Tukwila Fire Department

Comprehensive Master Plan

This is the FINAL DRAFT report. ESCi has not completed the final editing process. This report is provided in advance of the final edit at the request of the client, therefore the document may contain spelling or grammatical errors. A final edit process is being conducted prior to issuance of the FINAL REPORT.

ESCi EMERGENCY SERVICES CONSULTING inc.

Prepared by:
Bruce Caldwell
Martin Goughnour
Don Stewart
Lane Wintermute

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Executive Summary

The executive summary provides an overview of the Tukwila Fire Department Master Plan. The purpose of this executive summary is to abridge the key points of the document for readers, saving the reader time, and as an organizer for the reader.

Purpose and Report Conventions

This report by Emergency Services Consulting inc. (ESCi) answers the request of the City of Tukwila for a Tukwila Fire Department Master Plan. The plan evaluates the current operational stability and any potential improvement in efficiencies that may be available as well as the development of options for future delivery of services for the future. The first section, Current Service Delivery Analysis is an in-depth assessment of the TFD management, assets, operations, and service delivery.

The section titled, Future System Demand Projections provides a thorough and detailed evaluation of the risks facing the department, population projections, population growth and how demographics of the community will affect future service demand.

Future Delivery System Model(s) offers strategies that ESCi believes to be feasible for implementation in order to improve effectiveness, efficiency, and cost avoidance in service delivery.

ESCi recognizes that information, by its very nature, is often incomplete as it changes from moment to moment. Efforts were made to compile data that was complete, comprehensive, and accurate. The information gathering process included a broad evaluation checklist of the organizational units, measuring results against acceptable industry standards and best practices. Whenever possible, ESCi made quantifiable comparisons to other fire service organizations and nationally recognized standards and practices. Checklists and documentation were followed by one-on-one interviews with key staff.

Current Service Delivery Analysis

The current service delivery is both effective and efficient. TFD is a highly skilled, service oriented organization. However, as with most contemporary emergency service providers the ability to continue to deliver quality services over time is a daunting challenge.

The fast pace of community growth, an effective population of over 150,000, and commercial development, increases the challenge to TFD to continue providing the current level of service now enjoyed by the citizens of Tukwila.

ESCi has provided recommendations that if implemented would provide more efficiency, reduce exposure and risk as well as improve services and programs. A complete list of recommendations is in Appendix B: Summary Table of Recommendations.

Future System Demand Projections

This section contains a community risk analysis. The analysis is based on occupancy type and density, and involves a graphical representation of the community-wide risks. In order to develop service demand projections, population growth forecasts based on census and development data were created. Our finding is that TFD will continue to be an emergency service provider to a growing population, likely exceeding 20,000 by 2025. To identify workload potential to the year 2030, ESCi multiplied projections by a forecast incident rate derived from incident per capita rates. Analysis results indicate that overall call volume will continue to increase over the next two decades.

Future Delivery System Model(s)

The Tukwila Fire Protection Master Plan intention is to provide long-term strategies. The master plan identified the most critical issues the fire department will face over the next two decades. The process initiated in the previous section, reviewed community growth, identified risks, and evaluated service demands. ESCi compiled the information in that section and the evaluation of future service demands, to provide a recommended long-term strategy. The recommended strategies are a guide for growth and development of an effective TFD organization; in its current form and forward should annexation growth occur.

Required Investments In Existing Facilities, Apparatus, and Staffing

The Fire Master Plan reviews the Tukwila Fire Department, as it exists in 2008. It identifies the ***existing*** informal LOS (level of service) provided by the fire department as responding to an emergency call within 5 minutes and 34 seconds 90% of the time.

For TFD to maintain this LOS to the current "effective population" (residents and workers), ESCi determined the capital facilities, operational, and maintenance requirements of the fire

department. To preserve the current LOS and eliminate further service degradation, ESCi makes the following recommendations:

Capital Facilities:

- Increase the Aid Car to a 24-hour unit
- Use the ladder truck at Fire Station No. 54 for responses requiring a truck-company
- Remodel Fire Station No. 51
- Replace Fire Station No. 52
- Complete seismic upgrades, if needed, for Fire Station No. 53
- Replace Fire Station No. 54

Personnel:

- Hire 7.8 FTE personnel to staff the Aid Car
- Hire an assistant fire chief – logistics and strategic planning
- Hire a training captain
- Hire a deputy fire marshal
- Hire two civilian fire inspectors
- Hire a public educator/public information officer

Projected Investment Requirements related to New Construction and Population Growth

The City of Tukwila population and the workforce are anticipated to sustain growth for the next 15 years. According to the King County – *Buildable Lands Report for 2007* the City is expected to provide capacity for as many as 3,035 new homes (both single and multi-family) and as many as 16,000 new workers. The "effective population" that would be served by the Tukwila Fire Department is projected at approximately 157,740.

Should development of the Tukwila South Project occur, as projected in the Environmental Impact Statement (EIS), an estimated additional 22,427 workers and 700 new homes (1,505 residents) would be added to the City. The Tukwila Fire Department would then be serving a daily population of approximately 180,000.

The City has the choice to maintain, to increase or decrease the existing level of service as growth and new development occur. ESCi recommends that the City *maintain the current level of service to existing and annexed areas, new development and redevelopment in the City*. It is critical that the City plan and adopt how it will provide service to the existing and new populations and not continue to "play catch-up."

The following items were identified as needed in order to continue the existing level of service to serve the City's projected effective population between 2008 and 2022:

Capital Facilities and Operations:

- Move the ladder truck to Fire Station No. 51
- Purchase a new engine for Fire Station No. 54
- Relocate Fire Station No. 51, if Tukwila South Project annexes and develops
- Relocate Fire Station No. 52, if Fire Station No. 51 is relocated

Personnel and Maintenance:

- Hire 18-24 firefighters to staff new fire engine at Fire Station No. 54

ESCi has provided an Appendix C: Response Time Thresholds and Triggers. This section is a self-assessment matrix to determine when certain strategies such as additional staffing, apparatus, or additional fire stations are required.

Finally, ESCi project team members would like to thank the members of the City of Tukwila and the TFD staff, particularly Chief Nick Olivas, for their able assistance in preparing this Master Plan. We recommend that this master plan report be included into the City of Tukwila Comprehensive Plan and serve as a planning tool for the future.

Objective Four: Current Service Delivery Analysis

Introduction

This report includes an in-depth study of all aspects of administrative, operational, and support services of Tukwila Fire Department (TFD). The evaluation and analysis is an assessment of the following subject areas:

- Organizational Overview
- Management Components
- Planning for Fire, Rescue, and EMS
- Personnel Management
- Organizational Staffing
- Training Program
- Capital Assets
- Fire Prevention/Public Education Programs
- Current Deployment Strategies and Performance

Utilizing these elements, the Emergency Services Consulting inc. (ESCi) project team conducted an in-depth study of all aspects of TFD's administrative, operational, and support services.

The evaluation and analysis of data and other information is based on Washington State laws and regulations, National Fire Protection Association (NFPA) standards, Center for Public Safety Excellence (CPSE.[1]) self-assessment criteria, health and safety requirements, federal and state mandates relative to emergency services, and generally accepted best practices within the emergency services community

Each report section provides the reader with detailed and general information about that element as appropriate, as well as in-depth observations and analysis of any significant issues or conditions that are pertinent. Observations are supported by data collected as part of a

[1] CPSE, formerly the Commission on Fire Accreditation International (CFAI).

review and interview process. Finally, specific recommendations are included to address identified issues or to take advantage of opportunities that may exist.

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Task One: Organizational Overview

This section provides information about and establishes a baseline of statistics regarding the city of Tukwila (City) and the Tukwila Fire Department (TFD) as identified in research conducted by Emergency Services Consulting inc. (ESCi). Included are discussions about governance, structure of the organization, size and general nature of the community, and a broad overview of available resources dedicated to fire and emergency medical services (EMS) functions. A more detailed analysis of the service delivery system is found in subsequent sections.

Responsibilities and Line of Authority

Tukwila, Washington is a municipal corporation, formed under the laws of the state of Washington, and is provided the authority to levy taxes for operating a fire department.

The City operates under the mayor/council form of government, as established by the City Municipal Code, in which the mayor and city council members are elected directly by the voters. The mayor/council is provided with broad authority to govern the provision of fire protection and emergency services within the City, including operating a fire department, appointing officers and members, purchasing land and equipment, entering into contracts, issuance of bonds, and levying of taxes.

The mayor is the chief executive officer and the official and ceremonial head of the City. The mayor proposes an annual budget to the council and presides over all city council meetings. The annual budget cycle may be changed due to a proposal by the mayor to move to a two year budget cycle beginning in 2009. The council has the authority to set City policies and enact laws, while the mayor is responsible for the enforcement of the policies and laws. The council has no direct authority over department heads; they are hired by and directly supervised by the mayor. A city administrator is hired by the mayor/council and acts as the administrative head of city government. He/she provides the council with information needed to make informed policy decisions and is responsible for the efficient administration of all City departments and carries out the day-to-day management of municipal affairs.

The roles and authorities of the council, mayor, and the city administrator are further clarified within City Municipal Code and written city policy documents.

The position of fire chief is hired by the mayor, but is under the direct supervision of the city administrator. The present chief, Nicholas J. Olivas, considered an *at-will employee*, and is not a member of a bargaining unit. The chief's authority is defined in both state law and the City Municipal Code.

History, Formation, and General Description of the Agency

The Tukwila Fire Department was formed in 1943 and has steadily grown into a solid municipal agency, providing fire, EMS, rescue, and various other services to a diverse community of approximately nine square miles. A total of 66 uniformed and civilian personnel staff four fire stations.

The stations house a fleet of front line and reserve fire and emergency response apparatus, including five engines, two ladder trucks, and two medical aid vehicles (aid cars). A hazardous materials (HazMat) response trailer, decontamination unit, rescue truck and rescue trailer, portable light tower, boat, and a Gator™ are also part of the TFD fleet.

This year marks the centennial celebration for the City. Incorporated in 1908, Tukwila has continued to grow and flourish as a center of commerce for South King County. While the landscape has changed significantly, and the movement of goods on flat bottom riverboats up and down the Duwamish River to the fertile valley has ceased, the area is still an important link in regional trade. At the crossroads of two interstate highways -- I-5 and I-405 -- and within five minutes of an international airport, Tukwila is a local leader in retail/commercial sales, warehousing and distribution of goods, and manufacturing. Population in 2007 is 17,240, a 45 percent increase from 1990.

Effective Population

In addition to the *static* or census population figure of a community, there is also another population number, sometimes more significant than the number of people living in a community. This population is referred to as the *effective* population, or the number of people who work, do business, or travel within the jurisdiction. In some cases, effective population is due to a community being a tourist destination, business or commercial hub or having a large university located in the community. TFD protects a large commercial/retail and several major travel routs in addition to the City's static population.

The following figure shows the static and effective population numbers for the City of Tukwila.

Figure 1: Effective Population

Tukwila Fire Department Effective Population Figures[2]	
Static Population	17,240
Employment Population	40,500
Commercial/Retail/Business Population	100,000
TOTAL	**157,740**

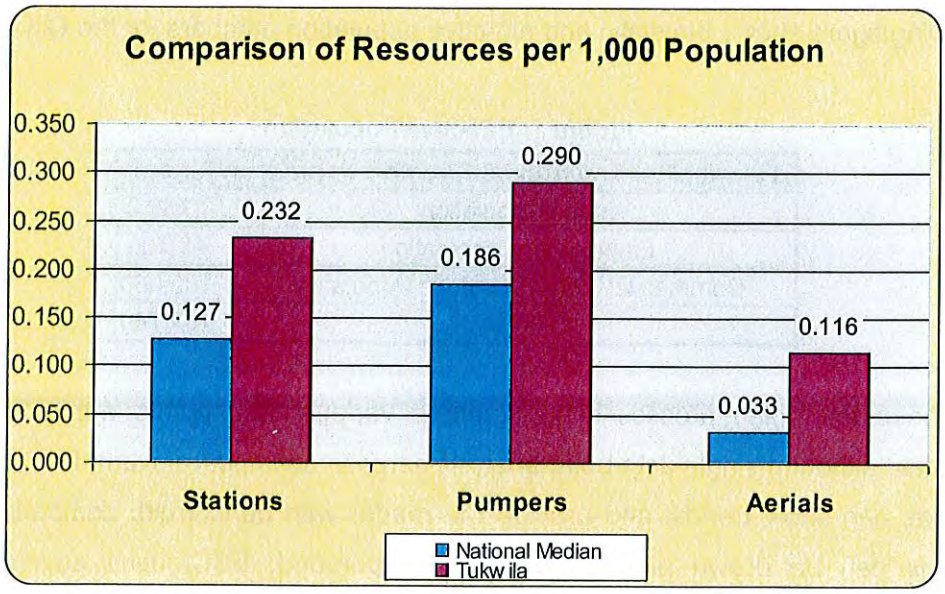
Part of the master plan process is to compare various data points with comparable size communities; although single data point analysis sometimes is not relevant, Data comparison in many areas can show trends, and provide the reader with benchmark comparisons to which conclusions can be drawn and further analysis pursued. ESCi uses several benchmark comparables from many sources to compare various elements of community emergency services systems. The following are comparables looking at resources and firefighters available per 1,000 population.

The following figure shows the resource comparison of TFD with the national median[3] of like size communities that reported and are located in nine western states.

[2] Effective population figures supplied by Derek Speck, Economic Development Administrator, City of Tukwila.

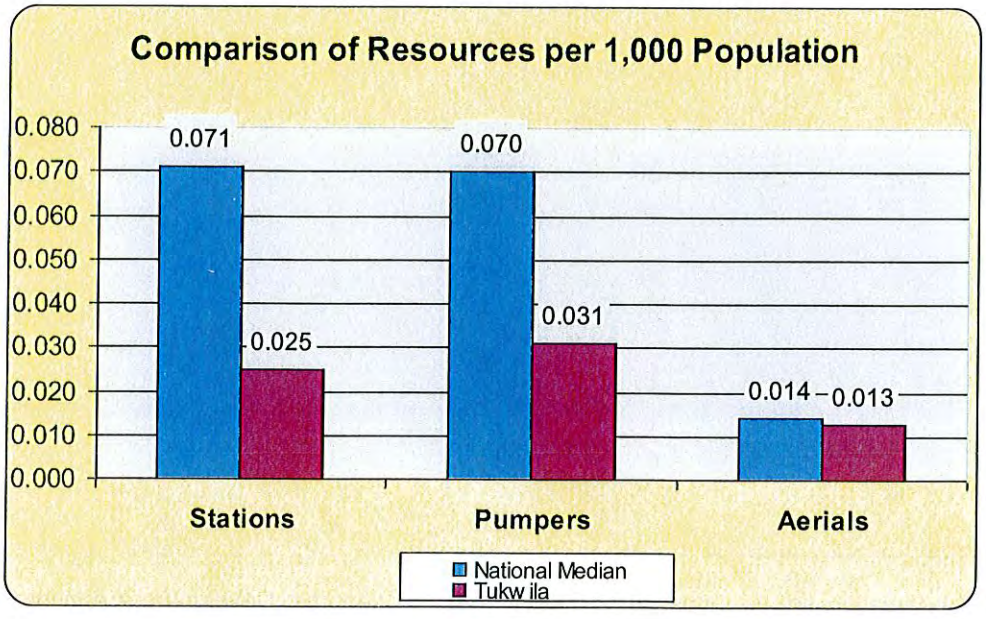
[3] Source: FEMA/NFPA, *A Needs Assessment of the U. S. Fire Service*, FA-240/December 2005.

Figure 2: Resources per 1,000 Population



In all categories shown, TFD maintains more resources than communities their size. However, when you consider effective population, the community assets at risk, and the major transportation routes bisecting the community, the number of resources is not out of line. The next figure shows the comparison of resources per population with effective population figures included.

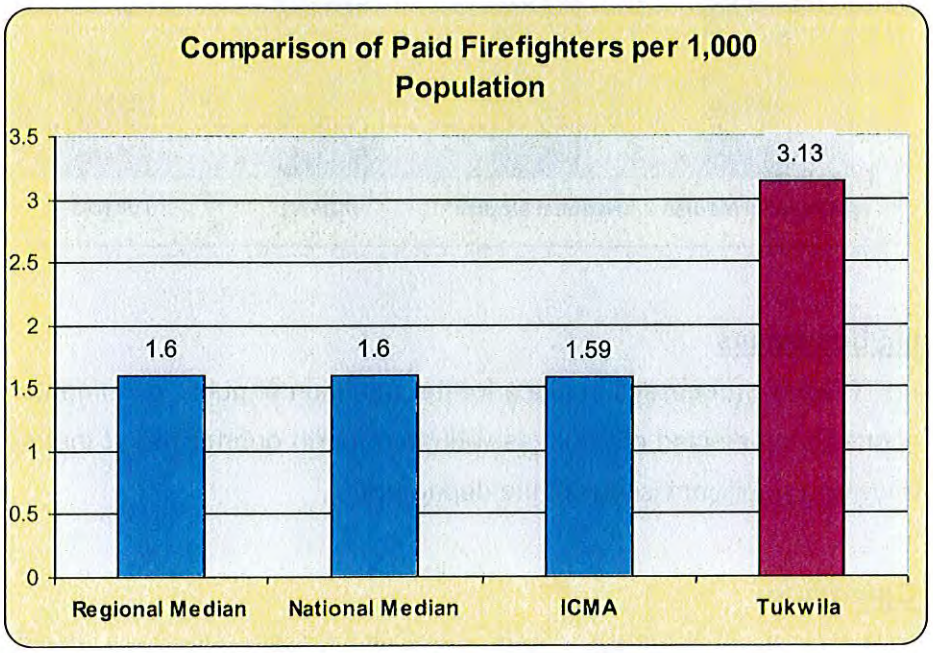
Figure 3: Comparison with Effective Population



When effective population is used as a comparable, TFD resource does not match up with communities with similar population numbers. On the other hand, TFD is charged with protecting a small static population base and an effective population base that fluctuates during the day.

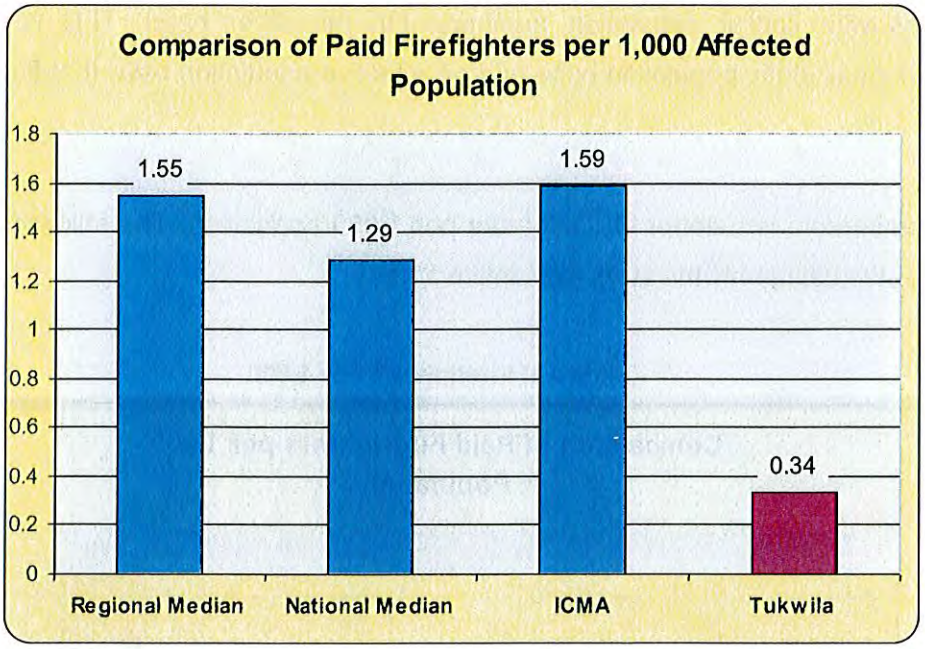
Another comparable is number of firefighters per 1,000 population. The following chart shows this comparable using only the static population figures.

Figure 4: Firefighters Per 1,000



When the effective population figures are included in the comparables, it is apparent that the firefighter resources per 1,000 is diminished and fall below in all benchmark comparables.

Figure 5: Firefighters per 1,000 Effective Population



Records and Documents

The City and TFD have processes in place for the retention of public documents. TFD provides quarterly reports to the elected officials, as well as a fourth quarter report that summarizes the yearly activities and significant issues of the department.

Chain of Command

In any organization, there is always a path along which information and directions flow. This *chain of command* is the recognized conduit of communication for organizational business and authority. As is the case with most fire departments, TFD uses a hierarchical sequence for ensuring that necessary information is transmitted in an orderly and timely manner. Roughly following the rank structure that exists, department members send and receive various data with relative effectiveness. This process appears to be functioning satisfactorily, with the exception of the concerns voiced by some members that the fire chief has too infrequent direct communication with the bulk of the work force.

Recommendation:

The fire chief and/or other executive staff officers should plan and implement a method of regularly meetings with department personnel.

Organizational Structure

A well-designed organizational structure should reflect the lines of responsibility and authority within the agency, provide for the equitable distribution of the workload, and clearly define the official path of internal communication. The lines of an organizational chart visually clarify accountability, coordination, and supervision. Detailed job descriptions should provide the particulars of each job within the organization, helping to ensure that each individual's specific role is clear and focused on the organization's overall mission.

Span of control, also known as span of management, is a human resources management term that refers to the number of subordinates a supervisor can effectively manage. Developed in the United Kingdom in 1922 by Sir Ian Hamilton, the concept of span of control evolved from the assumption that managers have finite amounts of time, energy, and attention to devote to their jobs. In his research of British military leaders, Hamilton found that leaders could not effectively control more than three to six people directly.

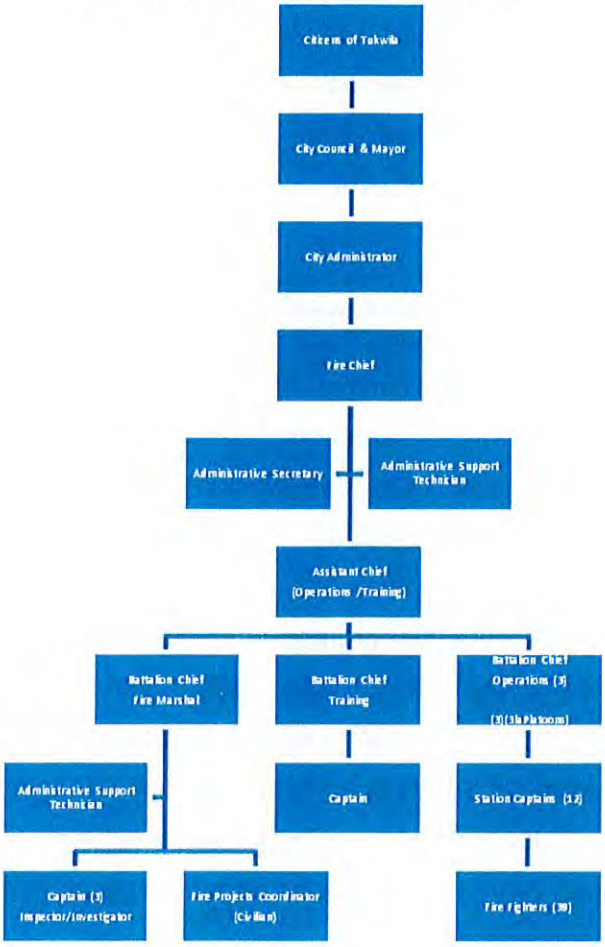
This generally accepted rule of thumb for span of control is still considered relevant today and applies not only to the military, but also correspondingly to the fire service. It is important to note that all managers experience a decrease in effectiveness as their span of control exceeds the optimal level. In other words, the limitations implied by span of control are not shortcomings of individual managers, but rather of managers in general. In addition, it is important to understand that span of control refers only to direct reports rather than to an entire corporate hierarchy (all personnel in the fire department).

> *"Extending span of control beyond the recommended limits engenders poor morale, hinders effective decision making, and may cause loss of the agility and flexibility that give many entrepreneurial firms their edge."*[4]

[4] Hendricks, Mark. *Span Control,* Entrepreneur. January 2001.

The following chart is the current organizational structure of TFD.

Figure 6: TFD Organizational Chart



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

While there appears to be no significant problems in the areas of unity of command and span of control, issues exist with regard to task loading due to limited numbers of administrative staff and other program support staff.

The department is performing a wide variety of services. Each of these services, be it fire prevention, reports and record keeping, emergency response, training and safety, or public interaction, requires a significant effort with regard to preparation, execution, and follow-up.

It was noted in our discussions with department administrative personnel that the department did have two assistant chiefs prior to the implementation of the battalion chief positions. With the addition of the much needed battalion chiefs positions, the department was forced to relinquish the second assistant chief position. At the time, this strategy may have made sense, however in hind sight, due to the growth in community risk, the need for strategic planning, and the amount of administrative tasks that must be provided; we recommend that another assistant chief be added to support a new logistics and planning division.

Operating Budget, Funding, Fees, Taxation, and Financial Resources

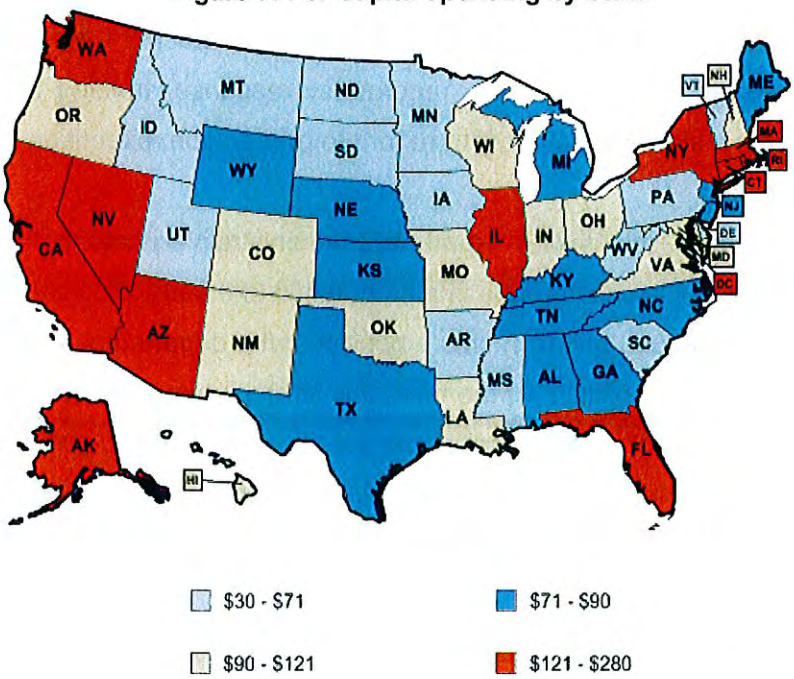
Budgeting for small cites in Washington has, for several years, been a challenging undertaking. Many public entities in the Pacific Northwest are experiencing a flattening or a downturn in their revenue growth. There are a number of factors influencing governmental revenues in Washington State, including I-747 and an overall slowing of economic growth. That being said, because of retail and warehousing industry, Tukwila has growth opportunities that have consistently presented themselves.

For 2008, the assessed valuation for city is $4,437,373,744, an increase of some $57 million over 2007. Reflecting this growth, the 2008 budget for the City has increased approximately six percent from 2007 to $44,849,643. As is common in municipal budgets, approximately 70 percent of the dollars go towards salaries and benefits.

For comparison purposes, the following figure shows the various levels of local fire protection spending per capita for all 50 States. As illustrated, Washington State has one of the highest per capita spending on fire services.[5]

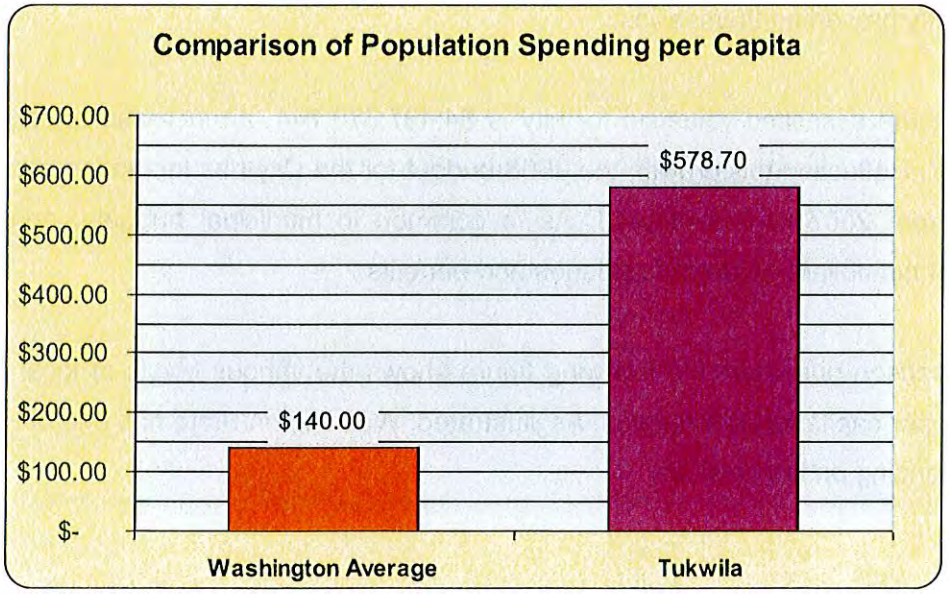
[5] Government Sourcebook: *State and Local Fire Protection Spending Per Capita.*

Figure 7: Per Capita Spending by State



The following chart shows the comparison of fire protection spending per capita for Washington compared to TFD.

Figure 8: Per Capita Spending Static Population

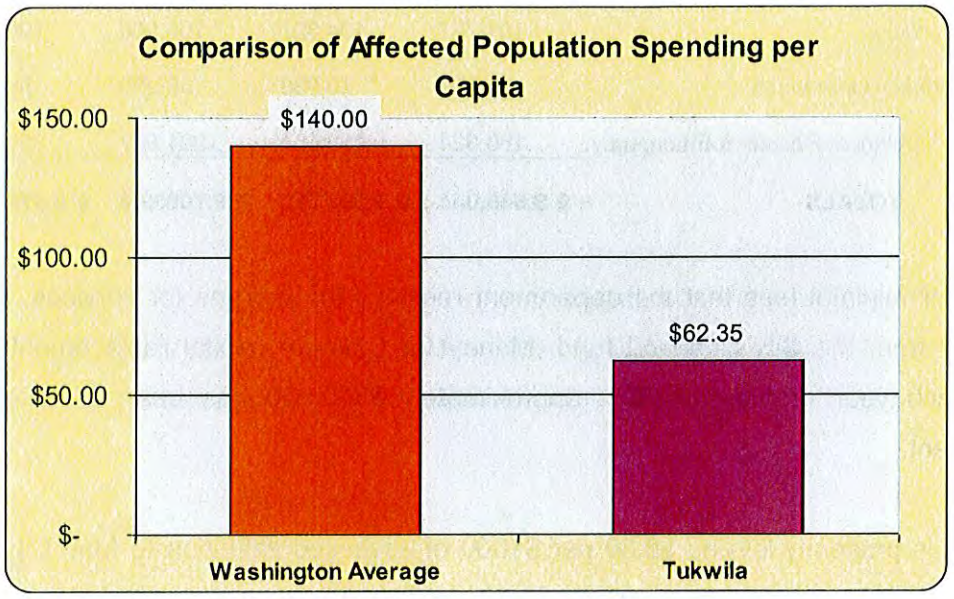


Per capita spending in TFD is more than in the state of Washington average. Once again, there are many factors that impact per capita spending - TFD is a larger department than most cities

in their population category due to the industrial and commercial infrastructure, a local decision to provide for a higher level of protection, the impact of effective populations such as hotels and motels, the employment population, and the value and infrastructure at risk

In the next chart, we include the effective population number estimate of 42,000 population - daily employment, staying in local hotels and motels, and over 100,000 population related to commercial and retail activity. As seen, this brings the per capita spending well below the Washington average.

Figure 9: Effective Population Per Capita Spending



The TFD budget for 2008 is $9,976,794, with distribution into program areas as shown below.

Figure 10: Budget History

PROGRAM OBJECT	2005 ACTUAL	2006 ACTUAL	2007 BUDGET	2008 BUDGET
Administration	$ 567,812	$ 546,343	$ 650,324	$ 649,220
Suppression	6,876,887	7,400,238	7,677,950	7,907,283
Prevention & Investigation	528,917	757,796	750,035	748,520
Training	234,340	252,768	263,929	282,713
Facilities	101,767	104,327	106,500	106,500
Special Operations	65,987	70,233	58,223	58,369
Ambulance, Rescue & Emergency	159,334	162,054	201,897	224,189
TOTALS	**$ 8,535,044**	**$ 9,293,759**	**$ 9,708,858**	**$ 9,976,794**

Except for minimal fees that the department receives for charges for services, all revenue is allocated from the City's general fund. Money for Citywide capital replacement needs is set aside each year. For fiscal 2008, approximately $300,000 has been allocated to the fire department.

The City is presently levying $2.60 per $1000 of assessed valuation to fund City functions. In addition, King County (County) collects $1.50 per $1000 for operation of the Medic One system. This system provides advanced life support (ALS) services to the City. Through a complex allocation system, the County distributes monies to cities and fire districts. Tukwila accepts these dollars directly into the general fund.

At present, the City has debt obligations in the amount of $22.1 million, including approximately $685,000 from a prior fire department bond.

It is worthwhile to mention some of the various fund recovery options available to Washington State fire departments. This is not an exhaustive list, nor are these components necessarily applicable to all departments, but they could provide opportunity for otherwise untapped revenue sources.

- ✓ **Washington State Mobilization:** Fire departments can charge back for involvement in their responses under this plan. Similar agreements could also be made with the Department of Natural Resources and specific federal and state forest management groups to provide wildland team responses. This includes a billing for out-of-pocket expenses.

- ✓ **Hazardous Materials (Hazmat) Responses:** Washington State law provides specific language under Title 52 allowing for cost recovery of hazardous incident responses that are over and above the normal routine combat readiness costs.

- ✓ **Technical Rescue Responses:** TFD could bill for incidents involving technical rescue responses that fall under the category of *responses as a result of a violation*, which is not uncommon given the nature of most technical rescue responses. Examples of this are hang gliders hung up in no jump zones, trench collapse due to improper shoring, and high risk behaviors that are cited by either the fire marshal or the police.

- ✓ **Violation Responses:** TFD could bill for any response that generates a cited violation from the fire marshal, police, or a state or federal agency responsible for overseeing public safety or work environments (WISA, OHSA, DOT, etc.). All costs related to this type of response would be billed.

Finally, we encourage the City to embark on a long-range financial planning and/or trend analysis for the fire department. And as mentioned, continuing budgeting challenges and possible economic downturns will create even greater threats to sustaining adequate funding for fire and emergency services. A comprehensive long-range financial plan is a useful forecasting tool for preparing or avoiding this problem. The Government Finance Officers Association (GFOA) has a consulting branch that can develop a long-range forecast and plan.

Recommendation:

The City should develop a comprehensive long range financial plan for the all City departments.

Current Description of Emergency Response Infrastructure

The delivery of fire suppression and rescue services is no more effective than the sum of its parts. It requires efficient notification of an emergency, rapid response from well-located facilities in appropriate apparatus, with sufficient staffing, following a well-practiced plan of action.

The most visible and valued of the services provided by the TFD is the response to and control of emergency events. The department provides a variety of emergency response services including:

- Fire suppression
- First response EMS (emergency medical service) and limited basic life support (BLS) transport
- Code enforcement
- Fire and life safety plan reviews
- Occupancy inspections
- Hazardous materials emergency response
- Entrapment and other technical rescue
- Other specialized rescue services

To effectively operate in the emergency response environment, fire departments must capitalize on managing various aspects of a large business enterprise. A lion's share of this effort goes into supporting the primary mission, including those components shown in the bullet points above. However, there are additional requirements that have to be met and a substantial infrastructure that must exist for the organization to function at its best. Therefore, additional personnel should be considered that will provide the program oversight and organizational focus needed to meet the challenges faced by TFD.

An obvious and very important supporting program is training. TFD has built a strong system to help ensure members are provided with the skills and tools to safely and effectively perform their duties. This program focuses largely on in-service and on-the-job training. The basic program guidance provided by the training officer is appropriate and program needs and direction are identified. However, a system for defining goals and objectives for the training program is underdeveloped. Finally, development of a comprehensive training manual would be a wise investment in time and effort.

Emergency dispatch is another area of support. TFD is dispatched by Valley COM along with four other cities. Valley COM is a well respected organization that provides adequate service to the department.

In addition to emergency response aspects, TFD operates an aggressive fire and life safety code enforcement, inspection and new construction plans review program. The department is endowed with a full-time fire marshal and prevention division staff who operate an active and effective fire prevention program. However, the work load of the division is high, and additional tasks can not be accommodated by current personnel.

Proactive measures to prevent loss of life and reduce the frequency of fire are a definite positive addition to any city. Fire departments that devote time to educating the public in the area of life safety see benefits in many ways. TFD does not have a dedicated person to provide this critical component of prevention but attempts to provide public education when time is available or by request. However, the City and TFD are to be congratulated on starting to address the issue of residential sprinklers in their adoption of the 2006 International Fire Code and their stand alone sprinkler ordinance. This measure will most assuredly have a positive impact on the community over time.

When examining infrastructure, it is prudent to consider facilities and apparatus. TFD is in need of several facility upgrades. A training center if affordable would be a significant enhancement to the department's training program. We believe that at least two stations will need substantial upgrading or replacement in the near future. The apparatus fleet status is good, although the long-range plan for apparatus replacement developed in 2005 should be reviewed and full funding sought. We discuss this later in the report.

Task Two: Management Components

Organizational growth and management are areas that commonly challenge fire service leaders. TFD does not appear to be immune from this experience. Furthermore, future community growth will bring an increase in workload and needed changes in staffing to meet service demand. Often, increases in organizational infrastructure are required to support the personnel responding to the community's needs. The modern fire department must address management complexities in areas that include the consistency and adequacy of response, maintenance of competencies, and recruitment of a qualified and diverse workforce. This section examines the department's efforts to manage the organization and its preparations for the future.

In this survey objective, ESCi considers the department's management in day-to-day operations. This includes an examination of TFD's philosophical ideals as expressed by its mission, vision, and values statements. We look to assure that such visionary principles conform to the core values of managers and members and address several other important questions. Are goals and objectives consistent with the direction of the department? Are operating procedures documented, current, and available? Are appropriate financial controls in place? What are the current critical issues and future challenges facing the department? Communication internal to the department is checked, as is external communication to the community. Last, we review security issues concerning hard records, electronic data, offices, and buildings and check to ensure that all necessary reports and records are produced and maintained.

