Inasmuch as an increase in survivability correlates with the degree to which fire fighters are trained in emergency medicine, the fire department should pursue efforts to ensure that, of the four firefighters assigned to all engine companies, two fire fighters should certified as EMT-Paramedics (EMT-Ps).**

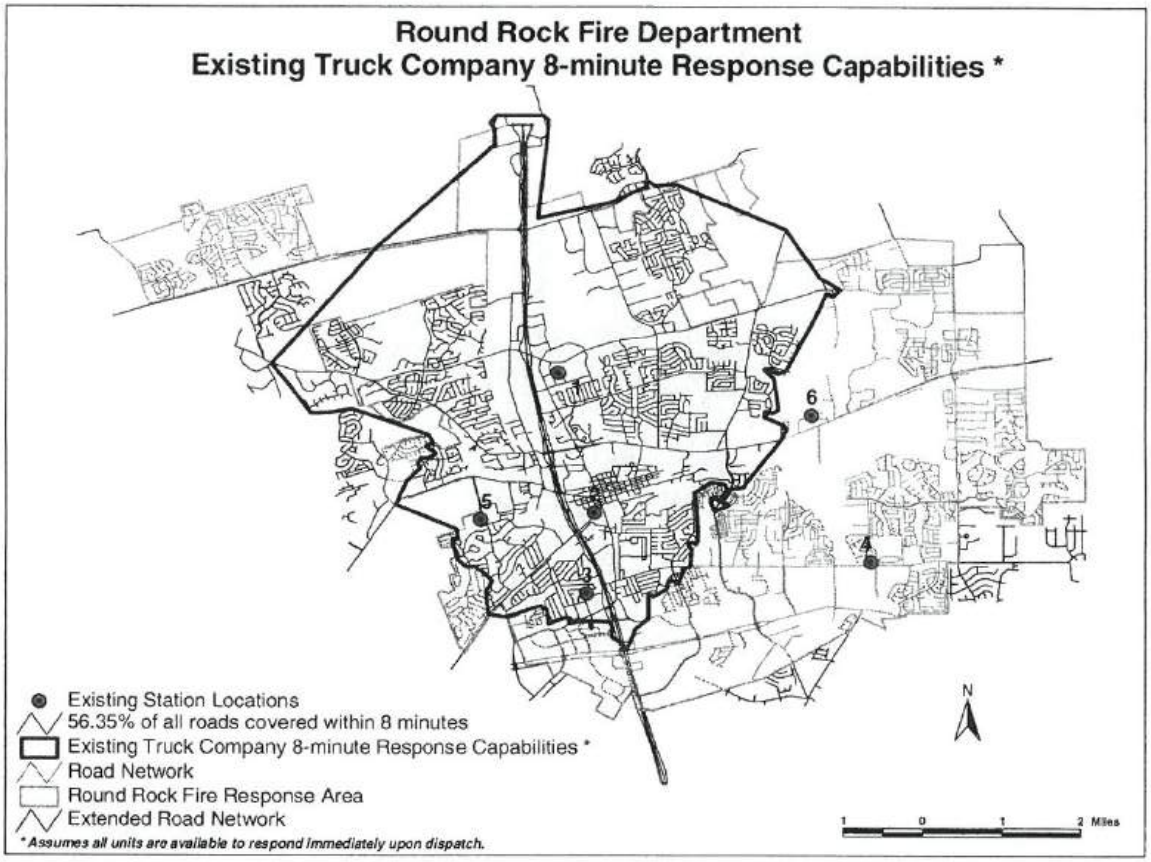
[88] The Journal of the American Medical Association (October 28, 1992): 2290.

MAP 20



Map 20 indicates the existing ladder truck company 4-minute response capabilities. Currently, the ladder truck deploying from the Central Station is capable of responding to **14.82% of all roads located within the Round Rock Fire District in 4 minutes or less,** *assuming all units are available to respond immediately upon dispatch.* The unavailability of a ladder truck to respond to emergencies within its primary response district creates a gap in services to that area of the community, and a delay in fire department response.

MAP 21



Map 21 indicates the existing 8-minute response area for the ladder company when responding from its assigned station. Ladder companies play a vital role on the scene of a structure fire securing building access, conducting search and rescue, and overseeing the ventilation of dangerous, superheated products of combustion from the building. Currently, the ladder company is capable of responding to **56.35% of all roads located within the Round Rock Fire District in 8 minutes or less,** *assuming all companies are available to respond immediately upon dispatch.*

The Importance of the 8-minute Ladder Company Response In Structural Fire Fighting Operations:

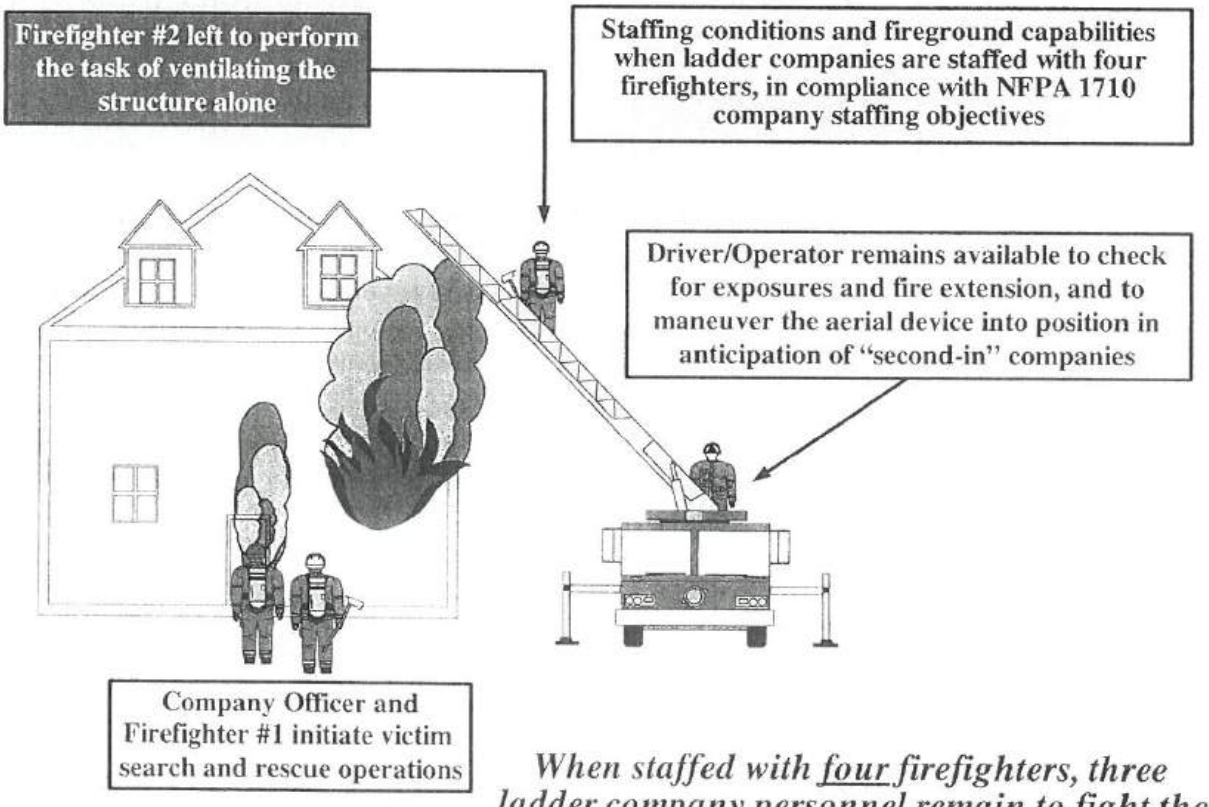
Ladder companies play a vital role on the scene of a structure fire securing building access and overseeing the ventilation of dangerous, superheated products of combustion from the building. The importance of being able to ventilate a building efficiently, effectively, and *in coordination* with interior attack operations is key to supporting search and rescue operations. Once the superheated gases and smoke from the building have been ventilated, fire fighters conducting interior fire suppression and rescue operations are able to more clearly locate the seat of the fire and more effectively perform victim search and rescue. The rapid extrication of victims from inside a burning structure is critical to saving lives: the quicker fire victims are removed from the structure, the quicker they can be treated by fire department and medical personnel for smoke inhalation, burns, and other injuries related to fire. Thus, the response of the ladder truck *in concert with* other fire suppression companies assigned to respond to a structure fire is critical

to initiating *safe* and *effective* fire suppression and rescue operations. Any delay in response translates directly into a proportional *increase* in the expected loss of life and property.

To ensure the rapid extrication of fire victims, NFPA 1710 states that "Fire companies whose primary functions are to perform the variety of services associated with truck work, such as forcible entry, ventilation, search and rescue, aerial operations for water delivery and rescue, utility control, illumination, overhaul and salvage work... shall [also] be staffed with a **minimum of four on-duty personnel.**"[89] A crew of four is required to make a safe initial attack on a fire, with a crew of two working inside the burning structure and a backup crew of two standing by to assist as necessary. This is known as the "2 In/2 Out" regulation.

The Round Rock Fire Department currently staffs the ladder truck with three fire fighters, ***which is not in compliance with NFPA 1710***. On the scene of a fire, however, the operator of the ladder must remain with the apparatus to safely operate the aerial device, leaving a crew of only three to support the attack or complete search and rescue activities. Figure 9 illustrates the fireground operations of a ladder company staffed with four firefighters.

FIGURE 9:
"LADDER COMPANY FIREGROUND OPERATIONS WHEN STAFFED WITH FOUR FIREFIGHTERS"



[89] NFPA 1710, Section 5.2.2.2 and 5.2.2.2.1

When staffed with four firefighters, ladder companies are capable of ventilation of the structure, and can initiate fire suppression and rescue operations more *safely* and more *effectively* than ladder companies staffed with less than four firefighters. **When staffed in compliance with industry standards, firefighters are 79% more efficient than three-person crews in ventilating the structure, 10.7% more effective in accomplishing victim search and rescue, and 80.2% more efficient in checking for exposures and fire extension.**

Table 6 details the efficiencies of staffing a ladder company with 3 vs. 4 firefighters.

TABLE 6:
"LADDER COMPANY EFFICIENCY: 3 FIREFIGHTERS VS. 4 FIREFIGHTERS"

NUMBER OF FIREFIGHTERS	ROOF VENTILATION	SEARCH & RESCUE	CHECK EXPOSURES FOR FIRE EXTENSION
5 Firefighters	**100.0%**	**100.0%**	**100.0%**
4 Firefighters	**79.0%**	**90.3%**	**80.2%**
3 Firefighters	0.0%	79.6%	0.0%

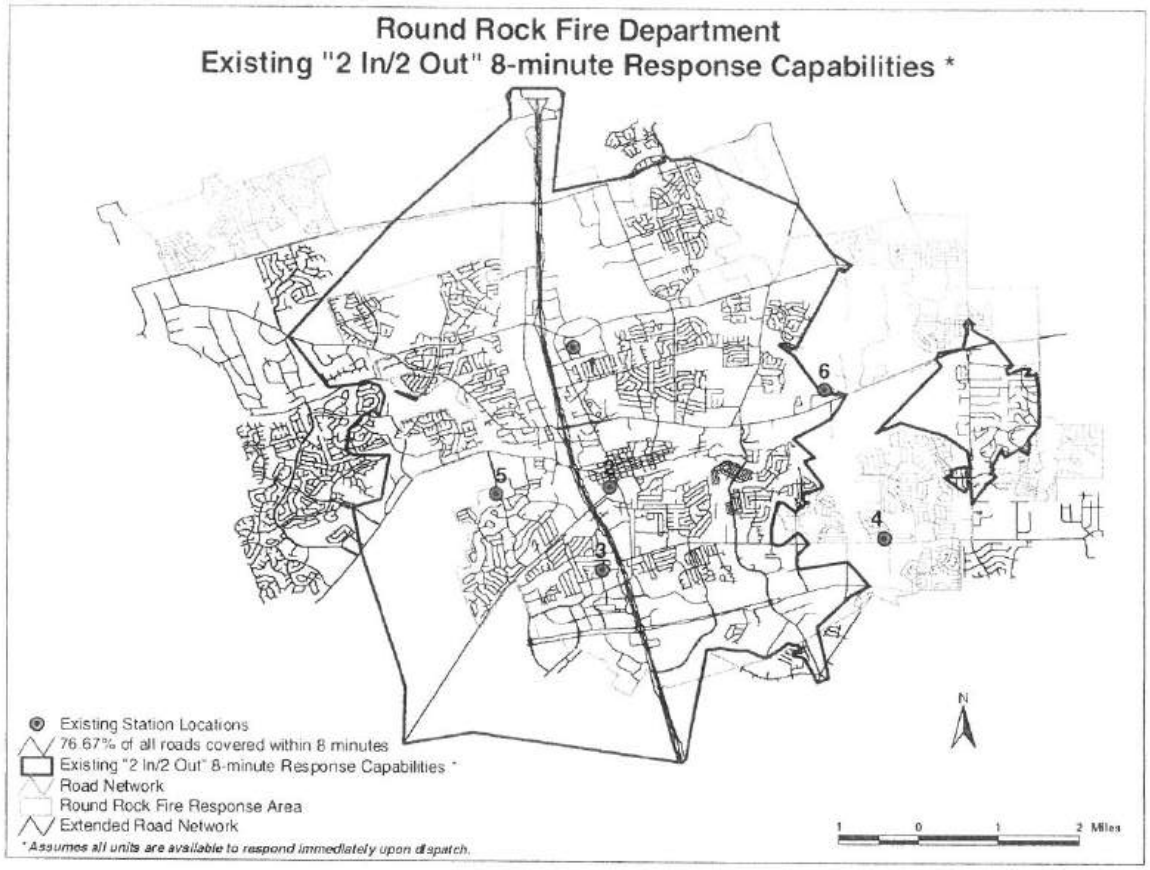
For these reasons, **it is the recommendation of this study that the Round Rock Fire Department ensure the safe and effective delivery of emergency services by staffing all fire suppression apparatus with *at least* four multi-role fire fighters cross-trained to the level of EMT-B.**[90]

The "2 In/2 Out" regulation requires that, at a minimum, a crew of four is required to make a safe initial attack on a fire, with a crew of two working inside the burning structure and a backup crew of two standing by to assist as necessary. The Round Rock Fire Department currently staffs Truck 1 with only three firefighters. On the scene of a fire the driver/operator of a ladder truck must remain with the apparatus to safely operate the aerial device. This leaves a crew of only two fire fighters on each ladder company to attack the fire or complete search and rescue activities. Therefore, a fire attack initiated by a single ladder company would not be in compliance with the "2 In/2 Out" regulation until a second fire suppression company arrives and is available to assist the first company in the event of an unexpected emergency.[91] For these reasons, **it is the recommendation of this report that the Round Rock Fire Department staff all fire suppression apparatus with *at least* four multi-role fire fighters, two of which are certified in the delivery of ALS.**

[90] NFPA 1710, §5.2.2.1.2 and §5.2.2.2.2 - "In jurisdictions with tactical hazards, high hazard occupancies, high incident frequencies, geographical restrictions, or other pertinent factors as identified by the authority having jurisdiction, these companies shall be staffed with a minimum of five or six on-duty members."

[91] Occupational Safety and Health Administration, 29 CFR 1910.134 and National Fire Protection Association, Standard 1500

MAP 22



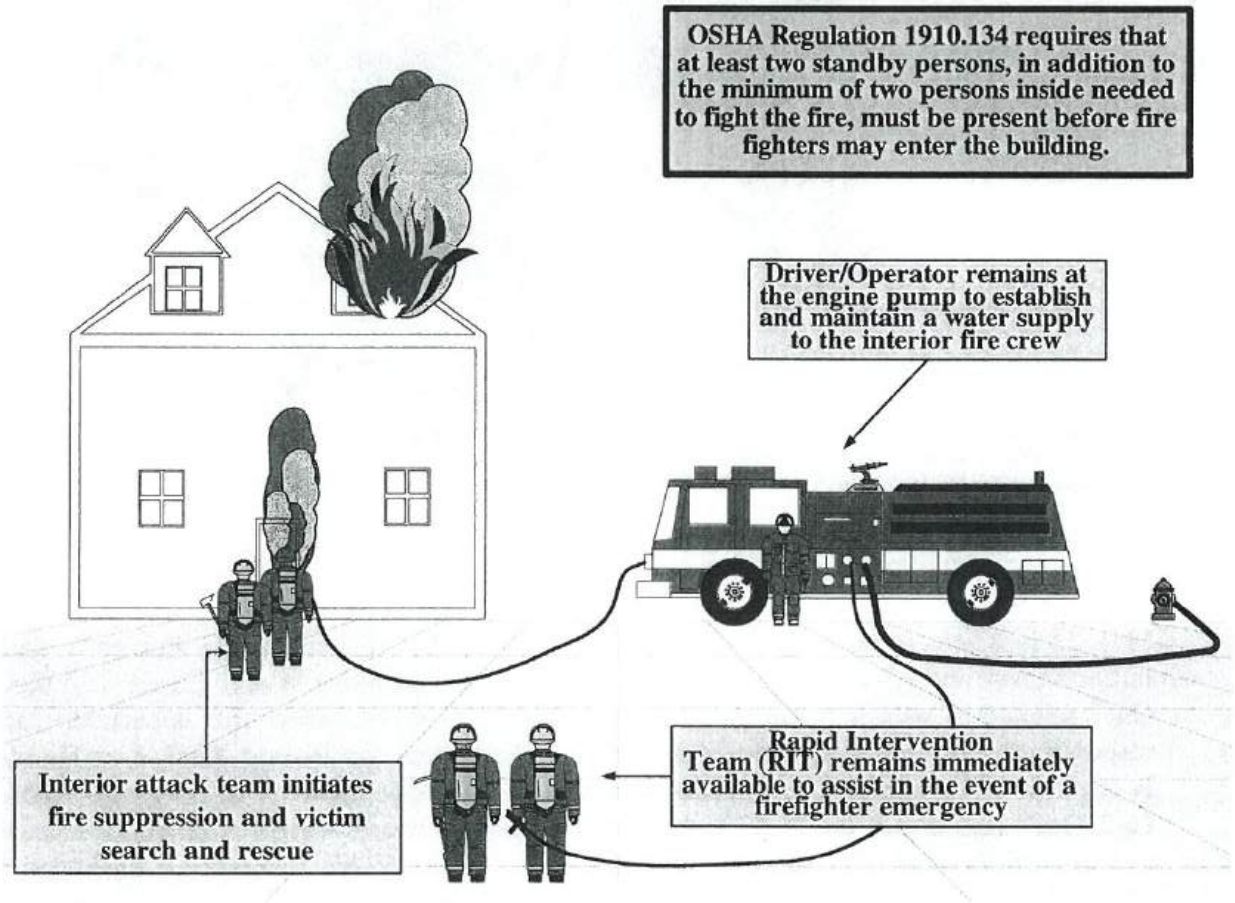
Map 22 indicates those areas where the Round Rock Fire Department is currently capable of initiating *safe* and *effective* fire suppression and rescue operations in accordance with the "2 In/2 Out" regulation within 8 minutes. Under these conditions, when fire department units are responding from their assigned stations, it is predicted that **the Round Rock Fire Department is capable of initiating fire suppression and rescue operations in accordance with the "2 In/2 Out" regulation on 76.67% of all Fire District roads within 8 minutes,** *assuming all units are fully staffed at existing staffing levels and available to respond immediately upon dispatch.*

OSHA's "2 In/2 Out" Regulation

The "2 In/2 Out" policy is part of paragraph (g)(4) of OSHA's revised respiratory protection standard, 29 CFR 1910.134. The safety of fire fighters engaged in interior structural firefighting is the major focus of paragraph (g)(4) of the OSHA Respiratory Protection standard. OSHA's interpretation on requirements for the number of workers required being present when conducting operations in atmospheres that are immediately dangerous to life and health (IDLH) covers the number of persons who must be on the scene before firefighting personnel may initiate an interior attack on a structural fire. An interior structural fire (*an advanced fire that has spread inside of the building where high temperatures, "heat" and dense smoke are normally occurring*) would present an IDLH atmosphere and, therefore, require the use of respirators. In those cases, at least two standby persons, in addition to the minimum of two persons inside needed to fight the fire, must be present before fire fighters may enter the

building.[92, 93] This requirement is mirrored in NFPA 1500, which states that "a rapid intervention team shall consist of at least two members and shall be available for rescue of a member or a team if the need arises. Once a second team is assigned or operating in the hazardous area, the incident shall no longer be considered in the 'initial stage,' and at least one rapid intervention crew shall be required." Figure 10 illustrates the OSHA 2 In/2 Out regulation.

