



MUNICIPAL TECHNICAL
ADVISORY SERVICE

SPARTA, TENNESSEE

Fire Management Study

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Table of Contents

Table of Contents	1
List of Tables	1
List of Figures	2
Introduction and Scope of Work	3
Background	3
Community Risk – General Overview	4
Fire Department Overview	7
Future Needs	20
Funding for fire services	23
Minimum full time staffing levels	23
Volunteer recruitment and retention	26
Equipment	27
The need to replace apparatus	28
Appendix A – Structure Fire First-Alarm Personnel Response	33
Appendix B – Unit 410 Tools and Equipment Inventory	34
Appendix C – Hydrant Flow Data Summary from 08/12/97	35
Appendix D – Repair Estimate for Unit 407	36
References	37

List of Tables

Table 1 – Sparta Fire Department Stations and Apparatus	3
Table 2 – Zoning Classifications	5
Table 3 – Ten Highest Basic Fire Flows	6
Table 4 – Major Employers	6
Table 5 – Total Emergency Responses for 2010	15
Table 6 – Distribution of Emergency Responses by Month	16
Table 7 – Dollar Loss to Fire for the Past Three Years	16
Table 8 – Typical Initial Attack Response Capability	21
Table 9 – Sparta Fire Department Responses Per Station – 2011	24

List of Figures

Figure 1 – Public Protection Classification (ISO Rating) in Tennessee	4
Figure 2 – 1½ Mile Response Zones of Sparta Fire Stations	8
Figure 3 – 2½ Mile Response Zone of Sparta Ladder Truck	9
Figure 4 – Central Service Area (North Spring Street – Station 1)	10
Figure 5 – East Service Area (East Bockman Way – Station 2)	11
Figure 6 – Central Service Area (Polk Street – Station 3)	12
Figure 7 – Sparta Fire Department Training/Burn Building Front Side	18
Figure 8 – Sparta Fire Department Training/Burn Building Rear Side	18
Figure 9 – Generalized Flashover Curve	22
Figure 10 – Percent of Responses by Station – All Responses	25
Figure 11 – Percent of Responses by Station – Aircraft Standby Removed	25

Introduction and Scope of Work

This study was conducted at the request of Kirk Young, Fire Chief for the City of Sparta. The study's purpose is to review the capabilities of the Sparta Fire Department and make recommendations for improvement where possible. A written request to MTAS from Fire Chief Kirk Young authorized MTAS to conduct an official fire department study.

Background

The City of Sparta is located in White County in Middle Tennessee on the Highland Rim 15 miles south of Cookeville and is the county seat for White County. Sparta has a population of 4,925 per the 2011 census and covers 6.73 square miles.

Sparta is governed by a Mayor-Alderman form of government where the seven-member elected city council enacts legislation and sets policy and the city manager oversees all operational activities.

Fire protection is a local policy issue, and a community must balance local resources against acceptable risk. The City of Sparta has chosen to provide fire services as a city function through a municipal fire department established in Section 7 of the City Charter. The Sparta Fire Department is a combination fire department recognized by the State of Tennessee. There are 6 paid fire personnel, which includes the fire chief, and approximately 19 volunteers, of which about half are very active. The fire department operates 3 engine companies and one aerial ladder truck from 3 fire stations. Staffing levels on engines are minimal, with usually just one paid firefighter, as the majority of the fire department members are volunteers.

Sparta Fire Department Stations		
District	Equipment	Address
1	Engine 413, 1,250 gpm pump Ladder 1, 100' aerial	715 North Spring Street
2	Engine 407, 1,000 gpm pump	303 East Bockman Way
3	Engine 409, 1,250 gpm pump	513 Polk Street

Table 1 – Sparta Fire Department Stations and Apparatus

Because of the efforts of the city and the fire department, Sparta residents and business owners enjoy an Insurance Services Office (ISO) Public Protection Classification of 5, which it received on February 1, 1998. This places Sparta in the top 30% of communities in Tennessee (see Figure 1) in terms of fire protection and indicates that Sparta has made good decisions in planning for community fire protection.

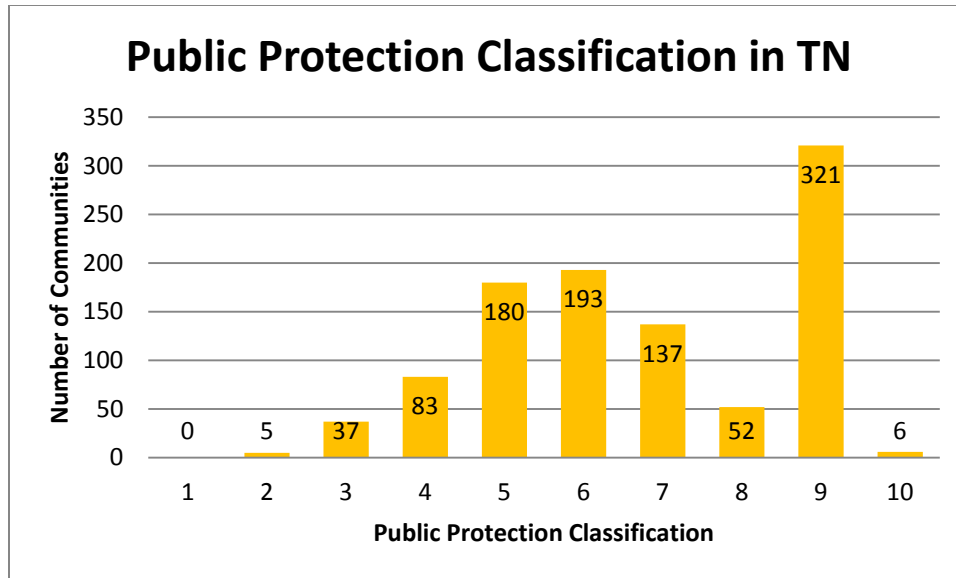


Figure 1 – Public Protection Classification (ISO Rating) in Tennessee

The White County E-911 Emergency Communications Center receives calls for emergency fire and medical services for locations inside Sparta’s corporate limits and dispatches the appropriate emergency resources.

Water for public consumption and fire suppression is provided by the City of Sparta. The water plant capacity is 4.5 MGD, average consumption is 2.7 MGD, and storage capacity is more than 3.5 million gallons. The water pressure and the gallons-per-minute fire flows needed for fire suppression operations are not adequate to protect many of the properties at risk (see Appendix C).

Chief Young has been creative with resources, getting things fixed and repaired by reusing materials where possible, such as the floor tiles when renovating the two older fire stations, using county inmate labor to assist with station maintenance, and using volunteers with building trade skills, etc., for station repair and maintenance. One example of a significant cost savings was the use of volunteers to bring the fire department radio system into compliance with FCC narrow banding requirements, and to reprogram the radios with statewide mutual aid frequencies. This creativity and involvement of volunteers saves money and builds ownership and pride in the fire department.

Community Risk – General Overview

Sparta covers 6.73 square miles and has a population of 5,000 people per a 2009 census estimate. The city’s urban growth boundary is 29.4 square miles, so Sparta has a lot of room to grow with 22.67 square miles available for annexation.

Sparta and White County are part of the largest micropolitan area in Tennessee and participants in a regional economic and community development program called the Highlands Initiative, which includes Putnam and Overton counties. This is a long-range strategic plan to assist in expanding existing business and industry and to draw new companies to the area. According to Sperling’s Best Places in America, the future job growth for Sparta over the next ten years is predicted to be 31.5%. When the economy improves, Sparta can expect to see an increase in business, industry and residential development with the associated growth in jobs and the need for emergency and essential services from the fire department.

Approximately 59.88% of the land in Sparta is zoned residential, with the remaining land area zoned as commercial (31.5%) and industrial (8.62%) (see Table 2).

ZONING CLASSIFICATIONS	Acres	Sq. Miles	Percent
C-A – Offices, Light Commercial	32	0.05	0.74%
C-B – Mid-range Commercial (Restaurants, etc.)	6.4	0.01	0.15%
C-C – Downtown Commercial, no off-street parking	19.2	0.03	0.45%
C-D – Open Commercial	1,299.20	2.03	30.16%
M-I – Manufacturing, Industrial	371.2	0.58	8.62%
R-A – Single Family Residential	2,265.60	3.54	52.60%
R-B – Multi-family Residential, some Single Family	313.6	0.49	7.28%
TOTALS	4,307.20	6.73	100.00%
Table 2 – Zoning Classifications			

Two major transportation routes serve Sparta: US Highway 70 and State Highway 111. There are no major geographic barriers affecting the flow of traffic within the city. Sparta is about a 90 minute drive from three major cities. Nashville is located approximately 95 miles to the west on I-40, Knoxville is located approximately 98 miles to the east on I-40, and Chattanooga is located approximately 80 miles to the south on Highway 111.

Manufacturing is the largest segment of Sparta’s economy (see Table 4 for major employers), followed by retail sales. In addition to the industrial occupancies, commercial occupancies include mostly retail and business uses that are distributed throughout the community. A community’s basic fire flow is determined by the fifth highest fire flow required in the community, and for Sparta that is 4,500 gallons-per-minute (see Table 3). However, ISO sets the maximum basic fire flow needed for a community at 3,500 gpm, and since Sparta’s fifth highest flow exceeds that, the basic fire flow is 3,500 gpm. Because of the basic fire flow, Sparta needs a minimum of three first-out fire engines. The water system should be capable of supplying enough water to meet the community’s domestic and fire protection needs, and the fire department should be capable of delivering the water effectively to suppress fires. Properties protected by automatic sprinkler systems, such as Hillsman Modular Molding and THK

Rhythm, are not considered when determining the needed fire flow for a given community.