Mission, Vision, and Planning

A century ago, when Tukwila came into existence, fire departments existed largely as a result of some past catastrophe, usually a very recent conflagration. City fathers would typically come to the realization that it would be unwise to let the town burn down twice, and so a fire company was formed. Those early pioneers of fire control and behavior were unknowingly setting the stage for years to come. They planned to prevent a future calamity by providing some resources to respond to the event. The *fire lads* probably didn't have much interest in managing the affairs of their newly formed organization, nor would they likely be thinking about economic trends or

community patterns that would affect their ability to provide service. They knew one thing, if something was burning; it was their job to put it out.

In reality, not much has changed between then and now. The modern fire service is still tasked with fighting fires and saving lives, and a whole lot more. And most departments are very good at what they do. However, in today's environment, there is much more complexity to managing an organization than there was in the past. Responding to and embracing a dramatically changed social, economical, and cultural environment is just as important to fire departments as it is to Microsoft, General Foods or Toyota Motors. The department faces a challenge to continually evaluate its role in the community and to make modifications as needed.

That turn of the century crew with hand drawn pump wagons was unambiguous in their mission. Today's fire department should be too. It is critical that the organization has a clear understanding of why it exists, and what is expected of it. Fire agencies are *mission driven* organizations that require a clear and concise mission statement to guide the group and its members. It is important in today's constantly evolving business and economic environment, for an organization to keep its mission statement focused and up-to-date. It will serve as a reminder and be a concise declaration of why the department exists. A mission statement should be easily recalled by all department members, and the mission should be displayed in a number of venues. In some organizations, the mission statement becomes the basis by which individual and organizational performance is measured.

An old saying states that *"If you don't know where you are going, you will probably end up somewhere else."* Successful fire departments are guided by plans that lead the agency into the future and strive to meet a vision of the organization's future composition and condition. Leadership executives must continually endeavor to set the course for the department and to clearly cast the vision to the members and the community. The future shape and function of the organization will be molded to a great extent by the efforts of its leaders today.

Strategic planning addresses the steps that an organization will take to close their performance gaps and answer critical organizational issues, and is most effective over a three to five year period. Master and long-range planning provide a broader perspective of where the organization will be in the future. Long-range planning can support the health of an organization by predicting important future changes and the organization's potential response to that change.

TFD has carefully crafted a mission statement that reflects the organization's purpose. It was recently reviewed, and the executive staff endeavors to effectively and regularly model its tenants at staff meetings and training sessions. A code of ethics to support this important statement is being developed.

To support the mission, annual goals and objectives are developed at staff retreats. These are presented to the membership and reviewed on a quarterly basis. The goals and objectives are directly linked to programs and tied to division/personnel performance statements and plans. Performance expectations are articulated for individual personnel through policy and procedures and through the annual performance evaluation process.

The study and evaluation currently underway by ESCi will provide the department with a master plan that will include strategies for moving forward over the next 20 to 25 year horizon. Without a plan and well laid out *road map,* the agency will be unaware of critical issues such as community risk protection needs and other external forces that will affect services and performance standards.

TFD has developed a long-range strategic plan. The plan is a six year plan; however funding the plan has been problematic. TFD, as well as other city departments, compete for available funding and do not have direct control over budget allocations and funds, including those funds that address facility needs. Many of the areas identified in the six year plan were dependent on access to 303 Facility Funds which proved inadequate.

Recommendations:

The department mission statement should be prominently displayed and incorporated into department documents.

The City of Tukwila should review its allocation of the 303 funds.

Standard Operating Guidelines, Rules, and Regulations

Organizations that operate successfully are typically governed by a set of clear policies that provide a pathway towards the vision and that lay the foundation for an effective organizational culture. These policies set the boundaries for both expected and acceptable behavior, while not discouraging creativity and self-motivation. Organizations maintain policy and procedure manuals at multiple levels.

Rules, regulations, and codes are the policy-level direction provided by a governing body, such as a city council. Administrative rules are the responsibility of the highest-level organization administrator. They provide instruction and direction for compliance with the organization's policies and provide guidance and instruction to all employees. Operational policies or guidelines, when developed by a department, will provide department-specific guidance.

ESCi was provided with a copy of TFD's policies or procedures. These same documents are available to all employees on the department/city intranet. However, based on limited review, ESCi found that the standard operating procedures (SOPs) lack some critical components related to basic function and direction for the department.

The cornerstone document of any policy system is the founding document. Tukwila Fire Department does not have a policy that describes the policy development process. This founding document should describe the purpose and intent of the policy manual, how the manual is to be organized, when a policy is reviewed, and definitions and explicit descriptions of key words.

Regardless of the quality or condition of such policies and guidelines, their availability and familiarity to all personnel is critical. A significant financial and legal risk exists when day-to-day practice does not follow guidelines, procedures, or policy, a condition for which we found no evidence of at TFD. A number of factors can cause a practice to shift gradually away from policy. An out-of-date policy is one of the factors where practice commonly does not match policy. When this occurs, the policy-making authority must either enforce the policy or change it to match the practice. SOPs must reflect any legal mandates impacting the department. When policies are driven by regulation, the practice must match the policy.

As previously discussed, TFD maintains a set of policies on-line in the agency's intranet site, and hard copies of the policy manuals are also available in the department. It was reported to ESCi that the SOPs are not subject to any regular formal review, but there have been numerous recent changes and updates. Whether the proposed or updated document addresses and/or is compliant with the necessary laws and/or rules is covered at the time of the initial draft. However, there is no ongoing or formal process continuing to track this aspect, except by the training officer and/or various chief officers who through personal interest, may follow such details.

When SOPs are reviewed and/or adopted, there is a standard process that is followed. It includes an opportunity for labor to review and comment, and changes or amendments are discussed at various department meetings at all organization levels. In general, the standard chain of command is followed, but committee review and/or input is common. New policies are distributed and training is provided when necessary.

Recommendations:

Audit all policies and procedures for gaps between practice and policy

Review and revise all policies and procedures as needed

Establish a regular time schedule for reviews of SOPs

Establish a founding policy document that describes:

The purpose and intent of the policy manual

How the manual is to be organized

When a policy is to be reviewed

Definitions and explicit descriptions of key words

Establish a method and responsible person to ensure TFD is meeting all legal mandates.

Financial Controls

Governmental agencies have an obligation to the citizens to be good stewards of the operating funds with which they are provided. The City and TFD are very careful to do just that. Both entities use the standard Budget Accounting and Reporting System (BARS) as required by the State of Washington. Financial reviews are performed on a regular basis and the entire City financial operation is audited annually by the State of Washington.

Internal Evaluation of Critical Issues

It is extremely important that there be a clear understanding of critical internal issues facing TFD. Without such an understanding, organization leaders are not prepared to face these concerns. In addition, the enunciation of critical issues to employees and members increases their awareness of the organization's priorities and assists them in becoming focused on solutions.

TFD has identified critical issues facing the department. Staffing and facilities are presently acknowledged as issues needing attention. Critical issues are discussed in several different environments including informal settings, staff retreats, officer meetings, and labor management meetings. Minutes of retreats and officer meetings are placed on line for all personnel to read.

Internal Evaluation of Future Challenges

Equally important as identifying critical issues is the task of ascertaining what challenges will face the department at some future point. Having an appropriate level of forward thinking permits an agency to identify what external challenges may present themselves to the agency in the coming years. This awareness of future challenges ensures that the department does not miss opportunities or blindly stumble into a crisis unprepared.

TFD looks critically at future issues or challenges during management retreats and other information sharing venues. The following items have been identified as being of concern or possible challenges:

- Likely annexation of 500 acres at the south edge of the jurisdiction and the affect of growth on response and services provided by TFD
- Increasing legal mandates for training and necessitated logistics to meet them

TFD provides opportunities for personnel to comment on various issues and provides minutes of meetings for dissemination to TFD personnel.

Internal & External Communications

Communication within public safety organizations is paramount, especially to individuals in positions that contain an element of personal risk. Organizations with clear and effective internal

communications perform at a safer and higher level than organizations that do not communicate well. Internal communication must occur in all directions and at all levels to be most successful.

Similarly, external communication and community relations programs must be well structured. These systems can take any number of forms. In some organizations, all members are responsible for communicating with the public. In others, public information or public affairs are handled by a specific person or group.

Successful organizations utilize a multi-faceted approach to communication. Whether for internal or external communications, each agency must determine its own approach. Some of the following elements, and others, are utilized in many departments:

Figure 11: Internal Communication Plan Components

Elements of Successful Internal Communication Plans:

A formal internal communication plan is established and communicated throughout the organization

All personnel (top to bottom) are held responsible for communication and the distribution of information

Personnel are coached or provided with listening skills training

Employee satisfaction surveys are utilized to determine if the communication plan is effective

Effective personnel are required to acknowledge critical written information

Open-door policies are communicated at all levels and codified (chain of command is not subverted)

Procedures provide direction regarding the use and organization of bulletin boards

Face-to-face meetings and forums that include members at all levels are offered on a periodic basis

Staff meetings occur on a regularly scheduled basis, have a time limit, and an agenda that describes what is to be accomplished and who is invited

Meeting minutes are provided to all personnel

Technology is used to supplement instead of supplant communication between members

Email is limited (if possible) to the distribution of orders, meeting minutes, critical information, and short memorandums

Shift personnel are provided time to exchange information and to communicate during shift change periods

Telephone, web, or video conferencing are utilized in remote locations

Organizational sub units meet on a regular basis (division or station level)

Sub unit representatives are sent to broader organizational meetings

Upper level management visit sub unit meetings on a periodic basis

A newsletter (paper or web-based) is published for the distribution of non-critical information.

At TFD, there is ongoing dialogue among the fire chief, assistant chief, and administrative staff support personnel. Officers meetings are conducted and minutes are kept of these meetings and are available for review.

Additionally, minutes of safety committee and equipment committee, shift safety meetings and staff retreats are made available to all personnel.

Email is available for all members; the predominate means of distributing department memorandums.

Several times a year, the fire chief holds open forums to allow input and encourage discussion. This format has proven to be very valuable, and is a natural pairing to the open door policy that exists within the department. In addition, there are regular labor/management meetings held to discuss various topics of concern. Discussions with labor representatives reveal a high level of trust and open dialog between them and the administration.

Bulletin boards are provided in each station and at headquarters. There is currently no defined procedure covering the use of bulletin boards. In addition to department materials, there is also a bulletin board for union and labor and industries materials.

The key to a successful open door policy is to encourage and allow open communication while not subverting the chain of command. Informal communication should always be encouraged and heard. When the communication goes beyond information, advice, or reaches a decision-point that belongs at a different level of the organization, it should be referred to the correct person.

TFD practices an informal open door policy that is encouraged throughout the management staff. Although a formal written open door policy has not been developed, a defined chain of command communication path has been clearly communicated to all staff. The open door system appears to be functioning well within TFD.

All members have some form of employee mailbox. Voice mail is provided on a limited basis to selected individuals/positions.

Figure 12: External Communication Plan Components

Elements of Successful External Communication and Community Relations Programs:

A formal external communication plan is established, set in procedure, and communicated throughout the organization

A complaint process procedure is established

Personnel are coached or provided with training on public relations

Response personnel are empowered to provide value-added service beyond normal response services

Public information officer(s) are identified and their deployment identified in procedures

Citizen satisfaction surveys are utilized

Relationships the media are established

Media and press release procedures are identified

Citizen focus groups are utilized to acquire feed-back on specific issues

An advisory committee is seated to discuss on-going issues

A key communicators group of influential people is utilized to provide feed-back and to inform the community

Community group and service club meetings are attended on a regular basis

An annual fire station open house is held

Website is available and kept up-to-date

An email distribution list is utilized to distribute news and information

A newsletter (paper or web-based) is published and distributed throughout the community

Newsletters from other public entities and industry are utilized to distribute information

At this time, TFD does not have a formal community relations or communication plan focused business and community groups. The department makes use of its website to communicate with the public. In addition, the department contributes to the City newsletter. A full-time public educator/public information officer (PIO) position would provide a resource not now available. Many agencies meld both tasks to provide a single point of contact for the department, and to develop and disseminate information of interest to the community.

Recommendation:

Provide a full-time public educator/public information officer (PIO) position to oversee the public aspects of education and dissemination of information.

Decision Making Process

It is a widely held belief that when organization employees are provided with the opportunity to engage in the decision-making process, the organization benefits from a higher level of commitment and ownership in the organization's success.

At the senior executive level of TFD, the decision-making process is somewhat flexible. It can be autonomous or by consensus.

The preferred management methodology of the fire chief is described as being balanced and includes collaboration together with a necessary authority component when required.

A formalized decision-making policy has not been established. This is not to mean decisions are not being made. It is important that all personnel understand and have a sense on how decisions are made. This knowledge can instill confidence and provide a sense of inclusion within the ranks on how decisions are derived that may have significant impact on them or the workplace.

Recommendation:

Formally adopt a decision-making process that solicits input vertically and horizontally from the appropriate organization levels and create a policy that reflects this new format.

Document Controls

Records management is a critical function for any organization. A variety of uses are made of written records and, therefore, their integrity must be protected. Washington State law requires public access to certain fire and EMS department documents and data. Clear written procedures are currently in place which provide for public records access and media access through the fire department administrative staff.

Paper records (hard copy files) are adequately secured with passage and container locks with limited access. Important computer files are backed-up to an offsite secure data location on a regular and consistent basis.

The Health Insurance Portability and Accountability Act (HIPPA) included regulations that require all individually-identifiable health care information be protected to ensure privacy and confidentiality when stored, maintained, or transmitted. Medical incident records contain protected medical information and sufficient personal information regarding the patient to create a concern over HIPPA requirements. The department has adequate security provisions in place to protect this information

Reports and Records

TFD's record and reporting systems appear to be adequate and efficient. Personnel records are complete and up-to-date, and maintained in a manner that protects private medical information. Records are maintained on employment history, discipline, commendations, work assignments, injuries, and exposures, that latter being kept at City offices. Self-contained breathing apparatus, gas monitors, ladder, and pump testing are completed and records maintained. Breathing air sampling is conducted quarterly. Vehicle test and maintenance records are held at the city public works shops.

The records management system for incidents is effectively computerized using Microsoft XP Professional operating platforms on a series of networked personal computers. The data collection methods used is compliant with NFIRS (National Fire Incident Reporting System) standards. Incident information, activity summary, and other analyses are available.

Financial activities, including budgets, expenditures, revenues, purchase orders, and other encumbrances are logged by fire department personnel, but the actual records are kept by the City. Management and operational reports are also completed on a weekly basis and distributed to all members.

Security

The department maintains a current, annual inventory of capital assets and a process is in place to maintain this inventory. A report of these assets is sent to the City each year. New assets are logged, and a property sticker is attached. Bar coding is used for the inventory system Newer

technologies, such as radio frequency identification (RFID) when combined with the correct software applications, have the added benefit of providing department leadership with critical information regarding replacement schedules, ongoing maintenance costs, loss, and in the case of federally funded items, immediate location reporting.

A petty cash box is kept at headquarters in the business office. Credit cards and account cards are available for captains and above; extensive purchasing controls are in place.

Tukwila Fire Department has a significant investment in facilities, apparatus, equipment, and other items, along with its financial assets. Protecting these assets is very important. Stations are reported to be consistently locked and secure from unauthorized entry. Steps have been taken to address security issues where the public enters the building. Public access to the buildings is limited to business areas or when accompanied by an employee or member. Some newer apparatus have keyed entry locks, but no other type of vehicle theft deterrent systems is employed.

Cipher locks are used to prevent unauthorized entry. However, no security alarm system is provided for automatic notification of unauthorized entry or break-in. Further, there are no perimeter protections in place that would limit access to the grounds of the stations. There are monitored internal fire protection systems in all the stations, for fire alarm, and/or sprinkler water flow.

Department computers are programmed with password security on sensitive file access and software to provide an additional level of security and data integrity. Firewall protection is in place for computers accessing the internet and other outside servers. The protection is adequately up-to-date and capable of preventing most unauthorized network intrusions. Up-to-date virus protection software is utilized on all incoming email and files or operating systems are regularly scanned for undetected virus infection.

Recommendations:

Work with local law enforcement and develop a plan for ongoing security of the fire stations. Specifically, their advice on perimeter fencing, security cameras, and updated access controls.

Provide theft deterrent systems for all vehicles.

Task Three: Planning for Fire Protection, Rescue, and EMS

In order to do a better job with available resources, fire departments must focus on improving services while identifying programs or activities that may no longer serve its changing needs. Through planning, the organization is able to establish a vision for the future, create a framework within which decisions are made, and chart its course for the coming years. The quality and accuracy of the planning function determines the success of the organization.

To be truly effective, an emergency services agency must consider planning on three distinct levels:

1. Tactical planning
2. Operational planning
3. Master planning

Tactical planning is the development of strategies for potential emergency incidents. Operational planning is the organization of day-to-day activities (as primarily outlined by a department's standard operating guidelines and procedures) and the integration of the agency into other local, regional, or national response networks. Master planning is preparation for the long-term effectiveness of the agency as the operating environment changes over time.

Current Planning Processes

Both formal and informal planning occurs within TFD. Annual budgets address short-term financial planning, and a six-year strategic plan has been developed, although funding issues have hampered the execution of the plan.

Critical Issues

Any planning process must take into consideration various critical aspects of current and future department operations. Time is spent at various levels within TFD and opportunities to involve department members in identifying and discussing critical issues are provided.

Tactical Planning

A firefighter's typical work area is usually quite foreign to him or her. Often, their first visit to a building is when the structure is involved in fire or some other emergency. This is also the point

in time where the internal environment is at its worst. Contrary to Hollywood's portrayal of the inside of a building on fire, visibility is at or near zero due to smoke. A lack of familiarity with a building can easily lead a firefighter to become disoriented or injured by an unfamiliar internal layout, or by equipment or other hazards that might be encountered.

It is critically important that firefighters and command staff have comprehensive, accurate information readily at hand to identify hazards, to direct tactical operations, and to use built-in fire resistive features. The best way to compile and update this information is to develop building familiarization tours and pre-fire (pre-incident) plans and to conduct tactical exercises, either on-site or by tabletop simulation.

Establishing a comprehensive process to create and maintain pre-incident plans is a work in progress at TFD. Electronic versions are being produced from older paper copies, although they are not yet available through the Mobile Data Terminals (MDT) in the apparatus. The plans are an easy-to-use, quick reference tool for company officers and command staff. They include:

- Building construction
- Occupant characteristics
- Incorporated fire protection systems
- Capabilities of public or industrial responding personnel
- Water supply
- Exposure factors
- Facility layout

A defined list of target hazards has also been developed. Target hazards are defined as:

- Buildings with large potential occupant loads
- Buildings with populations who are partially or completely non-ambulatory
- Buildings of large size (greater than 12,000 square feet)
- Buildings that contain process hazards, such as hazardous materials or equipment

Emergency agencies provide services in a rapidly changing, all risks environment. With improved methods of providing service come increased regulation of activities, new risks to protect, and other challenges that can quickly catch the unwary off guard. Only through continuous internal and external environmental awareness and periodic course corrections can

an organization stay on the leading edge. The tactical planning process will help keep the department prepared.

Operational Planning

Tukwila Fire Department enjoys local and regional mutual aid and automatic aid agreements with neighboring emergency services organizations. Aid agreements, contracts, and inter-governmental agreements are currently in place and are regularly utilized as shown later in this report.

The emergency management function of the City is established, and is located in the Public Works Department. King County maintains formal responsibility for broader emergency management functions and serves as the Local Emergency Planning Committee (LEPC). All Superfund Amendment and Reauthorization Act (SARA) information is currently being forwarded to this committee. The fire department does not have close contact with the committee regarding this important information.

SARA Title III required extremely hazardous substance (EHS) facilities to develop comprehensive emergency plans for their facility. EHS facilities are those using over a threshold limit of certain materials. The Act required local fire departments coordinate with the involved industries to ensure quality responses to emergencies. With current staffing in prevention, it is extremely challenging to keep pace with rapidly changing occupancies and processes occurring within the City. Additional personnel should be added in the prevention division to ensure EHS facilities are in compliance.

TFD in concert with the King County Department of Emergency Management (DEM) and the LEPC need to confirm that all EHS facilities within their service area have been identified to ensure that local plans have been developed and that fire department operations have been coordinated with each local plan.

Additionally, the department needs to confirm that mandated Tier II reporting forms are being received reviewed, properly filed, and available for training and use during emergency responses. The status of this process is in question.

At a minimum, pre-incident planning should include the cataloging and identifying of all occupancies with hazardous materials and hazardous processes.

It is important to note that in region-wide disasters – despite the best intentions of a County Disaster Plan – smaller communities are consistently over-looked for at least the first 72-96 hours of a disaster as resources are funneled into larger population centers. Emergency managers understand this fact and prepare plans, resources, communications, and management components to be self-sufficient and to provide for its own continuance of government services.

Master Planning

While the Tukwila Fire Department has an adopted mission statement, as well as an organizational vision for the future, other components of a comprehensive planning package have not been defined. Organizational or member value statements do not exist and a full analysis of strengths and weaknesses has not been completed. Annual goals and objectives have been developed and published to all members

Broader organizational goals, objectives, and timelines have not been established or formally vetted due to limited staff time at the administrative level. Therefore, TFD's members direct their efforts at the immediate issues of the day, and are unable to commit significant time to planning for future service delivery, evaluating service improvement opportunities, or developing new programs and services desired by the customer. We believe that an additional dedicated assistant chief position, whose charge is logistics and strategic planning, would provide the expertise for TFD to implement long-term planning processes throughout the agency.

Strategic planning is an important element for any organization. We highly recommend and encourage TFD to renew their six year strategic planning and strongly encourage the City to provide the necessary resources to move the plan to fruition.

This final thought on planning. To completely understand the ability of an organization to move forward and address upcoming challenges, it is imperative to know the current state of readiness. Many evaluation tools are available for fire departments to use. Some are more cursory in nature, but still provide useful information. Others offer very detailed views into every

aspect of the department's operations. ESCi believes that the completion of this master planning process will provide a solid foundation for the City and TFD for the future.

Recommendations:

Establish a method and schedule to incorporate pre-fire plans into the mobile data technology.

Coordinate with King County DEM for hazardous materials, hazard information and update pre-fire plans accordingly.

Review the City emergency plan regularly and provide recommendations for updates as needed.

Task Four: Personnel Management

Human resource (HR) management is based on the assumption that workers and members of organizations are individuals with varying goals, desires, needs, and wants. As such, the workforce should never be thought of as an inanimate business resource. Because people represent the very foundation of any successful organization, HRM should take a positive view of workers, assuming that all wish to contribute productively; and that the main obstacles to any endeavor result from a lack of knowledge, insufficient training, or process failure.

Careful attention must be paid to managing the workforce to achieve maximum productivity for the organization and maximum satisfaction for the individual. A safe working environment, fair treatment, and recognition for a job well done are key components to job satisfaction.

It is important that organization members know to whom they should go when they have a problem, question, or issue related to their relationship to the department. In large companies, a human resource department typically handles this function. Staff within such a department addresses questions, issues, and tasks related to appointment, benefits, performance, disciplines, promotion, or termination of employees.

Personnel Policies and Rules

For the TFD, the human resource management functions rest entirely with the city. All specific information related to personnel issues, compensation, and related topics, resides with the City human resource manager. Consequently, TFD has little involvement is this particular management component.

The City's personnel policy manual is strictly related to HR functions. Copies are available for review at fire department headquarters. New hires receive orientation and benefits review during their initial weeks of employment, and are instructed on how to access the desk manual on-line. The orientation also covers specific operational guidelines and the department's harassment policy. Not all department HR policies are up-to-date at this time, nor is there a retention plan in place for HR policies and procedures.

Recommendations:

Provide copies of the HR manuals at all fire stations.

The City should establish a process to regularly review and update HR polices.

Develop and implement a retention plan for HR policies.

Compensation and Benefits

Tukwila Fire Department is a full career fire department. All emergency response personnel below the rank of assistant fire chief are represented by the International Association of Firefighters (IAFF) Local 2088. The department's staff employees are also unionized. The fire chief is an at-will employee and is not represented. The assistant chief is a civil service employee, but not represented.

The forms of compensation offered to employees include salary, health insurance, retirement pension, dental insurance, vision insurance, clothing allowance, standby pay, and longevity pay as negotiated for and documented in the labor contracts, or set in policy for non-represented staff.

Reports and Records

The maintenance of adequate and up-to-date personnel records is critical in every organization that depends on the effective performance of its people. It is every bit as important for administrative employees as for operational staff and volunteer members. The HR manager maintains adequate written or computerized records of all personnel.

At the City, original application materials are retained in order to create a full historical record of the employee or member's participation in the organization, from initial appointment to separation. Additional documents and records referring to assignments, promotions, commendations, discipline, and other personnel actions personnel are kept organized and updated. Copies of reports describing details of accidents or other injuries or injury-related incidents are maintained in the employee's confidential medical file for future reference. Some files related to discipline, recognition and injury are duplicated for storage at fire department headquarters.

Personnel records are locked, secured, and fire safe. Files maintained on each employee include personnel, medical, and labor and industries. Records of health evaluations, exposures to hazardous substances or contagious diseases, and other medical records are protected under federal privacy laws, and are kept separate from routine personnel records. Access is strictly limited.

Disciplinary Process

Maintaining discipline in a paramilitary organization is crucial component of a well run department. Members must be allowed latitude to perform, using wisdom and judgment, but must also be held accountable for actions, whether good or less agreeable. It is important to establish a method by which employees are encouraged to exhibit behavior that reflects a high moral standard, and creates and maintains a safe and healthy working environment. To that end, disciplinary policies that focus on coaching, counseling, and behavioral modification instead of punishment have been shown to be very successful, especially in the current employment environment.

At TFD, a formal, progressive disciplinary process for personnel has been established. The rules are clearly communicated to members at orientation and at varying intervals throughout a member's career. Along with the progressive discipline process, a grievance procedure is outlined in the union contract. Due process and appeals process policies are also provided. Appeals may be made through the mayor's office or the Civil Service Commission. No past or pending legal action was reported to ESCi.

Counseling Services

Emergency services bring otherwise ordinary people into life and death situations that many times end tragically. Even though department personnel are trained responders, they do not have an impregnable shield that prevents them from being effective by traumatic events. Today's fire and EMS departments have recognized the need to provide a support system for their personnel who are exposed to traumatic incidents.

The department can call on the services of two different chaplains to assist with critical incident stress debriefings (CISD). These CISDs are facilitated by a consortium of King County professionals, from both the fire and medical communities. TFD employees also have direct

access to mental health professionals and to a department sponsored peer-support team, members of which have been trained in critical incident stress management (CISM).

An employee assistance program (EAP) is available to all members. It is recommended that the department remember that critical incident stress interventions are short-term processes. Frequently, longer-term support is needed. Failure to provide that support can ultimately lead to the loss of a valuable employee and could have a devastating impact on that individual's family.

The department uses EAP as a support for employees with drug/alcohol problems. In addition, an informal intervention program is in place.

Recommendations:

The department should formalize the intervention process.

Establish a model last chance agreement approved by both labor and management.

Application and Recruitment Process

Recruitment of personnel is a critically important function for emergency service agencies. The community places a tremendous amount of trust in fire department personnel, so the process used to select personnel should be comprehensive. Ensuring the highest quality candidates and retaining the best members must be of prime concern.

The TFD firefighter recruitment process contains fairly standard set of elements that is intended to ensure that success of all personnel hired. They are a written exam, physical ability test, psychological evaluation, medical exam, background check, and interview process.

The department utilizes *Publicsafetytesting.com* for initial written testing by those interested in applying for a career position. The successful candidate must also pass an oral board and chief's interview prior to receiving a conditional job offer. If successful, the candidate is sent for psychological testing and medical examination. The department usually receives a list of candidates twice per year. Final selection is made by the fire chief, following executive staff interviews.

Recommendation:

Conduct credit checks in addition to background checks on all applicants.

Testing, Measuring, and Promotion Process

It is important that the department ensure that once on staff, all personnel are evaluated periodically to ensure their continued ability to perform job duties safely and efficiently. Technical and manipulative skills should be evaluated on an annual basis. The intent of the evaluation is to provide documentation about a person's ability to perform their assigned responsibilities and measure knowledge, skills, and abilities (KSAs). Information provided by annual KSA evaluations provides valuable input into the department's training and education development process.

Understanding that regular evaluation and feedback for personnel is critical to behavior modification and improvement, TFD personnel are evaluated at each drill and receive appropriate feedback if necessary.

It is important to maintain such programs whenever possible. It has long been proven that employees and members sincerely wish to perform well, and to be a contributing part of any organization. The desire to succeed is best cultivated through feedback that allows a member to know what they are doing well or what they need to improve.

The department conducts annual assessments per the bargaining agreement. However there is no pass or fail at this time, and members may opt out by having a doctors' excuse. TFD supports a department-wide mandatory physical fitness program.

In addition to regular job performance evaluations, employees will greatly benefit from opportunities to advance in their career. TFD offers promotional examinations on a regular basis.

Health and Wellness Programs

Keeping members safe and healthy, once thought of as an expensive and unneeded extra, is today an important component of a fire department's method of operation. It has been clearly

documented[6] that it is by far cheaper to prevent injury than to pay for rehabilitation and work replacement. Modern, progressive departments are incorporating numerous methodologies into the daily routine of fire fighters to help in this regard.

The TFD has established medical standards; however, annual medical exams have not been required of personnel with the exception of members of the hazardous materials team.

The department has an established safety committee as described earlier. It is made up of an administrative officer, a battalion chief, and representatives from all three platoons. The committee meets monthly, reviewing all personal and vehicle accidents, as well as items of general concern, and make recommendations to the fire chief. Meetings are open for anyone to attend. Minutes of the meetings are available and distributed electronically.

[6] Pgs 454-458, American Journal of Industrial Medicine, Volume 43, Issue 4; *The Economic Consequences of Firefighter Injuries and Their Prevention,* National Institute of Standards and Technology, March 2005.

Task Five: Incident and Organizational Staffing

The Tukwila Fire Department employs career staff to accomplish its mission and deliver services to its citizens. This section provides an analysis of the organization's current staffing levels.

Administrative and Support Staff

One of the primary responsibilities of the department's administration and support staff is to ensure that the operations division can deliver excellent emergency services.

Efficient and effective administration and support are critical to the department's success. In the absence of sufficient oversight, logistics, planning, and finance, the operational entities will fail their operational goals. Additionally, like any other part of the department, administration and support require appropriate resources to function properly.

Analyzing the ratio of administrative and support positions to the total operational positions facilitates an understanding of the relative number of resources committed to this important function. An appropriate balance of administrative personnel to operational is critical to the success of the department's mission and responsibilities.

The administrative complement of TFD is comprised of three major divisions and the fire chief's office. Figure 13 summarizes the number of full-time equivalents (FTE's) assigned to administration and support. For the purpose of the following comparison, all personnel that are involved in direct external service delivery are considered operational, including fire prevention personnel. The fire marshal serves both functions and has been placed in the administrative list.

Figure 13: TFD Administrative/Support Personnel

Position Title	Number (FTE)
Fire Chief	1
Assistant Fire Chief	1
Office staff	3
Fire Marshal	1
Fire Prevention Personnel	1
Training	2
Total Administrative and Support	**9**
Percent Administrative & Support to Total Operational Personnel	**13.6%**

The administration and support staff for TFD is comprised of 12 FTEs. Statistically, TFD currently maintains a ratio of 13.6 percent of administrative to operational personnel. Based on experience with similar organizations, ESCi has determined that emergency services agencies require a 10 to 15 percent ratio of administration and support to operational personnel.[7]

Emergency Operational Staff

It takes an adequate and well-trained staff of emergency responders to put the appropriate emergency apparatus and equipment to its best use mitigating incidents. Insufficient staffing at an operational scene decreases the effectiveness of the response and increases the risk of injury to all individuals involved.

Figure 14 summarizes the personnel assigned to street-level service delivery.

Figure 14: TFD Field Operations Staffing

Position Title	Number (FTE)
Battalion Chiefs	3
Captains	12
Firefighters/EMTs	39
Fire Prevention Specialists	3
Total Operational Staff	**57**

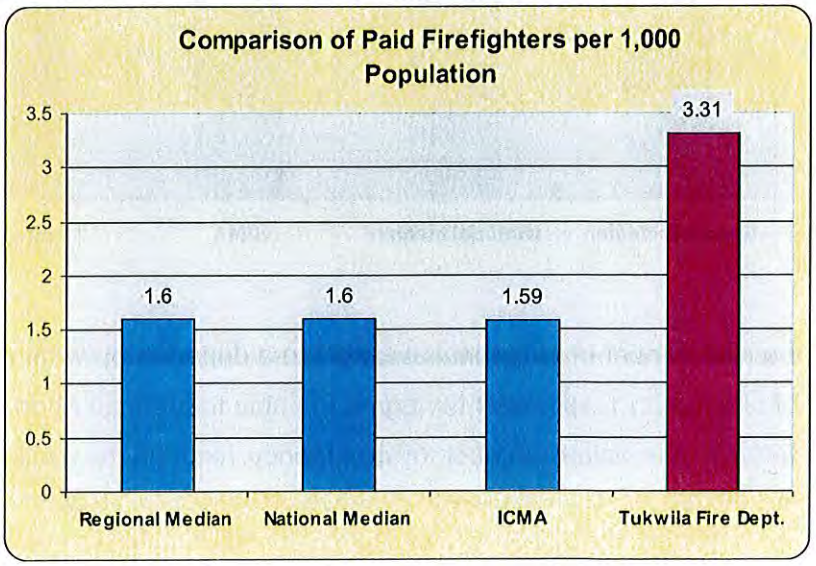
[7] ESCi recognizes that organizational goals, regulatory environment, and workload are the actual drivers that determine the number of administrative personnel required to deliver support services. The 10 to 15 percent ratio is used for comparison purposes.

The department's operations personnel provide fire suppression, first response emergency medical services (EMS) at the basic life support level (BLS), specialized rescue, and hazardous materials response. Paramedic services are provided by King County Medic One.

An analysis of emergency service staffing begins with comparison of available emergency service personnel to other communities of similar size and organization. The number of operational personnel, maintained by a fire department, provides some measure of the ability of the agency to assemble emergency workers to respond to request for assistance. The following chart shows the number of career operational personnel for TFD per 1,000 residents, and compares that number to the other medians[8] for agencies serving similar communities with a residential population between 10,000 and 25,000.

Figure 15 compares TFD's staffing per 1,000 population with three other comparables for departments serving similar populations (17,240). TFD has 3.31 firefighters for every 1,000 population compared to the average median of 1.6. This does not take into consideration effective population, community fire risk, geographical considerations, and other factors that may require more firefighter resources.

Figure 15: Comparison of Career Firefighters per 1,000 Population

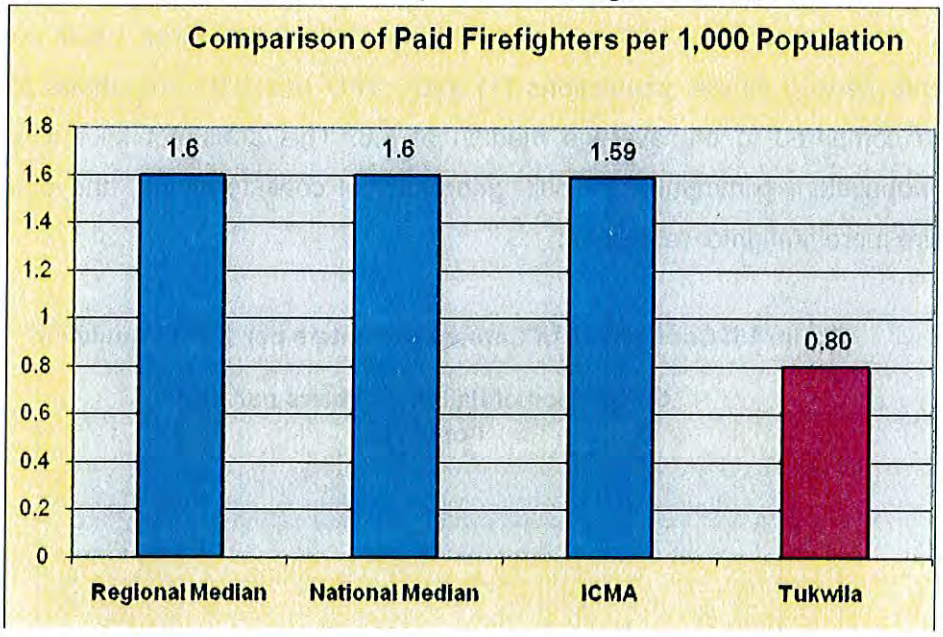


[8] U.S. Fire Administration/National Fire Protection Association, *Fire Department Profiles,* 2003, NFPA, Quincy, MA.

It is estimated that over 42,000 people work in the TFD jurisdiction and over 100,000 additional people conduct business, shop, and travel within the jurisdiction. This is knows as the *effective population*, or the population exceeding the 17,240 persons who call Tukwila home. When we chart the firefighters per 1,000 including the effective population figure, we can see that the number firefighters per 1,000 dramatically decrease due to the impact of the effective population.

The combined populations of effective and census populations indicates that although TFD serves a city of 17,240, they serve a much larger effective population and, therefore, must staff and maintain resources to meet the demands for this larger community.

Figure 16: Effective Population - Firefighters Per 1,000



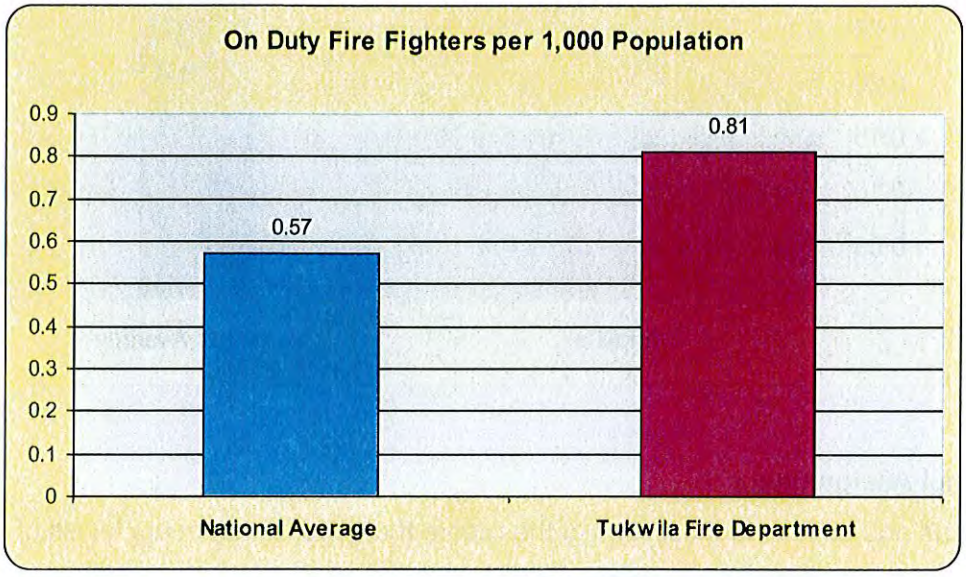
Regardless of the raw number of personnel available to a department, what matters most is the actual number of emergency responders the agency is able to produce at an emergency scene. This usually relates to the actual number of emergency responders available for immediate deployment.