FIGURE 10:
"OSHA '2 IN/2 OUT' ILLUSTRATED"



Two of the most important elements in limiting fire spread are the quick arrival of sufficient numbers of personnel and equipment to attack and extinguish the fire as close to the point of origin as possible, as well as rescue any trapped occupants and care for the injured. Several existing National Fire Protection Association standards address this time-critical issue. NFPA 1500 states, "while members can be assigned and arrive at the scene of an incident in many different ways, it is strongly recommended that interior fire fighting operations not be conducted without an adequate number of qualified firefighters operating in companies under the supervision of company officers. **It is recommended that a minimum acceptable fire company staffing level should be four members responding on or arriving with each**

[92] Under the NFPA standards relating to fire fighter safety and health, the incident commander may make exceptions to these rules if necessary to save lives. The Standard does not prohibit fire fighters from entering a burning structure to perform rescue operations when there is a "reasonable" belief that victims may be inside.
[93] Paula O. White, letter to Thomas N. Cooper, 1 November 1995 (OSHA)

engine and each ladder company responding to any type of fire." NFPA Standard 1710 further recommends that "fire companies whose primary functions are to pump and deliver water and perform basic fire fighting at fires, including search and rescue... shall be staffed with **a minimum of four on-duty personnel**,"[94] while "fire companies whose primary functions are to perform the variety of services associated with truck work, such as forcible entry, ventilation, search and rescue, aerial operations for water delivery and rescue, utility control, illumination, overhaul and salvage work... shall [also] be staffed with **a minimum of four on-duty personnel**."[95] For either fire suppression company, NFPA 1710 states that "in jurisdictions with tactical hazards, high hazard occupancies, high incident frequencies, geographical restrictions, or other pertinent factors as identified by the authority having jurisdiction, these companies shall be staffed with a minimum of five or six on-duty members."[96]

A number of incidents in which the failure to follow "2 In/2 Out" procedures have contributed to fire fighter casualties. For example, in Lexington, Kentucky, one fire fighter died and a second was severely injured following a fire where Kentucky OSHA later cited the fire fighters' employer for failing to utilize "2 In/2 Out" procedures. In a second case, two fire fighters died from smoke inhalation after being overcome by toxic fumes while fighting an accidental fire in Philadelphia, PA. Although two additional fire fighters were outside the home, both were engaged in support activities (hydrant hook-up and pump operation), and neither was fully accountable for monitoring the interior personnel.

There also exist a number of success stories following the adoption of "2 In/2 Out" procedures. In Pittsburgh, PA, the Fire Department implemented an accountability and rescue system following a fatal fire. In one instance, four fire fighters who were performing an interior attack on an apartment building fire became disoriented and were trapped in the building. The standby personnel were able to initiate rescue operations promptly and, although the four interior fire fighters and two of the rescuers were injured, all survived.[97]

"2 In/2 Out," Flashover, & Fire Department Operations:

Only those structure fires located within a limited area, as depicted in Map 9, where a sufficient number of personnel arriving on appropriate apparatus can arrive at a common destination within 8 minutes, will receive the equipment and personnel required to initiate *safe* and *effective* fire suppression and rescue operations in accordance with the OSHA and NFPA guidelines outlined in this report. As the progression of a structural fire to the point of flashover generally occurs within 10 minutes, it is predicted that those structure fires at the furthest reaches and beyond the extent of the 8-minute polygons indicated in Map 9 are *more likely* to continue to burn up to and beyond the point of flashover.

Flashover is a critical stage of fire growth for two reasons. First, no unprotected living thing in a room where flashover occurs will survive and the chance of saving lives drops dramatically. Second, flashover creates a huge jump in the rate of combustion, and a significantly greater amount of water is needed to reduce the burning material below its ignition temperature. A post-flashover fire burns hotter and moves faster, requires more resources for fire attack, and compounds the problems of search and rescue, exposure protection, and containment.[98]

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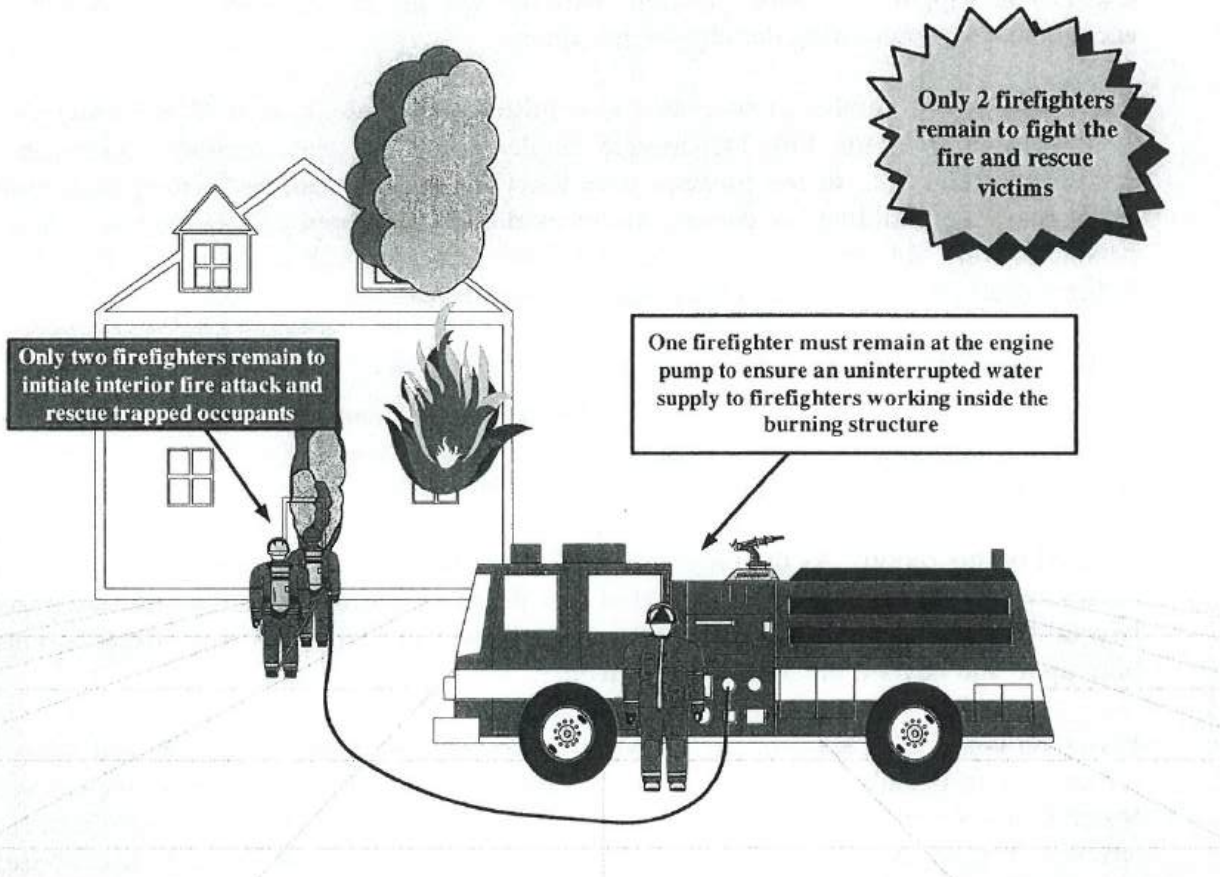
[94] NFPA 1710, § 5.2.2.1 and § 5.2.2.1.1
[95] NFPA 1710, § 5.2.2.2 and § 5.2.2.2.1
[96] NFPA 1710, § 5.2.2.1.2 and § 5.2.2.2.2
[97] John B. Miles, Jr., letter to J. Curtis Varone, Esq., 29 April 1998 (OSHA)
[98] The University of California at Davis Fire Department website; site visited April 2, 2004.

It is worth reiterating here that the ability of the fire department to assemble a sufficient number of firefighters to initiate "2 In/2 Out" fire suppression and rescue activities occurs *within* 8 minutes. It is very likely that the first-in company may arrive in significantly *less than* 8 minutes, and the second-in company may arrive closer to the 8-minute mark. This lag time between the arrival of units is significant in that if staffed with less than four fire fighters, fire companies are *completely* unable to perform fire and rescue operations in accordance with the "2 In/2 Out" regulation. Such is currently the case with the fire department's engine companies, which are staffed with only three firefighters. The incident commander may allow fire fighters to enter a burning structure to perform rescue operations when there is a "reasonable" belief that victims may be inside, but if fire companies that do so are staffed with *less than* four firefighters, they violate the "2 In/2 Out" regulation, increasing the risk of injury and death posed to themselves. Figure 11 illustrates engine company fire suppression staff with three firefighters.

FIGURE 11:
"EXISTING FIRE SUPPRESSION OPERATIONS FOR ENGINES STAFFED WITH 3 FIREFIGHTERS"

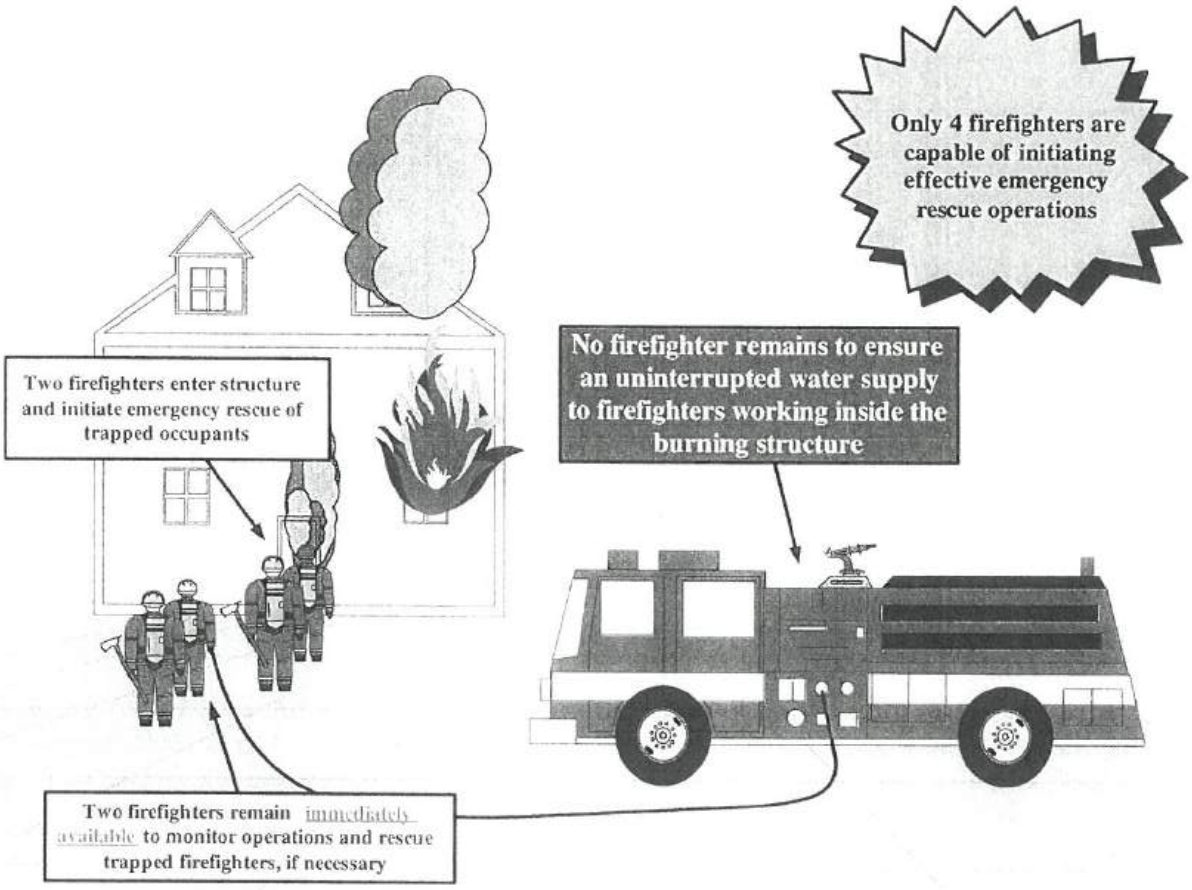


When confronted with occupants trapped in a burning structure and a single fire company is on scene, only a company staffed with four firefighters is able to initiate emergency search and rescue operations in compliance with "2 In/2 Out" operations. This would require the complete engagement of every fire fighter from the first-in fire company, staffed with four, to participate in the effort, and means that the driver-operator of the apparatus will not

< http://fire.ucdavis.edu/ucdfire/UCDFDfiresuppression.htm >

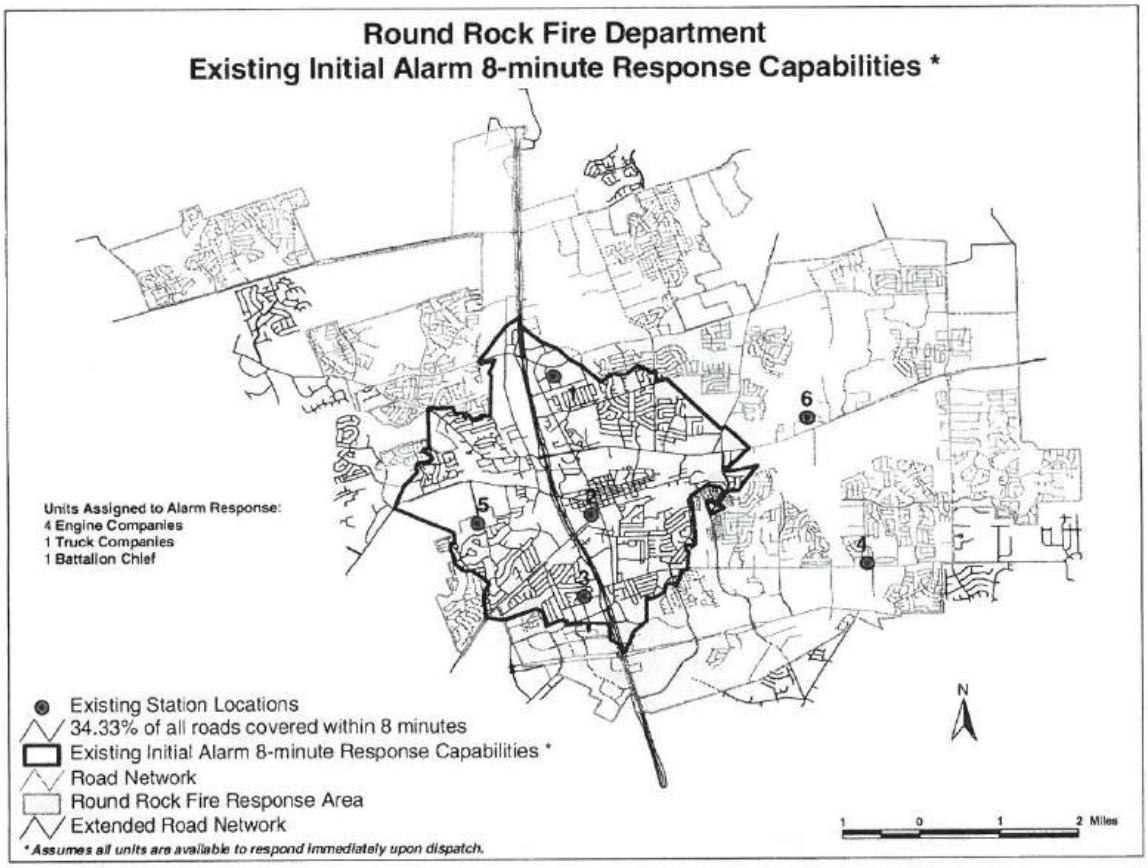
be able to tend to the pump to ensure the delivery of water to the fire fighters performing the initial attack and search and rescue operations. Figure 12 illustrates the 2 In/2 Out operations of a fire company staffed with four firefighters.

FIGURE 12:
"EMERGENCY '2 IN/2 OUT' OPERATIONS
WHEN FIRE COMPANIES ARE STAFFED WITH 4 FIREFIGHTERS"



Regardless, when there exists an immediate threat to life, only a company of four fire fighters can initiate fire suppression and rescue operations in compliance with the "2 In/2 Out" regulation, and in a manner that minimizes the threat of personal injury. In all other instances with a four-person fire company (i.e., when there is not an immediate threat to life), the first-in company must wait until the arrival of the second-in unit to initiate safe and effective fire suppression and rescue operations. This condition underlines the importance and desirability of fire companies to be staffed with four firefighters, and stresses the benefit of four-person companies and their ability to save lives without having to wait for the second-in company to arrive.

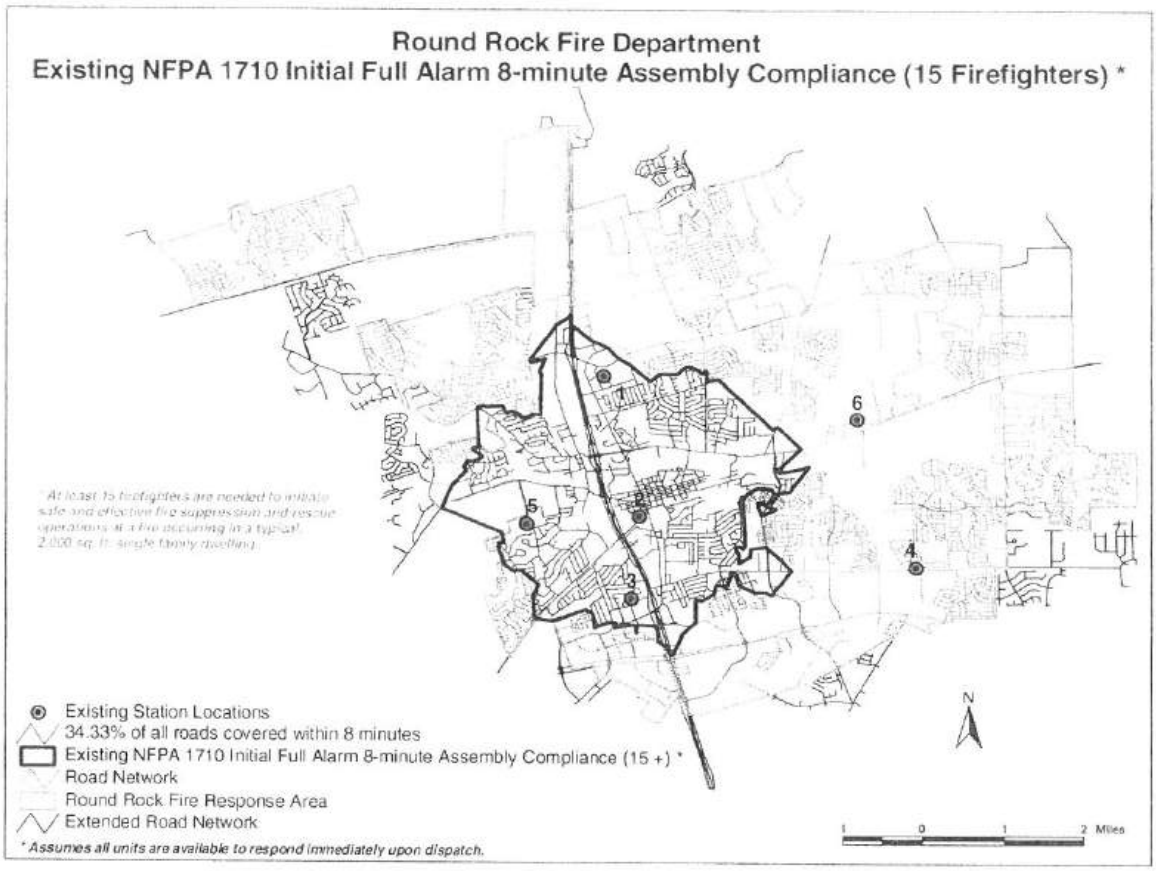
MAP 23



Map 23 indicates the existing 8-minute response capabilities of fire suppression companies and the Battalion Chief assigned to respond as part of an Initial (First) Alarm assignment for a fire in a residential structure. Currently, the units assigned to this alarm type are capable of assembling on only **34.33% of all roads within 8 minutes,** *assuming all units are available to respond immediately upon dispatch.* Under the existing deployment configuration, the GIS model is able to project that **on 65.67% of all Fire District roads, then, the fire department is unable to assemble, within 8 minutes, the fire suppression resources necessary to initiate safe and effective fire suppression and rescue operations for this alarm type.**

The Initial (First) Alarm for the Round Rock Fire Department consists of the one Battalion Chief, one Truck company and four Engine companies.

MAP 24



Initial Full Alarm Assignment Capability, as outlined in NFPA Standard 1710, recommends that the "fire department shall have the capability to deploy an initial full alarm assignment within an 8-minute response time to 90 percent of the incidents... [and that the] initial full alarm shall provide for the following: a minimum of one individual dedicated to establishing incident command outside of the hazard area, assisted by an aide; establishment of an uninterrupted water supply, which shall be maintained by an operator who shall ensure uninterrupted water flow application; establishment of attack and backup lines, operated by a minimum of two personnel each to effectively and safely maintain the line; provision of one support person for each attack and backup line to provide hydrant hookup, assist in line lays, utility control, and forcible entry; a minimum of one search and rescue team, consisting of two personnel; a minimum of one ventilation team, consisting of two personnel; and establishment of an Initial Rapid Intervention Crew (IRIC), consisting of a minimum of two properly equipped and trained personnel."[99] This breakdown of the expected capabilities of a full alarm assignment, in compliance with NFPA Standard 1710, requires a minimum contingent of fifteen fire suppression personnel, including the Incident Commander (IC) and the IC's aide[100], to arrive at the scene of a structure fire within 8 minutes of receiving the alarm.[101]

[99] NFPA Standard 1710, Sections 5.2.3.2.1 and 5.2.3.2.2, (a) – (h)

[100] NFPA Standard 1710, Section 5.2.1.2.5

[101] It should be noted that a minimum on-scene contingent of seventeen fire suppression personnel are required by NFPA Standard 1710 when a second pump and an aerial device are in operation at the incident scene.

