The City of Topeka

Fire & Rescue Services

Facility Deployment Study

Final Report

August 2006

Emergency Services Consulting inc.

City of Topeka Fire Department

DEPLOYMENT STUDY 2006

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Executive Summary

Purpose

This evaluation of the station, resource, and staffing deployment of the Topeka Fire Department in the City of Topeka, Kansas (City) is offered in response to a request from the City and the fire department. The request was to review and analyze current deployment of emergency resources in the City, and to assess the future needs of the department specific to fire station locations, apparatus, and operational staffing.

ESCi wishes to thank staff and elected officials of the City, as well as the fire department, for the excellent cooperation we received. All involved were candid in their comments and provided a large amount of information and data in a short amount of time.

Background Information

This report includes a detailed review of the resource deployment and staffing systems of the Topeka Fire Department.

The criteria used to evaluate the department have been developed over many years. These criteria include relevant National Fire Protection Association standards, national accreditation criteria, health and safety requirements, federal and state mandates relative to fire protection and emergency medical services (EMS), fire protection standards of the property insurance industry, and generally accepted practices within the fire and emergency services.

Each report objective provides the reader with general information about that element, as well as specific observations and analysis of any significant issues or conditions that are pertinent. Observations are supported by data collected as part of the survey and interview process.

Finally, specific findings and conclusions are included to resolve identified issues and concerns or to take advantage of opportunities that may exist.

Summary of Significant Recommendations

From the standpoint of general policy, ESCi recommends that the City of Topeka formally adopt a set of performance objectives to guide fire department deployment and its measurement of service delivery quality. As suggested within this study, the City may wish to conduct an assessment of customer expectations prior to finalizing these performance objectives. At a minimum, performance measures should be set for call processing time, firefighter turnout time, initial unit arrival time, and effective response force arrival time. These performance objectives are the most critical when planning or monitoring the deployment of fire and emergency medical resources.

In the absence of formal response time performance objectives set by the City, ESCi used nationally recognized performance benchmarks found in various national peer standards to evaluate current performance and plan for future deployment. ESCi identifies what level of improvement would be necessary for the City to achieve nationally recognized standards, but also offers guidance on what performance objectives the City could consider to maintain and monitor performance at or near the level currently experienced. All performance objectives are provided in industry-accepted percentile format rather than average; an explanation is provided for this methodology.

In order to achieve the performance objective found in *National Fire Protection Association (NFPA) 1221*[1], the Consolidated Emergency Communications Center will need to reduce its 95th percentile call processing time for incidents dispatched to the fire department by 78 seconds. ESCi recommends that the City work with the Consolidated Emergency Communications Center to identify software or hardware barriers to improving call processing time for fire department emergencies, in an effort to achieve performance that is closer to national standards.

In order to achieve the performance objective found in *NFPA 1710*[2], the Topeka Fire Department will need to reduce its 90th percentile firefighter turnout time by 54 seconds. ESCi recommends that fire department management work with its employees to identify any physical

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[1] *National Fire Protection Association 1221: Installation, Maintenance, and Use of Emergency Services Communications Systems*, 2002

[2] *National Fire Protection Association 1710: Organization and Deployment of Fire Suppression Operations, Emergency Medical Operations, and Special Operations to the Public by Career Fire Departments*, 2004.

or facility barriers to improving the firefighter turnout time, in an effort to achieve performance that is closer to national standards.

For the short and long-range future, the Topeka Fire Department (TFD) will be unable to reach a travel time performance objective for first-due company response time of four minutes or less to 90 percent of emergency calls through continued use of its current deployment scheme. Topeka can enjoy significantly improved levels of emergency service delivery through the adoption of a new deployment strategy, two options for which are provided in this report.

Current City Profile

Through analysis of current deployment and system performance, ESCi is able to identify several issues where improvement may be available. These issues are summarized in the following paragraphs.

- **Redundancy in engine company coverage in downtown area**
  The four-minute travel capabilities of the downtown engine companies from Stations #1, #3, #4, and #6 have significant overlap.
- **Service gap in engine company coverage in the Sixth and Fairlawn area**
  Despite considerable redundancy in downtown engine company coverage, the area around Sixth and Fairlawn has notable gaps in both four-minute response time capability and the Insurance Services Office (ISO)-recommended 1.5 mile engine company coverage.
- **Service gap in ladder/service company coverage in the northwest sections of the City**
  The northwest section of the City, directly north of Truck 8 and northwest of Truck 5, has notable gaps in both ladder/service company travel time capability and the ISO-recommended 2.5 mile truck coverage.
- **Service gap in engine and ladder/service company coverage in the far southern non-adjacent sections of the City**
  The southern areas of the remote City jurisdiction, near the airport and race track, are

also notable gaps in four-minute response time capability, as well as the ISO-recommended 1.5 mile engine company and 2.5 mile truck company coverage.

ESCi has provided a short to mid-term deployment strategy, identified herein as Strategy A, to provide improvements over existing deployment for the current City limits and its associate population, risk, and service demand. Strategy A would involve a modified distribution of twelve Topeka fire stations, geographically located to improve the conditions of redundancy and service gaps. Strategy A calls for continuing the use of all current TFD stations; except for Stations #3 and #6.

Under this strategy, Station #3 would be relocated to the vicinity of SW Fairlawn Road between SW 7th Terrace and SW 8th Avenue, and would be staffed by both an engine and truck/aerial company. Station #6 would be relocated to the vicinity of NE Seward Avenue and NE Golden Avenue and constructed large enough to accommodate both an engine and aerial/truck company. This deployment would result in the current number of fire stations, while adding one additional truck company.

<u>Future City Profile</u>

ESCi provided a long-term deployment strategy, identified herein as Strategy B, to provide a vision for future fire protection infrastructure for potential future City limits and associate population, risk, and service demand, based on projected land uses found in the City's comprehensive planning documents. Strategy B would involve a much wider distribution of eighteen Topeka fire stations, geographically located to improve conditions of redundancy and service gaps in current deployment, and maintain current performance levels throughout the growth and development of the City within the Fire Protection Planning Area.

Strategy B calls for continuing the use of ten current TFD stations, with the exception of Stations #3 and #6. As with Strategy A, Station #3 would be relocated to the vicinity of SW Fairlawn Road between SW 7th Terrace and SW 8th Avenue, and would be staffed by both an engine and a truck/aerial company. Station #6 would be relocated to the vicinity of NE Seward Avenue and NE Golden Avenue and constructed large enough to accommodate both an engine and aerial/truck company. In addition to these changes that are identical to Strategy A, six new stations would be constructed as growth and development occurred in the future.

- Proposed Station #13: SE Croco Road and SE 45th Street
- Proposed Station #14: SW Topeka Boulevard and SW University Drive
- Proposed Station #15: On SW Urish between SW 41st Street and the new extension of SW 45th Street
- Proposed Station #16: NW Brickyard Road and NW 35th Street
- Proposed Station #17: NE Meriden Road between NE 28th Terrace and NE 35th Street
- Proposed Station #18: NW Rochester Road and NW 39th Street

Each new station would have an engine company. In addition to existing truck companies, the strategy recommends three new truck companies. The number of area commanders (battalion chiefs and shift commanders) would also increase from three to four.

ESCi recommends the City adopt Strategy A as a three to five year deployment plan. This strategy will require the City to build two new fire stations to replace two existing stations during the three to five year time period. One new truck company would also be added.

ESCi further recommends the project to replace Station #6 be initiated first. Building a new Station #6 will permit the truck company currently at Station #3 to be relocated to the new Station #6. The new Station #3 would be built next, with Engine #3 being relocated there upon completion. The addition of a seventh truck company at the new Station #3 would be the final step in completion of this short to mid-term strategy.

ESCi recommends the City adopt Strategy B as a long-range fire protection master plan for the community. This strategy will ultimately require the City to build an additional six new fire stations. Six engine companies and two new truck companies would also be added.

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Fire and Rescue Services Facility Deployment Study

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Chapter 1 - Introduction and Community Overview

The Topeka Fire Department (TFD) is the operating department of the City of Topeka (City) designated to provide fire protection and emergency medical first response. The department began providing fire protection services in 1872. The department's jurisdiction encompasses the entire municipal limits of the City, as well as four specified commercial locations, outside the City, through contractual agreement. The response area includes densely populated urban areas as well as suburban residential areas of Shawnee County, and is situated along the Kansas River. The City of Topeka serves as the capital for the State of Kansas.

The community name derives from Indian term translated as *potato place* or *noisy*. Topeka was settled as a railroad stop in 1854. Local colleges and universities include Washburn University, Topeka Technical College, and Kaw Area Technical School. Local attractions include the Topeka Zoo, Gage Park Reinisch Rose Garden, the Brown v. Board of Education National Historic Site, Kansas Museum of History, Mulvane Art Museum, Historic Ward-Meade Park & Botanical Gardens, Cedar Crest, Combat Air Museum, and Great Overland Station.

TFD provides emergency services to a population of 122, 377[3] in an area of roughly 56 square miles. These services are provided from twelve facilities located within the jurisdiction. The department maintains a fleet of vehicles including 12 fire engines, two aerial trucks, four truck companies, one rescue truck, two wildland firefighting vehicles, and three specialty/utility vehicles. Five vehicles are available in a reserve fleet, not typically used for front-line service.

There are 249 individuals[4] involved in delivering these services to the jurisdiction. The department has a fire chief, deputy chief of operations, deputy chief of support services, fire marshal, and division chief of training. A business services manager, five clerical personnel, a communications officer, and a building maintenance technician provide additional support services. Primary staffing coverage for emergency response is through the use of career firefighters operating on 24-hour shifts. Three fire investigators, four fire inspectors, and three training officers also provide service on 24-hour shifts.

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[3] U.S. Census Bureau, 2000 census data.
[4] Current number at time of field research.

The department provides a variety of services including fire suppression, victim rescue, emergency medical first response, operations and technician-level hazmat response, code enforcement, and public fire safety education.

The Consolidated Emergency Communications Center provides emergency call receipt and dispatch service. Enhanced-911 telephone service, computer-aided dispatch, and a multi-channel radio system are in place.

Responsibilities and Lines of Authority

The City of Topeka is a municipal corporation, formed under the laws of the State of Kansas, and provided the authority to levy taxes for operating a fire protection system.

The City operates under a Council-Manager form of government. The council is provided with broad power and authority to govern the provision of fire protection and emergency services within the City including organizing a fire protection system, appointing officers and members, purchasing land and equipment, entering into contracts, issuance of bonds, and levying of taxes.

The role and authority of the council and the city manager is further clarified within city charter, ordinances, and written policy documents describing their function and tasks. The council maintains strictly policy-level involvement, avoiding direct management and hands-on task assignment, an arrangement established within written policy.

The fire chief is an at-will employee and is not provided with a personal services contract. The city manager provides an annual formal written evaluation of the chief's services as a means of documenting performance and establishing personal objectives.

Foundational Policy

Organizations that operate efficiently are typically governed by clear policies that lay the foundation for effective organizational culture. These policies set the boundaries for both expected and acceptable behavior, while not discouraging creativity and self-motivation.

TFD maintains five primary policy manuals - City Personnel Code, Standard Operating Procedures, Manual of Numbered Memorandums, City Manager Policy Manual, and the Collective Bargaining Agreement. The manuals were given a basic review for quality and content. Due to the number of different manuals one must refer to, the documents could be considered a bit disorganized, but it appears that a great deal of time went into writing the various policies and procedures in a professional and clear manner. The manuals include the appropriate policies either required by law or focused on reducing the risk of civil liability. These include a sexual harassment policy, family medical leave, and disciplinary policy. Other policies cover routine procedures, complaint handling, orientation of new members, and uniform use.

The standard operating guidelines are reasonably well organized, easy to understand and apply, and reflect current industry standards and best practices. Most of the procedures are reported to be reasonably up-to-date, but no prescribed system is in place to review and update the procedures on a periodic basis. The procedures contain adequate sections on emergency scene operations, and can provide field personnel with guidance on fireground operations such as fire streams, pump operations, search procedures, and evacuations.

Organizational Structure

A well-designed organizational structure should reflect the efficient assignment of responsibility and authority, allowing the organization to accomplish effectiveness by maximizing distribution of workload. The lines on an organizational chart simply clarify accountability, coordination, and supervision. Thorough job descriptions should provide the details of each position and ensure that each individual's specific role is clear and centered on the overall mission of the organization.

A review of this agency's organizational chart reveals that they are organized in a typical top-down hierarchy. The chart indicates a good distribution of workload and responsibility, as well as clear lines of accountability.

The organizational structure of the department demonstrates a clear unity of command, in which each individual member reports to only one supervisor (within the context of any given position), and is aware to whom he or she is responsible for supervision and accountability. This method of organization encourages structured and consistent lines of communication and prevents positions, tasks, and assignments from being overlooked. The overall goals and objectives of the organization can be more effectively passed down through the rank and file members in a consistent fashion.

The organizational structure is charted with clear, designated, operating divisions that permit the organization's core functions to be the primary focus of specific supervisors and assigned members. While some task-level activities may carry over from division to division, the primary focus of leadership, management, and budgeting within the division are clarified by the division's key function within the mission statement. Those individuals supervising or operating within a specific division are positively clear as to the role of the division and its goals and objectives.

The department has sufficiently analyzed its mission and functions, such that a resulting set of specific agency programs have been established. Organized, structured programs permit better assignment of resources, workload division, future planning development, and service delivery analysis. Those departments that have clarified their programs with titles, assigned leadership, resources, budget appropriations, performance objectives, and accountability are among the most successful.

The chief executive officer (fire chief) appears to directly supervise five other individuals, including the two deputy chiefs, two division chiefs, and an executive assistant. The chief's span of control falls within the range typically considered normal and acceptable. This is a positive reflection on the agency's organizational structure, since many times chief officers accept or encourage a span of control that greatly exceeds their ability to maintain good communication and leadership, often with good intentions, but just as often to the detriment of the department.

The fire chief has been provided with the authority to assist the Civil Service Commission with appointment, full authority for termination within the first twelve months of employment, and recommendation authority for termination after that period.

The department maintains a set of job classifications and descriptions that reasonably reflect the typical responsibilities and activities of the positions. The documents adequately describe most primary functions and activities, critical tasks, levels of supervision, and accountability, as well as reasonable qualifications. Some updating of job descriptions has recently been conducted.

The department currently maintains collective bargaining agreements (CBA) with certain classifications of employees within the organization that clarify the salary, benefits, and many of the working conditions under which the employees in that classification will operate. Currently, all operations positions from captain level down, fire inspectors, investigators, training shift officers, and the communications officer are covered by the CBA.

Maintenance of History

The Topeka Fire Department has significant levels of history retention programs in place. Appropriate records of all corporate or municipal meetings are maintained in accordance with the laws of the state governing various types of public meetings and decisions involving public funds.

The department maintains items of historical significance, including pictures, newspaper articles, etc. These are helpful when updating a historical perspective of the organization and the major events in its development.

A regularly maintained historical record serves as a valuable tool for planning and decision-making. It allows quick recollection of how the department has adapted to changes in the community. It provides valuable historical data to agencies, such as the Insurance Services Office, for evaluation purposes. It also allows for permanent memory of the people who have contributed to the success of the department in its service to the community.

A well-produced annual report can serve to satisfy this need. In addition, an annual report is a wonderful communications tool to share the department's efforts and activities with the public. Though it has produced annual statistical reports in the past, the department does not consistently publish or distribute an annual report of activities and accomplishments, failing to provide any specific historical record or measurement of its performance. Effort is underway to complete such a report for 2005.

At a minimum an annual report should include:

- Brief history of the department
- Summary of events and activities during the report year
- Description of major incidents handled by the department
- Descriptions of new or improved services and programs
- List of people who served with the department during the year
- Awards received by the department or individuals
- Financial summary including revenues and expenditures, grants, etc.
- Statistical analysis, with trends, of key community service level indicators

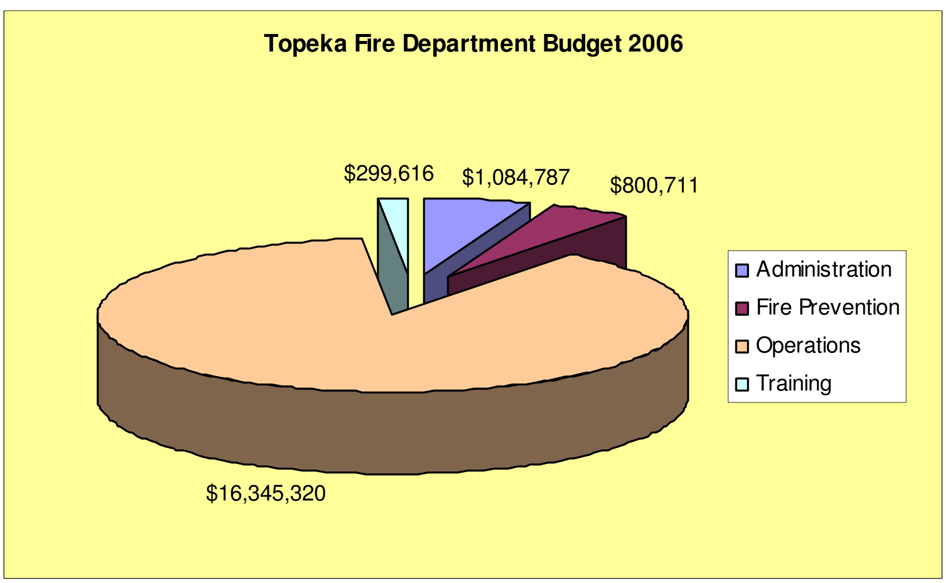
The annual report should be printed and distributed to the community and made available at such places as the local chamber of commerce and library.

Finance

The assessed value of the City of Topeka is $979,406,486 with a total current fiscal year tax rate for operations of 32 mils.

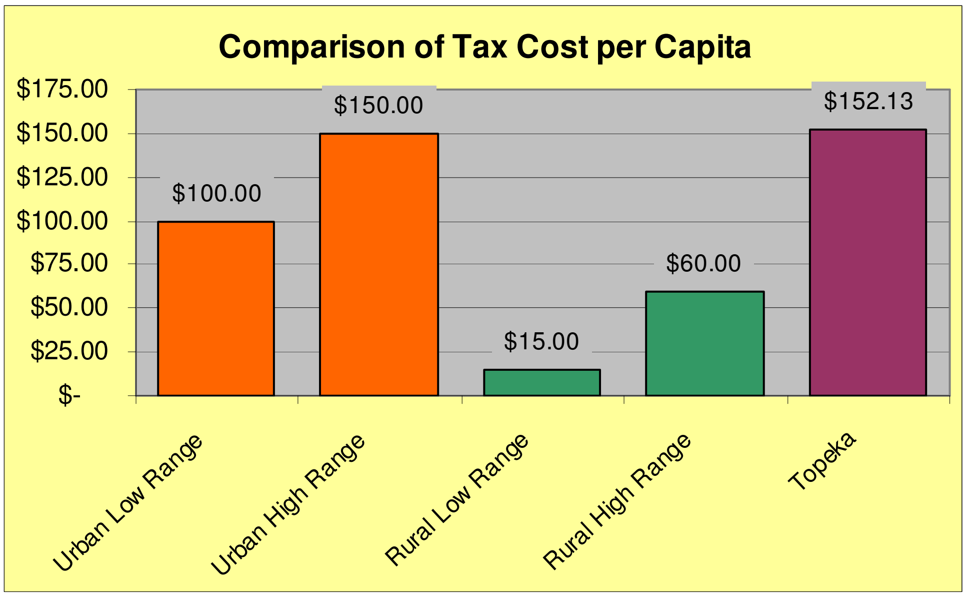
The following figure provides an overview of the current fiscal year budget for the fire department.

Figure 1: 2006 Fire Department Budget by Program



Given the population receiving direct services from the Topeka Fire Department, the following chart demonstrates service costs per person and contrasts this with other communities, both larger and smaller.

Figure 2: Fire Service Cost per Person



The comparison figures that are provided have been developed by ESCi and, as such, represent the company's collective experience with fire service tax costs as observed during work in agency evaluations, growth management plans, staffing studies, station location studies, merger and consolidation studies, and strategic planning in fire department agencies. As used in this chart, urban refers to those communities utilizing primarily career or combination staffing systems serving populations in excess of 20,000 persons or with average population densities of greater than 3,000 persons per square mile. Rural refers to those communities utilizing primarily volunteer staffing systems serving populations less than 20,000, or with average population densities of less than 3,000 persons per square mile.

Since the City of Topeka is a combination of urbanized residential and commercial development, ESCi selected to consider the urban cost ranges as the most appropriate benchmark. The chart in figure 2 above demonstrates a slightly higher cost per person within this community than is typically observed. However, it should be remembered that costs per capita can vary greatly based on the types of services provided in any given community when compared to another or by the overall number of non-resident transient population creating service demand.

System Benchmark Comparisons

The scope of work for this study included a request by the City of Topeka to conduct comparative analysis of the fire department and other agencies in order to "…compare levels of service and cost against peer fire service organizations." There is a limited selection of nationally recognized databases available for fire service benchmarks. This study uses two of the most accepted studies, the National Fire Protection Association's annual *Fire Department Profiles* and *Fire Loss* reports. The report is based on two data sources: the annual *NFPA Survey for U.S. Fire Experience*, 2004, and the *NFPA Fire Service Survey*, 2002-2004.

Annual reports, derived from a sample survey of United States fire departments, serves as the basis for national fire problem estimates. The sample is stratified by the size of the community protected by the fire department. All U.S. fire departments that protect communities of 100,000 or more are included in the sample, because they constitute a small number of departments with a large share of the total population protected. For departments that protect less than 100,000 population, a sample was selected stratified by size of community protected.

Survey returns in recent years have ranged from 2,800 to 3,500 departments annually. The survey also includes questions on the number of career and volunteer firefighters. The national projections are made by weighing sample results according to the proportion of total U.S. population accounted for by communities of each size. The *NFPA Fire Service Survey* is a three year cycle survey which attempts to survey about one third of the states each year. The survey includes questions on the number of career firefighters, the number of volunteer firefighters, length of work week, and number of apparatus and stations. In recent years, the survey has had a response rate of about 30 percent.

The following chart (figure 3) compares the number of resources by type of TFD to other communities of similar size in the north central region of the United States[5]. The chart shows

[5] The NFPA statistical data breaks the U.S. into four regional areas: north east, south east, north central, and west. Kansas falls into the north central region and comparison data is taken from that group.

that the department operates a higher number of stations with engine companies, and has a higher than average ratio of aerials to population served.

Figure 3: Comparative Analysis - Resources

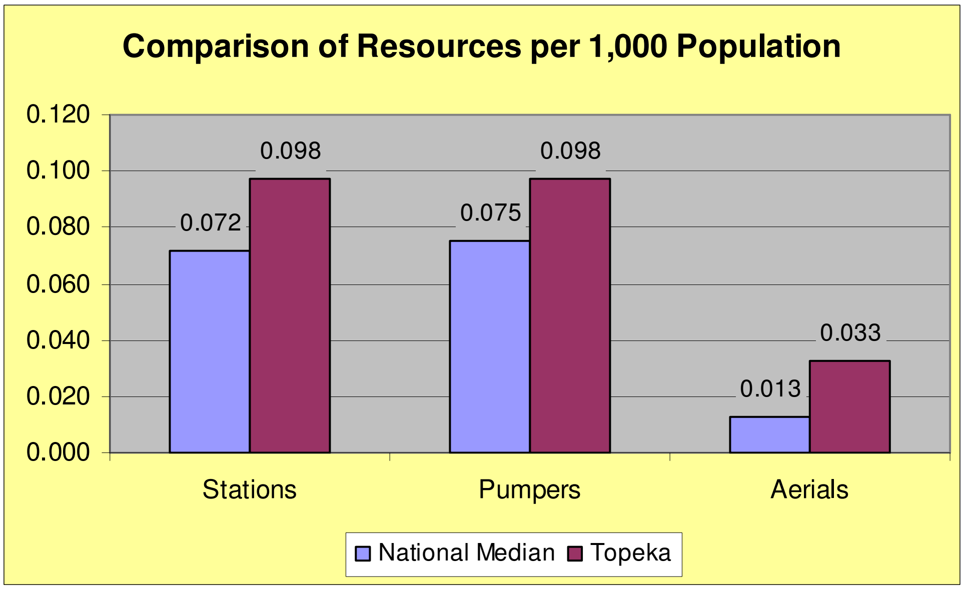
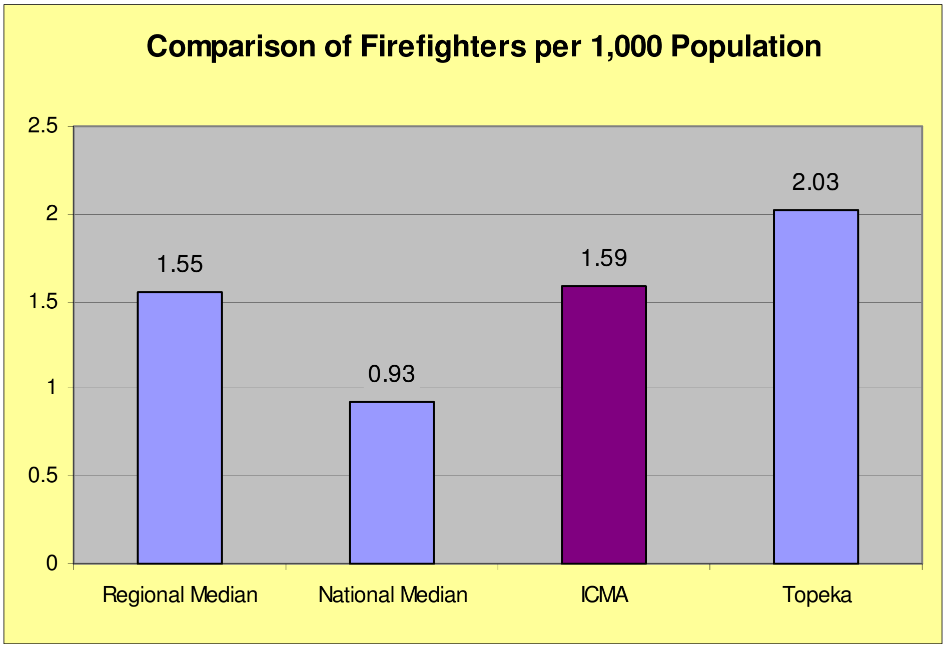


Figure 4 compares the number of firefighters in the department to other communities of similar size in the same region of the United States. Again, this comparison data is from the National Fire Protection Association's (NFPA) *2004 Fire Department Profiles*, as well as the International City Managers Association's (ICMA) public service data tables.

Figure 4: Comparative Analysis - Firefighters



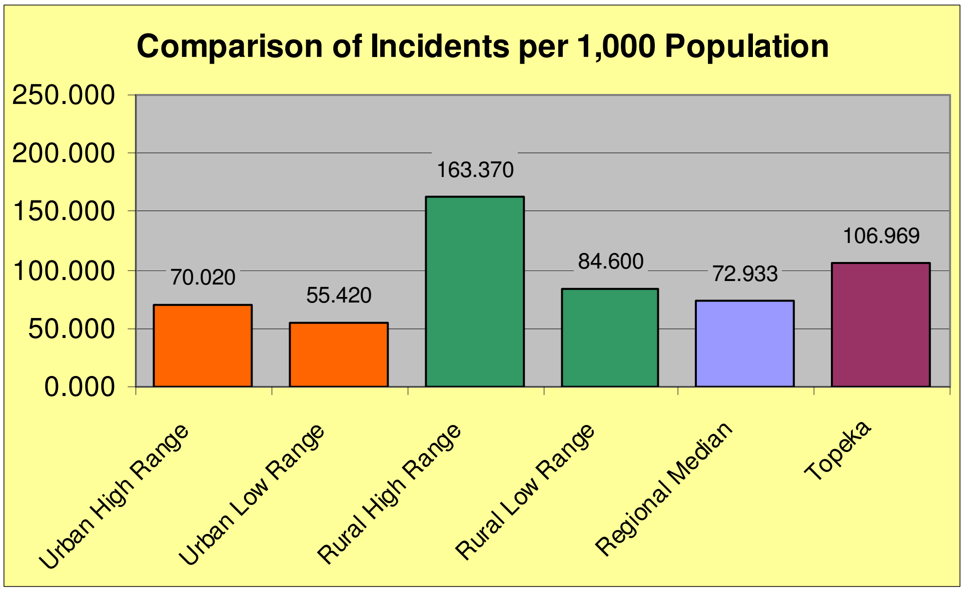
The chart demonstrates that TFD has a higher ratio of firefighters to population served when compared to the regional median figures from NFPA and ICMA. However, there are many mitigating circumstances that must be considered. One of the most important is actual workload, which is also abnormally high in volume in the Topeka response area. The next chart (figure 5) will compare the number of emergency incidents in Topeka to other communities of similar size in the same region of the United States. Additional comparisons are shown for the range of all urban communities studied[6].

The comparison[7] shows TFD with a **much higher** figure than the median benchmark, though it must be remembered that the benchmark study includes departments that do not provide emergency medical services (EMS)[8], and would be expected to have a lower incident workload. Still, we consider the overall ratio of emergency incidents to population to be **higher than normal**. This is most likely due to Topeka's position as a center for industry and transportation,

[6] For purposes of this comparison chart, urban refers to municipalities with populations in excess of 25,000. Rural refers to populations in smaller communities of less than 24,999.
[7] Comparison data is from NFPA Fire Department Profiles, 2004.
[8] The NFPA study, unfortunately, does not separate data for departments that perform EMS and those that do not.

as well as a community with a higher than average population of senior citizens, a condition that generates high volumes of service demand.

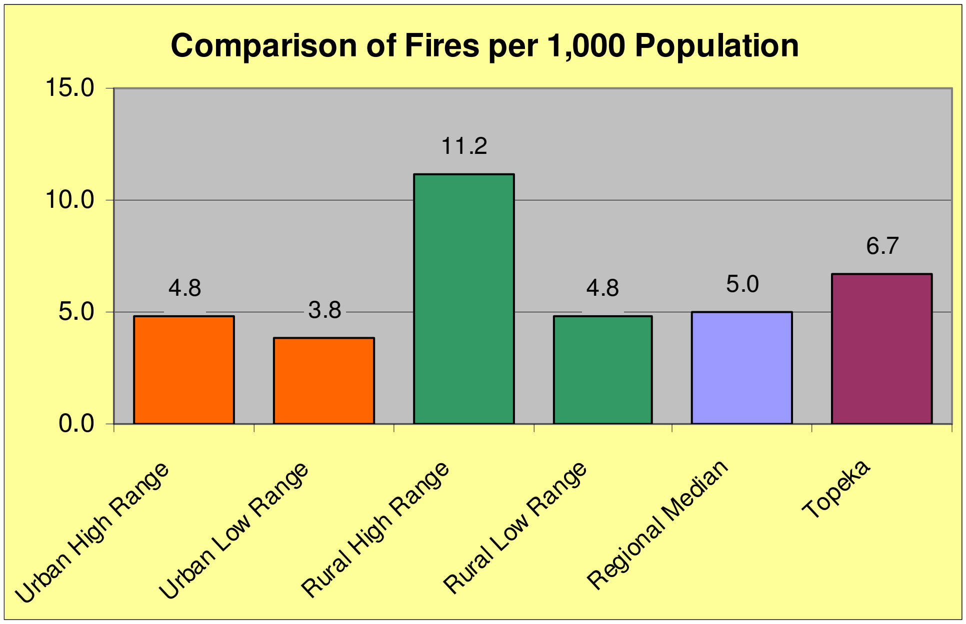
Figure 5: Comparative Analysis - All Incidents



The following chart compares the number of actual fire incidents in TFD's response area to other communities of similar size in the same region of the United States[9]. Additional comparisons are shown for large urban communities and smaller rural communities. The data indicates that, similar to its overall incident volume, TFD experiences a higher than typical number of actual fire incidents.

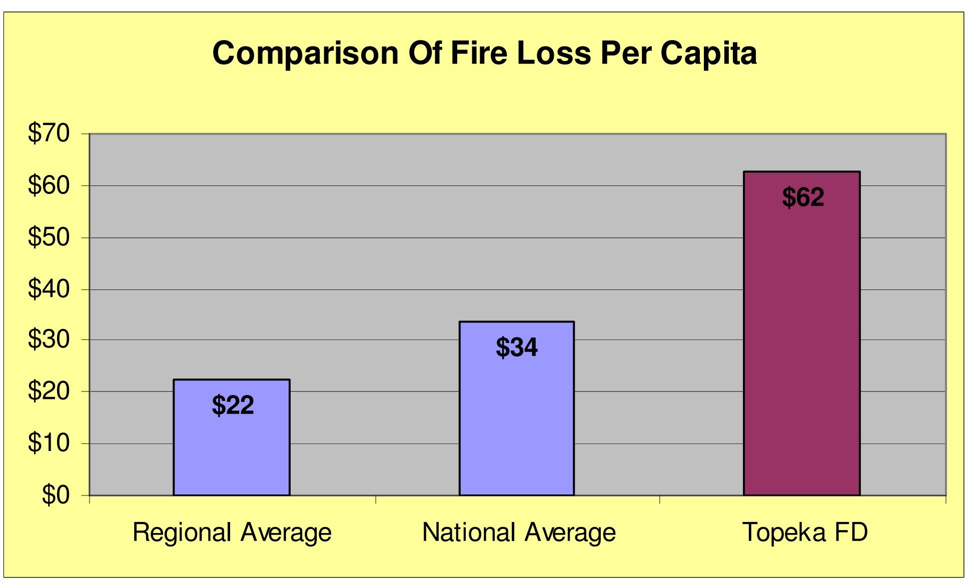
[9] Comparison data is from NFPA *Fire Department Profiles,* 2004.

Figure 6: Comparative Analysis - Fires



An examination of the three-year fire loss average for the community shows a higher level when compared to other similar communities in the region. This is an expected result from the higher quantity of fire incidents the community is experiencing.

Figure 7: Comparison of Fire Loss Per Capita



Chapter 2 - Methodology

Standards of Coverage

Standards of Cover is defined as "…those adopted written policies and procedures that determine the distribution, concentration, and reliability of fixed and mobile response forces for fire, emergency medical services, hazardous materials, and other technical responses."

The purpose of a Standard of Cover document is to provide TFD with a tool for:

- Assessing community fire and non-fire risk
- Defining baseline emergency response performance standards
- Planning future station locations
- Determining apparatus and staffing patterns
- Evaluating workload and ideal unit utilization
- Measuring service delivery performance
- Assisting in the strategic planning and policy development process relative to resource procurement and allocation

The key elements in a Standard of Cover document include:

- A determination of service levels to be provided throughout the fire department
- A community risk assessment that identifies the fire and non-fire risks common and/or unique to the fire department
- An analysis of the fire department's current response capability in terms of time, equipment, and on-scene performance
- A set of recommendations that describe how the fire department resources will be allocated and deployed to maximize emergency response effectiveness throughout the fire department's service delivery area

The concept of Standards of Cover (SOC) is not new to the fire service, or the Topeka Fire Department. In the past, this concept has been referred to simply as fire station location. The current application of this methodology has escalated as a result of the advocacy of the Commission on Fire Accreditation International (CFAI) for a more systematic means of developing fire agency performance, based on data. The SOC methodology, as provided by CFAI, is recognized as the only means of achieving equivalency for response coverage development, other than the outright adoption of other standards that are not based upon local considerations.

The CFAI accreditation process places strong emphasis on self-assessment, with the general premise that the best assessment is a local assessment. The CFAI process outlines a comprehensive and orderly approach to this process. One of the core concepts is the development of a SOC document. Although TFD does not have a formal SOC document at the current time, it is apparent that they will be moving in that direction. Several key components of an SOC document will be provided in this report.

In order to develop a comprehensive facilities, apparatus, and personnel deployment plan, a clear set of performance objectives must be developed. These performance objectives should be specifically based on the various types of emergency risks common to the department's response area. Three important factors must be considered. They are distribution of resources, concentration of resources, and reliability of the response of resources within the system.

A Community Based Risk Assessment is an analytical process of identifying and quantifying key factors within the community, that when combined, define risk in a way that can be compared to the fire department's response capability. These key factors include historical incident analysis, identification of general and specific hazards, identification of community values and their relationship to departmental expectations, and the potential severity, consequence, and frequency of certain events. This comparison provides a valuable strategic planning and resources deployment tool for the department.

A critical step in deployment, and the SOC process, is to identify and categorize risk types that may occur within the area served. In addition, it is appropriate to identify geographic areas of a community where variations in service levels may be appropriate. This is common in planning service delivery for jurisdictions that cover dense, urban areas, as well as more rural or even undeveloped land. Once risk categories and service levels are identified, resources can be deployed to match the risk in the best possible manner. The goal is to ensure sufficient resources are distributed throughout the community in such a manner as to provide adequate response without over committing valuable resources that could be used elsewhere.

Once the service area is subdivided into level of service areas, and risk categories are established for the anticipated types of incidents, the next step is to define a method of measurement to assess delivery capability.

Three concepts are used to measure system performance:

- Distribution (what and where)
- Concentration (how much)
- Reliability (how well)

Combinations of these three concepts provide a method to quantify delivery capability, and give policymakers detailed and useful information for the establishment of response goals. These measurements range from initial receipt of a call at the dispatch center, to the on-scene quantity and performance of firefighting personnel. Measurements are used to document current levels of performance, and establish response time goals and service level objectives for the future. These often result in revised deployment of facilities and resources.

Once performance standards have been established, they must be monitored to ensure that they are being met, or that progress is being made towards established standards. To accomplish this task, a compliance methodology should be developed that will provide monthly, quarterly, and annual feedback.[10]

[10] Compliance methodology is required as part of a CFAI SOC process.

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Chapter 3 - Existing Deployment

Services Provided

The Topeka Fire Department provides a full range of emergency services that are categorized into four areas:

Medical[11]	**Rescue**
Medical aids	Trapped or at risk victims
Multi-victim incidents	Specialty/technical rescue
Mass casualty	Disaster rescue
Fire	**Special Hazards**
Structures/fixed property	Hazardous materials
Mobile property	Airport – structural firefighting[12]

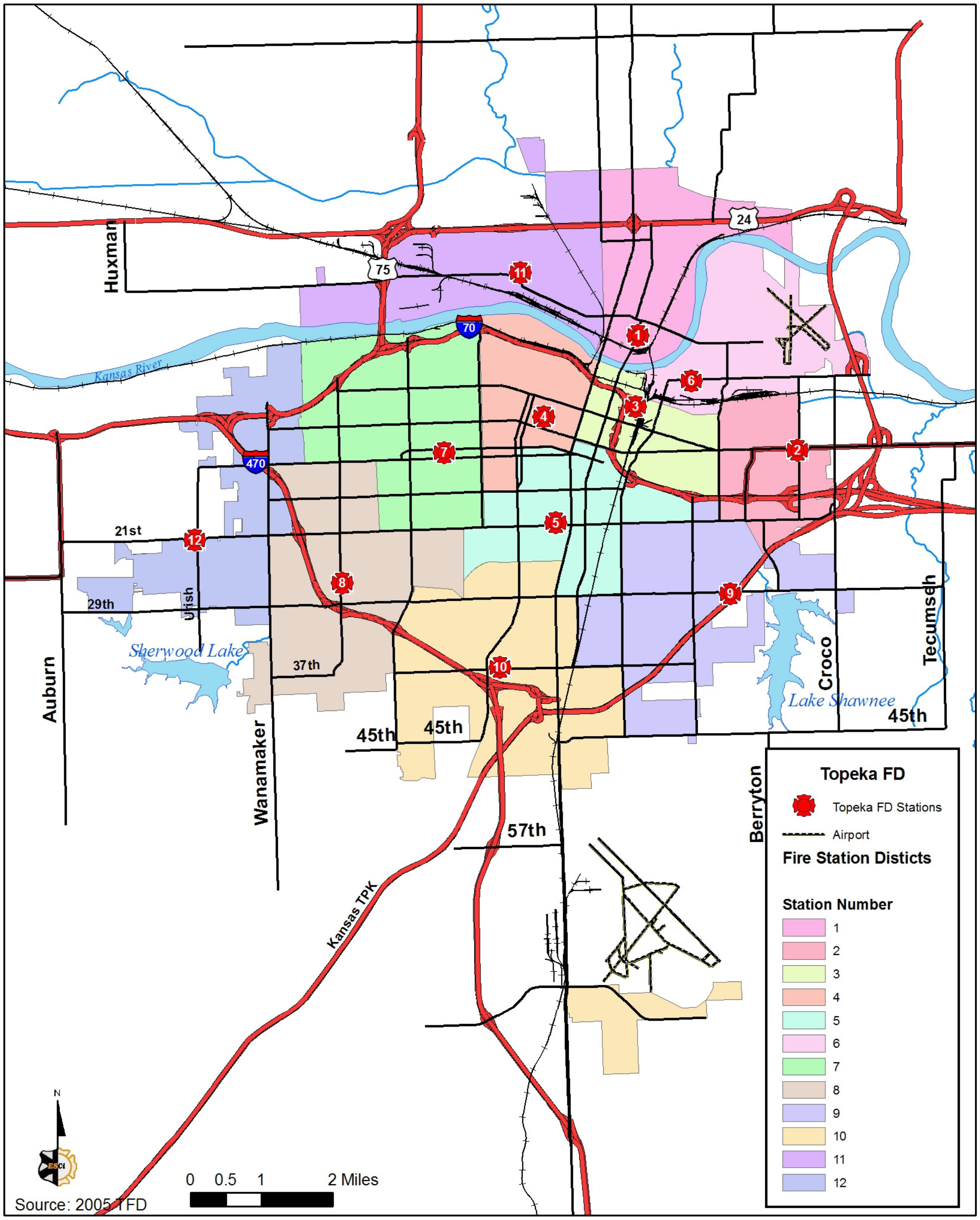
Current Facility Deployment

The department operates out of twelve facilities. The following map (figure 8) depicts these locations. In addition, the map shows the geographic areas assigned to each station as its *first-due* response territory or district using color-coded shading.