The national average of personnel available for immediate deployment (on duty) for populations similar to TFD is 9.8. TFD's typical on-duty staffing is 14. While the department's staffing system distributes up to 18 personnel on each of three shifts, 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 each shift. TFD's policy allows the shift staffing level to fall to a minimum of 14.

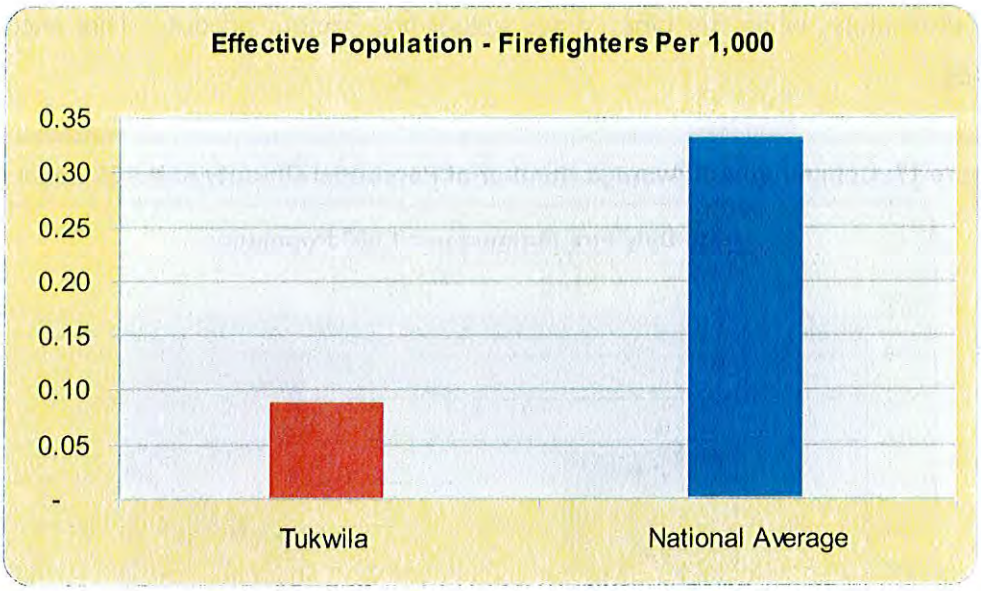
At first glance there appears to be a conflict between the data in Figures 17 and 18. However, each illustration represents a comparison against national and regional data sets, and one looks at total firefighters, while the other views actual fire fighters on duty. This accounts for the difference.

Figure 17: Comparison of Average Number of Personnel On-duty to the National Average



If we compare the next chart, on duty firefighters on duty daily using the effective population number, we see that the national average of cities with a population of TFD's effective population have about 0.30 firefighters per 1,000 population on duty daily, considerably more than TFD at 0.08 per 1,000.

Figure 18: Effective Population - Firefighters on Duty Per 1,000



Personnel Assignments

In previous and subsequent sections of the report, the need for adequate levels of management and administrative support and staffing are discussed. One thing is clear, departments the size of Tukwila cannot always adhere to job duties and tasks outlined in the formalized job descriptions. This practice is not unique to TFD, but indicates that job duties and descriptions should be frequently reviewed for accuracy, and strategies developed to maintain sufficient resources to meet the department's administrative and operational missions. With limited numbers of personnel, both administrative and operational, it is essential that personnel are flexible in their view of job duties, and do what is necessary to support the department's mission.

TFD has several areas in personnel assignments and staffing that beg a critical review. First, there are insufficient administrative personnel to provide planning and logistical program management. We recommend the addition of one assistant chief position whose primary responsibility would be to lead the logistics and strategic planning functions, and to provide

administrative oversight and expertise as an integral member of the department's management team. Further, we have identified the need for two civilian fire inspectors, one deputy fire marshal position, and a public educator/PIO position.

The training function requires additional personnel to manage a complex and mandated driven training program. ESCi has recommended that additional personnel be assigned to training for oversight, hands on delivery of classes, and development of training strategies and programs.

To alleviate the wear and tear on the truck, and to provide reliable staffing to deal with concurrency issues, we recommend that TFD staff an aid car full-time. The current practice of responding with the large truck company is not the best use of a very expensive resource, and trying to maneuver narrow streets with parked cars can be a daunting challenge at times.

Discussions and observations between ESCi and TFD staff, acknowledge that job duties and responsibilities *creep* into areas that may not be part of the formal job description. In addition to normal job position functions, additional routine duties and assignments are handled by the fire companies. Captains and firefighters often are assigned and/or volunteer for special tasks. Tasks are usually based on what equipment or apparatus resides at the station to which the officer or firefighter is assigned (i.e.: SCBA, PPE). Opportunities are provided for assignment of tasks based on interest or station assignment.

The department has a variety of committees on which administrative/support and operations staff can serve. Department committees are listed below:

- EMS Quality Management (King County)
- Safety Committee
- Equipment Standards Committee

Incident Staffing

Work at fire emergencies can be categorized into two key components — life safety and fire flow. Life safety relates to the number of building occupants, their location within the structure, their status, and their ability to take self-preservation action. Life safety tasks involve the search, rescue, and evacuation of victims. The fire flow component is the delivery of enough water to extinguish the fire and create an environment within the building that allows entry by firefighters, or the escape of occupants.

The number and types of tasks needing simultaneous action will dictate the minimum number of firefighters required to combat different types of fires. In the absence of adequate personnel to perform concurrent action, the command officer must prioritize the tasks and complete some in chronological order, rather than concurrently. These tasks include command, scene safety, search and rescue, fire attack, water supply, pump operation, ventilation, and back-up/rapid intervention.

The Center for Public Safety Excellence (CPSE) has developed a sample critical tasking analysis for the number of emergency workers required for various levels of risk. That analysis is summarized below.

Figure 19: Sample Critical Task Staffing Need Based on Level of Risk

Critical Task[9]	Maximum Risk	High Risk	Moderate Risk	Low Risk
Attack line	4	4	2	2
Search and rescue	4	2	2	
Ventilation	4	2	2	
Backup line/rapid intervention	4	3	2	2**
Pump operator	1	1	1	1
Water supply	1	1	1	
Utilities support	1	1	1	
Command/safety	2	2	2	1***
Forcible entry	*			
Salvage	*			
Overhaul	1*			
Communication	1			
Chief's aide	1	1		
Operations section chief	1			
Logistics	1			
Planning	1*			
Staging	1*			
Rehabilitation	1			
Division/group supervisors	2*			
High-rise evacuation	10*			
Stairwell support	10*			
Total Required	**51**	**17**	**13**	**4 to 6**

* At maximum and high-risk fires, additional personnel may be needed for these tasks.
** Backup line may not be required for certain incidents.
***Can often be handled by the first due officer.

Delivering sufficient numbers of personnel to the scene to accomplish all the various tasks that are required to effectively control an emergency is essential. The most labor-intensive incidents are structure fires. As shown by the preceding table, national criteria suggests at least 13 personnel be on scene of a fire in a single family home for safe and effective operations. More personnel are needed as the size of the structure increases, the life risk increases, or when special hazards exist.

[9] All tasks may be functional during the early moments of firefighting, but sometimes certain duties take place in sequence depending on the situation, thus reducing the total number of people needed.

At minimum staffing levels, TFD has 14 personnel available to respond to moderate risk emergencies. If fully staffed, there are 18 responders available, which just meet the criteria set by CPSE for high risk incidents.

TFD realizes that use of auto-aid is imperative to augment their on duty force. For this reason, the department actively participates in automatic response on emergencies, as well as providing automatic aid response to neighboring agencies. This strategy is commendable and should continue.

Task Six: Training Program

The delivery of safe and effective fire and emergency medical services is clearly dependant on a well-trained response force. The International Fire Service Training Association (IFSTA) states that:

> *"Regardless of the particular system used, an effective training program will include: (1) the continuous training of all levels of personnel in the department; (2) a master outline or plan; (3) a system for evaluating the scope, depth, and effectiveness of the program: and (4) revising the program, as required, to include advances in equipment, products, and techniques."*

Without a high quality, comprehensive training program, emergency outcomes are compromised, response personnel are at risk, and the department may be exposed to liability for the actions of its employees. Training and education of department personnel are critical functions for the TFD.

Anthony Granito, author of *Fire Service Instructor's Guide*, states the following:

> *"A good training program is undoubtedly the single most important factor producing and maintaining a high proficiency in any fire department. It not only produces high efficiency initially, but also affects future efficiency when we consider that the rawest recruit now being trained may be chief of the department or at least a senior officer in 20 or 30 years."*

The function of a training program is not merely imparting personal knowledge and technical skills to an individual, it is developing the self-confidence to perform correctly under stressful, if not hostile, conditions. A training program must be systematic, and must provide positive feedback to the trainee, firefighter, or officer. The goals of training should always focus on performance, never merely on acquiring a certain number of training hours.

Key elements of an effective training program should include:

Training administration	Training division staffing
Training schedules	Training facilities
Training goals and objectives	Motivation for training
Methodology for success	Company operations and performance
Varied types of reinforcement	Member targeted training
Organizational priority to training	Peer group commitment to training

General Training Competencies

In order to ensure that quality training is provided, it should be based on established standards of good practice. There are a variety of sources for training standards that the fire department can use as the foundation for its training activities. In the state of Washington, training is required by state statute, specifically Washington Administrative Code (WAC) 296-305-05501, which states:

> *"All members who engage in emergency operations shall be trained commensurate with their duties and responsibilities. Training shall be as frequent as necessary to ensure that members can perform their assigned duties in a safe and competent manner but shall not be less than the frequencies specified in this standard."*

Adequate training is critical if a fire department is going to be able to assure that it can effectively complete its mission of fighting fires and delivering emergency medical care. In addition, to effectiveness of service delivery, training directly effects an organization's ability to make sure that its personnel are able to operate safely without putting its citizens or its firefighter's at risk of injury or death.

The department has established the general direction of their training program appropriately. Each year, the department's command staff meets to establish direction for the upcoming year, including the training program. Quarterly reports to the city council review the year's training accomplishments and the department's plans for the next year.

Continuing education is provided to first comply with the minimum requirement of the WAC and further, to exceed those minimums with additional supplemental training, as deemed necessary. TFD has not formally defined goals and objectives for their training program. They have, however, committed to a set of quarterly and annual training objectives, although not to specifically defined program goals. The basic program guidance expressed by the training officer is appropriate, and the staff has done a good job identifying program needs and direction. A formal process of establishing defined goals and objectives, in the form of a strategic plan for the training program, is recommended as a means by which to enhance the effort.

It is important that a training program establish well-defined minimum annual training hours, or alternatively, competency-based minimum standards. Doing so enables the training officer to properly develop training plans and also provides measures by which training delivery can be

gauged. The department has not clearly established minimum hours of annual training or skills competencies. Instead, the training officer determines hours and training content on an as-needed basis, as necessary to meet the minimum training and recertification requirements of the WAC and other areas identified as important. ESCi recommends that annual training requirements be established and measured.

The department's training program is based on the *International Fire Service Accreditation Congress (IFSAC),* National Fire Protection Association, and International Fire Service Training Association firefighter standards and curriculum. Emergency medical service training is accomplished under the King County EMS System, by way of an innovative countywide EMS Online Competency-Based Training (CBT) system. The minimum EMS training level for department personnel is that of EMT-basic level, they do not have paramedics on staff; however one contracted paramedic is retained for training purposes.

TFD delivers ongoing education to line personnel at several levels that include entry-level probationary training, ongoing skills development and maintenance, and specialized services.

The department uses a number of standards and written sources in its training program, depending primarily on the IFSTA manuals. NFPA standards are also incorporated. Both are considered industry standards and of good quality.

Training is provided on the mandatory subjects including:

- Fire Suppression
- Emergency Medical Services
- Hazardous Materials Awareness
- Respiratory Protection
- Confined Space Awareness
- Hazard Communication
- First Aid/CPR
- Bloodborne Pathogens
- Two In / Two Out Rule and Application

Ongoing Skills Development and Maintenance

The training officer delivers ongoing education to the line personnel at several levels including entry-level probationary training, ongoing skills development and maintenance, and specialized services.

The department's training program is focused on the targeting of on-the-job and in-service training. Structural fire suppression training, various types of rescue instruction, and EMS training are delivered on a regular basis. Hazardous materials response training is delivered to

department personnel at the awareness and operations levels and 14 personnel are certified at the Hazardous Materials - Technician level. The content and composition of the programs appears to be well balanced and capable of addressing essential fire and EMS competencies and skills.

Annual skills maintenance efforts should include live fire training. However, TFD does not have a live fire training facility, and the use of abandoned buildings has become problematic due to environmental protection regulations. As a result, personnel are sent to the North Bend Fire Training Academy when possible.

Driver/operators are provided with drivers training, using the Emergency Vehicle Accident Prevention program (EVAP), a Washington State driver's training curriculum. The department does not have a vehicle driving course, however the Metro driving course is used for hands on driving exercises and testing. In addition, the Tukwila Police Department provided EVOP training for all day staff and battalion chiefs.

Pre-incident planning is essential, not only because it helps firefighters to be knowledgeable of a building's floor plan and characteristics, but also as a means to enhance firefighter safety. The department conducts regular pre-incident planning and incorporates the plans into its ongoing training in the form of a monthly safety meeting, during which a selected high-hazard facility is toured.

Competence Testing and Skills Assessment

Regular competence testing, to assure not only that personnel are receiving adequate training, but also that they are able to put their knowledge and skills into practice, is essential. Routine skills evaluation also provides a valuable tool for assessing the effectiveness of an organization's training program and identifying areas that need to be emphasized in the subsequent training calendar planning.

TFD does not have a procedure in place for annual competency testing. The training officer is in the process, however, of establishing a plan to conduct quarterly evaluation drills that are intended to correspond to defined quarterly training objectives. ESCi encourages this effort and recommends that a system of quarterly or annual skills proficiency testing be established.

A formal evaluation of actual training needs can enable the department to identify areas of weakness, as well as safety and operational risks, based on which future training plans can be established. The department has not undertaken the process of conducting a structured training needs assessment. Instead, training is based simply on state requirements, NFPA standards, and any identified supplemental needs, not on identified areas of necessary emphasis. It is recommended that the department conduct a formal training needs assessment process.

Entry Level Firefighter Training

The manner in which new firefighters are trained in their first months and years of employment lays the foundation for the development of their knowledge and skills for the entire future of their career. A good entry level training plan is the key to assuring that new recruits, whether career or volunteer, get a good start.

If a newly hired TFD firefighter does not possess a Firefighter I certification, he or she is required to attend the Washington State Fire Training Academy during which they receive training to the Firefighter I level, along with some additional supplementary education in hazardous materials and other baseline subjects. Upon their return, the recruit spends a minimum of two weeks assigned to a weekday schedule with TFD trainers. During this time, the new hire will complete a recruit task book that provides the necessary equipment and procedural orientation necessary before being assigned to a regular shift.

During the first year of employment, the firefighter will complete a further task book assignment and, upon successful completion, be ranked at the Third Class Firefighter level. In the second year, new hires complete additional defined training and achieve Second Class Firefighter status. At the end of a firefighter's third year, he/she will take the test for Firefighter II.

Lateral new employees, depending on history and experience, will not generally be required to complete the above sequence. Instead, they complete the two-week orientations described earlier and are placed in a probationary status for one year. They are also required to complete and test for Firefighter II.

In our review of the TFD entry level firefighter training process, we found that it was comprehensive and sufficient to assure that new employees are provided with the education necessary to allow the to function effectively and safely.

Recommendations:

Undertake a process of defining goals and objectives for the training program.

Establish annual training requirements in the form of hours or competencies.

Develop a system of quarterly or annual skills competency testing.

Training Administration, Schedule, and Facilities

Administration

For training to be viewed as a priority in an organization and for training delivery to be effective, it must be managed in a professional manner. Those responsible for assuring that the program meets the needs of the organization, while also looking out for the safety of department personnel, should be experienced in fire and EMS services and specifically trained in the planning, management and administration of fire service training programs.

The TFD training program is conducted under the direction of a battalion chief (BC) - training. The BC-training has been in the position for only one year, and has 28 years of service time with the TFD. A captain is also assigned to the training program.

The BC-training is charged with additional duties, as well. Specifically, he serves as the department's safety officer, as well as PIO. Further, there are times that the training officer is used in other capacities, as needed, which is viewed as sometimes compromising his ability to complete his regularly assigned work.

The training officer brings many years of quality experience to the position in addition to numerous certifications and extensive in-service training. We found that the training officer is highly knowledgeable and capable, and puts a great deal of effort into running an effective training program. ESCi recommends that all personnel assigned to the training function receive specific education in the operation of training programs, including the National Fire Academy Training Program Management courses.

Financial resources for funding additional training personnel are limited. In an effort to mitigate the need, the department takes advantage of regionalized training opportunities when available, including quarterly Zone III drills and active participation in the County Training Officers

Association. Continued involvement in regionalized training is encouraged and development of additional shared training opportunities is recommended. A cooperative effort toward joint operation of training programs is highly recommended and will be discussed in detail later in this report.

The size of the TFD organization, along with the critical importance of training with regard to both safety and quality of service delivery, suggests that additional staffing should be provided in the training division. It should be noted that the training officer is, to some extent, assigned additional duties outside of his training role due to administrative personnel limitations of TFD. This can divert efforts from training mandates and quality improvement. We recommend that the City add an additional trainer in the training division. This addition would allow for expansion and more *hands on* specialization in the training program. The addition of another trainer would provide the training officer some time capacity to do more long-term and strategic planning for this very essential and vital program

Training Scheduling

Tukwila Fire Department schedules training on a regular and ongoing basis. An internal web site details scheduled training sessions and assignments. Training subjects are prescribed by the training officer and posted on the training web site where the company officers are able to go to obtain their training directives. A calendar also details each day's scheduled training and provides instructions on assigned times and locations for sessions.

Facilities

Tukwila's classroom facilities are limited. The Station 51 meeting room is currently the best suited for classroom training, but it is not ideal in providing a quality learning environment. In addition, the station is poorly located, from a response coverage standpoint for the crews from the other stations attending training functions, and as result is not used a great deal for the reasons mentioned.

Due to coverage and facilities in the other stations, Station 54 is generally used for joint crew training. The station is used because it is centrally located in the coverage area and compromises response times the least. It is, however, very poorly configured for training. Classes have to be held in the crew quarters, using the kitchen table and moving furniture

around to add extra chairs. On the day of our site visit, a class was being held with 18 people in the kitchen and day room area, clearly too small for effective training delivery.

The department does not have a training ground or drill sight. A few small props have been constructed behind Station 54, but beyond that, there is no training tower, live fire burn room or other necessary training facility. Other agencies in the area have training sites and they are used by TFD at times. However, maintaining response coverage to the City and availability of the facility limits its use. As a result, certain training is generally conducted in parking lots or public streets.

Recommendations:

Provide additional and focused training and management courses, such as the National Fire Academy program for personnel in the training division.

We recommend that an additional training position be added to the training division.

When replacing a facility, we recommend that a training tower and live burn facility be included.

Training Procedures, Manuals, and Protocols

Training programs are best organized around a training plan and a training operations manual that serves to establish a foundational basis from which the departmental training is delivered. Training manuals, lesson plans, and performance standards assure that all personnel are receiving the same information and developing similar skills.

The department established training objectives that are organized in a training objectives book. There is not, however, a training operation manual that defines, in detail, the way in which the program is administered, program goals and objectives, and specific individual and company training standards and requirements. The training officer is reviewing several training manuals from neighboring jurisdictions with the goal to establish a similar document for TFD.

Recommendation:

- Develop a department training manual that details the operation, standards, and requirements of the training program.

Record Keeping and Clerical Support

Training records are a vital resource with which the department can measure program effectiveness, develop long-range training and education plans, as well as a means by which they can gather information that is useful in developing division reports, applying for grants, and documenting data on safety and other practices that may be invaluable in the event of a legal challenge.

The department's training record keeping is only partially computerized, with a considerable amount of information maintained in paper files. Training logs and rosters are completed in hard copy by the station crews. Those records go to the training office and are manually entered into an electronic training file.

TFD uses an internally developed software program called Firelink© for much of their inter-station data management, including scheduling of training. It is not used, however, for records management. The *Fire RMS* program, a multi-faceted, integrated fire service software package, has been purchased by the City, and is in limited use due to some technical issues with inter-station connectivity. The training portion of *Fire RMS* is not being use at all, at this time.

Training records management is in need of further development. More effective means of recording training activity need to be established, and more effective use of available records management software should be implemented. ESCi recommends a review of current training records management practices. In addition, we recommend the implementation of the training module in the *Fire RMS* program.

To accommodate adequate and accurate training records management, the training function needs administrative and clerical support. The training division has no assigned clerical support function; however the department secretary is available to assist, on an as-available basis

Recommendations:

Review and improve training data recording practice.

Implement use of the *Fire RMS* software training program module.

Task Seven: Capital Assets

Fire departments need a balance of three basic resources to successfully carry out their emergency mission - 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, the department will fail to execute its mission if it lacks sufficient fire apparatus distributed in an efficient manner.

Facilities

When the determination has been made the fire department has outgrown its facilities, a variety of considerations need to be taken into account. The solutions are more complicated than constructing new facilities and purchasing a fleet of fire trucks. While volunteer, career, and even combination departments have different facility requirements, there are basic needs each fire station has to address; more specifically, quick response time and housing of apparatus and equipment. Everything else depends on a particular department's budget and needs.

Consideration should be given to the ability of the facilities to support the department's functions as it may exist today and in the future. The primary functions that should take place within the fire station environment should be closely examined; adequate, efficient space for all functions should be provided. Examples of these functions may include:

- Housing and cleaning apparatus and equipment
- Residential living for on-duty crew members (male and female)
- Administrative office duties
- Firefighter training/library area
- Firefighter fitness area

While this list may seem elementary, the lack of dedicated space compromises the ability of the facilities to support these functions and can detract from its primary purpose. The department's stations do not adequately meet all of the fundamental needs listed above. Station 51 administrative and living areas are cramped, training facilities are limited, and vehicles are stored outside due to lack of space.

The problem of storage and adequate office/administrative space will be compounded, should

additional staffing and equipment recommendations made by ESCi be added in the future.

Recommendation:

Complete a space needs assessment on all TFD facilities.

The following evaluation and general condition assessment was conducted.

Figure 20: Station 51 Observations

Station 51- 444 Andover Park East 	Originally built in 1970, this station serves the City's central business area. It is of primarily masonry and consists of four apparatus bays and additional staff vehicle parking. The station houses a structural fire engine, a technical rescue unit, and hazardous materials response vehicle, along with a number of staff and support vehicles. The building includes sleeping quarters for on-duty personnel, with a kitchen and living area and a training and meeting room. All of the department's administrative offices are located in this building. Office space is very limited and cramped. Apparatus bays and the living quarters provide limited space and the kitchen is located remotely from the sleeping quarters and day room. Several vehicles are stored outside of the building due to lack of bay space. Building shows numerous indications of deferred maintenance. The site is near to the core service area having good access to main arteries.
Design	This station is designed to house four vehicles in drive-through apparatus bays. Parking is adequate on the east side of station, accommodating training and meeting attendees. Public access is readily available to the office area and the meeting room.
Construction	Building is of concrete block construction with a concrete floor. Four overhead doors are on the building front and four on the rear. Roof is flat and its condition was not observed. Fire prevention and training space was added, along with the conference room in 1990.
Safety	Building is protected with fire sprinklers and with smoke detection and a central alarm system. The apparatus bay aprons are large enough to accommodate safe maneuvering. Two fire poles are used rarely but still in place, presenting a potential safety hazard. The structure has not received siesmic upgrades.
Environment	There is an exhaust removal system in the building. Building is reported to be noisy and concerns have been expressed regarding air quality.
Code Compliance	Building is ADA compliant. Building received seismic updates with the 1990 additions. Materials are stored in the electrical room in violation of codes.
Staff Facilities	This facility has several offices and a conference room. Office space is inadequate. Kitchen and day room are in separate areas, quarters for the on duty battalion chief are cramped. Crew quarters are not mixed gender appropriate.
Efficiency	Building appears to be marginally energy efficient.

Figure 21: Station 52 Observations

Station 52 – 5900 S 147th Street

Station 52 is a very small, two bay station that is comprised of wood frame and masonry construction. This station houses one structural fire engine and one reserve engine. The station was built in 1970 and was one of the two original City fire stations.

Sleeping quarters are provided for three on-duty personnel, with a kitchen and living area.

Apparatus bays and the living quarters are small with no room for future expansion. Office space is limited to the captain's sleeping area. Parking and access for the public is adequate. The building received an ADA update and partial remodeling in recent years. Building condition is fair, with signs of aging.

This station is located in a primarily residential area and positioned to provide primary backup coverage TFD's other station response areas.

Design	This station is designed to house two vehicles in two back-in only apparatus bays. Parking is adequate on one side of station for public access. No meeting room is present.
Construction	Building is of wood frame construction with a composite asphalt roof. The floors are concrete throughout. Two overhead doors are metal.
Safety	Building is protected with fire sprinklers in the apparatus bays only, which is monitored. Only local smoke detection, without a central alarm system are present. The apparatus bay aprons enter directly onto the street, with inadequate refuge from traffic for safe backing. There is no emergency backup power.
Environment	There is an exhaust removal system in the building.
Code Compliance	Building is ADA compliant. Building has not received seismic updates.
Staff Facilities	This facility has only one small office, in the captain's quarters. Day room, kitchen and sleeping areas are quite small. There is no room for future expansion or additional staffing.
Efficiency	Building appears to be moderately energy efficient.

Figure 22: Station 53 Observations

Station 53 – 4202 South 115th Street

Station 53 is the department's newest station, built in 1998. It is of wood frame construction and houses two fire engines in two drive-through apparatus bays.

Crew quarters include individual sleeping rooms for up to six personnel, with a current staffing level of four. The living area includes an adequate kitchen and good-sized day room area. There is also a large exercise room and office space.

The apparatus bays are adequate for the two vehicles and unused bay space is used for storage of an air trailer.

The building is disability accessible. The structure's condition is good.

Design	This station is designed to house two vehicles in a drive through bay configuration. It is of contemporary, single story design, intended to blend with the residential nature of the neighborhood. Parking is adequate on one side of station for public access.
Construction	The building is of wood frame construction. The floors are concrete throughout and large, double width aluminum doors are placed on the front and the rear of the bay area. The roof is asphalt composition and appears to be in good condition.
Safety	The station is fully sprinklered and has a centralized fire alarm system. The only emergency power is provided by a small portable generator that does not adequately support the building in the event of a power failure.
Environment	There is an exhaust removal system for the fire engines. Living areas are clean and comfortable.
Code Compliance	The building is ADA compliant.
Staff Facilities	This facility has plentiful living space, with some room for expansion. Living quarters, office areas and apparatus bays are modern and well designed.
Efficiency	Building appears to be reasonably energy efficient.

Figure 23: Station 54 Observations

Station 54 - 4237 S 144th Street

Station 54 is a smaller, two bay station which is located in the primarily residential Foster area. It is of both wood frame and masonry construction. This station houses one aerial ladder truck and two aid cars (ambulances), one of which is in reserve.

Sleeping quarters are provided for up to eight on-duty personnel, currently staffed with six, at full staffing. The building features a kitchen and living area which is good sized for its intended use. The kitchen area is also used for a training room for multiple companies, and is undersized for that purpose.

The apparatus bays provide adequate space for the two vehicles. A single office is in the front of the building, with sufficient parking and access for the public.

The building is disability accessible and two genders appropriate.

Design	This station is designed to house two vehicles in one back-in and one drive-through apparatus bay. Apparatus bay space is very limited. The building was updated and remodeled in 1990 and provides comfortable living quarters for on duty crews.
Construction	The residential portion of the building is of wood frame construction and the apparatus bay area is masonry. The floors are concrete throughout and two overhead doors on the front and one on the rear are wood. The roof is asphalt composition and appears to be in fair condition.
Safety	The building has fire sprinklers throughout and a central fire alarm system. Emergency power is provided only by a small portable generator, wich is inadequte to provide back up power, given the size of the building. The structure has not received siesmic upgrades.
Environment	There is an exhaust removal system.
Code Compliance	The building is ADA compliant. Building has not received seismic updates.
Staff Facilities	This facility has only one small office. Kitchen and day room are adequate. The builiding is configured for two gender use. The station, while used as the primary training location, lacks adequate space for training activities.
Efficiency	Building appears to be reasonably energy efficient.

Long range planning for the maintenance and replacement of fire stations is critical. Too often, fire departments fail to plan for, or are unable to finance, the considerable cost associated with replacing fire stations. As a result, organizations often find themselves burdened with aging building that they are unable to improve or replace. Deferred maintenance issues are apparent in most of the department's stations. Facility maintenance is managed via a City facility maintenance fund, and is not under direct control of the fire department. ESCi supports the effort of TFD to acquire funds for day to day maintenance items and for minor repairs.

TFD is confronted with just this concern. No long-term replacement plan has been established for the replacement of their fire stations and Stations 51 and 52, in particular, will be in need of substantial upgrading or replacement in the near future. We are concerned about the department's ability to meet these facility demands and recommend that the City conduct a detailed assessment of the current condition of their fire stations and develop a long-range plan for their future repair and/or replacement.

Recommendations:

Conduct a thorough review of the condition and projected service life of the existing fire stations.

Develop and a capital facilities replacement plan and determine funding mechanisms.

Vehicle Replacement Plan

Fire apparatus are typically very unique and expensive pieces of equipment, often very customized to operate efficiently in a narrowly defined mission. A pumper may be designed such that the compartments fit specific equipment and tools, with virtually every space on the truck designated in advance for functionality. This same vehicle, with its specialized design, cannot be expected to function in a completely different capacity, such as a hazardous materials unit or a rescue squad. For this reason, fire apparatus is very expensive and offers little flexibility in use and reassignment. As a result, communities across the country have sought to achieve the longest life span possible for these vehicles.

Unfortunately, no mechanical piece of equipment can be expected to last forever. As a vehicle ages, repairs tend to become more frequent, parts more difficult to obtain, and downtime for

repair increases. Given the emergency mission that is so critical to the community, this factor of downtime is one of the most frequently identified reasons for apparatus replacement.

Because of the large expense of fire apparatus, most communities have efforts in place to plan ahead for the cost of replacement. To properly do so, communities often turn to the long-accepted practice of establishing a life cycle for the apparatus that result in a replacement date being anticipated well in advance. Many communities set aside incremental funds during the life of the vehicle so replacement dollars are ready when needed.

TFD has proposed a vehicle replacement plan in the past; however the plan was not adopted by the City. As a result, the department does not maintain a formal schedule that places all apparatus on any specified replacement cycle from date of primary service.

A formal replacement program typically works fine for the purpose of fiscal planning, but selecting the life cycle of apparatus can be very difficult. This decision is influenced by the following factors:

- Actual hours of use of any specific piece of equipment can vary significantly in comparison to other similar apparatus even within the same fire department. Attempts to shuffle like apparatus among busy and slower fire stations to more evenly distribute hours of use have proven difficult. Frequent changes in apparatus create familiarity and training challenges. In addition, certain response areas may have equipment and tool requirements that are not in common with others.

- Actual hours of use, even if evenly distributed, do not necessarily equate to intensity of use. As an example, a pumper making mostly emergency medical responses will not age as rapidly as a pumper with a high volume of working fire incidents that require intense use of the pump or hydraulics. Likewise, road mileage can also be a poor indicator of deterioration and wear.

- Technology, which is increasingly a factor in fire equipment, becomes outdated even if the apparatus wear is not as significant. In some departments, crews at different fire stations deal with widely different technology on their pumpers based simply on age of the equipment. Like steam engines and modern electric locomotives, these differences can be significant, affecting everything from safety and lighting systems to automated digital pump pressure controls to injection foam generation.

NFPA 1901: Standard for Automotive Fire Apparatus is a nationally recognized industry standard for the design, maintenance, and operation of fire suppression apparatus. The issue of replacement cycles for various types of apparatus has been discussed in the committee that

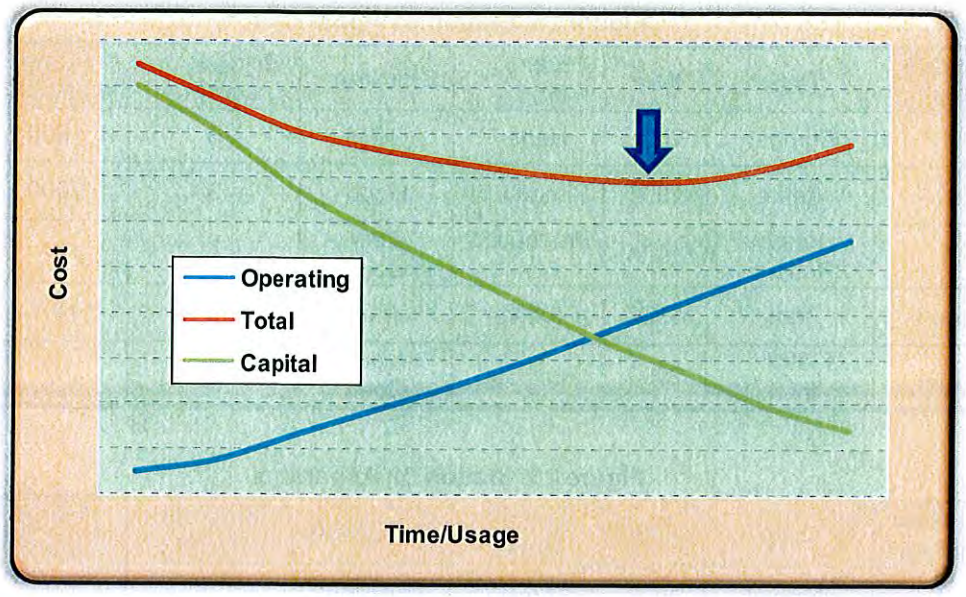
develops the standard for many years. In developing its latest edition, the committee calls for a life cycle of 12 years in front-line service and five years in reserve status for engines, and 15 years in front-line service and five years in reserve status for ladder trucks.

Does this mean that a fire engine cannot be effective as a front-line pumper beyond 12 years? A visit to some departments in the United States might prove otherwise. Small, volunteer fire departments with only a hundred or so calls per year often get up to 25 years from a pumper, though the technology is admittedly not up-to-date. Likewise, busy downtown city fire stations in some urban communities move their engines out of front-line status in as little as eight years.

The reality is that it may be best to establish a life cycle that would be used in the development of replacement funding for various types of apparatus, while applying a different method for actually determining the replacement date in real life in an effort to achieve greater cost efficiency where possible.

A conceptual model that may be used when a replacement cycle is considered is the *Economic Theory of Vehicle Replacement*. The theory states that, *as a vehicle ages, the cost of capital diminishes and its operating cost increases*. The combination of these two costs produces a total cost curve. The model suggests the optimal time to replace any piece of apparatus is when the operating cost begins to exceed the capital costs. This optimal time may not be a fixed point but rather a range over time. The flat spot at the bottom of the total curve in the following figure represents the replacement window.

Figure 24: Economic Theory of Vehicle Replacement



Shortening the replacement cycle to this window allows for an apparatus to be replaced at optimal savings to the department. If agencies do not routinely replace equipment in a timely manner, the overall reduction in replacement spending can be offset by a steep increase of maintenance and repair expenditures. Officials who assume that deferring replacement purchases is a good tactic for balancing the budget need to understand that two events may occur:

1. Costs are transferred from the capital budget to the operating budget
2. Such deferral may increase overall fleet costs

Regardless of its net effect on current apparatus costs, the deferral of replacement purchases unquestionably increases future replacement spending needs.

Tukwila Fire Department currently maintains a fleet of five engines (pumpers), two aerial ladder trucks, and two EMS Aid Cars, along with a number of support and special purpose vehicles. The following figure provides a summary of the front line apparatus used to deliver service.

Figure 25: Station 51 Apparatus

Apparatus Designation	Type	Year	Make / Model	Condition	Minimum Staffing	Pump Capacity	Tank Capacity
E 51	Pumper	2001	Darley	Good	3	1500	500
L 541	Aerial	1992	Simon LTI	Good	3	2000	300
R 51	Heavy Rescue	1996	International	Very Good	1	NA	NA
Explorers	Van	1992	Ford van	Fair	1	N/A	N/A
Haz Mat	Flatbed truck	2993	Ford 550	Very Good	1	NA	NA

Figure 26: Station 52 Apparatus

Apparatus Designation	Type	Year	Make / Model	Condition	Minimum Staffing	Pump Capacity	Tank Capacity
E 52	Pumper	2006	Ferrara	Excellent	3	2,000	500
E 521	Pumper	1994	Darley	Good	3	2,000	500

Figure 27: Station 53 Apparatus

Apparatus Designation	Type	Year	Make / Model	Condition	Minimum Staffing	Pump Capacity	Tank Capacity
E 53	Pumper	2007	Ferrara	Excellent	3	2,000	500
E 531	Pumper	1999	Darley	Good	3	2,000	500
Air 53	Air trailer	2005	Air Trailer	Excellent	1	N/A	N/A

Figure 28: Station 54 Apparatus

Apparatus Designation	Type	Year	Make / Model	Condition	Min. Staffing	Pump Capacity	Tank Capacity
L 54	Aerial Platform	2006	Pierce	Excellent	3	2,000	150
Aid 54	Aid Car	1998	Ford Road Rescue	Fair	3	N/A	N/A
Aid 541	Aid Car	1991	Ford Ambulance	Poor	2	N/A	N/A

Note: minimum staffing listed above is applicable only when those pieces of equipment are in service. Some vehicles listed are in reserve and are not staffed until put into use.

TFD has established the following schedule for apparatus service lives:

- Pumpers (engines) – 15 years (10 front line and 5 reserve)
- Ladder trucks – 15 years (10 front line and 5 reserve)

The following table provides an overview of the life expectancy and replacement costs for the department's apparatus. Since apparatus costs have accelerated faster than the cost of living, ESCi recommends using a 2.84 percent inflation factor, based on the Seattle CPI-W, to project fire apparatus replacement costs.[10] Replacement values have been calculated by using vehicle cost information consistent with the department's most recent purchases. The most recent engine cost was $525,000, including equipment.

