
Smithville Fire Rescue



Fire Station, Staffing, and Apparatus Deployment Study

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Table of Contents

Table of Contents	1
List of Tables.....	2
Introduction and Scope of Work	3
Background.....	3
Community Risk – General Overview	3
Public Safety-Fire Department	4
Fire Stations	6
Fire Apparatus.....	7
Insurance Service Office (ISO).....	9
Utility Services.....	11
Future Needs	11
How Many Fire Stations Does Smithville Need?.....	14
Fire Companies Defined	18
How Many Engine Companies Does Smithville Need?	18
How Many Ladder Companies Does Smithville Need?	20
How Many Tender/Tanker Companies Does Smithville Need?	21
Smithville Fire Apparatus	22
Smithville Company Staffing	22
Recommendation Implementation.....	24
Summary	24
Recommendations	26
Response Time Standard	26
Automatic Fire Sprinklers.....	26
Fire Stations	27
Current Stations.....	27
Additional Stations.....	27
Fire Apparatus.....	27
Operations Staffing.....	27
Appendixes	29
Appendix A-NFPA Home Fire Timeline	29

Appendix B-Engine Response Area Inner Polygon / Ladder Response Area Outer Polygon	30
Appendix C-Estimated Response Time Chart.....	31
Appendix D-Smithville City Limits / Fire Station Location	32
References	33

List of Tables

Table 1-Smithville Fire Department Station and Apparatus February 2022	6
Table 2-Smithville Apparatus Inventory-NFPA 1710 Evaluation.....	9
Table 3-Comparative Fire Departments By Population	13
Table 4-NFPA 1710 Apparatus Lifespan Analysis	27
Table 5 -Fire Department Staffing Comparison	28

List of Figures

Figure 1-Smithville City Limits.....	5
Figure 2-Graphic of Smithville’s Fire Station Location.....	7
Figure 3-NFPA 1901 Appendix D-Fire Apparatus Lifespan.....	8
Figure 4-Smithville Front-Line Apparatus.....	9
Figure 5 – Public Protection Classification (ISO Rating) in the US.....	10
Figure 6 – Public Protection Classification (ISO Rating) in Tennessee.....	10
Figure 7-Smithville Zoning Map.....	12
Figure 8-NFPA Home Fire Timeline.....	14
Figure 9-Smithville Fire Stations with 1.5-Mile Engine Response Areas.....	17
Figure 10-Smithville’s Recommended 1-Station Primary Coverage	19
Figure 11- Existing Ladder Company Deployment	21
Figure 12- NFPA 1710 Reference	22
Figure 13-NFPA 1710 Engine Company Staffing	23
Figure 14-NFPA Ladder/Service Company Staffing	24

Introduction and Scope of Work

The staff of the University of Tennessee Municipal Technical Advisory Service (UT MTAS) strives daily to meet its consensus mission. As an agency of the University of Tennessee and in collaboration with the Tennessee Municipal League, MTAS leverages the resource of the university to improve the lives of the people of Tennessee with technical consulting, research, and training for municipal governments. This study works toward UT MTAS's mission and was conducted at the request of Chief Charlie Parker, Fire Chief at the City of Smithville, Tennessee. On June 19, 2021, Chief Parker and I spoke at the Tennessee Fire Chiefs Annual Conference about this project. It was concluded that the purpose of this study is to evaluate the adequacy and deployment of current fire station locations, fire apparatus staffing, and fire apparatus deployment. UT MTAS will further work with city leadership to develop a phased implementation plan for any recommended improvements the city chooses to implement.

The University of Tennessee Municipal Technical Advisory Service (UT MTAS) will provide the final version of this report to the City of Smithville, Tennessee, in an electronic format.

Background

The City of Smithville, Tennessee was founded in 1838 and is geographically located entirely in DeKalb County, Tennessee. Smithville further serves as the county seat of DeKalb County. Smithville is situated in the central region of DeKalb County at the intersection of US Highway 70 and Tennessee State Route 56 a mere 13-miles from Interstate 40 that traverses the State of Tennessee east and west. Smithville residents, business, and commerce also have access to the Smithville Municipal Airport located in the city proper and Nashville International Airport located approximately 60-miles away. Smithville has easy access to a large recreational lake, Center Hill Lake. While the Caney Fork River is not navigable, the lake does provide ample opportunity for boating, hiking, camping, and other recreational activities.

A Mayor-Aldermanic form of government governs the city. The six-member Board of Mayor and Alderman are elected at large to serve the citizens without regard to districts or wards. Members of the Board of Mayor and Alderman serve on a 4-year term with half of the board up for election in any one election cycle.

Community Risk – General Overview

Smithville's corporate boundary geographically encompasses approximately 5.9 square miles and has a population of approximately 5,134 based on 2020 US Census Bureau data. The City's urban growth boundary (UGB) is larger, so additional growth is likely to occur. This prediction is based on the geographic location, livability, and the economic vitality of the region.

The City of Smithville is home to many manufacturing companies as well as the Smithville Municipal Airport. The City of Smithville hosts numerous festivals and gatherings annually; the largest being the Fiddler's Jamboree. The Fiddler's Jamboree is estimated to bring more than 100,00 participants annually. Each of these different types of facilities and festivals present unique hazards and challenges for the public safety professionals in the community.

From 2010 to 2020 Smithville's population increased by about 13.3% ranking Smithville as the 112th largest City in Tennessee. Smithville's population median age is 34.4-years which is younger than the state average of 39.0-years, but Smithville does have approximately 8.7% of its population over the age of 65. Statistically, older population segments tend to use emergency medical services more than other population segments. Approximately 8.51% of Smithville Fire Department's responses for 2020 were due to rescue/emergency medical incidents.

Smithville has a wide range of housing opportunities for residents. These opportunities range from apartment/home rental, condo to single family home ownership. Smithville has a rate of home ownership at approximately 37.8% with approximately 6.50% of the housing stock vacant. This number does not include houses in foreclosure, which means that the percentage of vacant homes and buildings is probably a little higher. Research by the National Fire Protection Association (NFPA) has shown that the incidence of fires in vacant buildings increases when the economy is weak, and that the risk to neighborhoods is greater as fires in vacant buildings are more likely to spread to adjacent homes than fires in occupied homes. Nationwide, almost half of all fires in vacant buildings are arson fires. Approximately 23.41% of Smithville Fire Department's responses for 2020 were due to fire incidents.

Smithville offers a diverse base of employment opportunities in the city. Residents and commuters are employed in the transportation equipment field (18.3%), educational services (8.0%), healthcare (7.2%), accommodation/food service (6.6%), and construction (4.9%) which account for the largest employment demographics in Smithville.

Smithville again can be predicted to continue to grow in population due to its geographic location, ease of commuting to other cities, convenience to areas of the state, nearby airports, community services, and nearby recreational attractions. Smithville is an attractive city with aesthetic design and has enough undeveloped land for additional residential and commercial growth.

Public Safety-Fire Department

In general, the level of public safety fire protection by a community is determined by local policy. The elected officials of the city (Mayor and Alderman) must identify the local risks then try to balance available local resources against what they determine to be acceptable risks in the community. It is the responsibility of the public safety fire professionals to ensure that their elected officials are keenly aware of the actual and perceived risks in the community.

The City of Smithville was founded on February 3, 1938. Since its inception, the fire department has continued to evolve. Today, the fire department is led by Fire Chief Charlie Parker supported by one full-time firefighter and a cadre of volunteer firefighters. The city seeks to provide all-hazards public safety fire services to the citizens and visitors to the community through their combination municipal fire department. This means that the fire department has both full-time paid and volunteer staff that responds to all types of emergency situations reported within the geographic limits of the city. The department is funded through general fund allocations of the City of Smithville annual budget. The fire department currently employs two full-time members supported by a number of volunteer staff.

The fire department maintains a fleet of 4 front-line fire apparatus/vehicles. These apparatus/vehicles are deployed from the city's one fire station located in the heart of downtown. Figure 1 graphically depicts the corporate limits of the city. The Smithville Fire Department responds to over 200 emergency calls for service annually. In 2021, the department responded to 35-fires total of which 16-fires were structure fires and 11-fires were vehicle fires. The department responded to 69-rescue/medical incidents. Response data is based on the Tennessee Fire Incident Reporting System (TFIRS).



Figure 1-Smithville City Limits

Fire Stations

The City of Smithville Fire Department responds to emergency and non-emergency calls for service from their one fire station located in the downtown district. A fire station is considered critical infrastructure due to the services that can be and/or are provided to the citizens and visitors to the community from each. It is imperative to proactively plan fire station's location, fire apparatus deployment, and staffing strategies based on the needs of the specific areas of the city. The primary focus of this study is to evaluate current fire station locations, fire staffing strategy, fire apparatus deployment, and identify any current and/or anticipate future needs of the department. Table 1 lists the current fire station location with the current apparatus deployment strategy.

Smithville Fire Department Fire Station and Apparatus		
Station	Equipment	Address
1	Command 1, Engine 1, Engine 2, Ladder 1	104 East Main Street, Smithville, Tennessee

Table 1-Smithville Fire Department Station and Apparatus February 2022

Figure 2 graphically depicts the general location of current downtown fire station with the corporate boundaries of the city denoted in yellow. A picture is worth a lot of words, so as you look over Figure 2, you notice that the fire station located in downtown seems to be off-centered and maybe not serve all the city as it could if located somewhere else. Part of this is an allusion based on strip annexation out to the airport and industrial park. As we will study a little later in this report, the station location is in a good place.



Figure 2-Graphic of Smithville's Fire Station Location

Fire Apparatus

Currently, Smithville Fire Department maintains a fleet of four fire apparatus and support vehicles including: two engine apparatus, one aerial ladder apparatus, and other response vehicles categorized in front-line service. The scope of this study did not comprehensively analyze the adequacy of each apparatus but took into consideration the years since the apparatus was manufactured or refurbishment and its deployment by type apparatus. A more comprehensive fire apparatus study can be completed as a separate UT MTAS project. This type project would study apparatus equipment inventory, equipment maintenance and testing, hose and pump testing, ladder testing, and vehicle inspection records. Any apparatus identified as needing additional testing or maintenance should be completed per a schedule and if an apparatus is identified to be replaced, the investment should be added to a capital equipment replacement plan.