[11] Ambulance service and advanced life support emergency medical service response is provided by American Medical Response Ambulance Company

[12] TFD provides structural response to the airport. They have a mutual aid agreement with the Air National Guard, who handles aircraft rescue firefighting duties (ARFF).

Figure 8: Topeka Fire Department Deployment



Both response capability and performance of this present deployment will be thoroughly analyzed and discussed elsewhere in this report.

Current Facility Observations

Fire departments need a balance of three basic resources to successfully carry out their emergency mission - specifically people, equipment, and facilities. Because firefighting is an extremely physical pursuit, the adequacy of personnel resources is a primary concern, but no matter how competent or numerous the firefighters are, the department will fail to execute its mission, if it lacks sufficient fire apparatus distributed in an efficient manner.

The TFD has several million dollars worth of capital assets in its apparatus and facilities. These assets are necessary to provide service, and must be maintained and replaced as needed. Maintenance and replacement plans should be created and maintained for facilities, apparatus, and other high value equipment. A funding mechanism should be established to ensure money is available to cover the cost of this effort.

There are a lot of questions facing a department that has outgrown many of its facilities, and the solutions are more complicated than remodeling or renovating fire stations. While many career fire departments have different facility requirements, there are basic needs each fire station has to address - quick response time, housing of apparatus and equipment, and adequate space for the necessary staff. Everything else depends on the department's budget and needs.

The TFD has twelve stations; the newest built in 1999 and the oldest built in 1927. Some of TFD's older fire stations have not been given any significant updating, and are marginally efficient, providing for only the basic needs of the assigned staff. Consideration should be given to the ability of facilities to support department functions, as they may exist in the future. Inadequate facilities for housing firefighters and apparatus detract from the department's mission. They can significantly limit available options for resource assignment. Inadequate facilities can hinder the ability to maintain a well-trained and fit workforce, and can affect employee morale.

The following pages contain detailed evaluation of each fire station as observed at the time of the field research by ESCi's project team.

STATION # 1
934 NE Quincy St.

Built in the mid thirties, this older facility consists of one apparatus bay. Not designed for two-gender staffing or today's fire apparatus. The station presents many concerns related to maintenance, public access, staff facilities, safety, and efficiency. The station blends nicely with the surrounding community. Because of the age of this structure, consideration should be given to renovation or replacement of this station to meet current standards. Any specific problems with this facility can be classified into the following seven categories.

• Design:	*This one story fire station has had little updating over the years. There is not enough room for the staff and equipment. The day room, kitchen, and apparatus floor are small. This station is not adequately designed for its functions today.*
• Construction:	*Construction design has led to high maintenance costs. HVAC system appears to be adequate. Station is clean and well maintained by the staff. It appears that the overhead front apparatus door may be inadequate for future vehicles.*
• Safety:	*Building is not sprinklered. No automatic monitored fire alarms, local smoke alarms only. Flammable and combustible liquids are not stored in approved cabinets. Overhead doors have a reversible system. Attic only has one means of egress. There are no fire extinguishers located throughout the building. The building has no back up generator.*
• Environment:	*There is an exhaust removal system. No oil separator for apparatus bay drains.*
• Code Compliance:	*Facility has not been upgraded for ADA compliance. The building should have a review of the electrical codes, including fire exit lights.*
• Staff Facilities:	*This station needs some major renovation for the kitchen, day room, locker room, sleeping quarters, showers, and bathroom areas. An exercise area is in the attic with low ceilings and no outside light or ventilation. Very narrow and steep steps to the attic. No office for the company officer.*
• Efficiency:	*Building is not efficient for todays fire service. Limited space utilization. Inadequate storage.*

STATION # 2
619 SE Rice Rd.

Built in 1992, this relatively modern facility consists of two apparatus bays. This station is an up-to-date facility, neat, and has adequate needs for a single company station designed for two gender staffing. Any specific problems with this facility can be classified into the following seven categories.

• Design:	*Aesthetically designed to fit the surrounding community structures. This station appears to meet the five basic design considerations: multipurpose, multi-user, response to the basic responsibilities of the facility, long life (with a fifty year life span), and the ability to maintain flexibility during its life.Water leaks at the entrance doorway are leaking onto the carpeting, window and ceiling leaks appear to be from the roof.*
• Construction:	*Construction design has led to some possible maintenance concerns.*
• Safety:	*Building is partially sprinklered, but out of service at this time. Fire alarm system is monitered at fire dispatch. Flammable and combustible liquids are not stored in approved cabinets. Overhead doors have a reversible system. No fire extinguishers located throughout the building. The building has a back up gasoline portable generator.*
• Environment:	*There is an exhaust removal system. The station has no underground storage tanks. No oil separator for apparatus bay drains.*
• Code Compliance:	*Facility is ADA compliant for the public section of the station.*
• Staff Facilities:	*Adequate, private cubicals in the dorm for staff. Firefighters enjoy a well-equipped workout room. Plenty of room to maneuver around vehicles. Washer and dryer are located in the female locker room. There is enough room for current staff and equipment as a single company station. The day room is small, otherwise the facility is adequately designed for its functions. No office for the company officer.*
• Efficiency:	*Relatively efficient building. Good space utilization.*

STATION # 3
318 SE Jefferson

Built in 1961, this contemporary facility consists of two apparatus bays and rear bay for chief officer. Several concerns related to maintenance, public access, staff facilities, safety, and efficiency are present. This station is an up-to-date facility, is neat, has adequate needs for a two company station, and accomodates two gender staffing. Any specific problems with this facility can be classified into the following seven categories.

• Design:	*Aesthetically designed to fit the surrounding community structures. This station appears to meet the fiver basic design considerations: multipurpose, multi-user, response to the basic responsibilities of the facility, long life (with a fifty year life span), and the ability to maintain flexibility during its life. There is enough room for the current staff and equipment.*
• Construction:	*Construction design has led to maintenance concerns.*
• Safety:	*Building is not sprinklered. No automatic monitored fire alarms, local smoke alarms only. Flammable and combustible liquids are not stored in approved cabinets. Overhead doors have a reversible system. No fire extinguishers located throughout the building.The building has a portable gasoline back up generator.*
• Environment:	*There is an exhaust removal system. The station has no underground storage tanks. No oil separator for apparatus bay drains.*
• Code Compliance:	*Facility has not been upgraded for ADA compliance. The building should have a review of the electrical codes, including fire exit lights.*
• Staff Facilities:	*This station needs some renovation for the kitchen, day room, locker room, sleeping quarters, showers, and bathroom areas. No office for the company officer. An extractor for turnouts installed at this station.*
• Efficiency:	*Building is not efficient for todays fire service.*

STATION # 4
813 SW Clay St.

Built in 1927, this older design, facility consists of two back in apparatus bays. The station presents many concerns related to maintenance, public access, staff facilities, safety, and efficiency. The station blends nicely with the surrounding community. Because of the age of this structure, consideration should be given to renovation or replacement to meet current standards. Any specific problems with this facility can be classified into the following seven categories.

• Design:	*This is the oldest station and has plenty of room for the single company staff and equipment. Accomodates two-gender staffing. The station is not adequately designed for its functions today. It has had a long life span and the ability to maintain flexibility during its life.*
• Construction:	*Well built in its day, but this station is in need of attention due to its age.*
• Safety:	*Building is not sprinklered. No automatic monitored fire alarms, local smoke alarms only. Flammable and combustible liquids are not stored in approved cabinets. Overhead doors have a reversible system. No fire extinguishers located throughout the building. The building has no back up generator.*
• Environment:	*There is an exhaust removal system. The station has no underground storage tanks. No oil separator for apparatus bay drains.*
• Code Compliance:	*Facility has not been upgraded for ADA compliance. The building should have a review of the electrical codes, including fire exit lights.*
• Staff Facilities:	*This station needs some major renovation for the kitchen, day room, locker room, sleeping quarters, showers, and bathroom areas No office for the company officer.*
• Efficiency:	*Building is not efficient for todays fire service. Parking lot is small, but handles shift assignments. Limited space utilization. Inadequate storage.*

STATION # 5
720 SW 21st. St.

Built in 1999, this relatively modern facility consists of four apparatus bays. A structural engineer should evaluate this building due to the sinking slab, possible foundation problems, and cracked walls. Does not adequately accommodate two gender staffing. Additional specific problems with this facility can be classified into the following seven categories.

• Design:	*Aesthetically designed to fit the surrounding community structures. This station does not meet the five basic design considerations: multipurpose, multi-user, response to the basic responsibilities of the facility, long life, and the ability to maintain flexibility during its life if maintained.*
• Construction:	*This station has major foundation problems, sinking and cracking slab floors with signs of many water leaks. Overhead doors are not alligned. Needs attention.*
• Safety:	*Building is not sprinklered. No automatic monitored fire alarms, local smoke alarms only. Flammable and combustible liquids are not stored in approved cabinets. Overhead doors have a reversible system which is OOS. No fire extinguishers located throughout the building. The building has a back up generator. Apparatus exit into traffic flow is not safe.*
• Environment:	*There is an exhaust removal system. The station has no underground storage tanks. No oil separator for apparatus bay drains.*
• Code Compliance:	*Facility is ADA compliant for the public section of the station.*
• Staff Facilities:	*The Battalion Chief's office is compromised and used as an entrance and exit from the locker room. Kitchen and day room are small for two companies. No office for the company officer.*
• Efficiency:	*Parking lot is small, but handles shift assignments. Building is not efficient for todays fire service.*

STATION # 6

1419 NE Seward

Built in 1935, this older facility consists of one apparatus bay. The station presents concerns related to maintenance, public access, staff facilities, safety, and efficiency. The station blends nicely with the surrounding community. Because of the age of this structure, consideration should be given to renovation or replacement to meet current standards. Any specific problems with this facility can be classified into the following seven categories.

• Design:	*Aesthetically designed to fit the surrounding community structures. This station does not meet the three basic design considerations: multipurpose, multi-user, and response to the basic responsibilities of the facility. It has had a long life span and the ability to maintain flexibility during its life.*
• Construction:	*Well built in it's day, but this station is in need of attention.*
• Safety:	*Building is not sprinklered. No automatic monitored fire alarms, local smoke alarms only. Flammable and combustible liquids are not stored in approved cabinets. Overhead doors have a reversible system. No fire extinguishers located throughout the building. The building has no back up generator.*
• Environment:	*There is an exhaust removal system. The station has no underground storage tanks. No oil separator for apparatus bay drains.*
• Code Compliance:	*Facility has not been upgraded for ADA compliance. The building should have a review of the electrical codes, including fire exit lights.*
• Staff Facilities:	*This station needs some major renovation for the kitchen, day room, locker room, sleeping quarters, showers, and bathroom areas. Kitchen and day room are small. A small exercise area is in the basement. Very narrow and steep steps to the attic. No office for the company officer.*
• Efficiency:	*Building is not efficient for todays fire service. Parking lot is small, but handles shift assignments. Limited space utilization. Inadequate storage.*

STATION # 7
1215 SW Oakley

Built in 1935, this older facility consists of two apparatus bays. The station presents some concerns related to maintenance, public access, staff facilities, safety and efficiency. The station blends nicely with the surrounding community. This structure should be reviewed for future remodeling to meet current standards, or replacement. Any specific problems with this facility can be classified into the following seven categories.

• Design:	*There is not enough room for staff and equipment Not designed for two-gender staffing or today's fire apparatus. The day room and kitchen are small. This station does not meet the three basic design considerations: multipurpose, multi-user, and response to the basic responsibilities of the facility. It has had a long life span and the ability to maintain flexibility during its life.*
• Construction:	*Well built in it's day, but this station is in need of attention. Basement floods from the sewer drain with a normal rain.*
• Safety:	*Building is not sprinklered. No automatic monitored fire alarms, local smoke alarms only. Flammable and combustible liquids are not stored in approved cabinets. Overhead doors have a reversible system. No fire extinguishers located throughout the building. The building has no back up generator.*
• Environment:	*There is an exhaust removal system.The station has no underground storage tanks. No oil separator for apparatus bay drains.*
• Code Compliance:	*Facility has not been upgraded for ADA compliance. The building should have a review of the electrical codes, including fire exit lights.*
• Staff Facilities:	*This station needs some major renovation for the kitchen, day room, locker room, sleeping quarters, showers, and bathroom areas. Kitchen and day room are small. No office for the company officer.*
• Efficiency:	*Building is not efficient for todays fire service. Parking lot is small, but handles shift assignments. Limited space utilization. Inadequate storage.*

STATION # 8
2700 SW Fairlawn

Built in 1988 remodeled in 2001, this facility consists of three apparatus bays. This station is an up-to-date facility. It is neat and has adequate needs for a multi company station and is designed for two gender staffing.

Any specific problems with this facility can be classified into the following seven categories.

• Design:	*Aesthetically designed to fit the surrounding community structures. This station appears to meet five basic design considerations: multipurpose, multi-user, response to the basic responsibilities of the facility, long life (with a fifty year life span), and the ability to maintain flexibility during its life.*
• Construction:	*Construction design has led to possible maintenance concerns. History of air conditioning problems*
• Safety:	*Building is not sprinklered. No automatic monitored fire alarms, local smoke alarms only. Flammable and combustible liquids are not stored in approved cabinets. Overhead doors have a reversible system. No fire extinguishers are to date with inspections. The building has no back up generator. No panic bar at basement exit door with exit light. Kitchen counter tops are exposed to high level of heat from stove, possible fire hazard. Water pressure relief valve over man door to apparatus floor is in a poor and unsafe location.*
• Environment:	*There is an exhaust removal system. The station has no underground storage tanks. No oil separator for apparatus bay drains.*
• Code Compliance:	*Facility is ADA compliant for the public section of the station.*
• Staff Facilities:	*Adequate, private cubicals in the dorm for staff. Firefighters enjoy a wel- equipped workout room. Plenty of room to maneuver around vehicles. There is enough room for the current staff and equipment as a two company station. The day room is small, otherwise the facility is adequately designed for its functions. No office for the company officer.*
• Efficiency:	*Relatively efficient building. Good space utilization.*

STATION # 9
2447 SE 29th St.

Built in 1961, this relatively modern, facility consists of two apparatus bays. Presents several concerns related to maintenance, public access, staff facilities, safety, and efficiency. This station is not adequate for a two company station. Accomodates two gender staffing.

Any specific problems with this facility can be classified into the following seven categories.

• Design:	*Aesthetically designed to fit the surrounding community structures. This station does not meet the five basic design considerations: multipurpose, multi-user, response to the basic responsibilities of the facility, long life (with a fifty year life span), and the ability to maintain flexibility during its life.*
• Construction:	*No problems noted.*
• Safety:	*Building is not sprinklered. No automatic monitored fire alarms, local smoke alarms only. Flammable and combustible liquids are not stored in approved cabinets. Overhead doors have a reversible system which is OOS. No fire extinguishers located throughout the building. The building has no back up generator.*
• Environment:	*There is an exhaust removal system. There are no underground storage tanks. No oil separator for apparatus bay drains.*
• Code Compliance:	*Facility is not ADA compliant for the public section of the station.*
• Staff Facilities:	*This station needs some renovation for the kitchen, day room, locker room, sleeping quarters, showers, and bathroom areas. Kitchen and day room are small. Doorway to apparatus floor from kitcken not adequate for safe and rapid response turnout. No office for the company officer.*
• Efficiency:	*Building is not efficient for todays fire service. Parking lot is small, but handles shift assignments. Limited space utilization. Inadequate storage.*

STATION # 10
2010 SW 37th

Built in 1960, this contemporary facility consists of two apparatus bays. This station is not adequate for a two company station. Accomodates two gender staffing. Presents several concerns related to maintenance, public access, staff facilities, safety, and efficiency.

Any specific problems with this facility can be classified into the following seven categories.

• Design:	*There is not enough room for the staff and equipment. The day room, kitchen, and apparatus floor are small. This station is not adequately designed for its function.*
• Construction:	*No problems noted.*
• Safety:	*Building is not sprinklered. No automatic monitored fire alarms- local smoke alarms only. Flammable and combustible liquids are not stored in approved cabinets. Overhead doors have a reversible system. No fire extinguishers located throughout the building. The building has a portable gasoline back up generator.*
• Environment:	*There is an exhaust removal system. The station has no underground storage tanks. No oil separator for apparatus bay drains.*
• Code Compliance:	*Facility is not ADA compliant for the public section of the station.*
• Staff Facilities:	*This station needs some major renovation for the kitchen, day room, locker room, sleeping quarters, showers, and bathroom areas. Kitchen and day room are small. Small station for two companies. No office for the company officer.*
• Efficiency:	*Building is not efficient for todays fire service. Parking lot is small, but handles the shift assignments. Limited space utilization. Inadequate storage.*

STATION # 11
2000 NW Lower Silver Lake Rd.

Built in 1972, this contemporary, facility consists of three apparatus bays. This station is in good condition for suppression personnel. There are no major concerns related to maintenance.

Any specific problems with this facility can be classified into the following seven categories.

• Design:	*Aesthetically designed to fit the surrounding community structures. This station appears to meet five basic design considerations: multipurpose, multi-user, response to the basic responsibilities of the facility, long life (with a fifty year life span), and the ability to maintain flexibility during its life.*
• Construction:	*No problems noted.*
• Safety:	*Building is not sprinklered. No automatic monitored fire alarms - local smoke alarms only. Flammable and combustible liquids are not stored in approved cabinets. Overhead doors have a reversible system. No fire extinguishers located throughout the building. The building has no back up generator.*
• Environment:	*There is an exhaust removal system. The station has no underground storage tanks. No oil separator for apparatus bay drains.*
• Code Compliance:	*Facility is ADA compliant for the public section of the station. No fire exit lights.*
• Staff Facilities:	*This station needs some renovation for the kitchen, day room, locker room, sleeping quarters, showers, and bathroom areas. Kitchen and day room are small. No office for the company officer.*
• Efficiency:	*No major problems noted.*

STATION # 12
2101 SW Urich Rd.

Built in 1996, this relatively modern, facility consists of two apparatus bays. This station presents a few minor concerns related to maintenance.

Any specific problems with this facility can be classified into the following seven categories.

• Design:	*Aesthetically designed to fit the surrounding community structures. This station appears to meet the five basic design considerations: multipurpose, multi-user, response to the basic responsibilities of the facility, long life (with a fifty year life span,) and the ability to maintain flexibility during its life.*
• Construction:	*No problems noted.*
• Safety:	*Building is partiality sprinklered. Automatic monitored fire alarms. Flammable and combustible liquids are not stored in approved cabinets. Overhead doors have a reversible system. No fire extinguishers located throughout the building. The building has a portable back up generator.*
• Environment:	*There is an exhaust removal system. The station has no underground storage tanks. No oil separator for apparatus bay drains.*
• Code Compliance:	*Facility is ADA compliant for the public section of the station.*
• Staff Facilities:	*Adequate, private cubicals in the dorm for staff. Firefighters enjoy a well-equipped workout room. Plenty of room to maneuver around vehicles. Washer and dryer in station. No office for the company officer. There is enough room for the current staff and equipment as a single company station. The day room is small, otherwise the facility is adequately designed for its functions.*
• Efficiency:	*No major problems noted.*

The following table summarizes the overall condition of the current TFD stations.

Figure 9: Summary of Facility Conditions

Station	Year Built	Condition	General Appearance
# 1	Mid-thirties	Old, but maintained, not well-suited for today's fire service	Fair
# 2	1992	Well maintained, some construction problems	Good
# 3	1961	Maintained, needs updating	Fair
# 4	1927	Old, but maintained, not well-suited for today's fire service	Good
# 5	1999	Poor, many structural problems, needs attention	Good
# 6	1935	Old, but maintained, not well-suited for today's fire service	Fair
# 7	1935	Old, but maintained, not well-suited for today's fire service	Fair
# 8	1988/2001	Very good, maintained, some construction problems	Very Good
# 9	1961	Good, maintained	Good
# 10	1960	Fair	Fair
# 11	1972	Very good, well maintained	Good
# 12	1996	Very good, well maintained	Very Good

Current Apparatus Deployment

The deployment of apparatus using the Standards of Response Coverage process involves evaluation of their distribution, concentration, and reliability as it relates to the specific risks within the community being served. For this reason, later sections of this report will have extensive analysis of these factors. However, deployment of apparatus is also discussed in this section to provide a basic understanding of the department's apparatus resources and locations, as well as their relationship to the Community Fire Protection Rating of the Insurance Services Office (ISO).

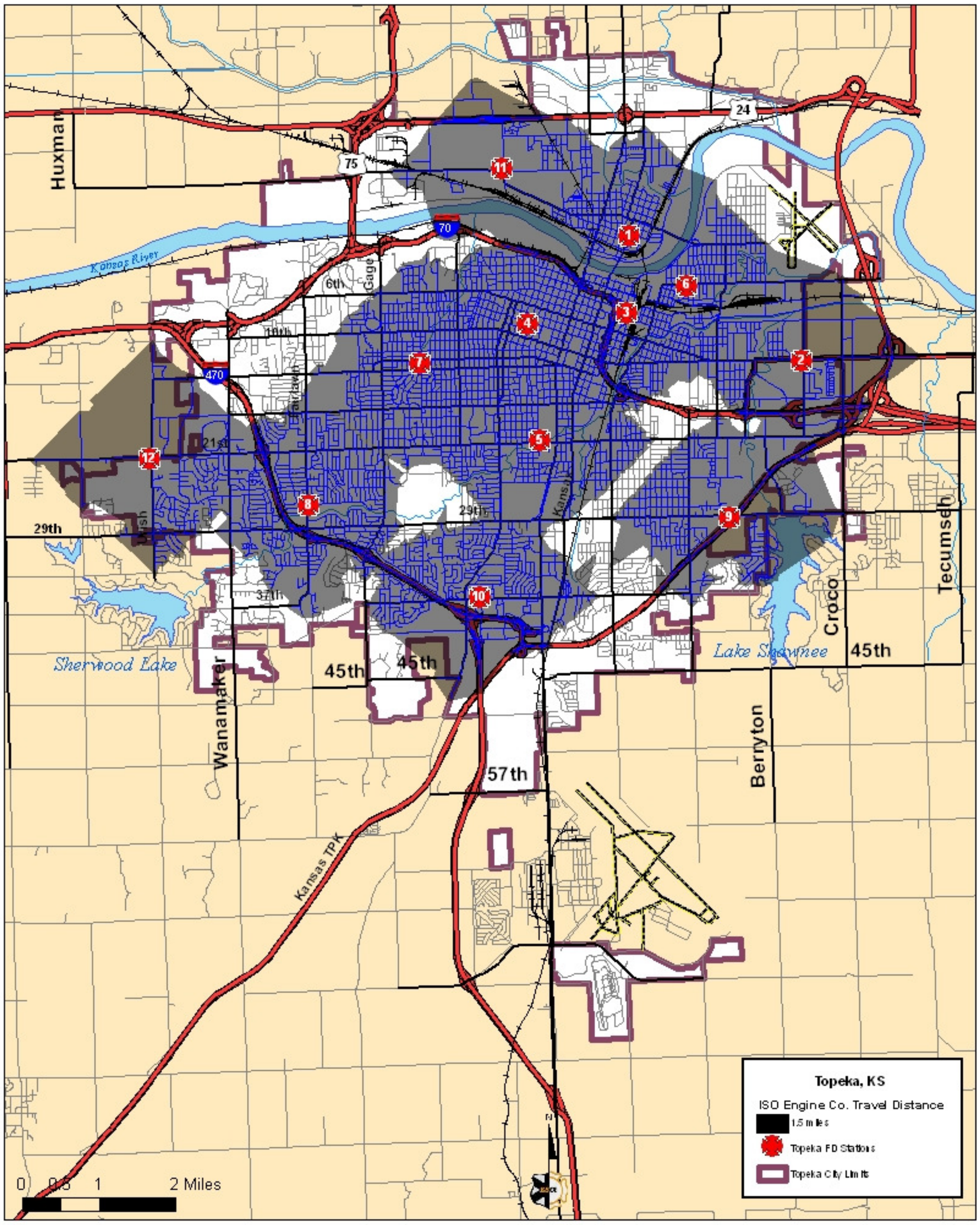
The ISO Community Fire Protection Rating is NOT a performance-based rating system, but is a long-standing program that has a direct affect on local property insurance rates. The system is based on a standard set of fire suppression infrastructure design criteria that does not account for actual response time performance, or even true service demand. Thus, system performance that is actually experienced by the customer has little to do with the ISO rating. For these reasons, ESCi does not utilize ISO as the primary criteria for establishing deployment plans. We do, however, consider the effects of deployment on insurance costs, via the Community Fire Protection Rating, and make every effort to merge optimum true system performance with optimum ISO credit for system design.

As indicated, the analysis of deployment issues related to community risk, performance, resource concentration, and reliability will be found in later sections of the report. Included here is a discussion on basic system layout and ISO credit for current system design.

In order to achieve optimum credit for the number and distribution of engine companies, ISO reviews response areas of each existing engine company and identifies the number of fire hydrants within those response areas. ISO analyzes whether there are additional geographic areas outside of the existing engine response areas where at least 50 percent of the number of hydrants, served by the largest existing response area, could be served by a new engine company were one to be added. If so, additional engine company distribution is recommended. For ISO review purposes, the response area of an engine company is measured at 1.5 miles of travel distance on existing roadways.

The following map (figure 10) displays the locations of engine companies and shows areas of the city that are within 1.5 miles of an existing engine company.

Figure 10: Current Engine Company Deployment and ISO Coverage



In reviewing the apparatus fleet of twelve engine companies in comparison to target levels established by the Insurance Services Organization for optimum credit, TFD likely operates sufficient engines as required at this time. Findings in this regard are, to at least some degree, validated by the department's *Improvement Statements* resulting from the most recent

Community Fire Protection Rating from ISO. This document indicates that, for maximum credit[13], Topeka requires twelve properly equipped engine companies.

However, hydrant locations were also made available by the City for analysis, and it appears that TFD may have an issue regarding distribution of these twelve engines. The analysis indicated that only 72 percent of the City's hydrants are within 1.5 miles of an engine, and that there may be areas not covered that are, individually, likely to be large enough to contain more than 50 percent of the number of hydrants found within the average engine company coverage. The map indicates such a gap is likely between Engines 7, 11, and 12. Conversely, there is indication of significant overlap in the coverage of Engines 3, 4, and 6.

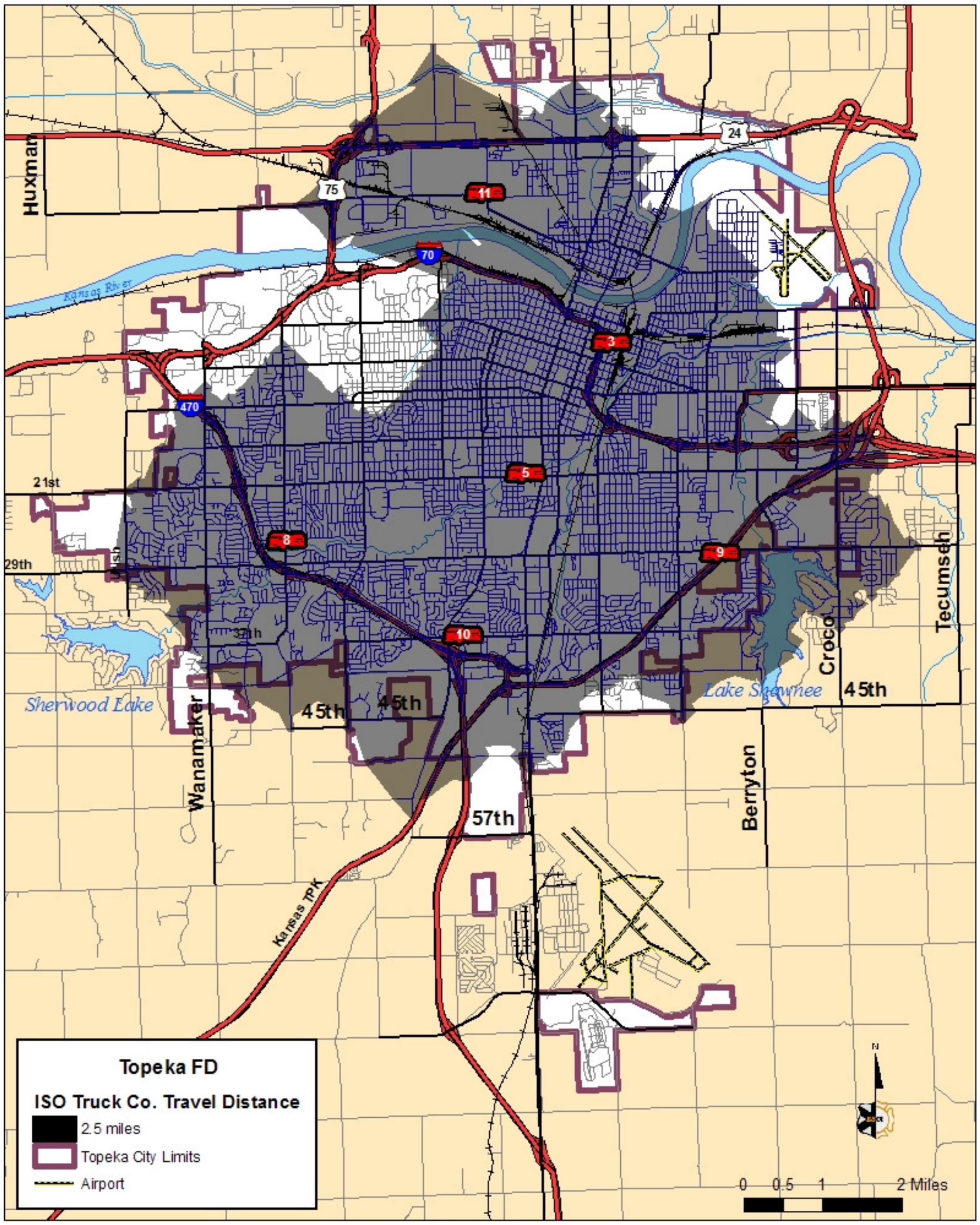
Based on this analysis, it is likely that the ISO recommendation for twelve engines is adequate to meet optimum credit, but that the distribution of Topeka's twelve engines could be improved. Again, this finding corresponds with the most recent Community Fire Protection Rating from ISO. This document indicated that Topeka received only 2.46 points out of a possible four points for distribution of companies.

In order to achieve optimum credit for the number and distribution of ladder/service companies (commonly called truck companies), ISO reviews the response areas of each existing ladder/service company, and identifies the number of fire hydrants within those response areas. As before, ISO analyzes whether there are additional geographic areas of the district outside of the existing ladder/service response areas where at least 50 percent of the number of hydrants served by the largest existing response area could be served by a new ladder/service company, were one to be added. If so, additional ladder/service company distribution is recommended. For ISO review purposes, the response area of a ladder/service company is measured at 2.5 miles of travel distance on existing roadways.

The following map (figure 11) displays the locations of ladder/service companies, and shows areas of the city that are within 2.5 miles of an existing ladder/service company.

[13] Maximum credit referred to is for Item 513, *Credit for Engine Companies* in the ISO rating schedule.

Figure 11: Current Ladder/Service Company Deployment and ISO Coverage



In reviewing the apparatus fleet of six ladder/service companies in comparison to target levels established by the ISO for optimum credit, TFD likely operates less than the required number of ladder/service companies at this time. Findings in this regard are, to at least some degree, validated by the department's *Improvement Statements* resulting from the most recent ISO

Community Fire Protection Rating. The document indicated that, for maximum credit[14], Topeka requires seven properly equipped ladder/service companies.

As previously indicated, hydrant locations were made available for analysis, and it appears that TFD may have issues regarding both quantity and distribution of these six ladder/service companies. The analysis indicates that only 85 percent of the City's hydrants are within 2.5 miles of a ladder/service company, and that there are areas not covered that are, individually, large enough to contain more than 50 percent of the number of hydrants found within the average ladder/service company coverage. The map indicates such a gap is likely between trucks at Stations #5, #8, and #11.

Based on this analysis, it is likely that the ISO recommendation for seven ladder/service companies is adequate to meet optimum credit at this time, and that the distribution of Topeka's six ladder/service companies clearly cannot meet the requirement. Again, this finding corresponds with the most recent ISO Community Fire Protection Rating, which indicated that Topeka received only 2.46 points out of a possible four points for distribution of companies.

Current Apparatus Observations

The TFD maintains a fleet of response vehicles that is well maintained, though nearly half the fleet is in excess of the front-line lifespan[15] for its type. The average age of apparatus is six years, and average condition is considered good. The department needs to make apparatus replacement a significant issue in both the short and long-term to ensure continued reliability for emergency service use.

The following chart lists all primary heavy apparatus used by the TFD, excluding smaller commercial-style utility or staff vehicles. It includes the year of manufacture and roughly estimated replacement-funding requirements based on life expectancy.

[14] Maximum credit referred to is for Item 513, *Credit for Engine Companies* in the ISO rating schedule.
[15] Apparatus useful life as established by ESCi for benchmarking vehicle condition by type and use. Not to be considered an industry standard. Based on actual conditions, vehicle life may be shorter or longer.

Figure 12: Topeka Fire Department Apparatus Replacement Funding

UNIT	YEAR	REPLACEMENT COST	ANNUAL FUND CONTRIBUTIONS	CURRENT CASH REQUIREMENTS
Engine 1	2005	$ 335,000	$ 22,333	$ 22,333
Engine 2	2001	$ 335,000	$ 22,333	$ 111,667
Engine 3	1995	$ 335,000	$ 22,333	$ 245,667
Truck 3	1998	$ 435,000	$ 29,000	$ 232,000
Engine 4	2003	$ 335,000	$ 22,333	$ 67,000
Engine 5	2005	$ 335,000	$ 22,333	$ 22,333
Aerial 5	1995	$ 875,000	$ 43,750	$ 481,250
CAT 5	1987	$ 140,000	NA	$ 140,000
Engine 6	1999	$ 335,000	$ 22,333	$ 156,333
Engine 7	1996	$ 335,000	$ 22,333	$ 223,333
Engine 8	2002	$ 335,000	$ 22,333	$ 89,333
Aerial 8	1998	$ 875,000	$ 43,750	$ 350,000
Haz-Mat 8	2005	$ 435,000	$ 29,000	$ 29,000
Engine 9	2001	$ 335,000	$ 22,333	$ 111,667
Truck 9	1997	$ 435,000	$ 29,000	$ 261,000
Engine 10	1998	$ 335,000	$ 22,333	$ 178,667
Truck 10	2004	$ 435,000	$ 29,000	$ 58,000
Engine 11	1992	$ 335,000	$ 22,333	$ 312,667
Truck 11	2000	$ 435,000	$ 29,000	$ 174,000
Engine 12	1996	$ 335,000	$ 22,333	$ 223,333
TOTALS			***$ 500,500***	***$ 3,489,583***

Does Not Include Reserve Vehicles

This chart shows that in order to meet apparatus replacement needs of current resources, $500,500 should be contributed to a reserve fund each year. Also, based on the age and replacement schedule of apparatus in use today, there should be $3,489,583 available in a reserve fund. This is based on a continuation of the current number and type of apparatus that TFD maintains.

It should be noted that the chart represents funding levels needed for a capital replacement fund that is both adequate and up-to-date, assuring cash is available for purchase at the expected time of replacement. This is not meant to exclude other funding methods from consideration. For instance, during time periods when the market provides low rates, municipal lease-purchase programs can be financially efficient.

Each piece of primary fire suppression apparatus was given a basic review for condition and safety. The following paragraphs describe any notations made during this review.

Engine - 1

2005 Crimson Custom Engine

Seating Capacity: 4
Pump Capacity: 1250
Tank Capacity: 750
Condition: Excellent

Additional Comments or Observations: No problems noted. Equipment is neat and mounted securely. Fire extinguishers are not annually inspected.

Engine - 2

2001 Luverne Custom Engine

Seating Capacity: 4
Pump Capacity: 1250
Tank Capacity: 750
Condition: Excelent

Additional Comments or Observations: Unit very clean, some problems with pump panel head set. Equipment is neat and mounted securely. Fire extinguishers are not annually inspected.

Engine - 3

1995 E - 1 Custom Engine

Seating Capacity: 4
Pump Capacity: 1250
Tank Capacity: 500
Condition: Good

Additional Comments or Observations: No problems noted. Equipment is neat and mounted securely. Fire extinguishers are not annually inspected.

Truck - 3

1998 E - 1 Custom Service Truck

Seating Capacity: 4
Pump Capacity: N/A
Tank Capacity: N/A
Condition: Good

Additional Comments or Observations: No problems noted. Equipment is neat and mounted securely.

Engine - 4

2003 Luverne Custom Engine

Seating Capacity: 4
Pump Capacity: 1250
Tank Capacity: 750
Condition: Excellent

Additional Comments or Observations: Rear discharge on driver's side leaks. Equipment is neat and mounted securely. Fire extinguishers are not annually inspected.

Engine - 5

2005 Crimson Custom Engine

Seating Capacity: 4
Pump Capacity: 1250
Tank Capacity: 750
Condition: Excellent

Additional Comments or Observations: No problems noted. Equipment is neat and mounted securely. Fire extinguishers are not annually inspected.

Aerial - 5

1995 Pierce Arrow Custom Ladder

Seating Capacity: 4
Pump Capacity: N/A
Tank Capacity: N/A
Condition: Fair

Additional Comments or Observations: Equipment is not mounted securely. Fire extinguishers are not annually inspected. This The paint is lifting at areas where there are incompatible metals.

CAT - 5

1987 Pierce Commercial Light & Air Unit

Seating Capacity: 4
Pump Capacity: N/A
Tank Capacity: N/A
Condition: Fair

Additional Comments or Observations: No problems noted. Equipment is not mounted securely. Fire extinguishers are not annually inspected.

Engine - 6

1999 Central States Custom Engine

Seating Capacity: 4
Pump Capacity: 1250
Tank Capacity: 500
Condition: Good

Additional Comments or Observations: No problems noted. Fire extinguishers are not annually inspected.

Engine - 7

1996 E - 1 Custom Engine

Seating Capacity: 4
Pump Capacity: 1250
Tank Capacity: 750
Condition: Good

Additional Comments or Observations: Structural crack in rear compartment body frame bracket – driver's side. Equipment is not mounted securely. Fire extinguishers are not annually inspected.

Engine - 8

2002 Laverne Custom Engine

Seating Capacity: 4
Pump Capacity: 1250
Tank Capacity: 750
Condition: Excellent

Additional Comments or Observations: No problems noted. Equipment is neat and mounted securely. Fire extinguishers are not annually inspected.

Aerial - 8

1998 HME / Ferrara Custom Ladder

Seating Capacity: 4
Pump Capacity: N/A
Tank Capacity: N/A
Condition: Fair

Additional Comments or Observations: History of electrical problems; batteries have a short life and are replaced often. Possible axle problems related to weight distribution. Equipment is neat and mounted securely. Fire extinguishers are not annually inspected.

Haz-Mat - 8

2005 Ford Commercial Flatbed truck & 5th wheel

Seating Capacity: 2
Pump Capacity: N/A
Tank Capacity: N/A
Condition: Good

Additional Comments or Observations: This unit may have possible weight concerns, truck may be too light for trailer. Equipment is neat and mounted securely.

Engine - 9

2001 E - 1 Custom Engine

Seating Capacity: 4
Pump Capacity: 1250
Tank Capacity: 750
Condition: Escellent

Additional Comments or Observations: No problems noted. Equipment is neat and mounted securely. Fire extinguishers are not annually inspected.

Truck - 9

1997 E - 1 Custom Service Truck

Seating Capacity: 4
Pump Capacity: N/A
Tank Capacity: N/A
Condition: Good

Additional Comments or Observations: No problems noted. Equipment is neat and mounted securely. Fire extinguishers are not annually inspected.

Engine - 10

1998 Ferrara Custom Engine

Seating Capacity: 4
Pump Capacity: 750
Tank Capacity: 1250
Condition: Good

Additional Comments or Observations: No problems noted. Equipment is neat and mounted securely. Fire extinguishers are not annually inspected.

Truck - 10

2004 Crimson Custom Service Truck

Seating Capacity: 4
Pump Capacity: N/A
Tank Capacity: N/A
Condition: Excellent

Additional Comments or Observations: No problems noted. Equipment is neat and mounted securely. Fire extinguishers are not annually inspected.

Engine - 11

1992 E - 1 Custom Engine

Seating Capacity: 4
Pump Capacity: 1250
Tank Capacity: 750
Condition: Good

Additional Comments or Observations: No problems noted. Equipment is neat and mounted securely. Fire extinguishers are not annually inspected.

Truck - 11

2000 HME Custom Service Truck

Seating Capacity: 4
Pump Capacity: N/A
Tank Capacity: N/A
Condition: Excellent

Additional Comments or Observations: No problems noted. Equipment is neat and mounted securely. Fire extinguishers are not annually inspected.

Engine - 12

1996 E - 1 Custom Engine

Seating Capacity: 4
Pump Capacity: 1250
Tank Capacity: 750
Condition: Good

Additional Comments or Observations: No problems noted. Equipment is neat and mounted securely. Fire extinguishers are not annually inspected.