Figure 29: Apparatus Replacement Costs Schedule

Unit	Year	Life Expectancy	Replacement Cost in Today Dollars	Annual Contribution Payment	Annual Funding Accrual
E 51	2001	15	$525,000	$35,000	$245,000
E 52	2006	15	$525,000	$35,000	$70,000
E 521	1994	15	$525,000	$35,000	$490,000
E 53	2007	15	$525,000	$35,000	$35,000
E 531	1999	15	$525,000	$35,000	$315,000
L 54	2006	15	$1,075,000	$71,666	$143,332
L 541[11]	1992	15	N/A	N/A	N/A
Aid 54	1998	13	$135,000	$10,385	$103,850
Aid 541	1991	13	$135,000	$10,385	$135,000
Rescue 51	1996	20	$175,000	$8,750	$105,000
		TOTALS	**$4,145.000**	**$276,186**	**$1,642,182**

As the table shows, to annually fund the capital replacement schedule, $276,186 needs to be set aside annually. The total capital replacement fund should have $1,642,182 now in order to meet the replacement life expectancy requirements.

Recommendations:

Continually review and evaluate current fire apparatus conditions and determine life expectancy and replacement based on current conditions.

Adopt and fund a long-range apparatus replacement plan to meet the projected replacement schedule.

[10] Consumer Price Index - All Urban Consumers, Series Id: CUURA423SA0, CUUSA423SA0, Seattle-Tacoma-Bremerton, WA.

[11] Replacement time will be determined by TFD.

Task Eight: Fire Prevention/Public Education Programs

Background

When evaluating fire prevention programs, we review the legal obligations, national standards, and best practices to which fire departments are accountable. Those responsibilities are specified in state laws, local codes, NFPA Standards and Codes, International Building Codes (IBC), International Fire Codes (IFC), and Uniform Electrical and Plumbing Codes. These laws, ordinances, and codes establish the authority and responsibility under which the fire department delivers fire prevention and life safety services. The references usually provide for the promulgation of regulations governing hazardous conditions, fire safety, life safety, and explosives.

Generally, fire prevention activities should include the following:

Fire Code Enforcement

- Proposed construction and plans review
- New construction inspections
- Existing structure/occupancy inspections
- Special risk inspections
- Internal protection systems design review
- Storage and handling of hazardous materials

Fire Safety Education

- Public education
- Specialized education
- Juvenile fire setter intervention
- Prevention information dissemination

Fire Investigation

- Fire cause and origin determination
- Fire death investigation
- Arson investigation and prosecution

Fire Prevention

Aggressive risk management programs, delivered as a part of an active fire prevention program, is a fire department's best opportunity to minimize the losses and human trauma associated with fire. The International Association of Fire Chiefs (IAFC) has defined proactive fire service as:

> *"...Embracing new, proven technology and built-in protection, like automatic fire sprinklers and early detection systems, combined with aggressive code enforcement and strong public education programs."*

A fire department should actively encourage the use of fire resistive construction, built-in early warning and fire suppression systems, as well as strive to develop an educated public, trained to minimize their risk to fire.

The most effective way to combat fires is to prevent them. A strong fire prevention program diminishes loss of property, life, and the personal disruption that accompanies a catastrophic fire. The impacts of fire are significant; it is reported that nearly 50 percent of all small businesses that are forced to close due to fire, never re-open. The economic consequence of a fire is estimated to be 2.5 times the actual damage that the fire causes to a structure and its contents.

Code Enforcement

The TFD is fortunate to be served by a full-time fire marshal and prevention division staff. The fire marshal assisted by three captain level inspectors and one civilian project manager.

It was apparent during ESCi's site visits that the department operates an active fire and life safety code enforcement, inspection, and new construction plans review program. However, due to the amount of new construction projects, combined with the ongoing need to inspect existing occupancies and enforce requirements of the fire code, the prevention office is being challenged to meet the associated demands due to limited manpower resources. The burden is compounded by a very large expansion project at a large shopping mall complex. This project alone is maximizing the capacity of the entire fire marshal's office. To further add to this challenge, the fire prevention offices are cramped with little room for storage of required records and work areas. The lack of space also impacts the training function, since this is a shared area with and the training staff.

The City has adopted and enforces the 2006 edition of the International Fire Code as the basis for its fire and life safety code enforcement programs. The code is supplemented by the adoption of the LPG appendix, as well as a residential sprinkler requirement for residential sprinkler installation that applies to homes that exceed 5,000 square feet in size or present defined access challenges. The department has also adopted a variety of other, well founded, ordinances addressing a number of key fire prevention, hazardous materials and inspection areas.

Residential Fire Sprinkler Systems

The City has included a requirement for the installation of residential fire sprinklers, under certain criteria, by ordinance. Specifically, sprinklers are required in newly constructed homes that exceed defined square footage thresholds or that include certain access challenges. The City has taken a progressive step in adopting these requirements, something that many communities have not done.

Sprinkler systems provide a level of protection that is often misunderstood and overlooked. Although sprinklers are required by code in most *commercial* buildings, eighty percent of the fire deaths experienced each year in the United States occur in *single-family homes*, where sprinklers are rarely required. The installation of residential fire sprinklers in homes is by far the most effective way to prevent the loss of lives and property and is becoming a trend in many communities across the country.

We were encouraged to see that Tukwila has broken new ground with the inclusion of residential sprinklers in their building requirements. ESCi further recommends modifying the requirement by ordinance in the future to include all new residential occupancies, regardless of size, location of other factors.

New Construction Plan Review

An essential component to a fire prevention program is new construction plans reviews. When proposed construction projects are scrutinized for compliance with fire code requirements, the reviewing agency has the opportunity identify critical issues early in the process and assure that they are corrected during construction.

When a new building is proposed within a fire department's boundaries, the structure is going to become the protection responsibility of the department for the building's life. If it is not constructed according to code, it may become a problem for the department in the future. Consequently, the fire department has a fundamental interest in ensuring that a structure is properly built.

The TFD fire prevention staff reviews plans for fire and life safety content for proposed new construction in the City. A sign-off from the fire department is required before a building permit will be issued for a given project. The review is conducted as a collaborative effort in conjunction with the City building department. The fire department assesses a fee for the plan reviews based on an internally developed fee schedule. Inspection fees are not charged. A fee schedule for repeat inspections is in place, but is not being used at this time.

We believe that over time, the timeliness and ability to meet the expectations and demands of the construction industry will be threatened due to limited human resources to perform this highly technical function.

General Inspection Program

Property inspections, designed to identify and eliminate potential fire hazards before an emergency occurs, are an important part of the overall fire protection system.

The recommended frequency for commercial fire safety inspections varies by the type of business. Generally, they are classified by degree of hazard. The table below describes the various hazard classes and the recommended frequency for fire safety inspections by class.

Figure 30: Recommended Frequency of Fire and Life Safety Inspections[12]

Hazard Classification	Example Occupancies	Recommended Frequency
Low	Apartment common areas, small stores, and offices, medical offices, storage of other than flammable or hazardous materials.	**Annually**
Moderate	Gas stations, large (>12,000 square feet) stores and offices, restaurants, schools, hospitals, manufacturing (moderate hazardous materials use), industrial (moderate hazardous materials use), auto repair shops, storage of large quantities of combustible or flammable material.	**Semi-annually**
High	Nursing homes, large quantity users of hazardous materials, industrial facilities with high process hazards, bulk flammable liquid storage facilities, and facility classified as an "extremely hazardous substance" facility by federal regulations	**Quarterly**

[12] Source: National Fire Protection Association.

The importance of effective code enforcement cannot be overemphasized. Without an effective program for regular formal fire inspections and code enforcement, hazardous conditions go unnoticed and uncorrected.

TFD has established an effective fire and life safety code enforcement program; however the effectiveness of the program is compromised due to limited human and technical resources.

The department's goal is to inspect all commercial occupancies, by either engine company crews or fire marshal's staff, on an 18-month rotation schedule. Due to staffing limitations and heavy workloads, however, actual inspection frequency is closer to a 24-month frequency.

For nearly all occupancy types, the first level of inspection work is handled at the engine company level. Engine crews are assigned commercial occupancy inspections in the course of the year, divided between the three shifts and three stations. These crews visit the locations, conduct their inspection, and complete a report of their findings and any follow up that is called for. A first re-inspection, if needed, is completed by the engine crew that made the initial inspection visit. Additional re-inspections are handled by fire marshal's office staff.

Typically, we will see company inspection assignments limited to the low and, at least, some of the moderate risk levels illustrated in the chart above. In the City, however, we understand that all of the occupancy types are inspected initially by engine companies, due to staffing limitations and workload in the fire marshal's office. This raises concern with regard to the training and capability of the engine crews to be able to effectively conduct some of the higher risk, more involved inspections. Engine company crews do certainly have the capability to inspect higher risk level occupancies, but have not received specialized training to conduct the higher risk inspections.

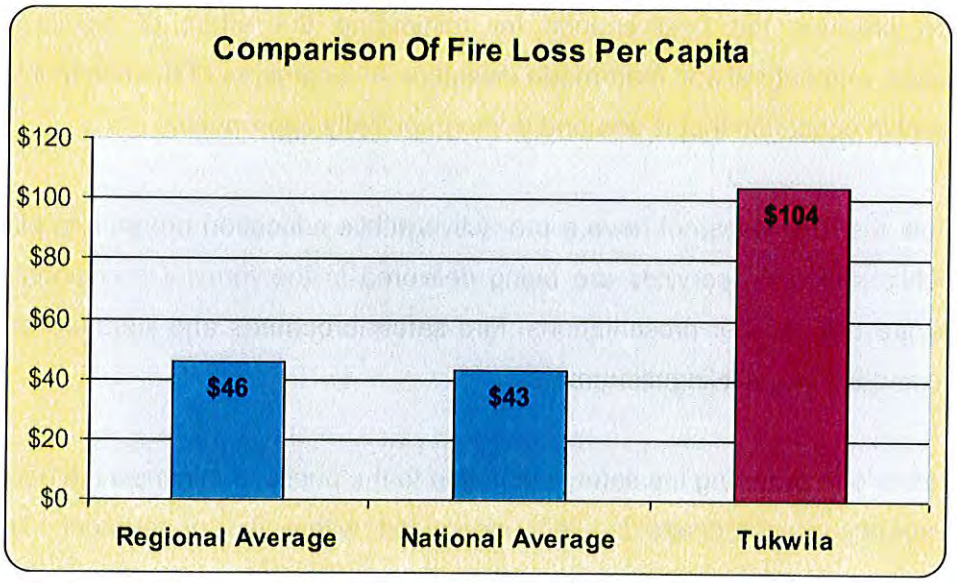
ESCi recommends the practice of engine company inspections be reviewed and the training of the engine crews match the skills and knowledge necessary to conduct higher risk inspections be verified. While we applaud the efforts of the engine companies and the department to provide timely and comprehensive inspections, we are concerned that in some cases, the level of expertise does not match the level of inspection complexities. Further, the engine company's primary purpose is to be available to respond to emergencies and to train in the proficiency of the tasks that must be performed during emergencies. Once again, we are concerned that

although commendable, the company inspection program will potentially degrade other aspects of their operational readiness over time unless additional assistance is provided in the prevention function.

Staffing in the prevention division is inadequate, given the workload and issues discussed above. The burden is especially heavy at this time, given the large construction projects that are under way. In addition, existing occupancy inspections are not receiving the level of attention that they deserve due to the heavy workload. ESCi recommends that additional inspectors be added in the prevention division.

The following figure shows the fire loss comparison for TFD and reportable communities the same size in the western United States.

Figure 31: Comparison of Fire Loss Per Capita[13]



The disparity between TFD and reportable similar size communities can be attributed to the high value and dollar amount of fires that occur in the TFD jurisdiction. Similar size cities have lower fire loss numbers due to less frequent high value loss fire incidents.

[13] This is based on static residential population, not effective population.

Recommendations:

Take steps to increase commercial inspection frequency to an annual or semi-annual inspection cycle.

Review the practice of having line-level crew conduct moderate and high risk inspections and verify their training and capability to perform all risk level inspections.

Increase the number of inspectors in the prevention section, limit company inspections to less complex occupancies, and ensure all company level personnel are trained to the level in which they function.

Consider the use of a contract fire and life safety plan review services to take the load off during busy times.

Public Education Program

Providing fire safety education to the public to minimize the occurrence of fire and emergency preparedness should be a priority for all fire agencies. Given the potential loss to a community, prevention provides the best chance for minimizing the affect of hostile fires, medical emergencies, and natural and man-made disasters. All segments of the community's population should receive education that is age and demographically appropriate.

At this time, the TFD does not have a pro-active public education program in place. Only very limited public education services are being delivered in the form of occasional school group tours and fire extinguisher presentations. Fire safety brochures and literature are available to the public and are in multi-lingual formats.

The importance of providing fire safety education to the public to minimize the occurrence of fire and emergency preparedness is well understood within the department. The chief has, however, been unsuccessful in repeated attempts to staff a public education position. Given the potential loss to a community, prevention and education provides the best chance for minimizing the affect of hostile fires, medical emergencies, and natural and man-made disasters.

Juvenile Fire Setter Intervention

Juvenile fire setter intervention programs are an integral part of an effective fire prevention agenda. National and state statistics have demonstrated that juvenile fire setting is a growing problem, existing in virtually every community, and that juvenile fire setting is often symptomatic of much greater problems. TFD has a high level of sensitivity to the juvenile fire setter issue and

actively processes referrals through the local School Resource Officer program. We commend the efforts in this area.

Recommendations:

Establish a pro-active public education program within the City.

We recommend that a full-time public educator be added in the fire marshal's office to oversee public education and also act as the TFD public information officer.

Fire Investigations

Accurately determining the cause of a fire is essential. In the event of a fire that is started intentionally, of course, prosecution of the responsible offender is critical to prevent additional fires. Identifying the cause of accidental fires is also of great importance. Understanding how accidental fires start is the most effective way to identify fire prevention and public education needs, customizing programs to actual community fire experience.

TFD line personnel perform preliminary fire cause determination at incident scenes. By policy, any fire loss that is estimated to be in excess of $10,000, or is of unknown or suspicious origin, is automatically referred to the fire marshal for investigation. In all other cases, the line crews exercise their judgment to decide whether further investigation is warranted and, if so, the fire marshal is called.

A regional fire investigation team (FIT) is not in place. Experience has demonstrated the considerable value of developing regional teams of this nature, which often prove to be an extremely viable resource, especially in larger, more complex fire investigations. Consideration of a FIT, through the Zone 3 fire services group, is recommended to provide a regional effort and to compound the talent pools of the participating agencies.

Recommendations:

Enhance the level of training for line staff in initial fire scene evaluation and evidence preservation.

Increase fire investigation training for command staff and line officers.

Consider the development of a Zone 3 Fire Investigation Team.

Pre-Incident Planning

Firefighters are often making their first visit to a particular occupancy when they respond to an emergency call. A lack of familiarity with the building can easily cause a firefighter to become disoriented or injured. In order to operate safely and effectively, firefighters must be knowledgeable of a building's floor plan, unique hazards, access issues, and built-in fire resistive features. This can be accomplished via building familiarization tours, development of pre-incident plans, and conducting tactical exercises on-site or by tabletop simulation.

The department has an active pre-incident planning program. TFD staff, however, indicates that the program is ineffective due to staffing limitations. It is estimated by TFD that pre-plan updates are about two years behind schedule. It can be assumed that as workload expands, this very important function may be further compromised.

Recommendation:

Continue with and expand the pre-incident planning efforts. Additional resources and expertise will be required within the prevention/inspection division to provide support and continuity of the pre-plan process and keep pace with the additional workload requirements.

Task Nine: Current Deployment Strategies and Performance

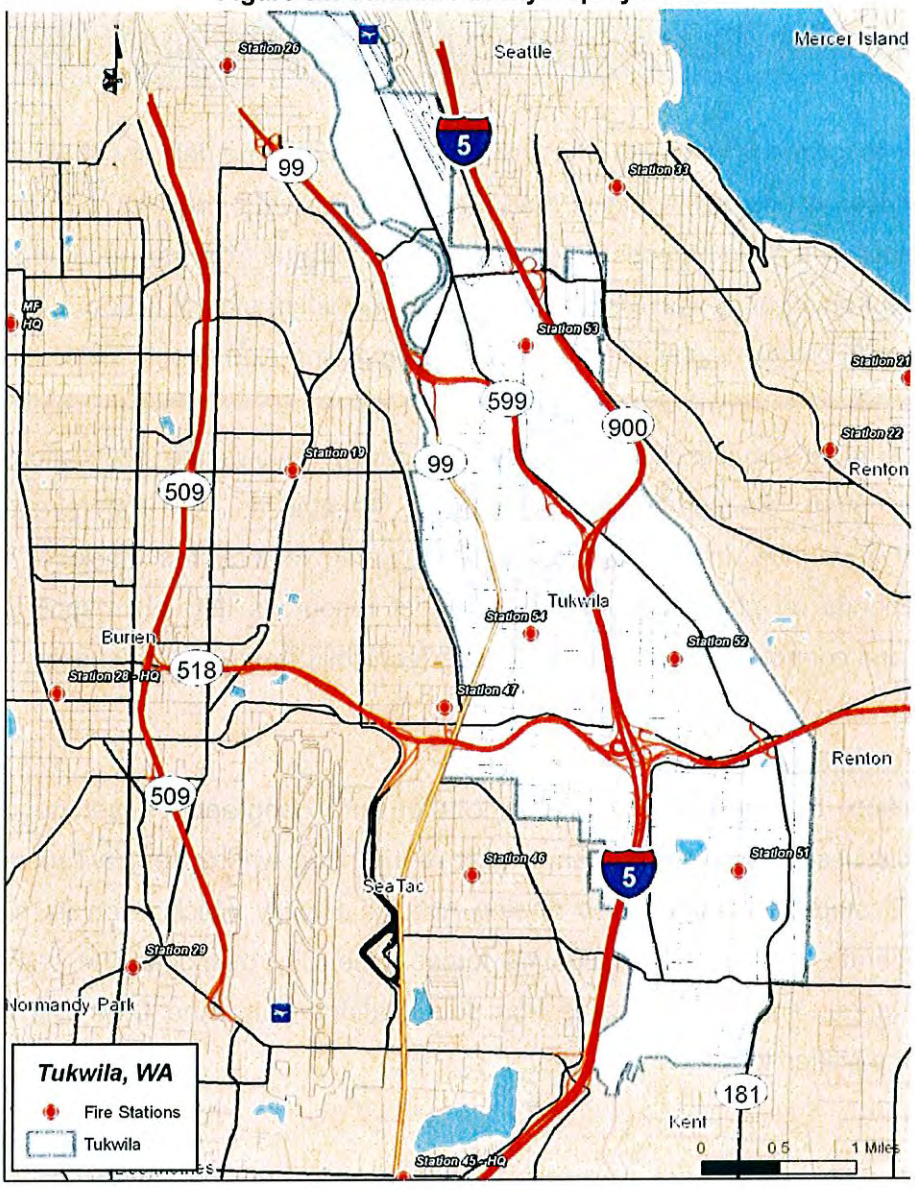
Emergency response is central to what fire departments do. The delivery of fire suppression and rescue services is no more effective than the sum of its parts; requiring efficient notification of an emergency and rapid response by appropriate apparatus from well-located facilities, staffed with sufficient emergency workers who follow an established plan of action. Virtually, all fire and EMS protection programs should focus on providing prompt and effective aid.

A fire department service delivery system evaluation reviews the notification and response system (dispatch), the number and location of fire stations, and the number and type of emergency apparatus. In addition to response-related factors, the efficiency of the delivery system depends on planning for efficient use of resources through mapping, risk analysis, command and control systems, mutual aid, and (very importantly) water supply.

Distribution Analysis

In this section, the department's station location and geographic coverage of its response district is discussed. This urban area is east of the ridge where Seattle/Tacoma International Airport is located and south of the Boeing Aviation Facility which is on its north side. Both facilities operate independent firefighting forces. The City overlooks the valley towards the Cascade Range. The TFD operates from four stations within the City. The following figure illustrates fire station locations.

Figure 32: Tukwila Facility Deployment



Response Time Objectives

The ultimate goal of any emergency service delivery system is to provide sufficient resources (personnel, apparatus, and equipment) to the scene of an emergency in time to take effective action and minimize the outcome of the emergency. This basic goal applies to fires, medical emergencies, and any other emergency to which the fire department responds. Before discussing TFD's current performance, it is important to gain an understanding of the dynamics of fire and medical emergencies.

Dynamics of Fire in Buildings

Most fires in buildings develop in a predictable fashion, unless influenced by highly flammable material. Ignition, or the beginning of a fire, starts the sequence of events. It may take some minutes or even hours from the time of ignition until flame is visible. This smoldering stage is very dangerous, especially during times when people are sleeping, since large amounts of highly toxic smoke may be generated during early phases.

Once flames appear, the sequence continues rapidly. Combustible material adjacent to the flame heats and ignites which in turn heats and ignites other nearby materials, if sufficient oxygen is present. As the objects burn, heated gases accumulate at the ceiling of the room. Some gases are flammable; most are very toxic.

At this phase, the spread of fire continues quickly. Soon, flammable gases at the ceiling reach ignition temperature causing an event termed *flashover,* where all flammable materials in the room ignite. Once flashover occurs, the damage caused by the fire is significant and the environment within the room can no longer support human life.

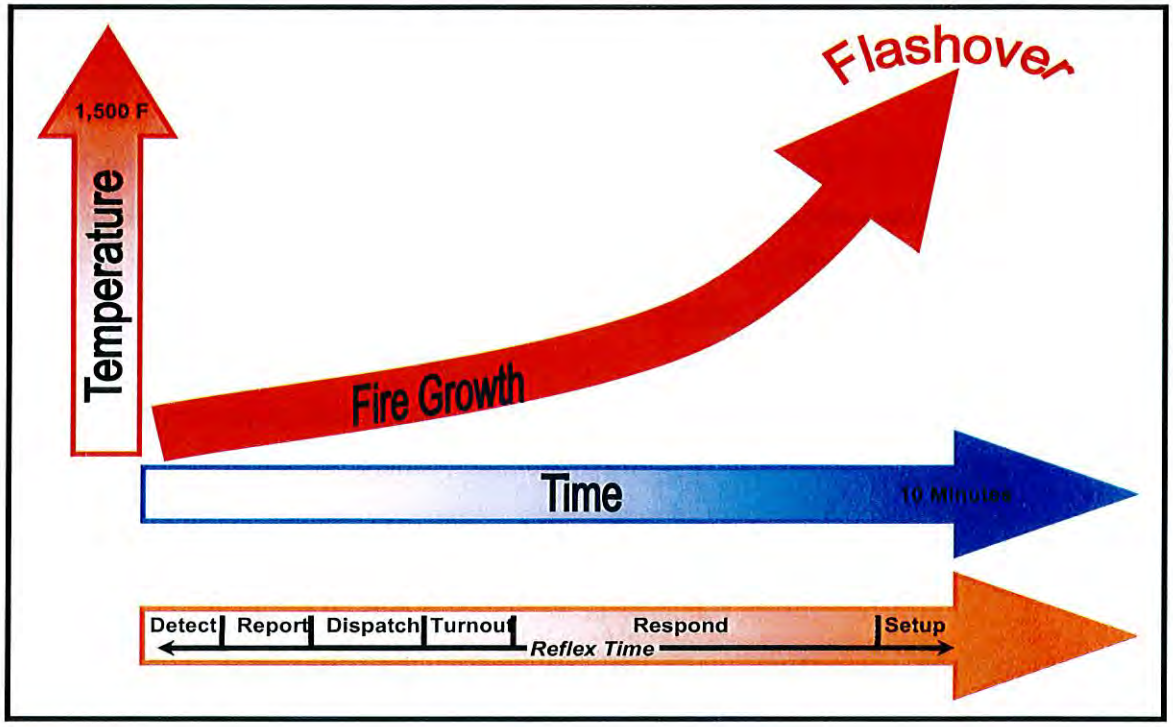
Flashover usually happens about five to eight minutes from the appearance of flame, in typically furnished and ventilated buildings. Since flashover has such a dramatic influence on the outcome of a fire event, the goal of any fire agency is to apply water to the fire before flashover takes place.

Perhaps as important as preventing flashover, is the need to control a fire before it does damage to the building's structural framing. Materials used to construct buildings today are often less fire resistive than the heavy structural skeletons of older frame buildings. Roof trusses and floor joists are commonly made with lighter materials more easily weakened by the effects of fire. Light-weight roof trusses fail after five to seven minutes of direct flame impingement. Plywood I-beam joists can fail after as little as three minutes of flame contact. This creates a very dangerous environment for firefighters.

In addition, the contents of buildings today have a much greater potential for heat production than in the past. The widespread use of plastics in furnishings and other building contents rapidly accelerates fire spread and increases the amount of water needed to control a fire effectively. All these factors make the need for early application of water essential to a

successful fire outcome. A number of things must happen quickly to achieve fire suppression prior to flashover. The figure below illustrates the sequence of events.

Figure 33: Fire Growth vs. Reflex Time



The continuum of reflex time includes six steps, beginning with ignition/detection and concluding with (most commonly) the application of water. The time required for each of the six components varies. The policies and practices of TFD may directly influence four of the steps, but two are only indirectly manageable. The six parts of the continuum are:

1. **Ignition/Detection**: The detection of a fire may occur immediately if someone happens to be present or if an automatic system is functioning. Otherwise, detection may be delayed, sometimes for a considerable period.
2. **Report**: Today, most fires are reported by telephone to a 9-1-1 center. Call takers must quickly elicit accurate information about the nature and location of the fire from persons who are apt to be excited. A citizen well trained in how to report emergencies can reduce the time required for this phase.
3. **Dispatch**: The dispatcher must identify the correct fire units, subsequently dispatch them to the emergency, and continue to update information about the emergency while the units

respond. This step offers a number of technological opportunities to speed the process including computer aided dispatch and global positioning systems.

4. **Turnout**: Firefighters must don firefighting equipment, assemble on the response vehicle, and begin travel to the fire. Good training and proper fire station design can minimize the time required for this step.
5. **Response**: This is potentially the longest phase of the continuum. The distance between the fire station and the location of the emergency influences reflex time the most. The quality and connectivity of streets, traffic, driver training, geography, and environmental conditions are also contributing factors.
6. **Set up**: Last, once firefighters arrive on the scene of a fire emergency, fire apparatus are positioned, hose lines stretched out, additional equipment assembled, and certain preliminary tasks performed (such as rescue) before entry is made to the structure and water is applied to the fire.

Clearly, the application of water in time to prevent flashover is a serious challenge for any fire department. That notion is supported by national research. The National Fire Protection Association studied data from residential structural fires occurring between 1994 and 1998 better understand the relationship between the growth of a fire beyond the room of origin and losses in life and property.

As the table below indicates, fires contained to the room of origin (typically extinguished prior to or immediately following flashover) had significantly lower rates of death, injury, and property loss when compared to fires that had an opportunity to spread beyond the room of origin (typically extinguished post-flashover). Incidents in which a fire spreads from the room of origin are likely to demonstrate six times the amount of property loss, and include a nearly nine times greater chance of fatal injuries. Fires that extend to other floors are even more dangerous.

Figure 34: Table of Fire Growth Compared to Life and Property Loss[14]

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

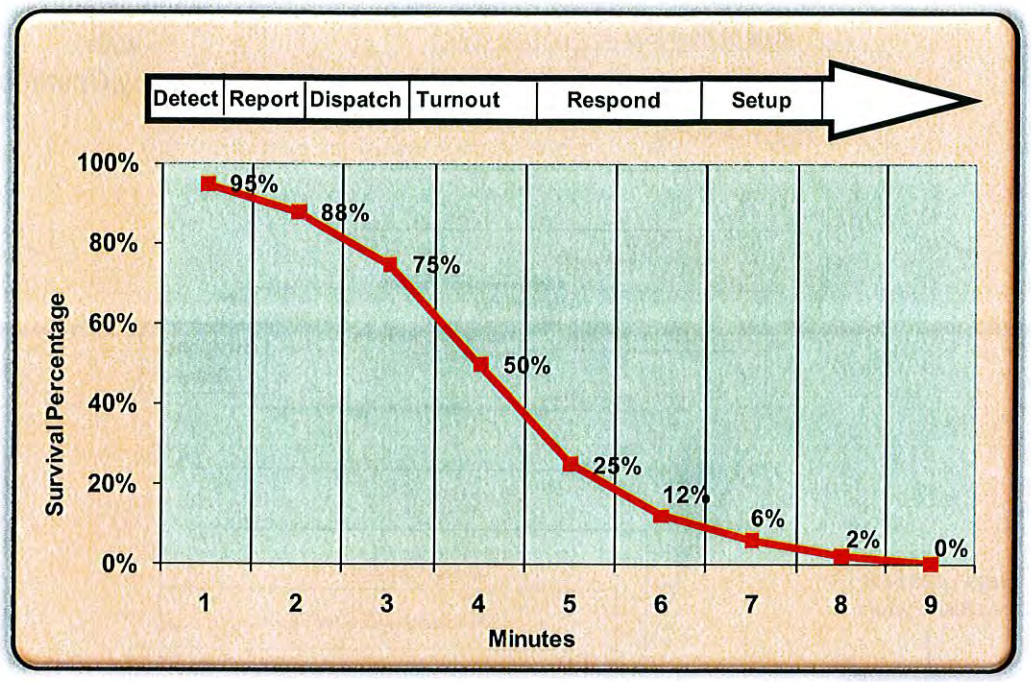
Cardiac Arrest Event Sequence

Cardiac arrest is the most significant life threatening medical event. A victim of cardiac arrest has mere minutes in which to receive lifesaving care if there is to be any hope for resuscitation. The American Heart Association (AHA) issued a set of cardiopulmonary resuscitation guidelines that are designed to streamline emergency procedures for victims of cardiac arrest, and to increase the likelihood of survival. The AHA guidelines include goals for the application of cardiac defibrillation to cardiac arrest victims. Studies show that the chance of surviving cardiac arrest falls by seven to ten percent for every minute between collapse and defibrillation. Consequently, the AHA 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.

[14] Data from NFPA *Annual Fire Experience Survey* and United State Fire Administration *National Incident Reporting System.*

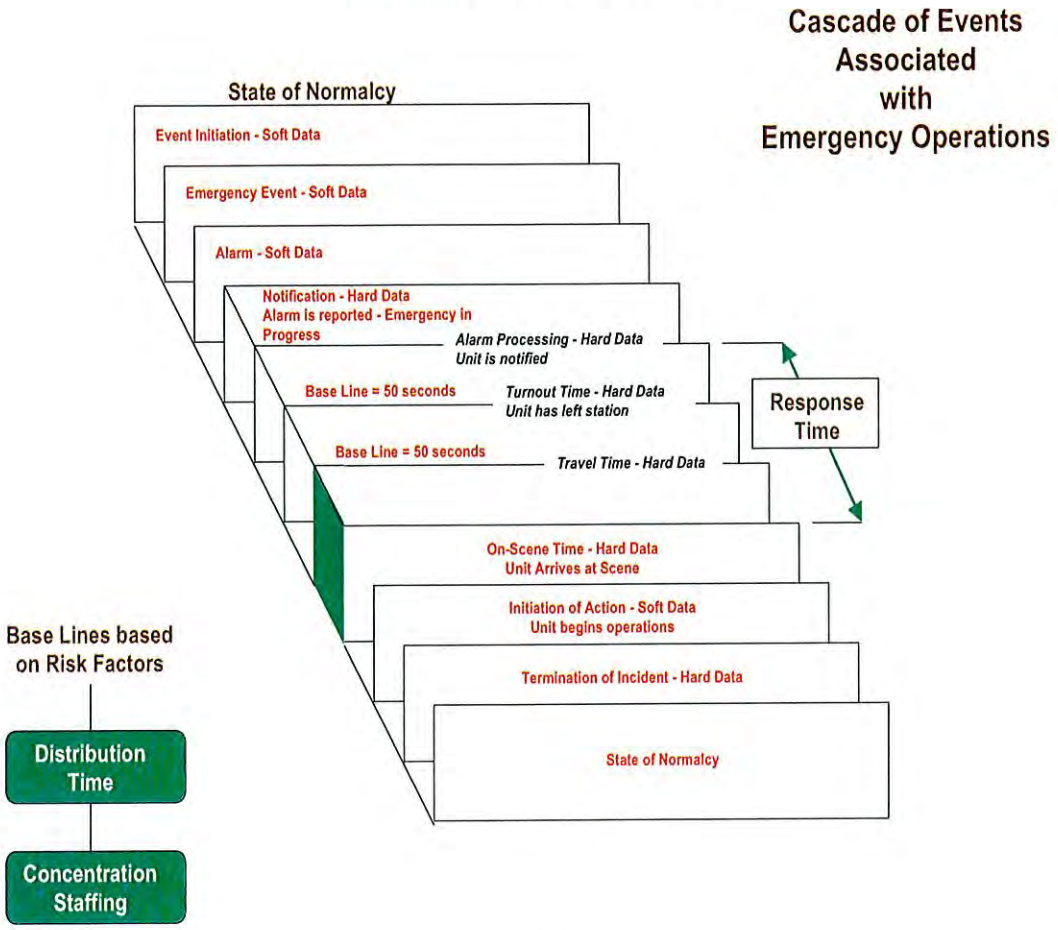
Figure 35: Cardiac Arrest Event Sequence



The percentage of opportunity for recovery from cardiac arrest drops quickly as time progresses. The six stages of medical response leading to mitigation 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. An Oregon fire department recently studied the effect of time on cardiac arrest resuscitation and found that nearly all of their *saves* were within one and one-half miles of a fire station, underscoring the importance of quick response.

The third time element is the passage of time from when either a fire or emergency occurs and the fire service arrives on scene. This is called the Cascade of Events. It illustrates that there are many components of time that must be kept as short as possible if the fire is to be controlled or the patient is to become a survivor.

Figure 36: Elements of Time



People, Tools, and Time

Time matters a great deal in the effective outcome to an emergency event. Time, however, is not the only factor. Delivering sufficient numbers of properly trained, appropriately equipped, personnel within the critical time period completes the equation. For medical emergencies, this can vary based on the nature of the emergency. Many medical emergencies are not time critical. However, for serious trauma, cardiac arrest, or conditions that may lead to cardiac arrest, response time is very critical.

Equally critical is delivering enough personnel to the emergency scene to perform all of the concurrent tasks required to deliver quality emergency care. For a cardiac arrest this can be up to six personnel - two to perform CPR, two to set up and operate advanced medical equipment, one to record the actions taken by emergency care workers, and one to direct patient care. Thus, for a medical emergency the real test of performance is the time it takes to provide the

personnel and equipment needed to deal effectively with the patient's condition, not necessarily the time it takes for the first person to arrive.

Fire emergencies are even more resource critical. Again, the true test of performance is the time it takes to deliver sufficient personnel to begin applying water on the fire, as this is the only practical method to reverse temperature increase and to prevent flashover. The arrival of one person with a portable radio does not provide fire intervention capability and should not be counted as *arrival* by the fire department. In order to enter a building to conduct interior firefighting properly, at least four personnel must be on the emergency scene. Consequently, the department should document the end of the reflex continuum as the time when (at least) four properly trained personnel are assembled at the fire and are ready to take action.

Emergency service agencies should have clearly defined performance objectives established to allow evaluation of capability and service delivery. An organization's performance objectives should clearly state both the current and desired emergency service capabilities in measurable terms. For emergency response, performance objectives should define response performance using both time and resource criteria. For example:

- Provide for the arrival of adequate resources to initiate basic emergency medical services at the scene of any medical emergency within "X" minutes following dispatch, 90 percent of the time.
- Provide for the arrival of adequate resources to initiate interior fire suppression operations at the scene of any fire within "X" minutes following dispatch, 90 percent of the time.

With measurable performance criteria, a fire department can develop deployment methodologies to achieve the desired level of service, and can quickly identify when conditions in the environment degrade performance.

Fire Service Industry Standards and Comparisons

There are a number of other standards and comparisons that can be used to evaluate the capabilities of TFD.

Insurance Rating

The Washington Survey and Rating Bureau (WSRB) evaluate fire protection capabilities of communities within the state. The WSRB uses a 1 – 10 rating scale with Class 1 being the best level of service (and lowest fire insurance premium cost) and Class 10 defined as no service at all.

The WSRB reviews fire protection based on:

- Adequacy of the water system to provide water for firefighting
- The qualifications of the fire department and the resources available to it
- The ability of the public to communicate the existence of an emergency to the department and the department's ability to quickly dispatch response forces
- The quality of the department's fire prevention programs
- Local climate conditions that may affect response

TFD received a Class 3 Washington Survey and Rating Bureau rating in 1990, and has maintained this rating to date.

ESCi cautions focusing system improvements solely to improve the WSRB rating, as this would likely provide little community benefit. In most cases, homeowners received the least expensive fire insurance premium at Class 5. Businesses may see small reductions below Class 5. Larger businesses are rated individually and are not effective by the community's overall rating. The department should consider measures to prevent further degradation of the rating.

National Benchmarks and Comparables

There are a variety of other standards and performance criteria developed by various organizations with an interest in fire and emergency services. The chart that follows lists a number of them.

Figure 37: National Benchmarks and Comparables

National Standard or Comparison	Organization	Tukwila Fire Department
Minimum effective company staffing is 4 firefighters	Dallas FD Study, Seattle FD Study, NFPA Standards, Federal OSHA	Met in some cases depending on daily staffing. Current staffing levels for engines is 3 or 4 firefighters
Engine company within 1.5 miles of built upon areas	Washington Survey and Rating Bureau	Met
Ladder truck within 2.5 miles of built upon areas	Washington Survey and Rating Bureau	Met
Staffed ladder truck if five or more buildings exceed 35' high	Washington Survey and Rating Bureau	Met
Average fire ground staffing to be 15 firefighters for moderate risk fires (single family residential) and up to 53 for high risk fires (industrial, high risk unprotected residential, etc.)	Center for Public Safety Excellence (International Association of Fire Chiefs)	The department is able to deliver sufficient personnel for high risk fires using duty staff and automatic aid
National average of on-duty personnel = 0.48 per 1,000 population	International City/County Management Association	Met
Average number of firefighters per 1,000 population in the western United States = 1.6	National Fire Protection Association	Current strength is 3.13 per 1,000 population[15]
Arrive at structure fire prior to flashover (typically 5 to 7 minutes from ignition)	FEMA, National Fire Academy	No stated performance standard adopted
Arrive at EMS call within 4 to 6 minutes of cardiac or respiratory arrest	American Heart Association	No stated performance standard adopted

NFPA 1710

The National Fire Protection Association (NFPA) issued a performance standard for fire departments comprised of all (or nearly all) career firefighters. The stated purpose of the standard is:

> "... [T]o specify the minimum criteria addressing the effectiveness and efficiency of the career public fire suppression operations, emergency medical service, and special operations delivery in protecting the citizens of the jurisdictions and the occupational safety and health of fire department employees."[16]

NFPA 1710 (among other things) identifies response time goals for fire and medical emergencies and a staffing standard for structure fires. Although the standard is not a legal mandate, it does provide a useful benchmark against which to measure the performance of a

[15] This figure does not include effective population number.