When analyzing fire apparatus for its useable lifespan, one must look to consensus standards for metrics to base our findings on. The National Fire Protection Association (NFPA) 1901: Standard for Automotive Fire Apparatus, 2016 Edition is the model consensus standard referenced when we analyze the adequacy of fire apparatus. NFPA 1901, in Appendix D, identifies 15-years as the useable lifespan for a front-line fire apparatus, 10- additional years (25-years) for reserve service, and when an apparatus reaches more than 25-years of age, it should be retired. Figure 2 is an excerpt from NFPA 1901 Appendix D. This standard should be used as a guide with the understanding that if the safety or adequacy of a fire apparatus comes into question, this standard will most likely be used as the guide.

NFPA 1901 Appendix D states: It is recommended that apparatus more than 15 years old that have been properly maintained and that are still in serviceable condition be placed in reserve status, be upgraded in accordance with NFPA 1912, and incorporate as many features as possible of the current fire apparatus standard (see Section D.3). This will ensure that, while the apparatus might not totally comply with the current editions of the automotive fire apparatus standards, many of the improvements and upgrades required by the current editions of the standards are available for the firefighters who use the apparatus.

Apparatus that was not manufactured to the applicable NFPA fire apparatus standards or that are over 25 years old should be replaced

Figure 3-NFPA 1901 Appendix D-Fire Apparatus Lifespan

When we analyze Smithville Fire Department’s fire apparatus fleet against the NFPA 1901 standard, fire apparatus should be categorized as front-line, reserve, or retired. Only one of Smithville’s in-service fire apparatuses has exceeded its NFPA identified usable front-line lifespan. In Table 2, apparatus highlighted in green meet the standard, apparatus highlighted in yellow are approaching their lifespan, and apparatus highlighted in red have exceeded their lifespan in their current status. Apparatus that has exceeded their lifespan in their current status should progress to the next status as soon as practical. Once an apparatus has served the city for more than 25-years, it should be placed out of service and honorably retired with a dignified ceremony. Refer to Figure 4 to see a picture of each front-line apparatus.



Figure 4-Smithville Front-Line Apparatus

Engine 1	Engne	N/A	1,500	Pierce	2018	4	Frontline
Engine 2	Engine	N/A	1,250	Pierce	2001	21	Frontline
Ladder 1	Ladder	75'	1,750	Pierce	2012	10	Frontline

Table 2-Smithville Apparatus Inventory-NFPA 1710 Evaluation

It is noted, in Table 2, that both Engine 1 and Ladder 1 are within their identified 15-year lifespan for front-line service. Engine 2 has exceeded its front-line lifespan and the department should consider replacing it as soon as practical. The current Engine 2 can be moved to reserve status for four additional years. At age 25, fire apparatus should be honorably retired and placed out of service.

Insurance Service Office (ISO)

The Insurance Service Office (ISO) is an insurance advisory organization that provides statistical and actuarial information to businesses like insurance companies. ISO focuses on property/casualty insurance, including both personal and commercial lines. Insurance companies can and usually does include ISO data into their rate metrics for a jurisdiction. ISO rates jurisdictions between a 1 (best) and 10 (worst) based on their ability to prevent and suppress structure fires. Smithville's Insurance Services Office (ISO) Public Protection Classification (ISO rating) is currently a Class 5/5X. The Class 5/5X ISO rating places Smithville within the top 33% of cities nationwide (Figure 5) as well as within the top 26% of cities in Tennessee (Figure 6). In terms of fire protection, this indicates that the leadership of the City of Smithville has made some good decisions but there are opportunities for improvement in the community's fire protection. Figure 5 and Figure 6 depict on a graph Smithville's ISO rating compared to other communities across the United States and Tennessee respectively.

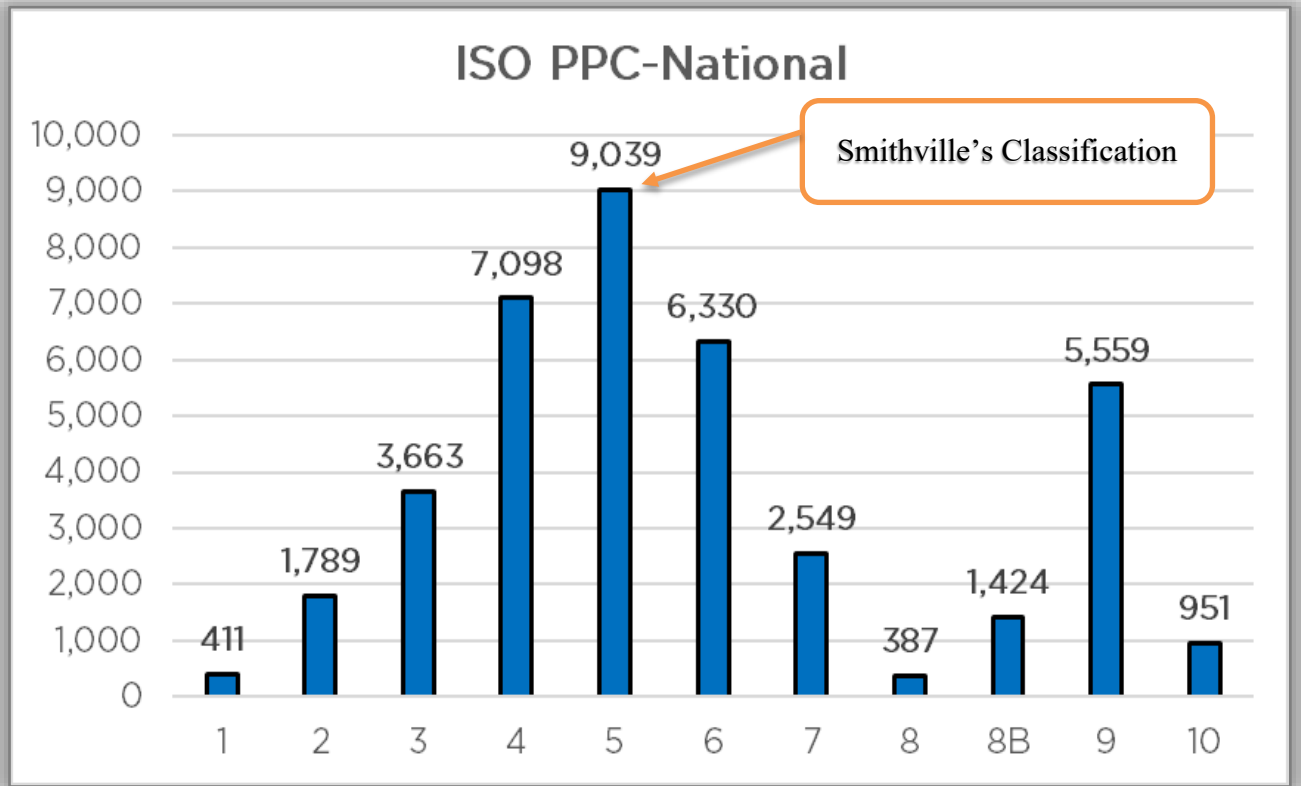


Figure 5 - Public Protection Classification (ISO Rating) in the US

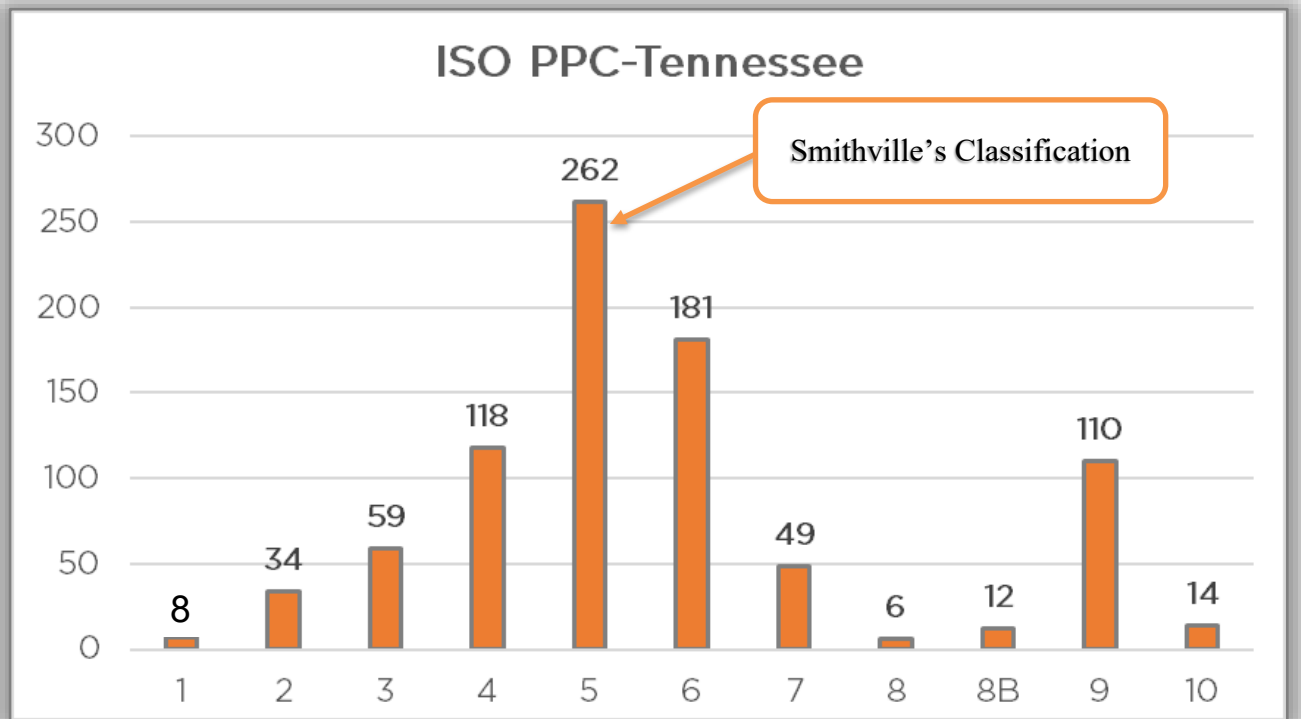


Figure 6 - Public Protection Classification (ISO Rating) in Tennessee

As previously noted, the Smithville Fire Department is an all-hazards fire department; its members strive to meet all the needs of the city. What this means to the community is that the fire department is alerted to and responds to all types of emergency incidents located geographically within Smithville's corporate city limits. The department also provides its services outside the corporate limits upon a request for mutual aid by other agencies. What this further means to the community is that the members of the fire department are properly trained, equipped, and routinely respond to any emergency call for service the citizens and visitors have. The scope and complexity of these incident responses can range from one person experiencing a medical emergency, to a plane crash at/near the airport, to an industrial fire/mass casualty incident at one of your manufacturing facilities.