Building	Needed Fire Flow
Sparta Tobacco Warehouse Co.	9,000
Savage Building Center	5,000
Farmers Tobacco Warehouse	5,000
Howell Parker	5,000
Unaka Co. Inc.	4,500
Honeywell	4,000
River States	4,000
PDR 173 Mose Dr	3,500
William Sorrell Sr	3,000
River States	3,000
Table 3 – Ten Highest Basic Fire Flows	

Sparta has several buildings that are either three or more stories in height or measure at least 35 feet to the eave. Sparta has numerous buildings that have a needed fire flow that exceeds 3,500 gpm. These buildings present a significant fire protection risk to the community in that loss of the building would have negative impacts on the local community and economy. The city should plan to protect these community assets by providing the Sparta Fire Department with sufficient resources for response, by requiring built-in fire protection through local fire codes, and by on-going property maintenance and upkeep through fire code compliance inspections.

Firm	Product	No of Employees
BASF	Plastic pellets	125
Casual Apparel	Military garments/sportswear	60
Federal Mogul Lighting	Mini incandescent lamps	229
Moeller Marine Products	Rotational molding, tanks, seats	253
Rhythm North America	Automotive parts	154
Tri-State Distribution, Inc.	Prescription vials	200
Table 4 – Major Employers		

Sparta offers an attractive residential community with aesthetic design, has sufficient undeveloped land (approximately 22.67 square miles) for planned residential and commercial growth, and is located next to the major transportation routes of US Highway 70 and State Highway 111 and is just 16 miles from I-40 making for convenient access.

Fire Department Overview

The Sparta Fire Department is organized under Chapter 3, Sections 7-301 through 7-331 of the city charter and is a recognized fire department by the state fire marshal's office. The fire chief is established as a department head in city government and Sections 7-309 and 7-313, among others, give the fire chief the authority to lead and manage the department and fire protection for the community. The department reports to the Tennessee Fire Incident Reporting System (TFIRS) and maintains good records of responses and activities. The department has a code of ethics to guide the actions and decision making processes of its members. Job descriptions for all positions are found in the Sparta municipal code.

The city is served by three fire stations strategically located so as to provide adequate distribution of fire apparatus over the 6.34 square miles of the city and to keep response times low (see Figures 2 through 6). Since Sparta is a mostly volunteer department, not all stations are staffed 24/7. This means that while more than 85% of the community is within 1½ road miles of a fire station, there may be a delayed response, or even no response, from a given station at any given time and a response time that does not correlate to the coverage provided by having three fire stations.