[16] NFPA 1710, *Standard for the Deployment of Fire Suppression Operations, Emergency Medical Operations, and Special Operations to the Public by Career Fire Departments*, 1.2.1, 2004 Edition.

career-based response system. To help understand the context of the analysis that follows this discussion, each performance standard is presented individually here.

NFPA 1710 establishes that a response *company* consists of four personnel. Not all four are required to be on the same vehicle; however, it is expected that the four will operate as a single functioning unit once on scene. Further, the standard recommends that the first company arrive at the scene of a structure fire within five minutes of dispatch, 90 percent of the time. NFPA uses the 90th percentile rather than average to assure a consistently high level of service. The standard also requires that all four personnel be on scene within the recommended five minutes, 90 percent of the time.

Safety regulations provide yet another reason to assemble at least four personnel at the scene of a structural fire quickly. As mentioned earlier, current laws require that before interior fire suppression may occur at least two personnel must be on the emergency scene and assigned to conduct search and rescue in case the fire attack crew becomes trapped or injured. This is referred to as the *two-in, two out* rule. The only exception allowed is if victims are known to be trapped inside the building, suppression effort may begin immediately.

Given TFD's typical staffing of engines, the time it takes for the second unit to arrive becomes very important to the achievement of the NFPA standard. If additional help is distant, the fire will continue to grow and rapidly contribute to the damage.

Finally, the NFPA standard specifies that the entire initial assignment (sufficient apparatus and personnel to combat a fire effectively, based on the level of risk) should arrive within nine minutes of dispatch, 90 percent of the time. This is to ensure that sufficient firefighters and equipment arrive soon enough to be effective in controlling a fire before substantial structural damage occurs.[17] *NFPA 1710* describes the following criteria as meeting the structure fire response standard:

- Turnout time within one minute, 90 percent of the time
- Arrival of the first fire company within five minutes of dispatch, 90 percent of the time
- Arrival of the entire initial response assignment (all units assigned to the call) within nine minutes of dispatch, 90 percent of the time

[17] See previous discussion about the *time/temperature curve* and the *effects of flashover*.

There are three time standards within *NFPA 1710* for emergency medical responses. They are:

- Turnout time within one minute, 90 percent of the time
- Arrival of a unit with first responder or higher level of capability (basic life support) within five minutes of dispatch, 90 percent of the time
- Arrival of an advanced life support unit, where this service is provided by the agency, within nine minutes of dispatch, 90 percent of the time

Resource Distribution Analysis

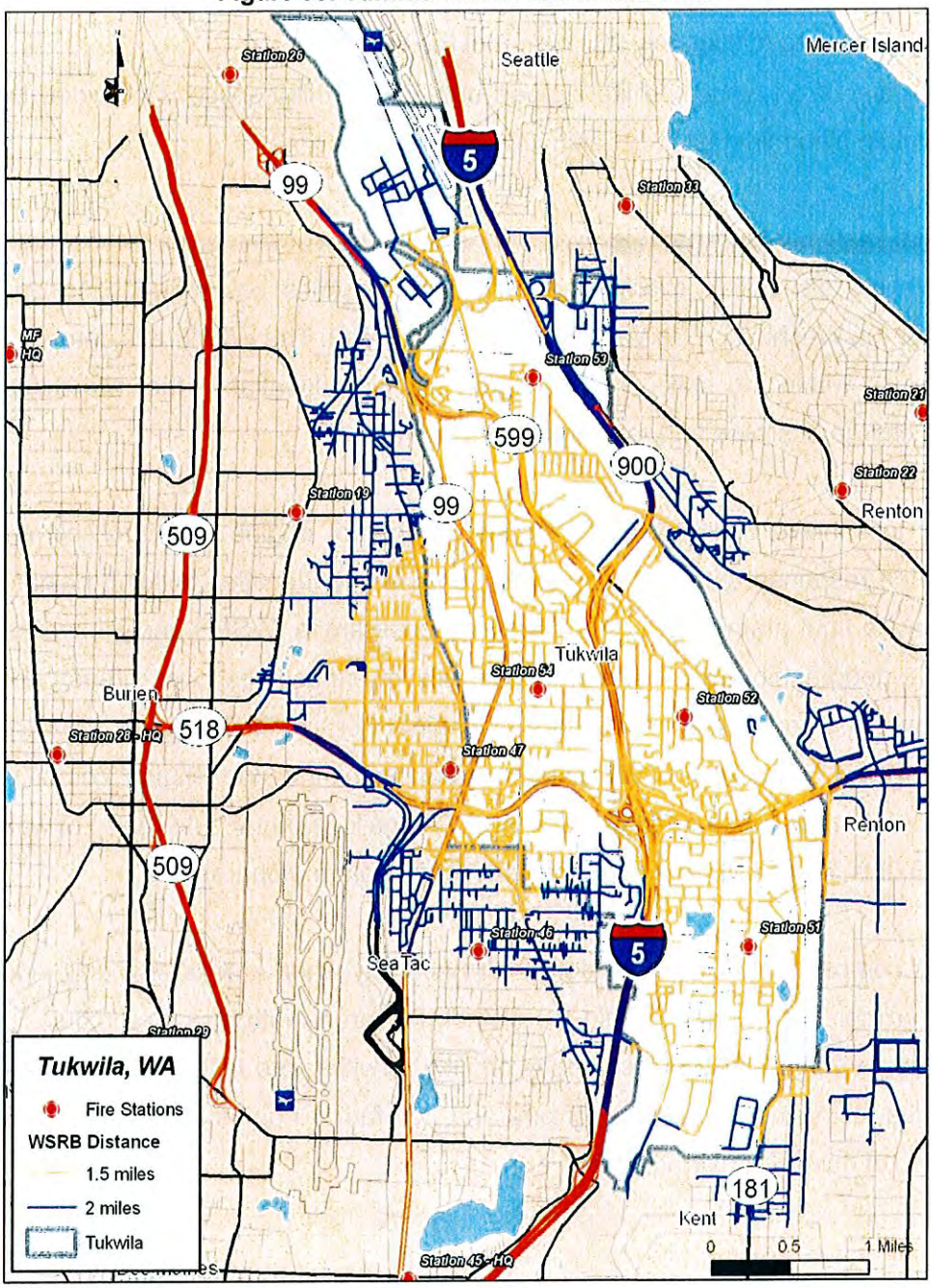
The following discussion examines the fire department's coverage based on credentialing criteria for the Washington Surveying and Rating Bureau. The WSRB evaluates fire protection in communities within the state of Washington and is influential in the rate determination that insurers charge business and residential customers.

In order to achieve optimum credit for the number of engine and truck companies, WSRB reviews the response area of each existing engine and identifies building heights and needed water flow to fight a structure within those response areas. WSRB analyzes whether there are additional geographic areas, outside of the existing station response areas, where additional water flow need could be served by a new engine. For WSRB purposes, the response area is measured at 1.5 miles of travel distance from each first due engine company on existing roadways for areas with a need of less than 5,000 gallons per minute (gpm) of water. According to WSRB, this may be increased to 2.5 miles for first alarm apparatus.

For truck companies, WSRB considers their necessity when at least five buildings with heights of three or more stories exist within the district. For areas with less than 5,000 gpm of needed water flow, the first due ladder company should be within two miles. This may be increased to three miles for residential districts of one and two family homes, and to four miles where the separation of dwellings average 100 feet.

The following map displays the areas of the City that are within 1.5 and 2.0 miles of an existing fire station.

Figure 38: Tukwila WSRB Travel Distance



Most properties within the City are within recommended WSRB distances. A ladder company is housed within Station 54 near the center of the district. A truck company is not required to have an elevating ladder or aerial device unless there are a sufficient number of buildings that would

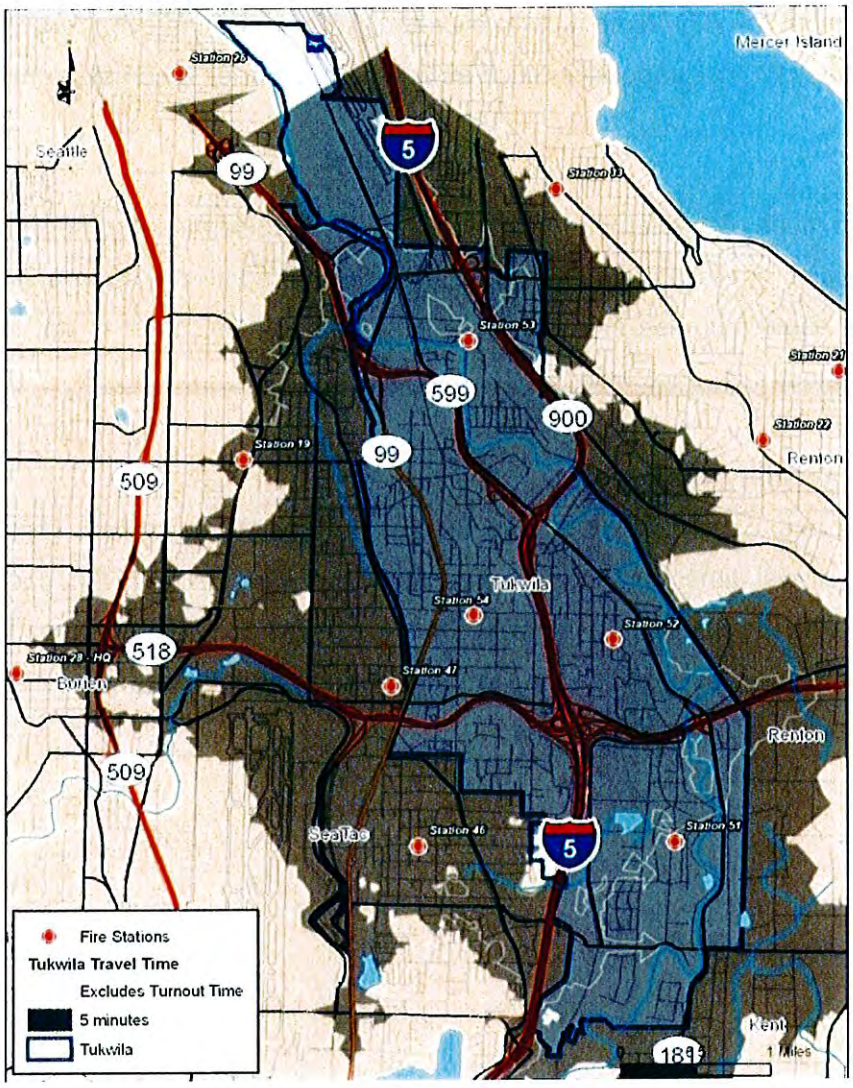
meet the three-story height and square footage limits. Other areas can receive credit for a truck company, without the requirement of an elevated device, and can even receive partial credit for a truck company if other apparatus, such as an engine, carries a complement of truck company equipment.

It is clear that much of the department's protection area would meet the necessary requirements for aerial devices or elevated ladders. It is possible that additional apparatus in reserve status may provide some increase in credit for reserve companies, but it is not likely to affect the overall community insurance rating.

Response Capability Models

The following map demonstrates a travel time model from TFD stations. The time is calculated by modeling travel time on the actual roadway network using given speed limits. Speed reduction has been applied to account for the apparatus to negotiate turns and intersections. The area shaded in black represents travel time for apparatus leaving their station. This model does not include firefighter turnout time.

Figure 39: Tukwila Travel Time Capability



The map illustrates the TFD fire stations can easily provide coverage within its fire response area under the five minute travel time mark.

Service Demand Spatial Distribution Analysis

There are several geographic distribution measures that are helpful in determining centers of service demand distributions, and whether these distributions are dispersed or more clustered in nature. Service demand distribution for the City as a whole and within the separate fire station areas is examined in three ways:

- The *mean center* of the distribution is the location which is the geographic center of concentration for service demand within the area studied.

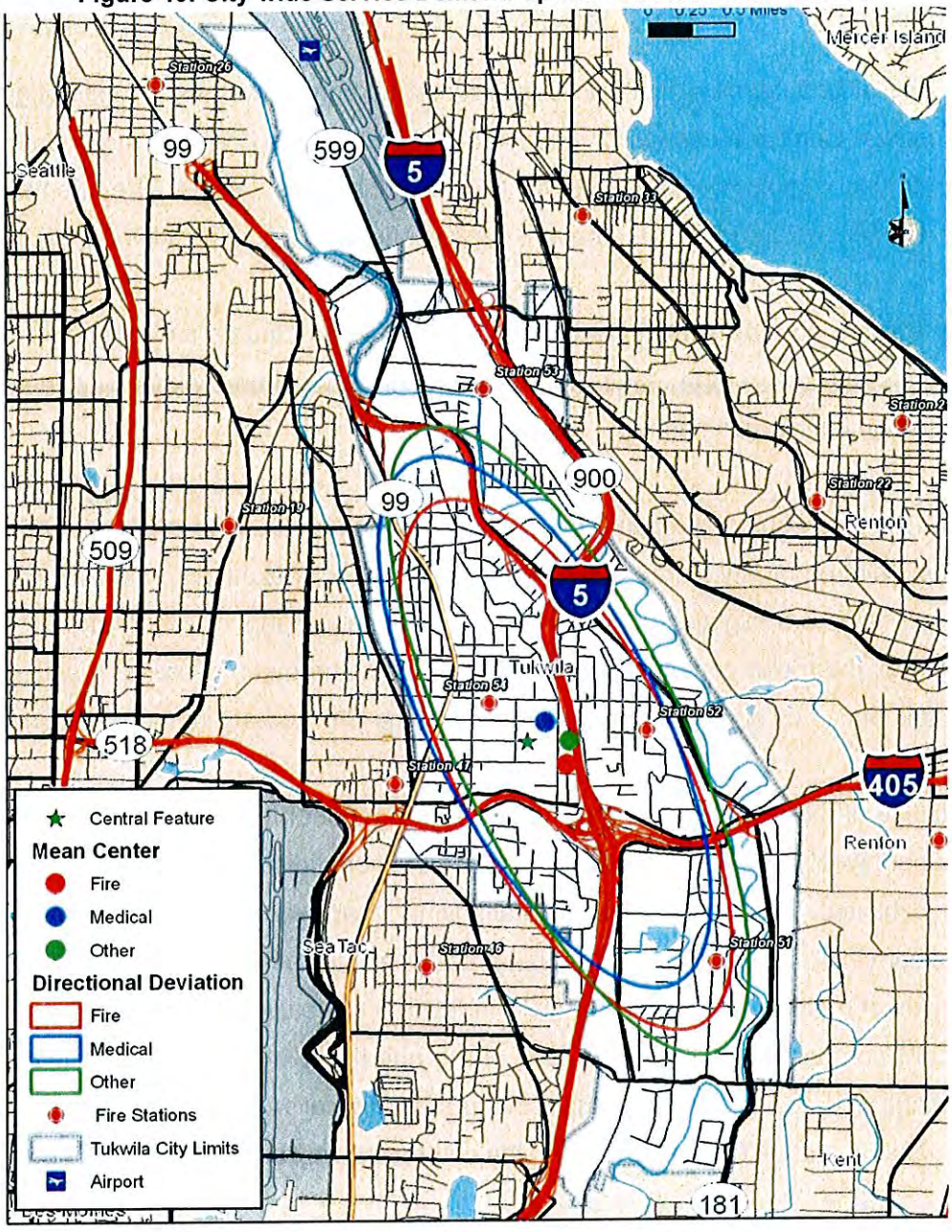
- The *central feature* is the call that is the shortest distance to all other calls in the study area.
- The *directional deviation ellipse* measures the compactness and orientation of the data points. Compactness refers to whether the data is dispersed or more clustered. This is often in comparison to another similar measure in the dataset. The orientation indicates a directional trend for the data and can be influenced by the study area shape.

In the following map series, ESCi examines the mean centers and directional deviation by call type and the central feature for all calls. This is displayed within City limits as a whole and within each station area.

The following figure represents the service demand distribution analysis. Due to the large Boeing aircraft facility on the City's north side, it is not unexpected that the mean centers for all call types are slightly southwest of the City's geographic center. It can be seen that by call type, the mean center of fire calls lies south of the mean center of medical calls, which are influenced by higher population centers on the City's west side near station 54.

Because of the distribution of service demand in most of this urban area, it is not surprising that northwest-southeast orientations to the directional distribution of each call type's ellipse are exhibited. The more subtle deviations in shape are more interesting because the medical calls are slightly more concentrated than fire events within the City. The smaller ellipses of medical and fire related calls indicate a more clustered distribution of these types of calls compared to the larger ellipse of the non-fire relate (*Other*) calls. Medical calls are concentrated more northwest than the fire event calls, reflecting population density by Stations 54 and 52 for the former and the commercial area by Station 51 for the latter.

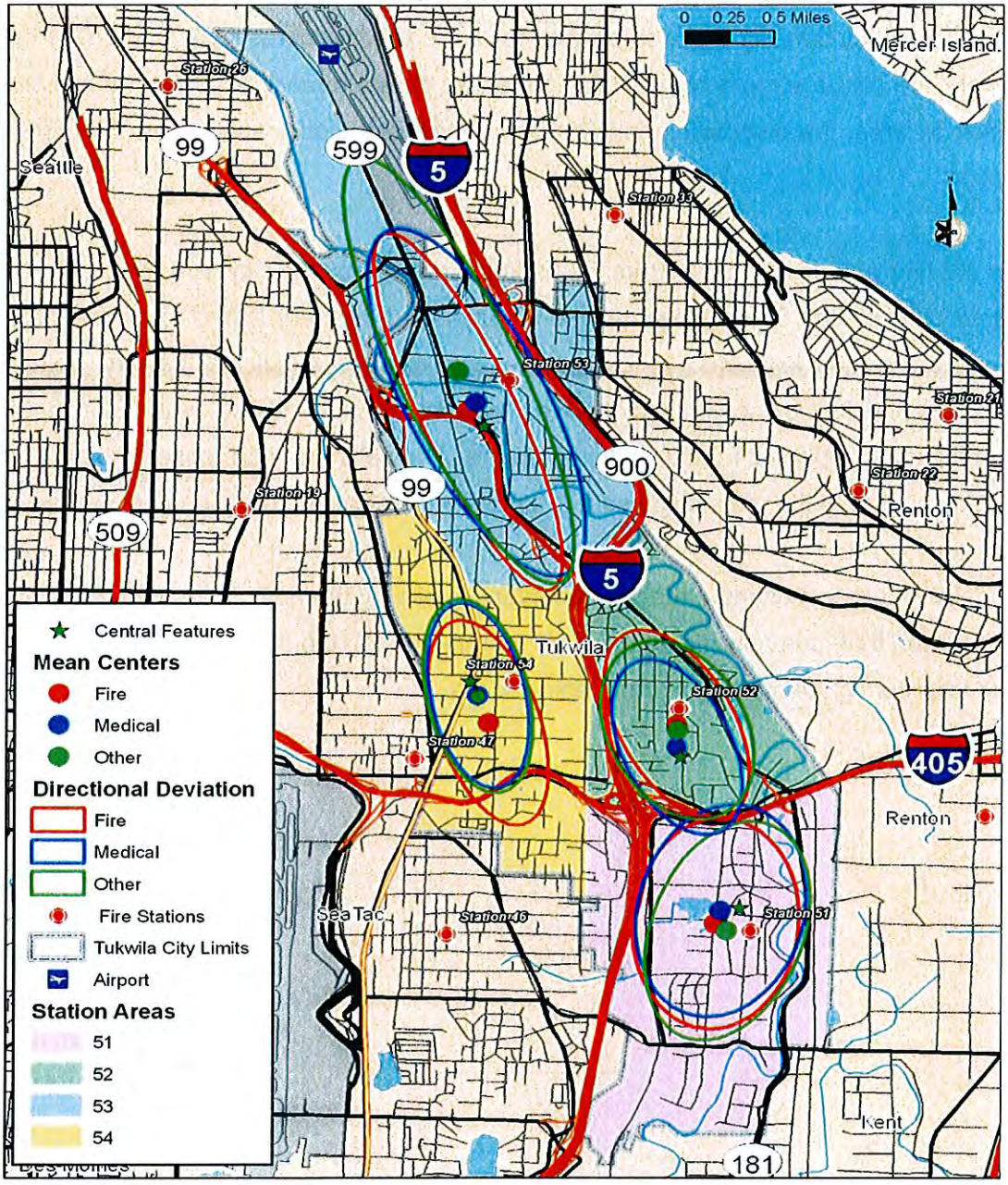
Figure 40: City-wide Service Demand Spatial Distribution Measures



The central feature is close to the medical call mean center due to the larger volume of these types of calls in the dataset.

The next map illustrates these spatial distribution measures of service demand by station area. These station areas have been determined by the fire department in developing dispatch protocols, in order to send the closest apparatus from the nearest fire station.

Figure 41: Service Demand Spatial Distribution Measures by Station Area



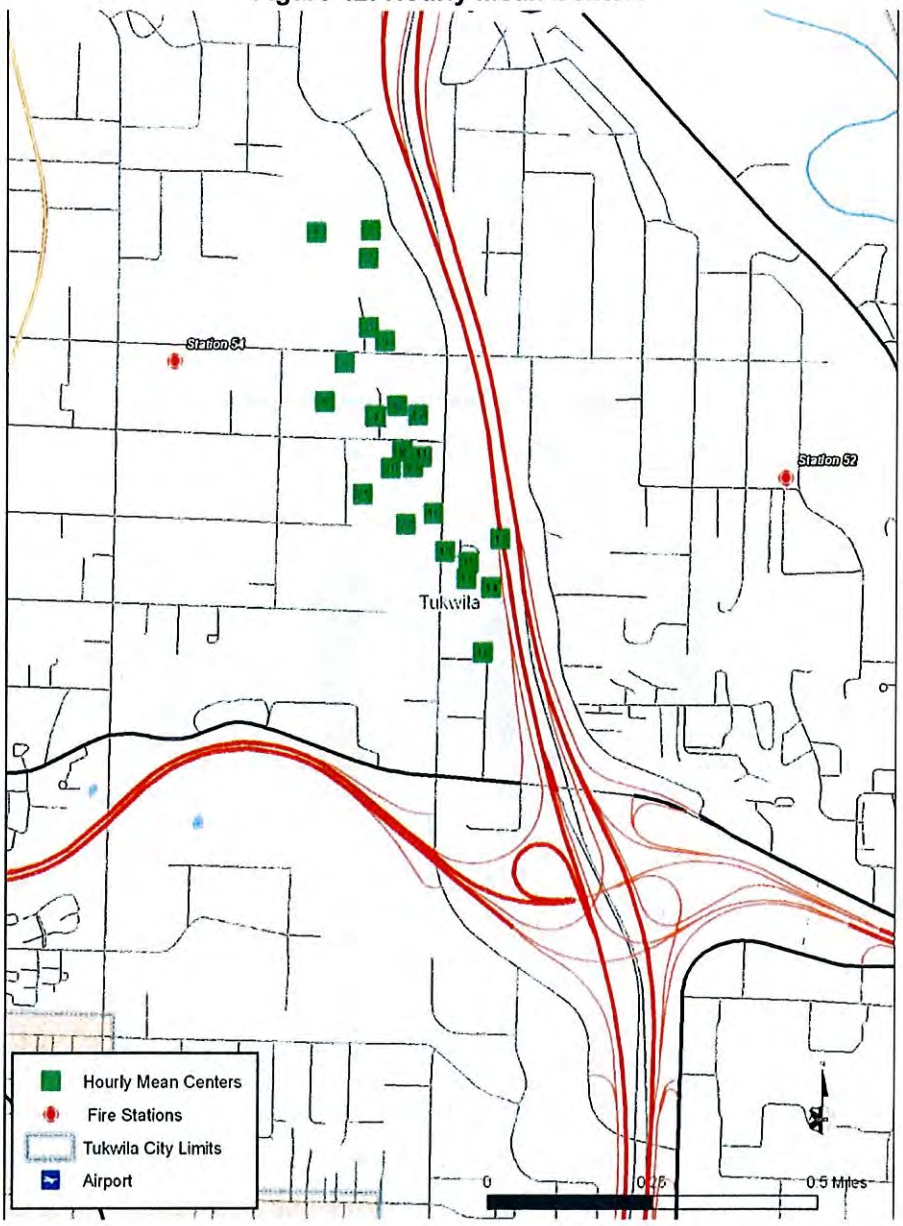
Because the spatial measure of the central feature indicates the call which is the shortest distance to all other calls that occurrred within the dataset, if a station was located nearby it would have the best opportunity to reach the service demand within the area in the shortest amount of time. The mean center illustrates the geographic distribution which is equidistant from all calls; in more rural areas it is a more pronounced distance from the central feature.

For Station 51's area, the mean centers and the central feature are clustered nearby the current station location indicating a choice location for a fire facilty. Interestingly, and unlike the City as a whole, fire calls are more compact while medical calls are most dispersed for this area. In the Station 52 area, the distribution centers are two to three blocks south from the current station location.

This call type's compactness mirrors the pattern observed by the City as a whole, but to a lesser degree. The Station 54 area has centers of distribution that are two to three blocks west from the current station location. The compactness of call types indicate that fire calls are more dispersed and further south than medical or other non-fire related calls. Station 53 is also several blocks northeast from it's central feature. Fire calls are more concentrated in this area, when compared to the more disperse distribution of medical and other non-fire related calls.

The following map illustrates the mean center of calls by the hour of the day within the City. It can be seen that, primarily during the early morning hours, the mean centers of calls are further north than during the afternoon and evening hours.

Figure 42: Hourly Mean Centers

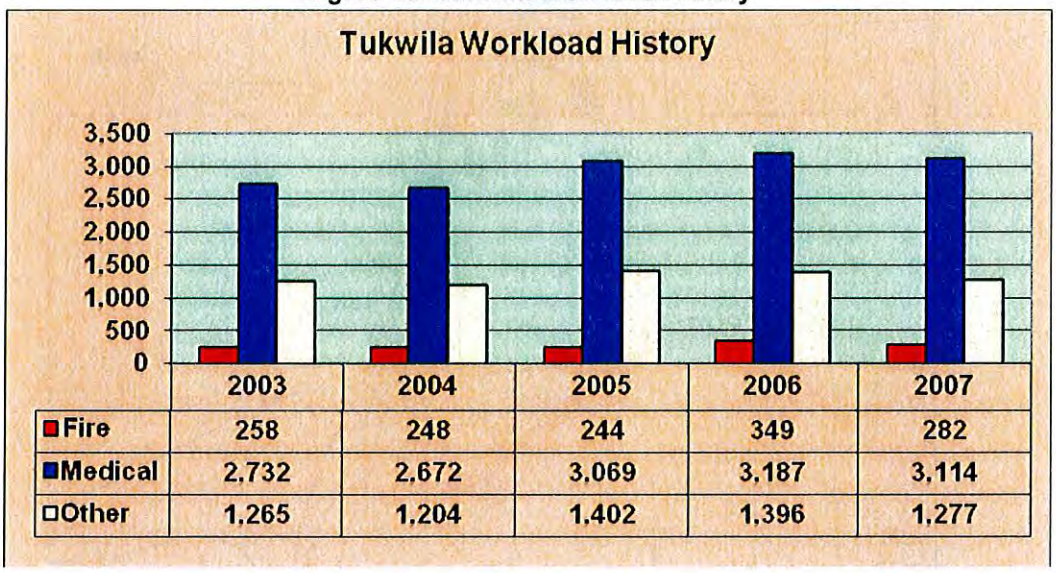


This would be useful for limited staffing options for apparatus, such as aid cars, whereby during the morning hours it could respond from Station 54, and during the afternoon and evening hours it could respond from Station 51.

Service Demand Analysis

The Tukwila Fire Department's service demand was analyzed using five years of data provided from its National Fire Information Reporting System database (NFIRS). The following subsections detail TFD's workload based on temporal and geographic means. We begin by examining annual workloads categorized by major call types. *Other* types of calls include non-medical or non-fire events such as alarms, smell of smoke, etc.

Figure 43: Tukwila Workload History

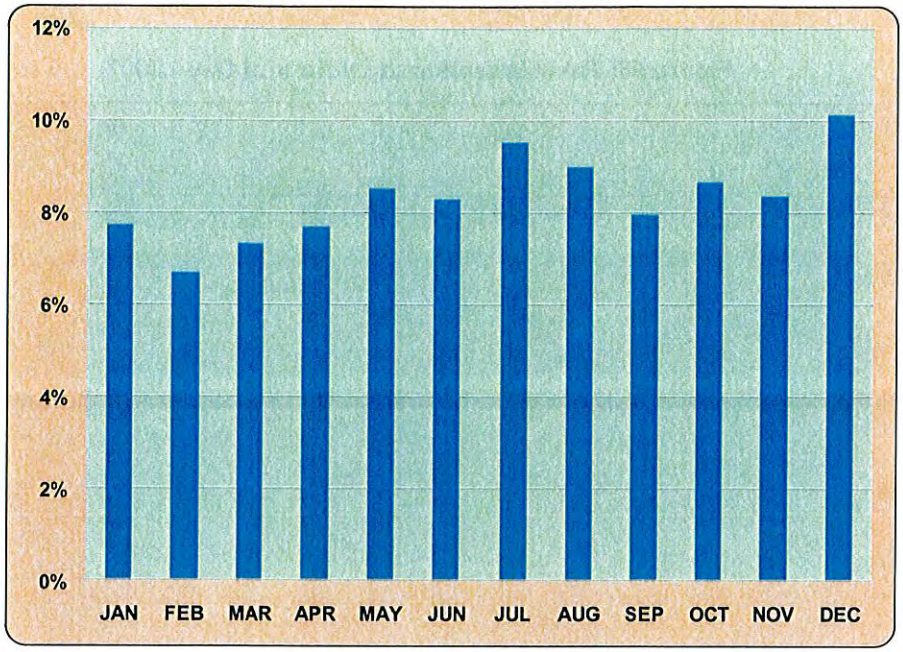


	2003	2004	2005	2006	2007
Fire	258	248	244	349	282
Medical	2,732	2,672	3,069	3,187	3,114
Other	1,265	1,204	1,402	1,396	1,277

Incidences of fire were decreasing within the City until 2006, when a larger number of fires were responded to by the department. The amount of fire incidents has slightly declined in 2007. Medical calls are usually the most prevalent calls for fire departments nationally; the role of the department in providing emergency medical services has increased significantly since 2003. Calls other than medical emergencies or fires have remained somewhat constant over the reporting years, with the highest response to *other* calls in 2005.

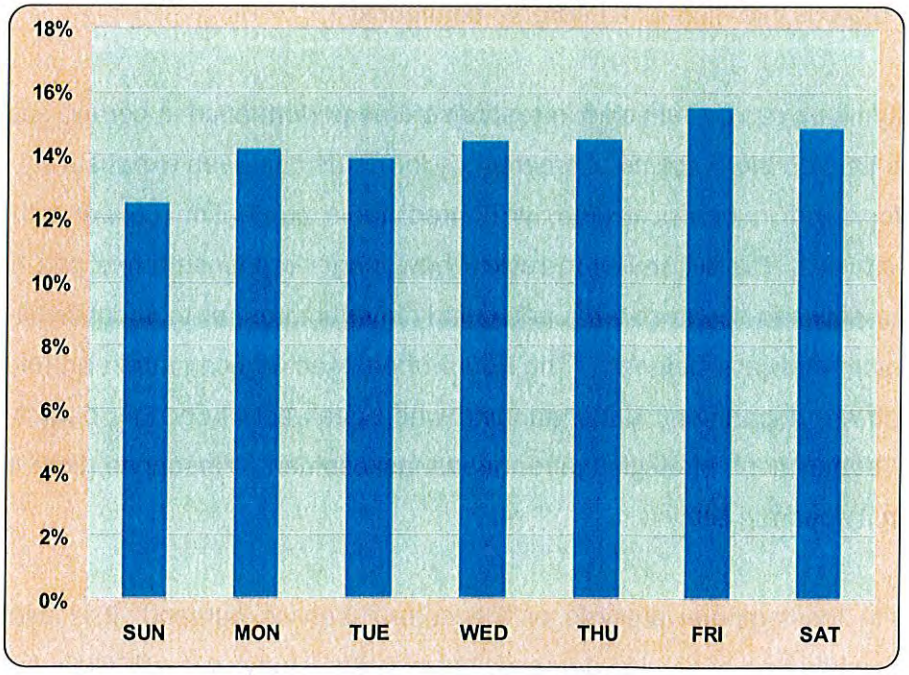
A review of incidents by time of occurrence reveals when the greatest response demand is occurring. The following charts show how activity and demand changes for the TFD based on various measures of time. ESCi began by breaking down yearly workload into monthly increments.

Figure 44: Tukwila Monthly Workload - 2007



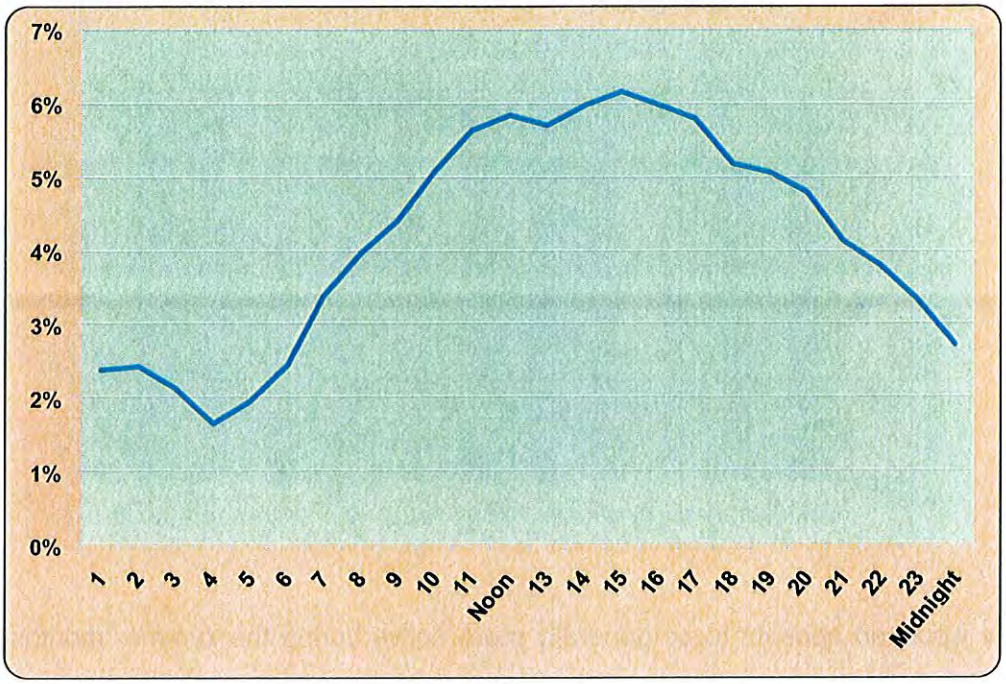
Monthly workload appears to be generally more active during the summer months, as well as during January and December. In further analysis, workload is examined by day of the week. It appears that service demand is highest on Fridays.

Figure 45: Tukwila Workload by Day of Week - 2007



The final analysis of historical workload concludes with examination of call types by hour of day.

Figure 46: Tukwila Workload by Hour of Day - 2007



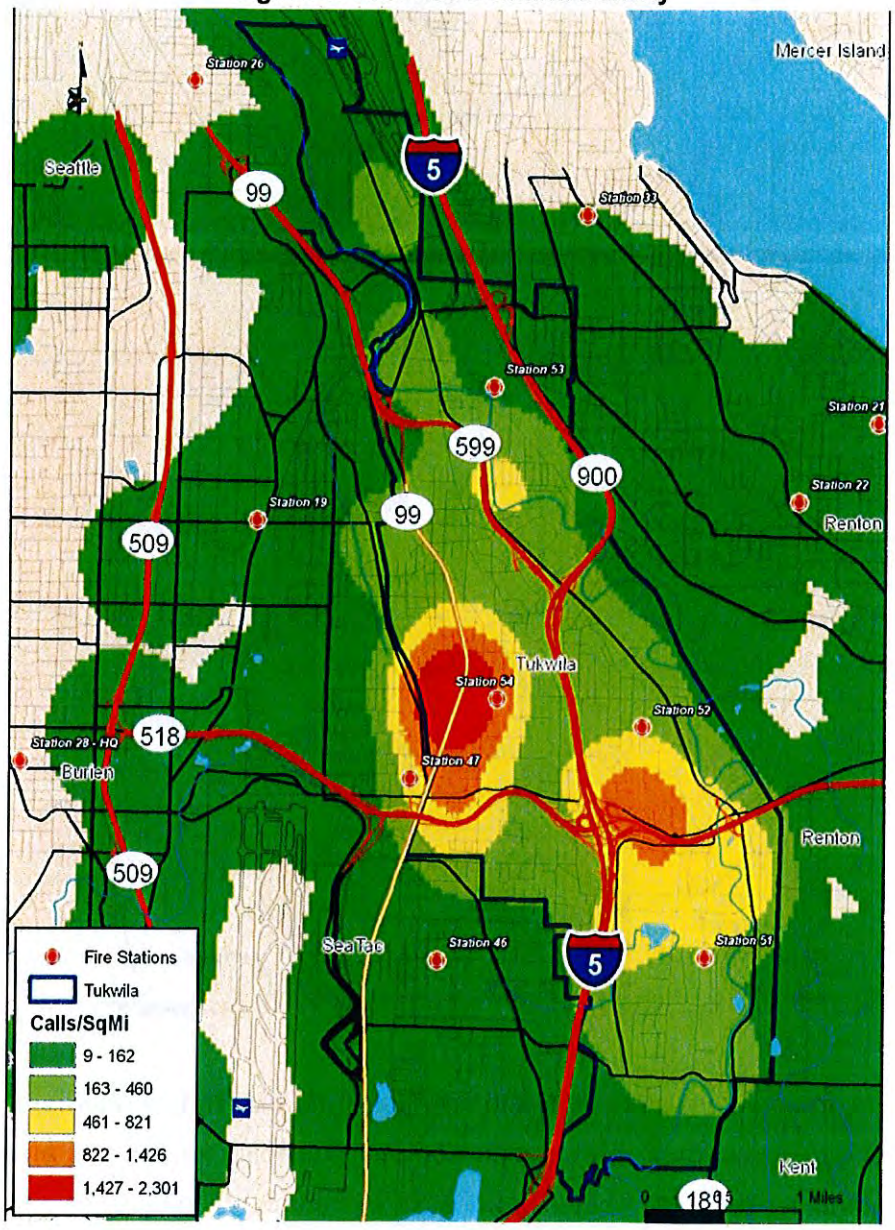
Activity for the fire company begins to increase at 5:00 a.m., building volume during the day to reach peak activity during at 3:00 p.m., before gradually declining into the evening as the community morphs into more of a bedroom community.