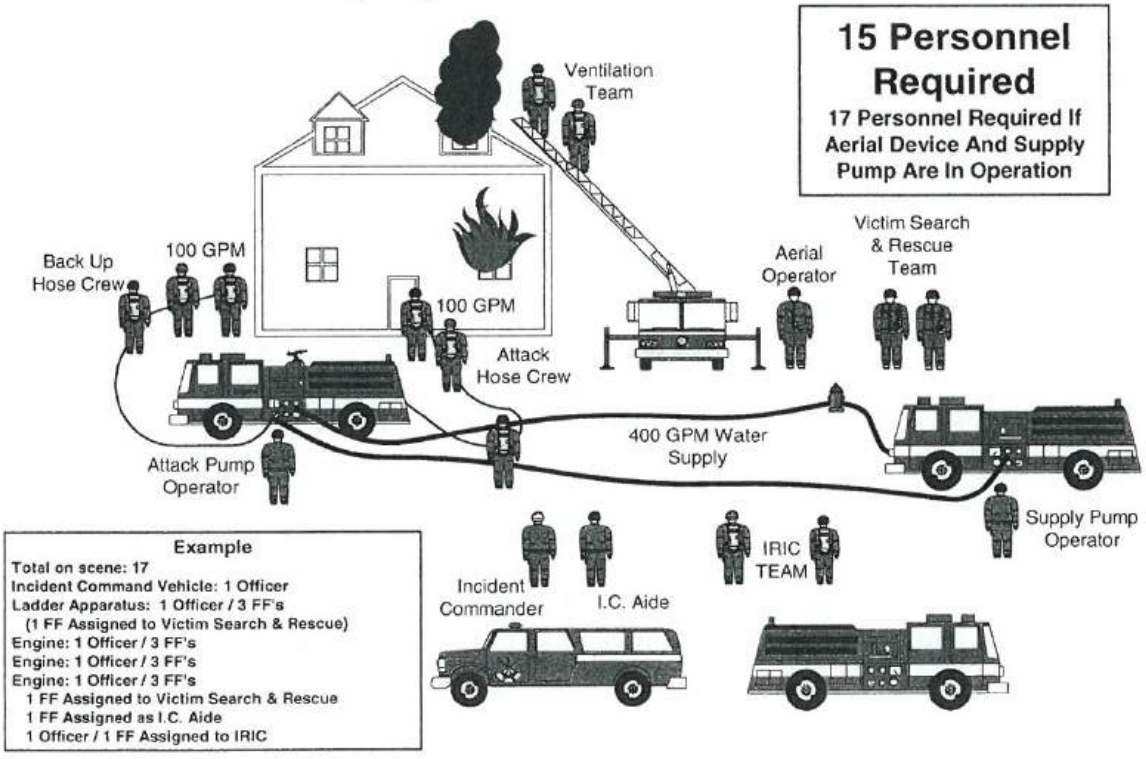
Map 24 examines the ability of the Round Rock Fire Department to respond to incidents with at least fifteen personnel within an 8-minute time frame. Utilizing all apparatus and personnel in all stations, it is predicted that **34.33% of all Fire District roads currently receive a sufficient number of fire suppression personnel within 8 minutes of receiving an alarm to comply with NFPA Standard 1710**, *assuming all units are fully staffed at existing staffing levels and available to respond immediately upon dispatch.*

NFPA 1710 states that "the fire department's fire suppression resources shall be deployed to provide for the arrival of an engine company within a 4-minute response time and/or **the initial full alarm assignment within an 8-minute response time to 90% of the incidents.**" Under the existing staffing and deployment configuration, then, it may be said **the Round Rock Fire Department is unable to assemble an initial full alarm assignment in compliance with NFPA 1710 on 65.67% of all roads within 8 minutes or less.** Due to the increased risk of flashover associated with fire propagation in those areas beyond the 8-minute response polygon depicted in Map 24, it is expected that, on nearly 65% of all roads located in the Round Rock Fire Department's response jurisdiction, fire suppression and rescue operations will be forced to shift from an offensive to defensive mode, thus increasing the likelihood of the loss of both life and property.

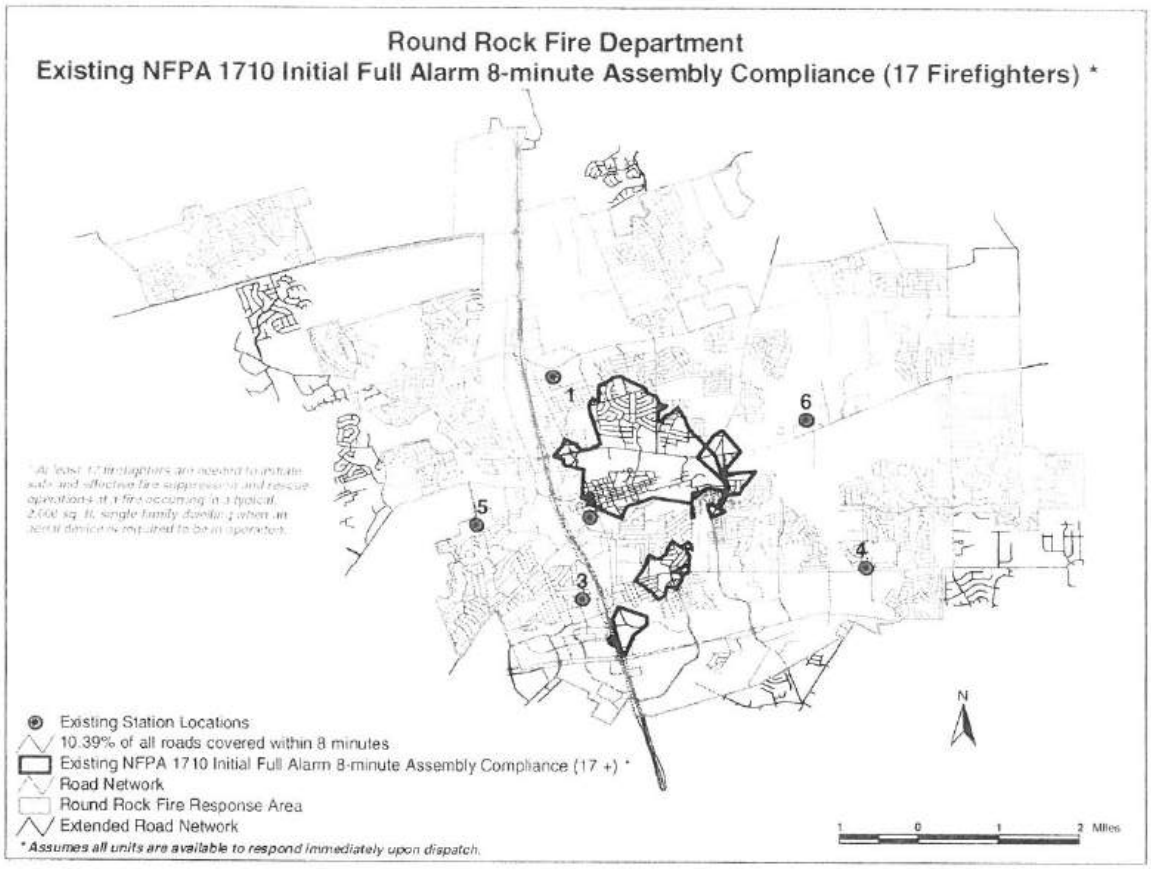
Figure 13 illustrates the initial full assignment capability deployed within 8 minutes staffed with fifteen fire suppression personnel.

Figure 13:

5.2.3.2.2 Initial Full Alarm Assignment Capability Deployed Within 8 Minutes



MAP 25

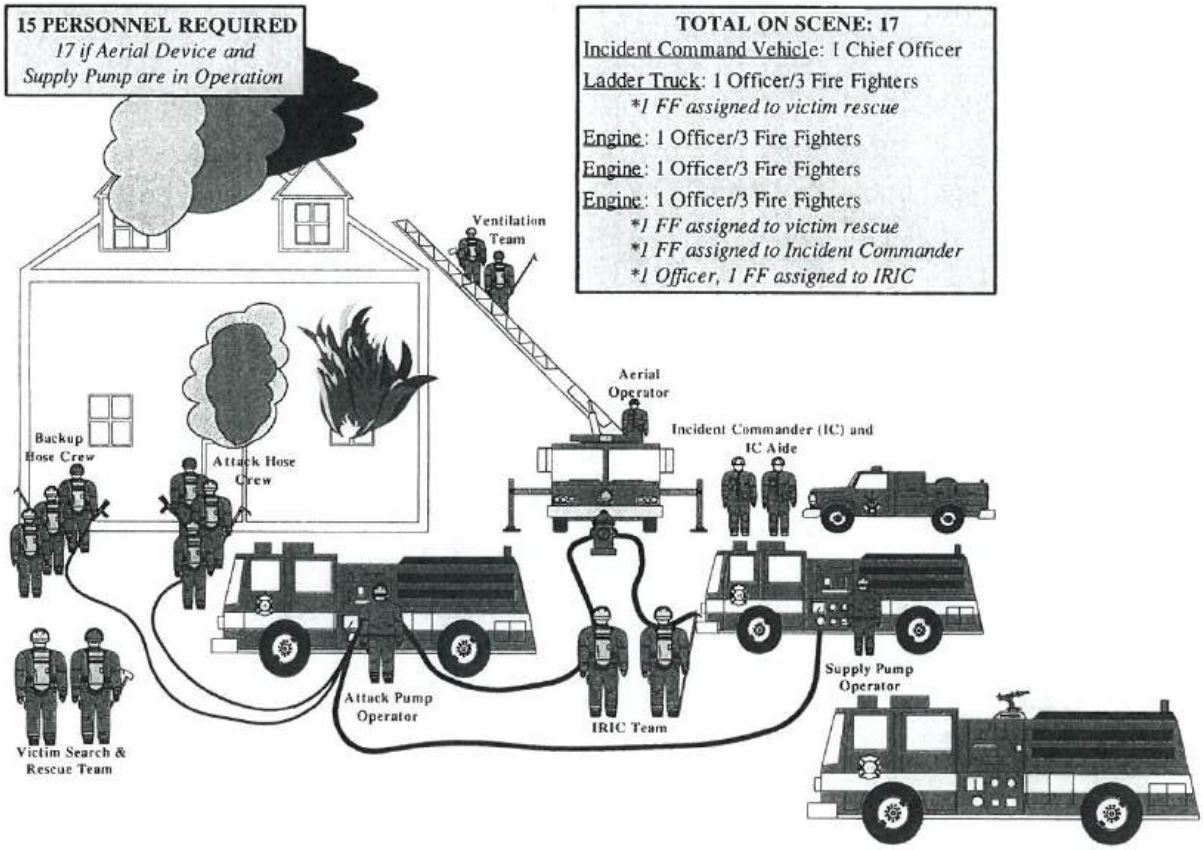


Map 25 examines the ability of the Round Rock Fire Department to respond to incidents with at least fifteen personnel within an 8-minute time frame. Utilizing all apparatus and personnel in all stations, it is predicted that **10.39% of all Fire District roads currently receive a sufficient number of fire suppression personnel within 8 minutes of receiving an alarm to comply with NFPA Standard 1710 when a second pump and an aerial device are in operation at the incident scene**, *assuming all units are fully staffed at existing staffing levels and available to respond immediately upon dispatch.*

Under the existing staffing and deployment configuration, then, it may be said **the Round Rock Fire Department is unable to assemble an initial full alarm assignment in compliance with NFPA 1710 on 89.61 % of all roads within 8 minutes or less, when a second pump and an aerial device are in operation at the incident scene.** Due to the increased risk of flashover associated with fire propagation in those areas beyond the 8-minute response polygon depicted in Map 25, it is expected that, on nearly 90% of all roads located in the Round Rock Fire Department's response jurisdiction, fire suppression and rescue operations will be forced to shift from an offensive to defensive mode, thus increasing the likelihood of the loss of both life and property.

Figure 14 illustrates the initial full assignment capability deployed within 8 minutes staffed with seventeen fire suppression personnel.

FIGURE 14:
NFPA 1710, SECTION 5.2.3.2.2:
INITIAL FULL ALARM ASSIGNMENT DEPLOYED WITHIN 8 MINUTES



Fire Growth, Flashover, and the Importance of a Rapid Response to a Fire in a Residential Structure:

The Smoldering Phase

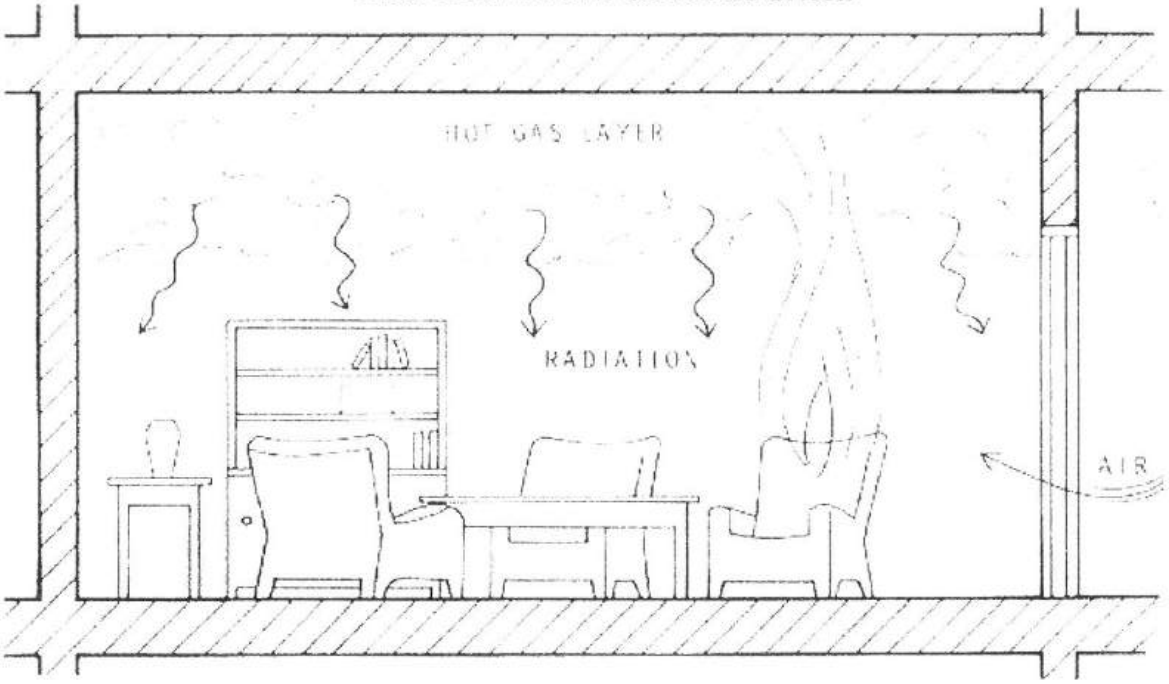
The first stage of any fire is the smoldering stage. When heat is applied to a combustible material, the heat oxidizes the material's surface into combustible gases. The oxidation process is exothermic, meaning that the oxidation process itself produces heat. The heat from oxidation raises the temperature of surrounding materials, which increases the rate of oxidation and begins a chemical chain reaction of heat release and burning. A fire can progress from the smoldering phase immediately or slowly, depending upon the fuel, nearby combustibles, and the availability of oxygen in the surrounding air.

The Free Burning Phase

The second stage of fire growth is the "free" or "open burning" stage. When the temperature of a fire gets high enough, visible flames can be seen. The visible burning at this stage is still limited to the immediate area of origin. The combustible process continues to release more heat, which heats nearby objects to their ignition temperature, and they begin burning. In a wildland fire the surrounding growth will ignite and the flames will spread, quickly if wind and dry growth are present. A structure fire is different, because the gaseous products of combustion, most of which are flammable and lighter than air, rise and are contained in the upper levels of the structure. When this occurs, the structure fire is at a critical point: either the

fire has insufficient oxygen available to burn and it progresses back to the smoldering stage, or it has sufficient oxygen available to move on to the next stage.

FIGURE 15:
"FIRE GROWTH IN A CONFINED SPACE"[102]



When an object in a room starts to burn (such as the armchair in Figure 15), for some time after ignition, it burns in much the same way as it would in the open. After a short period of time, however, confinement begins to influence fire development. The smoke produced by the burning object rises to form a hot gas layer below the ceiling; this layer heats the ceiling and upper walls of the room. Thermal radiation from the hot layer, ceiling, and upper walls begins to heat all objects in the lower part of the room and may augment both the rate of burning of the original object and the rate of flame spread over its surface.

At this point, the fire may go out if, for example, the first object burns completely before others start, or if sufficient oxygen cannot get into the room to keep the object burning. Sometimes, however, the heating of the other combustibles in the room continues to the point where they reach their ignition temperatures more or less simultaneously. If this occurs, flames suddenly sweep across the room, involving most combustibles in the fire. This transition from the burning of one or two objects to full room involvement is referred to as "flashover."[103]

Flashover

The third stage of fire growth is called *flashover*. It is the most significant moment of any structure fire. As combustible gases are produced by the two previous stages they are not wholly consumed. They rise and form a superheated gas layer at the ceiling. As the volume of this gas layer increases, it begins to bank down to the floor, heating all combustible objects regardless of their proximity to the burning object. In a typical structure fire, the gas layer at the

[102] Image courtesy of University of California at Davis Fire Department

[103] J.R. Mehaffey, Ph.D., Flammability of Building Materials and Fire Growth, Institute for Research in Construction (1987)

ceiling can quickly reach temperatures of 1,500 degrees Fahrenheit. If there is enough existing oxygen, usually near floor level, flashover occurs and everything in the room breaks out into open flame at once. The instantaneous eruption into flame generates a tremendous amount of heat, smoke, and pressure with enough force to push beyond the room of origin through doors and windows. Usually at the time of flashover, windows in the room will break, allowing for the entry of fresh air. The introduction of fresh air serves to further fuel the growth of the fire, increase the temperature of the fire, and aid in the spread of the fire beyond the room of origin. The combustion process then speeds up because it has an even greater amount of heat to move to unburned objects.

The ability of adequate fire suppression forces to greatly influence the outcome of a structural fire is undeniable and predictable. Data generated by the National Fire Protection Association provides empirical proof that rapid and aggressive interior attack can substantially reduce the human and property loss associated with structural fires. At each stage of a fire's extension beyond the room of origin, the rate of civilian deaths, injuries, and property damage grows exponentially. Table 7 details the relationship between fire extension and fire loss.