Aerial - 1 Reserve

1980 Pierce Arrow Custom Ladder

Seating Capacity: 4
Pump Capacity: N/A
Tank Capacity: N/A
Condition: Fair

Additional Comments or Observations: Equipment is loose and not secured. Fire extinguishers are not annually inspected.

Engine - 4 Reserve

1992 E - 1 Custom Engine

Seating Capacity: 4
Pump Capacity: 1250
Tank Capacity: 750
Condition: Fair

Additional Comments or Observations: Equipment is neat and mounted securely. Fire extinguishers are not annually inspected.

Truck - 1 Reserve

1990 E - 1 Custom Service Truck

Seating Capacity: 4
Pump Capacity: N/A
Tank Capacity: N/A
Condition: Serviceable

Additional Comments or Observations: Equipment is neat and mounted securely. Fire extinguishers are not annually inspected.

Current Staffing Deployment

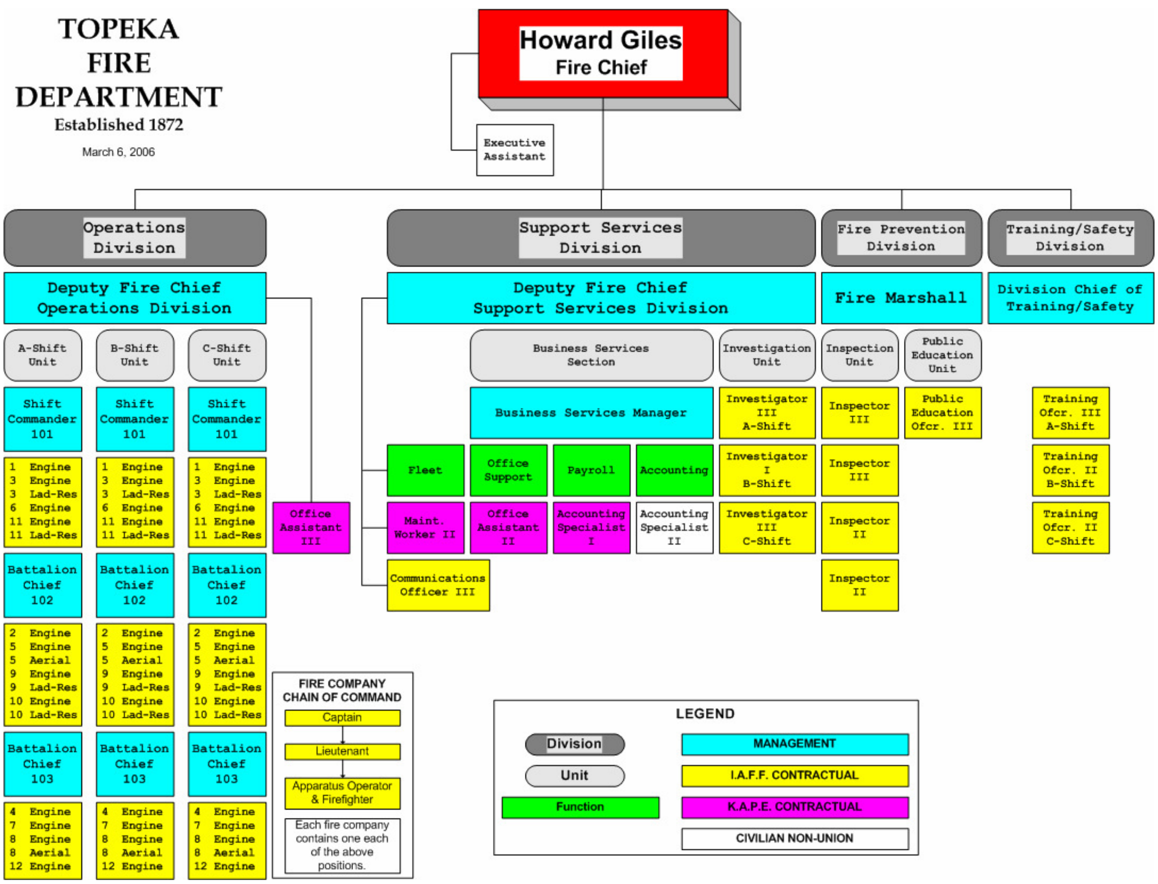
The department uses full-time career personnel to accomplish its mission and responsibilities to the City. Administrative functions are generally the responsibility of staff officers with support functions provided by administrative employees. Staffing for emergency response to fire, emergency medical, hazardous materials, technical rescues and other related incidents is provided by career personnel on 24-hour, rotating shifts.

Administration and Support Staff

One of the primary responsibilities of the department's administration and support staff is to ensure that the operational entities of the organization have the ability and means to accomplish their responsibilities on an emergency incident. Efficient and effective administration and support are critical to the success of the department. Without sufficient oversight, planning, documentation, training, and maintenance, the operational entities of the department will fail any operational test. Like any other part of the department, administration and support require appropriate resources to function properly.

Analyzing the ratio of administration and support positions to the total positions of the department facilitates an understanding of the relative number of resources committed to this important function. The appropriate balance of the administration and support component to the operational component is crucial to the success of the department's mission and responsibilities. The administration and support complement of the TFD is comprised of the fire chief and four divisions as depicted in the following figure.

Figure 13: TFD Administrative/Support Personnel



The following figure summarizes the personnel FTEs (full-time equivalents) assigned to administration and support.

Figure 14: Administrative/Support Staffing Summary

Administrative / Support Personnel	
Position Title	***Number (FTE)***
Fire Chief	1.00
Accounting Specialist II	1.00
Communications Officer III	1.00
Business Services Manager	1.00
Maintenance Worker II	1.00
Executive Assistant	1.00
Accounting Specialist II	1.00
Office Assistant II	1.00
Office Assistant III	1.00
Deputy Fire Chief	2.00
Training Officer	3.00
Division Chief	2.00
TOTAL	**16.00**

The administration and support staff for TFD is comprised of an authorized complement of 16 FTEs. Each organization should determine the proper ratio of administration and support staff to operational positions dependent upon local need. Statistically, TFD maintains a ratio of 6.9 percent of administration and support staff to total personnel.

Based on ESCi's experience with similar organizations, we have determined emergency service departments usually maintain a 10 to 15 percent ratio of administration and support. The TFD administrative and support staffing level is well below this comparison range, primarily due to the lack of executive and clerical support for staff personnel.

Emergency Services Staff

It takes an adequate and well trained staff of emergency responders to put the appropriate emergency apparatus and equipment to its best use in mitigating incidents. Insufficient staffing at an operational scene decreases the effectiveness of the response and increases the risk of injury to all individuals involved. The following figures summarize the career personnel assigned to *street-level* service delivery.

Figure 15: Field Operations Career Staffing Summary

Operations / Field Personnel	
Position Title	***Number (FTE)***
Shift Commander	3.00
Battalion Chief	6.00
Fire Captain	54.00
Fire Lieutenant	54.00
Apparatus Operator	54.00
Firefighter	54.00
Fire Inspectors	4.00
Fire Investigators	3.00
Public Educator	1.00
TOTAL	**233.00**

Regardless of the raw numbers of personnel available to a department, what matters most is actual numbers of emergency responders the agency is able to produce at an emergency scene. This almost always relates to the actual number of emergency responders available for immediate deployment. While the TFD career staffing system distributes up to 75 personnel on each of three shifts city-wide, it is important to note that this number is not necessarily reflective of the actual number of personnel on-duty. Due to sick leave, vacation, injuries, and other circumstances, the actual number of on-duty personnel often falls below the number assigned to a shift. TFD policy allows the shift staffing level to fall to a minimum of 59 personnel.

TFD personnel, assigned to operational duty, work a 24/24 rotating work schedule involving three different shifts (A, B, & C). This results in an annual average of 56 hours per week. An example of a 14 day rotating shift schedule is as follows:

A	**C**	**A**	**B**	**A**	**B**	**C**	**B**	**C**	**A**	**C**	**A**	**B**	**A**	**B**	**C**	**B**	**C**

The following chart summarizes the assignment of operational personnel by station and position per shift.

Figure 16: Minimum Operational Personnel by Station & Position per Shift

Station	Shift Commander	Battalion Chief	Captain	Lieutenant	App Optr/ FF	Total
One			1	1	1	3
Two			1	1	1	3
Three	1		2	2	2	7
Four			1	1	1	3
Five		1	2	2	2	7
Six			1	1	1	3
Seven			1	1	1	3
Eight			2	2	2	6
Nine			2	2	2	6
Ten			2	2	2	6
Eleven			2	2	2	6
Twelve		1	1	1	1	4
Shift	**1**	**2**	**18**	**18**	**18**	**57**

Current Staffing Observations

Topeka Fire Department provides a consistent, career staffing for all assigned apparatus. Engines and ladder trucks are staffed with three personnel each. All 9-1-1 calls received reporting smoke or fire are answered with a task force of two engines, two ladder/service trucks, and one shift chief; a total of 13 personnel.

Adequate staffing for a low-risk incident may be available from initial response from the stations at the time of dispatch. However, current procedures do not provide consistent four-person engine company staffing as outlined by *NFPA 1710*[16]. Four-person companies can only be assembled by combining the crews from multiple units arriving at the incident.

This issue is significant whenever there is an incident that involves the use of self-contained breathing apparatus (SCBA) due to the potential for an atmosphere considered *Immediately Dangerous to Life and Health* (IDLH). In such cases, OSHA regulations (29 CFR *Respiratory Protection* - 1910.134[g][4], *Procedures for Interior Structural Firefighting – two in, two out*) would require the presence of at least four persons in air packs. Based on these comparisons, TFD may wish to reconsider its standard response assignment to certain types of calls, by re-evaluating its critical tasking analysis on incidents involving required use of SCBAs.

[16] *National Fire Protection Association 1710: Organization and Deployment of Fire Suppression Operations, Emergency Medical Operations, and Special Operations to the Public by Careers Fire Departments*, 2004.

Additional observations regarding current staffing capability will be discussed in the analysis of resource concentration, with consideration of the department's ability to assemble adequate numbers of staff within effective time parameters.

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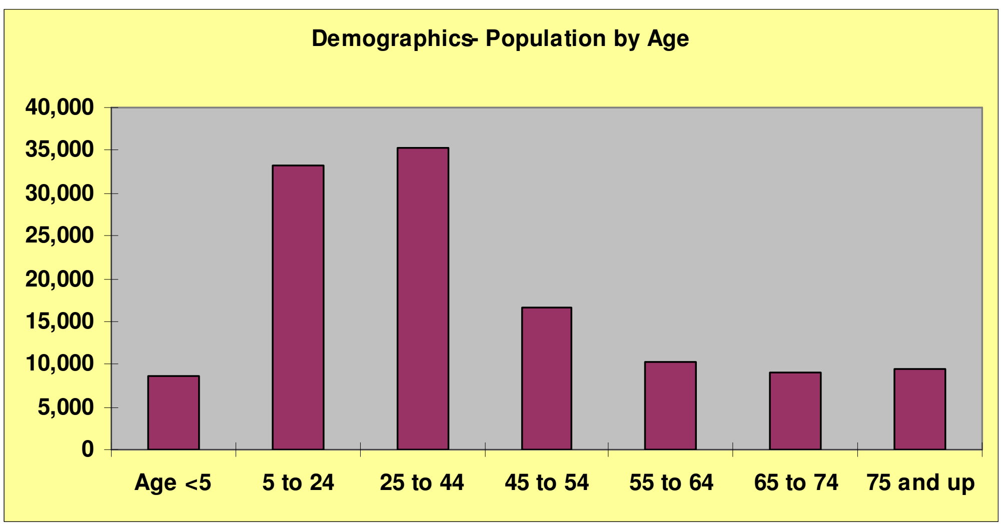
Chapter 4 - Community Risk, Population, and Service Demand

Current Population Information

The population of the entire service area of TFD was 122,377 in the 2000 United States Census. However, the Census Bureau has estimated some slight decline since the 2000 Census, with the City population estimated at 121,809 in 2004[17]. For the City, this population figure represents a modest 1.6 percent increase over the 1990 Census, when the population of Topeka was 119,883. The most significant portion of growth within the City has clearly occurred through additional housing development, since over 13 percent of the total housing in Topeka has been built since 1990[18].

The following figures provide some general demographic information on population and housing for the entire area served by the department[19].

Figure 17: Topeka Population by Age

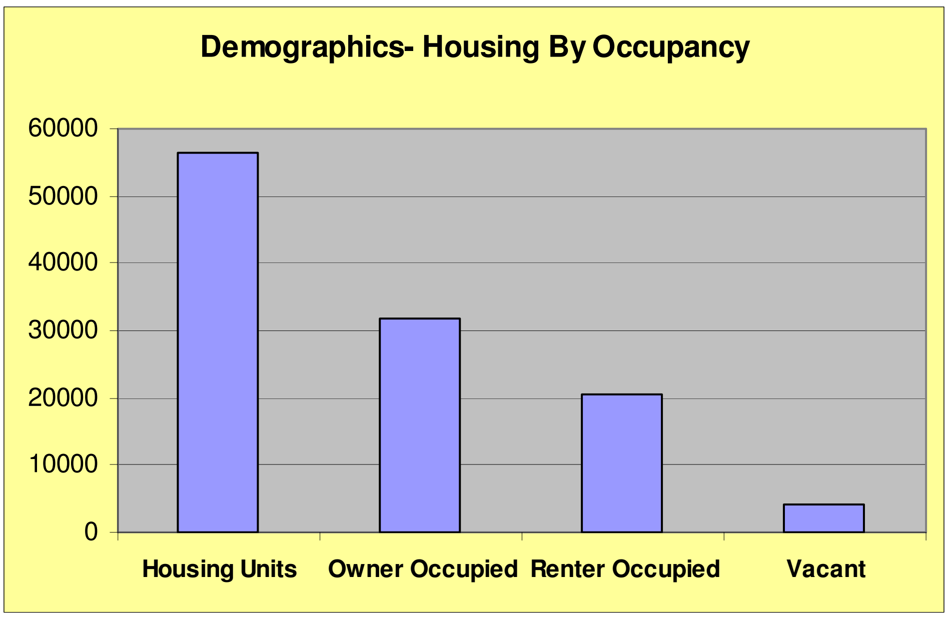


Selected Demographic Information- 1990 to 2000								
	Total Pop	Age <5	5 to 24	25 to 44	45 to 54	55 to 64	65 to 74	75 and up
2000	122,377	8,615	33,170	35,322	16,553	10,299	9,031	9,387
1990	119,883	8,864	32,520	38,836	10,968	11,014	9,623	8,058
change	2%	-3%	2%	-9%	51%	-6%	-6%	16%

[17] Population estimate for 2004 is from the U.S. Census Bureau Population Estimates Program.
[18] Data from the 2000 U.S. Census Bureau Table SF-3.
[19] Data from the 2000 U.S. Census Bureau Table SF-1.

As can be seen from figure 17, fifteen percent of the population is 65 years of age or older, and seven percent of the population is under five years of age, placing a total of 22 percent of the area's population within the significant target age groups that pose the highest risk in residential fire incidents. It is also worth noting that the number of residents over the age of 65 has increased by 16 percent since 1990, a change that can be expected to create a significant increase in service demand for emergency medical incidents. Within 20 years, the age group of 45-54 will be entering the ages which typically account for a higher percentage of EMS requests.

Figure 18: Topeka Housing by Occupancy

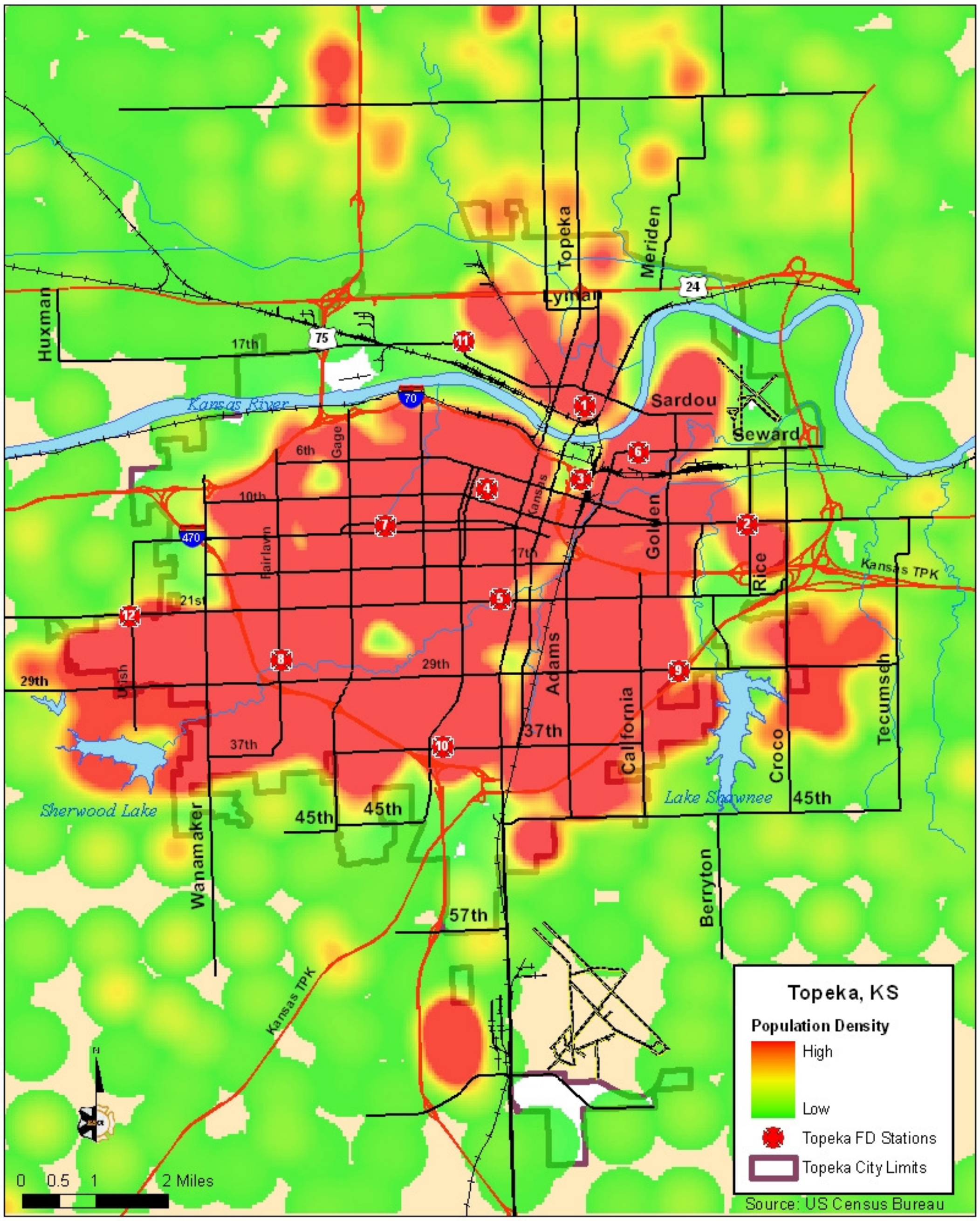


Selected Housing Information- 1990 to 2000				
	Housing Units	Owner Occupied	Renter Occupied	Vacant
2000	56435	31685	20505	4245
1990	49936	30353	19583	4726
change	13%	4%	5%	-10%

From the demographic information reviewed here, it is projected that Topeka could experience a higher than normal demand for emergency services, in comparison with other communities of its size, due to the aging population figures and loss of younger population groups.

It is also useful to assess distribution of the population within Topeka, since there is a direct correlation between population density and service demand. The following map displays population density of the City, based on information from the 2000 Census.

Figure 19: Topeka Population Density



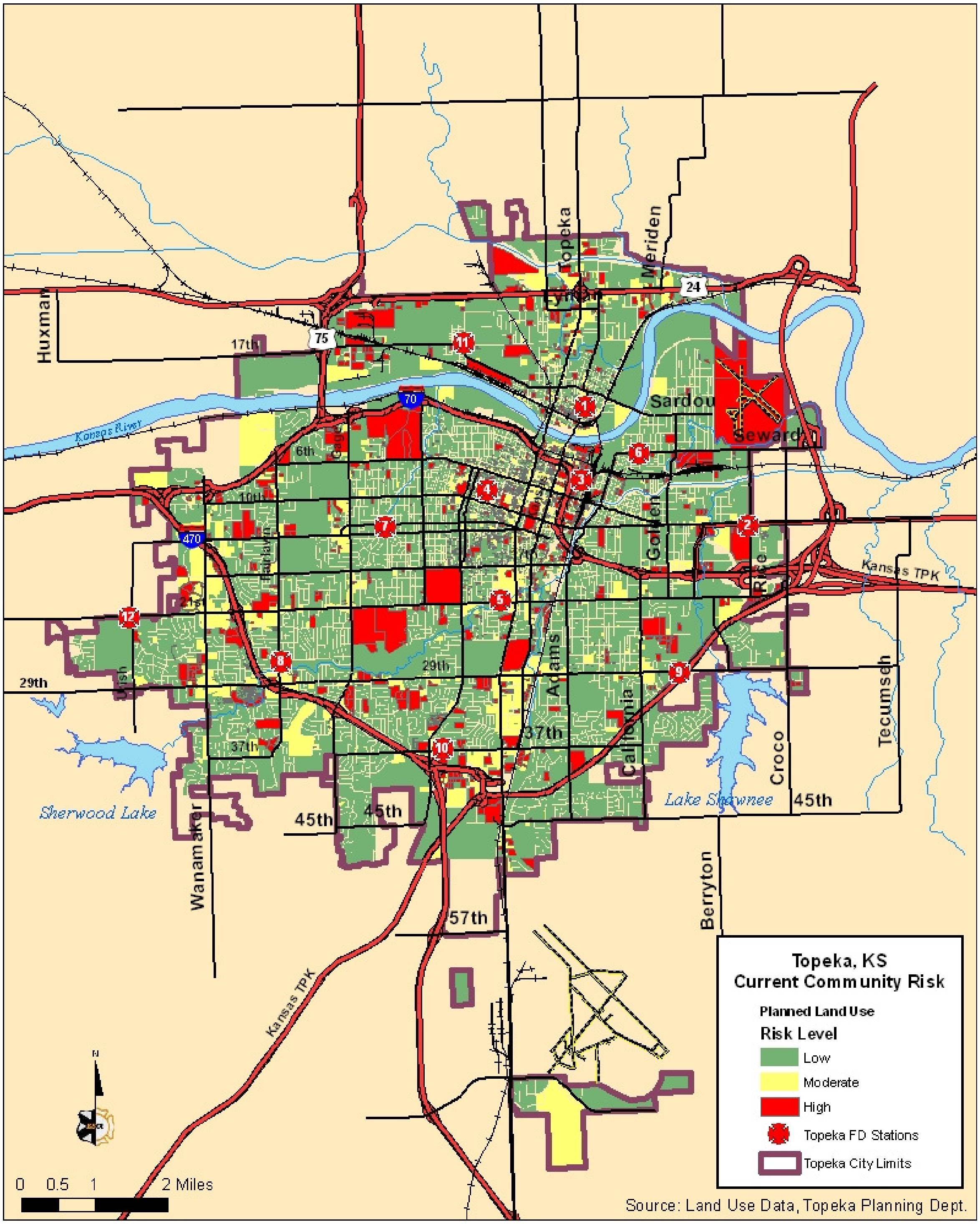
Community Risk

The fire service assesses the relative risk of properties based on a number of factors. Properties with high fire and life risk often require greater numbers of personnel and apparatus to effectively mitigate a fire emergency. Staffing and deployment decisions should be made with consideration of the level of risk within geographic sub-areas of a community.

The community's current fire risk assessment has been developed based on land use within its boundaries. These uses are found in the City's development code and zoning designations. The following map translates land use codes to categories of relative fire and life risk.

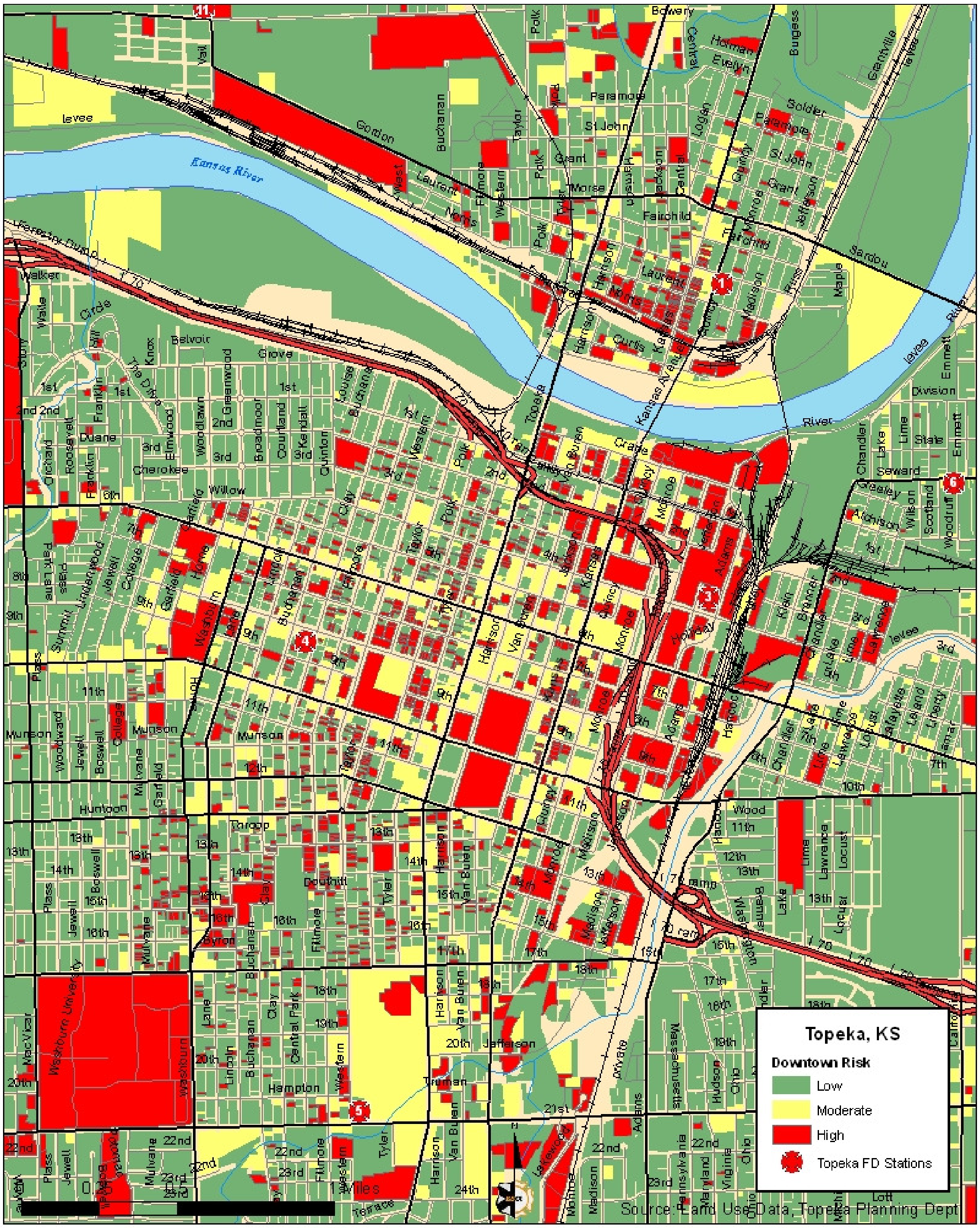
- Low risk – Areas zoned and used for agricultural purposes, open space, low-density residential, and other low intensity uses.
- Moderate risk – Areas zoned for medium-density single family properties, small commercial and office uses, low-intensity retail sales, and equivalently sized business activities.
- High risk – Higher-intensity business districts, mixed use areas, high-density residential, industrial, warehousing, and large mercantile centers.

Figure 20: Topeka Current Community Risk



A community's economic, cultural, and densest population usually centers on its downtown area. The following figure provides a close-up look to Topeka's downtown community risk.

Figure 21: Downtown Topeka Current Community Risk



The community contains mostly low and moderate risk properties. The predominance of highest risk is located in the City's downtown central area and off highway routes. These properties include mixed-use, institutional, and taller multi-family occupancies. There are, of course, high-risk occupancies elsewhere in the community, which include multi-family dwellings and assembly occupancies.

The City's zoning pattern generally contributes to the challenge of efficient fire resource deployment configuration. High-risk occupancies can be found distributed throughout the community rather than concentrated in one or two specific areas.

In addition to land use and occupancy, there are other factors to consider when evaluating risk. The following figures (22 and 23) detail some of the most important facilities within Topeka. These are facilities which account for cultural and regional attractions, public facilities of note, and historic sites. Although not a complete representation of target hazards, the geographic locations are especially important for emergency service resources.

Figure 22: Topeka Target Hazards

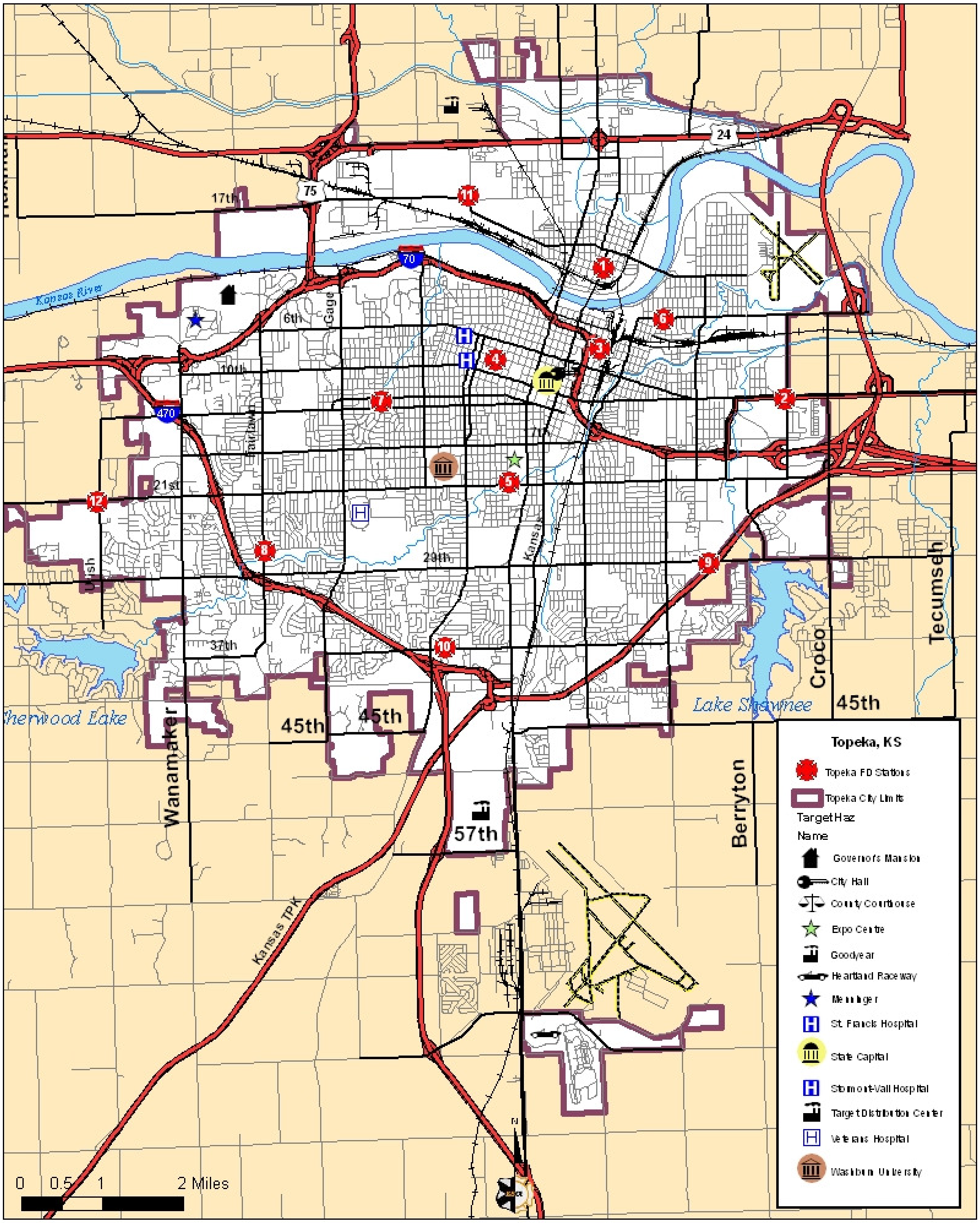
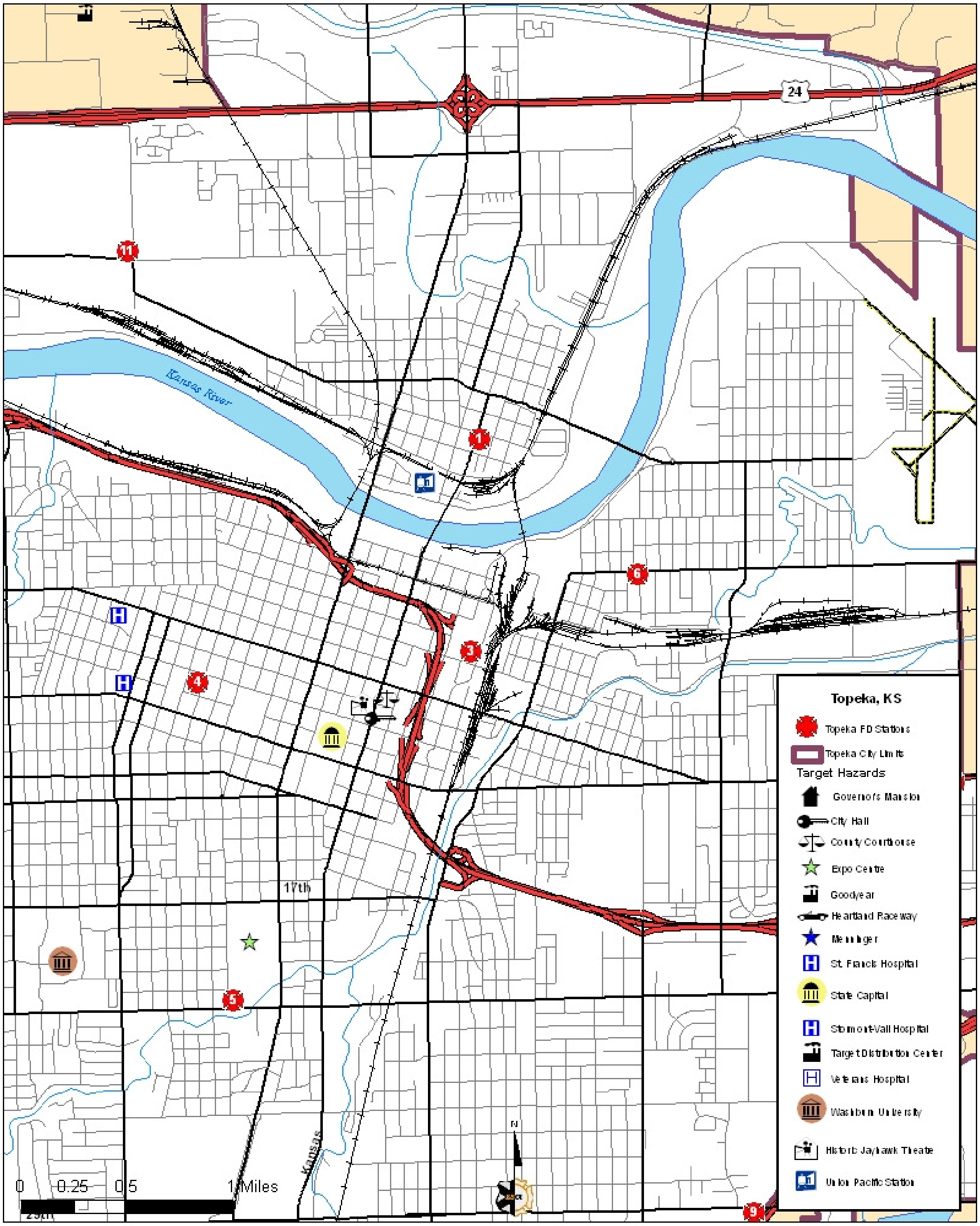
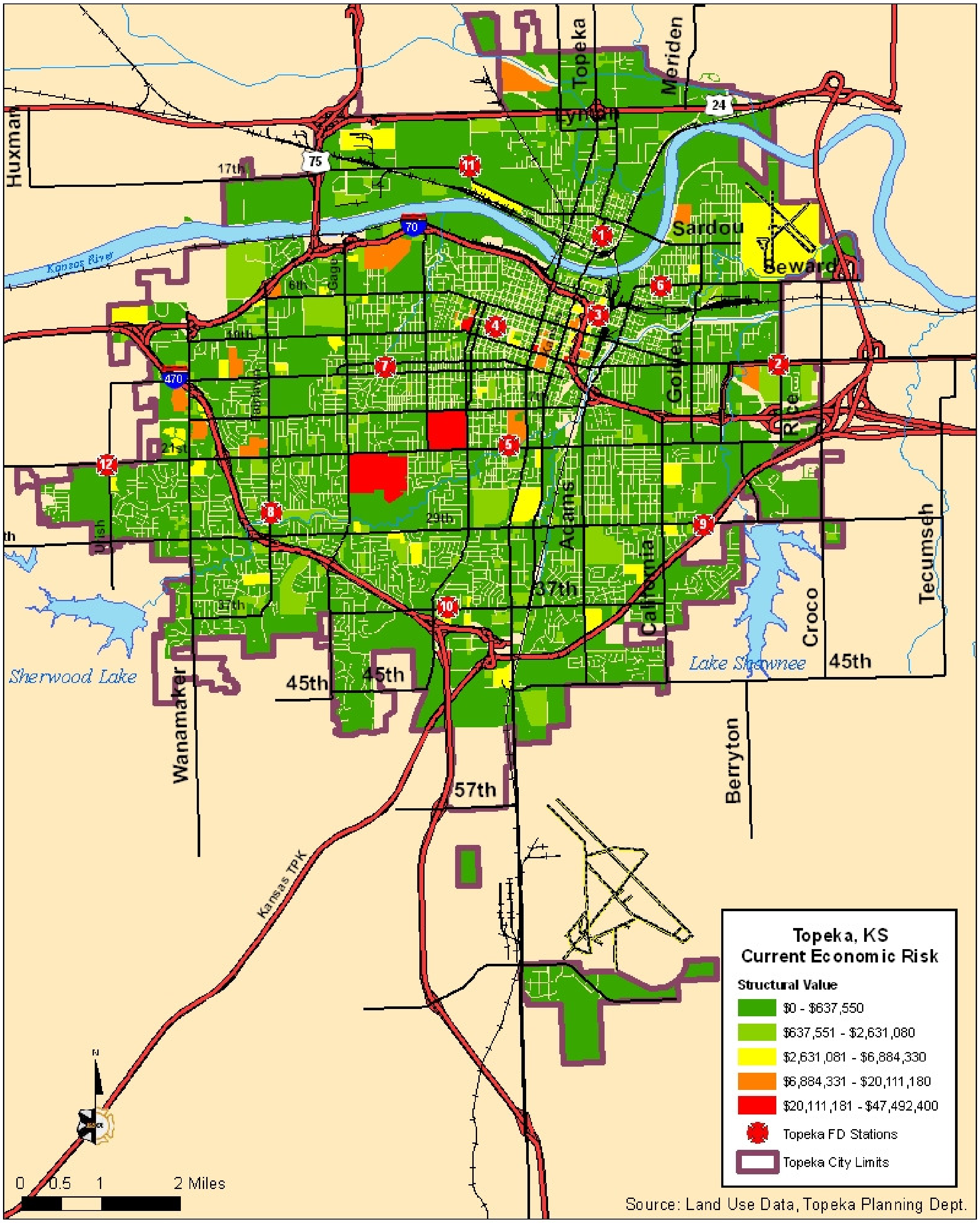


Figure 23: Downtown Topeka Target Hazards



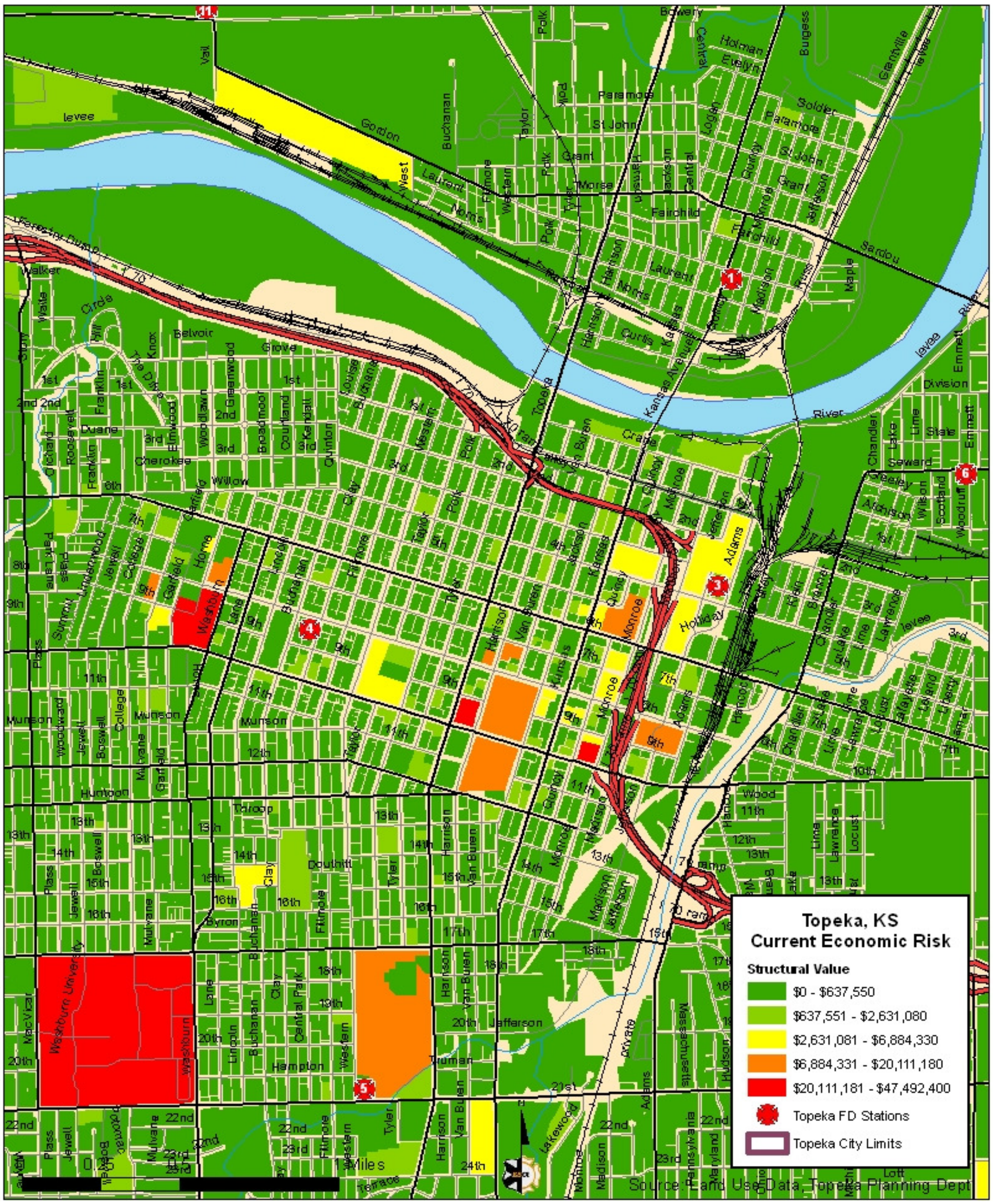
Economic value of property is extremely important to the viability of the local economy as well as the City tax base. By examining parcel data for structural value, results in figure 24, show which areas pose the greatest risk of financial and economic loss to Topeka.