Peak activity times can be reflected in response time performance in certain cases. 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. The hours of peak activity can strain an under-equipped or under-staffed fire department. Understanding when peak activity occurs begins the process of developing deployment strategies and needs assessment. Response time performance is examined in a separate section.

In addition to the temporal analysis of the current service demand, it is useful to examine geographic distribution of service demand. Later in this study, this will allow for assessing the location of stations in comparison to the actual service demand within the area. The following

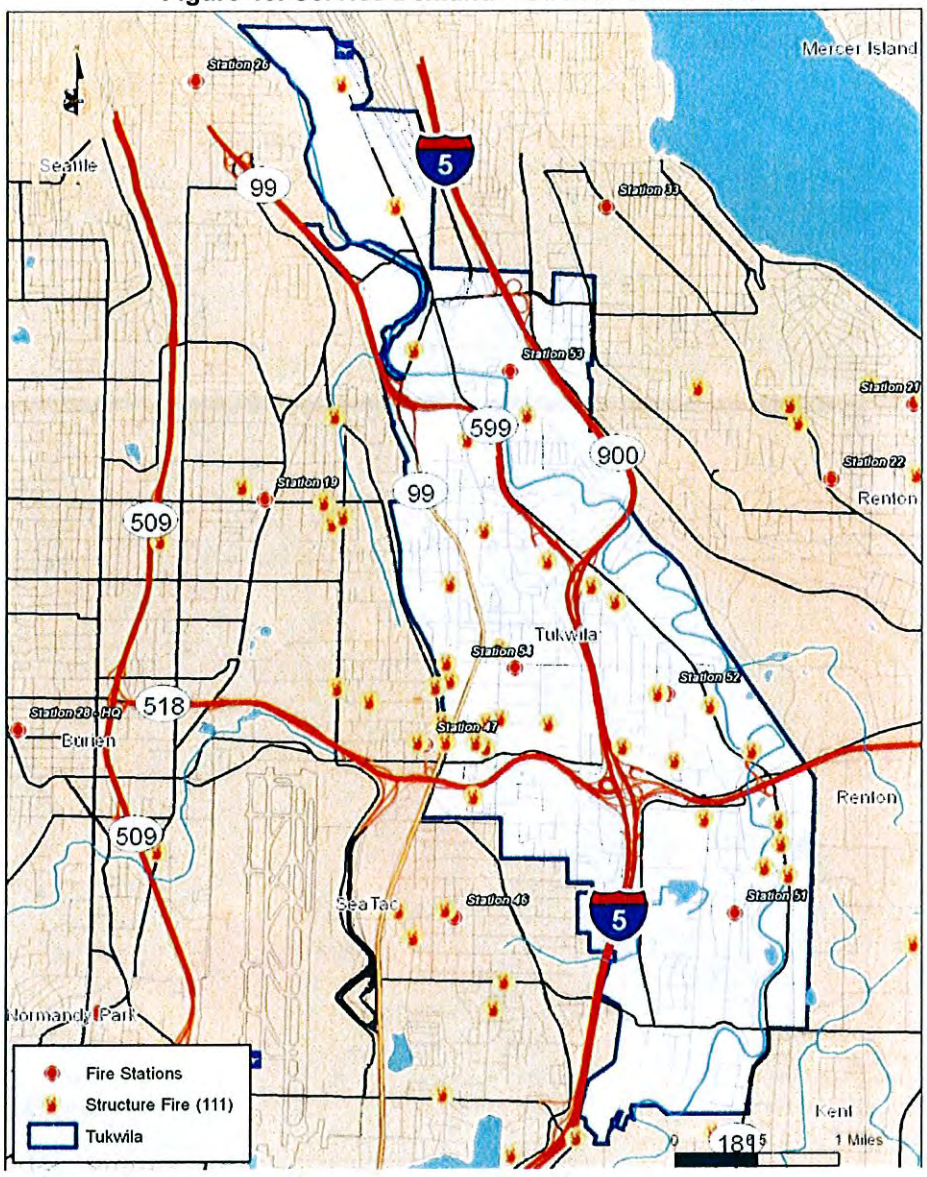
maps indicate the distribution of emergency incidents responded to by the department during the last year's worth of data.

Figure 47: Service Demand Density



The area of highest service demand is in the areas of higher population or areas of high concentration of workers. While the above map reflects all calls for service for TFD, it can be influenced by the prevalence of calls other than actual fire incidents. The following map illustrates the location of structure fires that were handled by the TFD over the same time period.

Figure 48: Service Demand – Structure Fire Calls



Fire incidents are most prevalent near International Blvd. and along Interurban Avenue, north of the I-405/SR 518 freeways. It can be seen from the preceding figures that a certain amount of service demand for the TFD comes from assisting surrounding departments, outside of its primary fire protection district. This may or may not occur in conjunction with the neighboring fire department.

Concentration Analysis

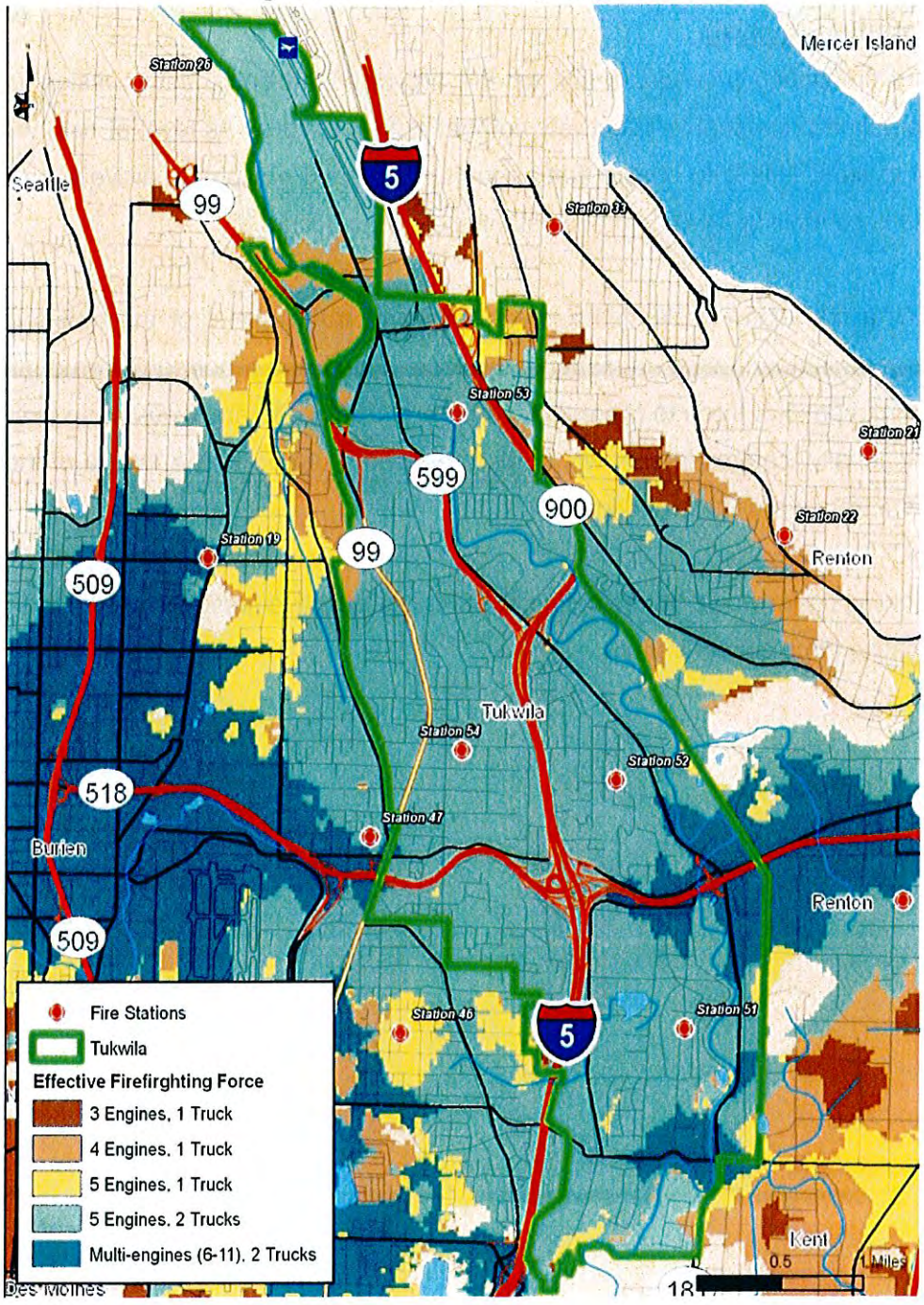
Standard firefighting procedures call for the arrival of the entire initial assignment (sufficient apparatus and personnel to effectively combat a fire based on its level of risk) within a certain amount of time. This is to ensure that enough people and equipment arrive soon enough to be effective in controlling a fire before substantial damage occurs.[18]

For TFD, a first alarm assignment strives to arrive at the scene of the reported fire incident within eight minutes. Based on response protocol and on the reported nature of an emergency, a varied response of three to five engines and one truck company would respond to a structure fire. Additionally, command staff would also respond, but due to the nature of their work, they may come from a multitude of origins.

The following figure would be the extent of the City's effective firefighting force in shaded ranges of firefighting force concentrations.

[18] See supplemental discussion about time/temperature curve and the effects of flashover.

Figure 49: Effective Firefighting Force



The map illustrates that much of the City enjoys the potential capability of an effective firefighting force should a major structure fire occur.

Resource Reliability Analysis

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. If a response unit is unavailable, a unit from a more distant station must respond, increasing overall response time. 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.

Unit hour utilization is an important workload indicator because it describes the amount of time a unit is not available for response, since it's already committed to an incident. The larger the number, the greater its utilization and the less available it is for assignment to an incident. The highest unit hour utilization (UHU) figures for fire suppression units are typically around 0.20 with some studies indicating that unit failure rates[19] at this workload will begin to hit 10 percent. Studies of fire-based medical units indicate that significant responder burnout can occur with 0.30 unit hour utilization. The following figure details the UHU for each of the department's apparatus for the last five years.

Figure 50: Tukwila Unit Hour Utilization

Year	Data Type	A54	B51	E51	E52	E53	E54	L54
2003	Total Calls	18	189	542	369	338	45	420
	Total Time	53:32:27	212:16:45	400:40:00	258:24:54	273:42:05	34:32:33	370:20:24
	UHU	0.01	0.02	0.05	0.03	0.03	0.00	0.04
2004	Total Calls	56	303	694	534	440	175	395
	Total Time	52:08:39	248:25:45	319:35:53	266:27:09	239:46:01	100:47:32	188:36:59
	UHU	0.01	0.03	0.04	0.03	0.03	0.01	0.02
2005	Total Calls	315	626	1365	1354	954	307	1303
	Total Time	148:14:33	268:43:51	527:16:28	525:32:24	401:30:18	127:23:50	493:08:31
	UHU	0.02	0.03	0.06	0.06	0.05	0.01	0.06
2006	Total Calls	303	627	1452	1492	1097	75	1558
	Total Time	145:56:53	307:35:59	583:35:29	624:38:07	482:21:01	27:43:49	627:18:35
	UHU	0.02	0.04	0.07	0.07	0.06	0.00	0.07
2007	Total Calls	323	460	1359	1370	987	7	1555
	Total Time	133:42:34	243:34:54	538:25:25	572:04:09	424:44:31	3:25:34	606:12:54
	UHU	0.02	0.03	0.06	0.07	0.05	0.00	0.07

[19] 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.

It can be seen that the overall utilization is currently well below recommended targets for all incidents, indicating that workload is not a factor in reducing response times, if need be.

Another way to look at resource workload is to examine the amount of time multiple calls happen within the same time frame on the same day. ESCi examined the calls from last year's data to find the frequency that a fire company's apparatus was handling multiple calls within any time frame. This is important; because the more calls occurring at one time can stretch available resources and extend response times from distant responding available apparatus. The fire department's data for the last year is examined for the frequency of call concurrency.

Figure 51: Tukwila Table of Concurrent Call Frequency

2007	All Calls		Fire Calls		EMS Calls		Other Calls	
Single	3452	73.87%	264	93.62%	2544	81.70%	1156	90.52%
2	904	19.35%	16	5.67%	465	14.93%	109	8.54%
3	234	5.01%	2	0.71%	93	2.99%	10	0.78%
4	50	1.07%			9	0.29%	2	0.16%
5	12	0.26%			2	0.06%		
6	7	0.15%			0	0.00%		
7	3	0.06%			0	0.00%		
8	2	0.04%			0	0.00%		
9	1	0.02%			0	0.00%		
10	1	0.02%			0	0.00%		
11	2	0.04%			0	0.00%		
12	1	0.02%			1	0.03%		
13	1	0.02%						
14	0	0.00%						
15	0	0.00%						
16	0	0.00%						
17	0	0.00%						
18	1	0.02%						
19	1	0.02%						
20	1	0.02%						

The data indicates that approximately 20 percent of the time last year, more than one call was occurring at the same time. As in most communities, the majority of calls happen singularly. However as communities grow, the propensity for concurrent calls will increase. When the concurrency reaches a level to which it stretches resources to near capacity, response times begin to extend. Although multiple medical calls will cause drawdown, especially as concurrency

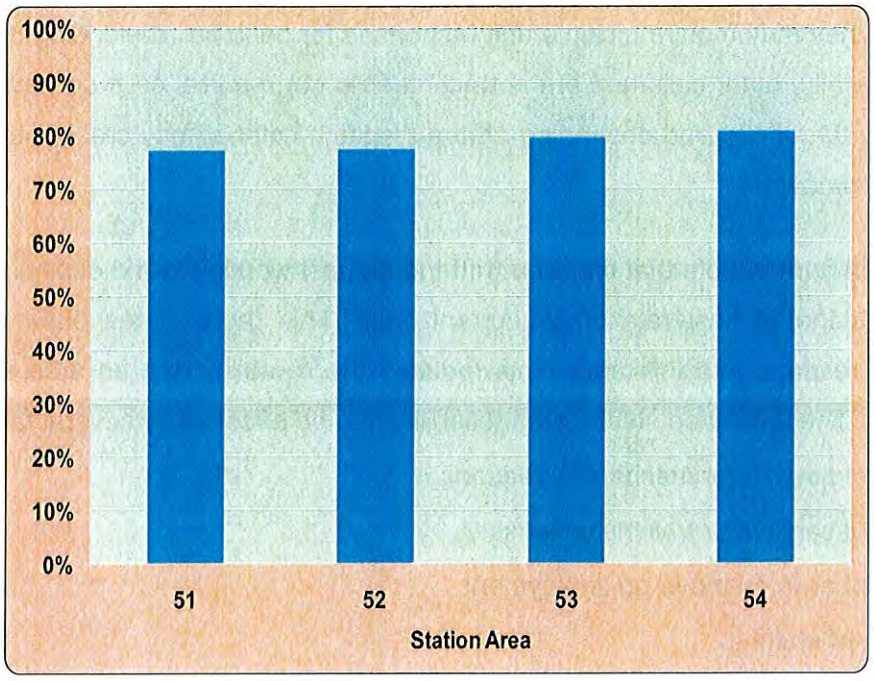
increases, they usually occupy one unit at a time. Concurrent fire calls however, are of more concern as they may require multiple unit responses for each call depending upon the dispatch criteria. Typically, other calls that are not actual fires nor medical calls do have higher rates of concurrency than fires, and depending on the dispatch criteria, may create period of extensive resource drawdown.

It is also important to note that the area with the highest workload, and especially medical calls, typically has the highest rate of concurrent calls. This requires response units from other stations, to respond into this area. This reduces the reliability that an area is covered by its primary unit. The impact on station area reliability can be effective by several factors such as:

- Out of service for mechanical reasons
- Out of service for training exercises
- Out of area on move-up deployment
- Lack of staffing
- Concurrent calls

When these factors impact the reliability of a station to respond within its prescribed territory, response time performance measures for the back-up station/apparatus can be negatively effective.

Figure 52: Station Area Reliability



Statistical Measures

Throughout this document, certain descriptive statistical measures are used which may not be familiar to all readers. In an effort to reduce confusion or the drawing of inaccurate conclusions, we provide a brief explanation of these terms. The measures most often used which require clarification are average, median, and percentile.

Average

The *average* measure is a commonly used descriptive also called the mean of a data set. It is a measure most commonly used to describe the central tendency, or the center of a data set. The average is the sum of all the data points in a set divided by the total number of data points. In this measurement, each data point is counted and the value of each data point has an impact on the overall performance. Averages should be viewed with a certain amount of caution because the average measure can be skewed if an unusual data point (known as an outlier) is present within the data set. Depending on the sample size of the data set, the resulting lopsidedness can be either very large or very small.

For example, assume that a particular fire station with a response time goal of six minutes or less had five calls on a particular day. If four of the calls had a response time of eight 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 calls, or 80 percent, were beyond the stated response time objective.

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 times have a direct influence on the total performance measurement. The farther they are from the desired performance, the greater the impact.

The reason to compute the average is because of its common use and because of the ease of understanding associated with it. The most important reason for not using averages for performance standards is that average 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.

Median

Median is the middle of a set of points. If the number of points is uneven, the median is the point precisely in the center making the same number of points above it as are below. If the number of points is even, the median is the average of the two points closest to the center. Median is often confused with average (mean); however, remember that average is dependent on the ***sum*** of the points, while just the number of points determines a mean. We typically use median to illustrate the middle of a benchmark range where the same number of points exist above it as below.

Percentile

With the average measure, it is recognized that some data points are below the average and some are above the average. The same is true for a median in which 50 percent of the data are below the median, and the other half are above – also called the 50th *percentile*.

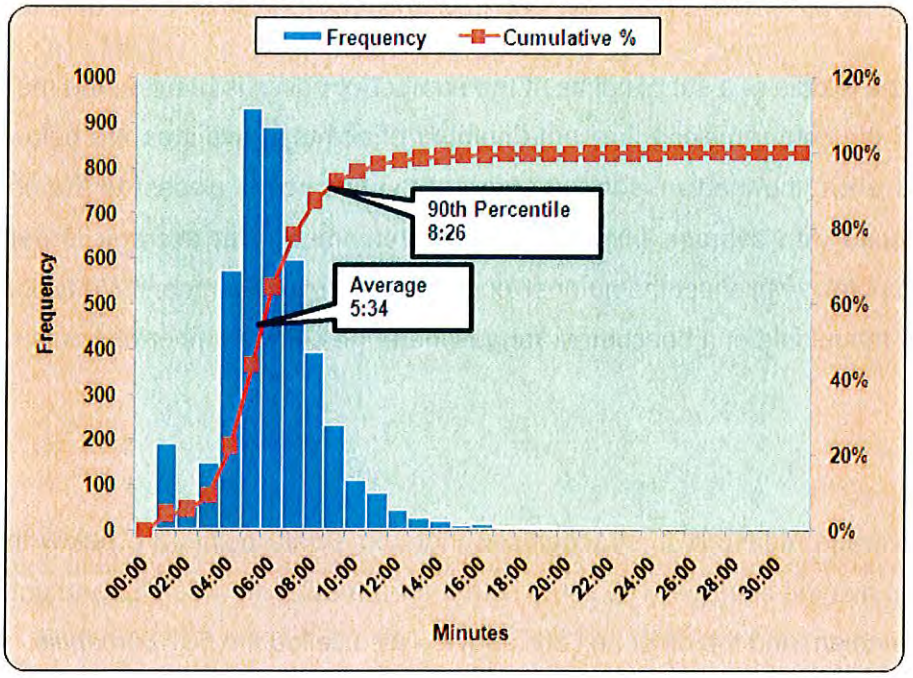
With percentiles (or fractiles), the actual value of the individual data does not have the same impact as it did in the average. The reason for this is that the fractile is nothing more than the ranking of the data set. The 90th percentile means that ten percent of the data are greater than the value stated, and all other data are at or below this level.

Higher fractile measurements are used normally to establish response objectives and to measure outcome because percentiles show that the majority of the data set has achieved a specified level of performance. This can be compared to the desired objective to determine the degree of success in achieving the goal.

Recorded Response Time Performance Analysis

Total response time is the amount of time a resident or business waited until an apparatus arrived at the scene of emergency, beginning when they first called the designated emergency number, often 9-1-1. It is made up of several elements which were discussed earlier (See *Response Time Performance Objectives*). Since a fire company has no influence on call processing time, the department is measured on response time from the time of dispatch to the arrival on scene. The following chart illustrates the overall response time frequency for the TFD over the last full year of data provided.[20]

Figure 53: Tukwila Response Time Performance History

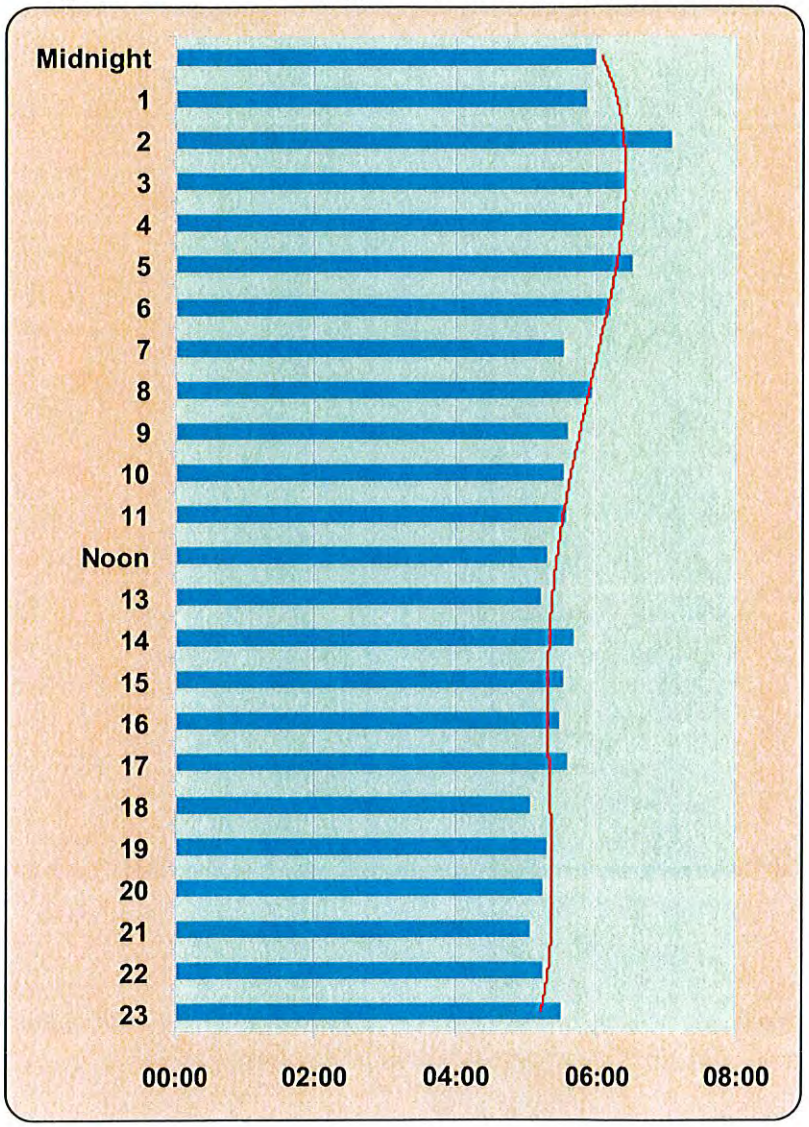


[20] Mutual aid calls and non-emergent calls were removed from response time analyses as they were found.

The most frequently recorded total response time was within the five minute range; specifically the average of all calls is five minutes and thirty-four seconds.[21] Ninety percent of all calls within the City are answered within an eight minute, twenty-six second response time.

Response times can vary by time of day in reflection of service demand workload, traffic congestion, weather, and distance to the call from the station, to name but a few. The following chart illustrates the average response time by hour of day.

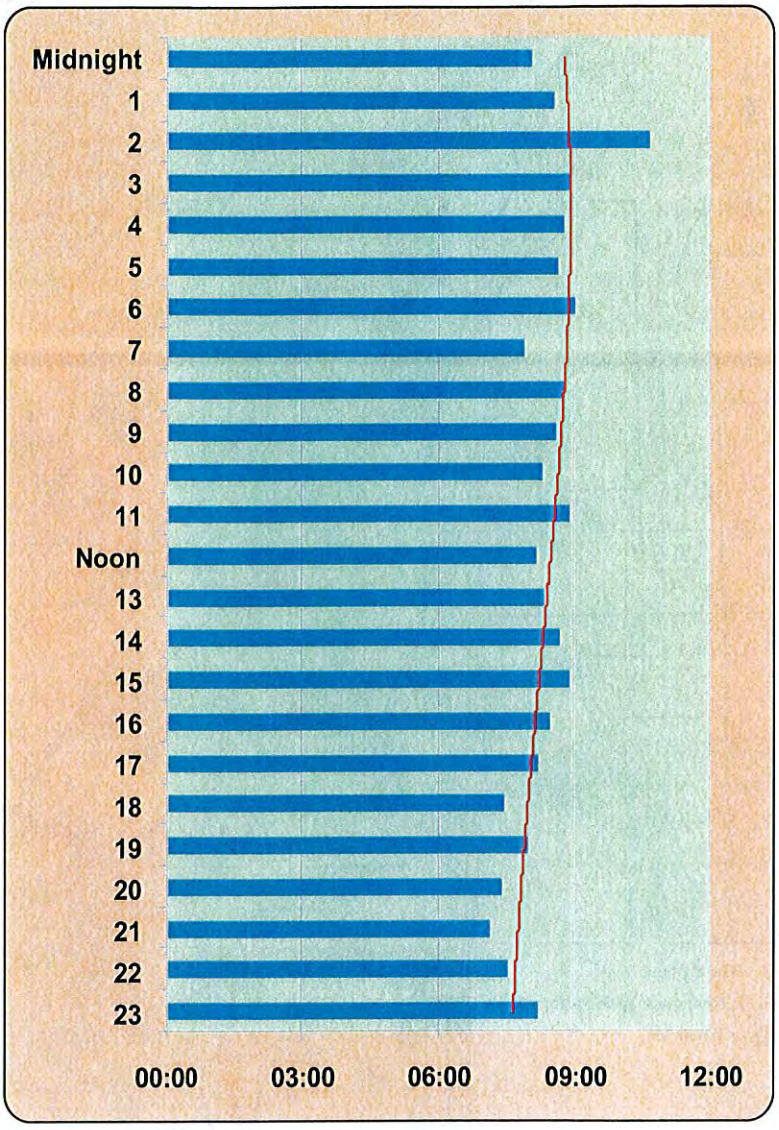
Figure 54: Tukwila Average Response Time by Hour of Day



[21] Source: The basis of time estimates is from two sources: Valley Com and Tukwila FD incident reports. This data was the estimate at the time of this report and actual times may be better or worse. They are not, and should not, be considered a standard.

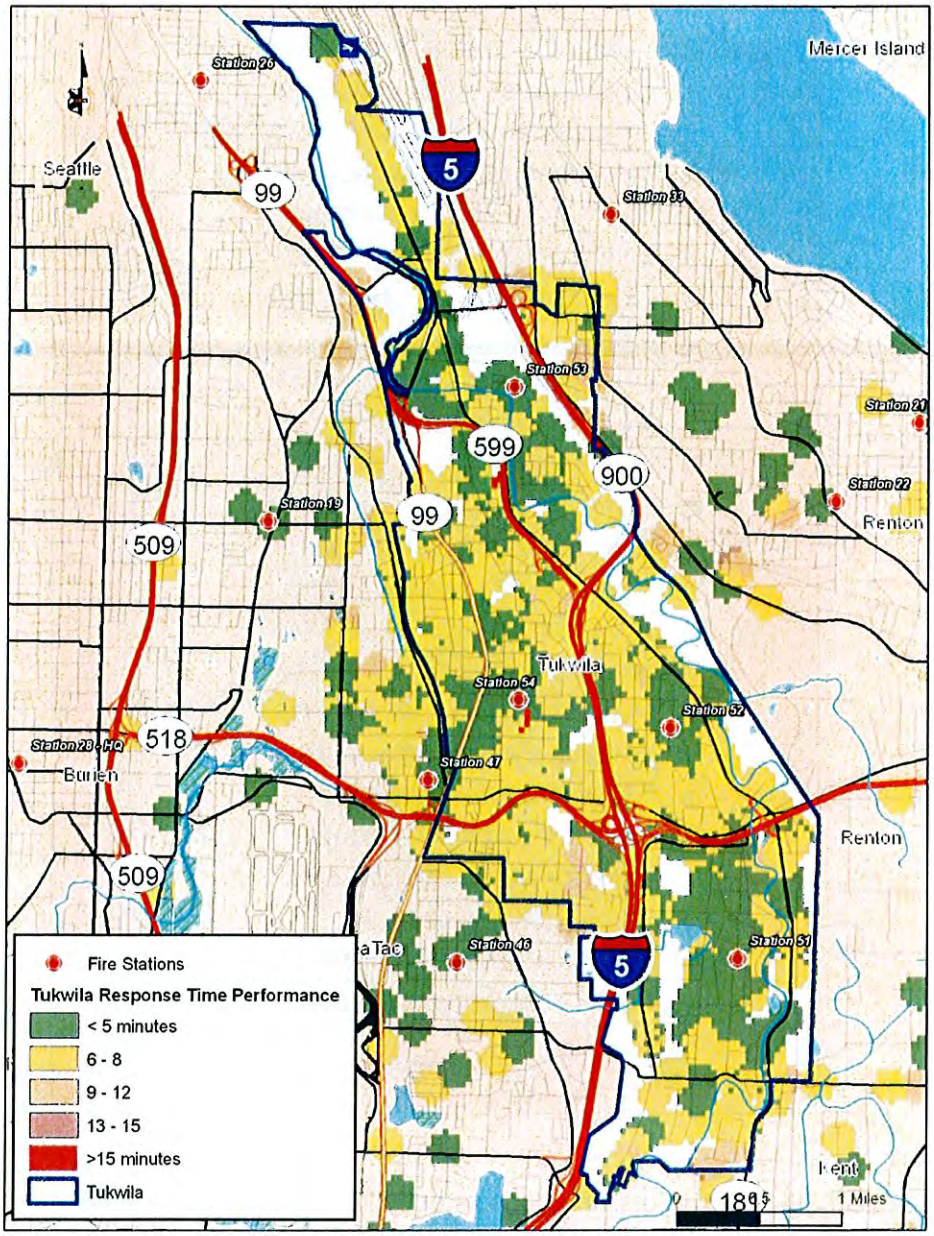
It appears that early morning hours tend to have longer response times than other times of the day. The early evening appears to be the best time of day for shorter response times. A stronger measure of response time is measured on a percentile basis. The following chart illustrates the hourly response time on these terms.

Figure 55: Tukwila 90th Percentile Response Times by Hour of Day



Once again, early morning hours have consistently longer response times than the rest of the day. Response time variations occur also by geographic regions. Typically, fire map boxes are established to guide the deployment of resources and reporting of incidents. In addition to viewing temporal changes in response time, it is also of value to view the impact of location on response times. In order to accomplish a more specific geographical analysis of current response time performance, ESCi evaluated the actual response time of each call and generated a predictive illustration of response performance based on historical records. The following map illustrates the amount of time is has taken from dispatch to an apparatus to arrive to actual incidents.

Figure 56: Tukwila Response Performance



The areas of longer response time are clearly visible through this map and, as expected, the actual response time performance is best in the area closest to the fire stations. It should be noted, the location of an apparatus when an alarm occurs is not known and should not be assumed to always be from the station, as other duties outside of the firehouse occupy the firefighter's time as well. An example may be responding from another call location that was just cleared or responding to another station's area.

Aid Car or Ladder Truck

TFD attempts to staff a full-time aid car if daily staffing is at full strength (18). Since *average* daily staffing is 14, staffing an aid car is sporadic and not consistent with medical call demands. Currently, TFD uses the truck company to provide first response to medical aid calls. A ladder truck or an engine provides more versatility than an aid car, since a call for a fire or rescue may necessitate the abilities of the ladder truck or engine. Aid cars are one dimensional and can only respond to EMS related calls, since they lack the ability to pump water or be used as an elevated device. However, the practice of using a ladder truck has several drawbacks, and is discussed below.

Responding to aid call with a ladder truck or engine poses several issues. First, using the truck company to respond to aid calls will add to Station 54 failure rates. A failure is when a call for service is made and the appropriate closest station is not in quarters to respond. This failure can be attributed to the station out of service for training, for maintenance and repair, or the apparatus and crew is previously engaged on another emergency call. This is critical if the next emergency event requires a truck company for a high rise emergency and the apparatus and crew are already engaged on a medical event; a response to the new call will be delayed.

In 2007, TFD responded to 4,341 calls for service. Of this number 3,155 calls for emergency medical service (EMS). EMS calls count for over 72 per cent of the TFD workload and by far make up the largest total of responses in the department.

To see the probability for station failure, the following table shows the unit hour utilization (UHU) for all TFD apparatus for 2007. L54 is the ladder company located at Station 54. This apparatus has responded to more calls than the other apparatus and has logged the highest total time of use at 606 hours, 12 minutes, and 54 seconds. This large UHU is mostly attributable to response to EMS related calls.

Figure 57: Unit Hour Utilization - 2007

	Data Type	A54	B51	E51	E52	E53	E54	L54
2007	Total Calls	232	460	1,359	1,370	987	7	1,555
	Total Time	133:42:34	243:34:54	538:25:25	572:04:09	424:44:31	3:25:34	606:12:54
	UHU	0.02	0.08	0.06	0.07	0.05	0.00	0.07

Most of the City street network is narrowed by parking and hampered by high traffic volume. Ladder truck apparatus, by its very size, are larger than most commercial trucks that use City streets. Couple the size of a ladder truck and add the emergency response component, we have a very large apparatus responding to many medical emergencies during the course of a year. Maintenance for ladder trucks is complex and can be very expensive to maintain. The wear and tear on the ladder truck responding to medical calls will have a detrimental effect on the life span of an apparatus that will cost well over a million dollars to replace.

ESCi believes that more agile vehicle (aid unit), paired with a well trained 24/7 crew of two, will be beneficial in mitigating the wear and tear on the aerial truck, reduce the UHU and limit station failure.

Recommendation:

- Staff a full-time 24-hour aid car. Limit the use of the ladder truck apparatus to truck company related calls.

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Future System Demand Projections

Tukwila is a centrally located city at the crossroads of industrial, commercial, and economic activity for the Puget Sound area. This full service City is advantageously located just east of SeaTac Airport and mid-point between Tacoma and Seattle. The City has outstanding access to transportation, a diverse work force, office developments, and a variety of residential housing, lodging facilities, and large regional retail centers.

Current Population Analysis

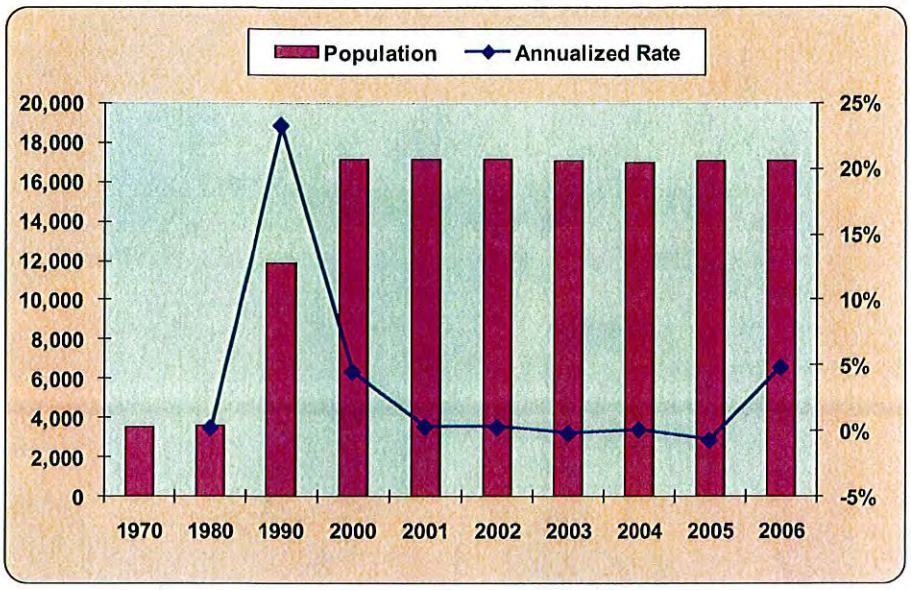
This section examines the population, demographic composition, and housing characteristics in the City (TFD service area). TFD is the single provider for fire protection and first responder EMS in the nine square miles of Tukwila corporate limits.

In 2007, the City's population was estimated at 18,000 according to the Washington State Data Center at the Office of Financial Management (OFM). This is a 4.7 percent increase from 2000, when the U.S. Census Bureau reported a population of 17,181. The City's 2007 estimate is more aggressive than an estimate from the U.S. Census Bureau in 2006 of 17,111.[22] The City reports a current population of 17, 240 residents for 2007.

The following chart illustrates the baseline residential population growth for the City since 1970.

[22] 2006 Population Estimates, U.S. Census Bureau.