TABLE 7:[104]
"THE RELATIONSHIP BETWEEN FIRE EXTENSION AND FIRE LOSS"

	RATE PER 1,000 FIRES		
Fire Extension in Residential Structures:	Civilian Deaths	Civilian Injuries	Average Property Damage
Confined to Room of Origin	2.07	24.30	$1,505.00
Confined to Floor of Origin	18.60	80.44	$12,134.00
Beyond Floor of Origin	27.23	55.37	$21,343.00

The Importance of Adequate Staffing to Conduct Safe and Effective Fire Suppression and Rescue Operations:

A prime objective of fire service agencies is to maintain enough strategically located personnel and equipment so that the minimum acceptable response force can reach a reasonable number of fire scenes before flashover is likely.[105] Two of the most important elements in limiting fire spread are the quick arrival of sufficient numbers of personnel and equipment to attack and extinguish the fire as close to the point of origin as possible, as well as rescue any trapped occupants and care for the injured. Rapid and aggressive interior attack of structure fires, as close as possible to the point of origin, can reduce human and property losses. Sub-optimal staffing of arriving units may delay such an attack, thus allowing the fire to progress to more dangerous conditions for fire fighters and civilians. "If the arriving units have adequate resources to handle the situation, then they will fight the fire aggressively and offensively. They will attack the problem head-on and, following department standards, will accomplish their objectives efficiently, effectively, and safely. If they do not have adequate resources to aggressively handle the situation, then they will have to fight the fire in a defensive mode of

[104] Source: National Fire Protection Association
[105] University of California at Davis Fire Department website; site visited June 7, 2004.
< http://fire.ucdavis.edu/ucdfire/UCDFDoperations.htm >

attack. This mode will continue until enough resources can be massed to then change to an aggressive, offensive attack."[106]

NFPA 1500 and 1710 both recommend that a minimum acceptable fire company staffing level should be **four members responding on or arriving with each engine and each ladder company responding to any type of fire.** Currently, the Round Rock Fire Department staffs all engine companies with only three fire fighters, out of compliance with professional standards for the provision of safe and effective fire suppression and rescue operations. At the scene of an emergency, the driver/operator of the engine must remain with the apparatus to operate the pump. Likewise, the driver/operator of the ladder truck must remain with the apparatus to safely operate the aerial device. Such activities, which help to ensure the safe and effective delivery of fire suppression and rescue services, leave a crew of only two firefighters from an engine company and three firefighters from a ladder company to support the attack or complete search and rescue activities. A fire attack initiated by a single fire company would not be capable of effecting a safe and effective fire suppression and/or rescue operation in compliance with the "2 In/2 Out" regulation until a second company arrives with sufficient personnel to support the fire attack and/or rescue operation, and to assist the first company in the event of an unexpected emergency.[107] Industry studies have confirmed that **four fire fighters are capable of performing the rescue of potential victims 80% faster than a crew of three fire fighters.**[108]

Any delay in the initiation of fire suppression and rescue operations translates directly into a proportional *increase* in expected property, life, and economic losses (reference "The Relationship between Fire Extension and Fire Loss," Table 7, p. 101). It warrants emphasizing that if a structure has no automatic suppression or detection system, a more advanced fire may exist by the time the fire department is notified of the emergency and is able to respond. Fires of an extended duration weaken structural members, compromising the structural integrity of a building and forcing operations to shift from an offensive to defensive mode.[109] This mode will continue until enough resources can be amassed to then change to an aggressive, offensive attack. For these reasons, **it is the recommendation of this report that all fire suppression companies be staffed on a twenty-four hour basis with four EMS cross-trained, multi-role fire fighters, in compliance with NFPA 1500 and NFPA 1710.**

NFPA 1710's requirements for the assembly of an Initial Full Alarm Assignment within 8 minutes, as illustrated previously (reference Map 23) is predicated on "a response to a structural fire in a typical 2,000 ft^2, two-story, single family occupancy without a basement and with no exposures (detached home). All communities respond to fire incidents in this type of structure on a regular basis and therefore the hazards presented by this scenario are not unusual."[110] However, the hazards in the Round Rock Fire District go beyond the typical hazards that are present in a typical 2,000 ft^2 detached single family residence. Recognizing this, NFPA 1710

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[106] National Institute for Occupational Safety and Health, High-Rise Apartment Fire Claims the Life of One Career Fire Fighter (Captain) and Injures Another Career Fire Fighter (Captain) - Texas, 13 October 2001

[107] Recall that a four-person fire company may initiate emergency search and rescue operations at the order of the incident commander if there is a "reasonable" and immediate threat to life.

[108] McManis Associates and John T. O'Hagan & Associates, Dallas Fire Department Staffing Level Study, (June 1984); pp. 1-2 and II-1 through II-7; Richard C. Morrison, Manning Levels for Engine and Ladder Companies in Small Fire Departments, (1990)

[109] According to the NFPA, "it's important to realize that every 250 GPM stream applied to the building can add up to one ton per minute to the load the weakened structure is carrying."

[110] NFPA 1710, § A.5.2.3.2.1

states that, "other occupancies and structures in the community that present greater hazards should be addressed by additional fire fighter functions and additional responding personnel on the initial full alarm assignment,"[111] which is covered in the NFPA's *Fire Protection Handbook.*

The *Fire Protection Handbook* is the preeminent resource guide for the fire service. The *Handbook* takes a systems approach to addressing the many complexities of modern fire protection, from the basics of fire behavior to fire protection information and analysis. It is in the "Information and Analysis for Fire Protection" section that the *Handbook* identifies initial attack response capabilities for **high hazard occupancies, such as schools, hospitals, nursing homes, explosive plants, refineries, high-rise buildings, and other high life hazard or large fire potential occupancies.**[112] Recognizing the increased risk to life and the loss of property in these occupancies, the NFPA recommends "at least four pumpers (engines), two ladder trucks, two chief officers, and other specialized apparatus as may be needed to cope with the combustible involved," and recommends that "**not less than twenty-four fire fighters and two chief officers" respond to fires in this hazard classification.**[113]

The Importance of Adequate Staffing to Conduct Safe and Effective Fire Suppression and Rescue Operations:

A prime objective of fire service agencies is to maintain enough strategically located personnel and equipment so that the minimum acceptable response force can reach a reasonable number of fire scenes before flashover is likely.[114] Rapid and aggressive interior attack of structure fires, as close as possible to the point of origin, can reduce human and property losses. Sub-optimal staffing of arriving units may delay such an attack, thus allowing the fire to progress to more dangerous conditions for fire fighters and civilians. According to National Institute of Occupational Safety and Health, "If the arriving units have adequate resources to handle the situation, then they will fight the fire aggressively and offensively. They will attack the problem head-on and, following department standards, will accomplish their objectives efficiently, effectively, and safely. If they do not have adequate resources to aggressively handle the situation, then they will have to fight the fire in a defensive mode of attack. This mode will continue until enough resources can be massed to then change to an aggressive, offensive attack."[115]

NFPA 1500 and 1710 both recommend that a minimum acceptable fire company staffing level should be **four members responding on or arriving with each engine and each ladder company responding to any type of fire.** Industry studies have confirmed that **four fire fighters are capable of performing the rescue of potential victims 80% faster than a crew of three fire fighters.**[116] Any delay in the initiation of fire suppression and rescue operations translates directly into a proportional *increase* in expected property, life, and economic losses. For these reasons, **it is the recommendation of this report that all fire suppression**

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[111] Ibid.

[112] John Granito, Fire Protection Handbook: 17th Edition, ed. Arthur E. Cote, P.E. (Quincy, MA: NFPA, 1991), §10, Ch.4, p. 41.

[113] Granito, §10, Ch.4, p. 41.

[114] University of California at Davis Fire Department website; visited February 4, 2004. < http://fire.ucdavis.edu/ucdfire/UCDFDoperations.htm >

[115] National Institute for Occupational Safety and Health, High-Rise Apartment Fire Claims the Life of One Career Fire Fighter (Captain) and Injures Another Career Fire Fighter (Captain) – Texas, 13 October 2001

[116] McManis Associates and John T. O'Hagan & Associates, Dallas Fire Department Staffing Level Study, (June 1984); pp. 1-2 and II-1 through II-7; Richard C. Morrison, Manning Levels for Engine and Ladder Companies in Small Fire Departments, (1990)

companies be staffed on a twenty-four hour basis with four EMS cross-trained, multi-role fire fighters, in compliance with NFPA 1500 and NFPA 1710.

IDENTIFICATION OF RESPONSE CAPABILITIES PURSUANT TO THE IMPLEMENTATION OF THE 5-YEAR PLAN

Summary

Presently, there are 6 Fire Stations in the Round Rock Fire District. The Round Rock Fire Chief has proposed an Option For Consideration For the 5-Year Plan. The 5-Year plan includes two additional Fire Stations in the north portion of the Round Rock Fire District. The two proposed Fire Stations, Station 7 and Station 8, will be located along Route 1431 on the eastern side of Interstate 35. Currently, the Round Rock Fire Department has 6 engine companies, 1 truck company, 1 brush unit and 1 battalion chief. The 5-Year Plan includes additional apparatus and modification to the current apparatus allocation at each current station. The addition of 6 new apparatus is proposed. The following list details the additional proposed apparatus within the 5-Year Plan.

- 1 Engine
- 1 Battalion Chief
- 2 Rescue
- 2 Quints

The total apparatus compliment after the implementation of the proposed 5-Year Plan would be the following:

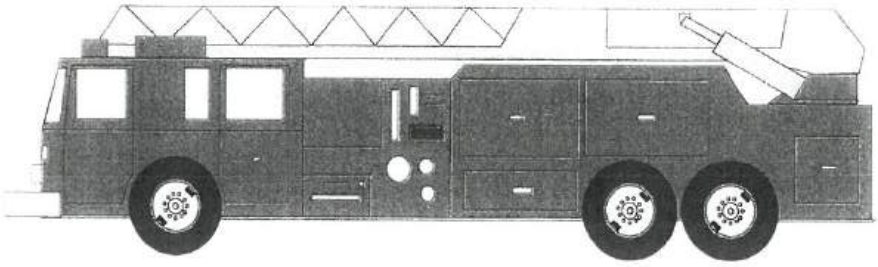
- 7 Engines
- 1 Truck
- 2 Battalion Chiefs
- 2 Rescue
- 2 Quints

Table 8 details the proposed allocation of all of the apparatus under the 5-Year plan at the 8 Round Rock Fire Stations.

TABLE 8:
"PROPOSED STATION LOCATION & DEPLOYMENT CONFIGURATION"

STATION	ADDRESS	APPARATUS	PERSONNEL
1	203 Commerce Boulevard	**Engine** **Quint**	**3 Firefighter/EMT-Bs** **3 Firefighter/EMT-Bs**
2	201 Florence Street	**Engine** **Battalion Chief**	**3 Firefighter/EMT-Bs** **1 Battalion Chief**
3	1991 Rawhide	**Engine** **Truck**	**3 Firefighter/EMT-Bs** **3 Firefighter/EMT-Bs**
4	3300 Gattis School Road	**Quint** **Rescue**	**3 Firefighter/EMT-Bs** **2 Firefighter/EMT-Bs**
5	350 Deepwood Drive	**Engine**	**4 Firefighter/EMT-Bs**
6	2919 Joe DiMaggio Way	**Engine** **Rescue**	**4 Firefighter/EMT-Bs** **2 Firefighter/EMT-Bs**
7	Route 1431 east of I-35	**Engine**	**3 Firefighter/EMT-Bs**
8	Route 1431 east of I-35	**Engine** **Battalion Chief**	**3 Firefighter/EMT-Bs** **1 Battalion Chief**

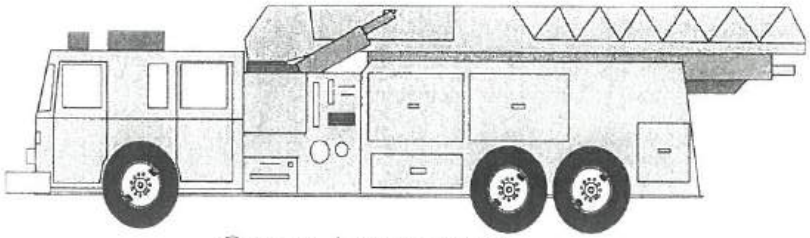
Proposed On-duty Staffing: 38



LADDER TRUCK:

Round Rock Fire Department truck company personnel are specially trained to perform a range of specific fireground activities. These specialized activities include, but are not limited to, forcible entry, ventilation, victim search and rescue, aerial operations for water delivery and rescue, utility control, illumination, overhaul and salvage work.

Currently, however, the Fire Department staffs Truck 1 with only three firefighters. In order to accomplish the truck company fireground tasks listed above, the NFPA requires at least 4 firefighters deploying from each ladder truck.

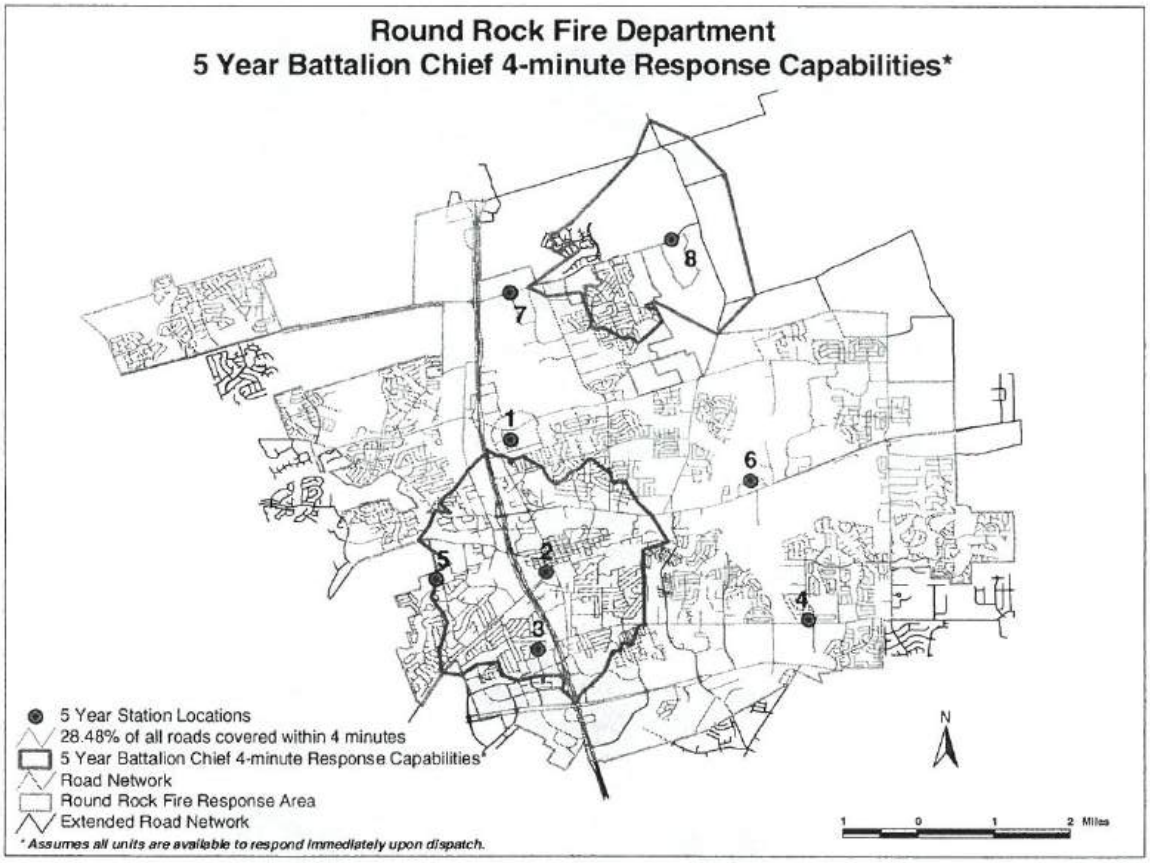


QUINT APPARATUS:

A quint is a hybrid vehicle, capable of operating in the capacity of an engine ***or*** a ladder truck. A quint has an aerial ladder but is smaller than a ladder truck, which allows for better access in restricted space, but is limited in its ability to reach higher floors because its aerial ladder is significantly shorter than that of the ladder truck. Quints also carry a limited amount of water, like an engine, but are restricted in the delivery of it due to a significantly reduced complement of available hose.

Under the proposed 5-Year Plan, the Round Rock Fire Department will deploy quints from Stations 1 and 4. As proposed by the 5-Year Plan, 3 firefighters will be allocated to each quint company. The limitations imposed by staffing the quint companies with only 3 firefighters (out of compliance with national standards) will restrict the Fire Department from performing the range of services normally provided by a regular ladder company (see above). Furthermore, due to staffing inadequacies on the quints, the ability of the Fire Department to operate said units as engine companies will be further compromised.

MAP 26



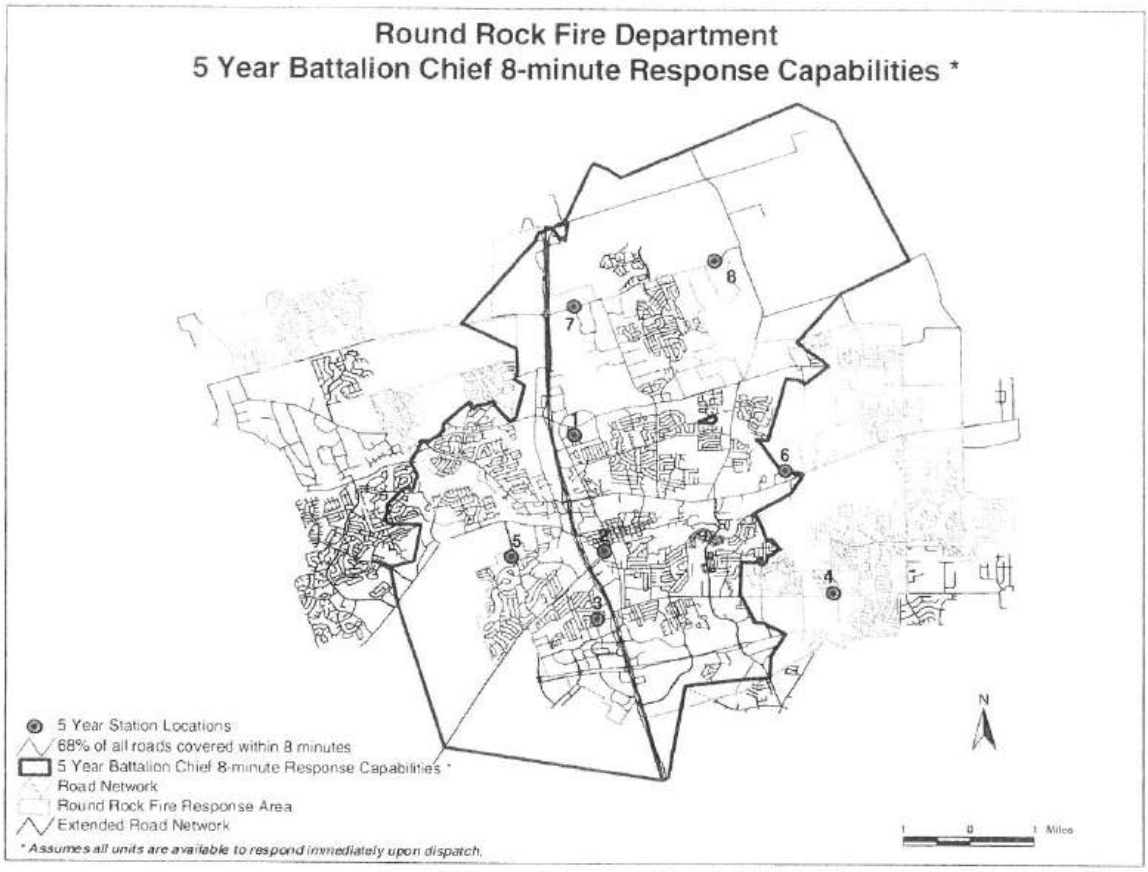
Map 26 indicates the anticipated 4-minute response capabilities of the Battalion Chiefs pursuant to the modification of the proposed 5-Year Plan. The GIS software calculates response capabilities at 28.48% of all roads within 4 minutes. **The ability of Fire Department Battalion Chiefs to respond to 28.48% of all roads within 4 minutes, pursuant to the modification of the proposed 5-Year Plan, translates into a 13.66% *increase* in Battalion Chief 4-minute response capabilities from the existing condition.**

Table 9 details the comparison of the existing 4-minute response capabilities of the battalion chief and 4-minutes response capabilities of the battalion chief under the proposed 5-Year Plan.

TABLE 9:
"COMPARISON OF BATTALION CHIEF 4-MINUTE RESPONSE CAPABILITIES"

SCENARIO	RESPONSE CAPABILITIES
Existing Battalion Chief 4-minute Response Capabilities	14.82% of all roads covered within 4 minutes
5-Year Battalion Chief 4-minute Response Capabilities	**28.48% of all roads covered within 4 minutes**

MAP 27



Map 27 indicates the anticipated 8-minute response capabilities of the Battalion Chiefs pursuant to the modification of the proposed 5-Year Plan. The GIS software calculates response capabilities at 68% of all roads within 8 minutes. **The ability of Fire Department Battalion Chiefs to respond to 68% of all roads within 8 minutes, pursuant to the modification of the proposed 5-Year Plan, translates into an 11.65% *increase* in Battalion Chief 8-minute response capabilities from the existing condition.**

Table 10 details the comparison of the existing 8-minute response capabilities of the battalion chief and 8-minutes response capabilities of the battalion chief under the proposed 5-Year Plan.