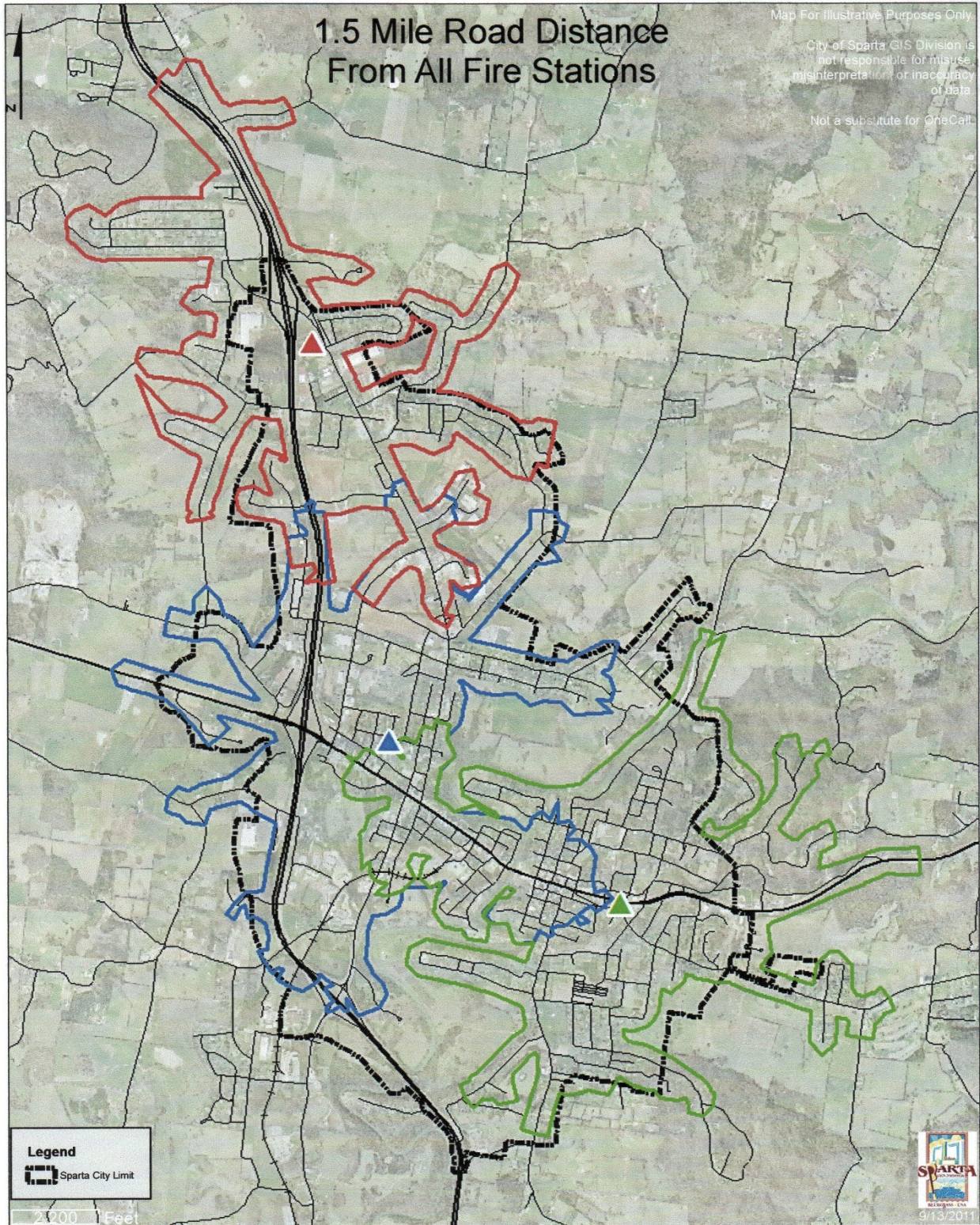


Figure 2 – 1½ Mile Response Zones of Sparta Fire Stations

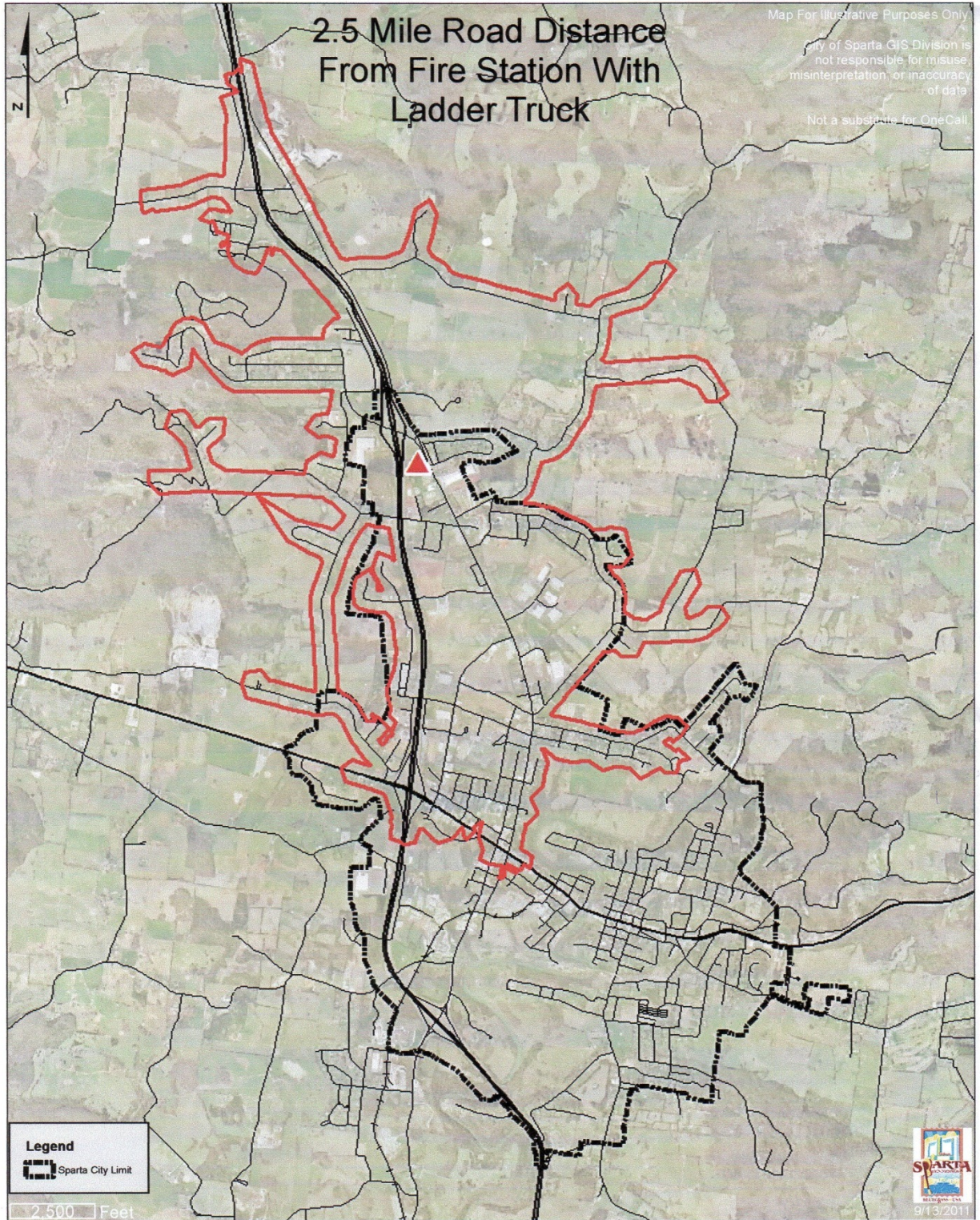


Figure 3 – 2½ Mile Response Zone of Sparta Ladder Truck

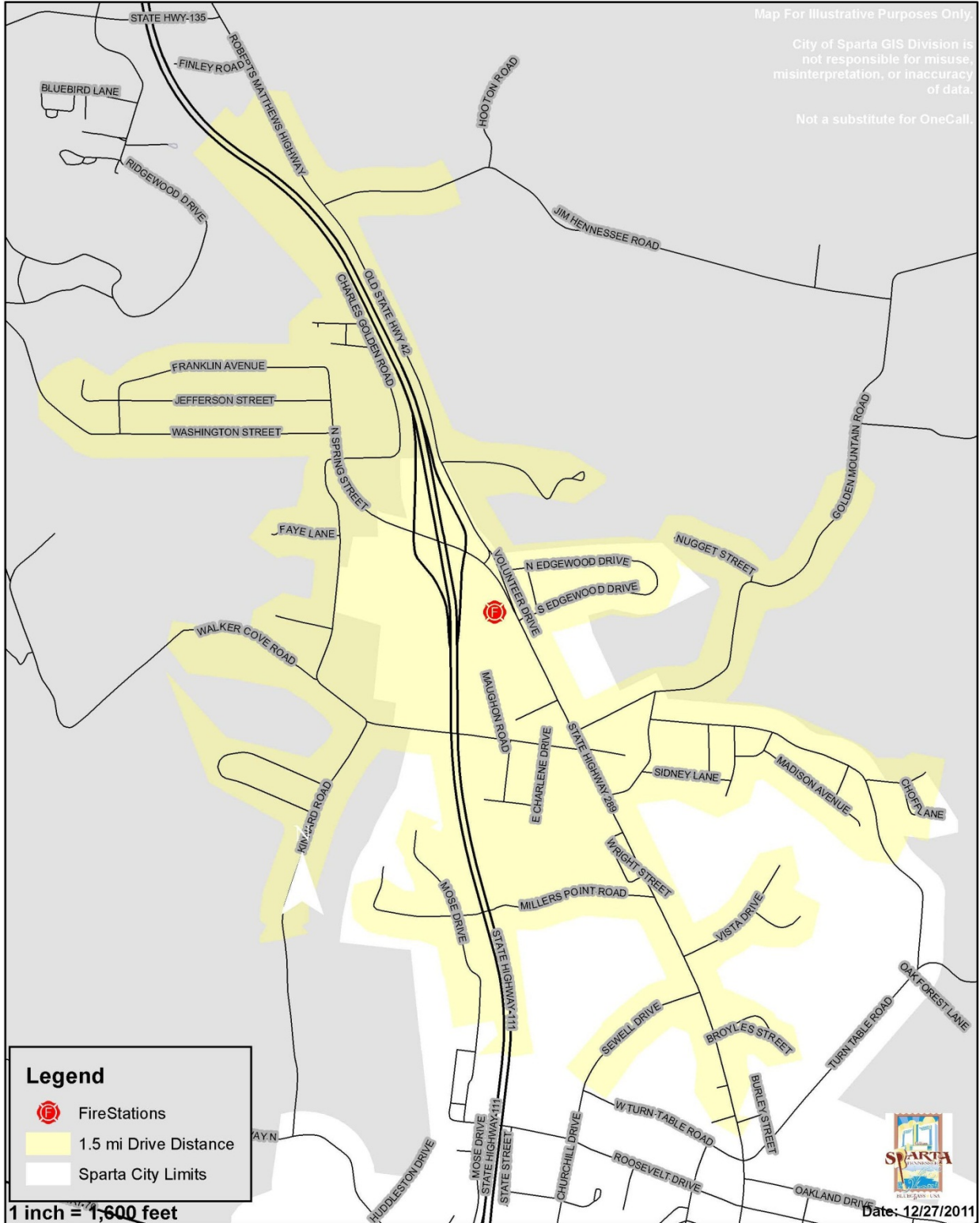


Figure 4 – Central Service Area (North Spring Street – Station 1)

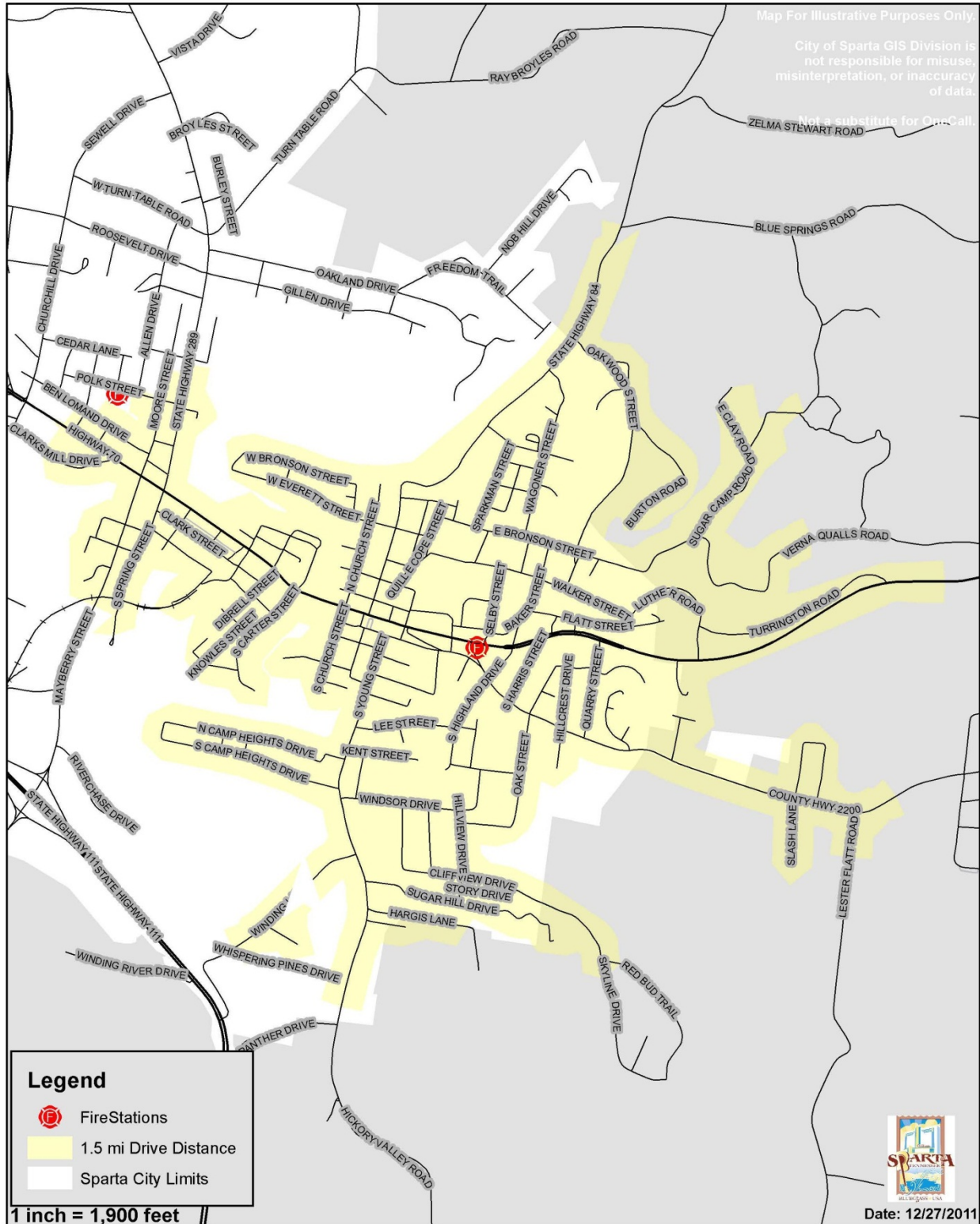


Figure 5 – East Service Area (East Bockman Way – Station 2)

The department operates three first out engines and one first out aerial ladder truck. The age of the fire engines, oldest to newest, is 23 years (1989), 11 years (2000), and 10 years (2001), with the aerial ladder truck being 33 years old (1978). The department does not have any reserve fire engines. ISO requires at least one reserve fire engine for every eight, or fraction thereof, required first out engines.

Staffing is primarily volunteer, though the department does maintain minimal paid staffing levels 24/7. The five paid firefighters work 24/72 shifts, which means there are 4 platoons (A, B, C and D) that rotate work days, with one platoon being on-duty for 24 hours and off duty for 72 hours. Having five paid personnel allows for one paid firefighter to be on-duty 24/7. Though the fifth person is there to provide relief for vacation, sick leave, training, and other absences, the fire chief occasionally works a shift to maintain minimum staffing levels (the fire chief worked two shifts in 2011).