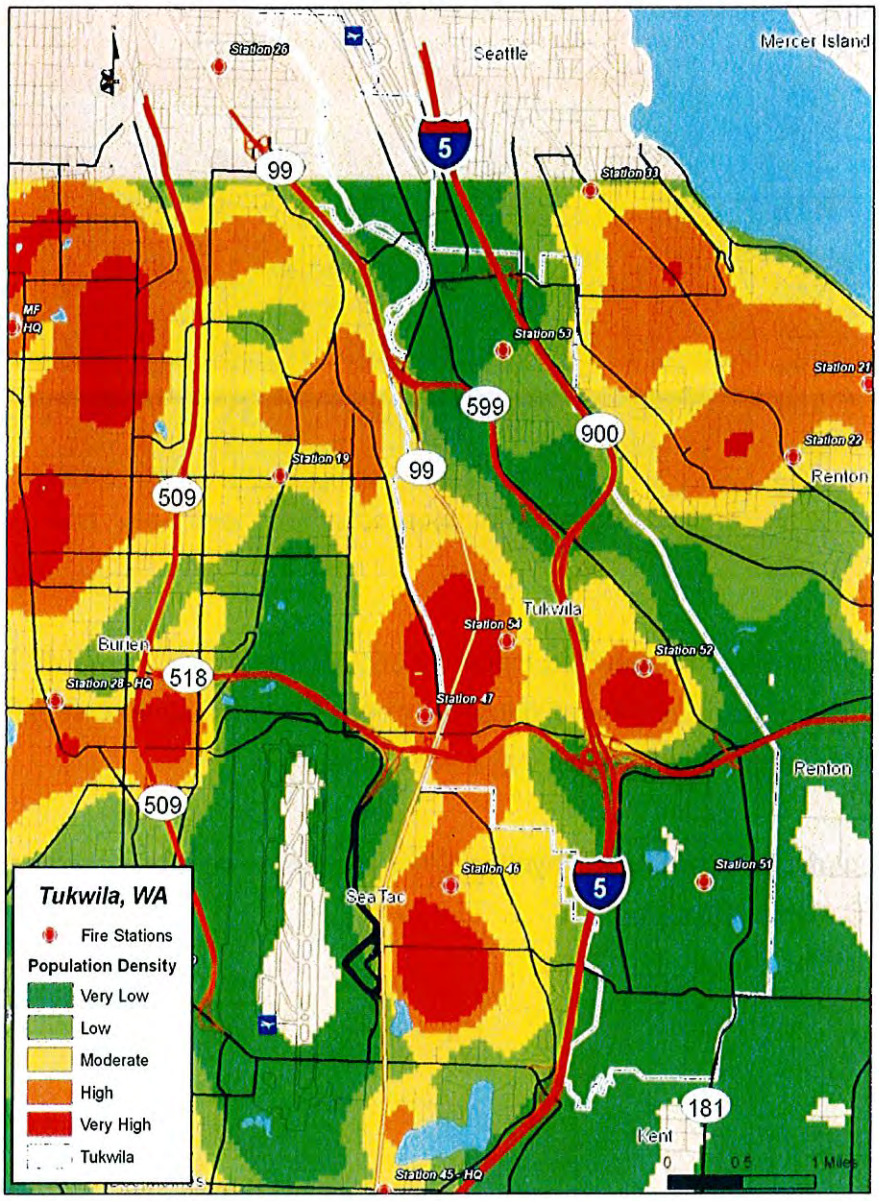
Figure 58: Tukwila – Historical Population, 1990 – 2007



Population in Tukwila has stabilized since an accelerated period of growth in the 1980s and 1990s. It is useful to assess the distribution of the City's population, since there is a direct correlation between population density and service demand.

The following map (Figure 59) displays the City's population density, based on information from the 2000 U.S. Census Block groups.

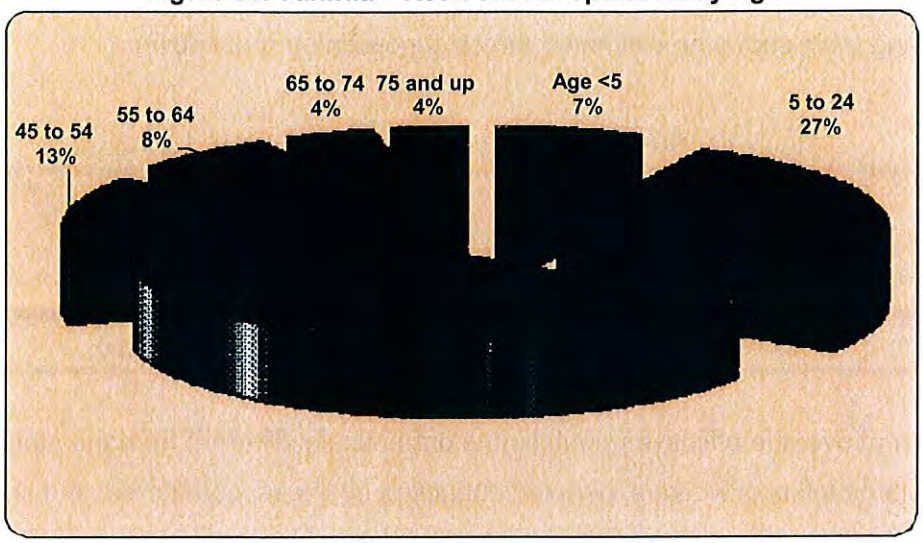
Figure 59: Tukwila – Residential Population Density



The highest concentration of population is north of Highway 518/I-405 and near Stations 54 and 52. As one factor influencing emergency service demand, the population age and socioeconomic characteristics composition were examined.

The following chart examines the City's population segmented by age groups.

Figure 60: Tukwila – Residential Population by Age



Selected Demographic Information 1990 – 2000								
Year	**Total Pop**	**Age <5**	**5 to 24**	**25 to 44**	**45 to 54**	**55 to 64**	**65 to 74**	**75 and up**
2000	17,181	1,233	4,672	6,409	2,261	1,261	726	619
1990	11,874	772	2,963	4,838	1,300	973	702	326
Change	**45%**	**60%**	**58%**	**32%**	**74%**	**30%**	**3%**	**90%**

As seen in the figure (Figure 60 above), eight percent of the population is 65 years of age or older, and seven percent of the population is under five years of age.[23] Fifteen percent of the City's population is in the age groups that are at the highest risk in a residential fire incident. Significant growth of the elder population is expected to occur over the next two decades. Those aged 40-50 years of age will be entering into a period of life when humans are more prone to medical events. This will have implications on the future EMS workload of the department.

Non-residents in the City are the effective population. The effective population consists of commuting workers, shoppers, and those traversing through major arterial routes. Precisely tabulating this volume can be challenging. These individuals are additional points of service

[23] U.S. Census population, year 2000.

demand not reflected by the static residential population analysis. Additionally, workers who commute to this area are not conveyed in residential population analysis.

The following table shows an estimated effective population breakdown.

Figure 61: Estimated Daytime Effected Population for Tukwila[24]

Total Resident Population	Estimated Influx of Workers	Estimated Workforce Living and Working in Tukwila	Estimated Influx of Workers	Estimated Daytime Population from Commerce, Business and Shopping	Total Estimated Daytime Population
17,240	42,000	-1,500	40,500	100,000	157,740

In the table above, the effective population is dramatically different from the static population of 17,240. A large influx of workers, people conducting business, commerce, and shoppers require TFD to be available and prepared to protect a population larger than those residing the City.

Current Housing Analysis

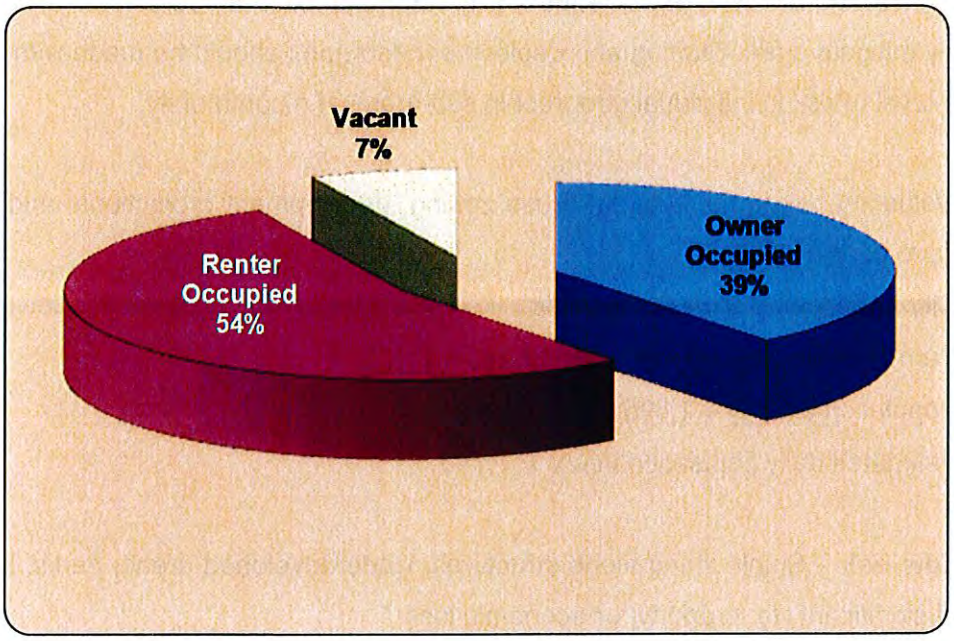
This section examines the housing characteristics of Tukwila and its composition geographically.

The following figure details the City's housing occupancy status – vacant, owner, or renter occupied.

[24] Source – Derek Speck, Economic Development Administrator, City of Tukwila, WA.

The following figure (Figure 62) details the occupancy types for housing within the City.

Figure 62: Tukwila – Housing by Occupancy



The following table shows the percentage of change in the three housing unit criterion.

Figure 63: Tukwila – Housing Unit 10 Year Change

Selected Housing Information, 1990 – 2000				
Year	**Housing Units**	**Owner Occupied**	**Renter Occupied**	**Vacant**
2000	7,725	3,045	4,141	539
1990	5,972	3,422	2,217	333
Change	**29%**	**-11%**	**87%**	**62%**

Nationally, negative indicators such as a rental and vacant properties correlate with a higher amount of emergency incidents. Although this is a single measure, it must be viewed cautiously in light of areas with similar numbers that tend to require abundant supplies of rental housing.

The following section is an examination of the fire and life risks associated with certain property type uses, the impact on a community's population projections, and the potential effect on the workload of the fire department.

Community Risk Analysis

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

When evaluating risk in the City, land use zoning, development projections, and the following criteria were considered:

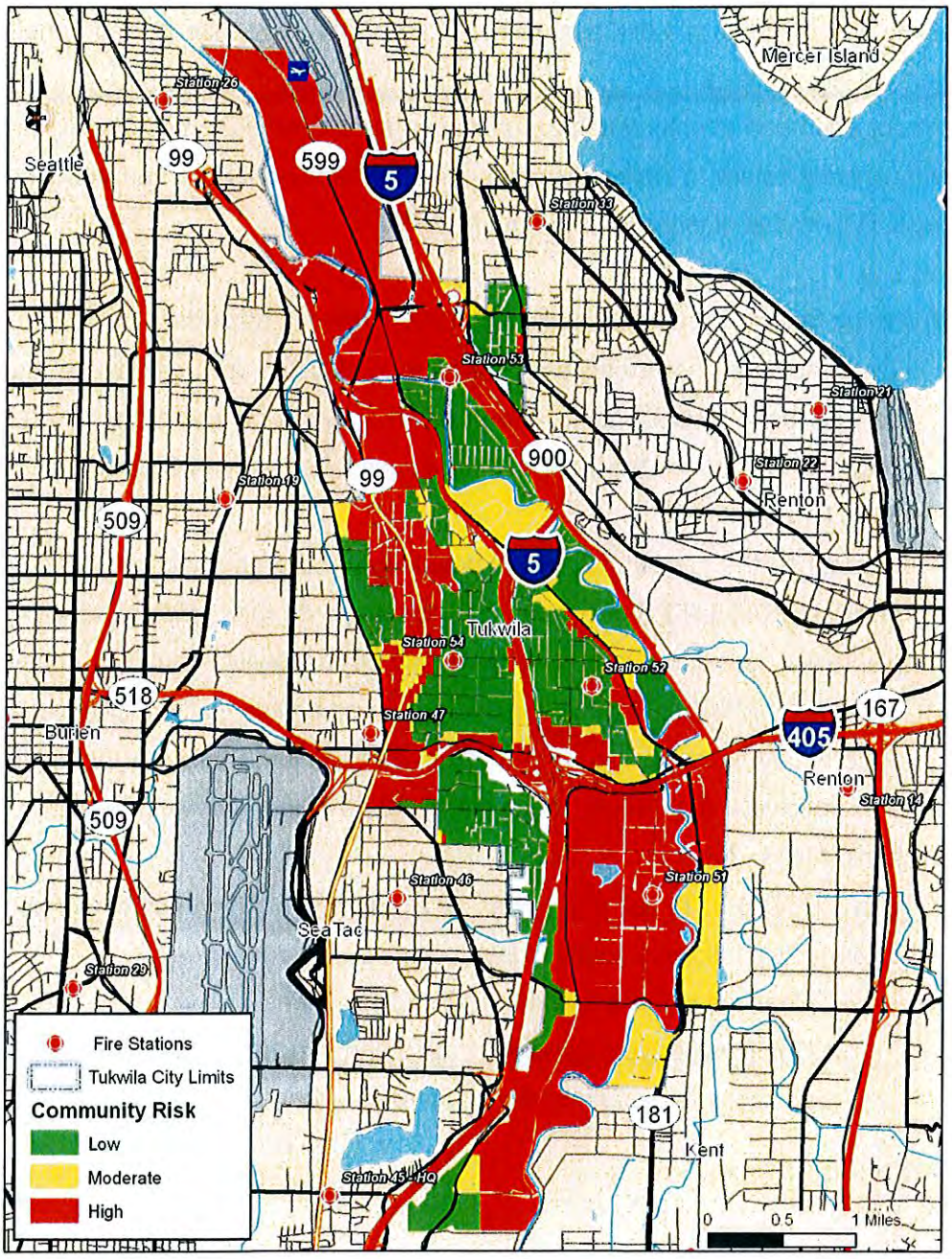
- City of Tukwila – 9.1 square miles
- Permanent (static) population – 17,240
- Population density – 1,895 per square mile
- Estimated daily population influx 157,740

- **Low risk** – Small, stand-alone structures. Underdeveloped areas, parks. Low likelihood of significant life, property, or economic loss.
- **Moderate Risk** – Buildings or areas with lower density populations, single or multi-family housing apartments not over two stories high and small stand-alone commercial properties or offices. Working structure fires in these types of occupancies will occasionally require extra alarms to control the fire.
- **High Hazard Risk** – Buildings or areas with a high risk of life, property, or economic loss. Property may or may not have built-in fire protection systems. Population density may be high (apartments, public subsidized housing three or more stories). Commercial properties may have some limited amounts of hazardous materials and normal combustible loads. Building or areas may have some commercial significance. Working structure fires in these types of occupancies may require some additional outside mutual or automatic aid at the scene. Pre-connected hose lines may or may not reach the seat of the fire.
- **Maximum Risk –** Buildings of ordinary construction, with no or limited built in fire protection, in close proximity of one another, and buildings with very high consequences relative to life loss, property loss, and economic loss. Working structure fires in these types of properties will almost certainly require extra alarms to control them. Pre-connected hose lines may not reach the seat of the fire.

- **Special Risk –** Single buildings or complexes presenting a risk to life or property above that of the surrounding area.

The following map translates land use (potential scale and type of development in geographic sub-areas) to categories of relative fire and life risk.

Figure 64: Tukwila Community Risk



Tukwila contains mostly higher risk properties. The predominance of highest risk is located at the City's north and south sides, and in certain non-residential developments along the major arterials such as International Blvd. and Interurban Avenue. The Boeing Corporation, on the very north side, shares the large commercial presence with other employers along these routes. A major shopping mall is also located on the southeast corner of the I-5/I-405 freeway interchange.

A review of a community's risk assessment for non-fire response is also beneficial. As TFD is considered an all hazard agency, non-fire related incidents factor into response activity. The criteria for each non-structural risk are assigned ratings of high, medium, and low. Each of the listed scenarios refers to major disasters causing loss of life, human suffering, and property damage. Day-to-day emergencies are not included.

The following factors are used to assess non structural risk hazards.

- The number of occurrences of the type of disaster under study for the past 25 years derives the HISTORY rating. If it an event has not occurred and if conditions have not changed to increase the hazard, the rating is *low*; once in 25 years - *medium*; and two or more times - *high*.
- Comparing the area at risk to the population and property density can derive estimates of VULNERABILITY. For example, thinly populated rural jurisdictions near nuclear power plants are considered less *vulnerable* than more heavily populated urbanized areas.
- The MAXIMUM THREAT is the greatest destruction that could occur for the disaster under study. For example, with a nuclear attack, jurisdictions within a high-risk or target area receive a *high* rating; those within 30-40 miles - *medium*; and other, more remote jurisdictions - *low*.
- The PROBABILITY of a disaster is a subjective judgment made primarily by local officials. The following guide is used:
    - Chances per year greater than 1 in 10 - high
    - Chances per year between 1 in 10 and 1 in 1000 - medium
    - Chances per year less than 1 in 1000 - low

The following table indicates the community risk assessment for non-structural fire response risks.

Figure 65: Summary Table of Hazards Analysis and Score

Threat	History	Vulnerability	Max Threat	Probability
Airplane Crash	low	high	high	low
Civil Disturbance	low	medium	medium	low
Drought	high	low	low	medium
Earthquake	medium	high	high	high
Electric Outage	high	medium	medium	high
Fire or Explosion	medium	medium	medium	medium
Flash Flood	low	low	medium	low
Flood, Major	low	low	low	low
Fuel Shortage, Major	low	medium	medium	low
Hazardous Materials	high	medium	high	high
Highway Accident	high	low	low	high
Nuclear Attack	low	medium	low	low
Pipeline Accident	low	high	high	medium
Structural Collapse	low	medium	High	high
Water Shortage/ Contamination	medium	medium	medium	medium
Windstorm/Ice/Severe Storms	high	high	high	high
Winter Storm	high	high	high	high

Future Population Projections

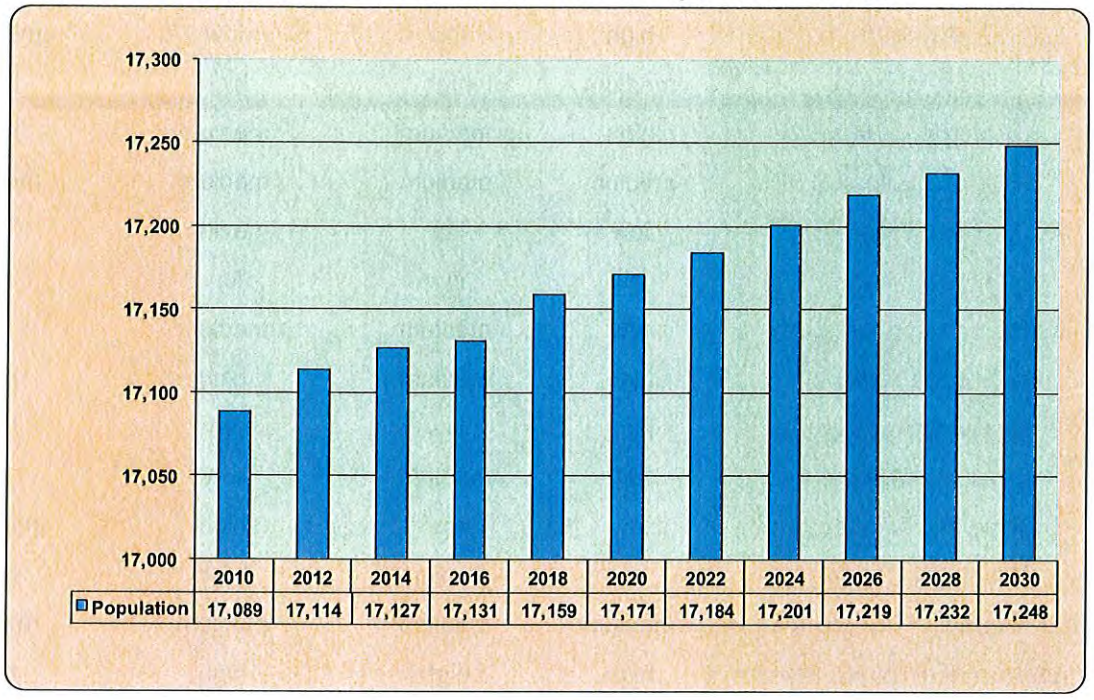
In order to develop service demand projections, growth, in terms of population based on census and development, was examined. It is not the intent of this study to be a definitive authority for the projection of future population in the service area, but rather to base our recommendations for future fire protection needs on a reasonable association with projected service demand. Since we know that 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.

As indicated earlier, the City's population has increased modestly over the last 15 years. ESCi anticipates this growth will continue into the future, but at a slower rate than in the past due to land availability. In developing forecasts for population growth, we typically develop a forecast

based on several decades of census experience. In the case of Tukwila, we used the estimate growth figures from the U.S. Census Bureau and assumed a similar rate of growth in a forecast created through the year 2030.

The population forecast appears in the following figure.

Figure 66: Tukwila – Census-based Population Forecast



	2010	2012	2014	2016	2018	2020	2022	2024	2026	2028	2030
Population	17,089	17,114	17,127	17,131	17,159	17,171	17,184	17,201	17,219	17,232	17,248

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

In the case of Tukwila, we used the estimate growth figures from the King County Buildable Land Report, 2007 and assumed a similar rate of growth in a forecast through the year 2030.

The figure below illustrates the development-based population estimate (Figure 67).

Figure 67: Tukwila – Development-based Population Projection

	2010	2012	2014	2016	2018	2020	2022	2024	2026	2028	2030
Population	18,077	18,352	18,640	18,933	19,204	19,447	19,597	19,862	20,161	20,400	20,633

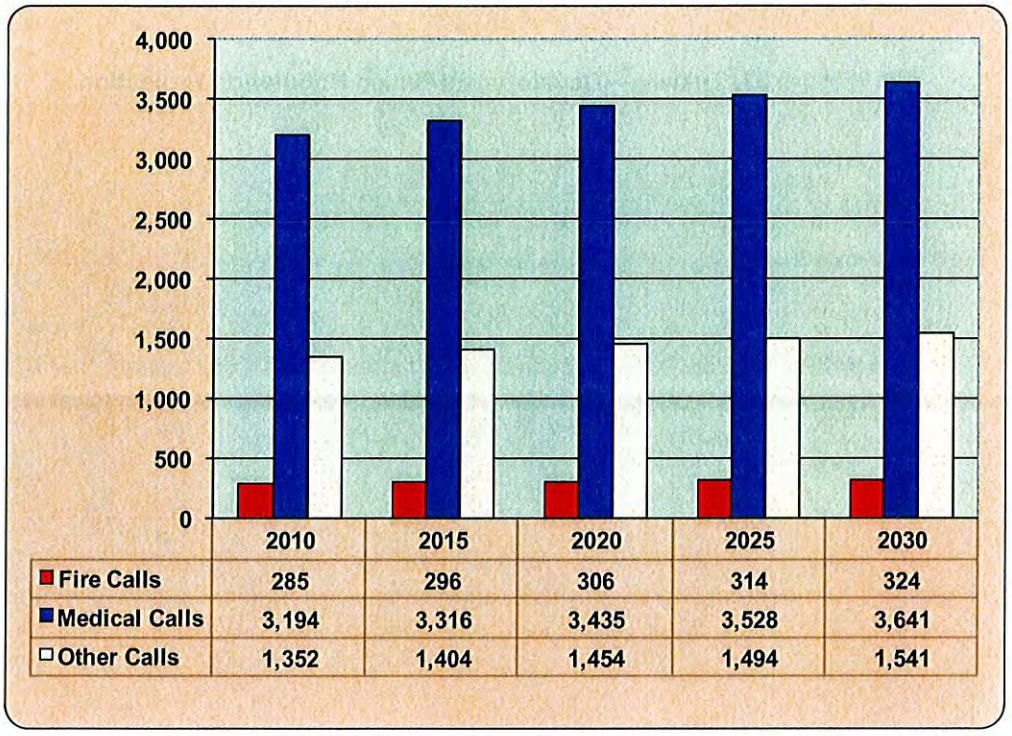
While we can see a variation in the population projections discussed here, one thing is certain; TFD will continue to be an emergency service provider to a growing population, likely exceeding 20,000 by 2025. Planning should begin now to acquire and maintain the resources needed to meet the continued demand for services.

Future System Demand Projections

In evaluating the deployment of facilities, apparatus, and staffing, it is essential that consideration be given to potential changes in workload and service area that would affect deployment. Any changes in service demand can require alteration and adjustment to the deployment of staff, resources, and equipment in order to maintain acceptable levels of performance.

For this study, ESCi used the City's population projections to forecast through 2030. These projections were multiplied by the forecast-incident-rate, derived from incident per capita rates. The incident rate identified potential workload. The analysis results are shown by year and type of call in the following chart and table.

Figure 68: Tukwila – Workload Projection by Type and Year



	2010	2015	2020	2025	2030
Fire Calls	285	296	306	314	324
Medical Calls	3,194	3,316	3,435	3,528	3,641
Other Calls	1,352	1,404	1,454	1,494	1,541

It is projected that incidence of actual fire events to remain relatively stable, thanks to automatic suppression systems and new construction features. ESCi believes that the increase of fire related calls could be positively impacted if the recommendation to hire a full-time fire educator and additional inspectors is acted upon. Other fire related alarms are expected to increase along with requests for medical aid (EMS). Medical calls are projected to increase more significantly due to a larger number of the population entering their senior years of life.

Future Delivery System Model(s)

The Tukwila Fire Protection Master Plan is intended to provide strategies that are long-term in nature. A master plan identifies the most critical issues the fire department will face over the long haul, out as much as twenty years in the future. We initiated that process in the previous section where we reviewed community growth, identified risks, and evaluated service demands. We will compile the information learned in that section, as well as the evaluation of future service demands, to provide a recommended long-term strategy. The recommended strategy is a guide for the growth and development of a healthy TFD organization, capable of providing the services that are valued most by its customers.

Future Deployment Recommendations

The following long-term resource deployment strategies are intended to enable the Tukwila Fire Department to continue its existing informal level of service of five minutes and thirty-three seconds response time, 90 percent of the time throughout the City, and, where possible, improve toward its target performance objectives of *NFPA 1710* standards as the community grows. In this section, operational performance levels are discussed. Additionally, existing facilities, the need for additional stations if necessary due to annexation growth, apparatus deployment and usage, as well as the staffing levels are discussed.

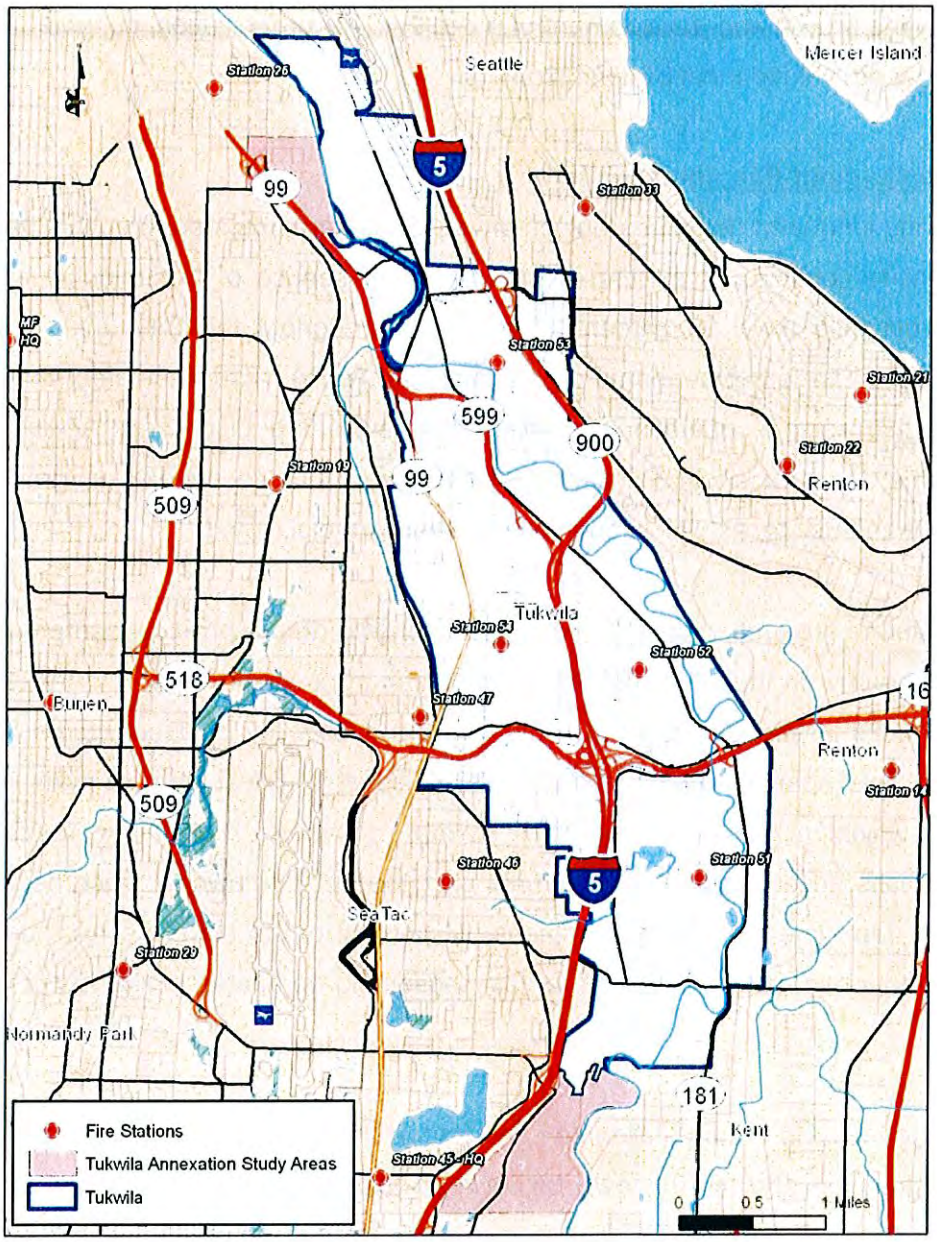
The provision of fire protection in Tukwila is challenging due to physical barriers that exist. The valley topography on the west side leads to a steep ridge which rises in the west part of town creating breaks in street connectivity - limiting the availability of direct routes for emergency apparatus. This connectivity of streets has additional physical barriers with limited access highways which divide the City into several sections. Highways provide for limited over/underpass access routes which create circuitous traffic flows to reach destinations. With the current deployment of TFD fire stations, 94 percent of the current service demand can be reached in four minutes of travel time or less, assuming apparatus availability in the respective stations.

According to the King County Buildable Land Report 2007, the City should experience growth of 3,000 housing units and 16,000 new jobs between now and 2022.

It is expected that future service demand patterns will essentially mimic current experience with higher volume near Station 54, the central highway interchange, the mall, and the commercial area between Station 52 and Station 51. There are, however, two areas on the north and south ends of the City, which may be subject to annexation. These areas would create a measurable level of service demand that TFD would need to serve.

The following map illustrates the location of annexation areas in relation to the rest of the City.

Figure 69: City of Tukwila Potential Annexation Area



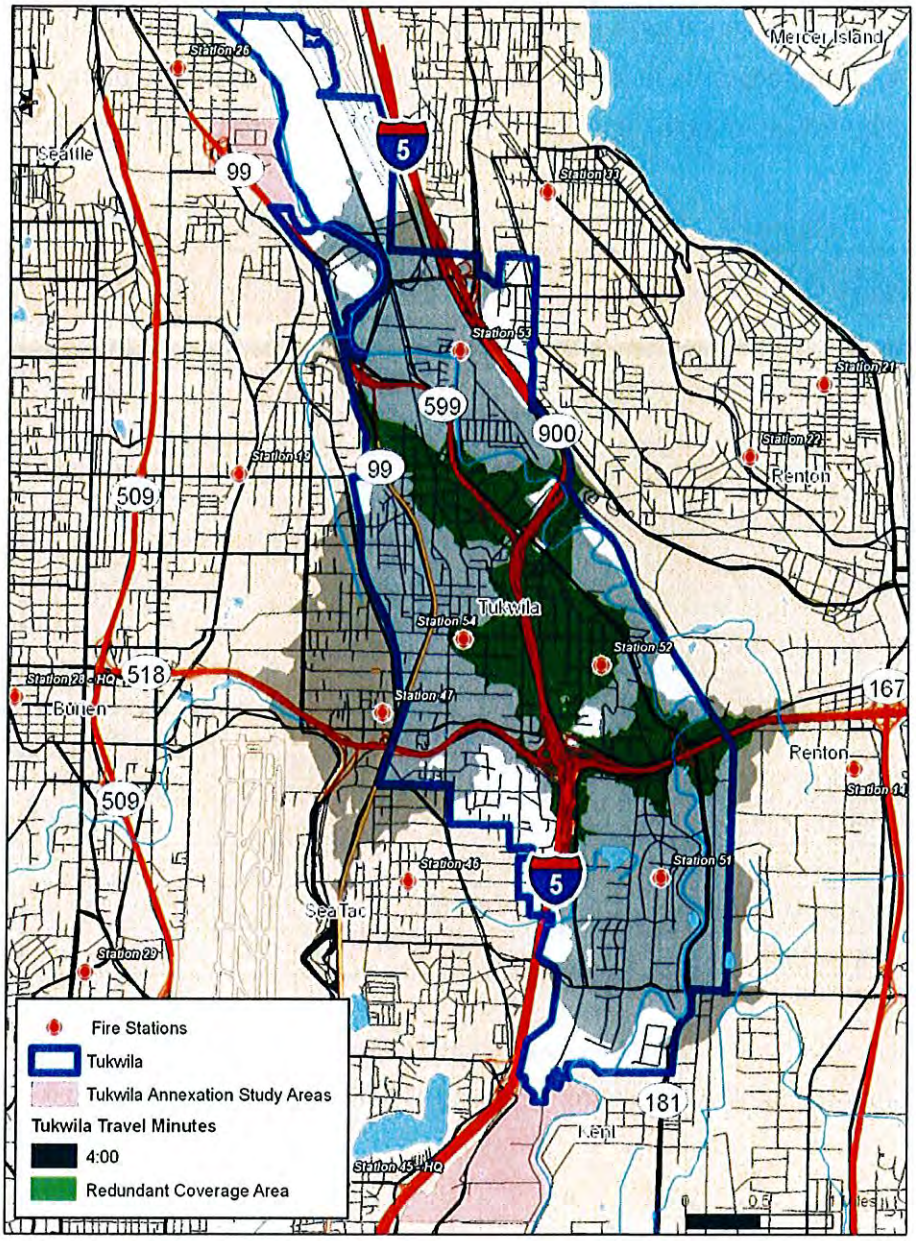
The north end annexation area is currently developed with commercial and industrial properties. The south end annexation area is also known as the Tukwila Valley South (TVS) area. The TVS annexation is 10.3 million square feet proposed of mostly commercial, retail, and offices. While these types of properties have not historically been the highest generators of service demand (detailed in the following table), it is apparent that they do generate additional service demand.

Figure 70: TFD - Historical Service Demand by Zoning Designation

Zoning Description	All Call Types	Fire Calls	Medical Calls	Other Call Types
Tukwila Urban Center	22.7%	25.8%	20.1%	28.6%
Low Density Residential	21.5%	29.0%	22.9%	16.8%
High Density Residential	13.8%	12.9%	14.7%	11.8%
Neighborhood Commercial Center	8.2%	7.1%	9.4%	5.5%
Commercial/Light Industrial	6.6%	7.7%	5.4%	9.3%
Manufacturing Industrial Center/Heavy	6.3%	4.5%	5.6%	8.1%
Regional Commercial Mixed Use	5.8%	5.2%	5.3%	7.3%
Medium Density Residential	4.4%	3.2%	5.1%	2.8%
Regional Commercial	3.4%	1.3%	3.3%	3.9%
Office	3.1%	0.6%	3.8%	1.9%
Manufacturing Industrial Center/Light	2.2%	1.3%	2.2%	2.4%
Residential Commercial Center	1.0%	N/A	1.2%	0.5%
Heavy Industry	0.5%	1.3%	0.3%	0.8%
Mixed Use Office	0.3%	N/A	0.3%	0.1%
Light Industrial	0.1%	N/A	0.3%	0.1%

Emergency response to both annexation areas is via a single roadway. Neither area falls within a modeled four-minute travel time from existing TFD fire stations (Figure 71).

Figure 71: TFD Four-Minute Travel Time Capability and Annexation Study Areas



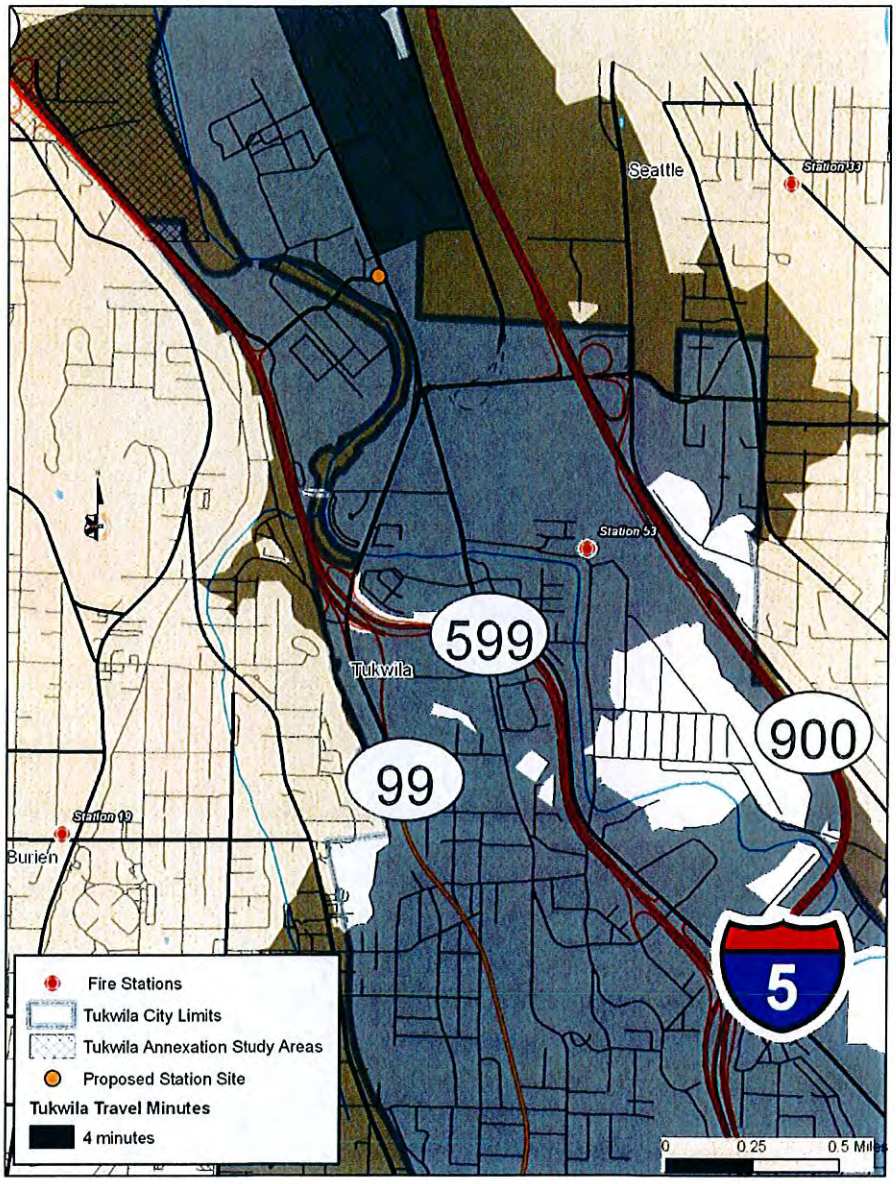
The green shading indicates the extent to which multiple apparatus can simultaneously reach an area in four minutes. Redundancy is beneficial in areas of high community risk and incidences where response protocol requires a multiple apparatus response. This would involve several stations such as a structure fire. Reducing redundant coverage is explored in the next section with alternates.