Figure 24: Topeka Economic Risk



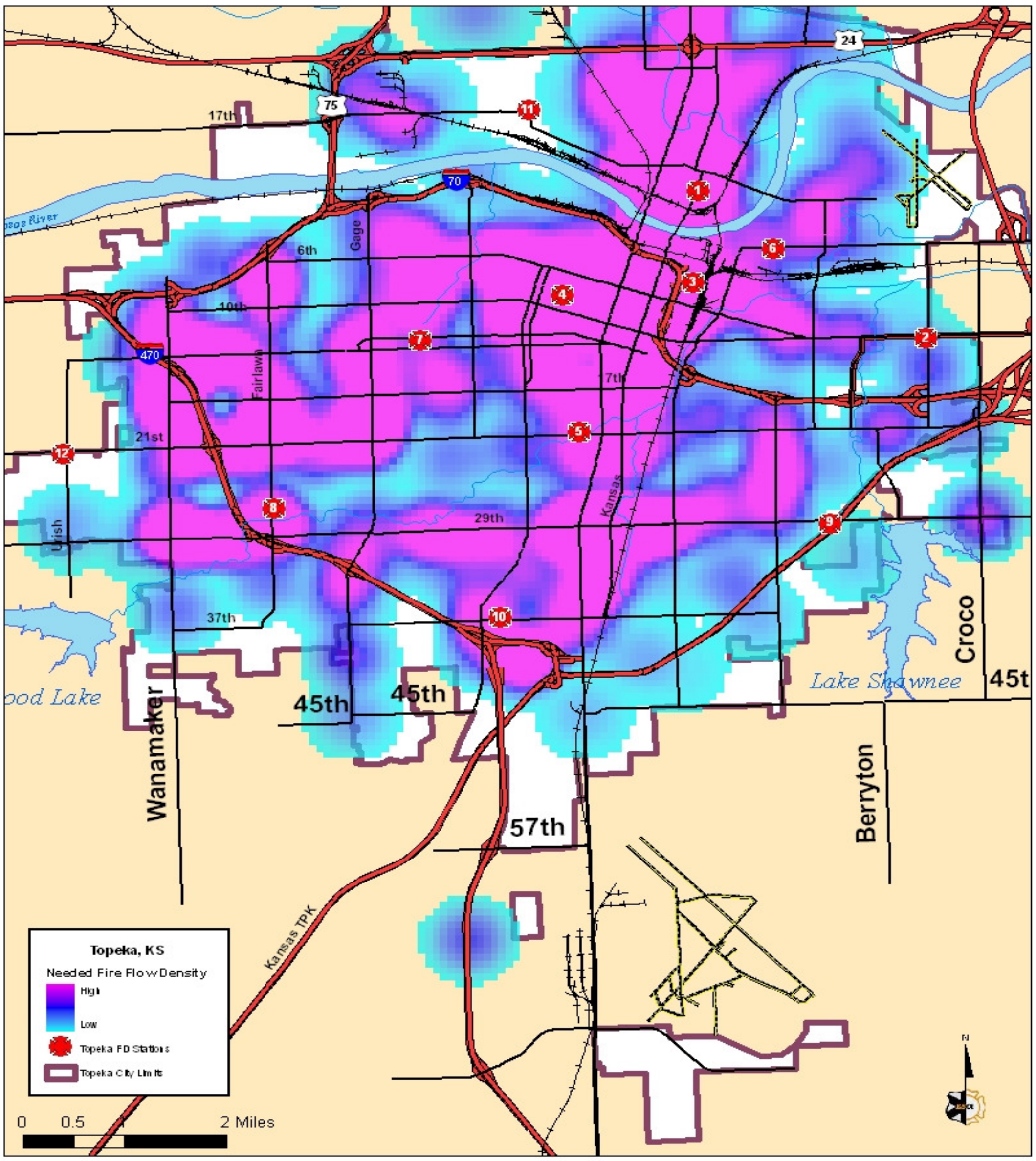
Smaller parcels downtown make it difficult to discern risk on a map that shows a larger area. In addition, in many communities the highest valued buildings are located downtown. The following figure provides a close-up view of economic risk in downtown Topeka.

Figure 25: Downtown Topeka Economic Risk



An additional risk consideration is the amount of water that is needed to control a fire in a structure. The ISO has established a method to calculate the amount of gallons per minute needed for fire suppression, based on a buildings construction, occupancy, exposure risks, alarms, and sprinkler systems.[20] Figure 26 indicates the density of buildings rated by the ISO, based upon the needed fire flow rating assigned.

Figure 26: Topeka Needed Fire Flow Density



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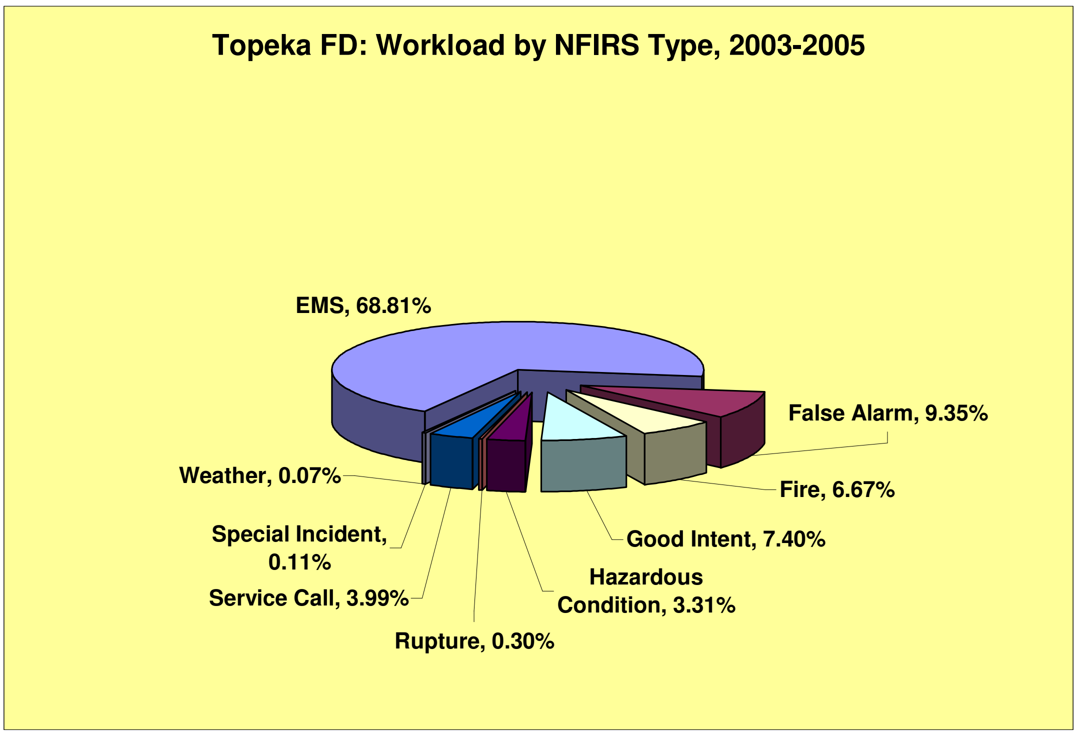
[20] See Insurance Services Office *Guide For Determination Of Needed Fire Flow*, edition 05-2006.

Current Workload Evaluation

The department responds to a variety of requests for service. Once a situation has been assessed by firefighters, it is categorized based on guidelines established by National Fire Incident Reporting System (NFIRS) categories. The following figure describes the workload for the past three years based upon these categories.

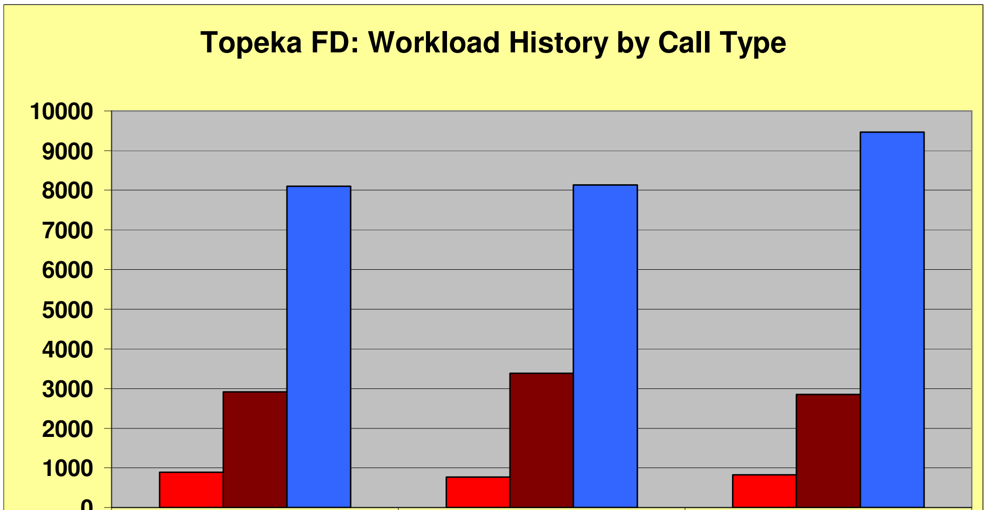
Figure 27: Workload by Type of Call



The department has experienced a reasonably stable number of fire and other non-medical responses, while experiencing a significant increase in emergency medical responses. The following chart (figure 28) shows how response volume has changed over the last three years based on general call types[21].

[21] The chart includes mutual aid responses provided to areas outside the limits of Topeka.

Figure 28: Workload Historical Data

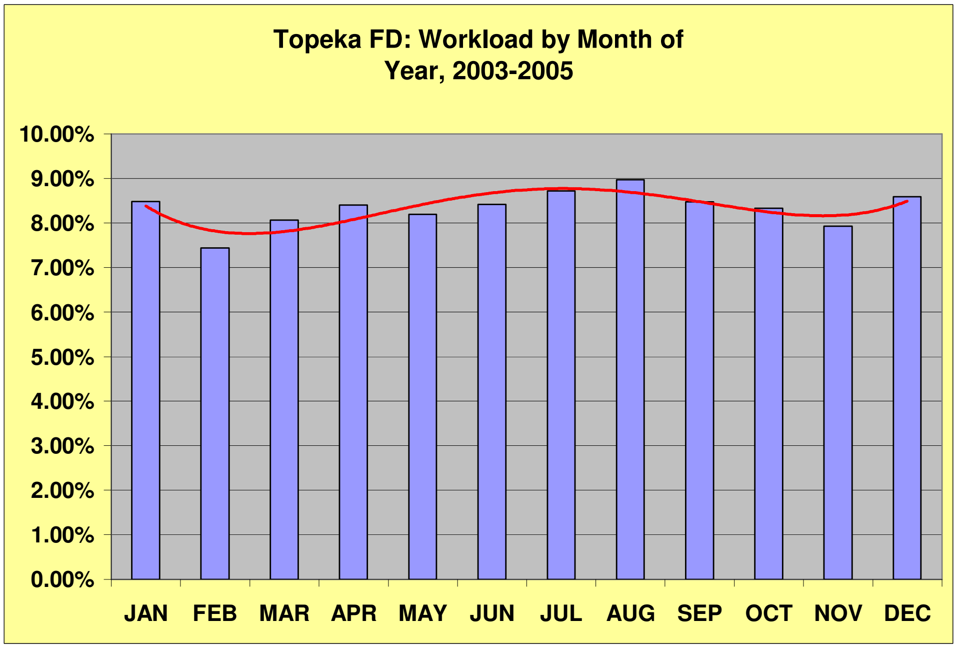


	2003	2004	2005
Fire	893	769	828
Other	2917	3383	2857
EMS	8093	8134	9464

A review of incidents by time of occurrence also reveals when the greatest response demand is occurring. For this analysis, since TFD utilizes the same staff and apparatus for response, ESCi will view workload collectively, rather than separately.

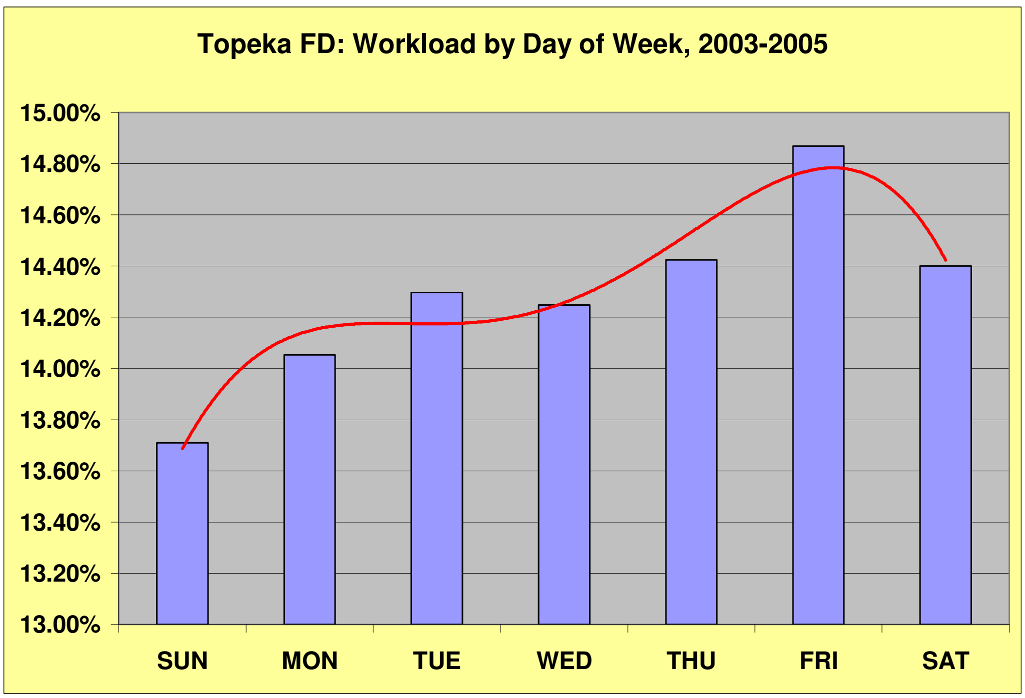
The following charts show how activity and demand changes for TFD based on month of year for each call type.

Figure 29: Workload by Month of Year



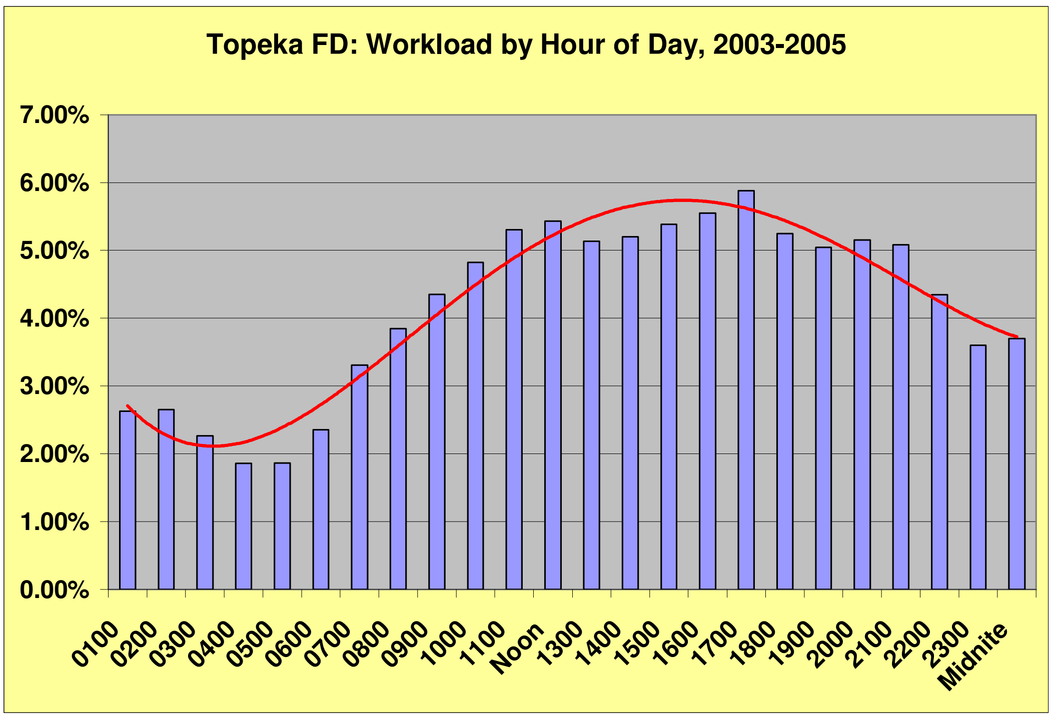
Monthly workload analysis reveals a relatively stable pattern throughout the year, rising into the summer and falling slightly into the fall months. Analyzing further, by examining workload by day of the week over the last three years, reveals a more erratic pattern. Workload rises through the week to peak on Fridays as illustrated in the following figure 30.

Figure 30: Workload by Day of Week



In further analysis, workload is examined for volume of calls by the hour of day in which they occurred historically. The following chart (figure 31) indicates that activity follows a similar pattern to most human activity by increasing during the daylight hours. Activity for the TFD begins to become more frequent at 6:00am, and begins to lessen at 6:00pm, reducing to a low point at 4:00am.

Figure 31: Workload by Time of Day



Current Service Demand Evaluation

The following maps indicate the distribution of emergency incidents responded to by the Topeka Fire Department for 2005.

Figure 32: Service Demand - All Incidents

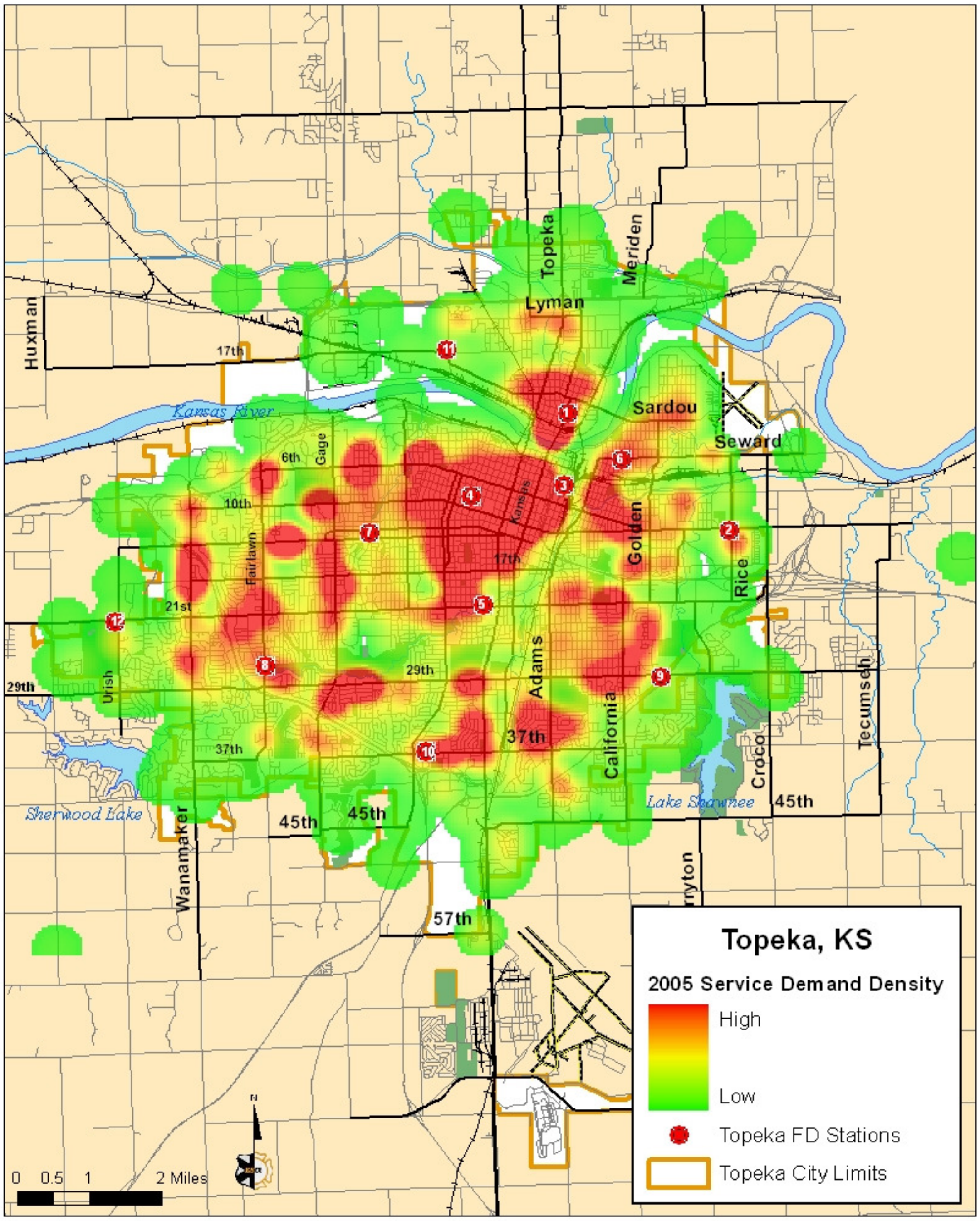
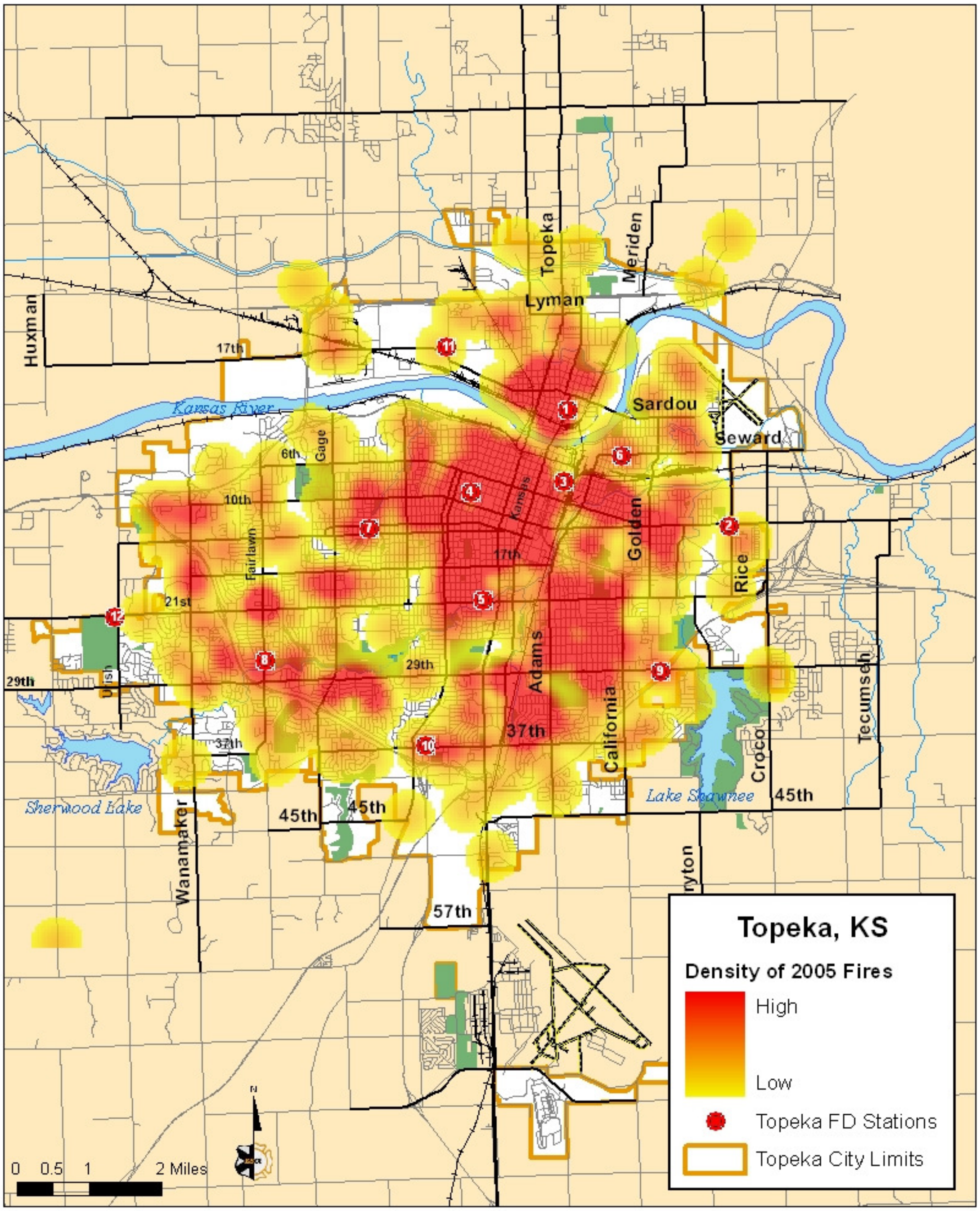


Figure 33: Service Demand - Fire Incidents Only



It is also noteworthy that 6.04 percent of emergency responses made within the city limits of Topeka were to ten specific addresses.

The following table indicates the locations of the most frequent repeat service users and the percentage of volume they accounted for in 2005.

Figure 34: Frequent or Repeated Incident Locations

Top Ten Frequent Calls for Service		
Address	**Calls**	**Pct**
501 SW FRANKLIN AVE	105	0.80%
600 N KANSAS AVE	92	0.70%
3415 SW 6TH AVE	85	0.65%
635 SW HARRISON ST	84	0.64%
600 SE MADISON ST	76	0.58%
3515 SW 6TH AVE	74	0.56%
116 NW CURTIS ST	71	0.54%
1312 SW POLK ST	71	0.54%
4900 SW HUNTOON ST	68	0.52%
600 SW 14TH ST	67	0.51%
Total	793	6.04%

Topeka Fire Department Risk Categories

Based on consideration of the preceding analysis of fire risk, service demand, land use, historical workload, and population, the department has established the following risk categories for consideration in its development of deployment and standards of response coverage.

Figure 35: Topeka Fire Department Risk Categories

Fire Risk:		
	Low	Areas with mobile property, outbuildings, structures with less than 1,000 gpm needed fire flow, and/or a BAR (building area ratio – % of land covered by building) of less than 10%.
	Moderate	Areas with single occupancy structures with a needed fire flow 1,000 to 2500 gpms and/or a BAR greater than 10% and less than 75%.
	High	Areas with multi-occupancy structures with a needed fire flow above 2,500 gpm, structures over three stories in height and/or a BAR greater than 75%.
Rescue Risk:		
	Low	Areas with a history or potential for rescue situations that require only the tools and knowledge set available on first due apparatus. Examples include: persons needing assistance up or down an elevation difference where simple solutions such as a rope or ladder will complete the rescue. Normally a single unit response.
	Moderate	Areas with a history or potential for rescue situations requiring the use of specialty equipment carried on all Topeka Fire Department truck companies. Examples include: traffic accidents with persons trapped, persons needing to be moved up or down an elevation while unable to walk or help themselves, multiple vehicle accidents, etc. Normally a two or three vehicle response.
	High	Areas with a history or potential for rescue calls requiring specialized equipment and training. Examples include: technical rescues of persons trapped by equipment, buildings or earth that will require extended and complex rescue solutions. Normally a three vehicle or more response.
	Special	Disaster responses to floods, landslides, tornados and other situations where large numbers of people are at risk. Types of rescues involved might include: extrication, low/high angle, trench, confined space, and building collapse.
Medical Risk:		
	Low	Areas with a history or potential for emergency incidents where predominately a Basic Life Support level of care is provided routinely (closest unit). Calls requiring basic first aid/EMT-1 skills. These areas would normally have low population densities and/or limited residential or commercial development. Tasks would normally include incident command, triage, patient handling, patient treatment, and patient transportation packaging and loading.
	High	Areas with a history or potential for needing multiple levels of emergency medical response. Paramedic level response may be summoned simultaneously. These areas would normally have high population densities and/or large numbers of "at risk" populations. Examples might include building collapse, multiple casualties. This risk level would normally be incident specific.
	Special	Disasters such as tornado, flood, pandemic, mass casualty incidents, etc. This risk level would normally be event specific.
Special Hazards Risk:		
		Hazardous Materials
	Low	Areas with hazards that would require Level D entry. Incidents that require only the tools and knowledge set available on first due apparatus. This risk would include incidents related to common chemicals such as those used in the home or business.
	Moderate	Areas with hazards that would require Level B or C entry. Incidents that require specialized tools and knowledge to deal with hazardous materials that are normally liquids or solids without acute hazards. This risk would include incidents related to chemicals used in light industry, larger amounts hazardous materials in transport or storage. The fire department's response team would respond but may or may not have primary responsibility for mitigation depending on type and magnitude of incident.
	High	Areas with hazards that would require Level A entry. Incidents involving "Acutely Hazardous" materials that require encapsulation of the workers and multiple specialized teams with a level of decontamination that is potentially hazardous. The fire department would not currently be the primary mitigation organization for this incident.
	Special	Weapons of Mass Destruction or terrorist acts.
		Airport Rescue Fire Fighting
		The fire department currently has primary responsibility for structural fire protection at the airport. They would respond and support a aircraft fire/rescue operations.

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Chapter 5 - Service Level Benchmarks

Correlation of Response Time and Outcome

The impact of response time on the outcome of emergency incidents has been exhaustively studied, both in the laboratory and in historical data, with predictable correlation between the two. Though seemingly intuitive, it is still useful to review how longer response times can have a negative effect on the ability to suppress fires, particularly in structures, or to successfully intervene in a life-threatening medical emergency.

According to tests conducted by the National Institute of Standards and Technology (NIST), flashover is likely to occur as early as five minutes after the appearance of flame in typically furnished and ventilated buildings[22]. Flashover is the point at which the surface temperature of combustibles is rapidly increasing toward their ignition point. Sufficient hot vapors and gasses build up and ignite, bringing other combustibles simultaneously to ignition. At this point, the intense pressure from the production of hot gasses and smoke push the fire quickly beyond the room of origin and begin involving other rooms or the structural members of the building itself. Smoke quickly extends to distant parts of the building.

Since flashover has such a dramatic affect on the outcome of a fire event, the goal of any fire agency is to be able to apply water to a fire before flashover occurs, containing the fire to the room of origin. Beyond just the laboratory tests, we can look at historical fire data to see how much impact this actually has.

The following table uses data from the National Fire Incident Reporting System and examines fire extension in residential fires over a five year period. It clearly demonstrates the dramatic increase in overall damage, loss of life, and civilian injuries as a fire spreads. In fact, a fire that spreads beyond the room of origin, on average, will produce almost seven times the dollar loss, and is over eight times as likely to result in a civilian death, even if contained to the same floor of the building.

[22] Source: National Fire Protection Association; *National Institute of Standards and Technology*.

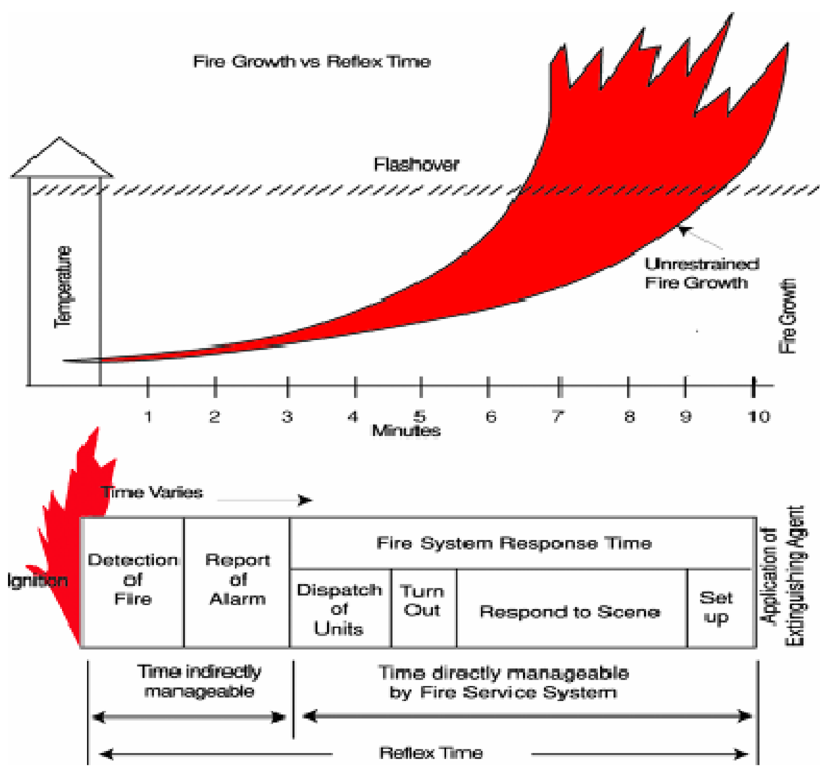
Figure 36: Correlations Between Fire Extension and Event Outcomes

Fire Extension in Residential Structure Fires 1994 - 1998			
	Rates per 1,000 Fires		
Extension	*Civilian Deaths*	*Civilian Injuries*	*Dollar Loss Per Fire*
Confined to room of origin	2.32	35.19	$3,385
Beyond room of origin; confined to floor of origin	19.68	96.86	$22,720
Beyond floor of origin	26.54	63.48	$31,912

Data from NFPA Annual Fire Experience Survey and USFA National Incident Reporting System

However, a number of things must happen quickly in order to make it possible to achieve fire attack prior to flashover. The chart below illustrates this process.

Figure 37: Fire Growth vs. Reflex Time



First, the fire must be detected. This can happen immediately if someone is in the space where the fire occurs, or it can be delayed significantly if no one is around. Automatic fire alarm systems can take the place of human eyes in unoccupied areas.

Next, the fire must be reported to the dispatch center. People reporting emergencies must be well trained so that needed information can be passed from the caller to the dispatcher quickly. The dispatcher must select the correct units to send to the fire, notify them, and provide needed information. There are a number of technology opportunities that can speed up this step.

Next, firefighters must don firefighting equipment, assemble on the response vehicle, and begin their response. The time required for this step is minimized through good training and proper station design.

Next, and potentially the longest phase, is the response to the scene. This period is most influenced by the distance between the fire station and the location of the emergency, but can also be influenced by the quality and connectivity of streets, traffic, driver training, and other conditions.

Finally, once firefighters have arrived, they must position their apparatus, lay out hose lines, don additional equipment, and perform various other tasks before they can make entry into the building and begin applying water.

As can be seen, a fire department is seriously challenged to achieve water application prior to flashover. However, it is reasonable to use this as a response and station location planning criteria.

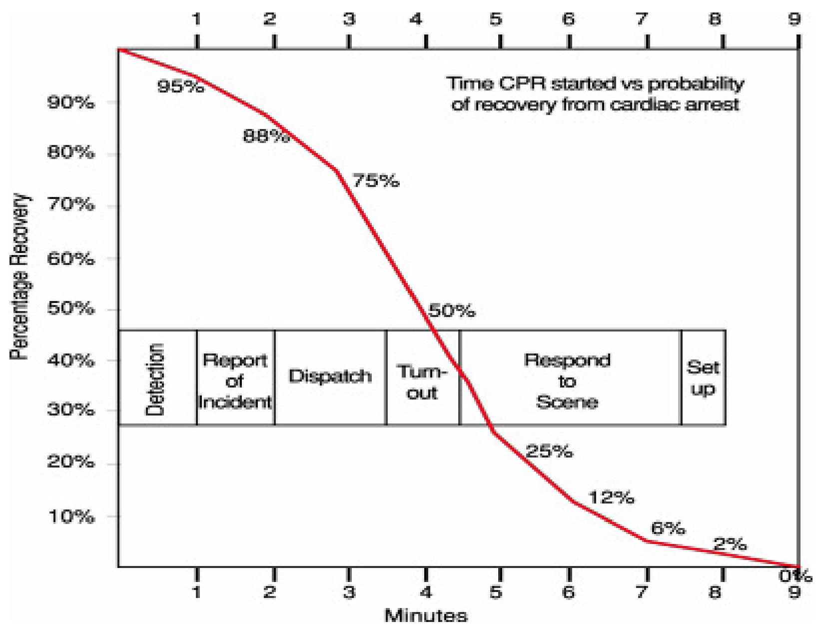
Cardiac arrest is the most significant life threatening medical event. A victim of cardiac arrest has mere minutes in which to receive definitive lifesaving care if there is to be any hope for resuscitation.

Recently, the American Heart Association (AHA) issued a new set of cardiopulmonary resuscitation guidelines designed to streamline emergency procedures for heart attack victims, and to increase the likelihood of survival. The AHA guidelines include new goals for the application of cardiac defibrillation to cardiac arrest victims.

Heart attack survival chances fall by seven to ten percent for every minute between collapse and defibrillation. Consequently, the AHA now recommends cardiac defibrillation within five minutes of cardiac arrest.

As with fires, the sequence of events that lead to emergency cardiac care can be visually shown, as in the following figure.

Figure 38: Cardiac Arrest Event Sequence



The percentage of opportunity for recovery from cardiac arrest drops quickly as time progresses. The stages of medical response are very similar to the components described for a fire response. Recent research stresses the importance of rapid cardiac defibrillation and administration of certain drugs as a means of improving the opportunity for successful resuscitation and survival.

Numerous peer-reviewed scientific studies have validated the linkage between lower response times and more desirable medical outcomes and, ultimately, patient survival. This is of the greatest importance in the case of critical, life-threatening, medical trauma conditions where the rapid provision of experienced medical care is likely to have a beneficial impact on improving patient outcomes. These conditions also include sudden cardiac arrest, respiratory arrest, obstructed airway, and uncontrollable bleeding.

J. P. Pell published, *The Effect of Reducing Ambulance Response Times on Deaths From Out Of Hospital Cardiac Arrest: Cohort Study* which reviewed 10,554 cardiac arrest patients. In Pell's study, it was clearly demonstrated that reducing ambulance response times from 15 minutes at 90^{th} percentile to five minutes at 90^{th} percentile was responsible for doubling the rate of patient survival to hospital discharge. K. B. Kern, in *New Guidelines for Cardiopulmonary Resuscitation and Emergency Cardiac Care*, published that "…an out of hospital goal of early defibrillation within five minutes of a telephone call is now recommended."

Well-published and researched EMS physician Mickey Eisenberg published a study entitled *Predicting Survival from Out Of Hospital Cardiac Arrest: A Graphic Model?* in which he reviewed 1,667 cardiac arrest patients. Utilizing multiple, linear regression analysis, his study became the foundation for community-based EMS planning, and how longer arrival times affect community survival. His conclusion was simple - *without timely intervention of CPR, defibrillation and advanced cardiac life support, the decline in survival is 5.5 percent per minute*. B.D. Jermyn, in *Response Interval Comparison Between Urban Fire Rescue Departments and Ambulance Services*, linked the impact on response to survival as decreasing between seven to ten percent, per minute without defibrillation.

It is clear that the longer it takes for properly trained and equipped emergency responders to arrive at a fire or medical, the more negative the impact on successful intervention. This is why it is critical to establish response time performance objectives from which resource deployment can be planned.

Average vs. Fractile Performance Measures

An average is the sum of all the values in the data set divided by the number of pieces of data. In this measurement, every piece of data is counted and the value of that data has an impact on the overall performance.

As an example, assume that a particular fire station with a response time objective of six minutes or less had five calls on a particular day. If four of the calls had a response time of 8 minutes while the other call was across the street and only a few seconds away, the average would indicate the station was achieving its performance goal. However, four of the five customers, or 80 percent of those served, did not receive a satisfactory level of service.