The department has a comprehensive standard operating procedures (SOP) manual that covers policies and procedures regarding the operation of the department, emergency response practices, training, safety, apparatus and equipment maintenance, daily station duties, etc. The rules, policies and procedures were formally adopted by the Sparta Board of Mayor and Aldermen via Resolution 90-M on August 16, 1990. Every member is issued a copy of the SOP manual and is expected to learn and follow the rules, regulations, and policies. The department has a respiratory protection program that complies with OSHA/TOSHA regulations. The department participates in the state firefighter certification program through the Tennessee Commission on Firefighting and Personnel Standards and Education.

The department has mutual aid agreements with surrounding departments to provide for manpower and other assistance on large incidents that exceed local resources.

As a department of the Sparta municipal government, the department's annual operating costs are funded from the city's general fund. The annual operating budget is approximately \$384,700. Sparta has a 10-year plan for infrastructure replacement, but the city does not project any fire apparatus replacements in the 10-year plan. The department has three pumpers manufactured in 1989, 2001, and 2002, and an aerial truck manufactured in 1978. The maintenance shop evaluated Engine 407, the 1989 engine, recently for a serious mechanical issue. The report estimated the repair cost between \$15,000 and \$18,000. Because of the age of the truck, certain parts are no longer available, and the repair estimate exceeds the value of the truck. If repaired, the pumper will be prone to further breakdowns and continual problems finding repair parts. The truck is 23 years old, and NFPA recommends apparatus that is 15 years or older be used as a reserve, and recommends removing apparatus from service when they reach 25 years of age. This study recommends that Sparta replace the 1989 Mack with a new pumper.

The city has adopted by reference and with amendments the 2003 edition of the International Fire Code. This code is no longer valid as it is more than 7 years older than the most current published edition of the model code adopted by the State of

Tennessee. The most current published edition is the 2012 edition, so a code that is no older than a 2005 edition should be adopted.

In addition to the emergency response services of fire suppression, emergency medical first responder services, vehicle extrication, and high angle rescue, the Sparta Fire Department provides other essential services to the community including fire inspections and code enforcement, fire and arson investigation, pre-incident fire planning, public education, the distribution and installation of smoke detectors, and standbys at special events.

The fire department has a comprehensive policy manual with rules and regulations addressing employee safety on the fire ground and in the station. The department uses the National Integrated Management System Incident Command System, follows OSHA's 2-in/2-out policy, and uses a personal accountability system on the fire ground. Portable radios are available, but the inventory is not sufficient to provide a portable radio for every firefighter entering a hazardous area. All first out apparatus have thermal imaging cameras. Housekeeping practices in the fire stations are good, and adequate storage facilities are available. Flammable and combustible liquids are not stored in the fire stations. Carbon monoxide is a safety and health issue for firefighters, and the fire stations need carbon monoxide warning signs. The department should consider installing a vehicle exhaust system in each station, and Assistance to Firefighters (AFG) grant funds may be available to assist with the cost of the systems.

Within the last three years, the fire department has had no reports of infectious disease exposure, hazardous materials or chemical exposure, or firefighter injuries, though the fire department does not maintain employee medical surveillance and exposure to hazardous materials records in accordance with OSHA regulation 29CFR1910.120.

The city and the fire department have written job descriptions for all fire department positions and a written recruitment and selection policy. The city conducts background checks on all new firefighters and verifies annually that all personnel who drive fire department vehicles have a valid driver's license. City policy requires immediate drug screening/testing for drivers involved in an accident while driving fire department vehicles or apparatus.

The department participates in the firefighter certification program administered by the Tennessee Commission on Firefighting and Personnel Standards. The fire chief has been appointed an Assistant to the Commissioner of Commerce and Insurance which provides the authority to enforce the fire code and state laws and regulations. The fire chief has completed the fire chief orientation class required by TCA 68-102-108(c).

The department participates in the Tennessee Fire Incident Reporting System (TFIRS) program as required by TCA and maintains response records. The average response time is 5.24 minutes, and the department arrives on the scene within six minutes, thirty-five seconds on 76% of responses.

The normal first alarm response assignment is two engines, one ladder, one chief, and one service van. The department does not have minimum staffing requirements per apparatus or shift, which is not unusual for a mostly volunteer fire department. The annual call volume is 231 runs, with the major number of calls being resolving a hazardous condition (40.26%), but with fire responses being the most labor intensive, averaging 11.83 person-hours per incident (See Table 5). The average number of responses per month is 19.33 (see Table 6). Of the 29 fire responses, there were 16 structure fires (83.33% of all fires), 7 vehicle fires (8.33% of all fires), and 6 brush/grass/trash fires (8.33% of all fires). The average number of suppression personnel on the scene of a structure fire (TFIRS Code 111) was 8.7, and NFPA recommends no fewer than 18 personnel total on a low-hazard incident such as a single-family dwelling fire. See Appendix A for the listing of the most recent 20 structure fire (TFIRS code 111) responses.

TFIRS Series Code	Description	Number of Responses	Percent of Total Responses	Total Person-hours All Incidents	Average Person-hours Per Incident
100	Fire	29	12.55%	343.07	11.83
200	Overpressure Rupture, Explosion, Overheat (No Ensuing Fire)	0	0.00%	0	0.00
300	Rescue and Emergency Medical Service (EMS) Incidents	26	11.26%	36.5	1.40
400	Hazardous Condition (No Fire)	93	40.26%	444.1	4.78
500	Service Call	6	2.60%	28.83	4.81
600	Good Intent Call	42	18.18%	32.63	0.78
700	False Alarm & False Call	32	13.85%	61.21	1.91
800	Severe Weather & Natural Disaster	2	0.87%	18.4	9.20
900	Special Incident Type	1	0.43%	2.2	2.20
	TOTAL	231	100.00%	966.94	4.19

Table 5 – Total Emergency Responses for 2010

Call distribution averages 19.33 calls per month, as shown in Table 6.

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Mean	Median	Mode
21	12	15	17	12	18	11	24	29	35	15	23	19.33	17.50	12
Table 6 – Distribution of Emergency Responses by Month														

The total fire loss for the past three years is shown in Table 7. The fire department investigates all fires, and they have identified the cause on 31.25% of structure fires in 2010. These four fires were responsible for 56.57% (\$358,250) of the fire loss. The cause on the remaining eleven fires and \$316,200 of loss is listed as unknown.

Year	Fire Loss in Dollars	Total Number of Fire Incidents	Average Loss per Fire Incident
2010	\$676,450	29	\$23,326
2009	\$89,685	29	\$3,093
2008	\$169,750	35	\$4,850
Table 7 – Dollar Loss to Fire for the Past Three Years			

The fire department operates apparatus that met NFPA standards at the time of manufacture. The oldest apparatus is the 1978 Seagraves ladder truck. The department has three engines, a 2002 Pierce, a 2001 Pierce, and a 1989 Mack. NFPA 1901 Annex D recommends that apparatus that is more than 15 years old be placed in reserve service, and apparatus that is more than 25 years old be replaced. The Seagraves ladder truck is 33 years old, and the Mack pumper is 22 years old. As mentioned earlier, Sparta should replace the Mack pumper now because of serious mechanical issues.

The department performs an annual pump test to NFPA Standard 1911 requirements on all pumpers and tests all fire hose annually to NFPA Standard 1962 requirements. The aerial ladder is tested annually to NFPA Standard 1911, and all ground ladders are tested annually to NFPA Standard 1932.

All personal protective equipment (PPE or turnouts) used by the fire department met NFPA and OSHA standards in effect at the time of manufacture. The department has and enforces a policy requiring the proper wearing and use of PPE. The department does not have a policy for the regular inspection and maintenance of PPE, but all PPE found to be damaged or defective is removed immediately from service and repaired or replaced as appropriate. The department has a replacement schedule for PPE, replacing six sets per year. Per NFPA Standard 1871, all PPE that is more than 10 years old from the date of manufacture should be retired from service.

The department uses self-contained breathing apparatus (SCBA) that meet NFPA standards. All personnel are fit tested annually as required by OSHA 1910.134 and appropriate records are maintained. The department has its own breathing air compressor to refill SCBA cylinders, and the air produced by the compressor is tested quarterly to insure that it is safe to breathe.

The fire department does not have a policy and practice in place to inspect hand tools and equipment on a regular basis and to repair or replace them as appropriate.

The main fire station has an automatic start backup generator; the other two stations do not. Since the stations that do not have automatic start generators are primarily volunteer staffed stations, this is not an immediate need. Fire stations are critical infrastructure facilities for a community, and Sparta should plan and budget for generators for these stations as funds allow.

The fire department has a dedicated training officer and a training program. Regular training sessions are held on the second and fourth Mondays of each month. Sparta firefighters completed a total of 614 hours of training in 2010. The department conducts training drills of at least 3 hours duration that include multi-company drills and night drills as required by ISO. The department does not train at least four times per year with mutual aid departments. The fire department has a homemade training tower and burn building (see Figures 7 and 8), but the safety and structural stability of the building is questionable. The former chief installed the structure, which consists of shipping containers welded together, without the benefit of engineering design or plans review. The footings may not be below the frost line. The structure is not anchored properly: it rests on poured concrete footings. This structure is not just an accident waiting to happen, it is a lawsuit waiting to happen should someone get hurt using the structure or the structure topple in a high wind since it is not properly anchored. MTAS recommends that the structure not be used for any purpose and that it be removed to prevent any possibility of injury.