Utility Services

Utility services are provided to the citizens of the City of Smithville by several different utility providers. Electricity: Smithville Electric Service, located at 611 East Broad Street in Smithville, provides electricity to the entire city and is managed by a board of directors including the City Mayor. Dekalb County electricity is provided by Caney Fork Electric Cooperative and Middle Tennessee Electric Membership Cooperation. Water: Water services are provided by Smithville Water Department located at 104 East Main Street in Smithville. Smithville water is responsible for not just potable water but also needed fire flow for fire suppression within the city. The adequacy of the water systems, water pressure and/or the needed gallons-per-minute fire flow to support adequate fire suppression operations were not part of the scope of this study. A comprehensive water study can be conducted as a separate UT MTAS project as a follow-up. There are three additional water purveyors in the area, DeKalb Utility District, Dowelltown-Liberty Water System, and the City of Alexandria. Natural Gas: Smithville and Dekalb County, natural gas services are provided by Middle Tennessee Utility District located at 1036 West Broad Street in Smithville. Telephone: Telephone services are provided by DTC Communications located at 111 High Street and Verizon Wireless located at 106 East Broad Street both located in Smithville.

Future Needs

Extensive review of the Smithville Fire Department's fire response areas, fire facility location, fire apparatus, fire staffing, and department response practices, the existing public safety fire services response resources are not adequate to provide the expected level of service delivery for a city of the size and scope of the City of Smithville. This inadequacy can largely be attributed to steady growth, low numbers of volunteers, and higher response time associated with relying heavily on volunteer fire fighting staff. All these conditions can cause additional risks to the firefighters as well as the citizens and visitors to Smithville.

Reviewing the map on Figure 7, it is noted that Smithville’s commercial land use is spread out along the major roadways from downtown to the edge of the geographic city limits. The industrial land use in the city is almost entirely located at the outskirts of the geographic city limits thus causing longer response times. We can predict estimated response times to areas of the city using the Rand formula of Travel (Travel Time = 1.7(D) + 0.65) + (Ring Time 0.25) + (Call Processing Time 1.00) + (Fire Department Turnout Time 1.00) as our guide. It is estimated that the Smithville Fire Department would have a response time of approximately 4.79-minutes to the industrial area surrounding the municipal airport with a full-time staff. Relying on volunteer staff, we must add the volunteer firefighters’ reaction time and availability which is unpredictable. The same response time scenario is true for an emergency response to DeKalb County High School campus on Highway 70. These predications assume firefighters on duty at station, ideal travel conditions; no roadways blocked, traffic congestion, and/or inclement weather conditions.

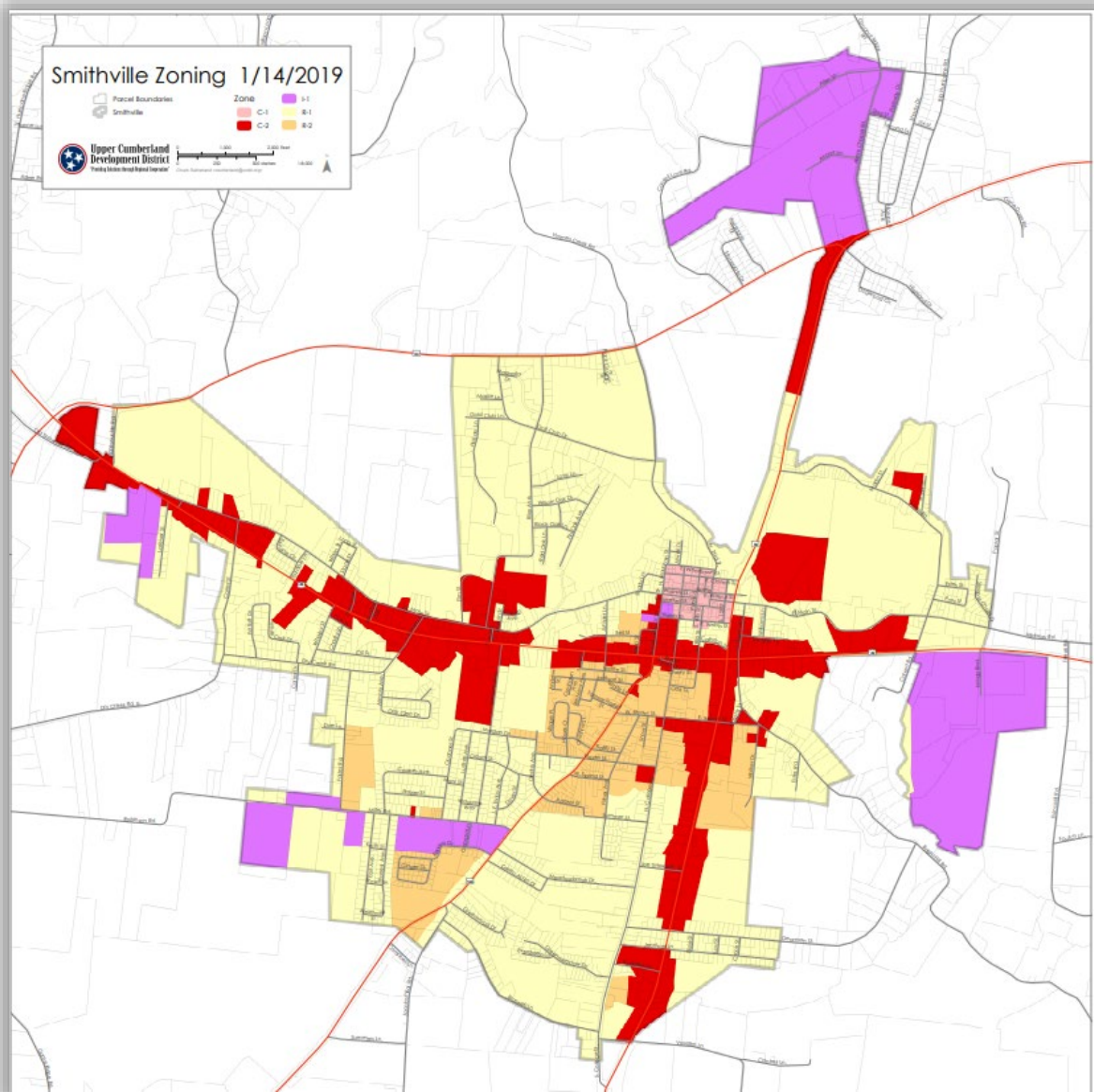


Figure 7-Smithville Zoning Map

We have called out response to commercial and industrial land use areas. These are economic drivers of the community providing jobs, tax revenue, etc. that keeps Smithville vibrant. When our citizens are in their homes, they can be especially vulnerable and will experience very similar response times when they have a fire and/or medical emergency at their home. Since Smithville Fire Department relies almost entirely on a volunteer firefighting force, it is predictable that fire/medical response times are going to be much longer due to volunteer firefighter reaction time and/or firefighter availability.

City	TN Grand Division	Population	Type Fire Department	Fire Stations	Full-Time Employees	Part-Time / Volunteer Employees	ISO Classification
Ashland City	Middle	5,193	Combination	2	9	30	4
Bolivar	West	5,226	Combination	1	12	19	4/4x
Etowah	East	3,603	Combination	1	9	11	
Jonesborough	East	5,860	Public Safety	1	7	10 / Plus Police	5
Madisonville	West	5,132	Combination	1	4	40	4
Mount Pleasant	Middle	4,787	Combination	1	15		3/3x
Rockwood	East	5,444	Combination	1	13	16	4
Smithville	Middle	5,004	Combination	1	2		5/5X
Sparta	Middle	4,998	Combination	1	5	16	4
Trenton	West	4,240	Combination	1	15	10	5
Waverly	Middle	4,297	Public Safety	2	14	15	4

Table 3-Comparative Fire Departments By Population

Table 3 compares the City of Smithville to other cities with similar populations across the State of Tennessee. You can immediately discern that Smithville Fire has fewer full-time employees than any of the other comparable city. Further, based on information provided by Chief Parker, it appears that Smithville has a lower number of volunteer firefighters than the comparable municipalities.

Using the Home Fire Timeline (Figure 8), we can ascertain that response time is one of the fire department’s most critical factors when responding to fire and emergency medical incident that happen. One of the goals at a structure fire incident is to prevent flashover; giving fire suppression crews time to rescue occupants. Flashover can be prevented through the use of automatic fire sprinkler systems or a quick-fire response with proper suppression techniques or preferably a combination of both. As the City continues to grow, City leaders must proactively plan to provide adequate public safety fire services and other City services in the annexed areas.

Leaders should look to national consensus standards for guidance and benchmarking their fire departments. No one standard outlines what is an acceptable response time. We must refer to the National Fire Protection Association (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 and the National Fire Protection Association (NFPA) 1221, Standard for the Installation, Maintenance and Use of Emergency Services Emergency Communications Systems are both consensus standards that outline maximum response times. In the case of Smithville, referring to NFPA 1710 and NFPA 1221, it can be surmised that a response time standard of six-minutes and thirty-five

seconds (6:35) to 90% of incidents is a realistic goal to attain. Smithville’s one fire station with a full-time staff is likely positioned to meet this response standard. However, relying almost exclusively on volunteer staff, especially nights and weekends, it is not likely the department will get near meeting this standard.

There are two major strategies to reduce fire department response time. If fire stations are too far away, we have to consider building additional facilities. This is not the case in Smithville. If the time to get fire apparatus on the road is too long due to volunteer staffing, we must consider additional full-time staffing. This appears to be the situation at Smithville.