The opposite can also be true where one call with an unusually long response time can make otherwise satisfactory performance appear unacceptable. These calls with unusually short or long response time have a direct impact on the total performance measurements and the farther they are from the desired performance, the greater the impact.

The most important reason for not using averages for performance standards is that it does not accurately reflect the performance for the entire data set. As illustrated above, one extremely good or bad call skewed the entire average. While it does reflect all values, it does not really speak to the level of accomplishment in a strong manner.

When you deal with fractiles or percentages, the actual value of the individual data does not have the same impact as it did in the average. The reason for this is that the fractile is nothing more than the ranking of the data set. The 90th percentile means that 10 percent of the data is greater than the value stated and all other data is at or below this level.

Fractiles are normally used for performance objectives and performance measurement because they show that the large majority of the data set has achieved a particular level of performance that is desired. Fractile analysis does this well.

Recognized Response Time Performance Benchmarks

Any discussion of response time performance centers on these four key time sequences:

- Call processing and dispatch
- Turnout time of firefighters
- Initial resource arrival
- Effective response force arrival

Though the following standards are not mandatory, they provide at least some targets against which to benchmark response time performance in the absence of formally adopted response time standards.

Call Processing and Dispatch

When it comes to call processing and dispatch time, *NFPA 1221: Installation, Maintenance, and Use of Emergency Services Communications Systems* provided a benchmark for call processing time (call pick-up to completion of unit notification) of 60 seconds or less. The standard calls for this performance to be met at least 95 percent of the time.

Turnout Time of Firefighters

For firefighter turnout times, *NFPA 1710* provides a benchmark for firefighter turnout time (from notification to apparatus response) of 60 seconds or less. The standard calls for this performance to be met at least 90 percent of the time.

Initial Resource Arrival

For initial unit response times, *NFPA 1710* provides several benchmarks for career fire departments.

- For fire incidents, the standard provides a benchmark for initial engine company arrival (from apparatus response to arrival on scene) of 240 seconds or less. The standard calls for this performance to be met at least 90 percent of the time.
- For emergency medical incidents, the standard provides a benchmark for initial arrival of trained medical responders with an automatic external defibrillator (from apparatus

response to arrival on scene) of 240 seconds or less. The standard calls for this performance to be met at least 90 percent of the time.

Effective Response Force Arrival

When it comes to effective response force arrival, *NFPA 1710* provides a benchmark only for the arrival of a full, first alarm assignment. Since resource assignment to a first alarm response may vary from department to department, an evaluation of whether any given agency's first alarm assignment is sufficient to make up an effective response force must be done on an individual agency basis. However, if one assumes the first alarm assignment is sufficient to be effective, the NFPA standard provides a benchmark for the full, first alarm arrival (from apparatus response to arrival on scene) of 480 seconds or less. The standard calls for this performance to be met at least 90 percent of the time.

It should also be noted that *NFPA 1710* contains the clause "and/or" between the first unit response time standard, and the full first alarm assignment response time standard. This seems to indicate that only one standard, or the other, needs to be met in any given incident. The document appendix provides the following explanation. *"This service delivery requirement is intended to have a fire department plan and situate its resources to consistently meet a four-minute, initial company fire suppression response, and an eight-minute full alarm fire response assignment. However, it is recognized that, while on some occasions (for example, a company is out of service for training) the initial company response may not be met in the four-minute requirement, the eight-minute criterion must always be met."*

Current Topeka Fire Department Response Time Performance Benchmarks

The City has not formally adopted specific response time performance objectives to guide resource deployment and measure ongoing system performance. The Topeka Fire Department indicates that an informal response time objective for the initial resource arrival has been four minutes from time of dispatch. This four-minute response time was said to include turnout time of the firefighters, as well as travel time to the incident. If this information is correct, this response time performance objective would be significantly more aggressive than *NFPA 1710*. However, this response time was reported to be measured at average rather than fractile 90^{th} percentile.

The City has not previously established formal or informal response time performance objectives for call processing.

Given the absence of formal response time performance standards, the NFPA standards will be used as an initial benchmark against which to evaluate system performance for this study. Additional recommendations regarding establishment of performance objectives will be provided following an analysis of current system performance.

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Chapter 6 - Distribution Analysis

ESCi examined the relationship between workload and distribution of initial response resources of the TFD. Critical, response time capability and performance of the initial response unit, often called the *first-due,* were reviewed.

Before reviewing the component of response time that is related to travel distance, ESCi reviewed the two basic components of response time that precede apparatus travel - call processing time and firefighter turnout time. These components are evaluated because they have the greatest impact on the arrival of the initial response resource, or first-due company. Following these components is a review of the physical distribution of stations, and the response time capability and performance of first-due units.

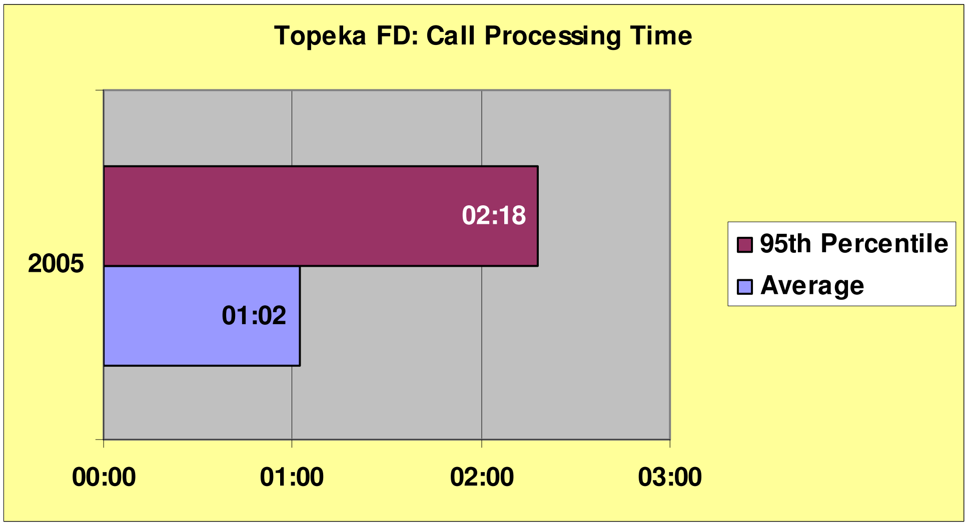
Call Processing Time Performance

ESCi examined time performance of the Consolidated Emergency Communications Center (CECC) in its processing of emergency calls, because of the impact this will have on all subsequent performances of arrival time. Call processing and notification of appropriate apparatus is the initial step in the City's effort to be responsive to its customer needs.

The following figures shows call processing time[23] for fire department incidents handled by the CECC during 2005. The figure shows both average and 95th percentile analysis.

[23] Call processing times greater than five minutes were assumed to be anomalies and were removed from the data prior to analysis.

Figure 39: Topeka Call Processing Time Performance



While the center's **average** call processing time is only slightly higher than the 60-second limit, its performance is over two times higher than the limit when analyzed at the **95th percentile** that the standard calls for.

In order to achieve the performance objective found in *NFPA 1221*, the Consolidated Emergency Communications Center will need to reduce its 95th percentile call processing time for incidents dispatched to the fire department by 78 seconds. While some reduction may be able to be accomplished through changes in procedure or equipment, a 78 second reduction will be very difficult to achieve.

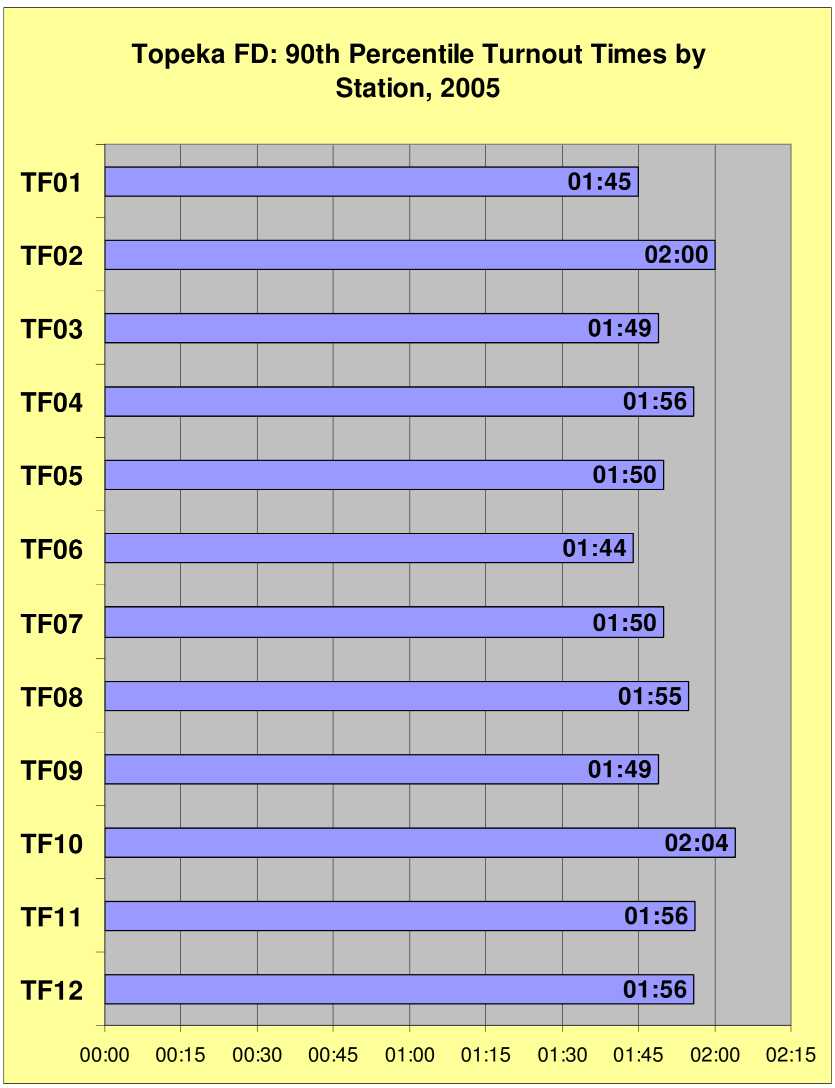
The City should be reminded at this point that *NFPA 1221* is not a mandatory standard, nor is it a regulation. The City is free to adopt a performance objective for call processing that differs from this standard. For instance, **if the City adopted a performance standard for call processing of 90 seconds or less, at least 80 percent of the time, the CECC would be in current compliance with that objective.**

Firefighter Turnout Time

Response time is measured from point of dispatch to the arrival on scene by the first apparatus. It is made up of two components - turnout time and travel time. Many variables can affect travel times which are not controllable by the fire department, such as weather, traffic, and speed limitations. Turnout time, however, is very much in control of the firefighters who are assigned to an apparatus or station. Turnout time is the interval from notification to apparatus response. As stated earlier, in career departments such as Topeka, *NFPA 1710* provides a benchmark for firefighter turnout time of 60 seconds or less, at least 90 percent of the time.

For the year 2005, the turnout time performance of the department was one minute and 54 seconds at the 90th percentile. The following figure displays the 90th percentile turnout time for each of the twelve fire stations in Topeka.

Figure 40: Topeka Firefighter Turnout Time Performance



In order to achieve the performance objective found in *NFPA 1710*, the department will need to reduce its 90th percentile firefighter turnout time by 54 seconds. While some reduction may be able to be accomplished through changes in procedure, a 54 second reduction may be difficult to achieve without at least some changes in certain station's layout, design, or hygiene facilities.

The City should again be reminded that *NFPA 1710* is not a mandatory standard, nor is it a regulation. The City is free to adopt a performance objective for firefighter turnout time that differs from this standard. For instance, **if the City adopted a performance standard for firefighter turnout time of 90 seconds or less, at least 80 percent of the time, the TFD would be in current compliance with that objective.**

Distribution Of Initial Response Resources

In the case of Topeka, first-arriving units are typically staffed by three persons. For most low-risk incidents, such as odor investigations, sparking transformers, and nearly all emergency medical incidents, this will represent a reasonable response for effective incident mitigation. This is not true for structure fires, since an interior fire attack requires a minimum of two firefighters on the outside of the structure and two firefighters on the entry team[24].

Thus, it should be understood that the analysis of first-due response time capability will not necessarily represent the response time of the Initial Attack Force (IAF). In Topeka, the initial attack force for structure fires would be a minimum of two apparatus[25].

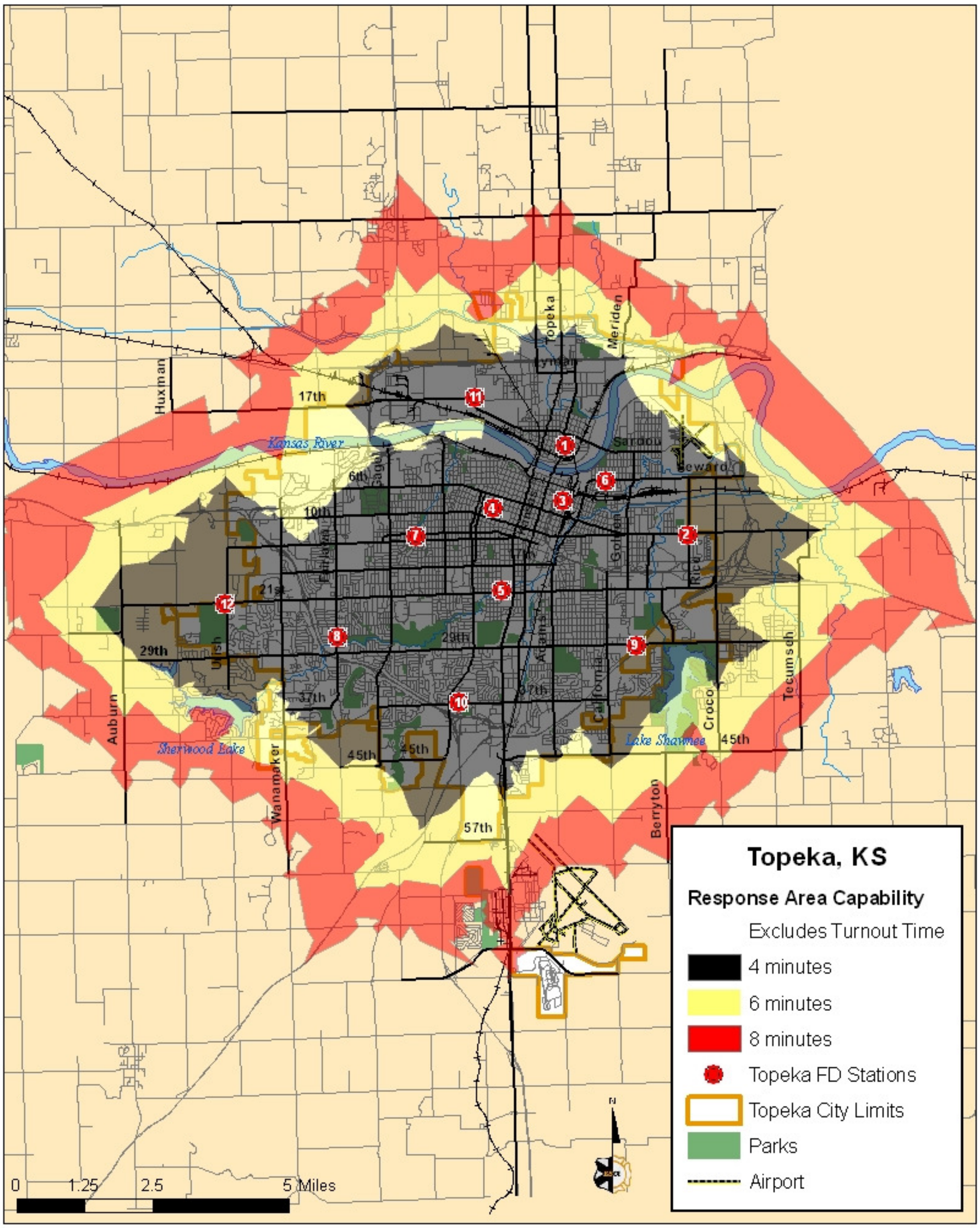
In order to visualize travel time capabilities of the existing road network, the following map demonstrates those areas within a four, six, and eight-minute travel time of these stations. Travel time is modeled using speeds assigned by road type, on the actual roadway network. Areas shown with dark overlay are within the four-minute travel time of an initial response fire apparatus. Areas shown with a yellow overlay are within the six-minute travel time of a fire

[24] This is absolute minimum to comply with OSHA CFR1910.134. Local requirements for a separate pump operator and, in some cases, incident commander are also typical.

[25] Initial Attack Force (IAF) should not be confused with the Effective Response Force (ERF). While the Initial Attack Force represents the minimum resources necessary to conduct an initial fire attack with a minimal crew, the Effective Response Force consists of all personnel and apparatus necessary to effectively and safely mitigate or control the emergency. Effective Response Force capability is studied in the Concentration Analysis.

station. Areas outside of a shaded overlay are eight minutes or more travel time from an existing fire station.

Figure 41: Distribution and Travel Time Capability

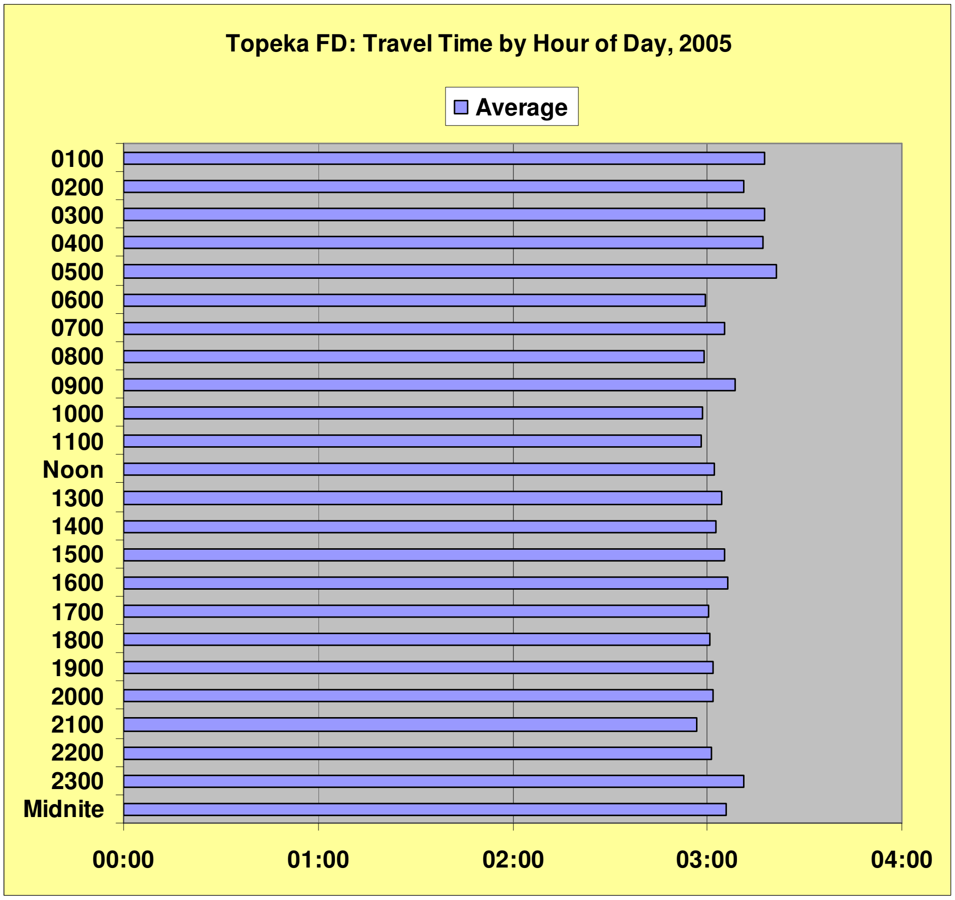


A detailed geographic analysis indicates that the current station deployment is physically distributed so as to be capable of reaching **85 percent** of the City's roughly 850 miles of street segments within a four-minute travel time. In addition to the geographic analysis of the current station coverage, it is also useful to examine a service demand analysis. This involves assessing station location in comparison to the actual service demand within the area. A detailed service demand analysis indicates that **this current station deployment strategy is physically distributed so as to be capable of reaching approximately 98 percent of the City's emergency incidents within a four-minute modeled travel time.**

First-Due Travel Time Performance by Temporal Analysis

The *average* travel time (excludes call processing and turnout) for emergency incidents occurring within the primary response area of TFD during all of 2005 was three minutes and four seconds. The average travel time ranged from a high average of three minutes and 22 seconds for calls between the hours of 5:00am and 6:00am (recall that this was the time of low service demand), to a low average of two minutes and 57 seconds for incidents between the hours of 9:00pm and 10:00pm.

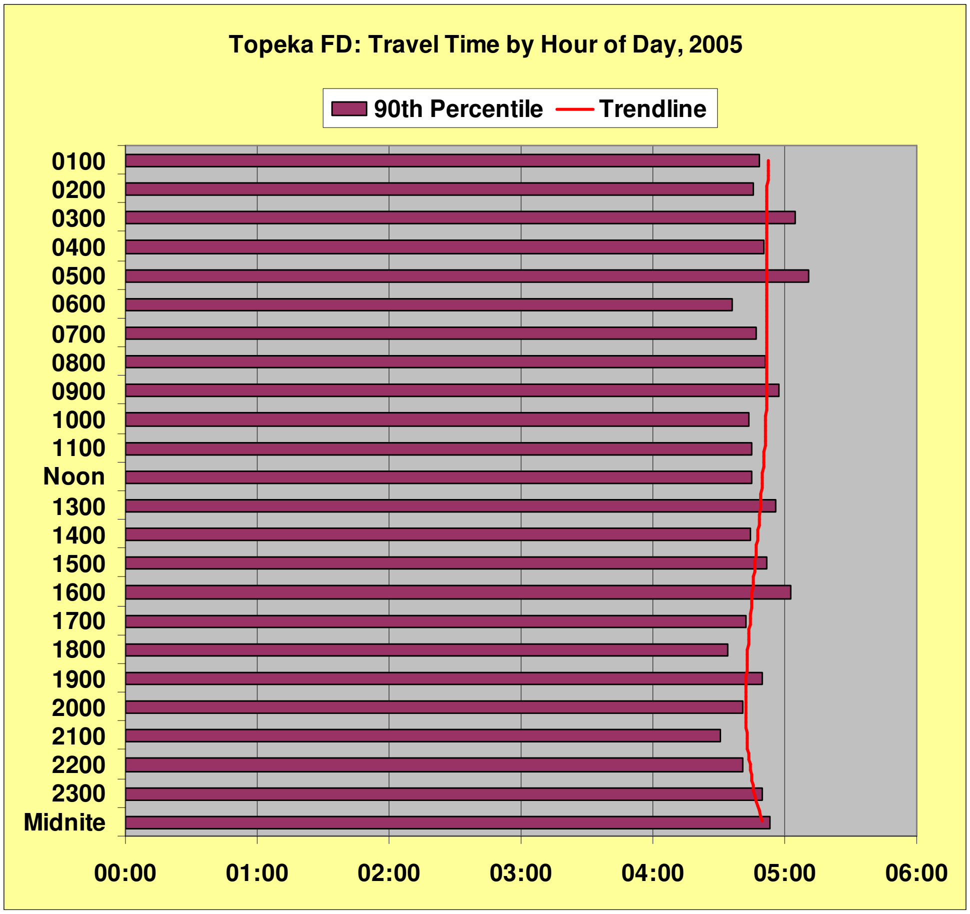
Figure 42: Average Travel Time by Hour of Day



Average response time is the system of performance measurement that TFD has informally used in the past. However, as stated earlier, recognized national benchmarks for response time objectives are analyzed as fractile performance, in this case at the 90th percentile.

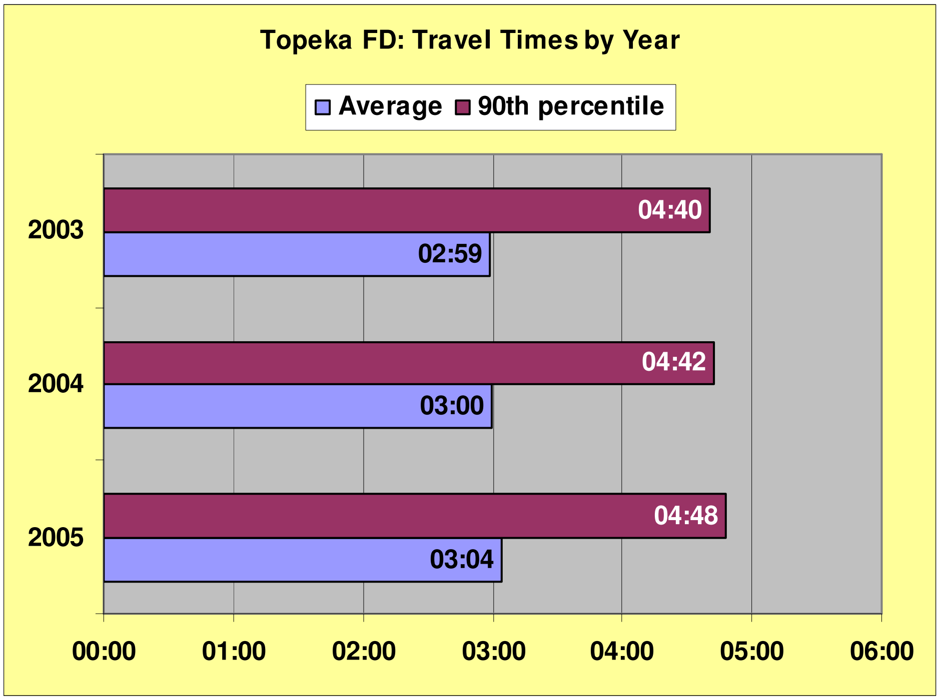
The overall 90th percentile travel time (excludes call processing and turnout) of the department within its primary jurisdiction was **four minutes and 48 seconds** for all incidents in 2005. The *90th percentile* travel time ranged from a high of five minutes and 11 seconds during the period from 5:00am to 6:00am, to a low of four minutes and 31 seconds during the period from 9:00pm to 10:00pm.

Figure 43: 90th Percentile Response Time by Hour of Day



It is also useful to observe travel time trends over a period of several years. The following chart illustrates changes in both average and 90th percentile travel time during the previous three years.

Figure 44: Three-Year Travel Time Trends

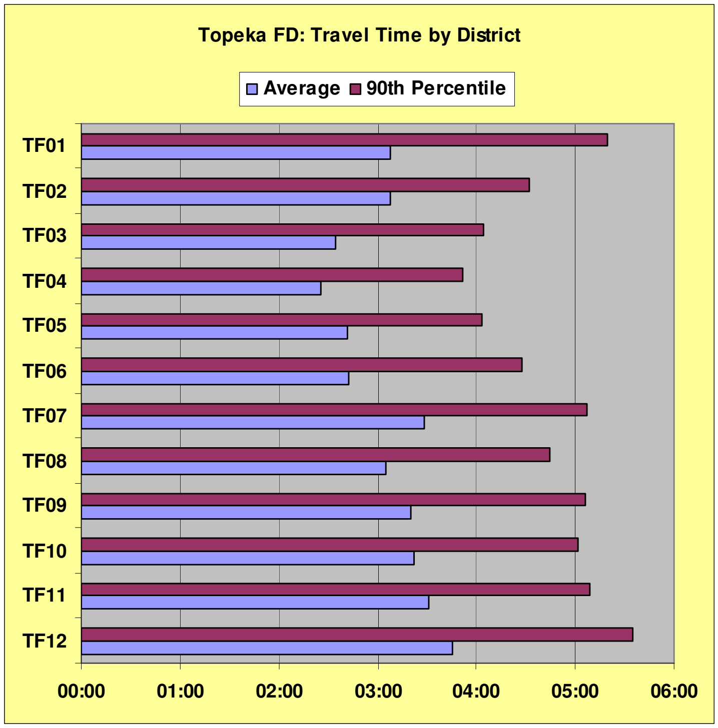


There has been a steady increase in response times over the past three years, amounting to a total of about 18 seconds. Though a seemingly insignificant amount, it is the nature of this trend that should be considered when evaluating the changing nature of service to the community.

First-Due Travel Time Performance by District Analysis

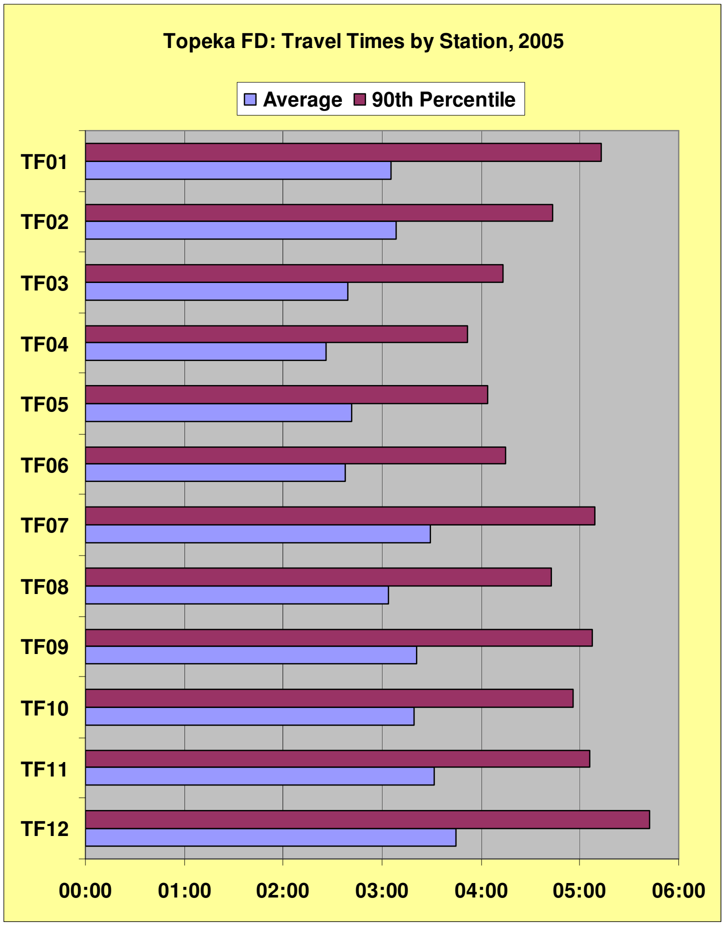
Figure 45 details the average and 90th percentile travel time performance for each of the twelve fire districts. The figure represents travel time performance of the first arriving unit, regardless of whether that unit came from the district's home station or an adjoining station.

Figure 45: Travel Time Performance by District



The following figure 46 details the average and 90th percentile travel time performance for each of the twelve fire stations. The figure represents travel time performance of any unit from each station, whether engine or truck, in any incident where it was the first unit to arrive on scene. Since the analysis includes any call to which the station's unit arrived first, regardless of whether it was in its own district or responding into another district, travel times will typically be somewhat longer.

Figure 46: Travel Time Performance by Station

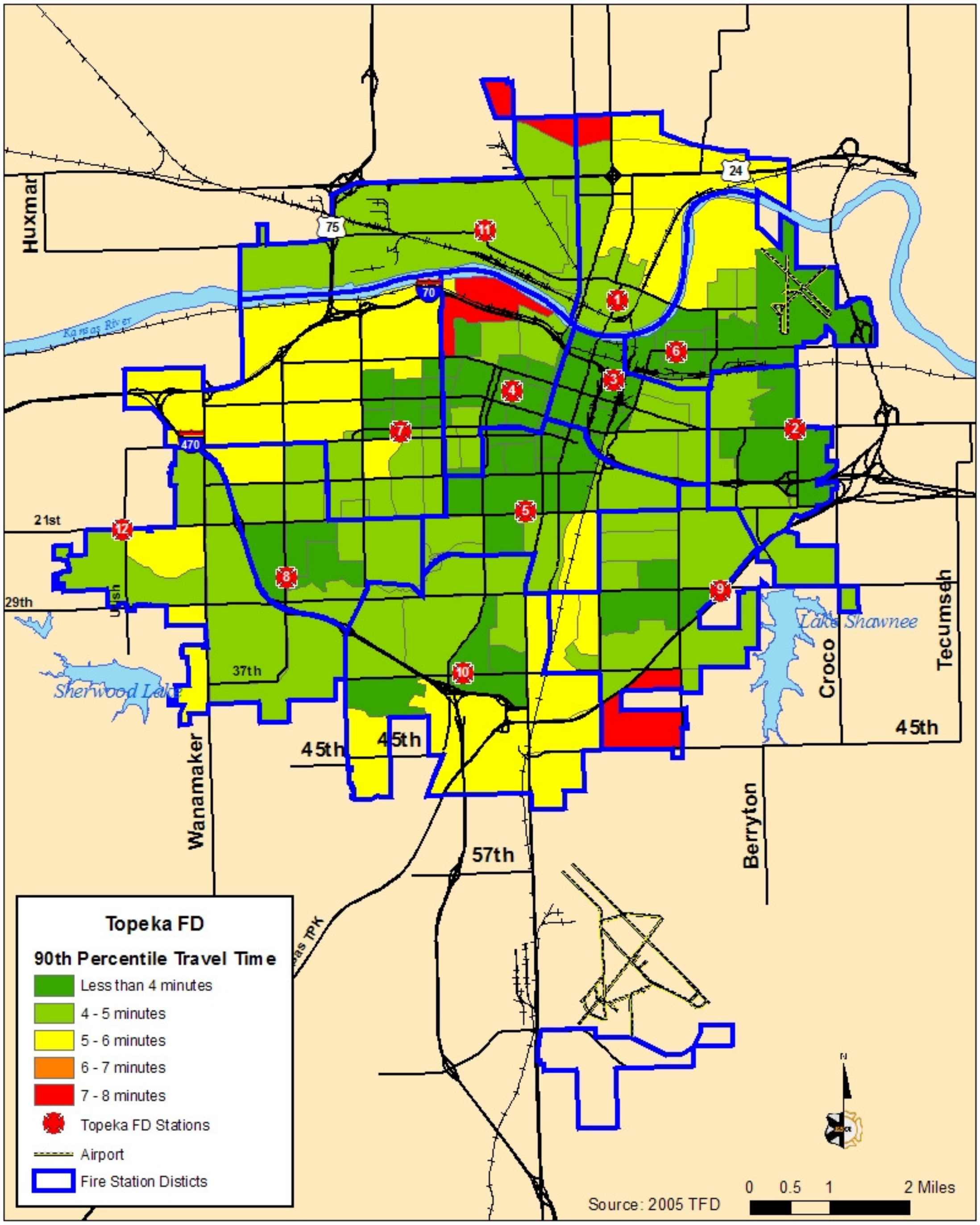


First-Due Travel Time Performance Geographic Analysis

It is important to the community that an apparatus arrives within the response time objective, regardless of where that apparatus responds from. To measure how well this is performed geographically, ESCi displayed the 90th percentile response time performance by census block group. The census blocks are small geographic areas used by the United States Census Bureau for population and demographic analysis, and are broken down to nearly a neighborhood by neighborhood level.

The following map depicts the range of 90th percentile response time performance by census block group.

Figure 47: 90th Percentile Response Time Performance by Census Block Group

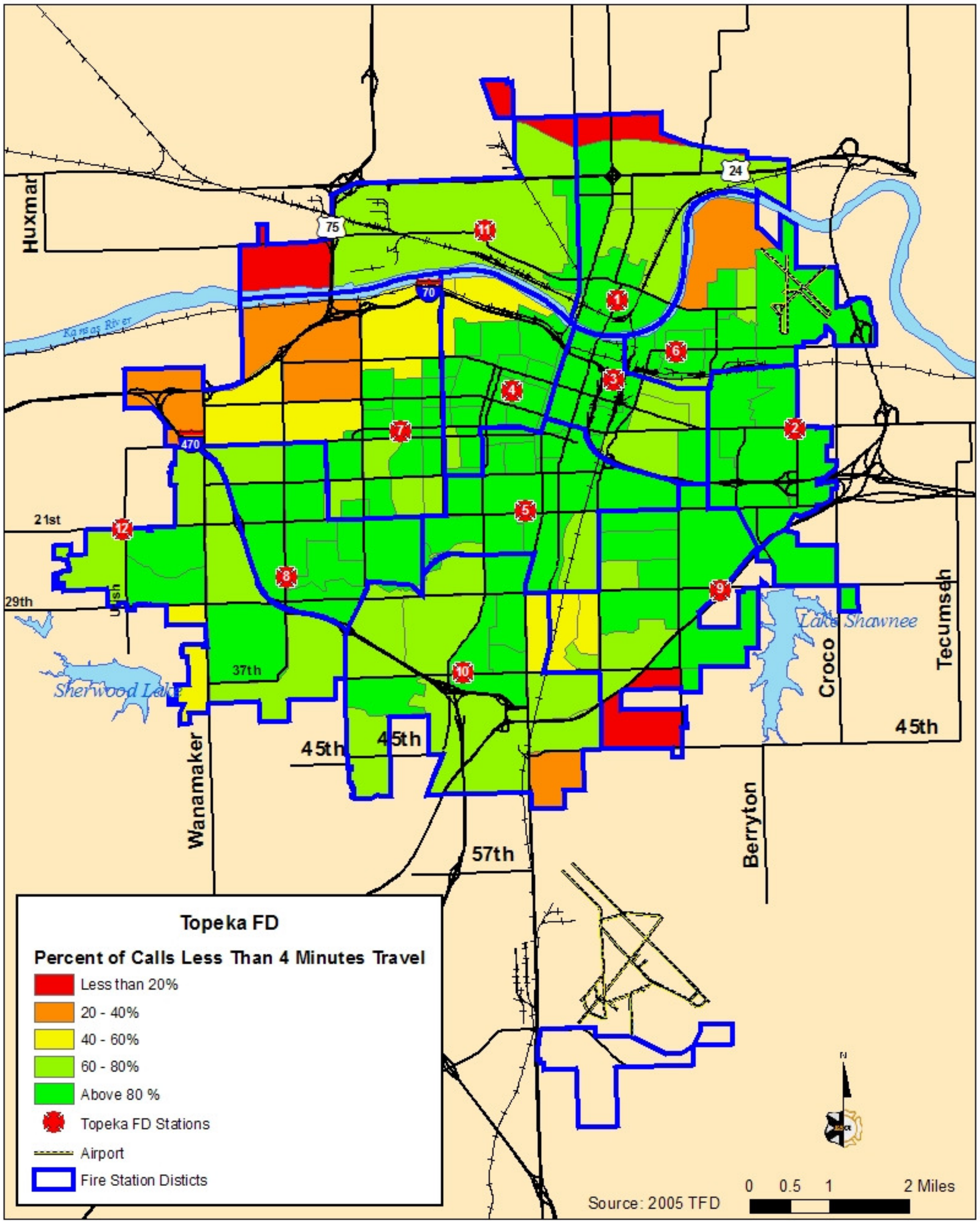


The areas of longer travel times are clearly visible through this map and, in the case of certain small pockets, may be due to limited connectivity of roadways due to railways and highways. When compared to the community risk map provided in this report, however, it is also noteworthy that certain areas of highest community risk are in areas of longer response time performance.

Since response time benchmarks for this report include a target travel time performance standard of four minutes or less, to at least 90 percent of all incidents, ESCi is able to graphically display the census block groups in which this performance objective is being met.

The following map (figure 48) displays those zones meeting the standard in green. Those zones not meeting the standard are displayed in increasing shades of yellow to red, based on the extent to which they are not meeting the performance standard.

Figure 48: Target Response Time Performance Success by Dispatch Zone



There is a large, clearly visible area on the northwestern side of the City where travel time performance at the benchmark of four minutes is consistently falling below 40 percent of incidents. This is in contrast to the 90 percent required in the benchmark objective.

Once again, we state that *NFPA 1710* is not a mandatory standard. The City is free to adopt a performance objective for incident travel time that differs from this standard. For instance, **if the City adopted a performance standard for incident travel time of four minutes or less, at least 80 percent of the time, the TFD would be in current compliance**. However, it should be noted that, while the entire City as a whole would meet this objective, the individual census blocks on the northwest side of the City would not achieve the objective.

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Chapter 7 - Concentration Analysis

The Topeka Fire Department defines a successful concentration network as one in which the system is capable of responding a sufficient number of personnel, with the correct apparatus and equipment to accomplish the following objectives:

- Stopping the emergency from continued escalation
- Providing for the safety and security of citizens and emergency responders
- Completing all critical tasks in a timely manner
- Providing for effective incident management

These objectives go beyond the capability of a single engine company. Concentration deals with the ability to place additional resources on scene within a time frame that permits effective intervention.

The initial step in the analysis of concentration is an understanding of the critical tasks that must be accomplished to successfully control and incident. By identifying these critical tasks, a department is better able to quantify necessary staffing and apparatus assignments, as well as response time performance of those resources, which will be necessary for an effective outcome.

Critical Tasking

The department has not conducted or documented a formal field validation and critical task analysis to date. This is something that should be done, in the future, to ensure that the effective response force is valid for the community's specific risks and risk levels, and to address the relationship between resource distribution and staffing patterns.

The first 15 minutes is the most crucial period in the suppression of a fire. How effectively and efficiently firefighters perform during this period has a significant impact on the overall outcome of the event. This general concept is applicable to fire, rescue, and medical situations.

Critical tasks must be conducted in a timely manner in order to control a fire or to treat a patient. Three scenarios commonly encountered are commonly utilized by fire departments when conducting field validation and critical tasking. They are a medium risk structure fire, a traffic collision with a trapped victim, and a cardiac arrest. Each scenario is conducted using standard operating procedures and realistic response times based on actual system performance. Each scenario is normally run multiple times with a variety of fire companies to validate and verify observations and times.