Figure 7 – Sparta Fire Department Training/Burn Building Front Side



Figure 8 – Sparta Fire Department Training/Burn Building Rear Side

The fire department has access to the training facilities at the Tennessee Fire and Codes Academy in Bell Buckle, which is approximately 96 miles from Sparta. While Sparta can use the academy facilities, it is logistically impractical to do so to conduct local training drills, so no ISO credit is available for the academy drill tower. With the shipping containers removed, it is possible to build a three-story wooden drill tower behind Station 1, which would provide some training credit for a drill tower. The department has a comprehensive training library that meets all ISO recommendations. The recruit training program is 86 hours in length and includes the 22 hour live burn program and meets state standards, and all firefighters are trained to this level. Seven firefighters are Firefighter II certified by the Tennessee Commission on Firefighting and Personnel Standards. Approximately 46% of fire department members have some level of EMS certification. Five are licensed paramedics, three are licensed EMT-IVs, and four are certified first responders.

The fire department conducts semi-annual pre-fire planning inspections of all 387 commercial, industrial, religious, education, and multi-family occupancies in Sparta. ISO gives significant training credit for pre-fire planning if all firefighters participate in the inspections and/or train on the pre-plans semi-annually and document that training, and all firefighters train on the pre-plans semi-annually.

The city maintenance division maintains the fire apparatus and keeps maintenance records. The fire department is taking bids for the repair, maintenance and inspection of fire apparatus from an outside maintenance vendor. The department should have a formal capital improvements program for the planned replacement of fire apparatus. NFPA recommends that apparatus still in good condition be relegated to reserve service upon reaching 15 years of age, and be retired from emergency response service upon reaching 25 years of age. The city should develop an apparatus replacement program to allow for budgeting and replacing apparatus following NFPA guidelines.

When ISO visited Sparta in 1997, the field agent witnessed 14 fire flows. Of those 14 fire flows, 13 were deficient in that the water system could not supply enough water for the given hazard. Water supply counts for 40% of the evaluation of a community's fire protection classification. The fire department has indicated that the city cannot determine the fire flow capabilities of the water system regarding the water needed for fire suppression activities. Sparta has a significant industrial community, and industry presents a fire risk that exceeds the risk found in residential and light commercial occupancies. Sparta has a high number of needed fire flows that equal or exceed 3,000 gpm (see Table 3), and providing adequate fire protection for these high risk occupancies is important. The water system is not capable of supplying adequate fire flows to some of these risks. A fire loss in a company with a large taxable value would negatively affect Sparta's economy. If the loss was severe enough, the company might not recover and local jobs would be lost.

The water department flushes and conducts annual inspections of 100% of the fire hydrants in the community. For maximum credit under the ISO fire suppression rating schedule, the fire hydrants should be inspected and tested semi-annually to American

Water Works Association (AWWA) Standard M17 or NFPA Standard 25 and adequate inspection records should be maintained. All of the fire hydrants open and close in the same direction, but about 5% of the fire hydrants have a non-standard operating nut. Only 87% of the fire hydrants have a 4" or larger pumper connection and two 2½" hose connections. For maximum credit under ISO, all hydrants should have standard size operating nuts, a 4" or larger pumper connection, two 2½" hose connections, and a six-inch minimum branch connection.

Future Needs

The community is protected by the Sparta Fire Department, a mostly volunteer combination department with fire dispatching resources provided by the White County E-911 Emergency Communications Center. In the event of a major fire or large incident, additional engine companies and resources are available from neighboring fire departments through mutual aid. While mutual aid is beneficial, mutual aid companies have long response times and cannot be counted on to be part of the initial response.

To help attract and retain commercial and corporate development, Sparta will need to offer the service of good fire protection. Sparta has an adequate number of fire stations under the ISO fire suppression rating schedule, but is not able to respond with a sufficient number of personnel to structure fires to provide an efficient and effective fire suppression effort.

Firefighting is very labor intensive, and extremes of heat and cold affect a firefighter's ability to perform strenuous work over long periods of time. Many tasks must be performed on the fire ground, including search and rescue, protecting exposures, forcible entry, ventilation, control of utilities, water supply, applying water through hose lines, salvage, and overhaul, in addition to complying with the OSHA regulation (known as 2-in, 2-out) requiring a rapid intervention team. In reviewing the number of personnel that responded to the twenty most recent structure fires, the fire department was able to respond a maximum of sixteen firefighters to one incident and as few as three firefighters to another incident, with an average number of responding personnel being 9.2, which includes the chief officer. A chief officer should respond to every incident, but ISO does not count that chief officer as one of the firefighters needed under the grading schedule. This means that ISO would give credit for an average of 8.2 firefighters per structure fire. Volunteer response averaged 4.85 firefighters per structure fire, with maximum response being 10 volunteers, and on one structure fire only 1 volunteer responded.

The level of fire protection provided in a community is a local policy decision balancing local risk against available resources. There is considerable debate about the minimum number of firefighters needed on an engine company, but there is a general consensus throughout the fire service that a minimum of 18 firefighters should be on the fire ground on the first alarm to provide a safe and effective firefighting effort or the risk for injuries or fatalities increases, flame spread increases, and property loss increases. NFPA recommends a minimum first-alarm response to different classes of hazards and this

response is summarized in Table 8 below. The information in the chart and the descriptions of the hazards is from Table 12.1.1 on page 12-12 of the NFPA Handbook 20th edition.

	High Hazard	Medium Hazard	Low Hazard
Engines	4	3	2
Aerial Ladder Trucks	2	1	1
Chief Officers	2	1	1
Firefighters	24	16	14
Safety Officers	1	1	1
RIT personnel	2	2	2
Total Personnel	29	20	18
Table 8 – Typical Initial Attack Response Capability			

High Hazard: Schools, hospitals, nursing homes, explosives plants, refineries, high-rise, and other high life hazard or large fire potential occupancies.

Medium Hazard: Apartments, offices, mercantile, and industrial occupancies not normally requiring extensive rescue or firefighting forces.

Low Hazard: One-two-, or three-family dwellings and scattered small businesses and industrial occupancies.

This report recognizes that the City of Sparta, like many cities, does not have the fiscal resources to provide the full initial response capabilities recommended by NFPA. The information is provided to use as a guide for determining a minimum level of response acceptable to the community for given risk levels, to illustrate the importance of on-duty staffing, and to emphasize the need for a strong volunteer program.

The phenomenon known as flashover should be considered when establishing staffing and service levels. As a fire grows in size, it gives off heat that heats other objects in the vicinity of the fire. At some point, all of 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. As shown in the graph in Figure 9, flashover can occur as early as 4 minutes of the start of a fire. 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. Sparta has a sufficient number of fire stations strategically located (see Figures 2 through 6) to provide an

average response time of five minutes, fourteen seconds (5:14), but the clock stops when the first unit arrives on the scene regardless of whether there are enough firefighters on the scene at that point to begin effective fire suppression operations. A quick response time (between 6 to 7 minutes on 90% of responses) with a sufficient number of firefighters is advantageous as firefighters need time after arrival to setup, rescue occupants if needed, lay fire hose, and gain access to the seat of the fire before they can actually begin to extinguish the fire. MTAS recommends a response time standard of having the initial company on the scene within six minutes, thirty-five seconds (6:35) of the initial call to 911 on 90% of all responses. The Sparta Fire Department places the first unit on the scene within 6:35 on 76% of all responses.

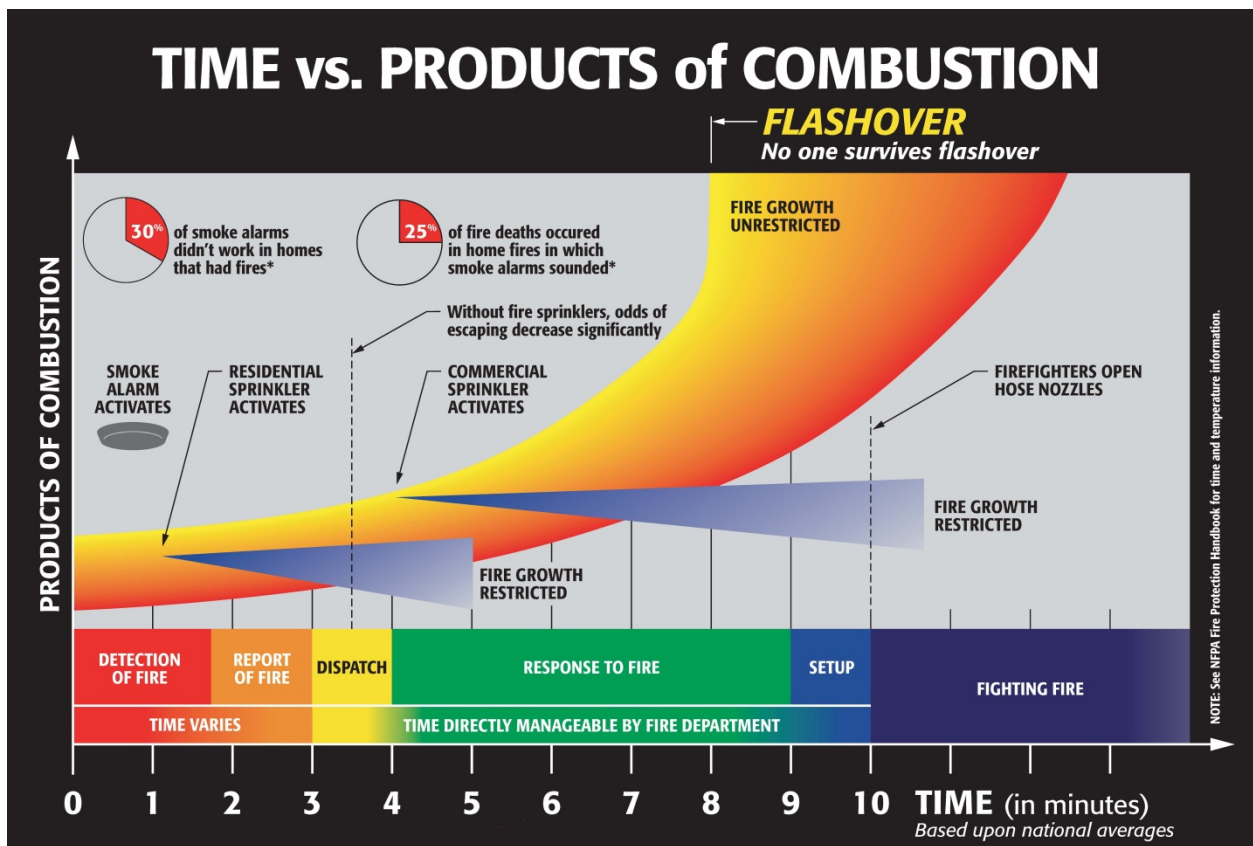


Figure 9 – Generalized Flashover Curve

With the above in mind, there are several challenges facing Sparta including:

- Funding for fire services,
- Minimum full time staffing levels,
- Equipment,
- The need to replace apparatus, and
- Volunteer recruitment and retention.

Funding for fire services

In paid departments, the largest expense is paid personnel, which is why a combination fire department makes sense provided the community supports the fire department by providing a sufficient number of qualified volunteers. If this is not the case, the city should look for ways to fund a sufficient number of paid personnel to provide 24-hour coverage at all three fire stations. The Federal Emergency Management Agency (FEMA) has a grant program called SAFER (Staffing for Adequate Fire and Emergency Response). The SAFER grant was created to provide funding directly to fire departments to help increase the number of trained on-duty firefighters available in their communities. SAFER is a matching grant, so if Sparta applied for and received a SAFER grant, the city would be obligated to fund 50% of the cost of the personnel over the period of the grant, which has ranged from three to five years in past grants.

Combination and volunteer departments can use SAFER grants for programs to recruit new volunteers and to provide incentives to retain existing volunteers. SAFER grants have funded recruitment campaigns, marketing activities, junior firefighter programs, and length of service award programs. The next SAFER grant application period should be opening soon, and Sparta should consider applying for a SAFER grant to increase the number of trained firefighters available in the community, either through hiring paid firefighters, increasing the number of volunteer firefighters, or a combination of both. As a resource for more information on how to use SAFER funds for recruitment programs, in 2011 the Pleasant View Volunteer Fire Department (\$31,000) and the Selmer Fire Department (\$143,652) received SAFER grants for recruitment programs.

Minimum full time staffing levels

The Sparta Fire Department has five paid firefighters that work on a four platoon system where each platoon works a rotating 24-hour shift in the schedule A Shift, B Shift, C Shift, D Shift, and the schedule repeats. One paid firefighter is on-duty at Station 1 24/7, and one paid firefighter is on-duty at Station 2 Monday through Friday from 8:00 AM until 5:00 PM. If the firefighter at Station 1 is off for any reason, the firefighter at Station 2 covers the vacancy at Station 1, which means there is no one on-duty at Station 2. Station 3 is an all-volunteer fire station and has never had any paid staffing. A volunteer firefighter pays rent to live at the station with the understanding that the volunteer responds with the engine if he is there at the station. This cost saving arrangement provides some level of staffing in what once was a station with no staffing.

In reviewing the most recent twenty structure fires (see Appendix A), it was noted that there was no response by on-duty volunteer personnel. On-duty volunteer personnel are volunteers who work an assigned shift at the fire station and respond to alarms from the fire station rather than respond from home to the station to get the fire truck, or from home to the scene. For on-duty manning, ISO gives credit for on-duty staffing and on-call staffing and does not differentiate between paid and volunteer in giving staffing credit. A volunteer working a shift at the station is credited the same as a paid firefighter working a shift at the station: 1-for-1 credit. To receive credit for volunteer ride out hours, the hours must be scheduled and the ride out time must be documented.

Volunteers count as on-duty personnel as long as they are scheduled, present, available to respond, and the time is properly documented. Therefore, the fire department should establish a volunteer firefighter work schedule where volunteers ride out following a schedule and the time is documented properly.

The majority of the department's calls occur in Station 2's district (see Table 9). The total response numbers, however, do not illustrate the disproportionate risk to response relationship. Looking at percentages based on total responses, the call volume is somewhat balanced across the three districts (see Figure 10), but if the aircraft standby calls are removed (see Figure 11), it is clear that the majority of fire responses are in Station 2's district. Station 2 is the closest to the central business district and the majority of Sparta's residents reside in this district. When this station is not staffed, the engine from Station 3 responds from over three miles away from the center of town, which is about a seven-minute travel time on top of the call processing, dispatch, and turnout time, which means a total response time of about ten minutes. The risk of a fire injury or fatality increases with the amount of time that passes from when the fire occurs until firefighters arrive and begin suppression operations. A ten-minute response time is too long to arrive before flashover occurs.

District	Address	Responses	Percent	Percent with Aircraft Standby Calls Removed
1	715 North Spring Street	91*	33.09%	13.62%
2	303 East Bockman Way	115	41.82%	53.99%
3	513 Polk Street	69	25.09%	32.39%
* Sixty-two (62) of the 91 calls are for aircraft standby.				
Table 9 – Sparta Fire Department Responses Per Station – 2011				

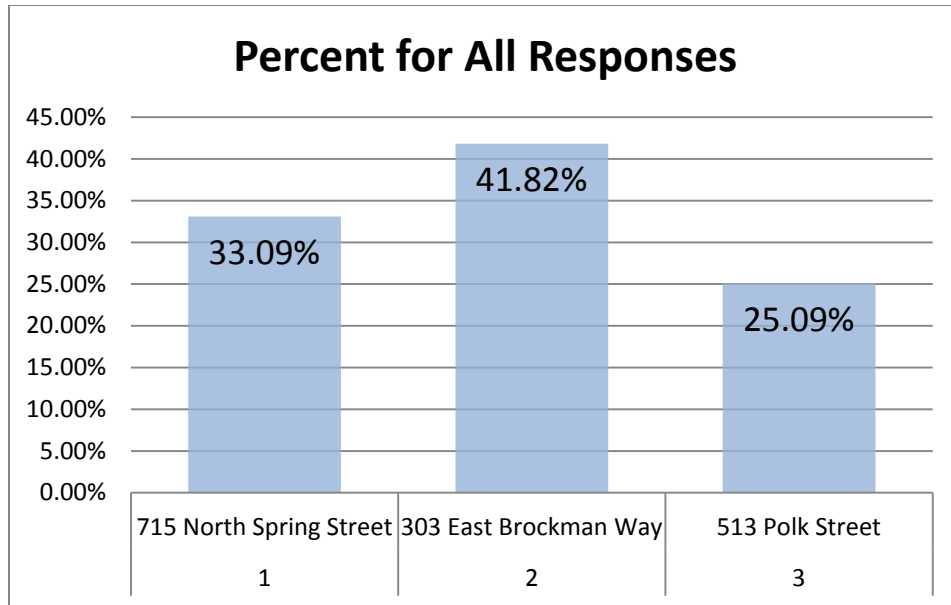


Figure 10 – Percent of Responses by Station – All Responses

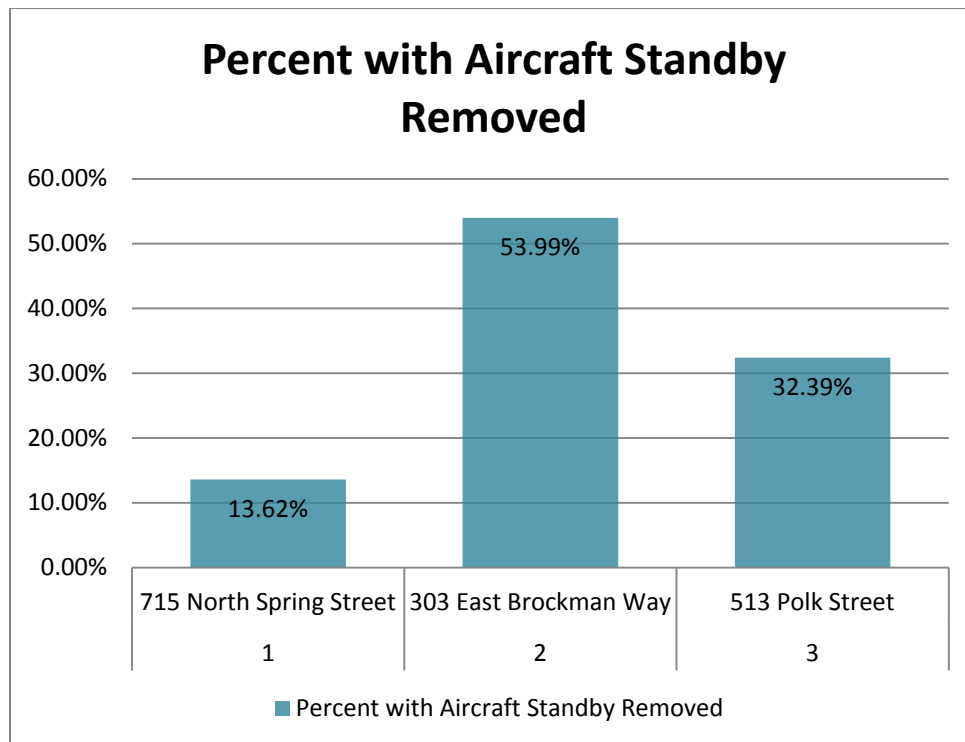


Figure 11 – Percent of Responses by Station – Aircraft Standby Removed

Consensus in the fire service is that a minimum of 18 firefighters are needed for an effective initial response to a residential structure fire. In 2010, Sparta averaged 9.5 firefighters on the scene of a structure fire, which means that firefighting operations are not as efficient or effective as they could be as many fire ground tasks cannot be

performed simultaneously, or there may not be enough firefighters on the scene to mount an interior fire attack, both of which increase the amount of property lost. Having an insufficient number of firefighters makes it more difficult for the chief to comply with the OSHA 2-in, 2-out regulation as those few personnel will be needed for active suppression operations. Since the same amount of work must be done on every fire, fewer personnel on the scene means that the firefighters work longer without relief, and fatigue compromises safety and increases the chance for injury.