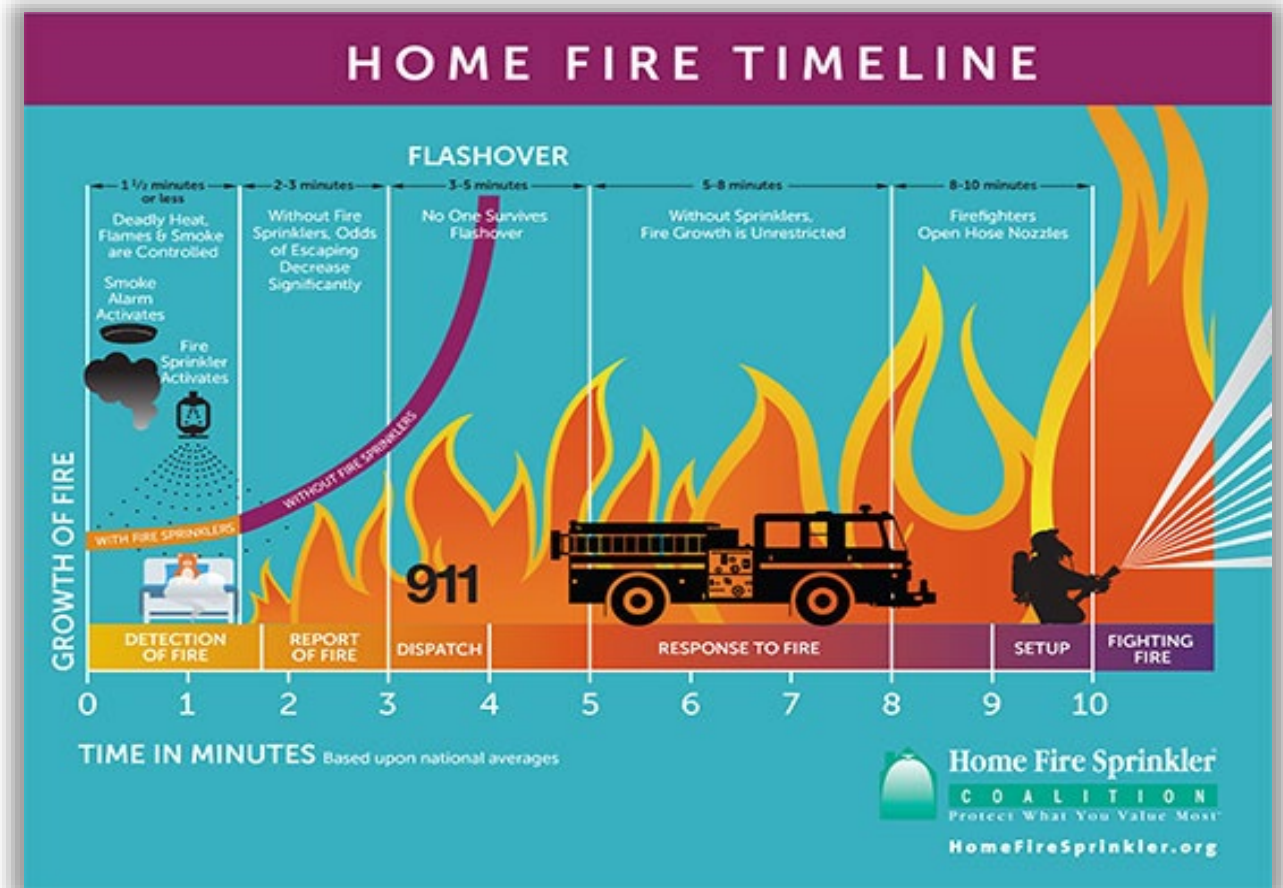


Figure 8-NFPA Home Fire Timeline

How Many Fire Stations Does Smithville Need?

To answer the question of how many fire stations does Smithville needs now, one can look at several sources for guidance. The first is the Insurance Services Office (ISO) Fire Suppression Rating Schedule. Section 561 of the schedule covers distribution of companies and states: “The built-upon area of the City should have a first-due engine company within 1.5-miles and a ladder-service company within 2.5-miles.” For a facility to be considered a fire station, there must be a fire apparatus credited as an engine apparatus housed there.

Using an “as the crow flies” radius of 1.5-miles to draw a circle does not adequately represent the geographical area that a single fire station can cover. Studies have shown that a polygon better represents the ISO required response area, and that the average size of the 1.5-mile polygon encompasses approximately 4.5-square miles. Two caveats: the polygon model assumes the even distribution of resources throughout the area, which is generally not the case, and the formula does not allow for geographical barriers, such as rivers, interstates, large factories, and railroads, but the formula is useful as a reference. Based upon a just under 6.0-square mile service area, a travel distance of 1.5-miles, Smithville needs 1.33-fire stations right now for adequate coverage. With the long travel distances associated with strip annexations taken into consideration, Smithville should plan for an additional fire station located near the high school campus. With the current school campus, along with commercial, industrial, and residential development in the works, it appears that a station will be needed in this area sooner rather than later to address community risk.

The ISO standard for distribution is 1.5-miles for an engine and 2.5-miles for a ladder company, but ISO will extend a community’s fire protection rating as far as five miles from a fire station provided there is adequate water available for fire protection. There is a caveat for basing fire protection on this five-mile distance, and that is the risks associated with extended response times. Travel time, measured as the time from when the fire department resource starts to roll until it arrives on the scene, is just one component of response time (see Appendix I). At 1.5-miles, the travel time for a fire engine is approximately 3:12 (time expressed as minutes: seconds). At five miles, the travel time is approximately 9:09. The response time, which includes ring time, call answering, call processing, turnout, and travel time, is much longer. Thus, a total response time of six or seven minutes for stations based on 1.5-mile distribution increases to twelve or thirteen minutes (or longer if call processing and turnout times exceed NFPA recommendations) based on 5.0-mile distribution. As stated earlier in this report, the level of fire protection provided in a community is a local decision, but due to the risk to the public, MTAS recommends basing community fire protection more toward the 1.5-mile travel distance than on the maximum 5.0-mile distance.

The second resource is the National Fire Protection Association (NFPA). NFPA addresses the number of fire stations needed in an indirect way based on minimum response times. NFPA Standard 1710 Section 5.2.4.1.1 allows a 240 second (4-minute) travel time for the first arriving engine company. Using an empirical model called the piecewise linear travel time function, based upon studies done by the Rand Institute estimating the average response speed of fire apparatus at 35 mph, one can determine that the distance a fire engine can travel in 4 minutes is approximately 1.97 miles. A polygon based on a 1.97-mile travel distance covers on average 7.3 square miles. Based upon a 5.9 square mile service area, a travel-time-calculated travel distance of 1.97 miles, and assuming all engine companies are evenly distributed (which they are not) Smithville would need 1.3- fire stations right now. However, the city is not evenly distributed, has several large buildings located around the city, and strip annexation out to the airport/industrial park have extended the corporate limits creating longer travel distance and time. Based on the scope and complexity of the risks to the public,

Smithville must consider planning toward the 1.5-mile travel distance model as previously discussed.

The previous two examples are based upon time and distance to be covered. A third resource is the ISO Fire Suppression Rating Schedule's determination of needed engine companies based upon the community's basic (needed) fire flow. Section 513 of the schedule requires one engine company for a basic fire flow of 500 to 1,000 gallons per minute (gpm), two engine companies for a basic fire flow of 1,250 to 2,500 gpm, and three engine companies for a basic fire flow of 3,000 to 3,500 gpm. Basic fire flow is calculated by determining the needed fire flow for all non-sprinkled properties in the community, and then the fifth highest is considered the basic fire flow for the community. A strong fire sprinkler ordinance can reduce community risk significantly, as ISO does not consider properties protected by automatic sprinkler systems when determining the basic fire flow, and properties equipped with fire sprinkler systems reduce the fire risk in the community. Smithville has adopted model codes that require fire sprinklers in certain types of buildings but should consider adopting a more restrictive sprinkler ordinance to require fire sprinklers in all one- and two-family residential occupancies to reduce risk to the community.

Finally, city leaders must consider the phenomenon known as flashover. As a fire grows larger, the fire gives off heat that heats other objects in the vicinity of the fire. At some point in the time-temperature curve, all the objects in the fire room reach their ignition temperature and ignite. The entire room bursts into flames, and the temperature rises to a point where no person can survive, including firefighters. This is called Flashover. The NFPA Fire Protection Handbook states: "During flashover, however, the temperature rises very sharply to such a level that survival of persons still in the room at that stage becomes unlikely. Thus, the time interval between the start of the fire and the occurrence of flashover is a major factor in the time that is available for safe evacuation of the fire area." The development of fire conditions to reach the point of flashover is a function of temperature rise over time. Therefore, a sufficient number of fire stations strategically located to provide quick response times can reduce the incidence of flashover, thus saving lives and property. As shown in the graph in Figure 8, flashover can occur within 3 to 5 minutes of the start of a fire. Locating fire stations to provide a total response time of three to four minutes is advantageous, as firefighters need time after arrival to setup, lay fire hose, and gain access to the seat of the fire before they can begin to search for trapped occupants or extinguish the fire. Referring to Appendix C, your study recommendations are based upon 1.5-mile fire station/engine company response. Under ideal conditions and taking into consideration the roles of 911 call-takers, emergency dispatchers, traffic travel time, and fire staff/equipment limitations, this would give Smithville Fire Department an estimated 5.78-minute total response time at 1.5 miles from the fire station.

Figure 9 shows the coverage area provided by the current fire station. The light green polygon areas represent 1.5-mile travel distances, or approximately 3:12 minutes/seconds travel times. Looking at this map, it is obvious that Smithville has areas of the city that fall outside of the 1.5-mile primary coverage area of an engine company.