To further validate the analysis process, results are compared with records from actual working fires and similar incidents from previous years. Overall results are reviewed to determine if the actions taken within the early minutes of an incident resulted in a stop loss or not, and if additional resources were required. The critical task analysis process demonstrates the rate in which the current deployment plan results in stopping loss, a high percentage of time within initial critical time goals.

The critical task analysis may demonstrate important differences based on apparatus configuration and staffing in the ability to enter a building on a working structure fire when it comes to executing the *two-in two-out* rule and fire ground operations.

Again, critical tasks are those activities that must be conducted in a timely manner by firefighters at emergency incidents in order to control the situation, stop loss, and to perform necessary tasks required for a medical emergency. The TFD is responsible for assuring that responding companies are capable of performing all of the described tasks in a prompt, efficient, and safe manner.

Fires - Critical tasking for fire operations is the minimum number of personnel to perform the tasks required to effectively control a fire in the listed risk category. Major fires (beyond first alarm) will require additional personnel and apparatus.

Emergency Medical – Critical tasking for emergency medical incidents is the minimum number of personnel to perform the tasks required to support the identified strategy based on the department’s adopted medical protocol.

The TFD was asked to perform a *desktop* analysis of critical tasking for the various types of incidents and risk levels common to their response district. This information was used in the review, and recommendation of standards of coverage.

Alarm Assignments and Performance Objectives

Definitions:

Critical tasking is the number of personnel identified in the critical tasking analysis described above.

Engines are units capable of pumping water and/or foam for fire attack equivalent to approximately 1,000 gpm or greater.

Trucks are units with an aerial device and/or rescue and utility service capability.

Other category includes such units as tankers, brush trucks, command, and utility vehicles.

Responding staff is the assigned complement of personnel that are intended to respond with those specific vehicles assigned in the department's response procedures (actual numbers may vary from incident to incident).

First unit arrival is the target response time for the arrival of the first due company and is expressed in minutes.

Full alarm arrival is the target response time for the arrival of the complete assignment to the incident.

In order to ensure sufficient personnel and apparatus are dispatched to an emergency event, the alarm response assignments and objectives on the following page have been established for the Topeka Fire Department.

Figure 49: Critical Tasking Objectives by Alarm Type

General Incident Type	Risk	Critical Tasking	Engines	Trucks	Rescues*	Other	Responding Staff	First Unit Arrival**	Full Alarm Arrival**
Structure Fire- Urban/Surburban	Mod	17	3	2	1	1	18	6:00	10:00
Structure Fire- Urban/Suburban	High	27	4	4	1	2	28	6:00	10:00
Structure Fire- Downtown Core	Mod	20	4	2	1	1	21	6:00	10:00
Structure Fire- Downtown Core	High	30	5	4	1	2	31	6:00	10:00
Non-Structure Fire Incident	Low	4	1	0	0	0	3	6:00	10:00
Hazardous Material	Low	6	1	0	0	1	4	6:00	10:00
Hazardous Material	Mod	20	3	2	2	2	21	6:00	10:00
Hazardous Material	High	Incident Specific						6:00	10:00
EMS	Low	3	1		1		5	6:00	10:00
EMS	High	Incident Specific						6:00	10:00
Rescue- Motor Vehicle Accident	Low	7	1	1		1	7	6:00	10:00
Rescue- Building Collapse	Mod	13	2	2	2	2	18	6:00	10:00
Rescue- Trench Rescue	Mod	13	2	2	1	2	16	6:00	10:00
Rescue- Low/High Angle	Mod	11	1	2	1	1	12	6:00	10:00
Rescue- Confined Space	Mod	13	1	1	1	2	10	6:00	10:00

* Certain calls include calculations for third-party ambulance(s).
** Times shown include call processing, turnout and travel time and are based on national benchmarks indicated in Chapter 5

After reviewing the Standards of Coverage resource requirements, it is noted that a few incident type categories currently have less personnel assigned to the initial response than the critical tasking analysis indicated would be needed. However, ESCi noted that some of these calls received an additional engine assignment by request of the incident commander on the initial call.

As stated earlier, the department may also wish to consider running field validation exercises with its crews, to verify the critical tasking analysis provided for this study. After field validation is complete, the department may find that the critical tasking can be adjusted appropriately upward or downward on each incident type.

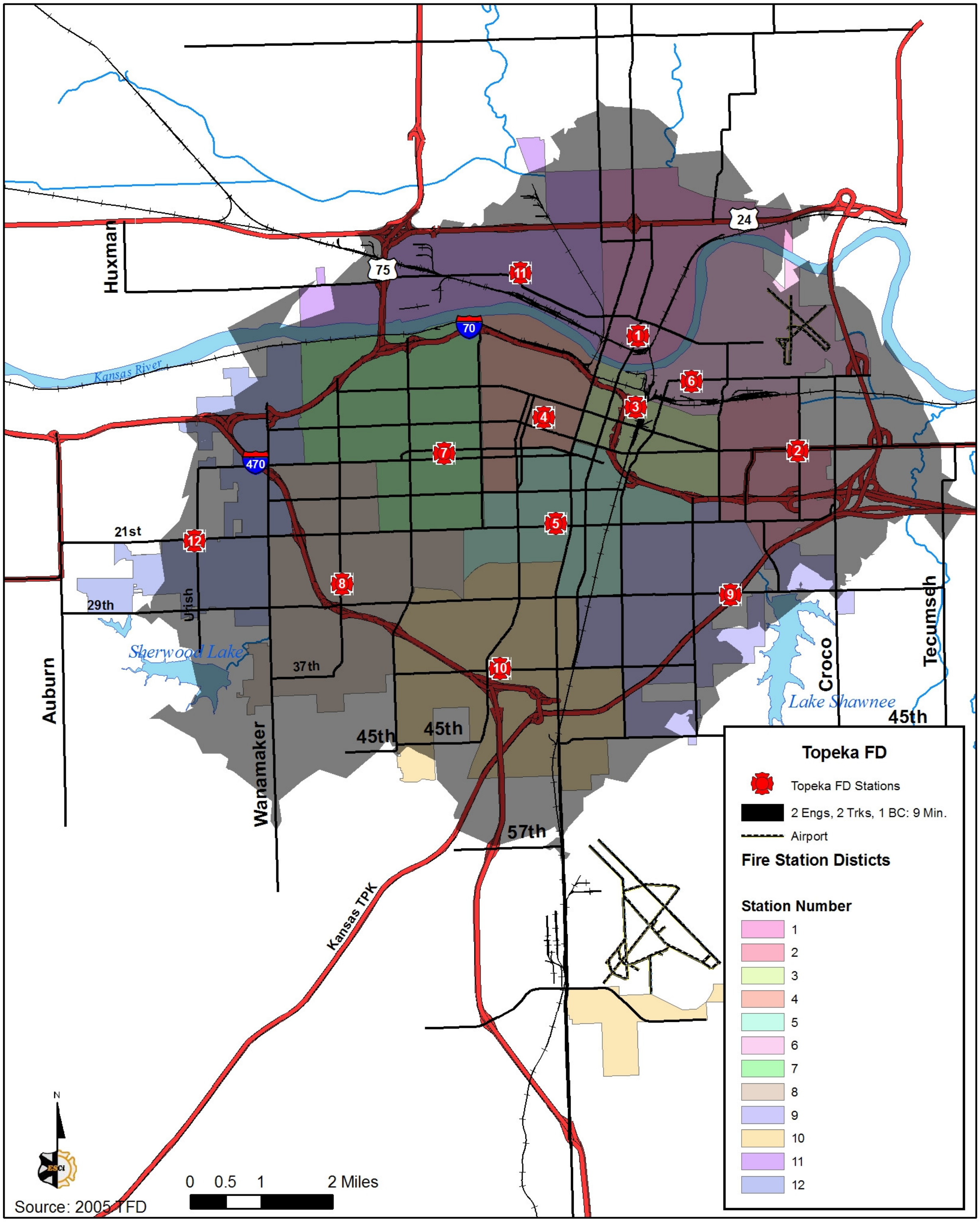
Concentration and Effective Response Force

As described in Chapter 5 of this report, the NFPA standard calls for the arrival of the entire initial assignment (sufficient apparatus and personnel to effectively combat a fire based on its level of risk) within nine[26] minutes, 90 percent of the time. This is to ensure that enough people and equipment arrive soon enough to be effective in controlling a fire before substantial damage occurs.[27] In Topeka, this initial alarm assignment currently consists of 15 firefighters, two engine companies, two truck companies, and a battalion chief.

The following figure depicts the current capability of the department to assemble an effective response force of two engines, two trucks, and a battalion chief within nine minutes in the response area of the City, assuming a one-minute turnout time and a computer modeled eight-minute travel time.

[26] One minute is provided for firefighter turnout time, eight minutes for travel, leaving a total response time of nine minutes from point of dispatch.
[27] See previous discussion about the *time/temperature curve* and the effects of flashover.

Figure 50: Effective Response Force Capability



The figure indicates only a very few small areas of the city where resource concentration based on deployment is insufficient to meet the objective. These are primarily located along the fringe boundaries of City limits, and are areas of very low service demand. This is a strong indication that resource concentration is sufficient to provide an effective response force within the nine-minute time objective to the vast majority of geographic areas of TFD's response area. There may be additional factors that impact the department's ability to assemble an effective response force within the stated time objective, such as turnout time or call processing times.

Workload issues affecting the availability of resources necessary to achieve effective response force will be discussed in the following chapter.

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Chapter 8 - Reliability Analysis

Resource Workload

The workload on emergency response units can be a factor in response time performance. The busier a given unit, the less available it is for the next emergency; thus, the higher its *failure rate*[28]. If a response unit is unavailable, an alternate unit, and/or a unit from a more distant station, must respond increasing overall response times. A cushion of surplus response capacity above average values must be maintained due to less frequent, but very critical times, when atypical demand patterns appear in the system. Multiple medical calls, simultaneous fires, multi-casualty events, or multiple alarm fires are all examples, and are not at all uncommon.

The following chart shows response activity by unit. This chart describes total response activity for each unit from 2004 and 2005. Total unit responses exceed total incidents for the year since many calls for service require more than one unit to respond. Using the total time on incident, unit hour utilization (UHU) is also calculated for TFD response units.

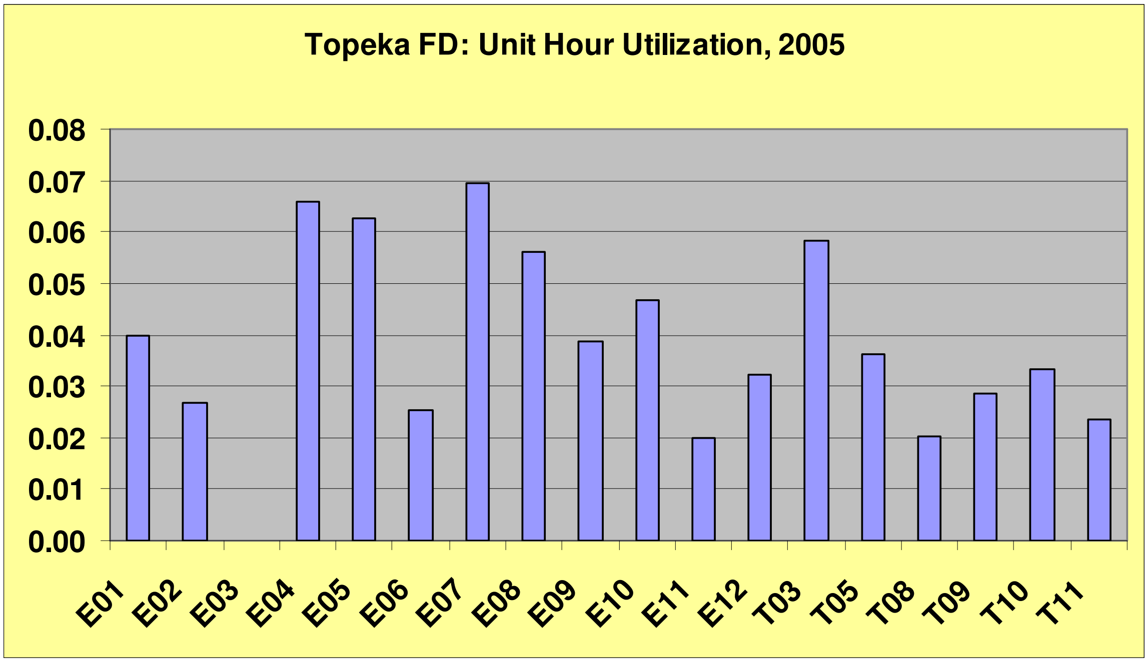
[28] *Failure rate* refers to the percentage of calls for which a unit is unavailable when it would normally be the closest and most appropriate unit. When an alternate unit must be dispatched, this is considered a *call failure* for the normally assigned unit.

Figure 51: Topeka Unit Hour Utilization[29]

	2005			2004		
Unit	Total Calls	Time	UHU	Total Calls	Time	UHU
101	883	316:42:52	0.04	794	269:16:28	0.03
102	880	293:55:58	0.03	778	238:46:13	0.03
103	657	183:14:41	0.02	545	159:42:41	0.02
E01	1155	349:53:33	0.04	1053	314:28:32	0.04
E02	669	235:43:30	0.03	710	207:39:00	0.02
E03						
E04	2067	577:24:49	0.07	2074	556:52:30	0.06
E05	2042	548:26:02	0.06	1920	529:40:50	0.06
E06	712	221:57:51	0.03	662	243:27:18	0.03
E07	2049	607:21:58	0.07	1808	518:12:47	0.06
E08	1720	491:43:29	0.06	1610	494:47:27	0.06
E09	1070	337:50:23	0.04	1042	313:27:52	0.04
E10	1387	409:37:07	0.05	1367	394:33:21	0.05
E11	502	173:12:07	0.02	420	142:44:36	0.02
E12	983	283:40:57	0.03	914	264:04:51	0.03
T03	1938	510:35:29	0.06	1814	440:09:40	0.05
T05	1331	316:52:28	0.04	1356	298:03:48	0.03
T08	726	176:16:43	0.02	746	193:56:46	0.02
T09	755	251:57:08	0.03	728	211:38:39	0.02
T10	1045	291:05:46	0.03	1025	242:03:48	0.03
T11	574	205:03:46	0.02	548	149:44:59	0.02

[29] Engine 3 was placed out of service during these time periods; it has since been placed in for service in 2006.

Figure 52: Unit Hour Utilization - 2005



Unit hour utilization rates for engines are usually higher than for truck companies, as they are dispatched first on every assignment. Truck 3, however, had a relatively high UHU with the absence of Engine 3 during 2005.

Recommended unit hour utilization maximums for fire department units are typically around 0.20, with some studies indicating that unit failure rates[30] at this workload will begin to hit 10 percent. All TFD response units are currently well below recommended targets, indicating unit workload is not likely a factor in achieving improved response times. Unit hour utilization is an important workload indicator; it describes the amount of time a unit is not available for response since it is already committed to an incident. The larger the number, the greater its utilization and the less available it is for assignment to an incident. Thus, it can be expected to have a higher failure rate.

[30] The unit failure rate is the percentage of calls for which a unit is unavailable due to handling an existing call, where it otherwise would have been dispatched as the primary unit.

Unit Failure Rates

In studying failure rates, ESCi examined how well the station within each district is able to handle calls. As stations may have multiple apparatus to respond with, this may reflect in lower failure rates for units than those stations equipped with a single piece of apparatus.

Figure 53: 2005 Failure Rates for TFD Stations

District	TF01	TF02	TF03	TF04	TF05	TF06	TF07	TF08	TF09	TF10	TF11	TF12
AF01												1
HJ04										1		
MF01												2
SL01	1	2			1						6	
ST01								1			2	
TF01	716		24	7	3	2	1	2	1	1	28	
TF02		548	15	1	1	3			5	2		
TF03	13	8	779	55	6	3	9		2			
TF04	2		108	1425	40	1	31			2		
TF05	1		19	28	1574	1	16	3	17	14		
TF06	3	5	48	1		454					1	
TF07		1		40	11		1670	27		1	6	6
TF08		1		2	3		48	1314	1	21	1	67
TF09		4	4		26	1	1	1	1120	10	1	
TF10		7	1		25			38	18	1351		6
TF11	23				1	5	7		1		409	2
TF12				1			4	42		1	2	770
TT01												1
TT02								1				
Grand Total	759	576	998	1560	1691	470	1787	1429	1165	1404	456	855
Failure Rate	5.67%	4.86%	21.94%	8.65%	6.92%	3.40%	6.55%	8.05%	3.86%	3.77%	10.31%	9.94%

Station #3 has a failure rate well in excess of 10 percent, but this is due to the amount of time that Engine 3 was shut down during 2005. Many of the engine company calls in its first-due response area were dispatched to other units, but were still credited as being in Station 3's first response area. This is a statistical anomaly resulting from the method of record keeping while Engine 3 was shut down.

Failure rates near 10 percent can create a *domino effect,* in that outside resources are pulled in to cover calls, thus leaving their own district vulnerable to higher failure rates. The blue shaded rates in figure 53 highlight which station was pulled into a district the most often, due to the alarm apparatus not being available. Station #4 was first-arriving on nearly 200 calls into other districts, and had a relatively high failure rate, but not in excess of 10 percent. Station #6, by contrast, was first-arriving on only 58 calls into other districts, and maintained a very low failure rate. The failure rates of surrounding stations should be considered, along with geography and travel time, in specifying the unit to be dispatched in place of any particular first-due unit.

When reviewing failure rates of units, it is important to remember the effect on the agency's ability to meet its response time performance objectives. This is because a failure rate of over 10 percent will cause a company to miss any performance objective that is set at 90th percentile. Even if unit distribution keeps travel times low and is adequate for achieving the objective 100 percent of the time, failure to be able to respond to over 10 percent of calls will mean failure to meet a 90th percentile objective.

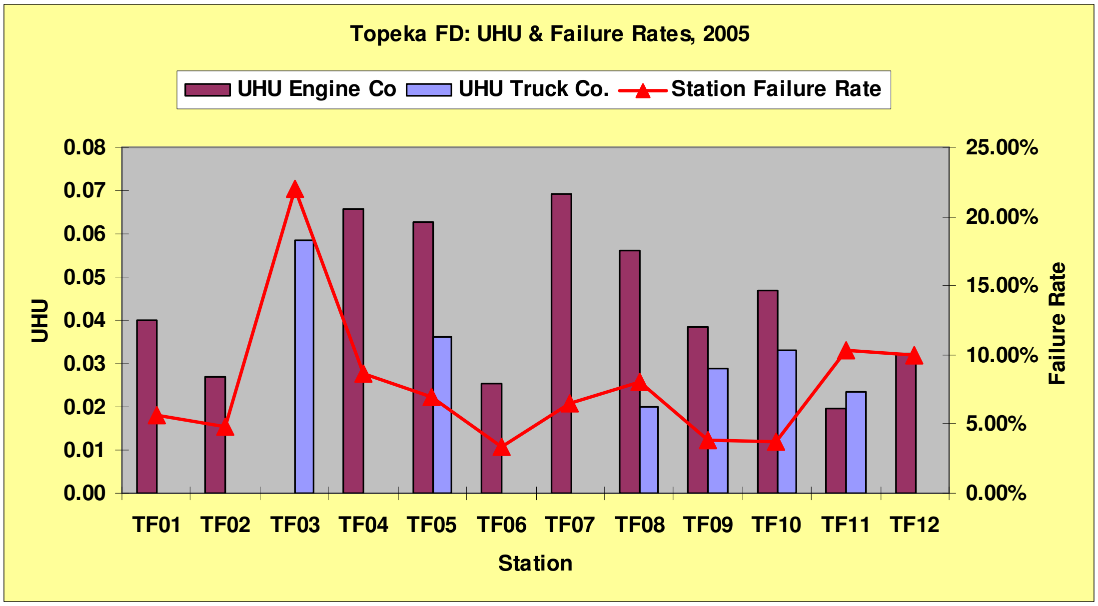
Equally important, however, is to understand that failure rates may or may not be cause by workload issues. If a given unit's workload is high enough, it will obviously have an increasing number of instances where it is occupied on one call and unable to respond on another. There are other reasons, though, why a unit may be unable to respond on a call, and these may be completely unrelated to workload. Some examples are:

- Taking a company out of service for training
- Taking a company out of service or out of area for training
- Sending a company to distant stations for fill-in
- Taking a company out of area for administrative functions
- Temporary closings of a station

High failure rates caused by high workload must be considered in deployment planning. In some cases, additional resources, or additional concentration of resources, may be needed. Failure rates caused by other issues may not require a change in deployment, but rather a chance in operating or administrative procedures.

To try to assist in analyzing the probable source of failure rates for units in Topeka, ESCi compared unit hour utilization (total committed workload) to failure rates in figure 54.

Figure 54: Failure Rates and Workload Comparison



Again, Station #3 has a failure rate that is a result of the method of record keeping while Engine 3 was shut down. Stations #11 and #12 are at or near the 10 percent threshold. However, neither has a correspondingly high unit hour utilization, or workload, that would seem to explain the failure rate. For example, both stations have workloads well below that of Station #7, but both have higher failure rates. The department should examine administrative, support, training, prevention, or other functions of any company's whose failure rate is unusually high in comparison to emergency workload, and seek procedural changes to reduce the failure rate.

Incident Concurrency and Resource Drawdown

Many dispatch criteria require the response of more than one apparatus, in areas which have just one apparatus. This requires response from units outside the alarm district. This can become exacerbated when concurrent calls occur within the department as a whole. To examine the extent of this issue for Topeka, the following table details the level of concurrent calls by type within the City.

Figure 55: Table of Dispatch Concurrency - 2005

Topeka Fire Department: Table of Dispatch Concurrency, 2005								
Dispatched	All Calls	%	Fire Calls	%	Other Fire	%	EMS Calls	%
Total	13152		827		2857		9464	
Single	8398	63.85%	735	88.88%	2524	88.34%	6924	73.16%
2 concurrently	3269	24.86%	67	8.10%	257	9.00%	1993	21.06%
3 concurrently	952	7.24%	19	2.30%	54	1.89%	427	4.51%
4 concurrently	294	2.24%	5	0.60%	12	0.42%	83	0.88%
5 concurrently	115	0.87%	1	0.12%	5	0.18%	23	0.24%
6 concurrently	50	0.38%			4	0.14%	4	0.04%
7 concurrently	22	0.17%			0	0.00%	2	0.02%
8 concurrently	16	0.12%			1	0.04%	2	0.02%
9 concurrently	7	0.05%					3	0.03%
10 concurrently	11	0.08%					1	0.01%
11 concurrently	5	0.04%					2	0.02%
12 concurrently	5	0.04%						
13 concurrently	4	0.03%						
14 concurrently	1	0.01%						
15 concurrently	2	0.02%						
16 concurrently	0	0.00%						
17 concurrently	0	0.00%						
18 concurrently	0	0.00%						
19 concurrently	1	0.01%						

For fire calls, those typically requiring the greatest number of resources, Topeka experiences two simultaneous calls about eight percent of the time. Given the number of resources in the city, this should not result in an unacceptable drawdown of available resources sufficient to affect assembly of an effective response force. Even if it were to delay the assembly of an effective response force beyond the nine-minute response time (dispatch to arrival), it would still not do so beyond 10 percent of the time, allowing the department to continue to achieve the objective at the 90th percentile.

Topeka experiences three simultaneous fire calls about two percent of the time. Assuming all three were structure fire responses, resources would still be adequate, but this could result in drawdown of resources such that a sufficient number of truck or service companies may no longer be available for an additional structure fire response. Still, the percentage of occurrences should permit the department to achieve its performance objectives at the 90th percentile.

Simultaneous structure fire incidents beyond three would result in a lack of truck/service company resources. Service equipment carried on engine companies would need to be utilized until additional ladder or service companies were freed up or responded from mutual aid.

Based on this analysis, ESCi determined that the department can handle the resource drawdown of three structure fire commitments, along with two to four other low-risk incidents simultaneously. At this point, the department's resources would be unable to adequately provide for an additional full structure fire response, and may be unable to handle additional low-risk responses or requests for additional apparatus at the structure fires. Mutual aid would be advisable at that point. This appears to be an acceptable and reasonable level of drawdown for a department of this size.

Chapter 9 - Community Expectations

The TFD has not completed a formal community expectation's process. This would normally be included in a strategic planning or SOC document development process, and should be considered for inclusion in future planning efforts. It would include input and feedback from both internal and external stakeholders. This could be handled through ongoing community satisfaction surveys, periodic community surveys, or personal interviews with select internal and external groups.

Each of the approximate 33,000 fire departments in the United States has their own composition, culture, and uniqueness. These, as well as other factors, place a specific demand upon each fire department as it relates to community needs and expectations.

Setting community expectations is part science and part politics. Once a comprehensive evaluation and categorization of community risk is completed, the fire department would review outcomes of emergencies. This process, in conjunction with identification and establishment of risk levels and risk categories, provides the foundation for future community involvement and input.

The science part of the process knows what risk categorization represents emergencies the agency is experiencing, and what degree of success the organization is having in mitigating them. Historical alarm information, in conjunction with incident specific results, serves as the basis for this review. Previous years' alarm information provided a good basis for identifying current performance. Three to five years of information will provide the basis for trending and forecasting. All of this information, and the subsequent analysis, will assist the organization and community in beginning to have answers to questions such as:

- Were the outcomes acceptable?
- Were the outcomes predictable?
- Can we take measures to prevent or reduce the impact of similar incidents in the future?

These and other questions will need to be answered at three specific levels - the fire department, administrative, and the policy making levels.

The political part of setting community expectations plays out in the desire and ability to make changes, pay for changes, and have the will to implement policy decisions. This is communicated and documented in two specific planning processes. First, Standards of Coverage identifies performance standards, and future goals and strategies designed to incrementally improve system performance. Second, strategic planning includes specific goals and objectives to accomplish future SOC strategies.

The community involvement process includes technical analysis and modeling, an operational review to make sure the analysis is intuitively sound and will work at the street level, fiscal review to ensure the current system's performance is sustainable from a fiscal level, and a review to ensure standards and goals are acceptable, are in sync with community expectations, and can be adopted by policy makers.

At the conclusion of the deployment planning process, the TFD will be in a position to formally pursue community input. Internal and external stakeholder input can play an important role in the development of both planning documents. The department could establish a blue ribbon committee or citizen task force, or use ongoing customer satisfaction surveys, periodic community surveys, or personal interviews with select internal and external groups.

Community expectations identified in the strategic planning process would include, but not necessarily be limited to:

- Response (time required to get there)
- Distribution (location of fire stations)
- Concentration (number of responding units and personnel)
- Reliability (is the response predictable)
- Training expectations of personnel
- Quality of equipment and tools the community is willing to financially support
- Community relations and public relations

The strategic planning process would also afford the community an opportunity to express any concerns that they might have relative to experiences with the fire department. It would also provide a vehicle for positive feedback.

Specifically, the SOC focuses on established performance standards and targets for future performance enhancements. In the SOC process, the community's expectations might include performance measures and goals that would be stated similar to some the examples below.

- Quick effective intervention (stop the escalation)
- Provide initial response resources that handle routine emergencies to a specific risk without the call for greater alarms or mutual aid
- Provide EMS response in a timely manner which will have a positive affect on survival rate and outcomes
- Provide hazardous materials response that can identify hazards, and initiate appropriate mitigation strategies
- Provide response to a major emergency or disaster, and initiating pre-conceived intervention or mitigation plans in a coordinated and systematic manner

In the final analysis, community involvement and the identification of community expectations are both critical components in the development of both the Standards of Coverage and the customer centered strategic plan.

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Chapter 10 - Future Improvement Strategies

During the course of this study, ESCi has extensively utilized geographic information systems (GIS) software to analyze response times of both apparatus and personnel by modeling response against the actual roadway network. This process allows creation and modeling of various deployment strategies with surprising accuracy.

In addition, the use of geographic placement of data relating to actual incident service demand from the previous calendar year, allows us to summarize the modeled performance of these deployment strategies, again with great detail.

The analysis of current resource and staffing deployment, found in a previous section, includes performance levels in both geographic coverage and service demand coverage. The following sections describe ESCi's analysis of new deployment strategies. In each strategy, specific locations are described for future fire station construction or relocation. It should be noted that these specific locations provide the point at which performance projection data was achieved, and represents ESCi's recommended *best-case* location. It is understood that additional factors, such as land availability, zoning, traffic patterns, etc., will also impact any decision on a specific fire station site.

Cost projections for each strategy must be based on certain conventions and assumptions. Wherever possible, actual budget data was used in future operating cost projections. In order to project capital cost, ESCi was obliged to make certain assumptions about the size and nature of any future facilities that are recommended. This is based on industry averages, and ESCi's collective experience. ESCi DID NOT conduct a full space or facility needs analysis to conclude the size and specific use(s) of proposed facilities. Square footage estimates were based primarily on the facility's projected use as described in the strategies, and did not account for potential additional uses, or space needs, that might exist. The City should conduct a full facility needs analysis for the fire department as an initial phase of any future facility project. This facility needs assessment could more accurately determine specific use(s) of any proposed facility, and identify the required square footage.

Current City Fire Protection Discussion

Topeka is providing a good level of fire protection services. Response times are good and compare well with other communities of its size. Areas with unusually long response times are few and relatively small. Resources are consistent with community needs. By all indications, Topeka has done an admirable job with its fire protection infrastructure, and displays a strong commitment to public safety.

Through analysis of current deployment and performance of the system, ESCi was able to identify several issues where improvement may be available. These issues are summarized in the following paragraphs.

Redundancy in engine company coverage in downtown area

The four-minute travel capabilities of the downtown engine companies from Stations #1, #3, #4, and #6 have significant overlap. Where workload, reliability, and call concurrency are an issue, this can be appropriate. Analysis indicates that workloads are well within normal ranges for those companies. Failure rates for these companies, even when reviewed during time periods when Engine #3 was shut down, were not beyond acceptable limits. The redundancy in this deployment may best be explained by tradition and community acceptance of *the way it has always been done*.

Service gap in engine company coverage in the Sixth and Fairlawn area

Despite the considerable redundancy in downtown engine company coverage, the area around Sixth and Fairlawn has notable gaps in both four-minute response time capability and the ISO-recommended 1.5 mile engine company coverage. Travel time performance for the census block groups analyzed in this region is consistently below levels found in the majority of the City. Service demand is moderate in the area, but adequate to justify engine company coverage that is equivalent with the remainder of the community.

Service gap in ladder/service company coverage in the northwest sections of the city

The northwest section of Topeka, directly north of Truck 8 and northwest of Truck 5 has notable gaps in both ladder/service company travel time capability and ISO-recommended 2.5 mile truck coverage.

Service gap in engine and ladder/service company coverage in the far southern non-adjacent sections of the City

The southern areas of remote City jurisdiction, near the airport and race track, have notable gaps in four-minute response time capability, as well as the ISO-recommended 1.5 mile engine company and 2.5 mile truck company coverage. Travel time capability is consistently below levels found in the majority of the City. However, analysis of actual performance was difficult to achieve due to the very limited demand for service. Service demand is quite low in the area at this time, but additional future growth and development is quite possible, resulting in additional service demand.

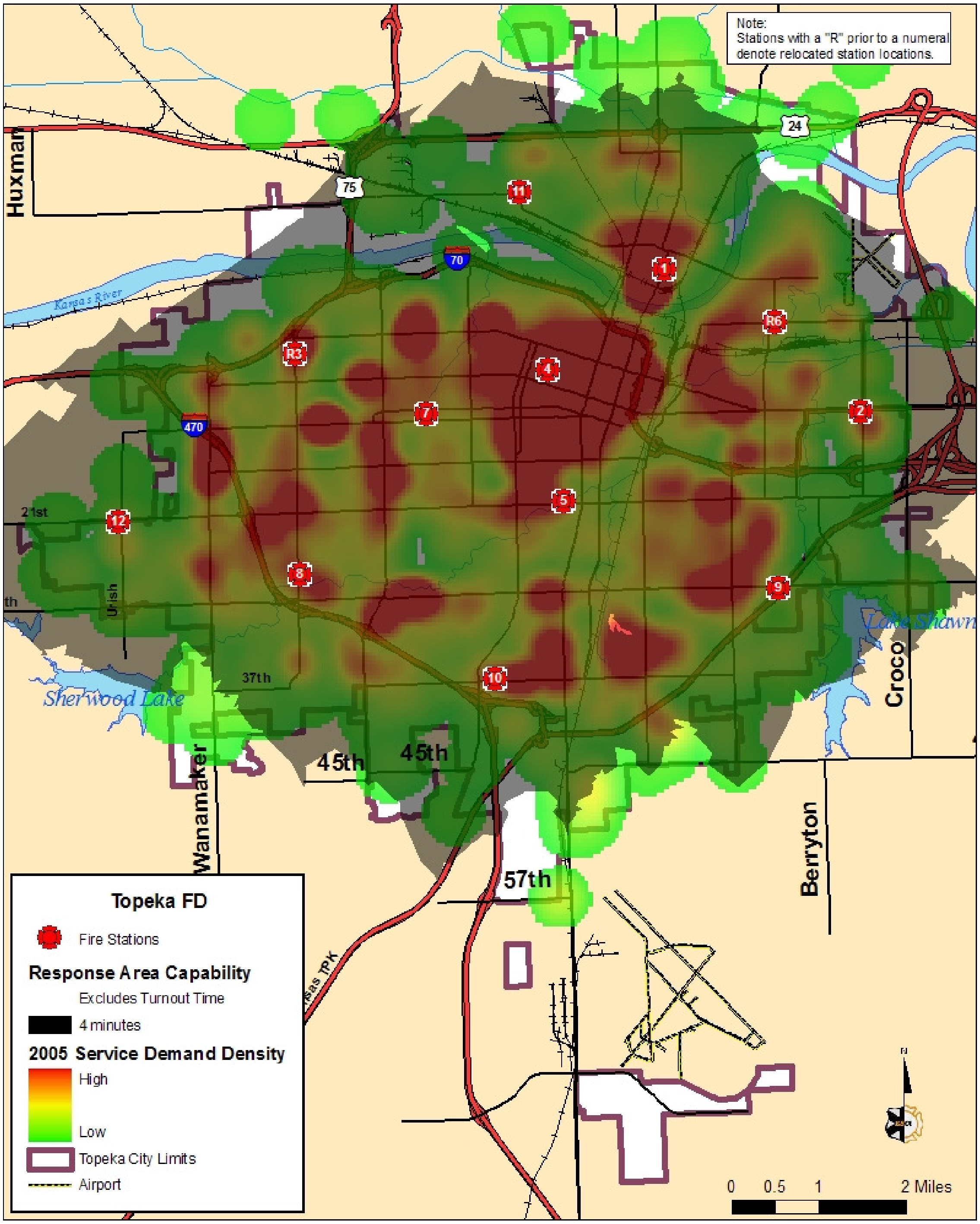
Deployment Strategy A – Current City Profile; Ideal Station Locations

Relocate Stations #3 and #6

Strategy A would involve a modified distribution of twelve Topeka fire stations, geographically located to improve the conditions of redundancy and service gaps. Strategy A calls for continuing the use of all current TFD stations, with the exception of Stations #3 and #6. Under this strategy, Station #3 would be relocated to the vicinity of SW Fairlawn Road between SW 7th Terrace and SW 8th Avenue, and would be staffed by both an engine and truck/aerial company. Station #6 would be relocated to the vicinity of NE Seward Avenue and NE Golden Avenue and constructed large enough to accommodate both an engine and truck company. This deployment would result in the current number of fire stations, while adding one additional truck company.

This strategy was considered, specifically, because it offers the opportunity for Topeka to provide a more consistent level of service throughout a greater geographic area of its jurisdiction, at or near its performance objective. The following figure demonstrates this deployment strategy. All areas within a four-minute modeled travel time of a TFD fire station are shown with a dark gray overlay to provide graphic depiction of service areas within the performance objective. Current service demand density is displayed in the background.

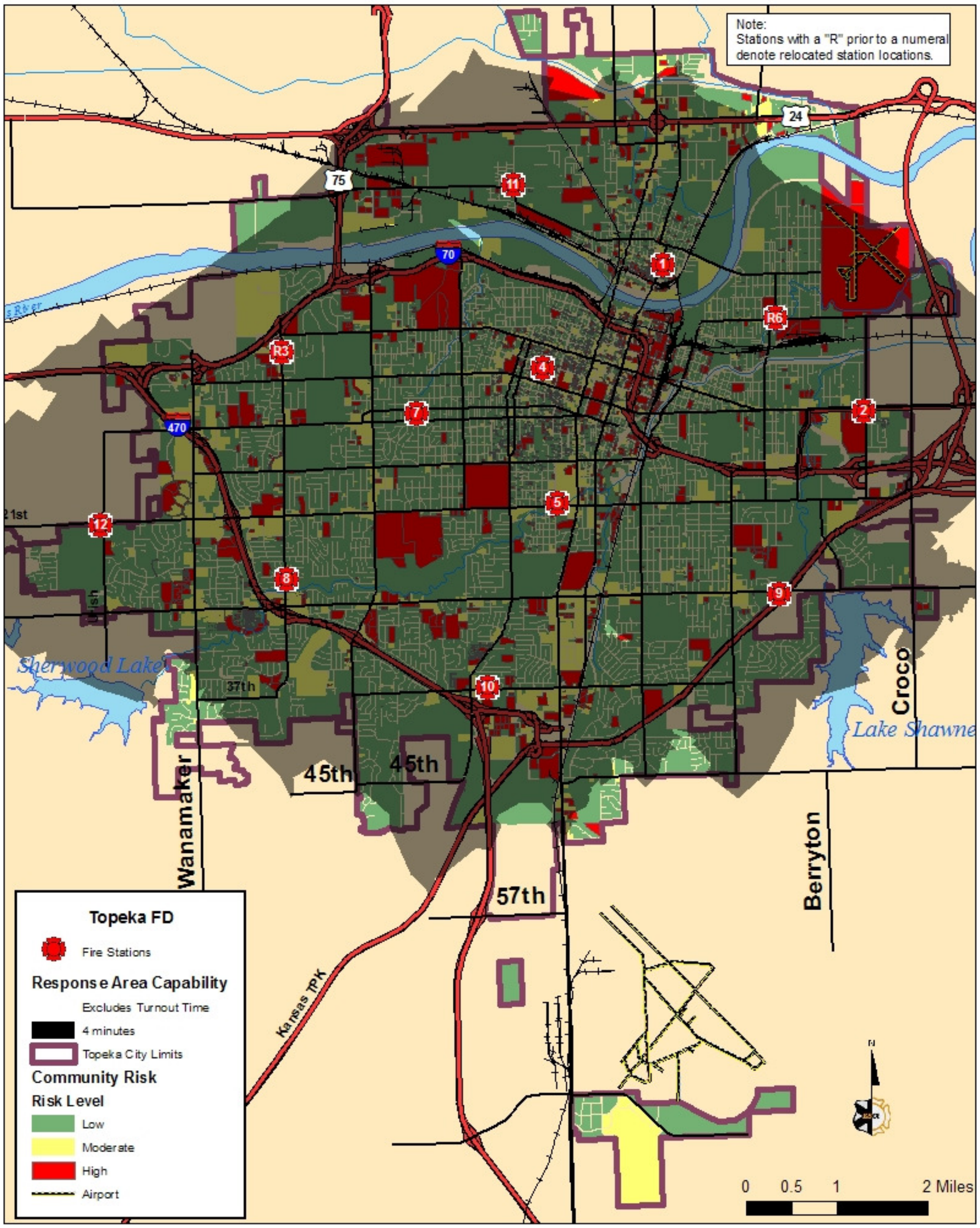
Figure 56: Deployment Strategy A and Current Service Demand



The most notable improvement in initial response distribution is in the northwest area of the City where the previous service gap was seen. All areas of high service demand are within the projected four-minute travel time.

The following map displays the same projected travel time capability against the current community fire protection risk ratings found earlier in this report.