Sparta should plan to increase the number of full-time firefighters to be able to provide one paid firefighter on-duty at every fire station 24/7. Adding personnel is a recurring and increasing expense, and Sparta should increase staffing in phases. Sparta has five full-time firefighters and has been on a four platoon system for at least 26 years. If Sparta stays on a four platoon system and places one firefighter at every station, at least eight additional personnel will be needed, for thirteen personnel. Thirteen personnel will provide three firefighters per shift times four platoons plus one firefighter to provide relief for paid leave and other absences. If Sparta were to change to a three platoon system, then five additional personnel would be needed, for ten personnel. Ten firefighters would provide three firefighters per shift times three platoons plus one firefighter to provide relief for paid leave and other absences.

To phase this in, Sparta could change to a three platoon system now and hire two additional firefighters. This would provide one full-time firefighter at Stations 1 and 2 24/7, with one firefighter to provide relief for paid leave and other absences. For the second phase, hiring three more firefighters would provide 24/7 staffing at Station 3. Adding personnel in two phases lessens the initial budget expense and provides 24/7 staffing at Station 2, which is the district with the greatest life risk, is where most of the calls occur (see Table 8), and is the immediate need. The three additional firefighters would be hired as financial resources allow. The phased approach dovetails with the fire chief's use of a volunteer living at Station 3 to provide staffing for part of the time.

Volunteer recruitment and retention

Volunteer recruitment and retention is closely tied to full-time staffing levels. A combination fire department is economical only if there are sufficient volunteers available in the community to provide an effective response. As noted above, volunteers can be used in creative ways, such as living at a fire station, to staff a fire station part of the time.

Recruitment can take many forms. The most effective recruitment tool is for a current volunteer firefighter to ask someone he or she knows to consider becoming a volunteer firefighter. Other recruitment tools include:

- An open house either on a regular drill night or at specific times during the year
- A sign in front of the fire station asking for volunteer firefighters
- An ad in the local paper
- Asking a local reporter to ride along for a day and write a story about what the fire department does and in the story mention the need for volunteers

- An insert in church bulletins
- Flyers handed out at community functions
- Having the fire chief speak to local community groups about the need for volunteer firefighters
- A citizen's fire academy where residents come for a couple of hours every week for several weeks and see what a firefighter does. Even if they don't become volunteers the department will have some new fire department advocates in the community.
- A way on the fire department's website for people to apply to be a volunteer
- Using social media such as Facebook and MySpace
- A neighborhood door to door campaign
- Talk with administrators at Tennessee Technological University in Cookeville about recruiting students there to serve as volunteer firefighters in exchange for room and board at a fire station
- Using the National Volunteer Fire Council as a resource for recruitment ideas. Their website is <http://www.nvfc.org>

Once the department has more volunteers, it is important to retain them. The fire department spends time and money training and equipping a volunteer, and the volunteer gains knowledge and experience that is valuable and difficult to replace if the volunteer leaves. Retention tools include:

- Department uniforms
- Per call compensation incentives
- Length of service awards program (Sparta has a program)
- Featuring a volunteer in a newspaper story
- Publicly recognize volunteers who have made a significant accomplishment on a call, or in completing a training program, or in the community
- Just saying "thanks for all you do" is very rewarding

Equipment

For full credit under the ISO grading schedule, the fire department needs to add some equipment to its fire apparatus. Engine 413 needs an additional 300 feet of 1½" or 1¾" fire hose. Engine 409 needs an additional 300 feet of 1½" or 1¾" fire hose, one 2½" solid stream nozzle, one hose clamp, and one portable radio. The ladder truck needs four additional SCBA, ten salvage covers, three portable floodlights, one power saw, one hand light, one 14-foot extension ladder, one 40-foot extension ladder, and a thermal imaging camera as an allowable exception to the oxyacetylene cutting torch.

The department has a 1989 GMC service van identified as Unit 410. Being a small department with limited staff, the chief has placed additional tools, equipment, and supplies on this van so these resources can be brought to the scene by a single firefighter, which is very efficient. The tools, equipment, and supplies carried on Unit 410 are listed in Appendix B. ISO gives partial credit for this unit as a service company,

which contributes to maintaining the Class 5 ISO rating. This unit provides specialized tools and equipment, such as the chlorine spill kits and non-sparking tools, for response to hazardous materials calls. On fires and other incidents where SCBA must be used, the four 6,000 psi cascade cylinders provide a way to refill SCBA air cylinders on the scene so firefighters do not run out of breathing air. For safety when refilling SCBA air cylinders, this unit needs an enclosed SCBA fill station but currently has no space in which to put it. Sparta should make replacing Unit 410 a priority because of the need to carry additional equipment and the fact that the unit is 22 years old.

The need to replace apparatus

Within the last decade, the NFPA standards covering the construction of fire apparatus have changed to reflect advances in technology, functional capability, and firefighter safety. Since the trucks are already paid for, it may seem to be cost efficient to continue to use older apparatus for first line service. However, older apparatus have few of the safety features, such as antilock braking systems, air bags, ergonomic design, and reinforced cabs, found in newer apparatus. In addition, the engine, transmission, and fire pump are old and the pumper may have difficulty passing the annual pump test. For these reasons, it is a good business practice to plan for the depreciation and orderly replacement of fire apparatus just as other capital assets are replaced when their useful life has ended.

Sparta operates apparatus that met NFPA standards at the time of manufacture. The 1978 Seagraves aerial ladder truck is the department's oldest apparatus at 34 years old. At 23 years of age, the department's 1989 Mack is the oldest of the three fire engines, followed by the 10 year old 2002 Pierce, and the 11 year old 2001 Pierce. NFPA 1901 Annex D recommends that apparatus that is more than 15 years old be placed in reserve service, and apparatus that is more than 25 years old be replaced. The Seagraves ladder truck and the Mack pumper are candidates for replacement.

MTAS recommends the development of a formal replacement schedule for all fire apparatus, planning for apparatus to have a projected first out service period of 15 years followed by a reserve service period of no more than 10 years provided the apparatus has been properly maintained and is still in serviceable condition. The department should specify apparatus with minimum seating for four firefighters and pumps rated to deliver at least 1,500 gpm. Because of water supply concerns and the potential for rural response, MTAS recommends a pumper/tanker to replace the 1989 Mack. Sparta should purchase all hose, tools, and equipment needed to outfit the new pumper/tanker.

ISO requires that a city have at least one reserve fire engine for every eight needed engines or fraction thereof. Sparta needs three first-out engines and one reserve fire engine, and it does not have a reserve fire engine. First-out Engine 407 is out of service for mechanical problems and the shop recommends replacement. This means Sparta now needs two engines. Sparta should purchase a new engine to replace Engine 407. Options for getting a reserve engine include but are not limited to:

1. Purchasing a second new pumper/tanker now with all needed hose, tools, and equipment, placing this engine in first out service, and placing the 2001 Pierce in reserve service.
2. Purchase a demonstrator model fire engine now, place that engine in first line service, and place the 2001 Pierce in reserve service.

Recommendations

The most efficient and cost effective way for the City of Sparta to provide an all-hazards service delivery program that addresses community risks and needs is in the following recommendations.

1. Continue to use the combination fire department model as this type of fire department for a community the size of Sparta can provide adequate, cost-effective services.
2. To maximize the efficiency and effectiveness of the combination model, develop a plan to phase in additional paid staffing to meet the goal of having a paid firefighter on duty at all three fire stations 24/7.
3. To maximize the efficiency and effectiveness of the combination model, increase the level of volunteer response through a combination of increased response levels of existing volunteers, recruitment of new volunteers, and development of a volunteer ride out program to increase the credit for on-duty manning.
4. Research and consider applying for a SAFER grant to increase the number of trained firefighters available in the community. SAFER grant information is available on the Internet from FEMA at <http://www.fema.gov/firegrants/safer/index.shtm>.
5. Appoint a volunteer coordinator to manage the recruitment and retention program.
6. Continue to maintain good working relationships with other fire departments as these departments will provide mutual aid response should Sparta have a major incident.
7. Remove the shipping container drill tower as soon as possible. To prevent any possibility of injury it should not be used for any purpose.
8. Adopt a response time standard for the community. Sparta is a perpetual organization that will outlast current leaders, and a 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. Sparta officials can use this standard to plan for future fire service improvements.
9. Adopt a minimum staffing response standard for the community. The response standard should identify the minimum number of firefighters the department desires to have present on every structure fire response. Use this standard to plan for future paid staffing levels and to establish volunteer firefighter recruitment and retention goals. The standard adopted should be based on the level of risk in the community, the level of service the community desires and can afford, and consideration should be given to NFPA Standards 1710 and 1720 in developing the standard Sparta adopts.