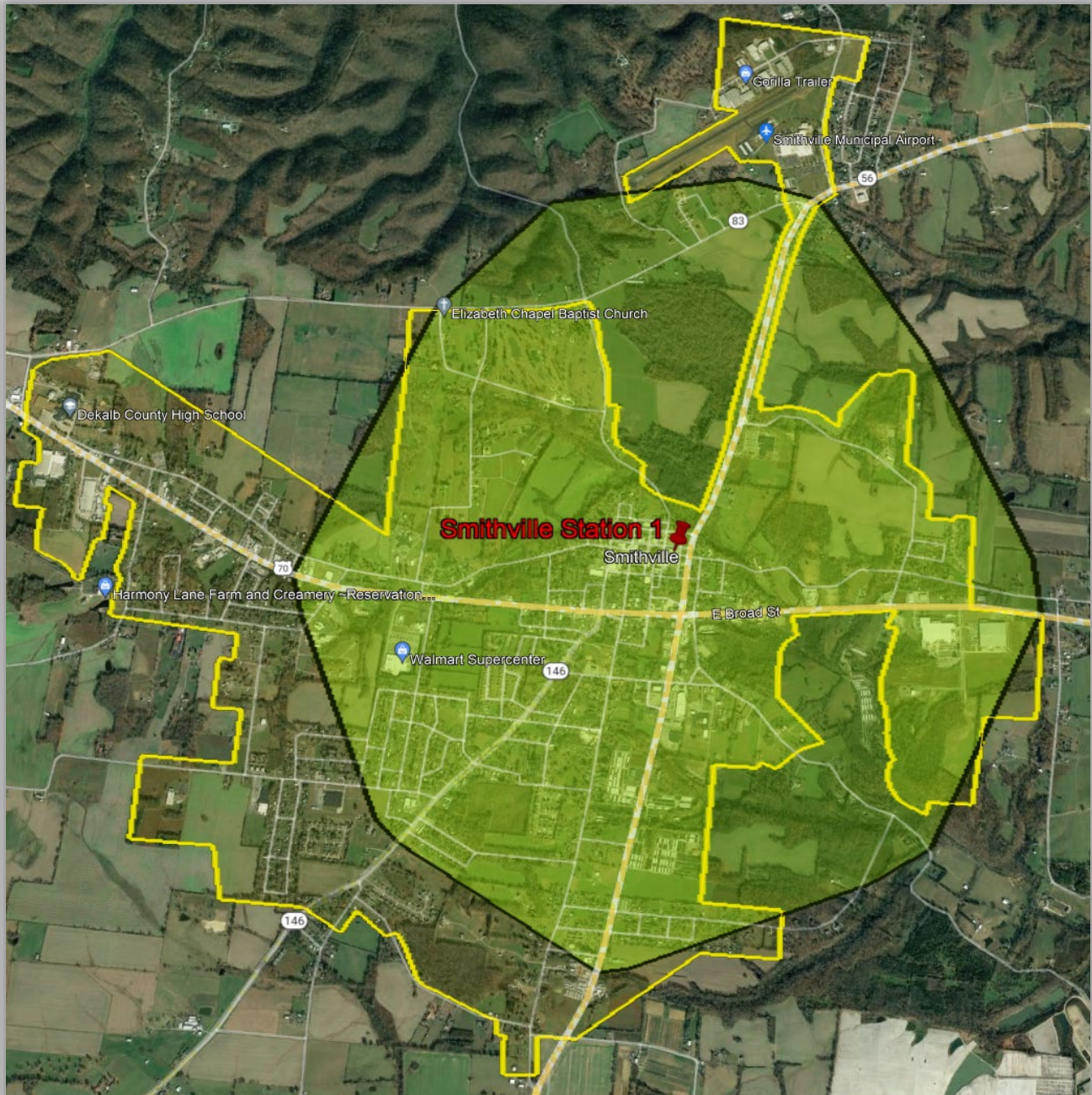


Figure 9-Smithville Fire Stations with 1.5-Mile Engine Response Areas

Taking into consideration the accepted methods to determine proper number and distribution of fire stations across a city and using existing station locations to reduce capital expenditures, to provide more adequate fire coverage for the city, Smithville is currently in a good position with the number of fire stations. As the City annexes additional area, the city must consider the potential need for constructing additional fire stations to ensure adequate coverage. Fire stations should be designed with the future needs of the department and community in mind. This means we must take into consideration anticipated apparatus deployment, staffing, response volume, population growth, applicable National Fire Protection standards, life safety codes, and building codes.

Fire Companies Defined

Fire departments utilize fire apparatus as tools to combat and extinguish unwanted fires. For the purposes of this study, we will define five categories of fire apparatus: engine, quint, ladder, and tender/tanker.

- Engine apparatus: fire apparatus with a permanently mounted fire pump of at least 750 gallons per minute (gpm) pump capacity, minimum 500-gallon water tank, and hose bed whose primary purpose is to combat structural and associated fires. An engine apparatus can earn full credit as an engine.
- Quint apparatus: fire apparatus that performs five different firefighting functions. Must have permanently mounted fire pump of at least 750 gpm pump capacity, minimum 300-gallon water tank, hose bed, ground ladders, and aerial ladder. A quint apparatus housed by itself can earn full credit as an engine and 0.50% credit as a ladder. A quint apparatus housed with an engine can earn 100% ladder credit.
- Ladder apparatus: fire apparatus equipped with an aerial ladder, elevating platform, or water tower that is designed and equipped to support firefighting and rescue operations by positioning personnel, handling materials, providing continuous egress, or discharging water at positions elevated from the ground. A ladder apparatus must be housed with an engine apparatus.
- Service apparatus: fire apparatus that is designed and equipped to support firefighting and rescue operations by positioning personnel, handling materials, and providing continuous egress. This apparatus is similar to a ladder apparatus without being equipped with an aerial ladder or elevated master stream device. A service apparatus must be housed with an engine apparatus.
- Tender/Tanker apparatus: is a specialized firefighting apparatus designed for transporting water from a water source to the scene of an emergency. Typically, water tenders support engine and/or ladder companies during fires and hazardous material incidents.

How Many Engine Companies Does Smithville Need?

A community needs an apparatus credited as an engine apparatus assigned to respond from each fire station. Fire stations should be planned with 1.5-mile polygon primary service areas to ensure quick efficient emergency response and earn maximum ISO credit. This can be accomplished by the deployment of an engine apparatus in each station. Figure 9 illustrates the current engine company deployment and its corresponding 1.5-mile coverage area. As identified by the number of fire stations needed, Smithville needs just over 2.0-apparatus

categorized as an engine apparatus strategically located across the city. Figure 10 depicts the 1.0-station deployment with its primary response area for each engine apparatus.

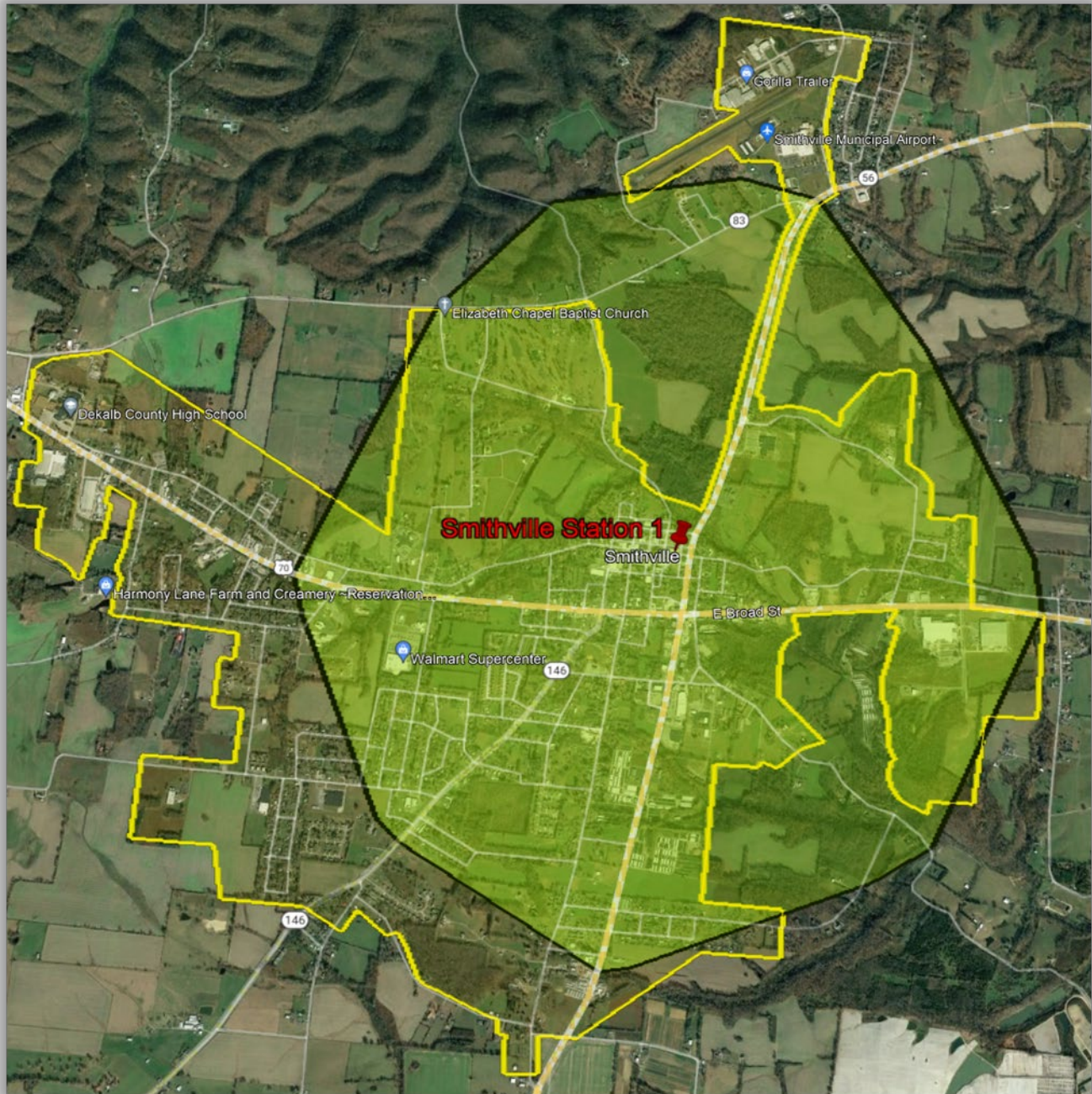


Figure 10-Smithville's Recommended 1-Station Primary Coverage

How Many Ladder Companies Does Smithville Need?

One can use the polygon model to determine the number of needed ladder trucks or service companies based upon ISO's maximum travel distance of 2.5-miles for a ladder or service company. The average size of a polygon for a ladder or service company is 12.5 square miles. Based upon a 6.0 square mile service area, a travel distance of 2.5-miles, and assuming the city limits are evenly distributed (which they are not) Smithville would need 1.0 ladder company right now.

A community needs a ladder company when it has at least five buildings that are three stories or more tall, five buildings more than thirty-two feet in height, a basic fire flow of 3,500 gallons per minute, or any combination of these conditions. Smithville has many buildings that meet these multiple criteria located throughout the city.

Based on accepted methods to determine proper ladder company distribution across a city and using existing station locations to reduce capital expenditures, to provide adequate ladder company coverage for the city, Smithville should have 1.0 ladder apparatus in front-line service. Currently, Smithville appears to have 1.0 credited ladder companies

The Department uses a quint apparatus, which is a combination apparatus that has the components/equipment of an engine apparatus and in addition it has components/equipment required for a ladder company. The use of quint apparatus is cost effective as the City receives up to full credit for an engine company and 0.50% credit for a ladder company when housed alone and earns up to 100% ladder credit if assigned to station with an engine as it is in Smithville.

Smithville has areas all around the city that have buildings that require a ladder company response. Smithville has one dedicated ladder company, Ladder 1. Figure 11 illustrates the current ladder company deployment with its corresponding 2.5-mile coverage areas. It is obvious that almost all areas of the city are located within the 2.5-mile response area of a ladder apparatus.