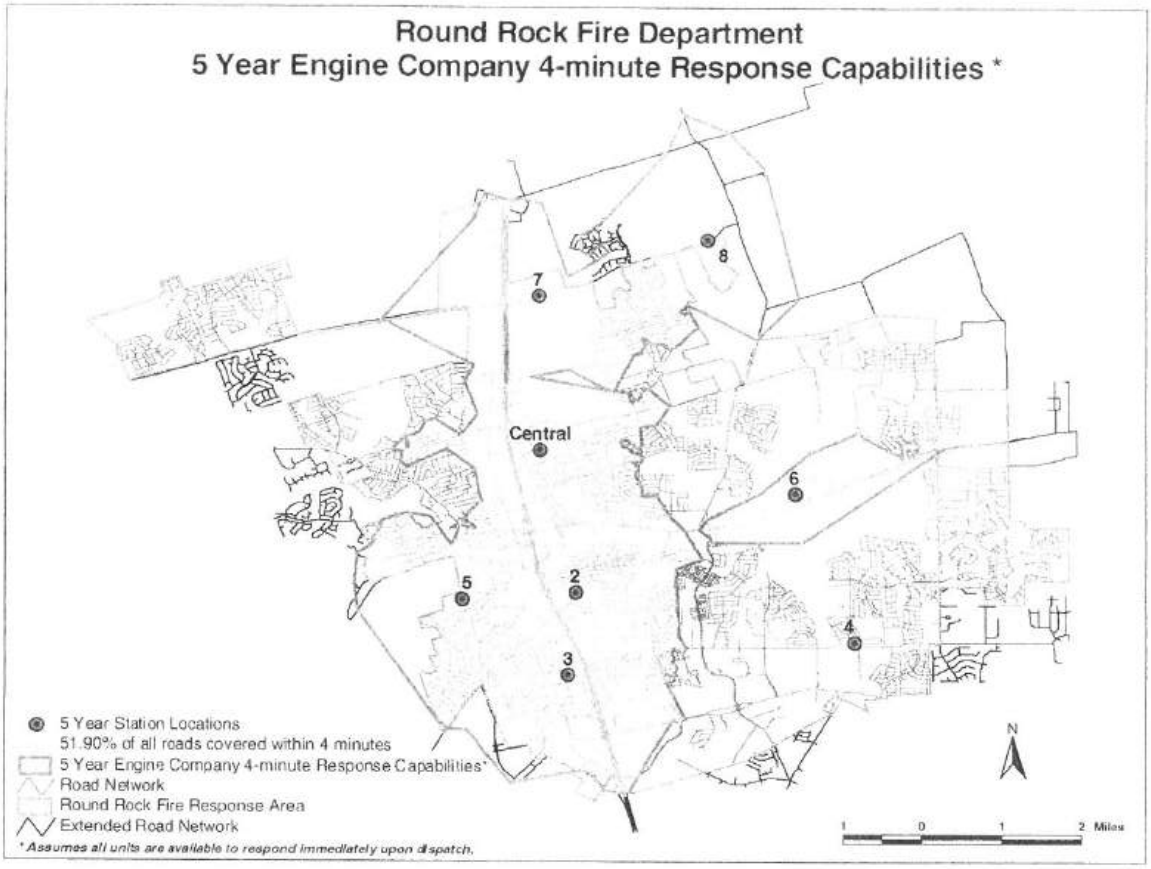
TABLE 10:
"COMPARISON OF BATTALION CHIEF 8-MINUTE RESPONSE CAPABILITIES"

SCENARIO	RESPONSE CAPABILITIES
Existing Battalion Chief 8-minute Response Capabilities	56.35% of all roads covered within 8 minutes
5-Year Battalion Chief 8-minute Response Capabilities	**68% of all roads covered within 8 minutes**

Engine Company 4-Minute Response Capabilities Pursuant to the 5-Year Plan

The 5-Year Plan modifies the placement of engine companies at current stations and incorporates additional engines at new stations within the Round Rock Fire District. Engine Company 4 currently at Station 4 would no longer be in service, replaced by a quint company, and two additional engine companies are proposed at Station 7 and Station 8. The anticipated 4-minute response capabilities of all engine companies pursuant to the 5-Year Plan are indicated in Map 28 on the next page.

MAP 28



Pursuant to the proposed modifications in the 5-Year Plan, the GIS software calculates engine company response capabilities at 51.90% of all roads within 4 minutes. **The ability of Fire Department Engine Companies to respond to 51.90% of all roads within 4 minutes, pursuant to the proposed modifications of the 5-Year Plan, translates into a 3.99% *decrease* in engine company 4-minute response capabilities from the existing conditions.**

Table 11 details the comparison of the existing 4-minute response capabilities of the engine companies and 4-minutes response capabilities of the engine companies under the proposed 5-Year Plan.

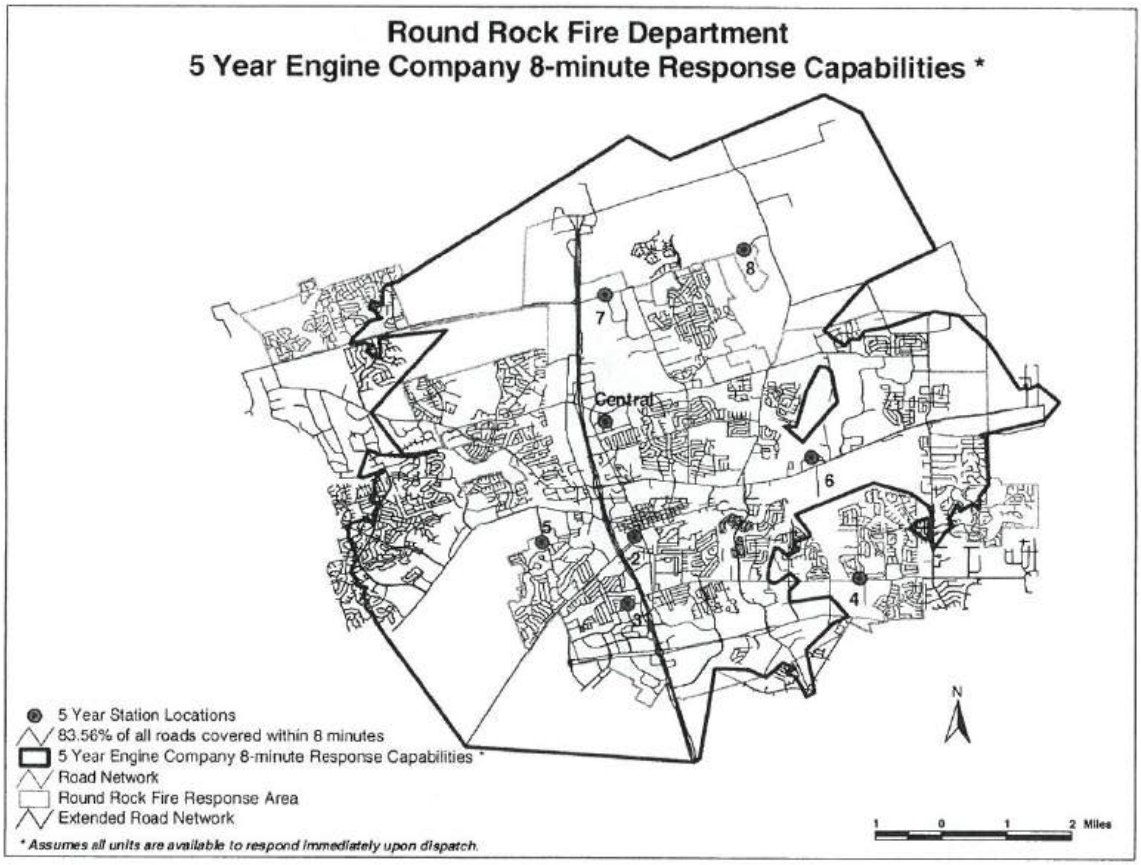
TABLE 11:
"COMPARISON OF ENGINE COMPANY 4-MINUTE RESPONSE CAPABILITIES"

SCENARIO	RESPONSE CAPABILITIES
Existing Engine Company 4-minute Response Capabilities	55.89% of all roads covered within 4 minutes
5-Year Engine Company 4-minute Response Capabilities	**51.90% of all roads covered within 4 minutes**

Engine Company 8-minute Response Capabilities Pursuant to the 5-Year Plan

The anticipated 8-minute response capabilities of engine companies pursuant to the modification of the 5-Year Plan are indicated in Map 29 on the following page.

MAP 29



Pursuant to the proposed modifications in the 5-Year Plan, the GIS software calculates engine company response capabilities at 83.56% of all roads within 8-minutes. **The ability of engine companies to respond to 83.56% of all roads within 8 minutes, pursuant to the 5-Year Plan, translates into a 9.7% *decrease* in response capabilities from the existing conditions, with the proposed modifications of the 5-Year Plan.**

Table 12 details the comparison of the existing 8-minute response capabilities of the engine companies and 8-minutes response capabilities of the engine companies under the proposed 5-Year Plan.

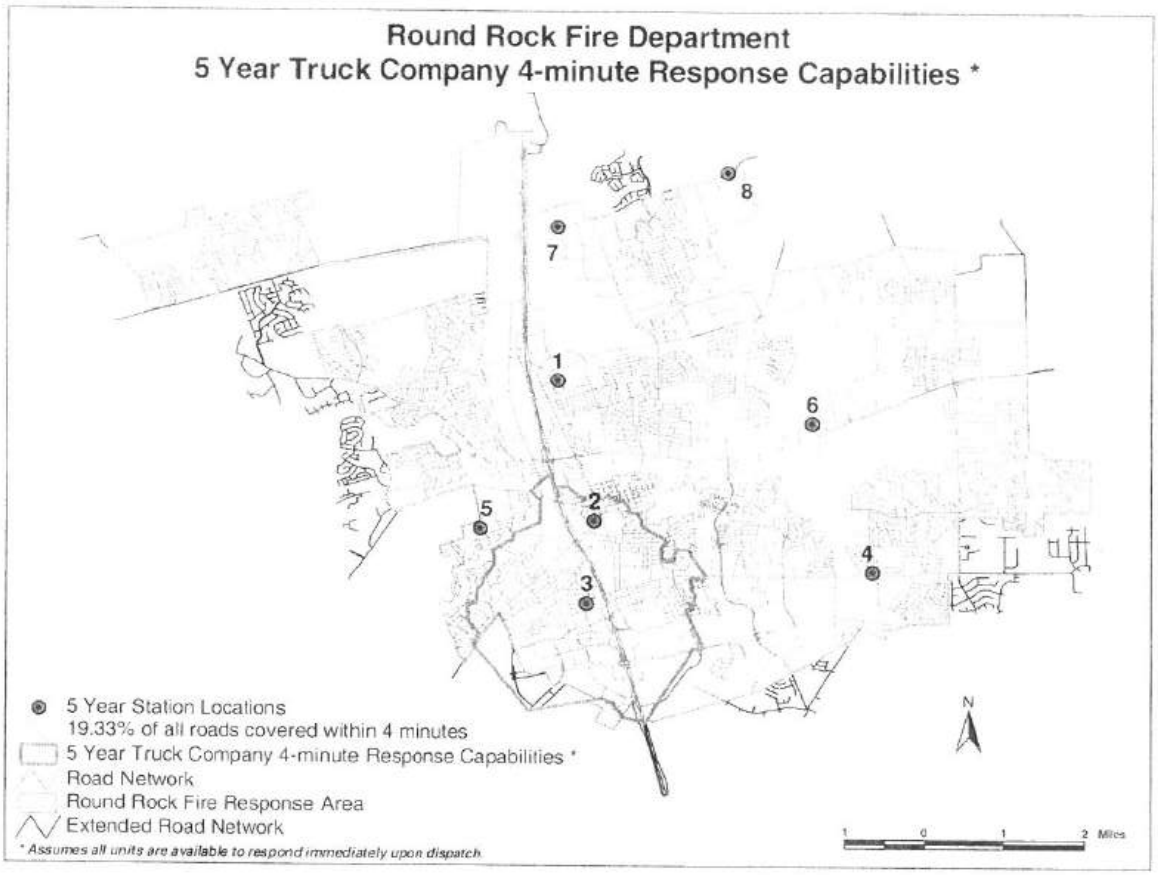
TABLE 12:
"COMPARISON OF ENGINE COMPANY 8-MINUTE RESPONSE CAPABILITIES"

SCENARIO	RESPONSE CAPABILITIES
Existing Engine Company 8-minute Response Capabilities	93.26% of all roads covered within 8 minutes
5-Year Engine Company 8-minute Response Capabilities	**83.56% of all roads covered within 8 minutes**

Truck Company 4-minute Response Capabilities Pursuant to the 5-Year Plan

The anticipated 4-minute response capabilities of truck companies pursuant to the modification of the 5-Year Plan are indicated in Map 30 on the following page.

MAP 30



Pursuant to the proposed modifications in the 5-Year Plan, the GIS software calculates the truck company response capabilities at 19.33% of all roads within 4-minutes. **The ability of the truck company to respond to 19.33% of all roads within 4 minutes, pursuant to the 5-Year Plan, translates into a 4.51% *increase* in response capabilities from the existing conditions, with the proposed modifications of the 5-Year Plan.**

Table 13 details the comparison of the existing 4-minute response capabilities of the truck company and 4-minutes response capabilities of the truck company under the proposed 5-Year Plan.

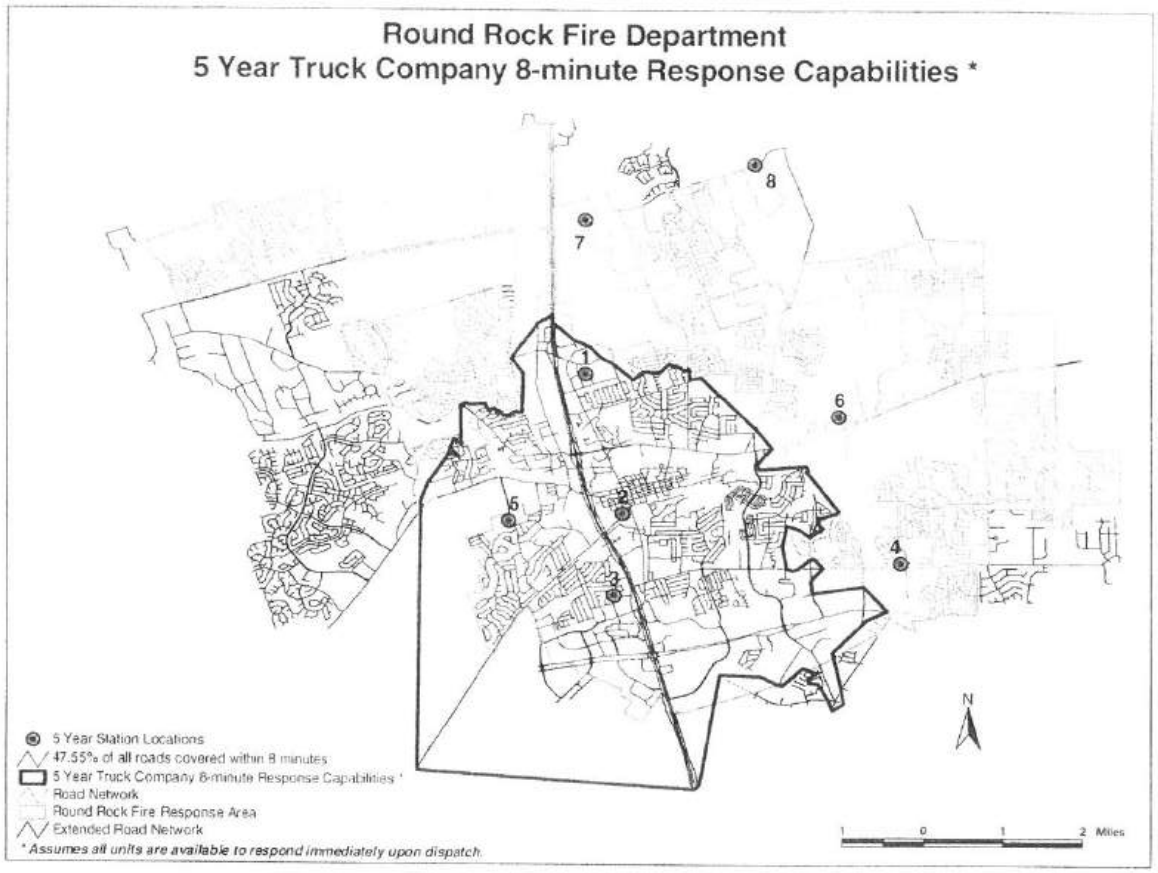
TABLE 13:
"COMPARISON OF TRUCK COMPANY 4-MINUTE RESPONSE CAPABILITIES"

SCENARIO	RESPONSE CAPABILITIES
Existing Truck Company 4-minute Response Capabilities	14.82% of all roads covered within 4 minutes
5-Year Truck Company 4-minute Response Capabilities	**19.33% of all roads covered within 4 minutes**

Truck Company 8-minute Response Capabilities
Pursuant to the 5-Year Plan

The anticipated 8-minute response capabilities of truck companies pursuant to the modification of the 5-Year Plan are indicated in Map 31 on the following page.

MAP 31



Pursuant to the proposed modifications in the 5-Year Plan, the GIS software calculates the truck company response capabilities at 47.55% of all roads within 8-minutes. **The ability of the dedicated truck company to respond to 47.55% of all roads within 8 minutes, pursuant to the 5-Year Plan, translates into an 8.8% *decrease* in response capabilities from the existing conditions, with the proposed modifications of the 5-Year Plan.**

Table 14 details the comparison of the existing 8-minute response capabilities of the truck company and 8-minutes response capabilities of the truck company under the proposed 5-Year Plan.

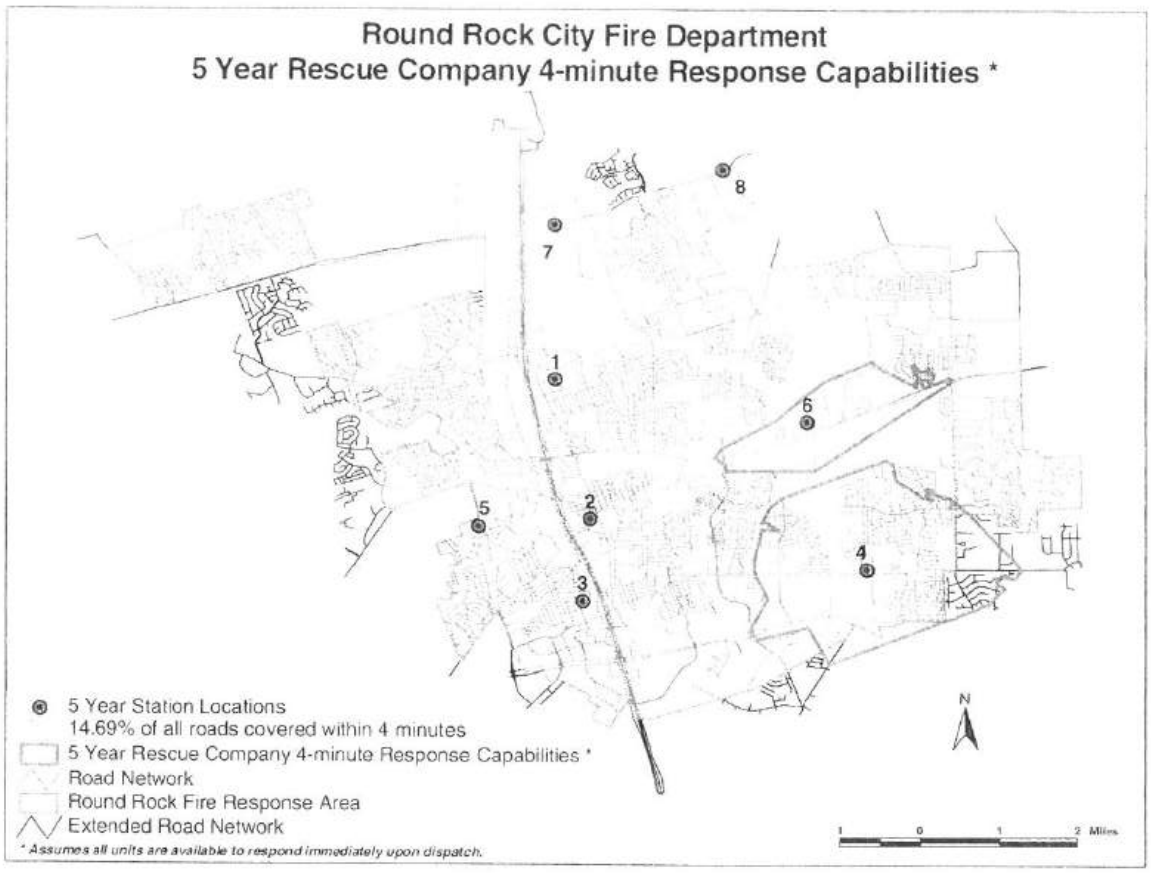
TABLE 14:
"COMPARISON OF TRUCK COMPANY 8-MINUTE RESPONSE CAPABILITIES"

SCENARIO	RESPONSE CAPABILITIES
Existing Truck Company 8-minute Response Capabilities	56.35% of all roads covered within 8 minutes
5-Year Truck Company 8-minute Response Capabilities	**47.55% of all roads covered within 8 minutes**

Rescue Company 4-minute Response Capabilities Pursuant to the 5-Year Plan

The anticipated 4-minute response capabilities of rescue companies pursuant to the modification of the 5-Year Plan are indicated in Map 32 on the following page.

MAP 32



Pursuant to the proposed modifications in the 5-Year Plan, the GIS software calculates the rescue company response capabilities at 14.69% of all roads within 4-minutes. **The ability of the rescue companies to respond to 14.69% of all roads within 4 minutes, pursuant to the 5-Year Plan, translates into a 14.69% *increase* in response capabilities from the existing conditions, with the proposed modifications of the 5-Year Plan.**

Table 15 details the comparison of the existing 4-minute response capabilities of the rescue companies and 4-minutes response capabilities of the rescue companies under the proposed 5-Year Plan.