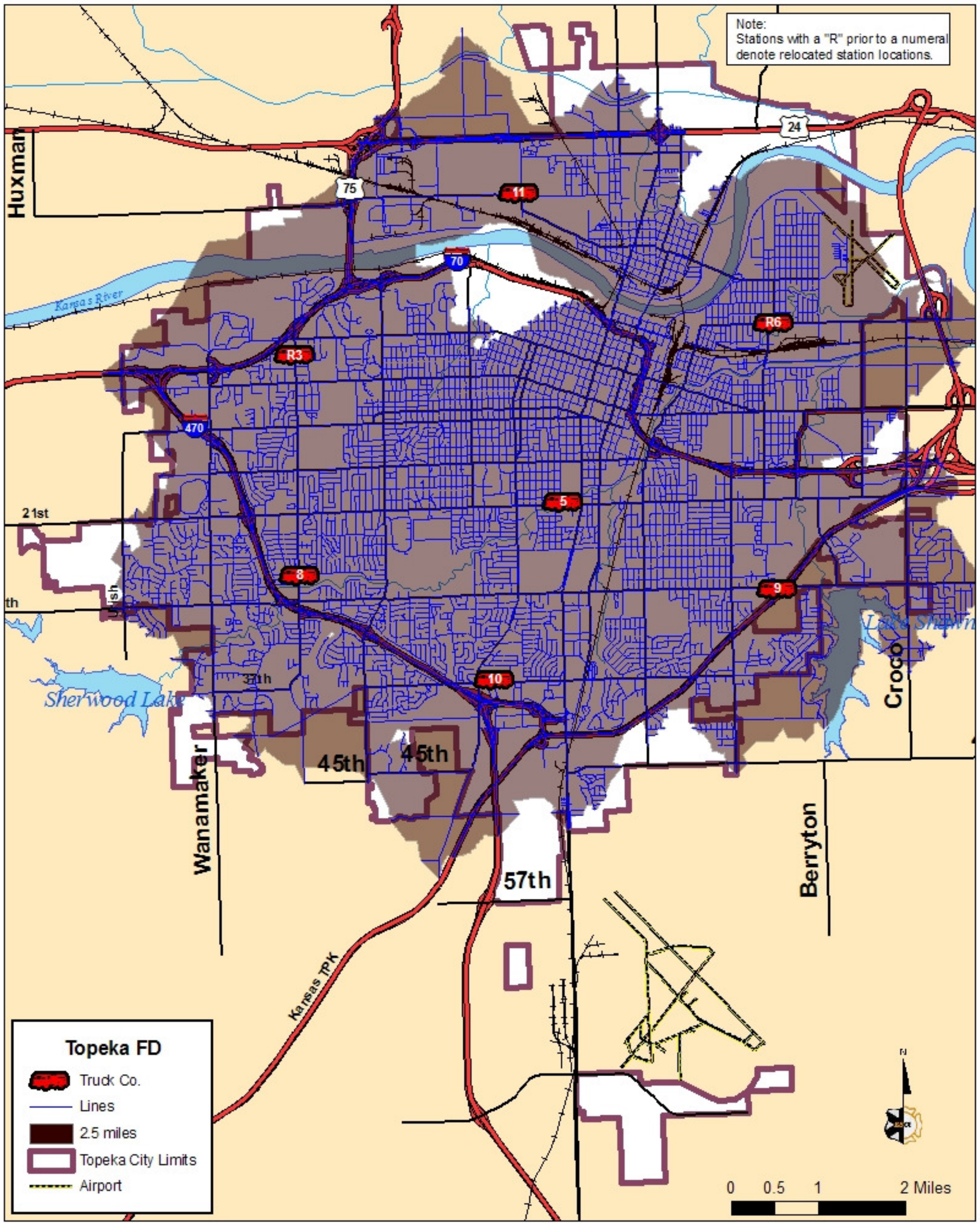
Figure 57: Deployment Strategy A and Current Fire Risk



As with service demand, most areas of highest risk are now within the four-minute travel time capability with the exception of some small parcels in the far northern sections of the City.

The following map (figure 58) displays the ISO standard 2.5 mile coverage under the new deployment of seven ladder/service companies.

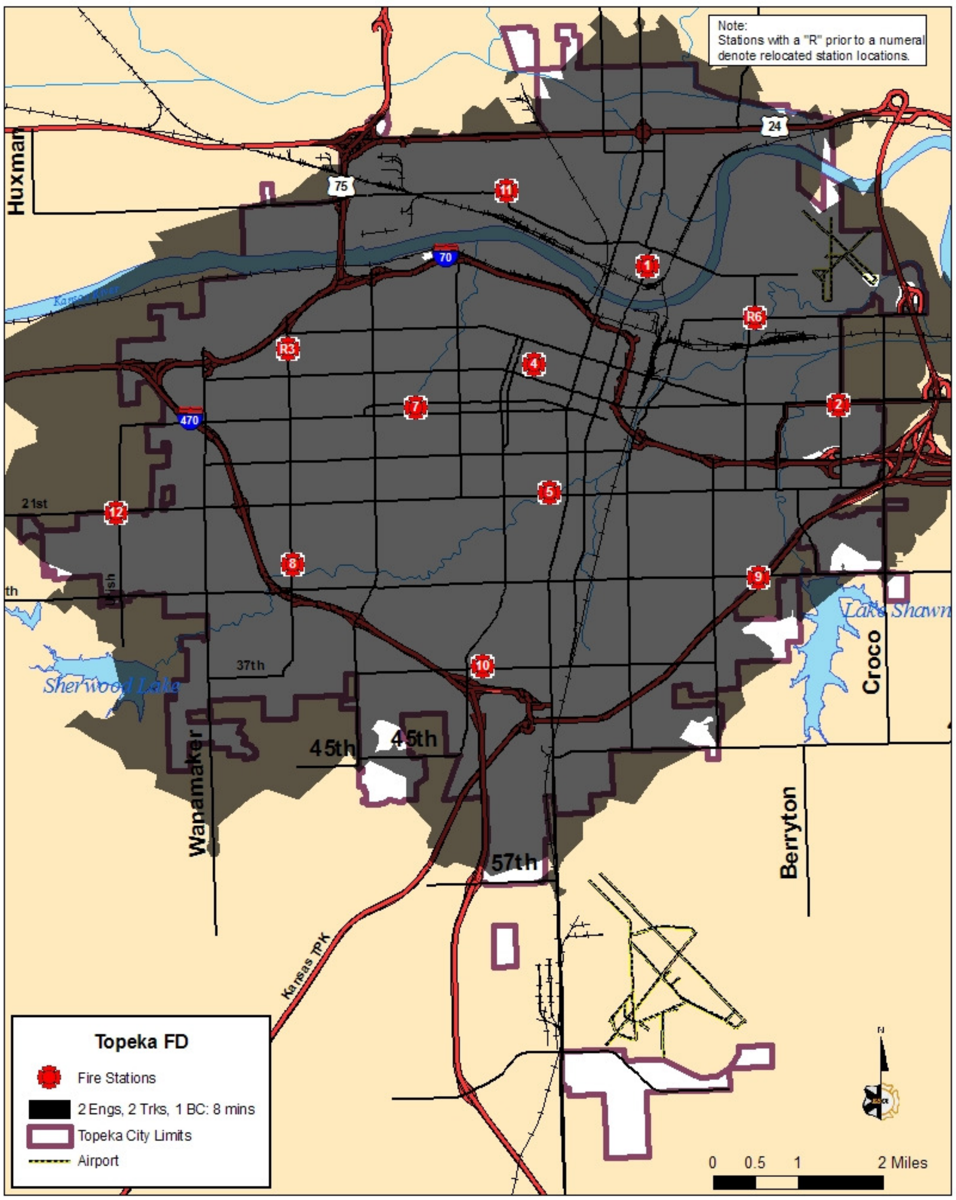
Figure 58: Deployment Strategy A - Ladder/Service Coverage



Notable improvement in coverage is seen in both the northeast and northwest portions of the City, where previous gaps in ladder/service coverage were most significant.

The following map displays the concentration of resources available under the strategy by showing the eight-minute capability for achieving an effective response force (two engines, two trucks, and one battalion chief).

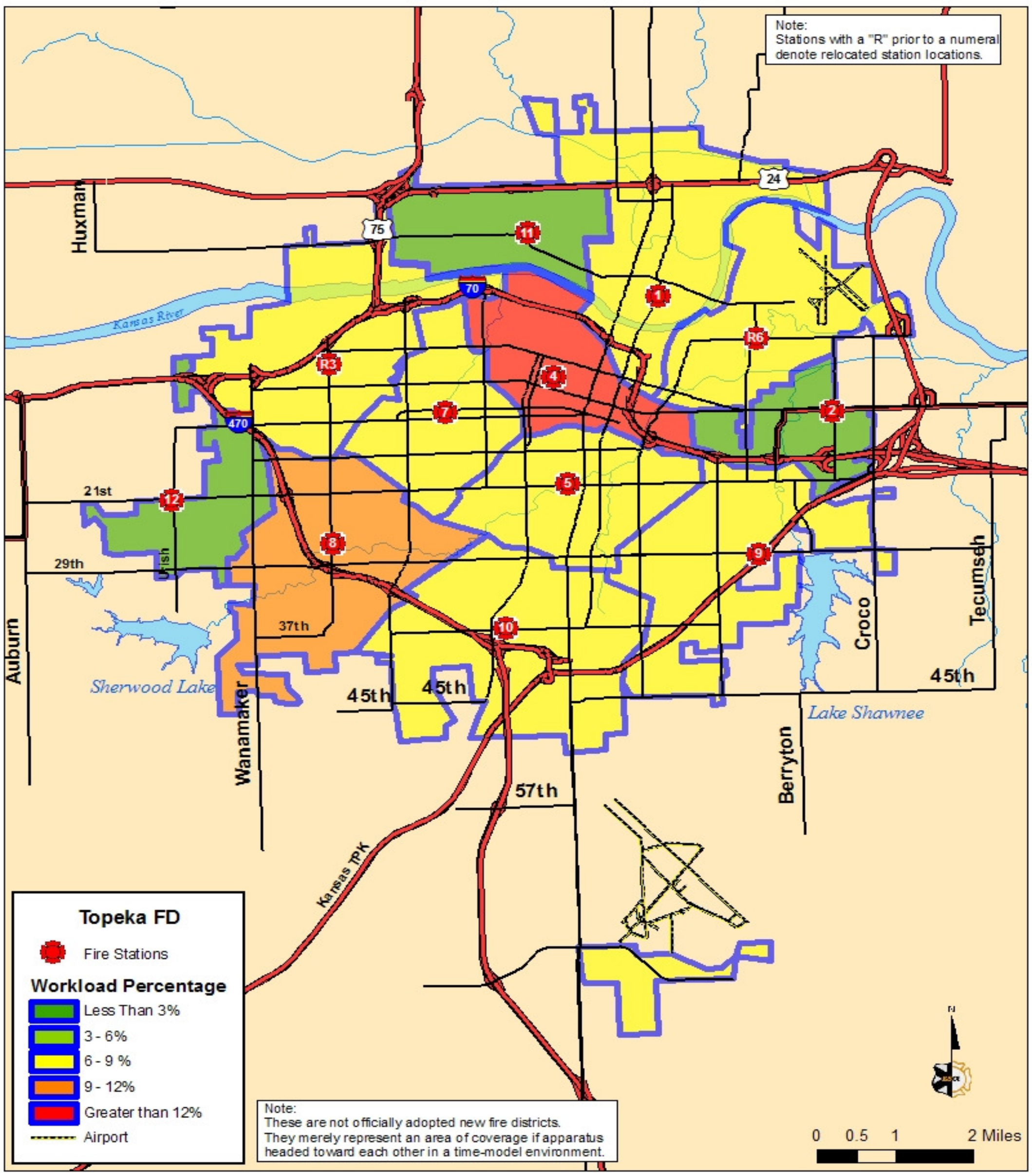
Figure 59: Deployment Strategy A - Effective Response Force Capability



Nearly the entire City remains within the effective response force deployment capability.

It should be understood that any deployment strategy which closes or relocates fire stations, will require a realignment of response district boundaries for the stations affected, in order to ensure closest unit response. The following map depicts general outlines of the closest unit response districts under the new deployment scheme in Strategy A, and identifies the projected workload distribution for each fire station's response area.

Figure 60: Deployment Strategy A - Workload Distribution

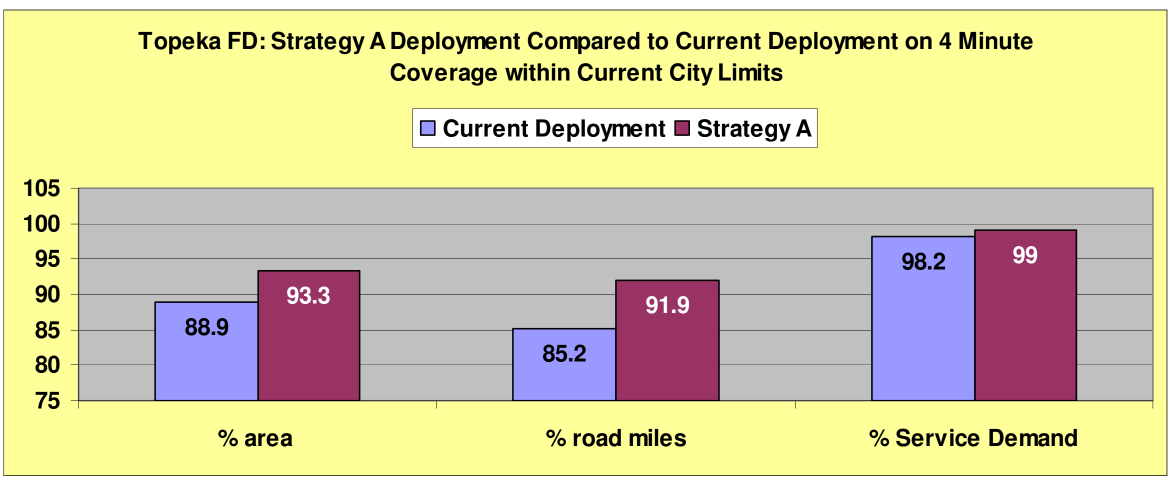


The strategy demonstrates improvement in workload balance with only one station exceeding 12 percent of total workload, compared with the current status of three stations exceeding 12 percent.

Strategy A Projected Performance

This deployment strategy demonstrates improvement in projected target-level service performance, when compared to the current deployment system. Performance models for the strategy, along with comparison figures of the current levels of response time capability experienced by the community, are provided. Performance projections are shown for the amount of City road miles and land area covered within the target response time, a good indication of overall geographic coverage. Performance projections are also shown for the amount of the City's emergency incidents covered within the target response time, a good indication of service demand coverage. The 2005 service demand and current street network were used in this analysis.

Figure 61: Strategy A Performance Analysis



As seen in the table, travel time capability would be at or below four minutes for just over 93 percent of land area, an improvement of about four percent, and around 92 percent of actual road miles, an improvement of about seven percent. Travel time capability would be at or below four minutes for 99 percent of all incidents, an improvement of about one percent. However, this improvement may be more significant, as development of the area around the proposed new location for Station #3 continues.

Strategy A Cost Projections

This deployment plan calls for continuing use of ten existing stations, and construction of two replacement stations. One additional truck company will be staffed under this strategy. For purposes of cost projection, ESCi used the following additional assumptions:

- Each new fire station is estimated at 9,500 square feet. This includes two-drive-through bays and living space for up to ten personnel. Cost is estimated at $175 per square foot[31], plus $650,000 per acre for land acquisition[32] estimated at 1.5 acres, and seven percent design fees.
- All staffing costs[33] are estimated at $75,056 for each captain, $65,965 for each lieutenant, $62,517 for each apparatus operator, and $46,445 annually for each firefighter[34]. Any new company consists of one captain, one lieutenant, one apparatus operator, and one firefighter per shift. At an estimated 30 percent leave ratio, additional firefighter FTE's are added to accommodate the need to fill in for vacation and leave time to maintain a minimum three-person company. A total of nine captains, nine lieutenants, nine apparatus operators, and 9.6 firefighters are included in this strategy's cost projection. It should be noted that there would also be some initial costs at hiring for new equipment, uniforms, and training.
- One new aerial truck is estimated for purchase at $875,000.

The following table projects capital and operating costs for Strategy A. These costs are in addition to current operating costs of the department and, thus, would represent new funds needed to support the strategy.

[31] Square footage cost estimate from Mark Schreiner, City Engineering.
[32] This is a $10 per square foot land acquisition estimate for properties in developed city areas. Land acquisition costs could be reduced to as little at $15,000 to $20,000 per acre by purchasing property well in advance of significant area development.
[33] All staffing costs include city pension and benefit contributions.
[34] Amount used was average of all ranges within each position.

Figure 62: Cost Projections - Strategy A

Strategy "A" Capital Costs	
Replacement Station #3 Construction	$ 2,428,875
Replacement Station #6 Construction	$ 2,428,875
Apparatus Additions	$ 875,000
TOTAL CAPITAL COSTS	**$ 5,732,750**
Strategy Annual Operating Cost Increases	
Annual Staffing	$ 759,238
TOTAL ANNUAL OPERATING COSTS	**$ 759,238**

Future City Fire Protection Discussion

During preparation for this study, the City requested consideration be given to future growth and potential expansion of both city size and emergency service demand. This is particularly important when the City is considering changes in current deployment to meet current service demand. Without an adequate look to the future, money can be spent for today's improvements that may later prove to be ineffective against service demand from new population and areas of developed risk.

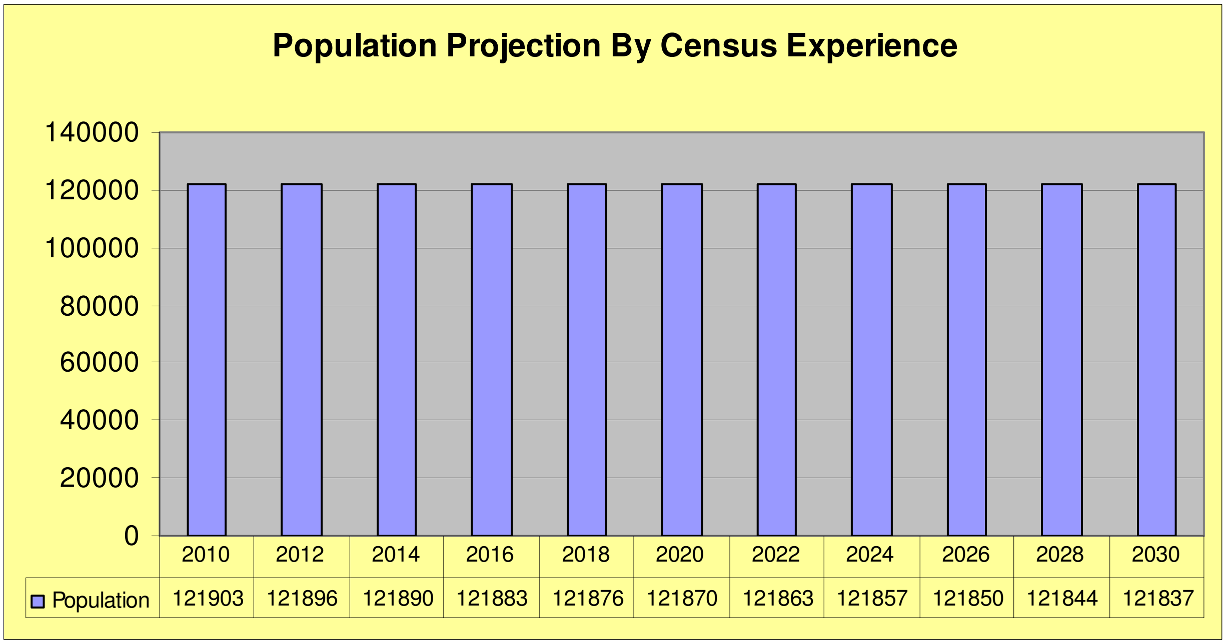
For this reason, ESCi's project team spent considerable time meeting with community planners in an effort to fully understand the community's comprehensive plan, and the anticipated nature of growth and development. This information was used to develop and outline a Fire Protection Planning Area for which service demand would be projected, and future deployment strategy would be developed.

Census-based Growth Projections

As indicated earlier in this section, the population of Topeka has increased, albeit slightly, in the last decade. Community planners anticipate that this modest trend will continue into the future.

In developing forecasts for population growth, ESCi develops a forecast based on several decades of census experience. In the case of Topeka, decennial census figures from 1970 through 2000, along with official estimates from 2001 through 2004 were used. A mathematical forecast is created through the year 2030. The resulting population forecast appears as follows.

Figure 63: Census-based Population Forecast

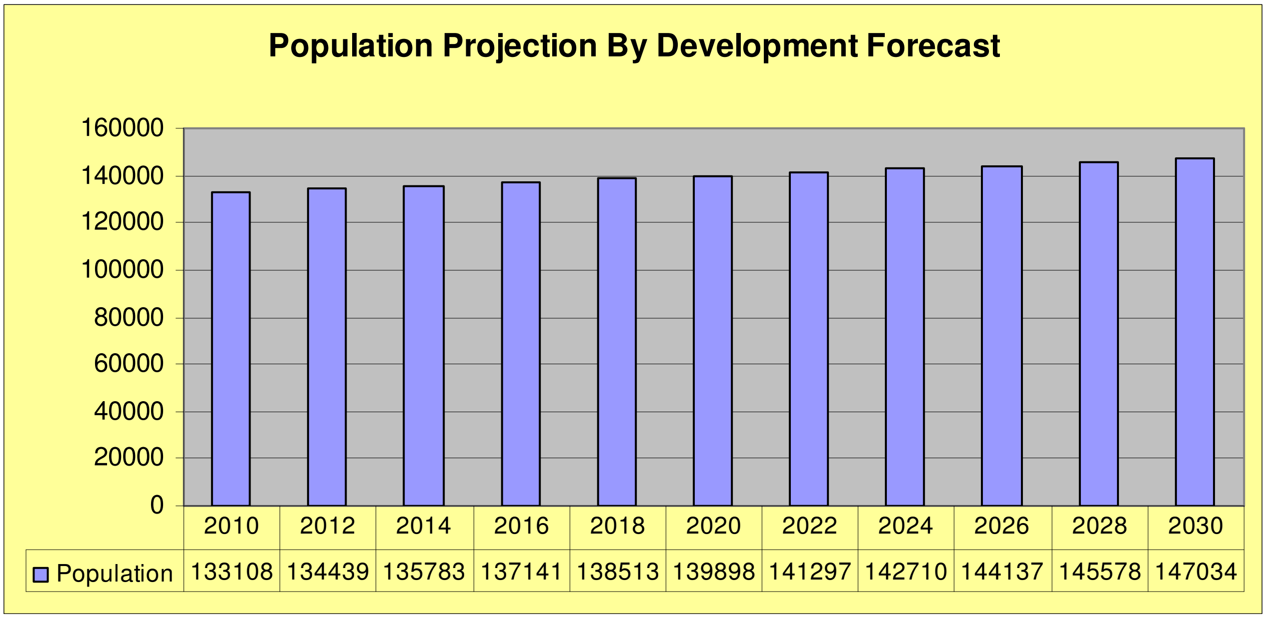


Development-based Growth Projections

While census-based population projections provide a mathematically-based estimate of future population based on historical data, they often fail to account for expected growth rate trends of an area. These changes often result from redevelopment, changes in employment capacity, or other socio-economic factors not reviewed in census-based projections. For this reason, ESCi offers population projections based on the review of available local development and business information.

In this case, ESCi reviewed information available from the *2025 Land Use/Growth Management Plan* for the Topeka region. The plan anticipates growth in Shawnee County that is greater than what is anticipated by the Kansas Division of Budget and the State Water Office. The plan's population estimate for the year 2030 was used to extrapolate population projections for Topeka. The resulting population forecast appears as follows.

Figure 64: Development-based Population Forecast



Information provided by the City in regard to housing unit permits, as well as inquiries regarding development, support the projections indicated above.

It is not the intent of this study to be a definitive authority for future population projection in the service area, but rather to base recommendations for future fire protection needs on a reasonable association with projected service demand. Since service demand for emergency agencies is based almost entirely on human activity, it is important to have a population-based projection of the future size of the community. While variation in the population projections are discussed here, one thing that can be certain is that Topeka Fire Department will continue to be an emergency services provider to a growing population, likely reaching as high as 147,000 by 2030. Planning should begin now to maintain the resources needed to meet the continuing demand for services.

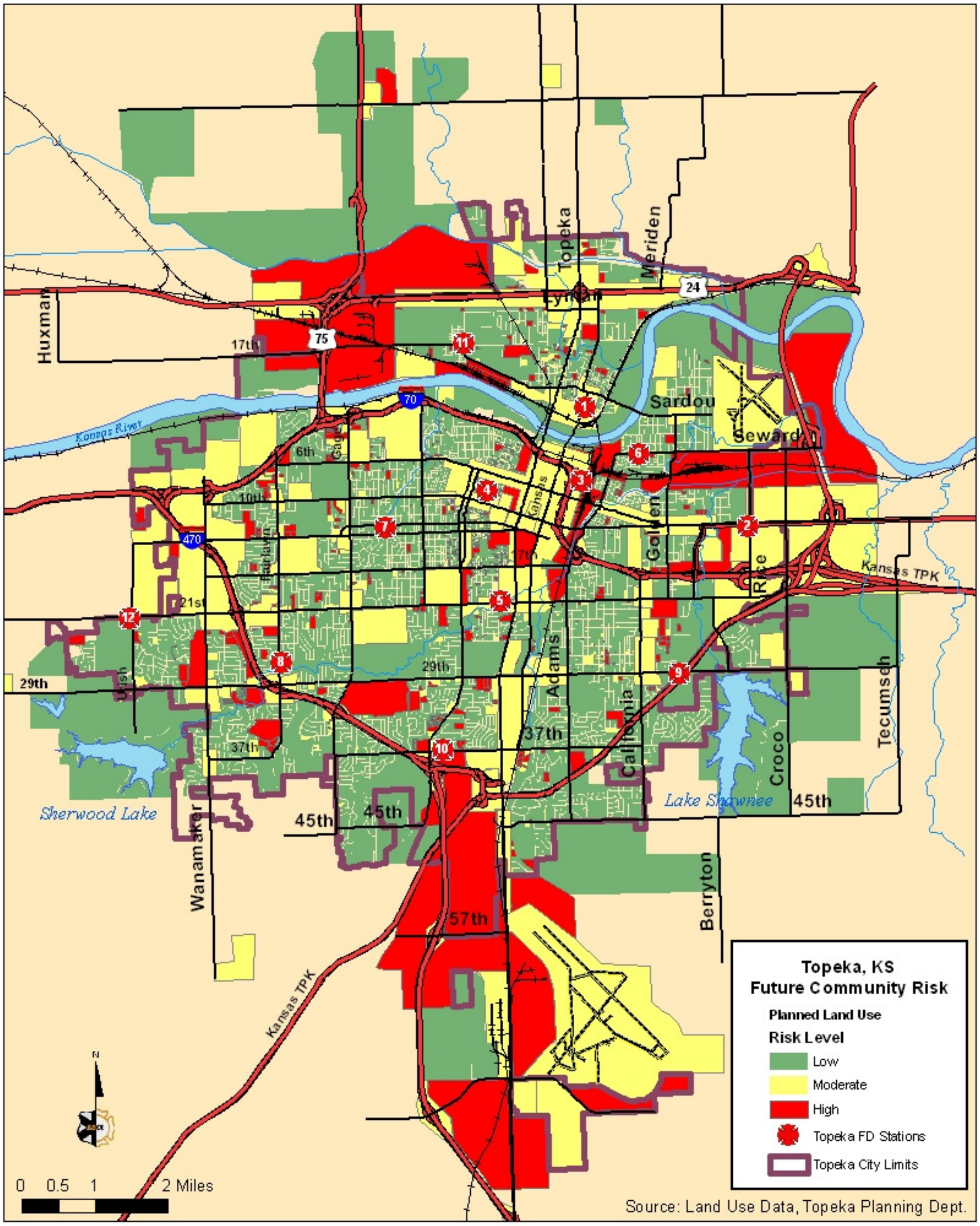
Future Community Risk

Plans for growth and land use management plans are in place to guide the future development within the City of Topeka. In the following figures, these plans for future land use have also been translated into community risk categories to help guide the evaluation of current resources in comparison to a potential future community of Topeka.

The same categorization method employed earlier was used in the evaluation of current community risk and applied to plans for future land use.

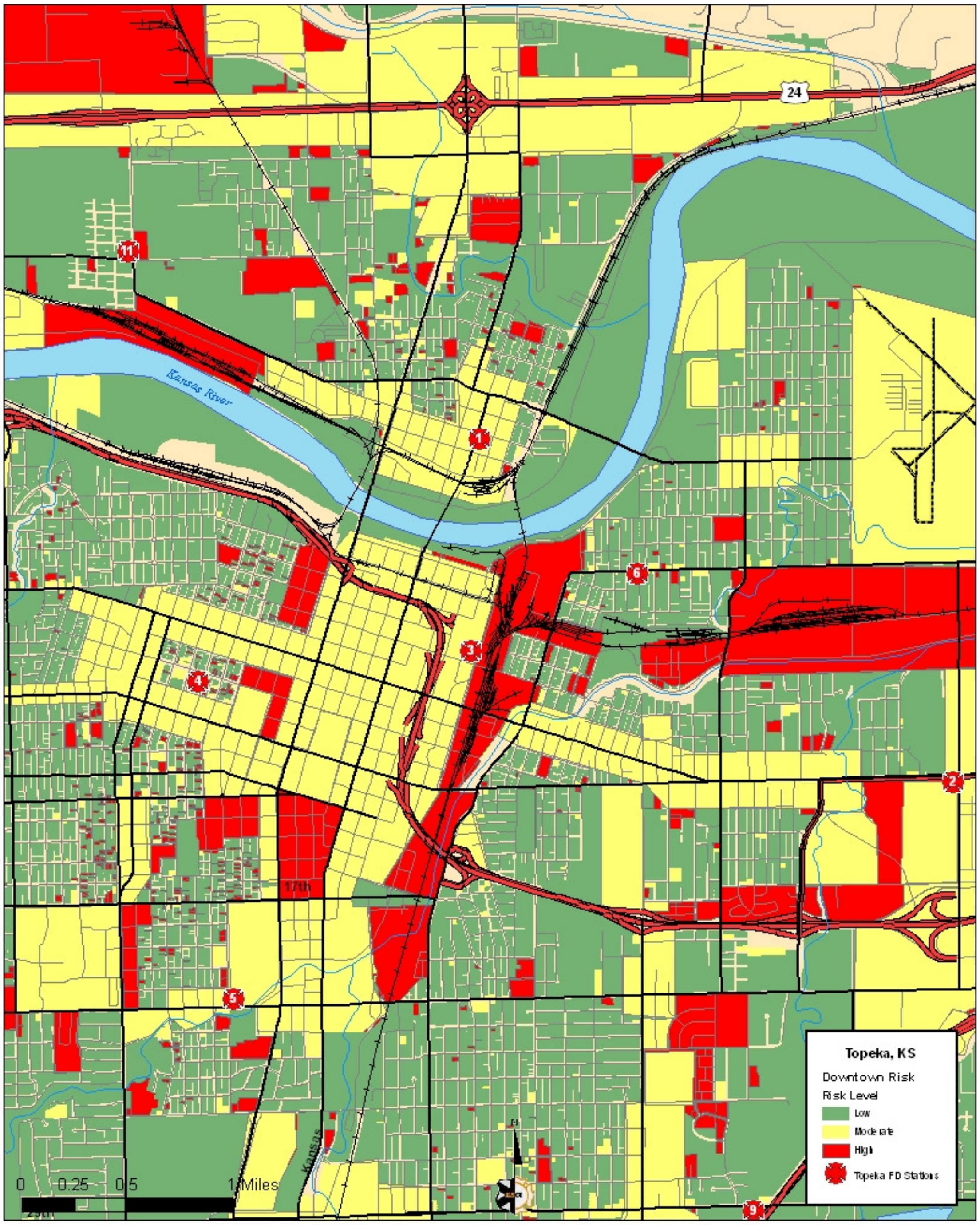
- Low risk – Areas zoned and used for agricultural purposes, open space, low-density residential, and other low intensity uses.
- Moderate risk – Areas zoned for medium-density single family properties, small commercial and office uses, low-intensity retail sales, and equivalently sized business activities.
- High risk – Higher-intensity business districts, mixed use areas, high-density residential, industrial, warehousing, and large mercantile centers.

Figure 65: Topeka Future Community Risk Assessment



Higher risk properties are planned for downtown, south near the airport, and along highway interchanges, which can often challenge access due to limited connectivity of roadways. Figure 66 provides a close-up view of downtown Topeka's potential community risk in the future.

Figure 66: Downtown Topeka Future Community Risk

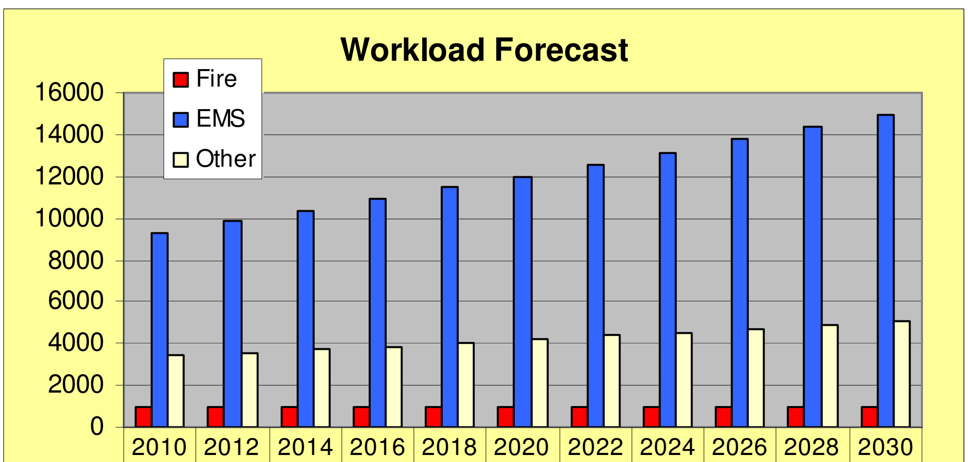


Workload Projections

In evaluating deployment of facilities, resources, and staffing, it is imperative that consideration be given to potential changes in workload that could directly affect such deployment. Any changes in service demand can require changes and adjustments in the deployment of staff and resources in order to maintain acceptable levels of performance.

ESCi utilized population projections obtained through community development data, and multiplied these by a blend of fifteen-year average and fifteen year forecast incident per capita rates to identify workload potential through the year 2030. The results of the analysis are shown, by year and type of call, in the following chart and table.

Figure 67: Workload Projection by Type and Year



	2010	2012	2014	2016	2018	2020	2022	2024	2026	2028	2030
Fire	948	950	951	953	954	955	956	957	958	959	960
EMS	9324	9844	10373	10911	11460	12018	12586	13165	13753	14352	14962
Other	3418	3568	3721	3877	4035	4197	4361	4527	4697	4870	5046

The number of actual fires is predicted to be relatively stable throughout the planning period. The number of EMS calls is predicted to continue to rise rather dramatically, a predictable result of both population growth, aging demographics, and continued increases in the public use of emergency medical services for initial entry into the medical care system. Other types of calls will also continue to increase with the addition of more built-in fire detection systems that generate alarm calls, increases in specialized services such as technical rescue and hazardous materials response, and general increases in the use of the fire department by the public as first responders to various types of urgent or critical situations.

Deployment Strategy B – Future City Profile; Ideal Station Locations

New Stations #13, #14, #15, #16, #17, and #18; Relocate Stations #3 and #6

Strategy B would involve a much wider distribution of eighteen Topeka fire stations, geographically located to improve the conditions of redundancy and service gaps in current deployment and maintain current performance levels throughout the growth and development of the City within the Fire Protection Planning Area. Strategy B calls for continuing the use of ten current TFD stations, with the exception of Stations #3 and #6. As with Strategy A, , Station #3 would be relocated to the vicinity of SW Fairlawn Road between SW 7th Terrace and SW 8th Avenue, and would be staffed by both an engine and truck/aerial company. Station #6 would be relocated to the vicinity of NE Seward Avenue and NE Golden Avenue and constructed large enough to accommodate both an engine and truck/aerial company. In addition to changes that are identical to Strategy A, six new stations would be constructed in the future as growth and development occurred.

Recommended locations for new fire stations are as follows. The order is suggested based on projected rates of growth as described by planning officials, but the actual order of any new station projects should be driven by the real estate market, and its resulting affect on growth and development.

- Proposed Station #13: SE Croco Road and SE 45th Street
- Proposed Station #14: SW Topeka Boulevard and SW University Drive
- Proposed Station #15: On SW Urish between SW 41st Street and the new extension of SW 45th Street
- Proposed Station #16: NW Brickyard Road and NW 35th Street
- Proposed Station #17: NE Meriden Road between NE 28th Terrace and NE 35th Street
- Proposed Station #18: NW Rochester Road and NW 39th Street

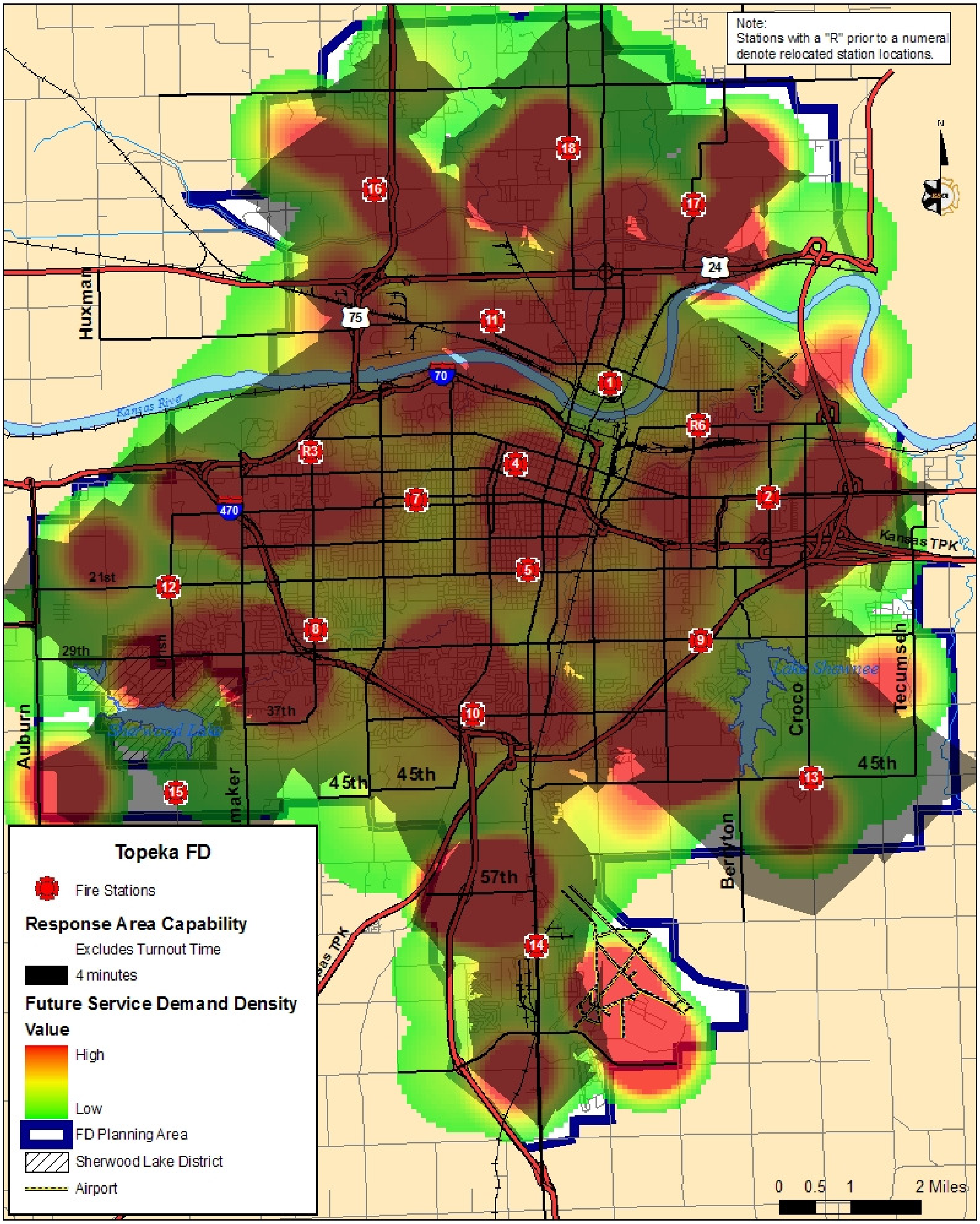
Each new station would have an engine company. In addition to existing truck companies, the recommended locations for new truck companies are as follows.

- Relocated Station #6
- Proposed Station #14
- Proposed Station #17

In addition to the suppression companies, the number of area commanders (battalion chiefs and shift commanders) in this strategy is increased from three to four.

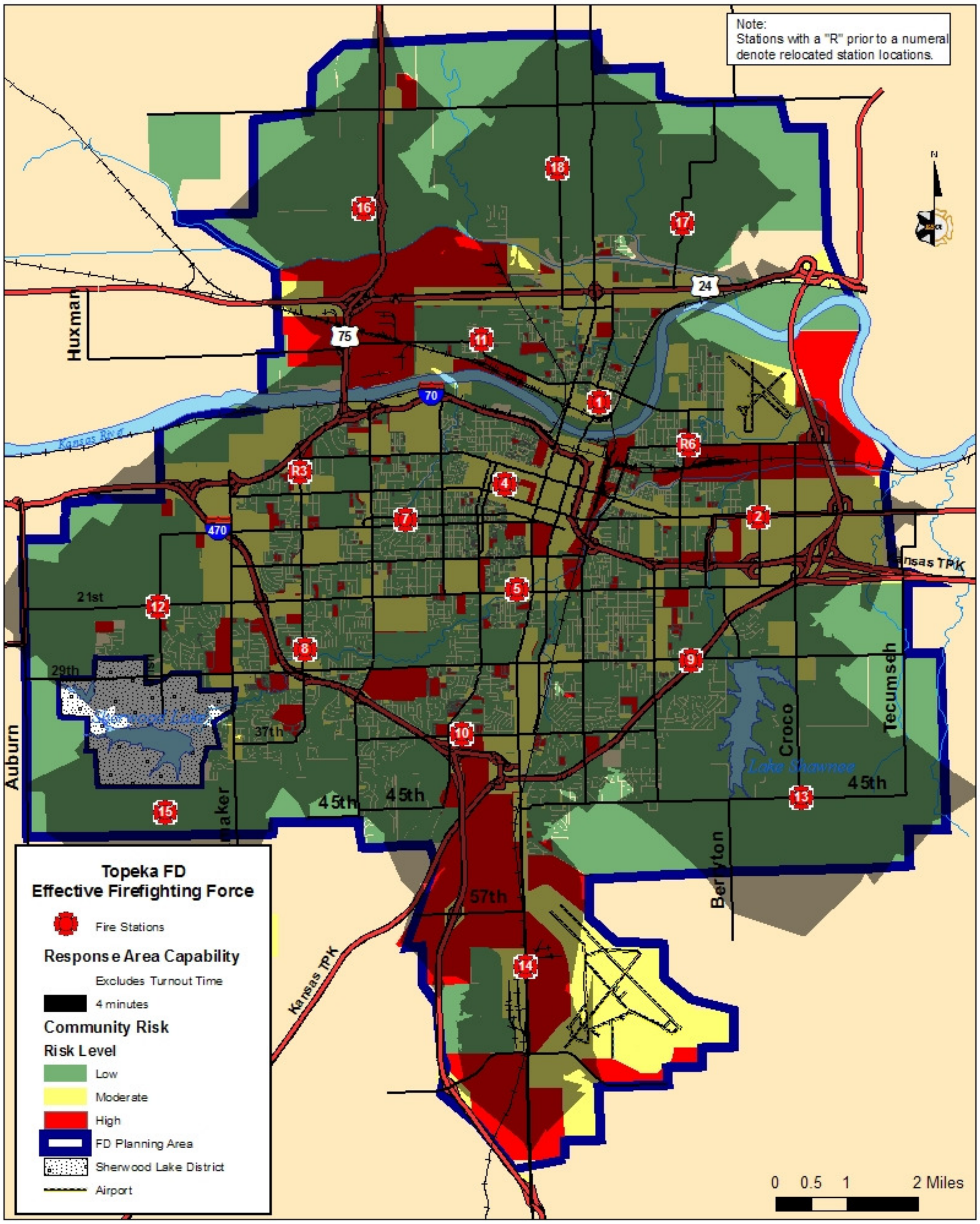
The strategy was considered specifically because it offers the opportunity for Topeka to provide a consistent level of service in areas of new city growth, expansion, and development, and remain at or near its performance objective. The following figure demonstrates this deployment strategy. All areas within a four-minute modeled travel time of a TFD fire station are shown with a dark gray overlay to provide graphic depiction of service areas within the performance objective. Projected future service demand density is displayed in the background. Most areas of high service demand are within the projected four-minute travel time.