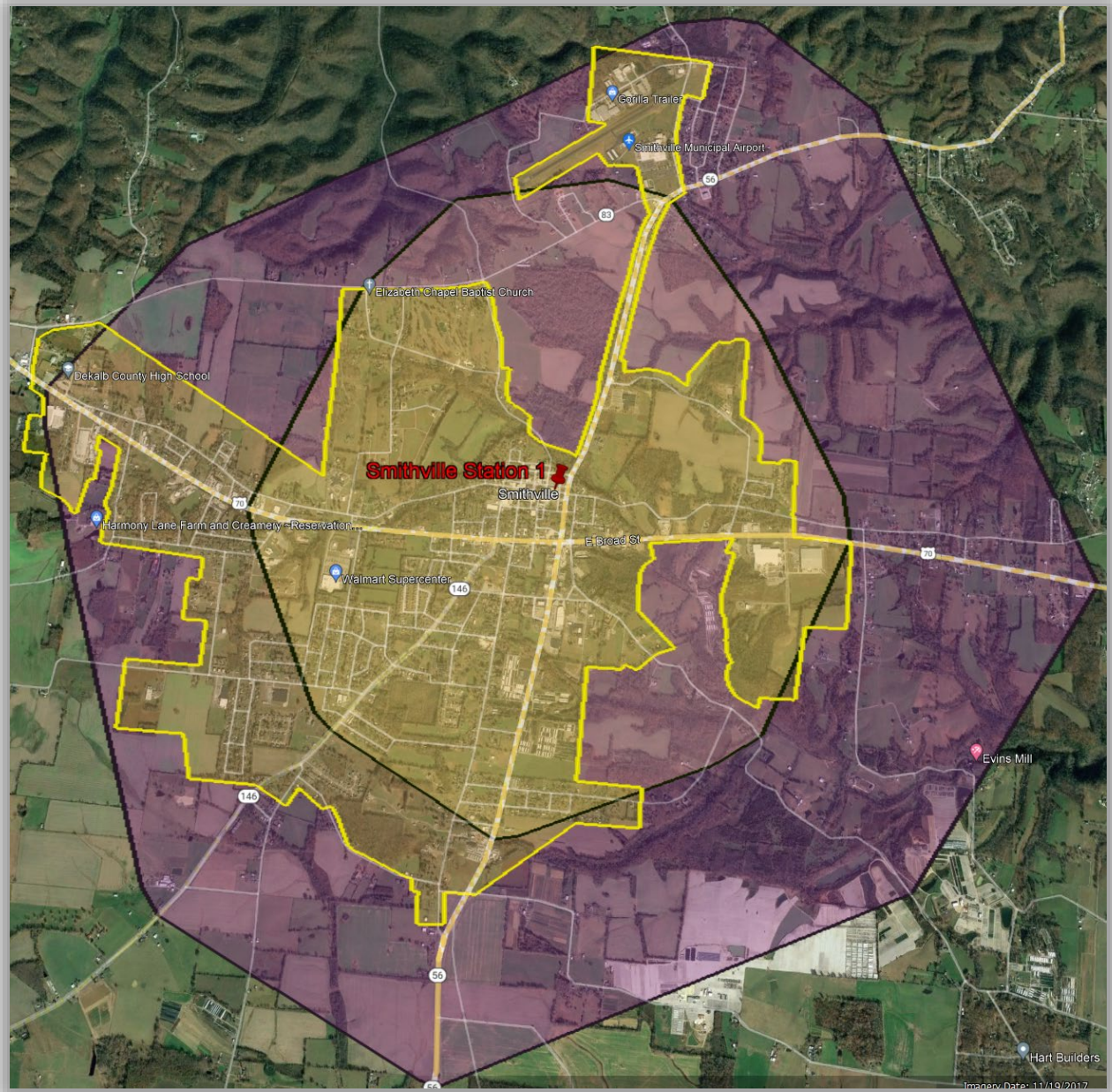


Figure 11- Existing Ladder Company Deployment

How Many Tender/Tanker Companies Does Smithville Need?

Smithville has what appears to be an adequate water system with an adequate number of fire hydrants located throughout the city. Smithville does provide aid outside the city which requires the needed fire flow water to be hauled to remote locations. The city does not own a water tender of its own but does have a relationship with DeKalb County to provide water tender operations for fire and emergency incidents outside the city limits of Smithville.

Smithville Fire Apparatus

Currently, Smithville Fire Department maintains a fleet of three engine apparatus, and aerial ladder apparatus, along with other response vehicles as front-line or reserve service. The scope of this study did not analyze the adequacy of each apparatus but only the apparatus age and deployment by type apparatus. A fire apparatus study can be completed as a separate UT MTAS project, or the department can self-audit its fleet to ensure compliance with the most recent edition of the National Fire Protection 1710 and 1901. Any apparatus identified as needing to be replaced should then be added to the City's capital equipment replacement plan.

An audit of Smithville's fire apparatus indicates that Engine 1 and Ladder 1 are well within their NFPA 1901 identified front-line lifespan. Engine 2 has exceeded its NFPA 1901 identified lifespan for front-line service. The city should plan to replace Engine 2 with a newer apparatus and put Engine 2 into reserve service.

NFPA 1710 Appendix D states: It is recommended that apparatus more than 15 years old that have been properly maintained and that are still in serviceable condition be placed in reserve status, be upgraded in accordance with NFPA 1912, and incorporate as many features as possible of the current fire apparatus standard (see Section D.3). This will ensure that, while the apparatus might not totally comply with the current editions of the automotive fire apparatus standards, many of the improvements and upgrades required by the current editions of the standards are available for the firefighters who use the apparatus.

Apparatus not manufactured to the applicable NFPA fire apparatus standards or that are over 25 years old should be replaced.

Figure 12- NFPA 1710 Reference

Smithville Company Staffing

Smithville Fire Department's current staffing strategy does not provide for a minimum staffing policy or practice for each company each day. The scope of this study only took into consideration the number of fire staff assigned for each company not the adequacy or training of that staff to provide needed services. A fire department staffing adequacy study can be completed as a separate UT MTAS project or the department can self-audit its staff to ensure adequate levels of training, competency, and credentialing are attained by appropriate staff. Department staffing should be provided to meet the needs of their critical tasking assignments. See Figure 13 and Figure 14 identifies the NFPA 1710 Staffing levels for an engine company and ladder company respectively. These standards also take into

consideration providing public safety fire services to high-hazard occupancies in the community.

5.2.3 Operating Units. Fire company staffing requirements shall be based on minimum levels necessary for safe, effective, and efficient emergency operations.

5.2.3.1 Fire companies whose primary functions are to pump and deliver water and perform basic fire fighting at fires, including search and rescue, shall be known as engine companies.

5.2.3.1.1 These companies shall be staffed with a minimum of four on-duty members.

5.2.3.1.2 In jurisdictions with a high number of incidents or geographical restrictions, as identified by the AHJ, these companies shall be staffed with a minimum of five on-duty members.

5.2.3.1.2.1 In jurisdictions with tactical hazards, high-hazard occupancies, or dense urban areas, as identified by the AHJ, these fire companies shall be staffed with a minimum of six on-duty members.

Figure 13-NFPA 1710 Engine Company Staffing

Smithville Fire Department’s staffing strategy assigns 1-firefighter during business hours Monday-Friday. There is no firefighter assigned to primary fire response apparatus (engine or quint) outside of business hours (nights and weekends). It was noted as a part of this study that the one firefighter Monday-Friday must switch between Engine 1 and Ladder 1 based on the emergency situation type.

5.2.3.2 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 known as ladder or truck companies.

5.2.3.2.1 These fire companies shall be staffed with a minimum of four on-duty members.

5.2.3.2.2 In jurisdictions with a high number of incidents or geographical restrictions, as identified by the AHJ, these fire companies shall be staffed with a minimum of five on-duty members.

5.2.3.2.2.1 In jurisdictions with tactical hazards, high-hazard occupancies, or dense urban areas, as identified by the AHJ, these fire companies shall be staffed with a minimum of six on-duty members.

Figure 14-NFPA Ladder/Service Company Staffing

Recommendation Implementation

To provide for firefighter safety, excellence in customer service, while helping to improve Smithville's Class 5/5X ISO Public Protection Classification, Smithville should consider the recommendations outlined in this study report and develop plans to implement each recommendation as soon as practical. The recommendations made, in this report, will require open mindedness at all levels of the organization and considerable resources so each must be planned for accordingly. Recommendations should be considered and planned for systematically to be achieved over time. It is almost always a good idea to develop plans with the objective to phase capital improvements and staffing strategies over multiple steps and fiscal budget years.

Summary

It is an honor and privilege to conduct this study for the City of Smithville. I am impressed with the caliber of men and women that serve every day as well as those that volunteer their time and talent to plan for and protect the citizens and visitors of the city. The City of Smithville currently has a Class 5/5X ISO Public Protection Classification rating. The Class 5/5X rating places the City in the bottom tier of communities nationwide and in the bottom half in Tennessee in terms of fire protection. Because of the Class 5/5X rating, residents and business owners should expect to live in a safer community while enjoying lower property

insurance rates. Growth has occurred without the accompanying growth in Fire Department resources. Smithville's existing fire station is strategically located to provide good coverage to meet ISO's fire station distribution requirements across the city. However, there are areas of Smithville that are geographically located outside the optimal response zone for the existing fire station. The city's leadership has not demonstrated a priority of firefighter safety by ensuring each fire company has a minimum staffing policy and practice. This minimum staffing policy should include a company officer assigned to each company.

Providing for an all-hazards fire department, especially one that provides the public safety fire services needed by the city is very complex. Smithville has many target hazards such as large facilities, schools, industry, airport, etc. spread throughout the city. There are large public events and gatherings in Smithville that present very real challenges for the fire department.

It is never advisable for a city to make significant changes to the organization or operation thereof to just maintain or chase after a better ISO Public Protection Class rating. What we find is that when departments have a practice of proactively planning and operating based on national standards, the firefighting forces are safer and work more efficiently meaning a sustained or improved ISO classification usually follows.