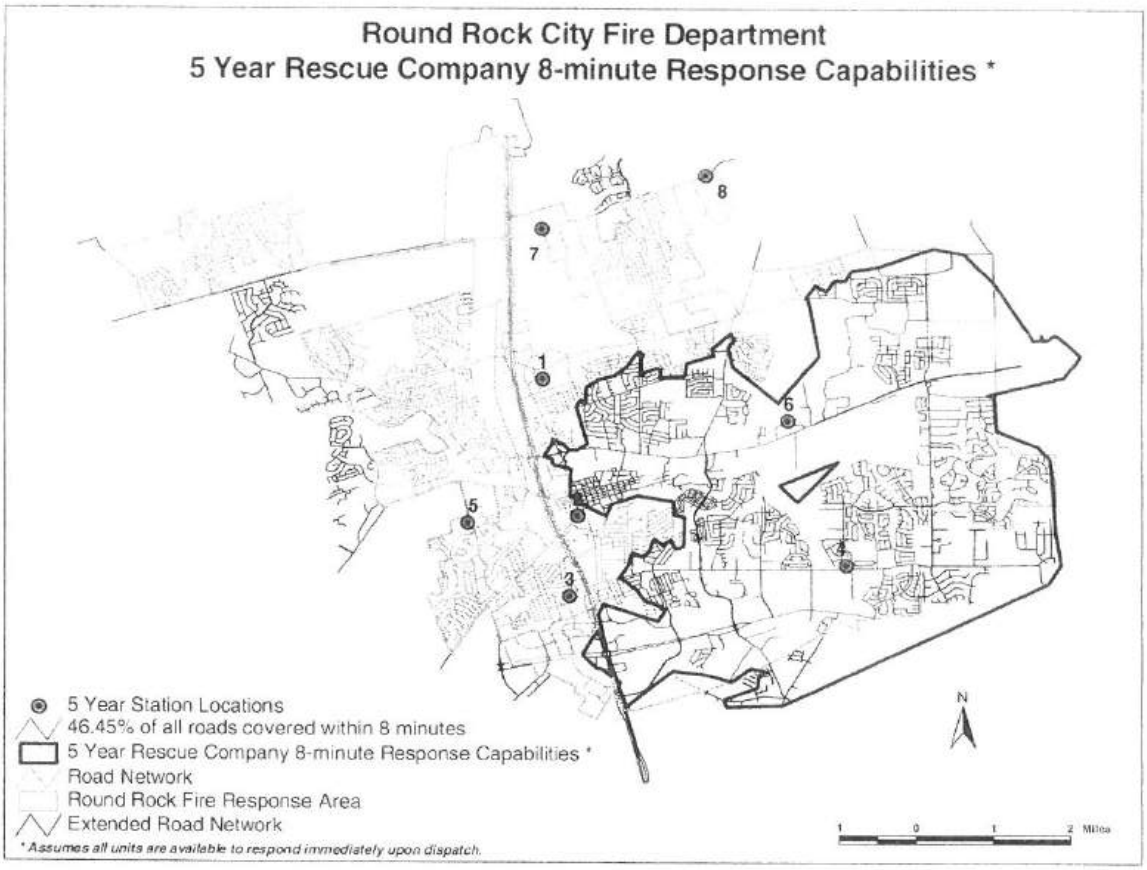
TABLE 15:
"COMPARISON OF RESCUE COMPANY 4-MINUTE RESPONSE CAPABILITIES"

SCENARIO	RESPONSE CAPABILITIES
Existing Rescue Company 4-minute Response Capabilities	Currently no Rescue Coverage
5-Year Rescue Company 4-minute Response Capabilities	**14.69% of all roads covered within 4 minutes**

Rescue Company 8-minute Response Capabilities Pursuant to the 5-Year Plan

The anticipated 8-minute response capabilities of rescue companies pursuant to the modification of the 5-Year Plan are indicated in Map 33 on the following page.

MAP 33



Pursuant to the proposed modifications in the 5-Year Plan, the GIS software calculates the rescue companies response capabilities at 46.45% of all roads within 8-minutes. **The ability of the rescue companies to respond to 46.45% of all roads within 8 minutes, pursuant to the 5-Year Plan, translates into a 46.45% *increase* in response capabilities from the existing conditions, with the proposed modifications of the 5-Year Plan.**

Table 16 details the comparison of the existing 8-minute response capabilities of the rescue companies and 8-minutes response capabilities of the rescue company under the proposed 5-Year Plan.

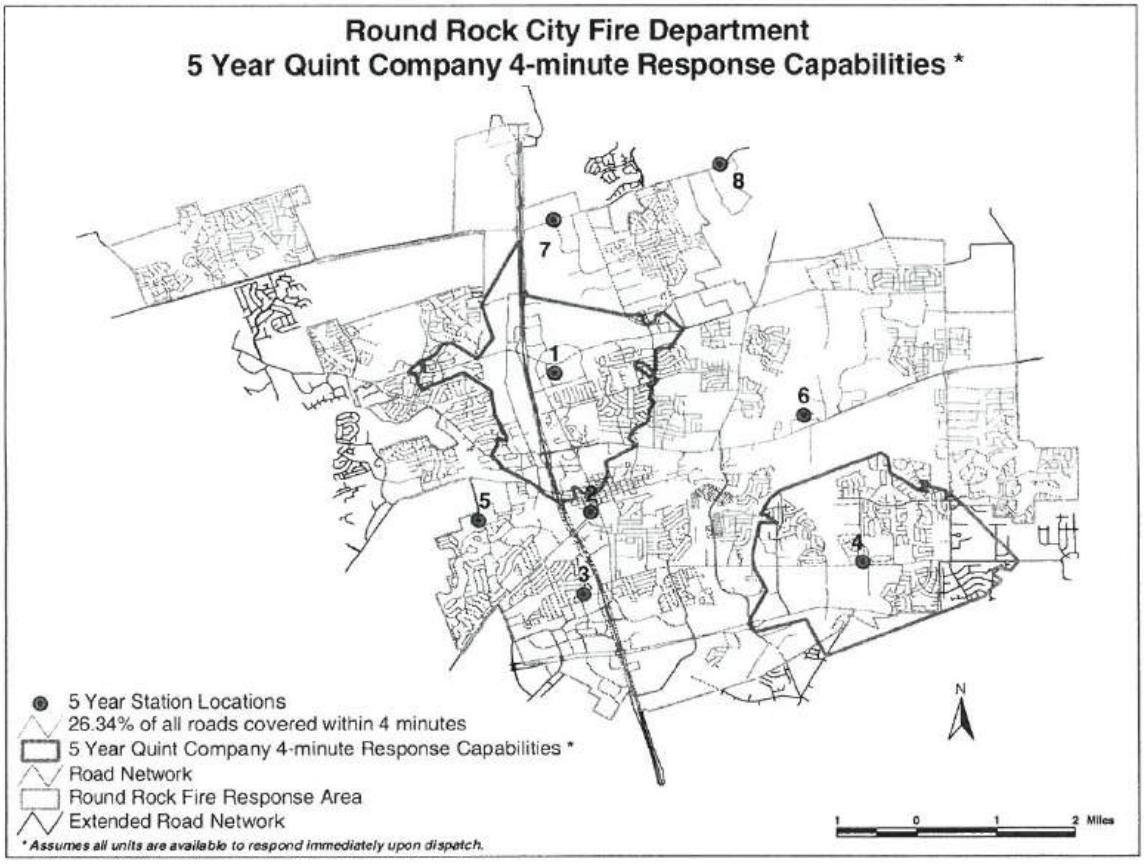
TABLE 16:
"COMPARISON OF RESCUE COMPANY 8-MINUTE RESPONSE CAPABILITIES"

SCENARIO	RESPONSE CAPABILITIES
Existing Rescue Company 8-minute Response Capabilities	Currently no Rescue Coverage
5-Year Rescue Company 8-minute Response Capabilities	**46.45% of all roads covered within 8 minutes**

Quint Company 4-minute Response Capabilities Pursuant to the 5-Year Plan

The anticipated 4-minute response capabilities of the quint companies pursuant to the modification of the 5-Year Plan are indicated in Map 34 on the following page.

MAP 34



Pursuant to the proposed modifications in the 5-Year Plan, the GIS software calculates the quint company response capabilities at 26.34% of all roads within 4-minutes. **The ability of the quint companies to respond to 26.34% of all roads within 4 minutes, pursuant to the 5-Year Plan, translates into a 26.34% *increase* in response capabilities from the existing conditions, with the proposed modifications of the 5-Year Plan.**

Table 17 details the comparison of the existing 4-minute response capabilities of the quint companies and 4-minutes response capabilities of the quint companies under the proposed 5-Year Plan.

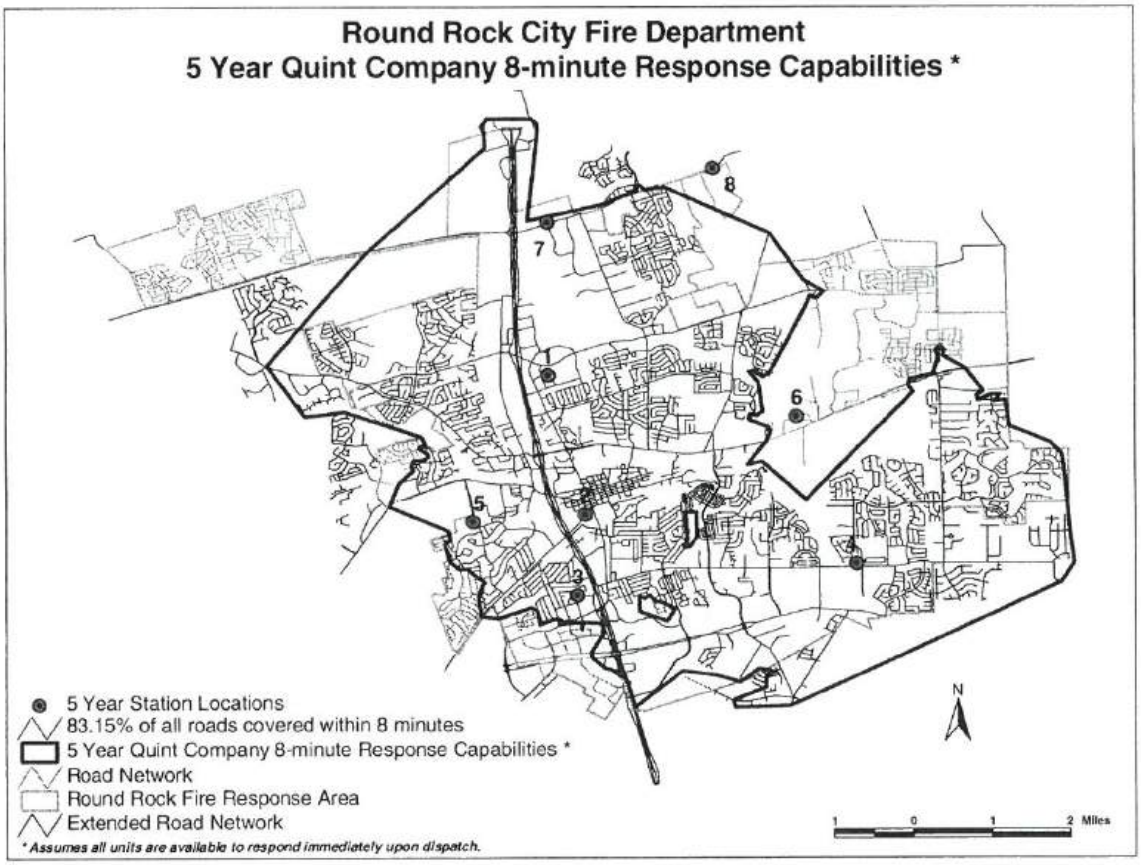
TABLE 17:
"COMPARISON OF QUINT COMPANY 4-MINUTE RESPONSE CAPABILITIES"

SCENARIO	RESPONSE CAPABILITIES
Existing Quint Company 4-minute Response Capabilities	Currently no Quint Coverage
5-Year Quint Company 4-minute Response Capabilities	**26.34% of all roads covered within 4 minutes**

Quint Company 8-minute Response Capabilities Pursuant to the 5-Year Plan

The anticipated 8-minute response capabilities of quint companies pursuant to the modification of the 5-Year Plan are indicated in Map 35 on the following page.

MAP 35



Pursuant to the proposed modifications in the 5-Year Plan, the GIS software calculates the quint companies response capabilities at 83.15% of all roads within 8-minutes. **The ability of the quint companies to respond to 83.15% of all roads within 8 minutes, pursuant to the 5-Year Plan, translates into an 83.15% *increase* in response capabilities from the existing conditions, with the proposed modifications of the 5-Year Plan.**

Table 18 details the comparison of the existing 8-minute response capabilities of the quint companies and 8-minutes response capabilities of the quint company under the proposed 5-Year Plan.

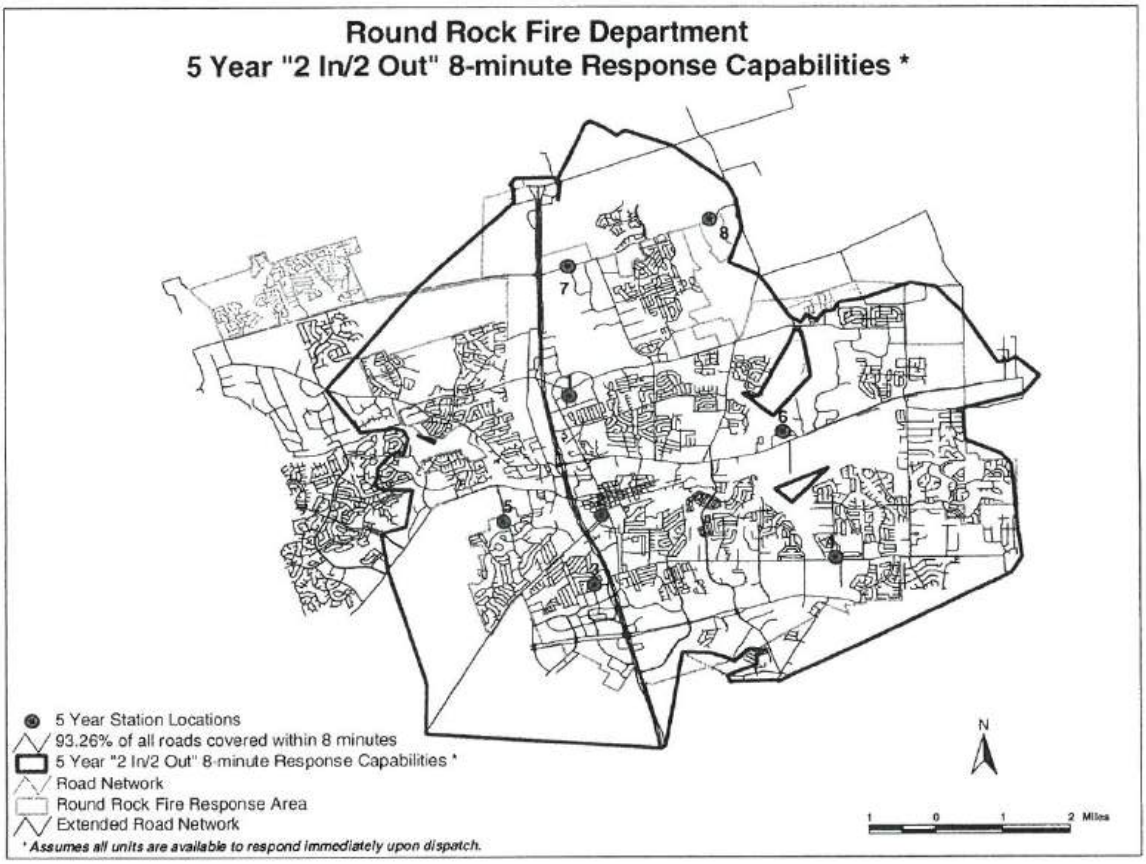
TABLE 18:
"COMPARISON OF QUINT COMPANY 8-MINUTE RESPONSE CAPABILITIES"

SCENARIO	RESPONSE CAPABILITIES
Existing Quint Company 8-minute Response Capabilities	Currently no Quint Coverage
5-Year Quint Company 8-minute Response Capabilities	**83.15% of all roads covered within 8 minutes**

"Two-In/Two-Out" 8-minute Response Capabilities Pursuant to the 5-Year Plan

The anticipated 8-minute response capabilities of "2 In/2 Out" response capabilities pursuant to the proposed modifications of the 5-Year Plan are indicated in Map 36 on the following page.

MAP 36



Pursuant to the proposed modification of the 5-Year Plan, the GIS software calculates "2 In/2 Out" capabilities at 93.26% of all roads within 8 minutes. **The "2 In/2 Out" capabilities to respond to 93.26% of all roads within 8 minutes, pursuant to the 5-Year Plan, translates into a 16.59% *increase* in 8-minute response capabilities from the existing conditions.**

Table 19 details the comparison of the existing 2 In/2 Out 8-minute response capabilities and 2 In/2 Out 8-minutes response capabilities under the proposed 5-Year Plan.

TABLE 19:
"COMPARISON OF '2 IN/2 OUT' 8-MINUTE RESPONSE CAPABILITIES"

SCENARIO	RESPONSE CAPABILITIES
Existing "2 In/2 Out" 8-minute Response Capabilities	76.67% of all roads covered within 8 minutes
5-Year Plan "2 In/2 Out" 8-minute Response Capabilities	**93.26% of all roads covered within 8 minutes**

The Initial (First) Alarm for the Round Rock Fire Department consists of the one battalion chief, one truck company and four engine companies. For the 8-minute Initial (First) Alarm analysis of the Round Rock Fire District with the apparatus configuration proposed in the 5-Year Plan the apparatus listed in the Initial (First) Alarm Assignment column of Table 20 below.

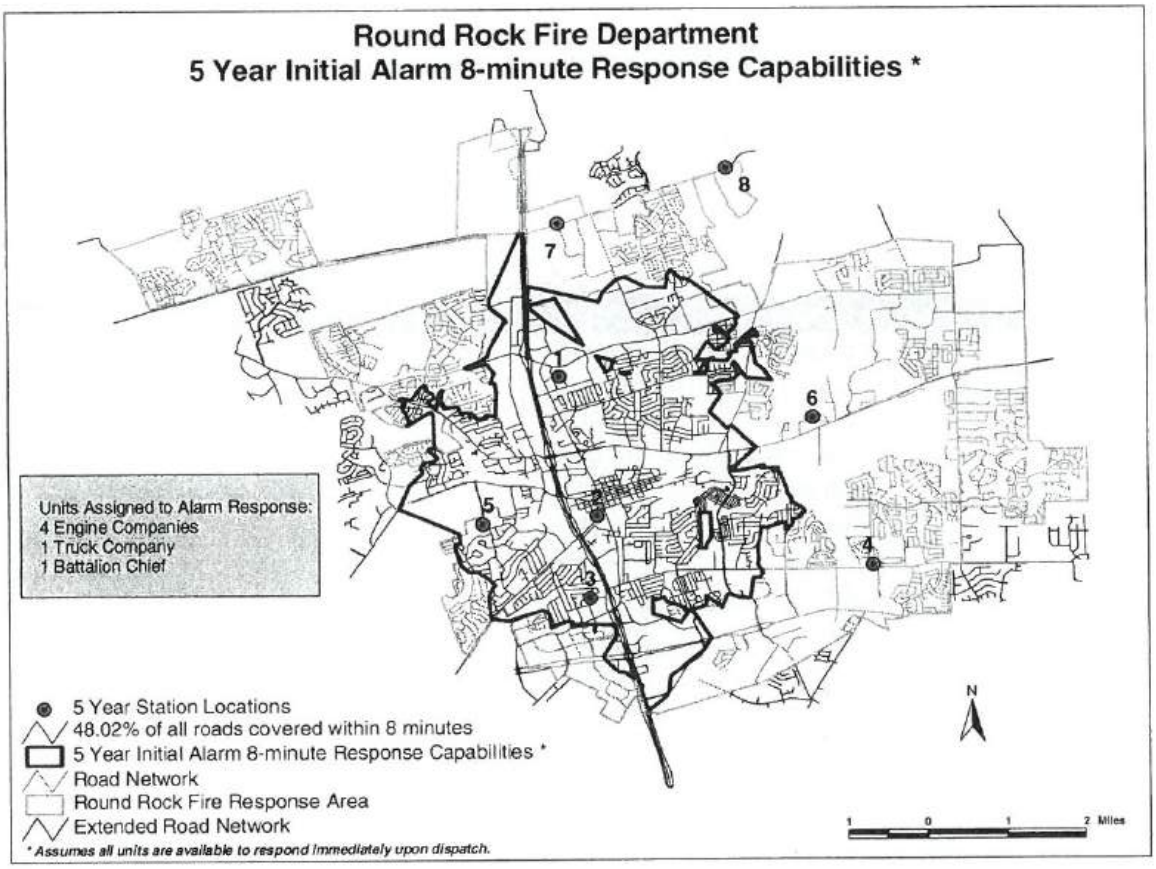
Table 20:
5-Year Plan Initial (First) Alarm Apparatus Assignment

STATION	APPARATUS	FULL (INITIAL) ALARM ASSIGNMENT
1	**Engine** **Quint**	(same) **Ladder**
2	**Engine** **Battalion Chief**	(same) (same)
3	**Engine** **Truck**	(same) (same)
4	**Quint** **Rescue**	**Engine** (same)
5	**Engine**	(same)
6	**Engine** **Rescue**	(same) (same)
7	**Engine**	(same)
8	**Engine** **Battalion Chief**	(same) (same)

The quints assigned to Station 1 and Station 4 are only capable of operating as an engine or a truck, not both simultaneously. Since, the quint at Station 1 is complemented by an engine company, it will be assigned as a truck company for the purpose of calculating the Initial (First) Alarm. The quint at Station 4 will be assigned as an engine company because it is the only apparatus at that station that can function as a fire suppression vehicle.