10. Adopt a sprinkler ordinance for all new commercial construction. ISO does not consider properties protected by a code compliant automatic sprinkler system when determining the needed fire flow for a community. In buildings protected by sprinklers, the sprinkler system either extinguishes the fire before the fire department arrives, or holds the fire in check until the fire department arrives to complete extinguishment. In a sprinklered building, the amount of time between the occurrence of a fire and reopening for business can be as little as a few hours versus months for a non-sprinklered building.
11. Research and consider adopting a residential sprinkler ordinance to require residential sprinklers in all new residential construction. Tennessee's fire mortality rate for civilians has been among the highest in the nation. During 2002-2010, the time period for 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 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.
12. Develop an apparatus replacement schedule and begin planning and budgeting for the scheduled orderly replacement of fire apparatus based on first out apparatus being no more than 15 years old, reserve apparatus being no more than 25 years old, and apparatus older than 25 years being retired from service.
13. Develop specification for and purchase a pumper/tanker with hose, tools, and equipment to replace the 1989 Mack.
14. Develop a plan to acquire a reserve fire engine with hose, tools, and equipment, through purchase of a new or demo apparatus and rotation of older apparatus.
15. Develop specifications for a new service unit, including any needed tools and equipment, and replace Unit 410.
16. Begin planning and budgeting for immediate equipment needs including all tools and equipment needed to bring all engines into compliance with the equipment schedule found in the ISO Fire Suppression Rating Schedule.
17. Begin planning and budgeting to provide a portable radio for each firefighter on the scene of an incident. This is a safety consideration.
18. Develop a policy to maintain employee medical surveillance and exposure to hazardous materials records in accordance with OSHA regulation 29CFR1910.120.
19. Adopt a fire code that is a published version year 2005 or newer. The code adopted must be within seven years of the most recent published edition of the state's model code, which is the 2012 edition.
20. Post carbon monoxide warning signs in all apparatus bays and budget for a vehicle exhaust removal system for all apparatus bays.
21. Conduct regular training drills, at least one per quarter, with the fire departments that Sparta runs with on mutual aid calls.
22. Develop a policy for regular inspection, maintenance, and replacement of damaged hand tools and firefighting appliances.

23. Conduct fire investigation and fire cause determination classes to improve the percentage of fires where the cause is determined. Use fire cause information to tailor fire prevention programs and to spot possible fire trends.
24. Develop a plan and budget to replace or upgrade all non-standard fire hydrants. Approximately 5% of the hydrants have a non-standard operating nut, and 13% of the fire hydrants do not have a 4" or larger pumper connection and two 2½" hose connections. For maximum ISO credit, all hydrants should have a standard size operating nut, a 4" or larger pumper connection, two 2½" hose connections, and a 6-inch or larger branch connection.
25. Conduct a fire hydrant flow test of the fourteen fire flow tests run in 1997 to see if any of these flows are still deficient. If they are, conduct a study to see what is needed to improve the needed fire flow for these risks.

Appendix A – Structure Fire First-Alarm Personnel Response

Date	Time	Chief Officer(s)	Off-duty Vol.	On-duty Vol.	Off-duty Paid	On-duty Paid	Total Personnel
1/31/2011	0039	1	3	0	2	1	7
1/27/2011	1038	1	2	0	2	2	7
1/21/2011	1922	1	9	0	4	1	15
1/18/2011	0143	1	4	0	1	1	7
12/30/2010	1703	1	9	0	4	1	15
12/28/2010	0917	1	9	0	2	1	13
12/24/2010	0346	1	4	0	3	1	9
12/23/2010	2324	1	5	0	2	1	9
12/9/2010	1340	1	2	0	1	1	5
11/27/2010	0117	1	5	0	1	1	8
11/22/2010	0830	1	5	0	0	2	8
11/18/2010	1531	1	4	0	1	1	7
10/30/2010	1022	1	4	0	4	1	10
10/15/2010	0712	1	6	0	3	1	11
10/5/2010	2054	1	10	0	4	1	16
10/5/2010	0113	1	1	0	0	1	3
9/25/2010	0307	1	2	0	4	1	8
9/23/2010	0344	1	5	0	4	1	11
9/23/2010	0815	1	2	0	1	1	5
9/7/2010	1645	1	6	0	2	1	10
	Average	1	4.85	0	2.25	1.1	9.2
Chief Officers:	The number of responding Chief Officers who did not perform firefighting duties . This means they served as the command officer or performed some other function.						
Off-duty Vol.:	The total number of call or volunteer personnel, including officers performing firefighting duties, who responded from home, business, etc.						
On-duty Vol.:	The total number of call or volunteer personnel, including officers performing firefighting duties, who responded from a regular on-duty assignment at the fire station.						
Off-duty Paid:	The total number of paid personnel, including officers performing firefighting duties, who responded from an off-duty status.						
On-duty Paid:	The total number of paid personnel, including officers performing firefighting duties, who responded from an on-duty assignment at the fire station.						

Appendix B – Unit 410 Tools and Equipment Inventory

- 4 – Self-contained breathing apparatus
- 4 – Spare SCBA cylinders
- 4 – 6000 psi cascade cylinders
- 2 – 20 lb fire extinguishers
- 1 – Gasoline powered generator
- 2 – 100 ft ropes
- 10 – 5 gallon containers AFFF foam
- 1 – leak seal plug & wedge kit
- 150 lbs absorbent
- 1 – file cabinet (pre-plans)
- 4 – boxes absorbent tubes & pads
- 4 – cases drinking water
- 2 – Chlorine spill kits
- 2 – large tarps
- 1 – hand light
- 1 – non-sparking tool kit
- 1 – chainsaw
- 1 – 12 ft A-frame ladder
- 1 – 10 ft attic ladder
- 2 – gas cans
- 10 – traffic cones
- 1 – bolt cutters
- 1 – Exhaust fan
- 1 – PPV blower
- 1 – water mist fan
- 1 – hydraulic spreader
- 1 – hydraulic cutter
- 1 – hydraulic combo tool
- 2 – hydraulic rams
- 1 – hydraulic power unit

Appendix C – Hydrant Flow Data Summary from 08/12/97

(Deficient fire flows are highlighted in yellow)

Test No	Type	Test Location	Needed Fire Flow in gpm	Available Fire Flow in gpm
1	Commercial	Sewell Dr & N. Spring	5,000	1,600
2	Commercial	N. Spring & Howell	7,000 5,000	1,300
3	Commercial Residential	N. Spring & Golden Mountain	3,000 750	1,800
4	Commercial	Hale & Sidney	3,000	1,800
5	Commercial	Mayberry & Fred Hill	3,500	3,000
6	Commercial Residential	Allen Dr & Warrior Lane	3,500 1,000	4,900
7	Commercial	Carter St & Carson St	2,500	1,900
8	Commercial Residential	High School St & Walker	2,250 1,000	950
9	Commercial	Smithville Hwy & Medic Dr	2,500	950
10	Commercial	Maughen Dr & Walker Cove	2,000	1,000
11	Commercial Residential	N. Spring & Gillen	2,750 1,000	2,300
12	Residential	S. Main & Cedar Bend	750	400
13	Commercial	Bronson St & Baker St	1,750	1,400
14	Commercial	Panther Dr & Hwy 111	3,000	650

Appendix D – Repair Estimate for Unit 407

Sparta, TN Estimate for Unit 407

Item Name	Part#	Qty	Price
Pro Poly Tank	800 Gallon	1	\$4,550.00
Hale Gear Box			
Primer Valve	538-0280-52-0	1	\$300.00
Gasket set	546-0872-50-0	1	\$65.00
Switch	200-2261-50-0	1	\$125.00
Strainer	010-0080-01-0	1	\$30.00
Relief valve-stem	538-1400-00-0	1	\$460.00
Relief valve-kit	546-1260-00-0	1	\$95.00
Rear cap bearing	008-0560-00-0	1	No longer Available
Front cap bearing	008-0570-00-0	1	No longer Available
Gear intermediate	031-0980-00-0	1	No longer Available
Gasket shift cap	046-5060-00-0	1	\$3.00
Gasket bearing caps	046-5130-00-0	2	No longer Available
Tailshaft bearing	250-0214-00-0	2	\$65.00 each/ \$130.00
Intermediate bearing	250-8040-00-0	1	\$200.00
Seal driveshaft	296-2540-00-0	2	No longer Available
Gasket/housing	046-6370-00-0	1	\$5.00
Rear bearing	250-0310-00	1	\$135.00
Rear bearing	250-0409-00	1	\$165.00
Rear bearing	062-0140-00	1	No longer Available
Gasket	546-0870-00-0	1	\$25.00
Glad set front	048-0210-00(Q-57FD)	1	\$150.00
Glad set rear	048-0200-00(Q-57R)	1	\$160.00
6" Compound gauge(liquid filled)	30-600 psi (white)	2	\$250.00 each/\$500.00
3.5" Compound gauge(liquid filled)	30-600 psi (white)	7	\$100.00 each/\$700.00
Misc. plumbing/clamps		1	\$500.00
	<u>PARTS</u>		<u>\$8,998.00</u>
	<u>LABOR</u>		<u>\$4,500.00 - \$6,500.00</u>
	<u>TOTAL ESTIMATE</u>		<u>\$13,158.00 - \$15,500.00</u>

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