Based on the scope and findings of this study, Smithville should implement as many of the recommendations specified in this report as feasible. These actions will improve firefighter safety, provide for quick and efficient services to the public, and could serve to improve Smithville's Class 5/5X ISO rating. It is important to note that a worsening of the ISO by 1 classification could lead to an increase in insurance premiums for residents of one- and two-family dwellings; further, an improvement of the ISO by 1 classification could lead to a decrease in insurance premiums for residents of one- and two-family dwellings. It is estimated that a shift in ISO by 1 classification could result in a 2%-5% increase/decrease in homeowner insurance premiums. Based on data obtained from the Tennessee Comptroller's Office and insurance companies, it is estimated using a 5% constant that this could have an impact of approximately \$95,726.65 savings for an improved ISO or additional cost for a worsened ISO to the citizens annually. Over 5 years using this 5% constant, equates to approximately \$478,633.26 in financial impact (positive or negative) for your citizens. This impact could be even more with an improvement of more than 1-ISO Public Protection Rating improvement.

Recommendations

The following recommendations outline the most efficient and cost-effective ways for the City of Smithville to provide for an all-hazards fire department delivering the wide range of programs and services needed to address unique community risks and needs. Recommendations will focus on four components of the fire department: fire station locations, fire apparatus deployment, fire apparatus staffing, and proactive community risk reduction.

Response Time Standard: Adopt a response time standard for the community. Smithville Fire Department is a perpetual organization that will outlast current leaders, and this study looks at current and anticipated future needs. Once adopted, the response time standard will serve as a planning guide for future leaders. This study recommends a response time standard of 6:35 (six minutes, 35 seconds) for 90% of all responses, which is based upon recommendations found in NFPA Standard 1710, Standard for the Organization and Deployment of Fire Suppression Operations. The 6:35 breaks down as follows: ring time – 15 seconds, call processing time – 60 seconds, firefighter turnout time – 80 seconds, travel time – 240 seconds. Using this standard, planners would look for fire station locations to maintain a 4-minute travel time to as much of the area to be protected as possible.

Automatic Fire Sprinklers: Adopt the most current fire code to include the sections that require automatic fire sprinkler systems in new construction homes/businesses and consider incentives for owners that retrofit sprinkler systems in existing buildings. Utilize resources like the National Fire Sprinkler Association as a resource as you plan for this step. It is worth noting that buildings equipped with fire sprinkler systems are much safer and occupants are more likely to survive if a fire occurs. Also, when determining the basic fire flow for a community, ISO does not consider properties protected by a code compliant automatic fire sprinkler system. In a sprinkled building, the amount of time between the occurrence of a fire and reopening for business can be as little as a few hours or days versus months, years or even never rebuilding for a non-sprinkled building. This will help provide greater safety for the citizens/visitors to the community as well as help ensure a steady revenue stream for the city.

- Tennessee's fire mortality rate for civilians has been among the highest in the nation. During 2002-2010, the time period included in the Tennessee Fire Mortality Study, the national fire mortality rate declined, but the rate in Tennessee increased. Residential structure fires account for about three-fourths of all civilian fire deaths in the state. Residential fire sprinklers save money and lives and are a good investment in a home, but they are controversial in many communities which is why this study recommends research on residential sprinklers before considering adopting an ordinance. Adopting an ordinance would be proactive for community safety.

Fire Stations:

Current Stations: One fire station serves Smithville currently. This facility is located in a strategic location to serve the city. This is a great foundation to move the department forward utilizing the current fire station location. An audit must be completed for the fire station to ensure that the facility provides adequately for firefighter safety and health as well as gender friendly. Current and future fire stations must help ensure that firefighters have minimal exposure to carcinogens especially at the fire station.

Additional Stations: Smithville does not need to consider building an additional fire station at this time. For future planning, Smithville should acquire property near the high school complex for a future fire station location.

Fire Apparatus

Smithville had a fleet of apparatus and vehicles. The scope of this study did not analyze apparatus' equipment and maintenance, just apparatus age based on the standard identified by NFPA 1901 Appendix D.

Referring to Table 4, Engine 1 and Ladder 1 are within their NFPA identified front-line service lifespan. Engine 2 has exceeded its front-line NFPA lifespan but does have some life left as a reserve apparatus. Smithville should consider developing a capital equipment improvement plan whereas the city would plan for large expenditures like fire apparatus over time.

Engine 1	Engine	N/A	1,500	Pierce	2018	4	Frontline
Engine 2	Engine	N/A	1,250	Pierce	2001	21	Frontline
Ladder 1	Ladder	75'	1,750	Pierce	2012	10	Frontline

Table 4-NFPA 1710 Apparatus Lifespan Analysis

As the leadership of Smithville plans for their future, the city should consider assigning a quint apparatus and crew to a new station near the high school complex. The quint apparatus makes for efficient operations and quick access to the roof of larger buildings.

Operations Staffing

The scope of this study did not focus on staff training or certification. However, this study did analyze the number of full-time fire suppression firefighters there are to staff apparatus 24-hours per day. It was noted that there are only two full-time staff members during business hours Monday-Friday with a tremendous reliance on volunteer staff. The city must consider recruitment of additional full-time firefighting staff. As we review similar size, some larger,

some smaller, it is apparent that Smithville has not invested in its fire force as other cities have.

Using NFPA 1710 as a guide, the city must consider developing and implementing a strategy to move the department closer to meeting this staffing standard of 4-firefighters per company. Even though the city has not adopted this standard, should the department experience a tragic line-of-duty serious injury or death of a firefighter, their non-compliance of this standard will most likely be a finding in the investigation. Table 5 is a current comparison of similar size cities by population and their investment in fire services.

The city must consider recruitment of a full-time firefighting force. It is recommended to plan a phased implementation of this recruitment over the next 2-3 fiscal years with a goal to have a minimum of 4-full-time fire suppression staff per 24-hour shift with a deputy fire chief and a fire chief to lead the organization. This would bring the total full time to 14-members. This force will be augmented by volunteer/part-time staff.

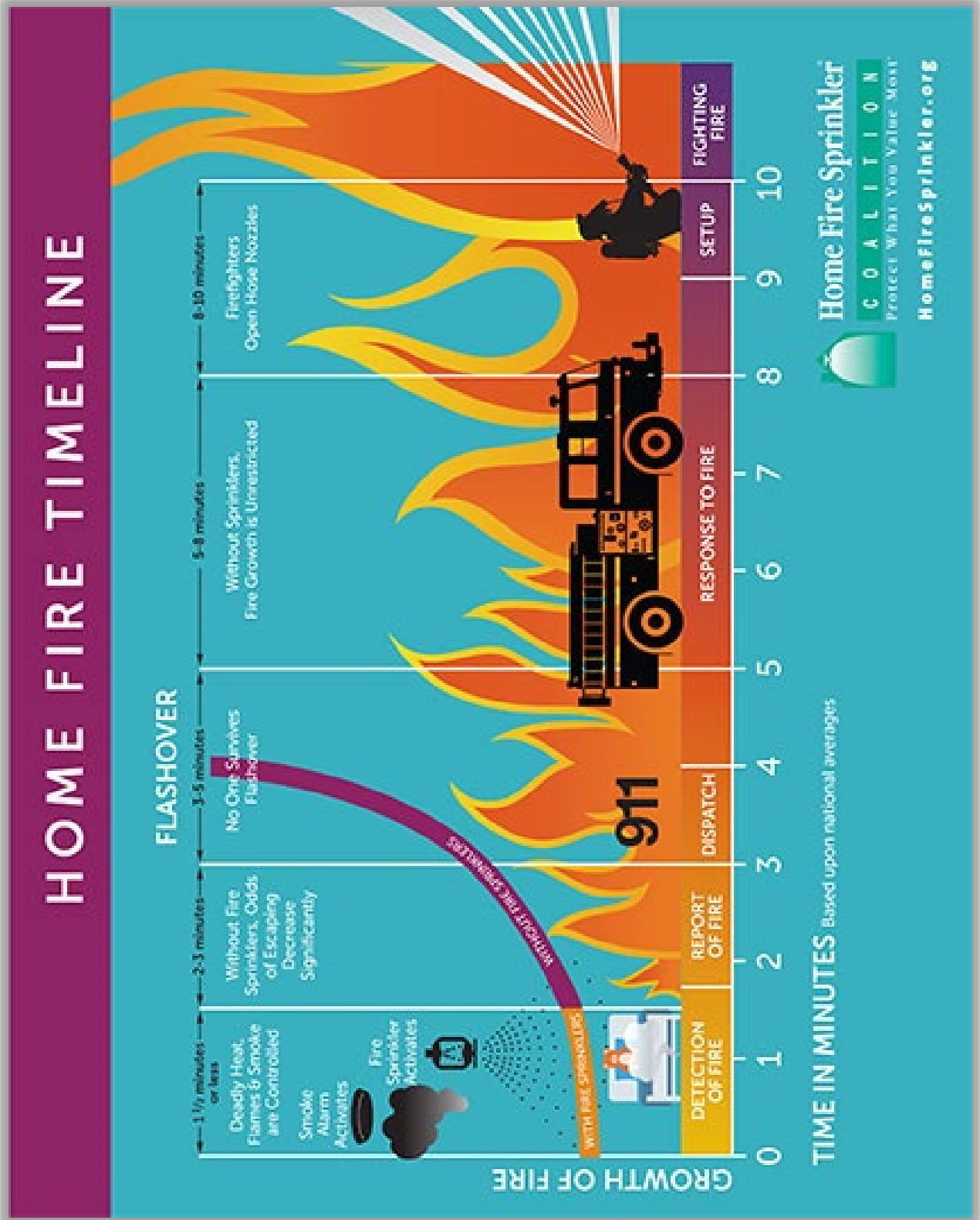
This additional staff will make it possible to add services like emergency medical response to the services offered by the department. This will bring great value to the department and save lives in the community. As you review Table 5, you can surmise that Smithville has considerably less full-time members per thousand citizens than other cities in Tennessee with similar population data.