The anticipated Initial Alarm 8-minute response capabilities pursuant to proposed modifications of the 5-Year Plan are indicated in Map 37 on the following page.

MAP 37



Pursuant to the proposed modifications of the 5-Year Plan, the GIS software calculates Initial Alarm assignment capabilities at 48.02% of all roads within 8 minutes. **The ability of the fire department to respond to 48.02% of all roads within 8 minutes, pursuant to the proposed modifications of the 5-Year Plan, translates into a 13.69% *increase* in 8-minute response capabilities from the existing conditions.**

Table 21 details the comparison of the existing Initial Alarm 8-minute response capabilities and the Initial Alarm 8-minutes response capabilities under the proposed 5-Year Plan.

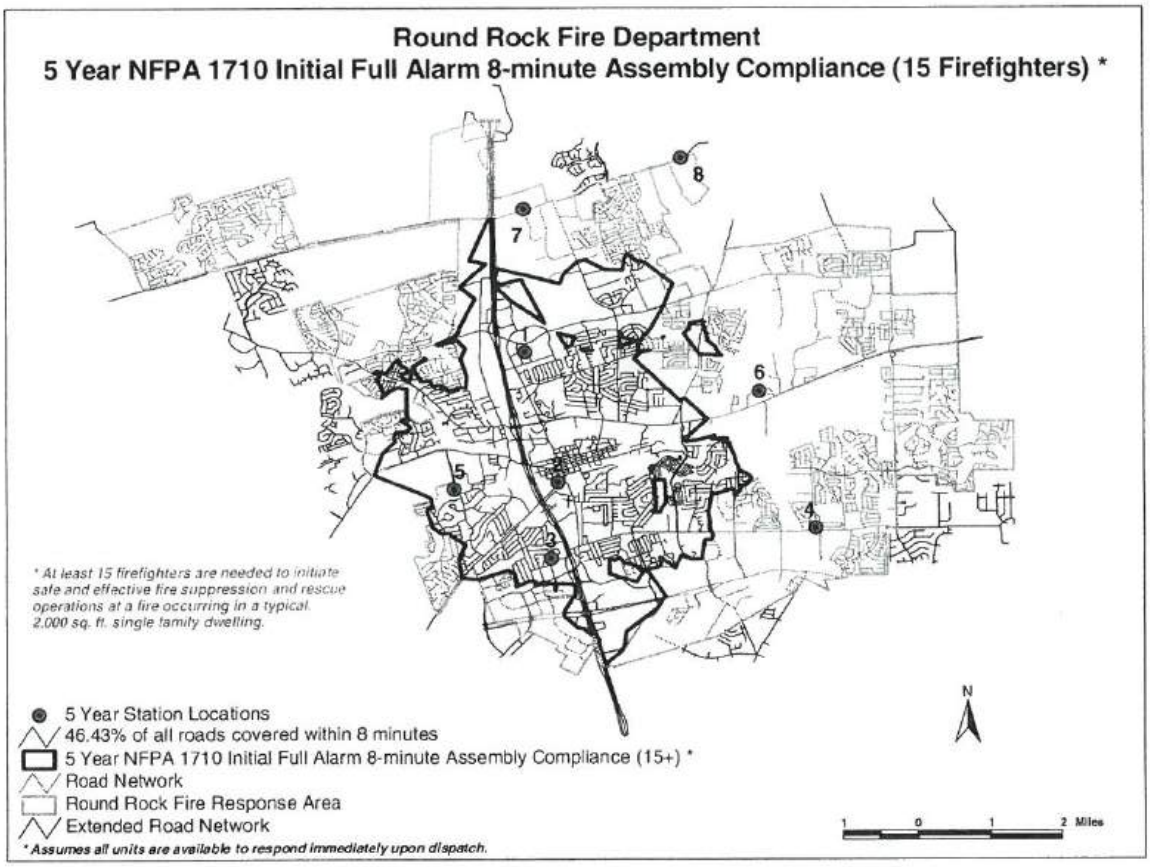
TABLE 21:
"COMPARISON OF INITIAL ALARM 8-MINUTE RESPONSE CAPABILITIES"

SCENARIO	RESPONSE CAPABILITIES
Existing Initial Alarm 8-minute Response Capabilities	34.33% of all roads covered within 8 minutes
5-Year Plan Initial Alarm 8-minute Response Capabilities	**48.02% of all roads covered within 8 minutes**

NFPA 1710 Full Alarm 8-minute Response Capabilities Pursuant to the 5-Year Plan

The anticipated NFPA 1710 Full Alarm 8-minute response capabilities pursuant to proposed modifications of the 5-Year Plan are indicated in Map 38 on the following page.

MAP 38



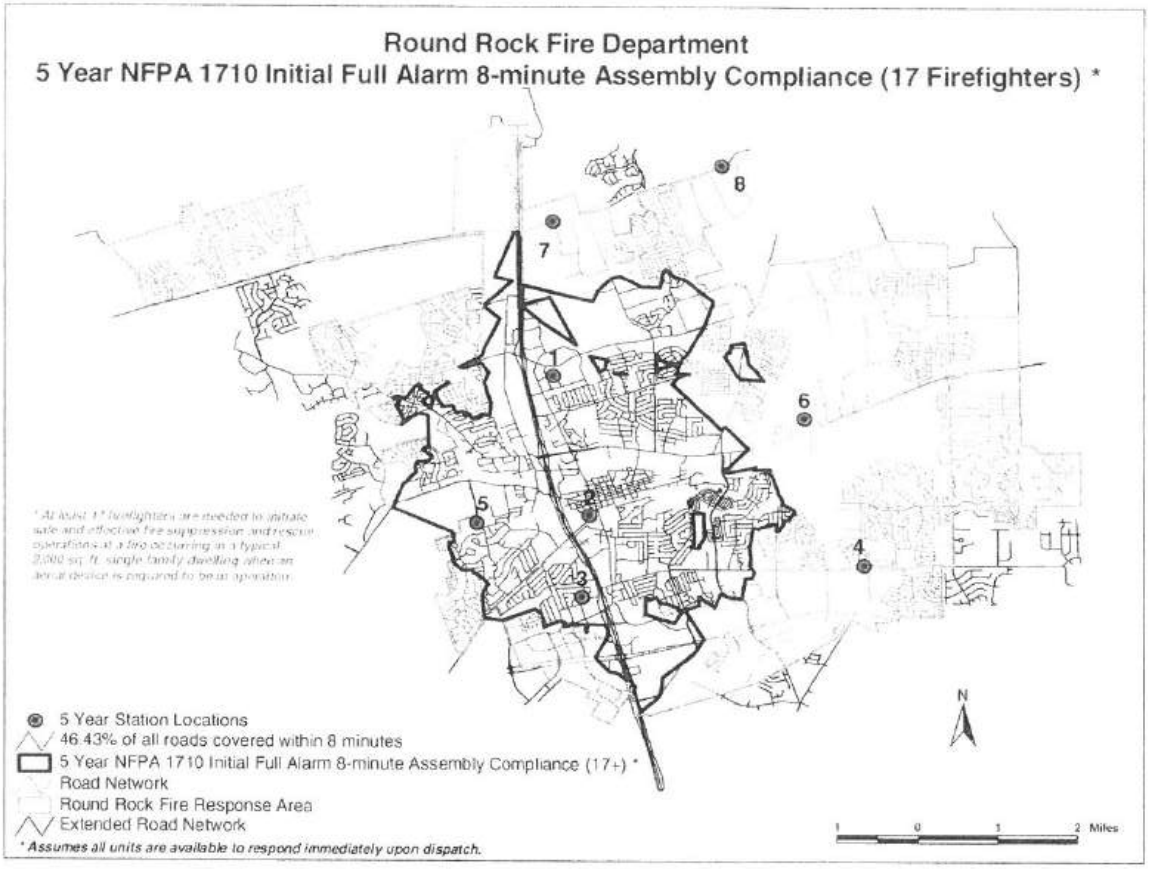
Map 38 examines the ability of the Round Rock Fire Department to respond to incidents with at least fifteen personnel within an 8-minute time frame. Utilizing all apparatus and personnel in all stations, it is predicted that **46.43% of all Fire District roads would receive a sufficient number of fire suppression personnel within 8 minutes of receiving an alarm to comply with NFPA Standard 1710**, *assuming all units are fully staffed at existing staffing levels and available to respond immediately upon dispatch.* **The ability of the fire department to respond to 46.43% of all roads within 8 minutes, pursuant to the proposed modifications of the 5-Year Plan, represents a 12.1% *increase* in NFPA 1710 Full Alarm 8-minute response capabilities from the existing condition.**

Table 22 details the comparison between the existing NFPA 1710 Full Alarm 8-minute response capabilities with fifteen fire suppression personnel and the NFPA 1710 Full Alarm 8-minute response capabilities with fifteen fire suppression personnel under the proposed 5-Year Plan.

TABLE 22:
"COMPARISON OF NFPA 1710 FULL ALARM 8-MINUTE RESPONSE CAPABILITIES"

SCENARIO	RESPONSE CAPABILITIES
Existing Full Alarm 8-minute Response Capabilities	34.33% of all roads covered within 8 minutes
5-Year Plan Full Alarm 8-minute Response Capabilities	**46.43% of all roads covered within 8 minutes**

MAP 39



Map 39 examines the ability of the Round Rock Fire Department to respond to incidents with at least seventeen personnel within an 8-minute time frame. Utilizing all apparatus and personnel in all stations, it is predicted that **46.43% of all Fire District roads would receive a sufficient number of fire suppression personnel within 8 minutes of receiving an alarm to comply with NFPA Standard 1710**, *assuming all units are fully staffed at existing staffing levels and available to respond immediately upon dispatch.* **The ability of the fire department to respond to 46.43% of all roads within 8 minutes, pursuant to the proposed modifications of the 5-Year Plan, represents a 33.04% *increase* in NFPA 1710 Full Alarm 8-minute response capabilities from the existing condition.**

Table 23 details the comparison between the existing NFPA 1710 Full Alarm 8-minute response capabilities with seventeen fire suppression personnel and the NFPA 1710 Full Alarm 8-minutes response capabilities with seventeen fire suppression personnel under the proposed 5-Year Plan.

TABLE 23:
"COMPARISON OF NFPA 1710 FULL ALARM 8-MINUTE RESPONSE CAPABILITIES"

SCENARIO	RESPONSE CAPABILITIES
Existing Full Alarm 8-minute Response Capabilities	10.39% of all roads covered within 8 minutes
5-Year Plan Full Alarm 8-minute Response Capabilities	**46.43% of all roads covered within 8 minutes**

CONCLUSIONS

CONCLUSIONS

This analysis reveals the extent of 4- and 8-minute coverage provided within Round Rock by the Round Rock Fire Department under existing and proposed staffing and deployment arrangements. Based on the output of the ArcView apparatus response model, the following conclusions can be reached *(note that the statements below pertain to a single incident only, and do not assume like performance in simultaneously occurring incidents)*:

BATTALION CHIEF

Existing Conditions
The Round Rock Fire Department's Battalion Chief is currently able to respond on **14.82% of all roads within 4 minutes**, and **56.35% of all roads within 8 minutes,** *assuming the unit is available to respond immediately upon dispatch.*

Proposed Conditions
This function will be immediately impacted by proposed changes to the existing staffing and deployment scheme. The current Battalion Chief located at the Central Station would be relocated to Station 2 and an additional Battalion Chief would be added at Station 8. These proposed modifications would **increase** the response capability of the Round Rock Battalion Chiefs by **13.66% for all roads within the 4 minute response area, 14.82% to 28.48%,** and **increase** the response capability to **11.65% of all roads within the 8 minute response area, 56.35% to 68%**, *assuming the units are available to respond upon dispatch.*

ENGINE COMPANIES

Existing Conditions
Round Rock Fire Department engine companies are currently able to provide fire suppression, disaster incident mitigation, and initial emergency medical services on **55.89% of all roads within 4 minutes** and **93.26% of all roads within 8 minutes,** *assuming all units are available to respond immediately upon dispatch.*

Proposed Conditions
This function will be immediately impacted by proposed changes to the existing staffing and deployment scheme. The elimination of Engine Company 4 by a quint company at Station 4 will impact the overall response capabilities under the 5-Year Plan. These proposed modifications would **increase** the response capabilities of the Round Rock Engine Companies by **6.55% for all roads within the 4-minute response coverage area, 55.89% to 51.90%,** and **decrease** the response capabilities by **9.7% for all roads within the 8-minute response area, 93.26% to 83.56%**, *assuming all units are available to respond immediately upon dispatch.*

TRUCK COMPANY

Existing Conditions
The Round Rock Fire Department truck company is currently able to provide fire suppression, disaster incident mitigation, and initial emergency medical services on **14.82% of all roads within 4 minutes** and **56.35% of all roads within 8 minutes.** *This percentage reflects the assumption that the truck company personnel are available to respond immediately upon dispatch.*

Proposed Conditions
This function will be immediately impacted by proposed changes to the existing staffing and deployment scheme. The relocation of the truck company from the Central Station to Station 3 will impact the overall response capabilities under the 5-Year Plan. These proposed modifications would **increase** the response capabilities of the Round Rock Truck Company by **4.51% for all roads within the 4-minute response coverage area, 14.82% to 19.33%**, and **decrease** the response capabilities by **8.8% for all roads within the 8-minute response area, 56.35% to 47.55%**, *assuming all units are available to respond immediately upon dispatch.*

BRUSH COMPANY

Existing Conditions
The Round Rock Fire Department brush unit is currently able to provide fire suppression, disaster incident mitigation, and initial emergency medical services on **25.07% of all roads within 4 minutes** and **58.5% of all roads within 8 minutes.** *This percentage reflects the assumption that brush unit personnel are available to respond immediately upon dispatch and not currently dispatched on Engine Company 2 due to cross staffing.*

Proposed Conditions
Under the proposed 5-Year Plan, the brush unit is decommissioned.

RESCUE COMPANY

Existing Conditions
Currently, there is no rescue company.

Proposed Conditions
It is anticipated that the ability of the rescue company to respond to **14.69% of all roads within 4 minutes** and **46.45% of all roads within 8 minutes** *so long as the rescue company personnel that staff and deploy said unit are available to do so immediately upon dispatch.*

QUINT COMPANY

Existing Conditions
Currently, there is no quint company.

Proposed Conditions
It is anticipated that the ability of the quint companies responding as an engine or truck company would respond to **26.34% of all roads within 4 minutes** and **85.15% of all roads within 8 minutes** *so long as the engine company personnel that staff and deploy said unit are available to do so immediately upon dispatch.*

"2 IN/2 OUT" OPERATIONS

Existing Conditions
Round Rock Fire Department fire suppression companies are currently able to initiate *safe* and *effective* fire suppression and rescue operations in accordance with the "2 In/2 Out" regulation on **76.67% of all roads within 8 minutes,** *assuming all units are staffed and available to respond immediately upon dispatch.*

Proposed Conditions
"2 In/2 Out" interior fire attack operations will be immediately impacted by proposed changes to the existing staffing and deployment scheme. The modifications proposed under the 5-Year Plan would **increase** the "2 In/2 Out" response capabilities of the Round Rock Fire Department by **16.59% for all roads within the 8-minute response coverage area, 76.67% to 93.26%,** *assuming all units are staffed and available to respond immediately upon dispatch.*

INITIAL (FIRST) ALARM RESPONSE

Existing Conditions
Round Rock Fire Department fire suppression companies and the Battalion Chief are currently able to assemble an Initial Alarm assignment on **34.33% of all roads within 8 minutes,** *assuming all units are available to respond immediately upon dispatch.*

Proposed Conditions
Initial Alarm response capabilities will be immediately impacted by proposed changes to the existing staffing and deployment scheme. The modifications proposed under the 5-Year Plan would **increase** the Initial (First) Alarm Response capabilities of the Round Rock Fire Department by **12.1% for all roads within the 8-minute response coverage area, 34.33% to 46.43%,** *assuming all units are staffed and available to respond immediately upon dispatch.*

NFPA 1710 INITIAL FULL ALARM, 15 FIREFIGHTERS

Existing Conditions
Round Rock Fire Department fire suppression and command units are currently able to assemble an "Initial Full Alarm" response, in compliance with NFPA 1710 performance objectives with fifteen fire department personnel, on **34.33% of all roads within 8 minutes,** *assuming all units are available to respond immediately upon dispatch.*

Proposed Conditions
NFPA 1710 Initial Full Alarm response capabilities will be immediately impacted by proposed changes to the existing staffing and deployment scheme. The modifications proposed under the 5-Year Plan would **increase** the NFPA 1710 Initial Full Alarm response capabilities by **12.1% for all roads within the 8-minute response coverage area, 34.33% to 46.43%,** *assuming all units are staffed and available to respond immediately upon dispatch.*

NFPA 1710 Initial Full Alarm, 17 Firefighters

Existing Conditions

Round Rock Fire Department fire suppression and command units are currently able to assemble an "Initial Full Alarm" response, in compliance with NFPA 1710 performance objectives with seventeen fire department personnel, on **10.39% of all roads within 8 minutes,** *assuming all units are available to respond immediately upon dispatch.*

Proposed Conditions

NFPA 1710 Initial Full Alarm response capabilities will be immediately impacted by proposed changes to the existing staffing and deployment scheme. The modifications proposed under the 5-Year Plan would **increase** the NFPA 1710 Initial Full Alarm response capabilities by **36.04% for all roads within the 8-minute response coverage area, 10.39% to 46.43%,** *assuming all units are staffed and available to respond immediately upon dispatch.*

SUGGESTED ENHANCEMENTS

Under the Option For Consideration For the 5-Year Plan

Incorporating the additional stations and apparatus from the Option For Consideration For the 5-Year Plan does not provide sufficient fire response coverage within the Round Rock Fire District. The 8 fire stations in the Round Rock Fire District under the proposed 5-Year Plan do not provide diverse enough geographic coverage or staffing to sufficiently respond within the Round Rock Fire District. This is most notable in the northwestern portion of the Round Rock Fire District.

Under the Option For Consideration For the 5-Year Plan the total apparatus would be the following:

- 7 Engines
- 1 Truck
- 2 Battalion Chiefs
- 2 Rescue
- 2 Quints

Under the Option For Consideration For the 5-Year Plan the total on-duty fire fighter staffing would be 38.

Suggested Enhancements

At minimum, an additional fire station, additional apparatus, and adequate apparatus staffing are necessary for improved response coverage. The International Association of Fire Fighters (IAFF) suggests the addition, at minimum, of one fire station with one engine company and one truck company. The initial suggested fire station, Station 9, should be located in the northwest portion of the Round Rock Fire District along Route 1431 on the western side of Interstate 35.

The total apparatus, at minimum, suggested by the IAFF would be the following:

- 8 Engines
- 2 Trucks
- 2 Battalion Chiefs
- 2 Battalion Chief Aides
- 2 Rescue
- 2 Quints

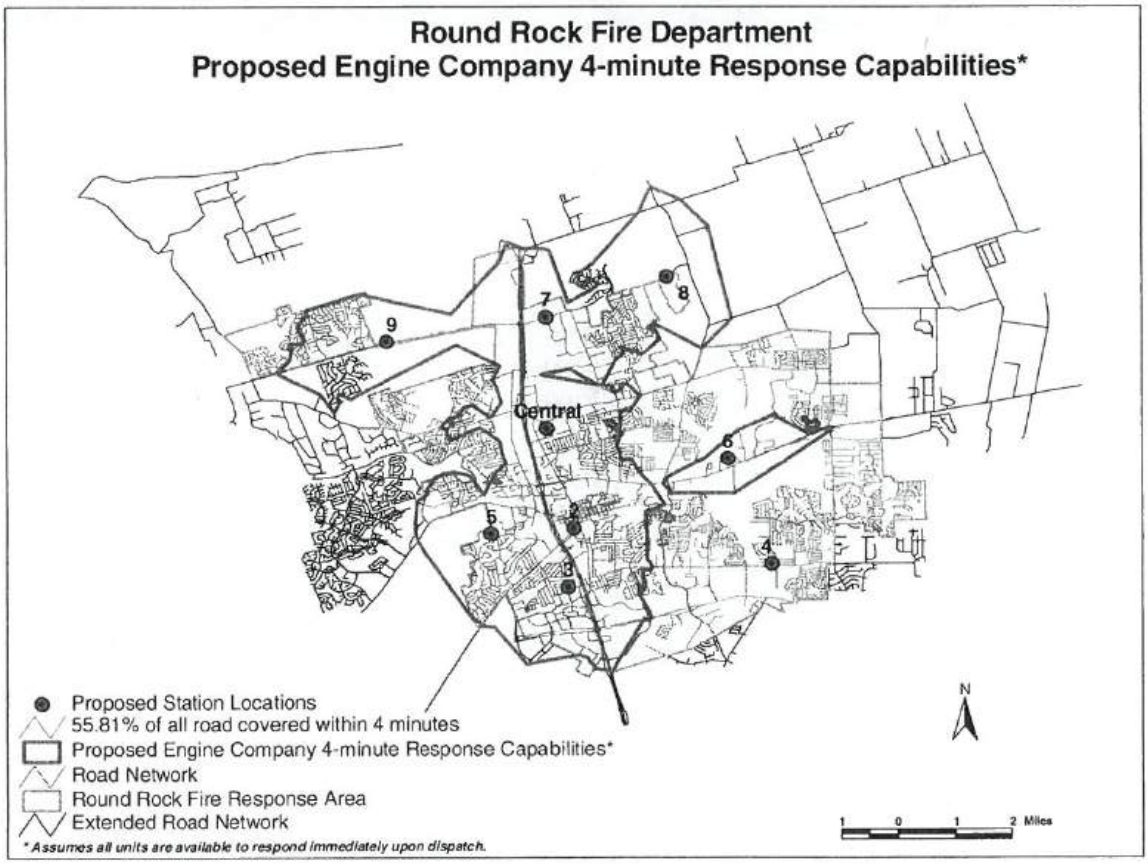
Table 24 details the suggested allocation of all of the apparatus suggested by the IAFF at the 9 Round Rock Fire Stations.