Figure 68: Deployment Strategy B and Future Service Demand



The following map displays the same projected travel time capability against the future community fire protection risk ratings found earlier in this section.

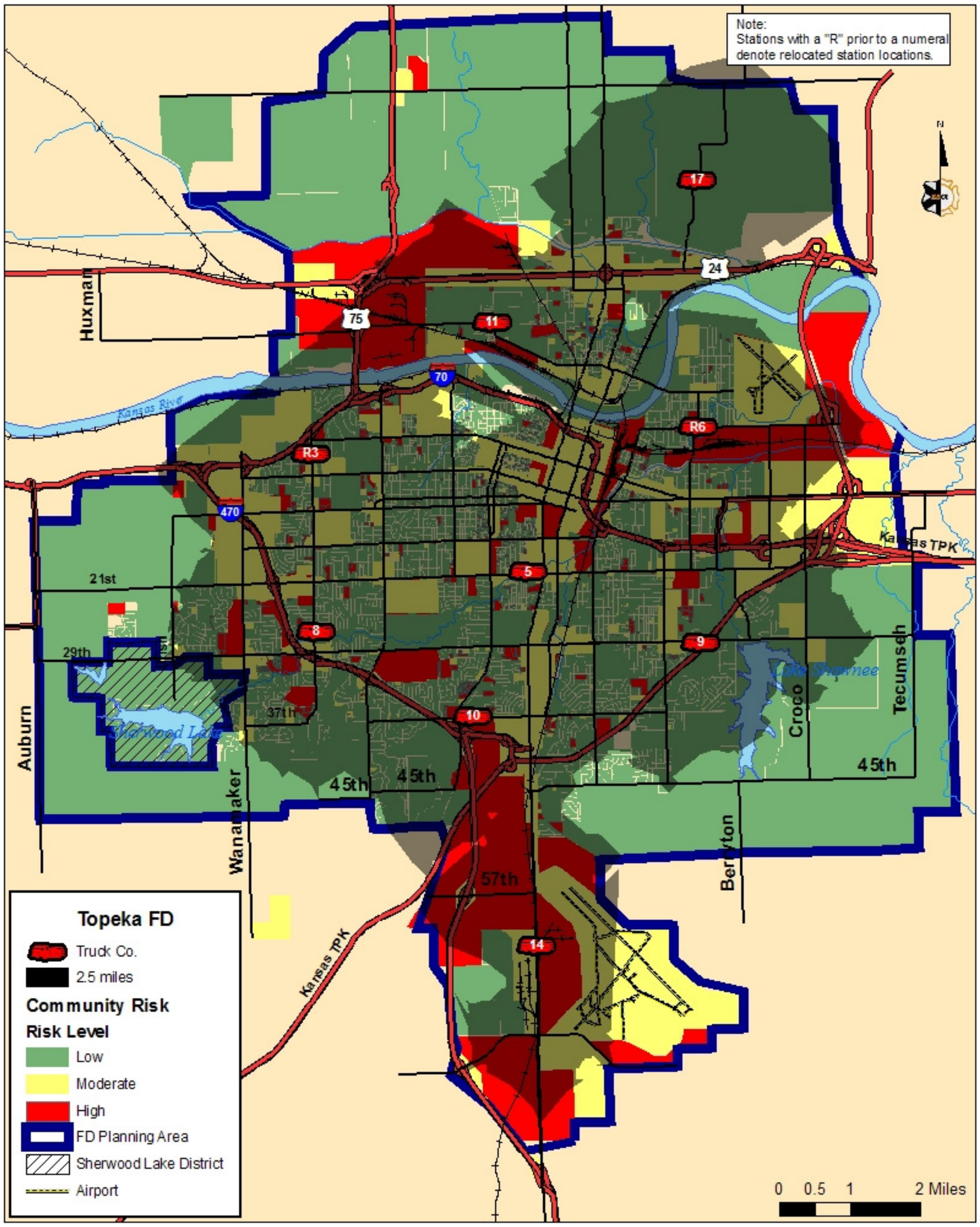
Figure 69: Deployment Strategy B and Future Fire Risk



As with service demand, most areas of highest risk are now within the four-minute travel time capability.

The following map displays the ISO standard 2.5 mile coverage under the new deployment of nine ladder/service companies.

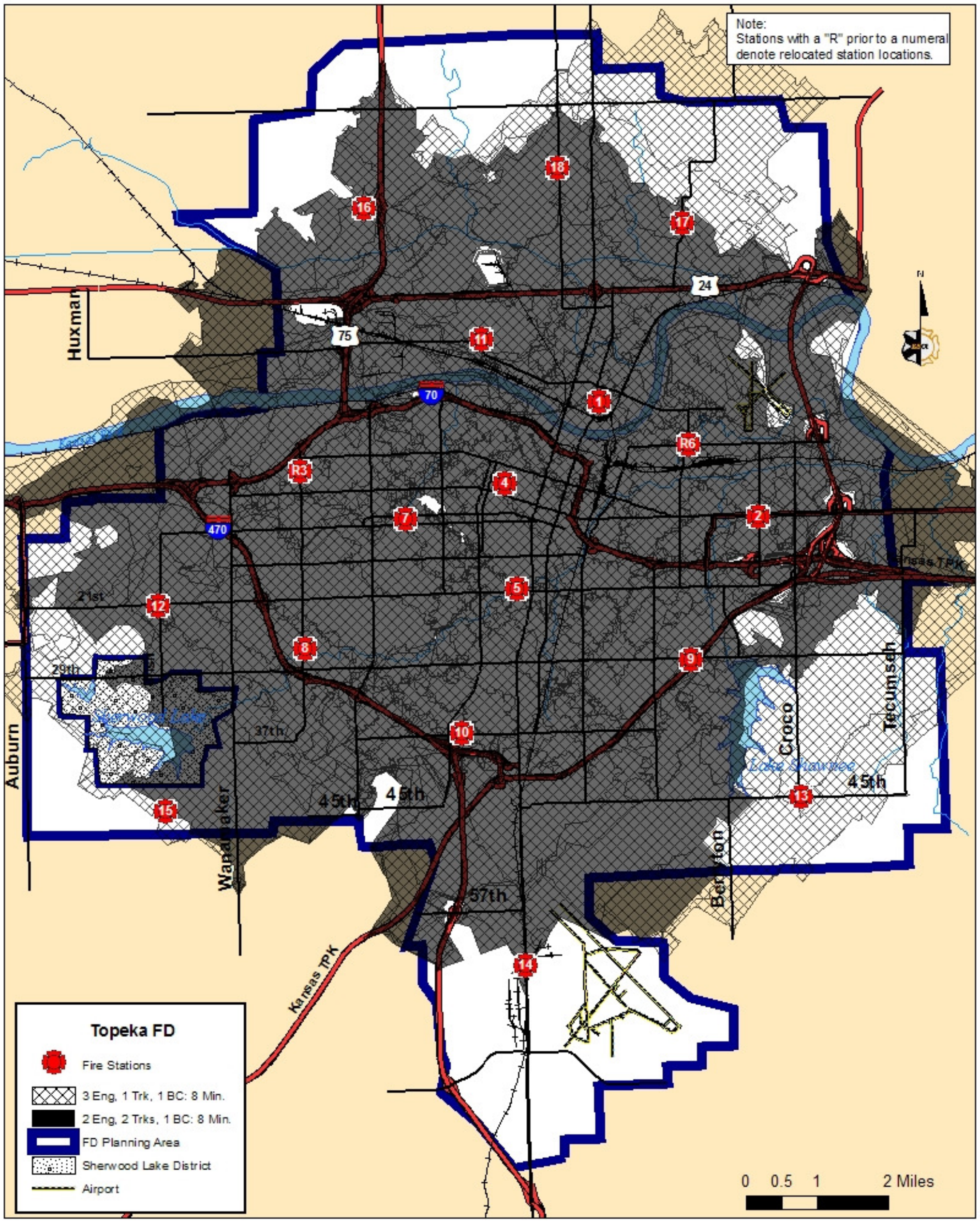
Figure 70: Deployment Strategy B - Ladder/Service Coverage



Coverage improvements can be seen in the highest risk areas of the city. While areas of coverage gap can be seen on the map (figure 70), many of these areas are lower risk, primarily low-density residential areas. Additional service credit under ISO could be achieved in those areas by accepting partial credit for service equipment carried on engine companies.

The following map displays the concentration of resources available under the strategy by showing the eight-minute capability for achieving an effective response force (two engines, two trucks, and one battalion chief). In order to provide additional ERF coverage, an alternate layer displays the eight-minute coverage, if one of the required truck companies is replaced by a third engine in certain areas near the edge of the planning area where primarily low-density residential housing is planned.

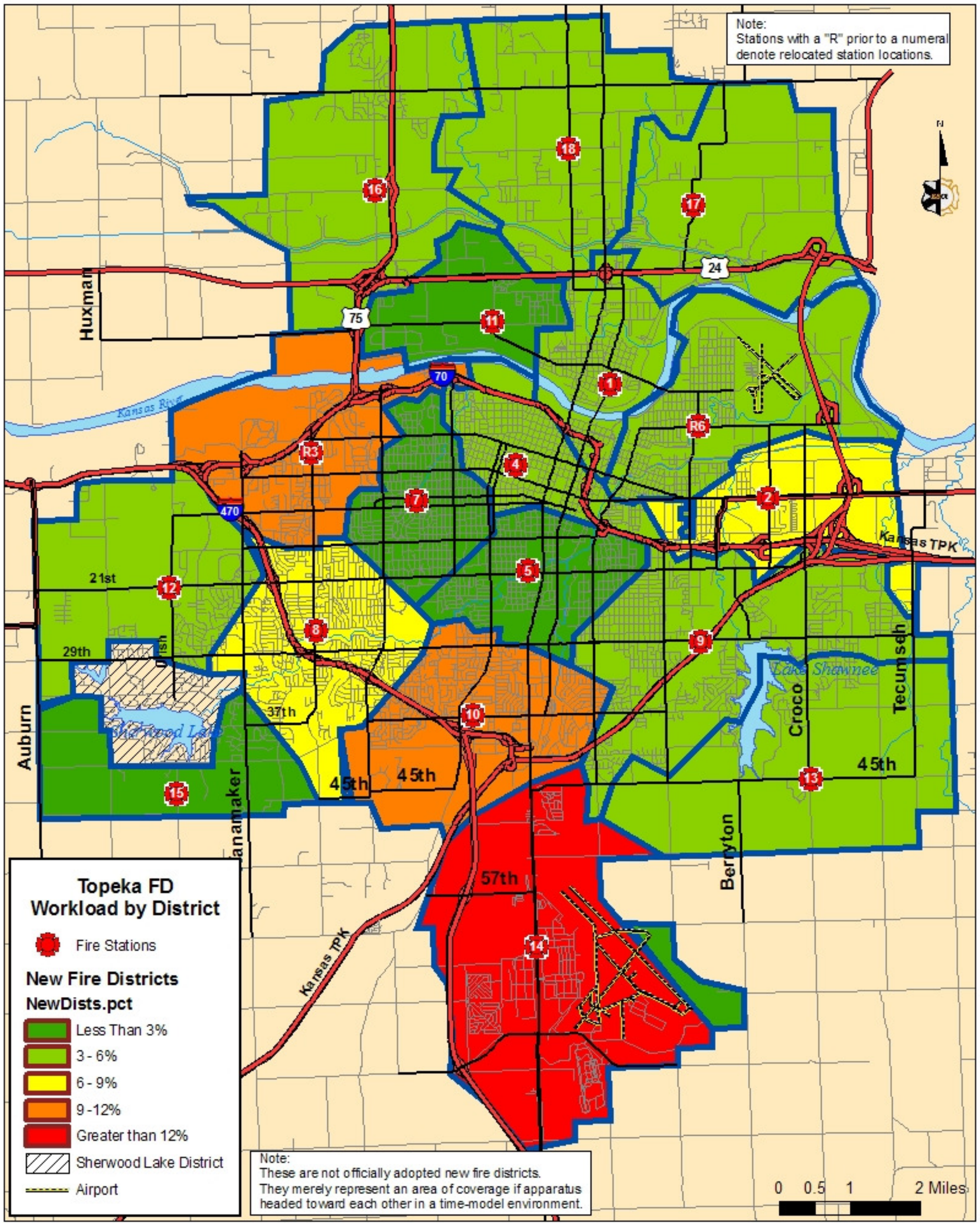
Figure 71: Deployment Strategy B - Effective Response Force Capability



Nearly the entire planning area remains within the effective response force deployment capability. The exception is the southern area around the airport and racetrack, where it may be advisable to use automatic aid from adjacent departments to assist in achieving effective response force.

As stated earlier, any deployment strategy which closes or relocates fire stations will require a realignment of response district boundaries for the stations affected in order to ensure closest unit response. The following map depicts general outlines of the closest unit response districts under the new deployment scheme in Strategy B and identifies the projected workload distribution for each fire station's response area.

Figure 72: Deployment Strategy B - Workload Distribution

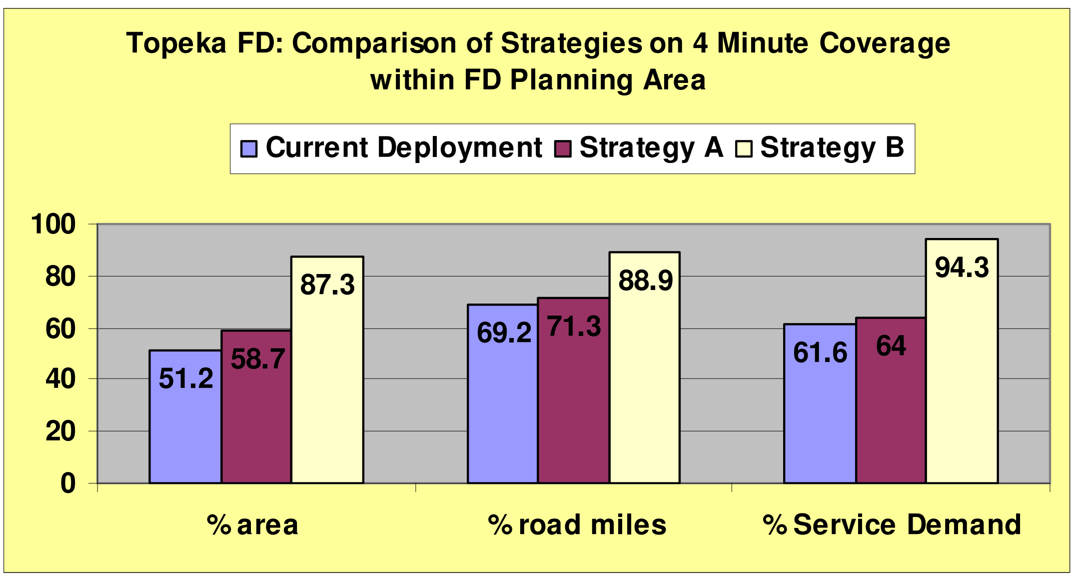


The strategy demonstrates improvement in workload balance with only one station exceeding 12 percent of total workload, compared with the current status of three stations exceeding 12 percent.

Strategy B Projected Performance

This deployment strategy demonstrates the capability to maintain or improve projected target-level service performance when compared to the current deployment system, as well as the recommended redeployment provided in Strategy A. Performance models for the strategy, along with comparison figures of the current levels of travel time capability experienced and those projected for Strategy A, are provided. Performance projections are shown for the amount of the city's projected future road miles and land area covered within the target response time, a good indication of overall geographic coverage. Performance projections are also shown for the amount of the city's projected future emergency incidents covered within the target response time, a good indication of service demand coverage. The future projected service demand and street network in the Fire Protection Planning Area were used in this analysis.

Figure 73: Strategy B Performance Analysis



As can be seen in the table, if the City were to do no further expansion of its fire protection infrastructure, or redeployment of stations while the projected growth and development occurred, the travel time capability of the system would degrade to a level where only a little over 60 percent of the emergency incidents would be within the target travel time performance objective. This would be a reduction from the 98 percent experienced today, and would be recognized as a significant degradation of service.

If the City were to adopt the recommended deployment in Strategy B, travel time capability would be at or below four minutes for just over 87 percent of land area, and around 89 percent of actual road miles. Travel time capability would be at or below four minutes for 94 percent of all incidents, just exceeding the range of the 90th percentile target the objective provides.

Strategy B Cost Projections

This deployment plan calls for the continuing use of ten existing stations, the relocation of two stations, and the construction of six new stations. For purposes of cost projection, we use the following additional assumptions:

- Each new fire station is estimated at 9,500 square feet. This includes two-drive-through bays and living space for up to ten personnel. Cost is estimated at $175 per square foot[35], plus $650,000 per acre for land acquisition[36] estimated at 1.5 acres, and seven percent design fees.
- All staffing costs[37] are estimated at $84,650 for each battalion chief, $75,056 for each captain, $65,965 for each lieutenant, $62,517 for each apparatus operator, and $46,445 annually for each firefighter[38]. Any new company consists of one captain, one lieutenant, one apparatus operator, and one firefighter per shift. At an estimated 30 percent leave ratio, additional firefighter FTE's are added to accommodate the need to fill in for vacation and leave time to maintain a minimum three-person company. A total of three battalion chiefs, nine captains, nine lieutenants, nine apparatus operators, and 9.6 firefighters are included in this strategy's cost projection. It should be noted that there would also be some initial costs at hiring for new equipment, uniforms, and training.
- Annual operating costs for new facilities (maintenance, supplies, and utilities only) are estimated at $3.15 per square foot.
- Although some redistribution of existing apparatus may occur, additional apparatus would be needed to meet the proposed number of fire stations. Six new engines are estimated at $330,000 each, and three new aerial trucks are estimated at $875,000 each.

[35] Square footage cost estimate from Mark Schreiner, City Engineering.
[36] This is a $10 per square foot land acquisition estimate for properties in developed city areas. Land acquisition costs could be reduced to as little at $15,000 to $20,000 per acre by purchasing property well in advance of significant area development.
[37] All staffing costs include city pension and benefit contributions.
[38] Amount used was average of all ranges within each position.

The following table projects capital and operating costs for Strategy B. These costs are in addition to current operating costs of the department and, thus, would represent new funds needed to support the strategy.

Figure 74: Cost Projections - Strategy B

Strategy "B" Capital Costs	
Replacement Station #3 Construction	$ 2,428,875
Replacement Station #6 Construction	$ 2,428,875
New Station #13	$ 2,428,875
New Station #14	$ 2,428,875
New Station #15	$ 2,428,875
New Station #16	$ 2,428,875
New Station #17	$ 2,428,875
New Station #18	$ 2,428,875
Apparatus Additions	$ 4,605,000
TOTAL CAPITAL COSTS	**$ 24,036,000**
Strategy Annual Operating Cost Increases	
Annual Staffing	$ 7,087,092
Annual Operating Costs	$ 179,550
TOTAL ANNUAL OPERATING COSTS	**$ 7,266,642**

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Chapter 11 - Policy Recommendations

To provide guidance to policymakers for the City of Topeka, ESCi will summarize primary findings and study conclusions in this section.

General Policy

From the standpoint of general policy, ESCi recommends the City formally adopt a set of performance objectives to guide fire department deployment, and its measurement of service delivery quality. As suggested within this study, the City may wish to conduct assessment of customer expectations prior to finalizing these performance objectives.

The measurements should include:

- Call processing and dispatch time standards
- Firefighter turnout time standards
- First unit arrival time standards
- Initial attack force time standards that include arrival time, as well as apparatus and staff minimums required to safely initiate first control actions
- Effective response force time standards that include full force arrival time, as well as the apparatus and staff minimums required to safely achieve control of an incident

Throughout the report, recommendations for performance objectives based on nationally recognized standards have been provided. These objectives can be used as planning standards (goals) for future service improvements. In addition, ESCi has identified the department's current performance levels that could be used as an immediate standard for continually monitoring performance, and to identify any degradation of service levels.

Call Processing and Dispatch

In order to achieve the performance objective found in *NFPA 1221*, the Consolidated Emergency Communications Center will need to reduce its 95^{th} percentile call processing time for incidents dispatched to the fire department by 78 seconds. ESCi recommends the City work with the Consolidated Emergency Communications Center to identify software or hardware barriers to improving the call processing time for fire department emergencies in an effort to achieve performance that is closer to national standards. Consideration should also be given to enhanced performance monitoring (using fractile analysis), as well as improved quality assurance processes.

Firefighter Turnout Time

In order to achieve the performance objective found in *NFPA 1710*, the Topeka Fire Department will need to reduce its 90th percentile firefighter turnout time by 54 seconds. ESCi recommends fire department management to work with its employees to identify any physical or facility barriers to improving firefighter turnout time, in an effort to achieve performance that is closer to national standards. Consideration should also be given to monthly performance monitoring using fractile analysis, as well as a system of accountability for observed patterns of longer turnout times by specific shifts or specific employees.

Resource Distribution

In the short and long-range future, the Topeka Fire Department will be unable to reach a travel time performance objective for first-due company response time of four minutes or less to 90 percent of emergency calls through continued use of its current deployment scheme. Topeka can enjoy significantly improved levels of emergency service delivery through the adoption of a new deployment strategy, two options for which are provided in this report.

ESCi recommends the City adopt Strategy A as a three to five year deployment plan. This strategy will require the City to build two new fire stations to replace two of its existing fire stations during that time period. One new truck company would also be added.

ESCi further recommends the project to replace Station #6 be initiated first. Building a new Station #6 will permit the truck company currently at Station #3 to be relocated to the new Station #6. The new Station #3 would be built next, with Engine 3 being relocated there upon completion. The addition of a seventh truck company at the new Station #3 would be the final step in completion of this short to mid-term strategy.

ESCi recommends the City adopt Strategy B as a long-range fire protection master plan for the community. This strategy will ultimately require the City to build an additional six new fire stations. Six engine companies, three new truck companies, and one battalion chief would also be added.

As with any master plan, the fire protection system infrastructure described in Strategy B need not be initiated until service demand in any specific area reaches a level where the department's performance, in that particular area, demonstrates the need. For instance, if the City does no further annexation, none of the strategy will be needed. If the City annexes certain portions of the Fire Protection Planning Area, but development and growth is slow to arrive, there may still not be a need to initiate a new station in that area, until demand increases. For this reason, ESCi recommends the strategy be adopted as a long-range planning vision, but implemented in shorter three to five-year phases as annexation, growth, and development dictate.

Emergency Services Consulting inc. believes that good master planning decisions are best made by informed local elected officials, and we have endeavored to provide adequate data and analysis to support the decision-making effort. The City of Topeka can use the information and performance projections to confidently select an appropriate future deployment strategy, knowing that the decision is based on sound principles of data analysis.

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Appendix A: Apparatus Condition Chart

The following chart identifies the criteria used by ESCi in the evaluation of apparatus for this report.

Excellent	Like new condition. No body or paint defects. Clean compartmentation. Interior cab complete, in full working order with no modifications. No significant defect history. Age is less than 25 percent of life expectancy.
Good	Body and cab have good appearance with no rust and only minor cosmetic defects or dents. Clean compartmentation with no visible rust or corrosion. Interior cab is in full working order and good appearance. Normal maintenance history with no significant defects or high downtime. Age is less than 75 percent of life expectancy.
Fair	Body and cab have weathered appearance with minor surface rust and some cosmetic defects or dents. Unimpeded compartmentation with only surface rust or corrosion. Interior cab is in reasonable working order and appearance. Only repairable tank or plumbing leakage. Showing increasing age-related maintenance, but with no major defects or unreasonable downtime. Age is less than 100 percent of life expectancy.
Serviceable	Body and cab have weathered appearance with surface corrosion, cosmetic defects or dents, and minor rust-through of non-structural metals (body panels). Unimpeded compartmentation with significant surface rust or corrosion and/or minor rust-through (not affecting use). Interior cab is in rough, but working order, often with local repairs or modifications to compensate for problems. Occasional or intermittent tank or plumbing leakage. Showing increasing age-related maintenance, but with no major defects or unreasonable downtime. Most service parts still available. Age is greater than 100 percent of life expectancy.
Poor	Body and cab have weathered appearance with surface corrosion, cosmetic defects or dents, and visible rust-through of non-structural metals (body panels). Significant rust or corrosion is present in structural or support members. Use of compartmentation is impeded with significant corrosion and rust-through. Interior cab is in rough condition with defects impeding safe and proper use. Unrepairable tank or plumbing leakage. Problematic age-related maintenance, major defects, or unreasonable downtime are evident. Service parts difficult or impossible to obtain. Age is greater than 100 percent of life expectancy. Vehicle exceeds its GVWR.

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Appendix B: Maps

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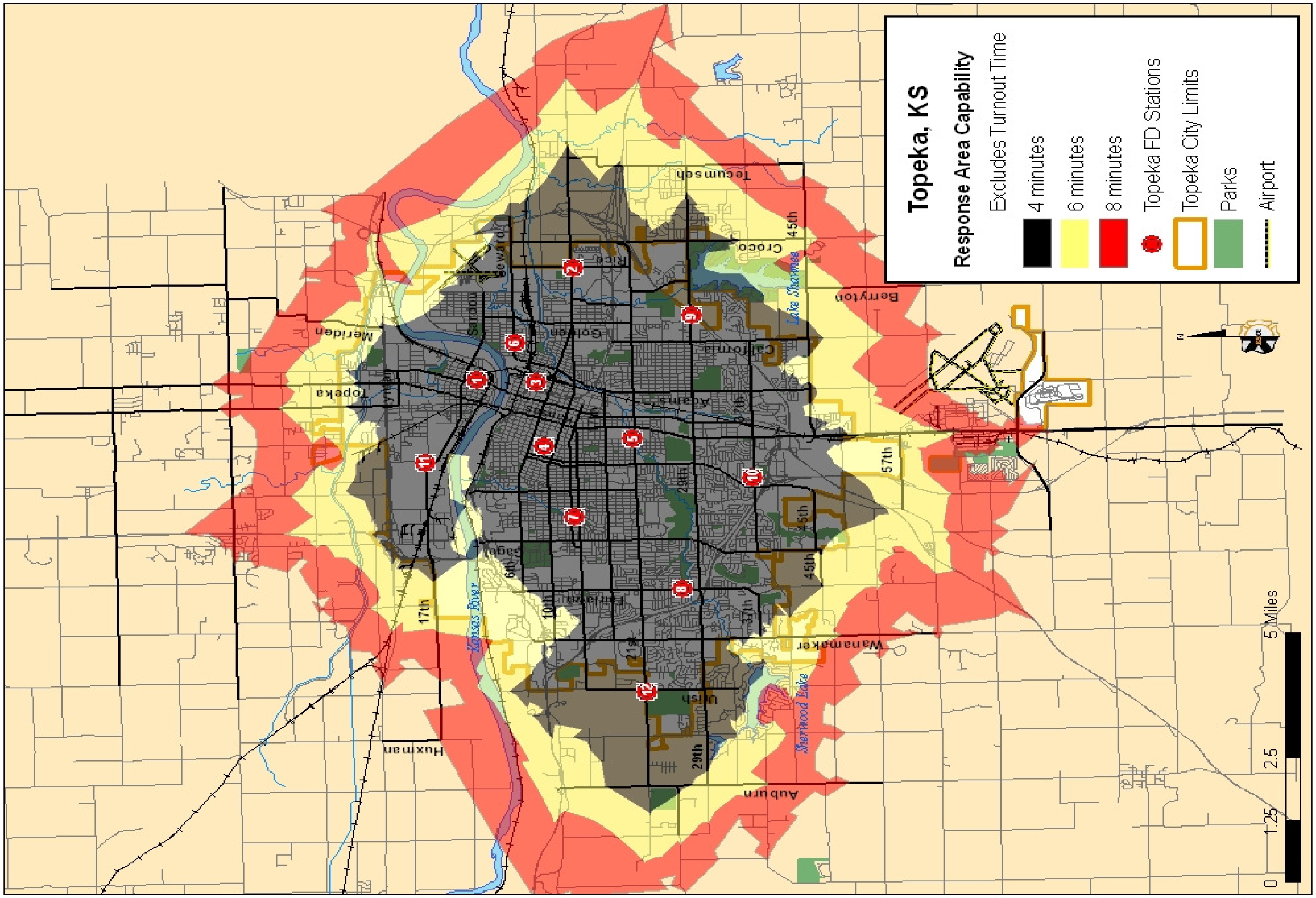
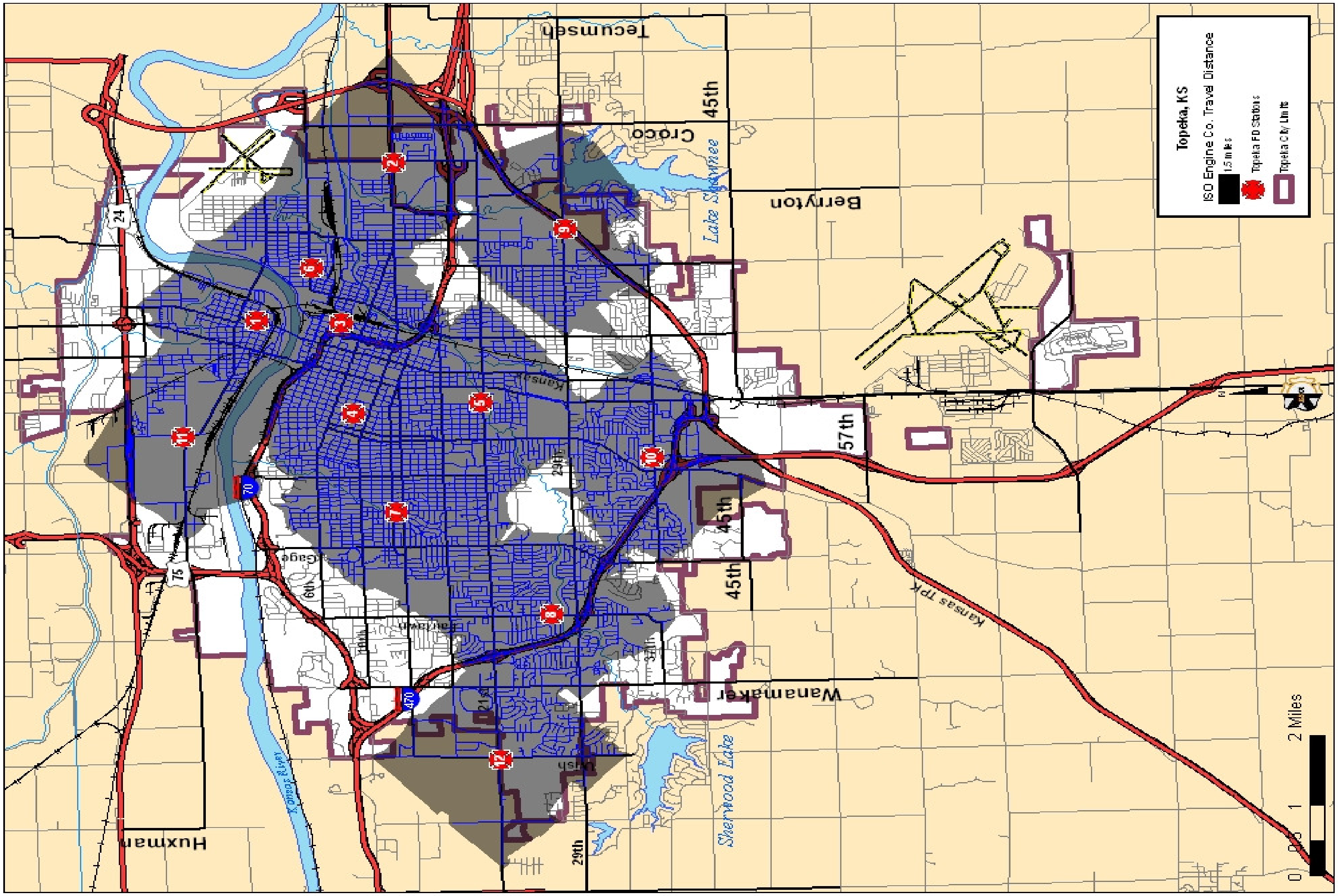
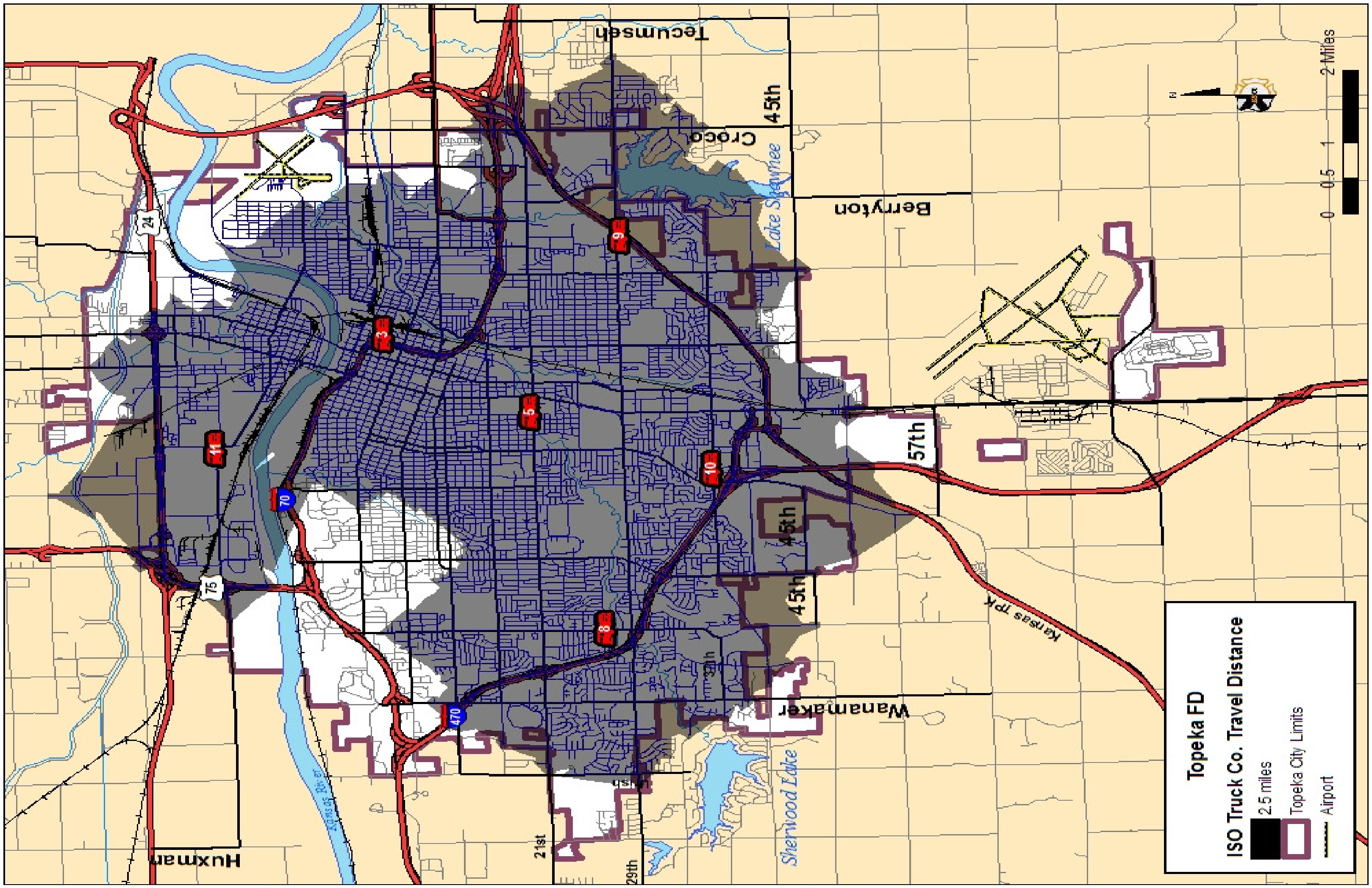
TFD Current Station Response Time Capability



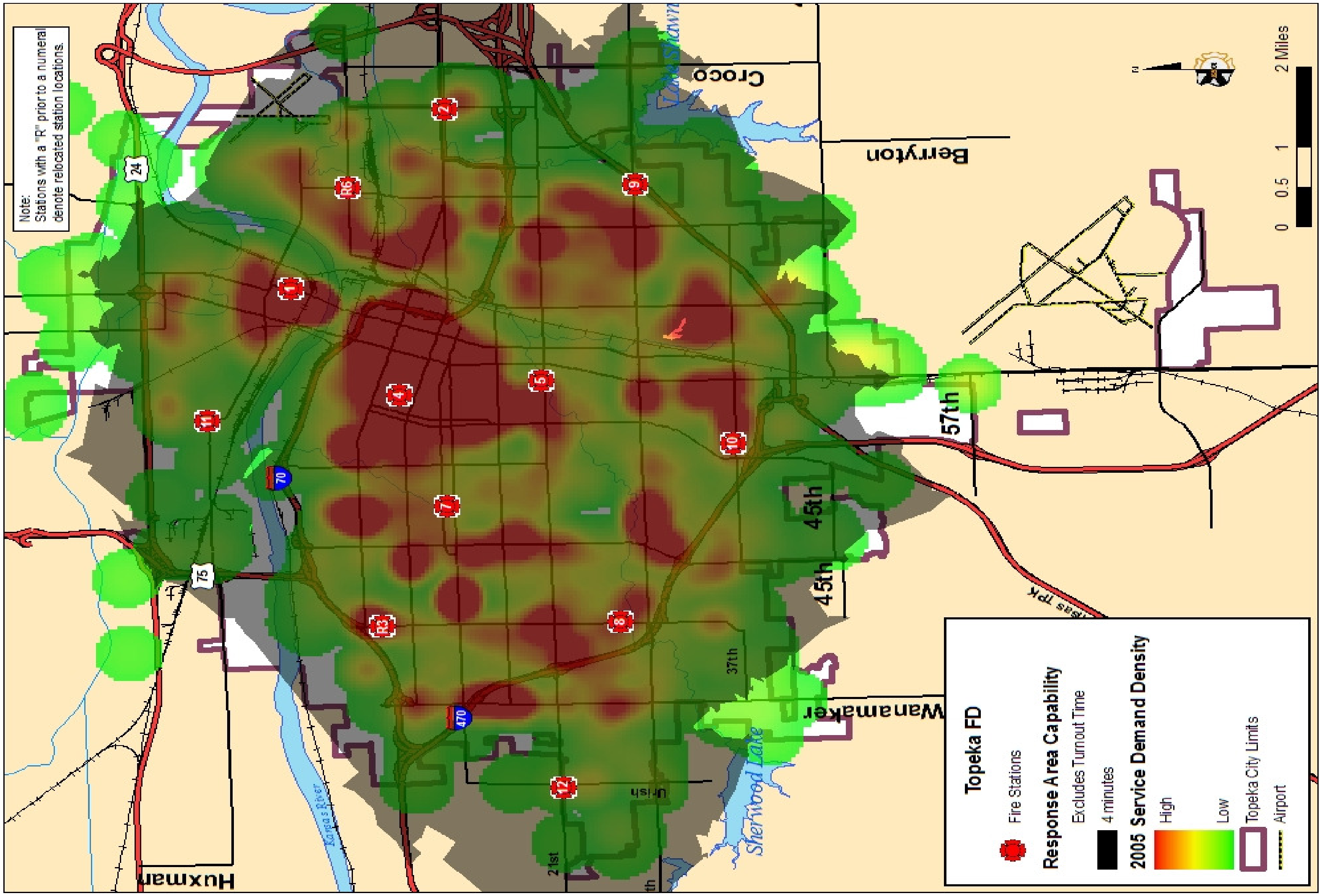
Current Engine Company Deployment and ISO Coverage



Current Ladder/Service Company Deployment and ISO Coverage



Deployment Strategy A



Deployment Strategy B