City	TN Grand Division	Population	Type Fire Department	Fire Stations	Full-Time Employees	Part-Time / Volunteer Employees	ISO Classification
Ashland City	Middle	5,193	Combination	2	9	30	4
Bolivar	West	5,226	Combination	1	12	19	4/4x
Etowah	East	3,603	Combination	1	9	11	
Jonesborough	East	5,860	Public Safety	1	7	10 / Plus Police	5
Madisonville	West	5,132	Combination	1	4	40	4
Mount Pleasant	Middle	4,787	Combination	1	15		3/3x
Rockwood	East	5,444	Combination	1	13	16	4
Smithville	Middle	5,004	Combination	1	2		5/5X
Sparta	Middle	4,998	Combination	1	5	16	4
Trenton	West	4,240	Combination	1	15	10	5
Waverly	Middle	4,297	Public Safety	2	14	15	4

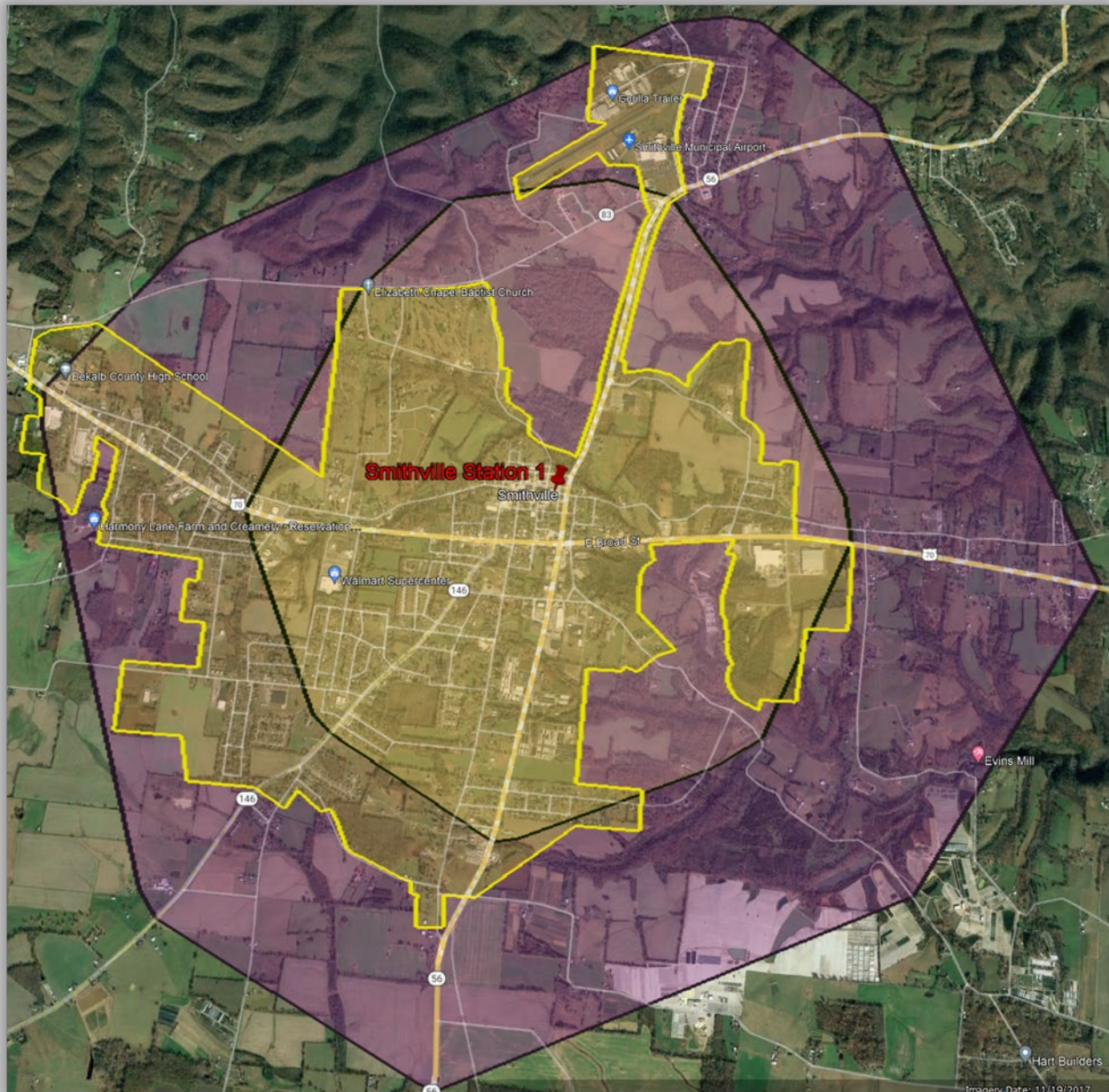
Table 5 -Fire Department Staffing Comparison

Appendixes

Appendix A-NFPA Home Fire Timeline



Appendix B-Engine Response Area Inner Polygon / Ladder Response Area Outer Polygon



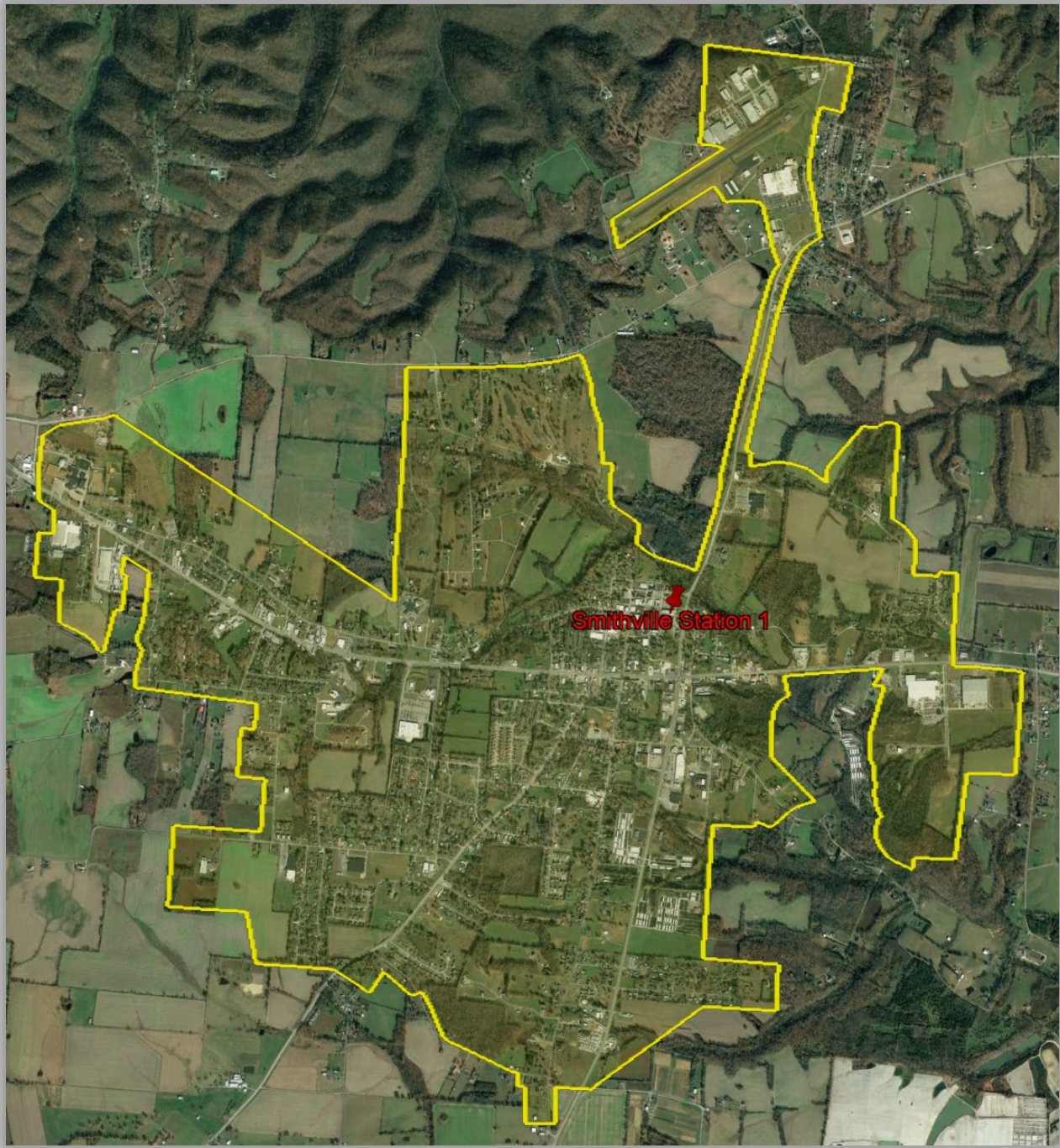
Appendix C-Estimated Response Time Chart

Distance To Travel in Miles	Estimated Travel Time	Ring Time	Call Processing Time	Fire Dept. Turnout Time	Total Response Time
0.25	1.08	0.25	1.00	1.33	3.66
0.38	1.30	0.25	1.00	1.33	3.88
0.50	1.50	0.25	1.00	1.33	4.08
0.75	1.93	0.25	1.00	1.33	4.51
1.00	2.35	0.25	1.00	1.33	4.93
1.25	2.78	0.25	1.00	1.33	5.36
1.50	3.20	0.25	1.00	1.33	5.78
1.75	3.63	0.25	1.00	1.33	6.21
2.00	4.05	0.25	1.00	1.33	6.63
2.25	4.48	0.25	1.00	1.33	7.06
2.50	4.90	0.25	1.00	1.33	7.48
2.75	5.33	0.25	1.00	1.33	7.91
3.00	5.75	0.25	1.00	1.33	8.33
3.25	6.18	0.25	1.00	1.33	8.76
3.50	6.60	0.25	1.00	1.33	9.18
3.75	7.03	0.25	1.00	1.33	9.61
4.00	7.45	0.25	1.00	1.33	10.03
4.25	7.88	0.25	1.00	1.33	10.46
4.50	8.30	0.25	1.00	1.33	10.88
4.75	8.73	0.25	1.00	1.33	11.31
5.00	9.15	0.25	1.00	1.33	11.73
5.25	9.58	0.25	1.00	1.33	12.16
5.50	10.00	0.25	1.00	1.33	12.58
5.75	10.43	0.25	1.00	1.33	13.01
6.00	10.85	0.25	1.00	1.33	13.43
6.25	11.28	0.25	1.00	1.33	13.86
6.50	11.70	0.25	1.00	1.33	14.28
6.75	12.13	0.25	1.00	1.33	14.71
7.00	12.55	0.25	1.00	1.33	15.13

Notes:

- Travel time was calculated using the Rand formula of $T = 1.7(D) + 0.65$ to estimate travel time, where “T” is time and “D” is the distance to be covered expressed in miles.
- The 15-second ring time, 60-second call processing time, and 80-second turnout time are based on recommendations found in NFPA Standard 1710.
- Minutes expressed as decimal minutes: to compute seconds, multiply the number to the right of the decimal number by 0.60. For example, 3.66 decimal minutes equals 3:40 (3-minutes, 40-seconds).

Appendix D-Smithville City Limits / Fire Station Location



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Municipal Technical Advisory Service
INSTITUTE *for* PUBLIC SERVICE