TABLE 24:
"SUGGESTED STATION LOCATION & DEPLOYMENT CONFIGURATION"

STATION	ADDRESS	APPARATUS	PERSONNEL
1	203 Commerce Boulevard	**Engine** **Quint**	**4 Firefighter/EMT-Bs** **4 Firefighter/EMT-Bs**
2	201 Florence Street	**Engine** **Battalion Chief**	**4 Firefighter/EMT-Bs** **1 Battalion Chief & 1 Aide**
3	1991 Rawhide	**Engine** **Truck**	**4 Firefighter/EMT-Bs** **4 Firefighter/EMT-Bs**
4	3300 Gattis School Road	**Quint** **Rescue**	**4 Firefighter/EMT-Bs** **2 Firefighter/EMT-Bs**
5	350 Deepwood Drive	**Engine**	**4 Firefighter/EMT-Bs**
6	2919 Joe DiMaggio Way	**Engine** **Rescue**	**4 Firefighter/EMT-Bs** **2 Firefighter/EMT-Bs**
7	Route 1431 east of I-35	**Engine**	**4 Firefighter/EMT-Bs**
8	Route 1431 east of I-35	**Engine** **Battalion Chief**	**4 Firefighter/EMT-Bs** **1 Battalion Chief & 1 Aide**
9	Route 1431 west of I-35	**Engine** **Truck**	**4 Firefighter/EMT-Bs** **4 Firefighter/EMT-Bs**

Suggested On-duty Staffing: 56

MAP 40



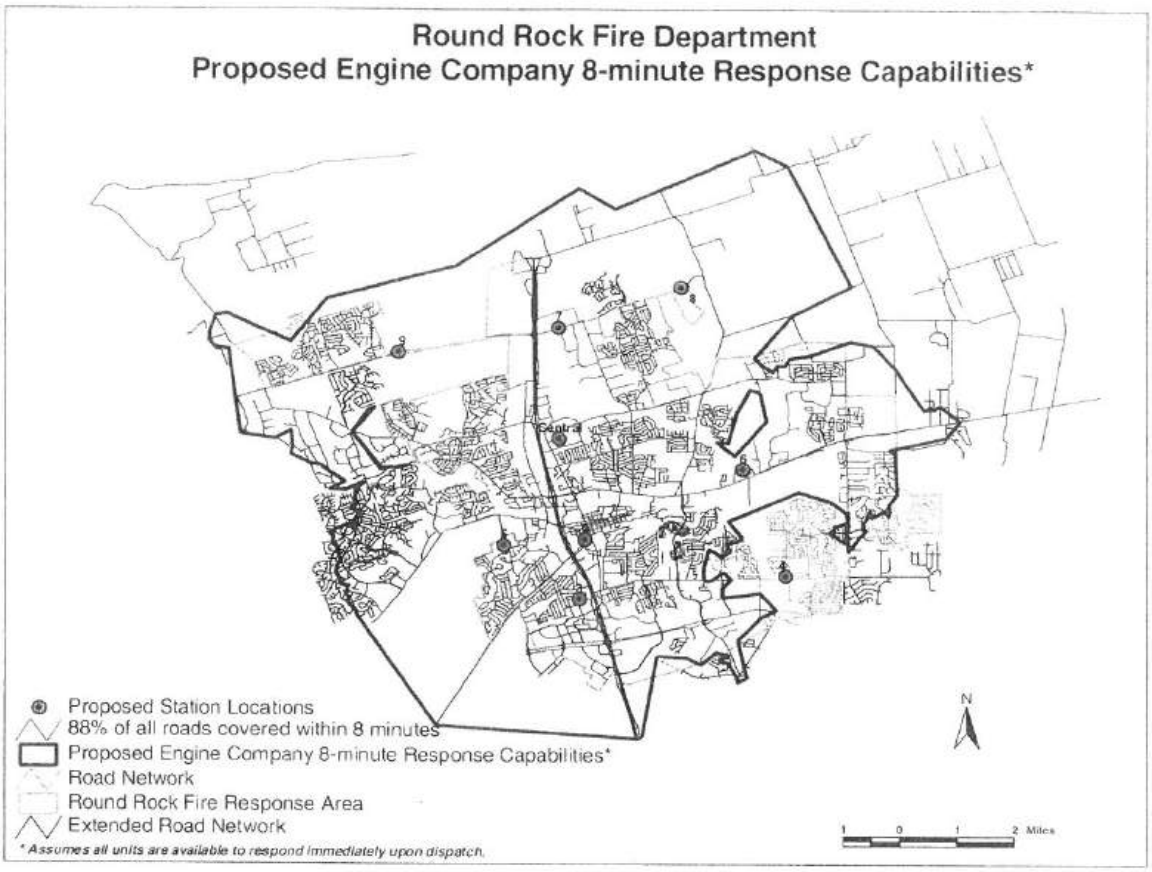
Map 40 indicates the anticipated 4-minute response capabilities of the Engine companies pursuant to the implementation of IAFF suggestions. The GIS software calculates response capabilities at 55.81% of all roads within 4 minutes. **The ability of Fire Department Engine Companies to respond to 55.81% of all roads within 4 minutes, pursuant to implementing IAFF suggestions, translates to a 3.91% *increase* in the Engine Companies 4-minute response capabilities from the proposed conditions under the 5-Year Plan.**

Table 25 details the comparison of the proposed 4-minute response capabilities of the engine companies under the proposed 5-Year Plan and 4-minutes response capabilities of the engine companies from the IAFF suggestions.

TABLE 25:
"COMPARISON OF ENGINE COMPANY 4-MINUTE RESPONSE CAPABILITIES"

SCENARIO	RESPONSE CAPABILITIES
Existing Engine Company 4-minute Response Capabilities	55.89% of all roads covered within 4 minutes
5-Year Engine Company 4-minute Response Capabilities	**51.90% of all roads covered within 4 minutes**
Suggested Engine Company 4-minute Response Capabilities	**55.81% of all roads covered within 4 minutes**

MAP 41



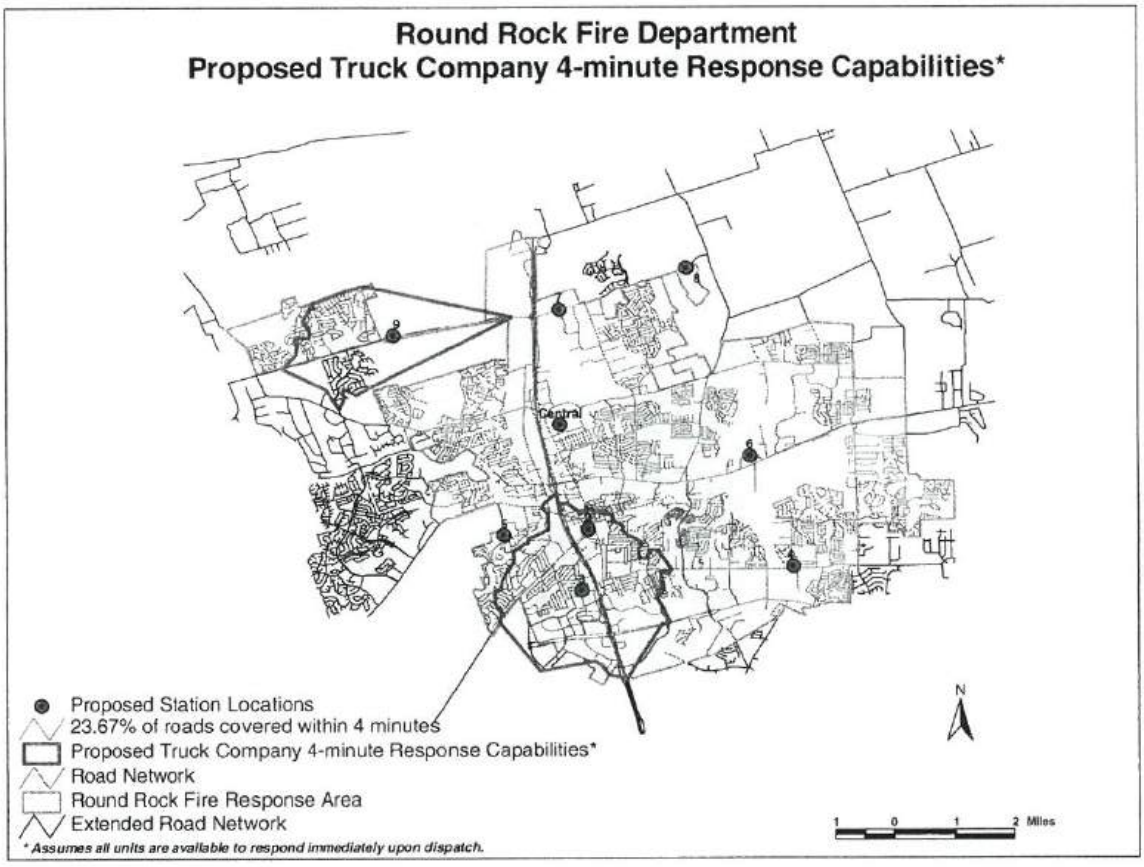
Map 41 indicates the anticipated 8-minute response capabilities of the Engine companies pursuant to the implementation of the IAFF suggestions. The GIS software calculates response capabilities at 88% of all roads within 8 minutes. **The ability of Fire Department Engine Companies to respond to 88% of all roads within 8 minutes, pursuant to the implementation of the IAFF, translates into a 4.44% *increase* in the Engine Companies 8-minute response capabilities from the proposed conditions under the 5-Year Plan.**

Table 26 details the comparison of the proposed 8-minute response capabilities of the engine companies under the proposed 5-Year Plan and 8-minutes response capabilities of the engine companies from the IAFF suggestions.

TABLE 26:
"COMPARISON OF ENGINE COMPANY 8-MINUTE RESPONSE CAPABILITIES"

SCENARIO	RESPONSE CAPABILITIES
Existing Engine Company 8-minute Response Capabilities	93.26% of all roads covered within 8 minutes
5-Year Engine Company 8-minute Response Capabilities	**83.56% of all roads covered within 8 minutes**
Suggested Engine Company 8-minute Response Capabilities	**88% of all roads covered within 8 minutes**

MAP 42



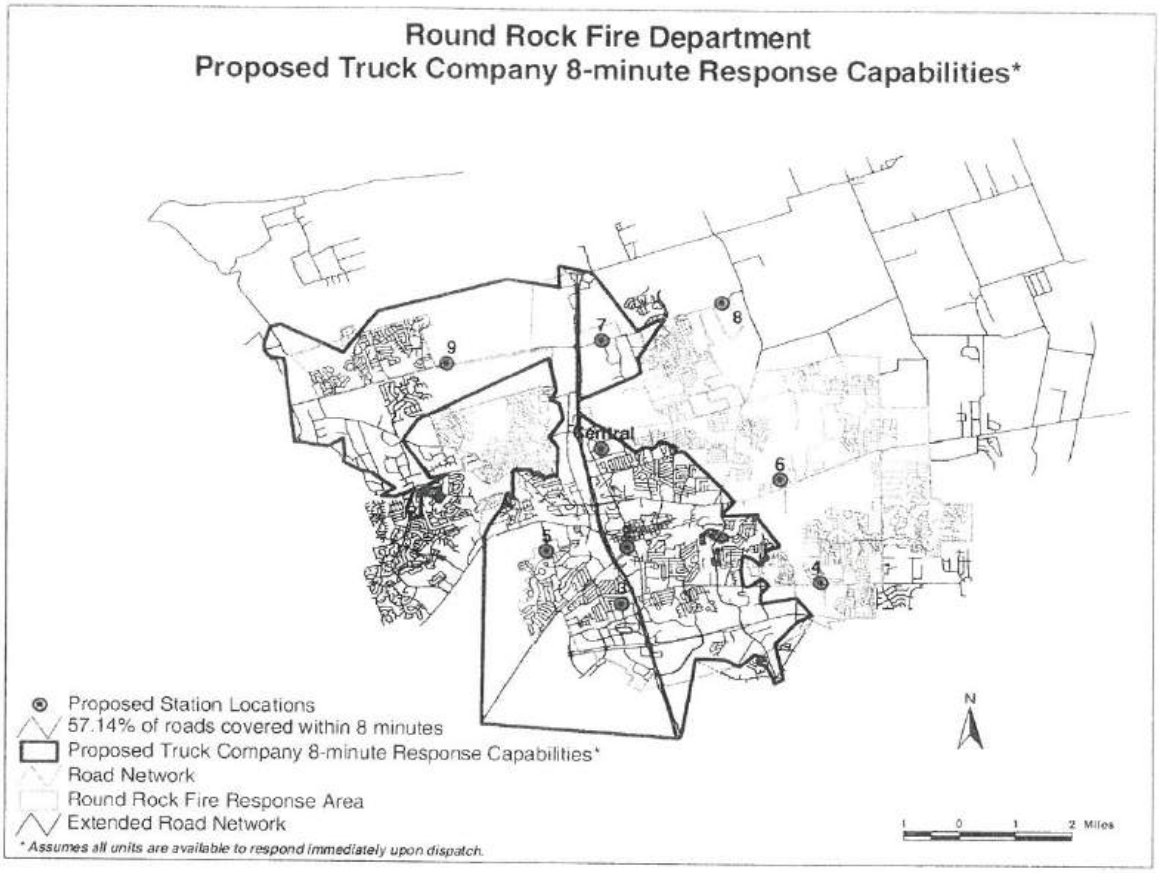
Map 42 indicates the anticipated 4-minute response capabilities of the Truck companies pursuant to the modification of the IAFF suggestions. The GIS software calculates response capabilities at 23.67% of all roads within 4 minutes. **The ability of Fire Department Truck Companies to respond to 23.67% of all roads within 4 minutes, pursuant to the implementation of IAFF suggestions, translates to a 4.34% *increase* in the Truck Companies 4-minute response capabilities from the proposed conditions under the 5-Year Plan.**

Table 27 details the comparison of the proposed 4-minute response capabilities of the truck companies under the proposed 5-Year Plan and 4-minutes response capabilities of the truck companies from the IAFF suggestions.

TABLE 27:
"COMPARISON OF TRUCK COMPANY 4-MINUTE RESPONSE CAPABILITIES"

SCENARIO	RESPONSE CAPABILITIES
Existing Truck Company 4-minute Response Capabilities	14.82% of all roads covered within 4 minutes
5-Year Truck Company 4-minute Response Capabilities	**19.33% of all roads covered within 4 minutes**
Suggested Truck Company 4-minute Response Capabilities	**23.67% of all roads covered within 4 minutes**

MAP 43



Map 43 indicates the anticipated 8-minute response capabilities of the Truck companies pursuant to the implementation of IAFF suggestions. The GIS software calculates response capabilities at 57.14% of all roads within 8 minutes. **The ability of Fire Department Truck Companies to respond to 57.14% of all roads within 8 minutes, pursuant to the implementation of IAFF suggestions, translates to a 9.59% *increase* in the Truck Companies 8-minute response capabilities from the proposed conditions under the 5-Year Plan.**

Table 28 details the comparison of the proposed 8-minute response capabilities of the truck companies under the proposed 5-Year Plan and 8-minutes response capabilities of the truck companies from the IAFF suggestions.

TABLE 28:
"COMPARISON OF TRUCK COMPANY 8-MINUTE RESPONSE CAPABILITIES"

SCENARIO	RESPONSE CAPABILITIES
Existing Truck Company 8-minute Response Capabilities	56.35% of all roads covered within 4 minutes
5-Year Truck Company 8-minute Response Capabilities	**47.55% of all roads covered within 4 minutes**
Suggested Truck Company 8-minute Response Capabilities	**57.14% of all roads covered within 4 minutes**

ENHANCEMENT CONCLUSIONS

Even though the addition of Station 9 increases the overall response capabilities of the Round Rock Fire Department within the Round Rock Fire District, the response coverage could still be improved upon. Additional fire stations and apparatus would help increase emergency response capabilities in the Round Rock Fire District. Note that the Quint company, at Station 4, could be used as either an engine company or a ladder company, depending on the nature of the emergency situation.

The business of providing emergency services has always been labor intensive, and remains so to this day. Although new technology has improved firefighting equipment and protective gear, and has led to advances in modern medicine, it is the fire fighters who still perform the critical tasks necessary to contain and extinguish fires, rescue trapped occupants from a burning structure, and provide emergency medical and rescue services.

While it is impossible to predict where most of a jurisdiction's fire and medical emergencies will occur, the Round Rock Fire Department should examine where emergencies have typically occurred in the past and make efforts to ensure these areas continue to enjoy the same level of coverage, while adjusting resources and deployment in an effort to achieve complete compliance with NFPA Standard 1710. Areas with accelerated development and growth will require additional coverage in the future. Any projected increase in emergency response demands should also be considered before changes are implemented, focusing on associated hazard types and planned response assignments.

In addition, a fire department should be designed to adequately respond to a number of emergencies occurring at once in a fashion that aims to minimize the loss of life and the loss of property that the fire department is charged with protecting. Any proposed changes in staffing, deployment and station location should be made only after considering the historical location of calls, response times to specific target hazards, compliance with departmental Standard Operating Procedures, existing national standards, including NFPA 1500 and NFPA Standard 1710, and the citizens' expectation of receiving an adequate number of qualified personnel on appropriate apparatus within acceptable time frames.

FINAL SUMMARY

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The business of providing emergency services has always been labor intensive, and remains so to this day. Although new technology has improved firefighting equipment and protective gear, and has led to advances in modern medicine, it is the fire fighters who still perform the critical tasks necessary to contain and extinguish fires, rescue trapped occupants from a burning structure, and provide emergency medical and rescue services. When staffing falls below minimum acceptable levels so does service; at this point, the goals and expectations set by the community are essentially abandoned. The staffing deficiencies that prevail in the Round Rock Fire Department are illustrative of this condition.

It is generally accepted that a municipality has the right to determine the overall level of fire protection it wants. However, regardless of the level of fire protection chosen by the citizens, neither they nor their elected representatives have the right to jeopardize the safety of the employees providing those services. Citizens pay for protection of life and property through their tax dollars, and they assume that their elected and appointed officials will make informed decisions regarding that protection. Too often, however, that decision making process has been based solely on budgetary expedience. Irrespective of the resources provided, citizens continue to believe that fire fighters are prepared to provide an aggressive interior assault on fires, successfully accomplishing victim rescue, fire control, and property conservation. They do not expect fire fighters to take defensive actions- to simply surround a fire and "drown it"- because to do so would be to concede preventable loss of both life and property.

The ramifications of staffing reductions as they pertain to the loss of life and property within a community are essential when considering modifications to a fire department's deployment configuration. While it is impossible to predict where most of a jurisdiction's fire and medical emergencies will occur, the Round Rock Fire Department should examine where emergencies have typically occurred in the past and make efforts to ensure these areas continue to enjoy the same level of coverage, while adjusting resources and deployment in an effort to achieve complete compliance with NFPA Standard 1710. Areas with accelerated development and growth will require additional coverage in the future. Any projected increase in emergency response demands should also be considered before changes are implemented, focusing on associated hazard types and planned response assignments.

In addition, a fire department should be designed to adequately respond to a number of emergencies occurring at once in a fashion that aims to minimize the loss of life and the loss of property that the fire department is charged with protecting. Any proposed changes in staffing, deployment and station location should be made only after considering the historical location of calls, response times to specific target hazards, compliance with departmental Standard Operating Procedures, existing national standards, including NFPA 1500 and NFPA Standard 1710, and the citizens' expectation of receiving an adequate number of qualified personnel on appropriate apparatus within acceptable time frames.