Facilities

The following discussion describes the attributes of current station locations and enhancements that may be derived from station relocation.

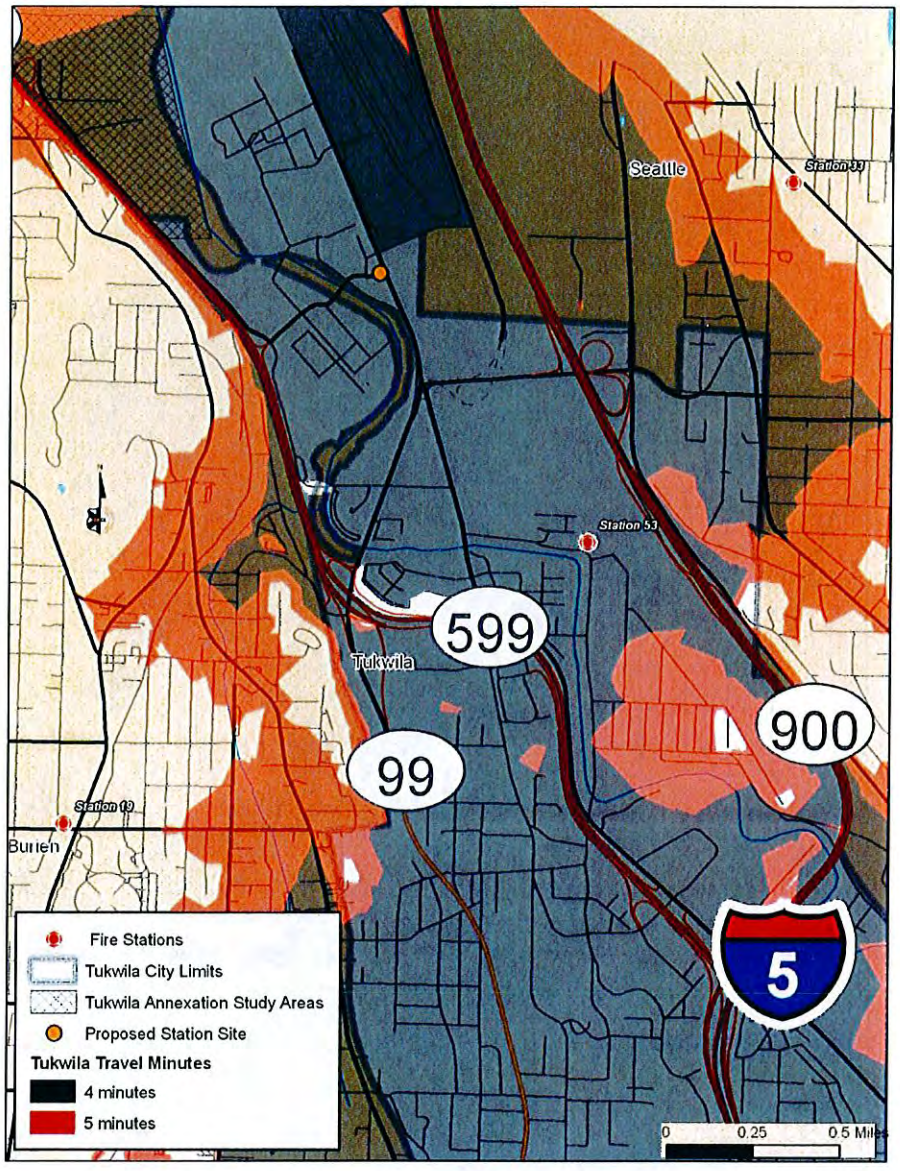
In the north end annexation study area, Station 53 would need to be relocated if coverage in this area if response time parameters are to be met. A new fire station located at 112th and East Marginal Way would provide coverage for this area within four minutes (as shown in the following figure). The existing fire station location is not modeled.

Figure 72: TFD Relocated Fire Station No. 53 Travel Time Capability – Option A



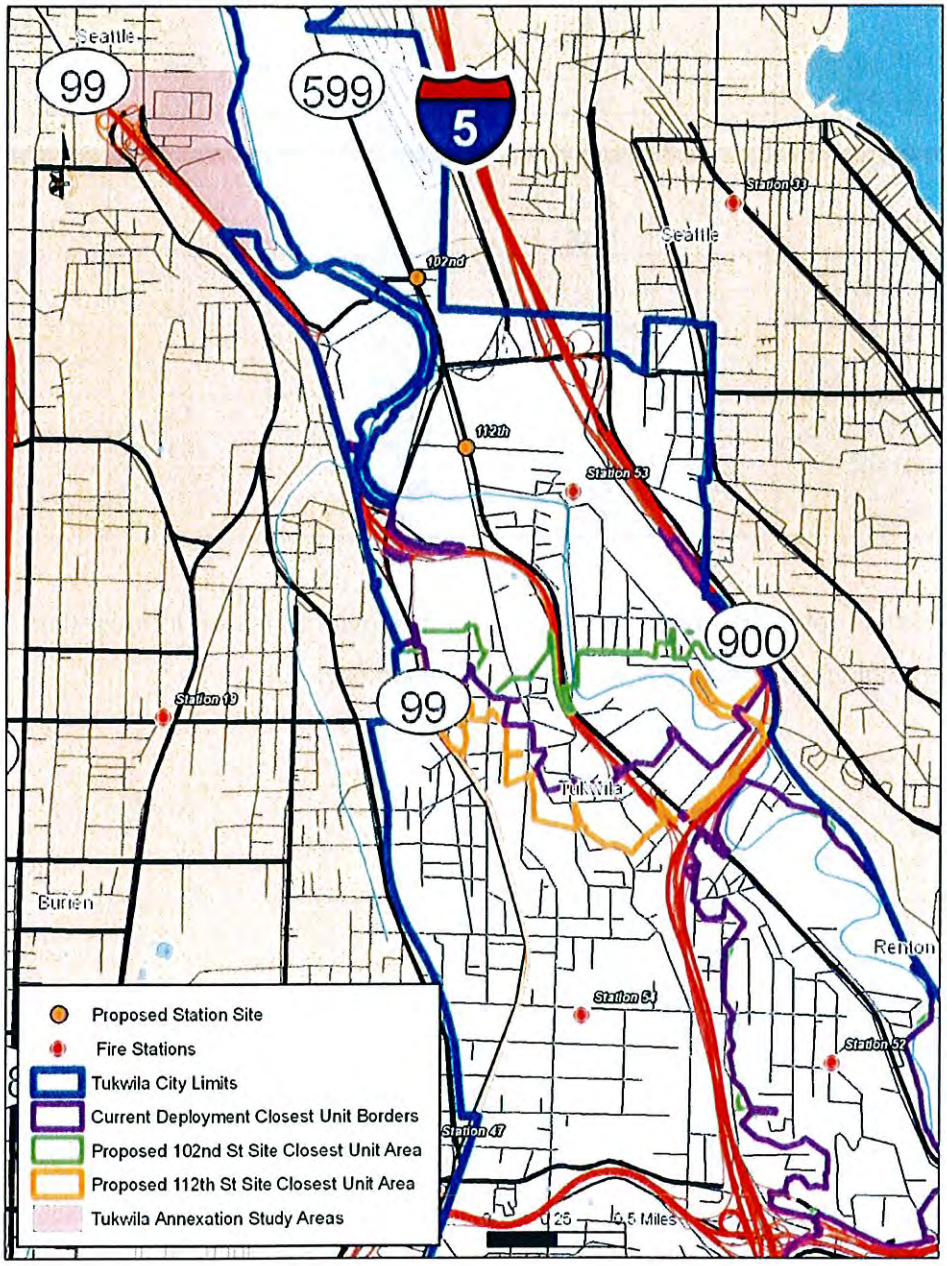
While a certain extent of the redundant service area coverage would be reduced naturally, a portion southeast of the current station location is unable to be reached within four minutes. Alternatively, a relocated station at 112th Street and East Marginal way would continue coverage to the area, but reduce the ability of an apparatus to reach the northern annexation study area by another minute as illustrated with the following map (Figure 73). Again, the current fire station location (Station 53) is not modeled. Additionally, the pedestrian bridge over the creek on 112th is also blocked to the modeling routes.

Figure 73: TFD Relocated Fire Station No. 53 Travel Time Capability – Option B



Relocation would create changes to closest unit areas, for not only distance, but also travel speeds of roadways the stations are located on as well. The following map illustrates the changes that would result from relocating Station 53 along East Marginal Way compared to the current location.

Figure 74: TFD Closest Unit Response Areas, Relocated Fire Station No. 53



The following table details the affect on workload and performance for all TFD stations based on closest travel time to historical incidents in the response areas.

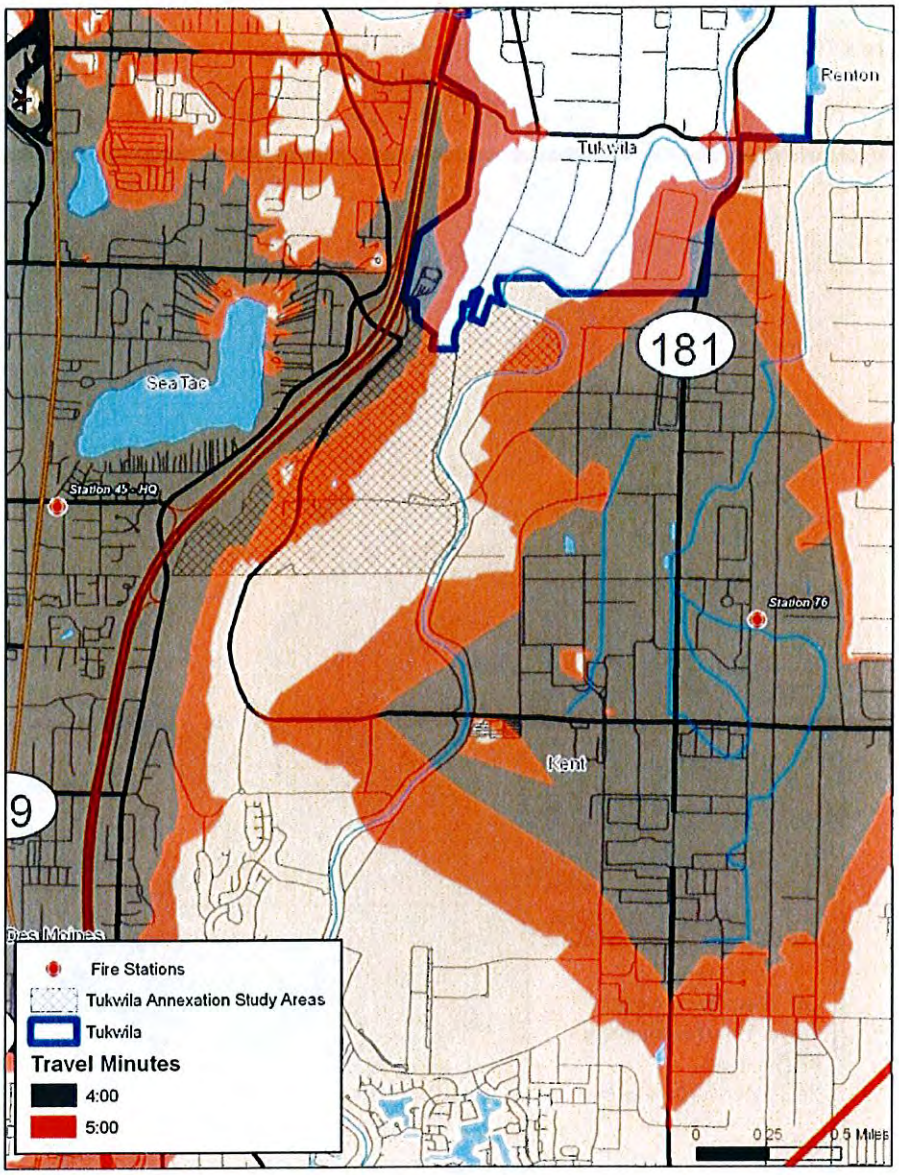
Figure 75: Call Volume & Travel Time, Net Changes for Relocated Fire Station No. 53

Facility Deployment Scenarios	Station Number	Call Volume	Total Travel *Hours* to Closest Incidents	Call Volume Difference	Total Travel Time Difference (Hours)
Current Facility Deployment	53	556	27.25	N/A	N/A
	54	1645	54.41	N/A	N/A
	52	507	20.32	N/A	N/A
	51	955	36.34	N/A	N/A
Total		3663	138.33	N/A	N/A
Stn 51 @ Southcenter Pkwy/180th St.	53	556	27.25	0	0.00
	54	1618	51.93	-27	-2.49
	52	777	36.63	270	16.31
	51	712	30.60	-243	-5.74
Total		3663	146.42	0	8.08
Station 52 @ 15000 block of 65th St	53	557	26.16	1	-1.09
	54	1602	51.32	-43	-3.09
	52	771	26.31	264	5.99
	51	733	26.63	-222	-9.71
Total		3663	130.42	0	-7.91

With the station relocation on a main arterial it improves the overall travel time, but the 102nd Street site would place additional workload on Station 54.

In the Tukwila Valley South (TVS) annexation area, SeaTac Fire Station No. 45's apparatus can reach a small portion of this area within a four or five minute travel time as illustrated in the following map. According to modeling, Kent Fire Department Fire Station No. 76's apparatus is unable to penetrate into this area within the five-minute travel time.

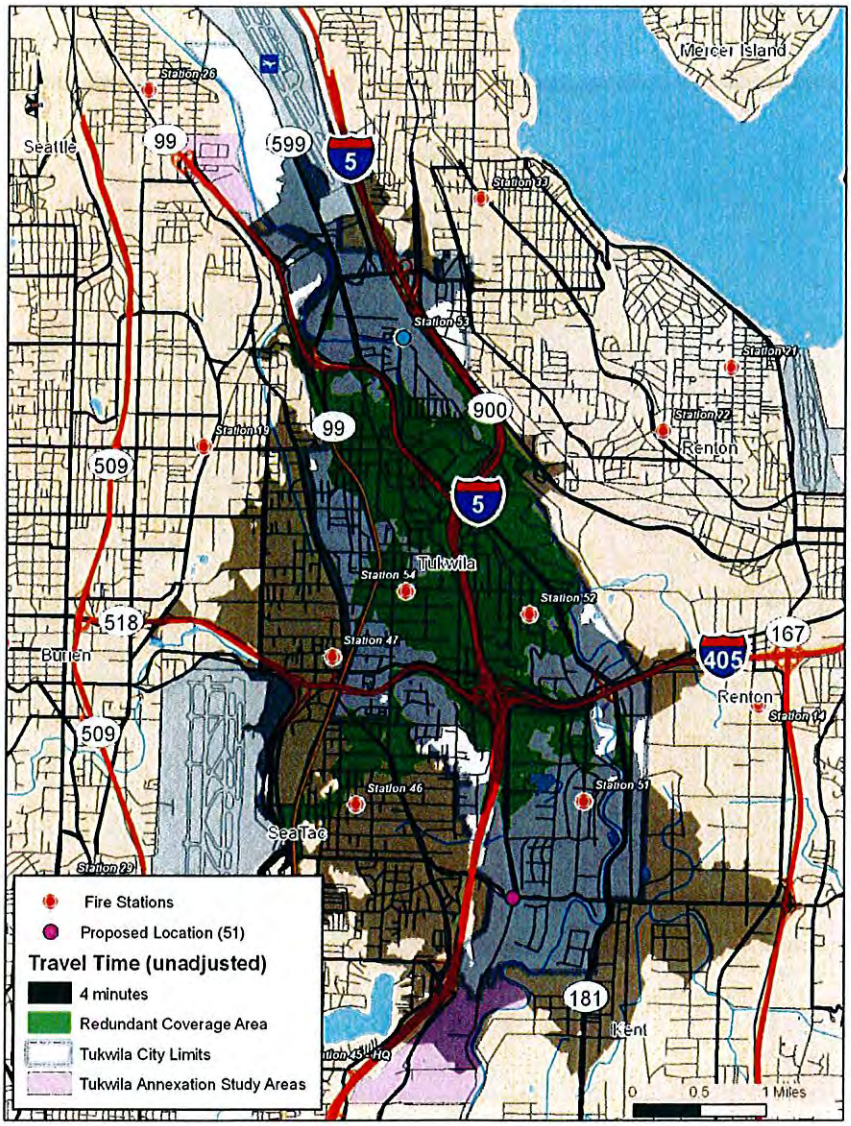
Figure 76: TFD – TVS Annexation Study Area - Mutual Aid Travel Time Capability



Another proposed relocation site for Station 51. to provide better coverage into this area. is Southcenter Pkwy. and 180th Street.

The following map illustrates this location and the unadjusted[25] travel time capability reflecting existing conditions. If this annexation occurs, Southcenter Parkway would be relocated slightly; made into a four lane road with a posted speed of 35 -45 mph. This new road reconfiguration would impact response times. The current location of Station 51 is not used in this travel time model, only the proposed location is used.

Figure 77: TFD Proposed TVS Station Unadjusted Travel Time Capability - 4 minutes

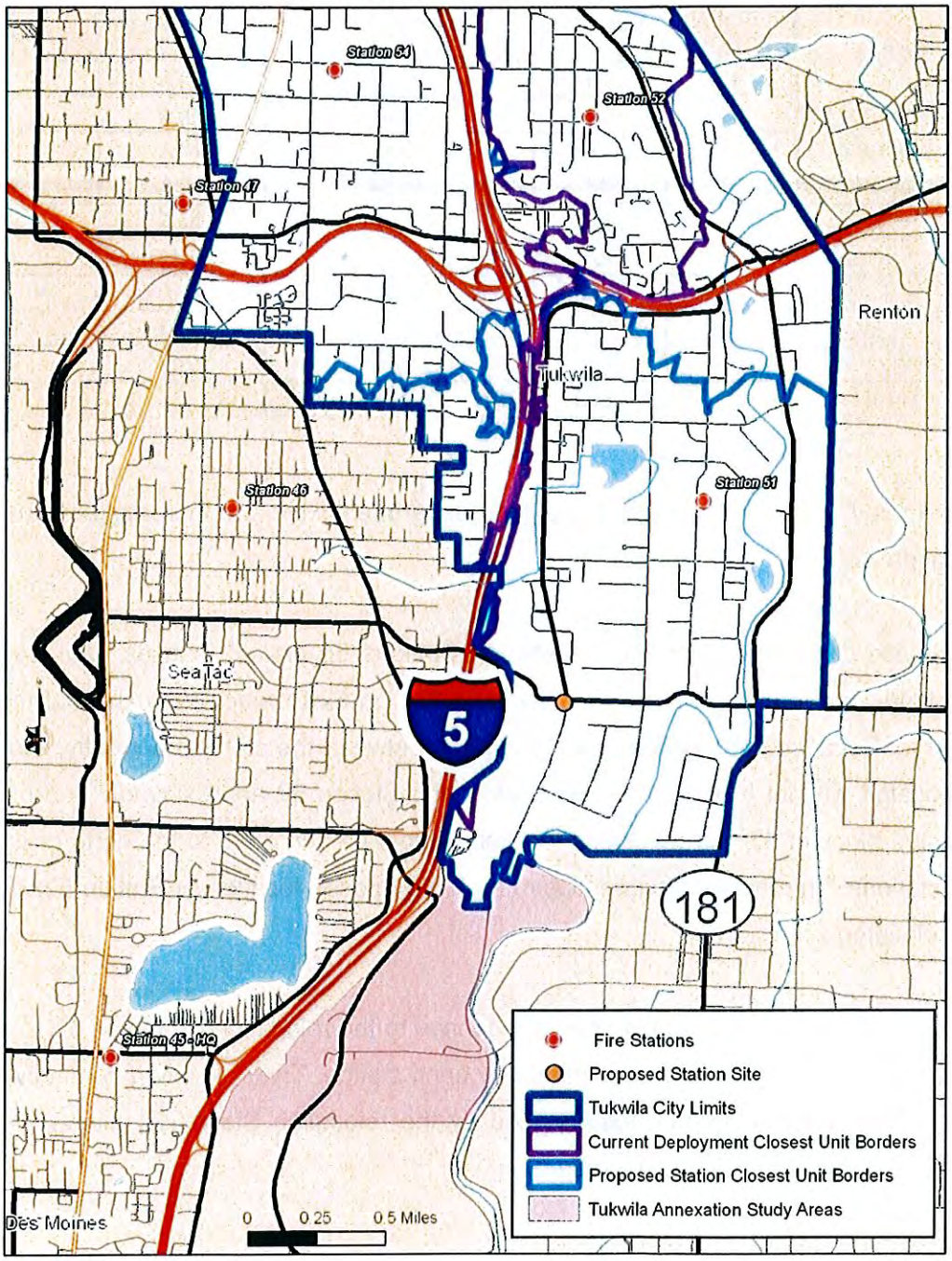


This relocation strategy will impact the closest unit response areas.

[25] Unadjusted travel time is derived by removing certain traffic calming devices and disregard for road type.

The following map illustrates the changes that result from relocating Station 51 further south compared to the current location.

Figure 78: TFD Closest Unit Response Areas – Relocated Fire Station No. 51



The following table details the changes in workload and station performance based on closest travel time to historical incidents in the closest station response areas, if Station 51 is relocated.

Figure 79: Call Volume & Travel Time Net Changes for Relocated Fire Station No. 51

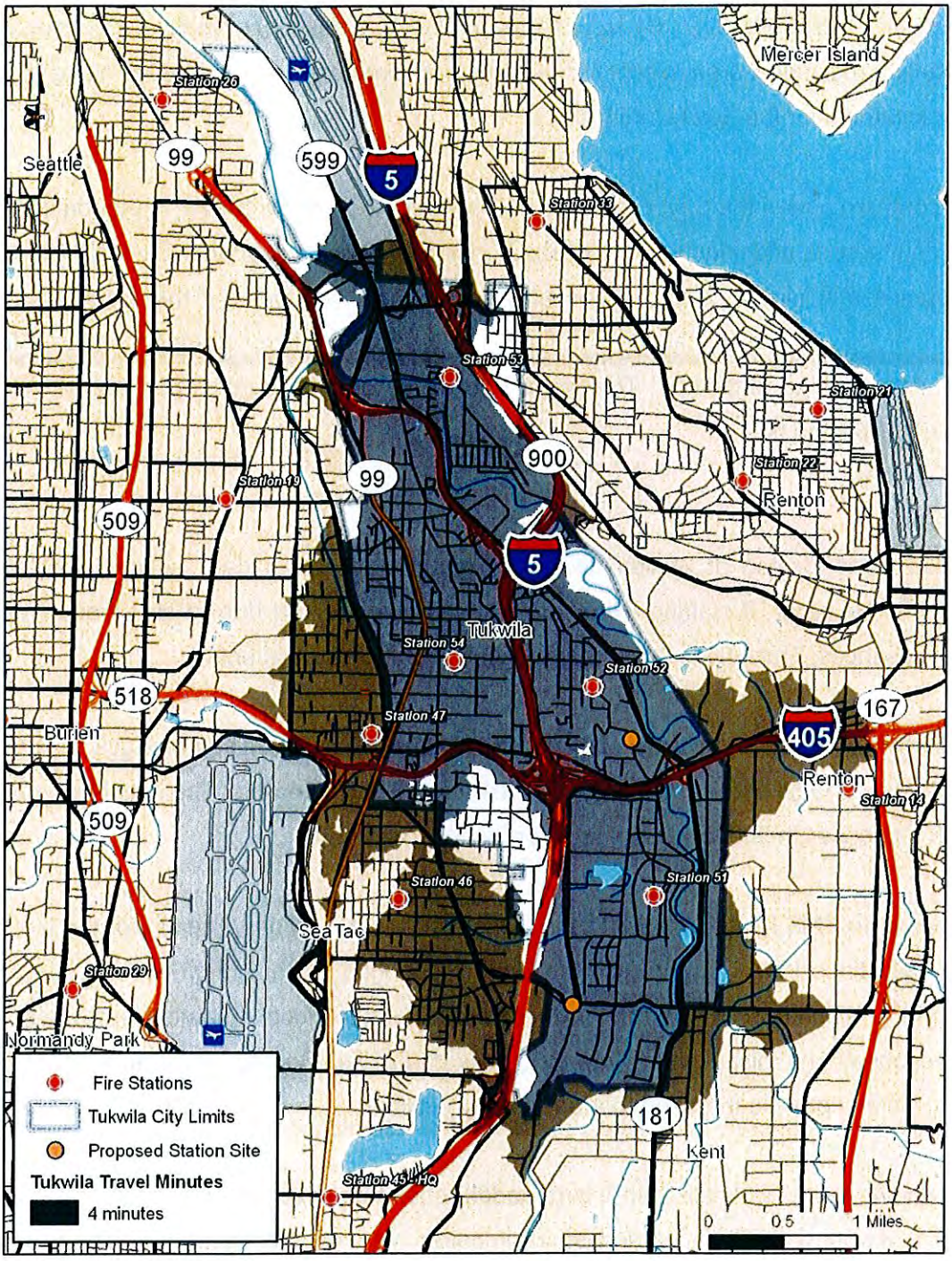
Facility Deployment Scenarios	Station Number	Call Volume	Total Travel *Hours* to Closest Incidents	Call Volume Difference	Total Travel Time Difference (Hours)
Current Facility Deployment	53	556	27.25	N/A	N/A
	54	1645	54.41	N/A	N/A
	52	507	20.32	N/A	N/A
	51	955	36.34	N/A	N/A
Total		3663	138.33	N/A	N/A
Stn 51 @ Southcenter Pkwy/180th St.	53	556	27.25	0	0.00
	54	1618	51.93	-27	-2.49
	52	777	36.63	270	16.31
	51	712	30.60	-243	-5.74
Total		3663	146.42	0	8.08

The net result would increase the travel time department wide and increase response workload for Station 52.

The service demand coverage gap between Stations 51 and 52 causes an increase in total travel time. Apparatus must travel further from Station 52 to reach the calls that they are now closest to. Because there is redundant coverage between the stations currently, Station 52 can be relocated without loss in coverage. Relocating Station 52 approximately one mile south to the 15000 block of 65th Street closes the gap without creating one to the north or east with the other stations. The following figure illustrates the proposed location of Station 52, once Station 51 is relocated southward.

The result of relocation for Station 52, in response to the relocation of Station 51, is a reduction in total travel time to the closest incidents by each station. This relocation generally erased the increased the total travel time experienced by the relocation Station 51 alone. The following map shows the relocation response area.

Figure 80: Proposed Station 52 Relocation Site



Apparatus

The ladder truck at Station 54 is used as the primary response vehicle. This station serves primarily a residential area except for some higher community risk properties along International Blvd. located near the SeaTac City limits.

The southern part of the City, east of I-5 and south of the I-405 freeway, is predominately higher risk commercial and industrial properties, including large regional retail facilities. Based on thresholds and triggers (included as an appendix in this report), if the southern annexation occurs along with the relocation of Station 51 to the south, it is recommended that TFD relocate the ladder truck to Station 51. This move will require an additional staffed engine company be housed at Station 54.

Aid Car

An aid car is located at Station 54. TFD staffs the aid car if daily adequate personnel are available. However, if staffing levels are at minimum strength due to sick leave, vacation, or other absences, Truck 54 is the primary response unit on all incidents.

An analysis of unit hour utilization of Truck 54 reveals the current UHU of Truck 54 is 606 hours, 12 minutes, and 54 seconds, the highest UHU of all TFD apparatus. The high UHU correlates to 1,555 responses in 2007, again the most of all TFD apparatus.

Response to EMS related calls with the ladder truck is the primary reason for the high UHU on Truck 54, since King County EMS is a tiered response system. First, local emergency units respond to all medical calls placing the responsibility on the local emergency provider to provide first response and initiate definitive emergency care. King County Medic units respond only to ALS calls and provide transport to area medical facilities.

Responding to medical calls with a large ladder truck has several drawbacks. Response time is slowed, maneuverability and access is impaired when larger apparatus (engine or truck) encounters traffic congestion, narrow driveways or streets, and parking on both sides of the street. Figure 35, *Cardiac Arrest Event Sequence,* illustrates that patient survival is compromised the longer the response time. Cardiac defibrillation and airway management are critical tasks that must be initiated in the first five minutes of a cardiac event. Survivability decreases approximately seven to ten percent for every minute between collapse and

defibrillation. The American Heart Association recommends that cardiac defibrillation occur within five minutes of cardiac arrest.

Larger fire apparatus are not cost effective to use on EMS response. They require frequent maintenance, repair, and have a shorter life expectancy when used in this manner. Further, increased fuel costs are avoided by using an aid car.

ESCi believes that several positive benefits will be derived from staffing an aid car. We offer the following benefit considerations:

- Staffing an aid car will reduce station failure rates caused by multiple calls for service (concurrency).
- Unit hour utilization will drop, extending the service life of the apparatus.
- Maneuverability and access is improved using a smaller response vehicle.
- Staffing an aid car will support the unofficial response time goal of TFD.
- Less usage of the ladder truck will provide savings on fire apparatus maintenance and reduce diesel fuel costs.
- If relocated, the ladder truck company will add a resource to handle concurrency in Station 51's response area.
- If the ladder truck is relocated to Station 51, an engine will be needed for Station 54 ($575,000).

Considering current and projected workload, and potential cost avoidance, it is recommended that TFD alter the current method of responding to medical calls. This can be accomplished by staffing an aid car for medical related calls at Station 54.

Staffing

ESCi has recommended that consideration be given to several new positions in TFD support functions. The benefits of each position to the organization are discussed below.

- An assistant chief position is recommended. This position would be responsible for logistics and strategic planning. The addition of this position would provide additional administrative capacity in the department, plan and oversee support services, purchasing, and inventory control, and have responsibility for long-term strategic planning and be charged with implementation the TFD Master Plan.

- We recommend the addition of a training captain. Working under the guidance of the battalion chief - training, this position would provide needed capacity and the hands on presence in training. This position would also coordinate training strategies between shifts, assist in long-term training development, career development, the certification process, and information technology.

- We recommend a deputy fire marshal. Working under the guidance of the battalion chief - fire marshal, this position would provide additional administrative capacity to the department; assist in oversight and planning of a comprehensive inspection/code enforcement and public education program, pre-incident planning, training, and assistance to firefighters who perform basic company level inspections.

- We recommend two civilian inspector positions. Current and future workload projections will necessitate more inspection and code enforcement capacity. The addition of these positions would assist in providing the needed capacity to ensure that all inspectable properties in Tukwila receive comprehensive and timely inspections.

- We recommend a public educator/public information officer. TFD does not have an effective, pro-active public prevention education program due to limited staff resources. With a large number of multiple housing units, condominiums, hotels, and commercial buildings, this position would plan, develop, and oversee targeted fire and health prevention themes. This position would also act as the single point of contact for news releases and the media during emergencies.

- We recommended that TFD staff an aid car. In order to accomplish this delivery system improvement, an additional 7.8 new firefighter positions would be required. This number provides a staffed aid car with two FTEs daily. In order to cover for vacation time, sick leave, and other vacancies, this will require the additional 1.8 FTEs.

- If Station 51 is moved further south, we have recommended that the ladder truck from Station 54 be re-assigned to Station 51. This will necessitate the placement of an engine company in Station 54, with a full complement of engine company personnel (18-24 depending on daily coverage pattern). ESCi has not included the cost of the engine

company personnel in our personnel recommendations, but want to bring the issue to the forefront, so officials understand their will be additional financial impact required in this scenario.

The following table shows all recommended positions.

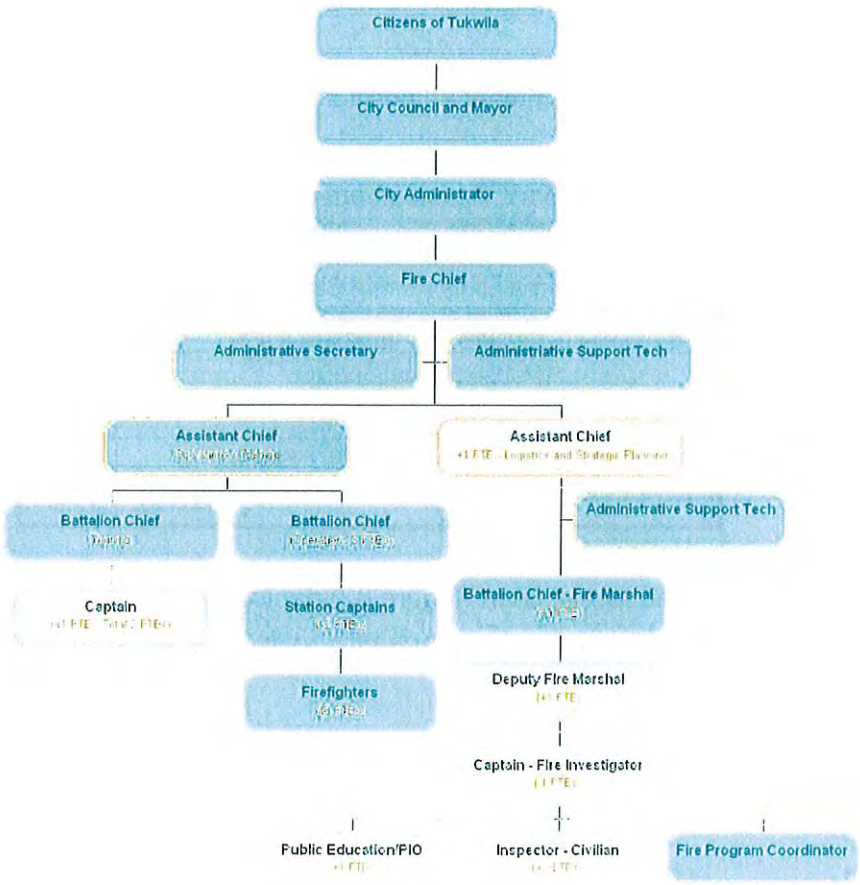
Figure 81: Recommended New Positions

Position	FTEs
Assistant Chief – Logistics and Strategic Planning	+1.0
Inspectors (civilian)	+2.0
Public Education/PIO	+1.0
Captain- Training	+1.0
Firefighters[26] – Aid Car 24/7 Staffing	+7.8
TOTAL	**12.8**

The recommended organizational chart (Figure 82) depicts how the new positions would align in the organization, and shows direct oversight and reporting functions. New positions are shaded in yellow.

[26] This figure does not include additional engine company personnel due to relocating Truck 54 to Station 51.

Figure 82: TFD Recommended Organizational Chart



Capital Improvement Planning – Facilities

Fire Station No. 51

This station is the headquarters station for TFD. The facility, in its current state, does not have adequate storage or office space. Several vehicles are stored outside of the building due to lack of apparatus bay space. An adjacent lot provides an opportunity for station additions, however if this facility is relocated further south and west of its current location, we would not recommend remodeling this station. If TFD moves the truck to Station 51, the apparatus bay will have to accommodate a much larger apparatus in length and height.

The anticipated cost to build a new headquarters station including reasonable project expenses would be approximately $11,870,000 not including land acquisition. Cost is based upon 25,000 square feet.

Figure 83: Fire Station No. 51 Cost Estimate

Fire Station No. 51 Headquarters	Estimated Costs
Cost Tabulation	
New Construction @ $400[27] sq. ft.	$ 10,000,000
Site Development @ $6 sq .ft.	Unknown
Subtotal Construction Cost	**$ 10,000,000**
Project Soft Costs	
Furnishings and Equipment @ 3%	$ 240,000
Construction Management @ 6%	$66,000
Specialty Consultants @ 5%	$40,000
Permits/Fees/Inspections @ 2%	$24,000
Contingency @ 15%	$1,500,000
Subtotal Soft Costs	**$ 1,870,000**
Total Project Estimated Cost (2008 Dollars)	**$11,870,000**

Fire Station No. 52

This station is a wood frame; masonry constructed two bay neighborhood fire station. This station constructed in 1970 was one of two original City fire stations. Because of age and size, this facility is no longer suited for occupancy and should be replaced. This station, based on the

[27] This figure is based on information provided by TFD from information they have received from an architectural firm.

southern annexation potential whereby Station 51 is moved further south, may also need to be relocated to provide coverage based on the gap created by moving Station 51 further south.

The anticipated cost to build a new fire station would be approximately $4,557,600 not including land acquisition. Cost is based on an 8,700 square feet structure.

Figure 84: Fire Station No. 52 Cost Estimate

Fire Station No. 52	Estimated Costs
Cost Tabulation	
New Construction @ $400[28] sq. ft.	$ 3,480,000
Site Development @ $6 sq .ft.	N/A if current site can accommodate structure
Subtotal Construction Cost	**$ 3,480,000**
Project Soft Costs	
Furnishings and Equipment @ 3%	$104,000
Construction Management @ 6%	$208,000
Specialty Consultants @ 5%	$174,000
Permits/Fees/Inspections @ 2%	$69,600
Contingency @ 15%	$522,000
Subtotal Soft Costs	**$1,077,600**
Total Project Estimated Cost (2008 Dollars)	**$4,557,600**

Fire Station No. 53

Station 53 constructed in 1998 is the newest TFD station. Inspection of this station indicated a well maintained facility with an ample sleep area and adequate living facilities. We recommend that a seismic evaluation, as well as an energy audit, be conducted and appropriate upgrades be initiated.

Fire Station No. 54

Station 54 is a small two bay station located in a residential area. The station houses one ladder truck, two aid cars, a small office area, kitchen, and day room. The station day room also doubles as a training room. Its configuration and size does not lend itself to a quality-learning environment. ESCi recommends this fire station be replaced.

[28] This figure is based on information provided by TFD from information they have received from an architectural firm.

The anticipated cost to build a new fire station including reasonable project expenses would be approximately $5,240,000, not including land acquisition. Cost is based on a 10,000 square feet structure.

Figure 85: Fire Station No. 54 Cost Estimate

Fire Station No. 54	Estimated Costs
Cost Tabulation	
New Construction @ $400[29] sq. ft.	$ 4.000,000
Site Development @ $6 sq .ft.	N/A if current site can accommodate structure
Subtotal Construction Cost	**$ 4,000,000**
Project Soft Costs	
Furnishings and Equipment @ 3%	$120,000
Construction Management @ 6%	$240,000
Specialty Consultants @ 5%	$200,000
Permits/Fees/Inspections @ 2%	$80,000
Contingency @ 15%	$600,000
Subtotal Soft Costs	**$1,240,000**
Total Project Estimated Cost (2008 Dollars)	**$5,240,000**

Figure 86: Capital Facility Improvement Summary

	Proposed Improvements
Fire Station No. 51	$ 11,870,000
Fire Station No. 52	$ 4,557,600
Fire Station No. 54	$ 5,240,000
Total Improvements *(2008 Dollars)*	**$ 21,667,600**

Figure 87: Projected Timeline for Construction

	2009	2010	2011	2012	2013	Total
Station 51	$3,000,000	$8,870,000	$0	$0	$0	$11,870,000
Station 52	$0	$1,000,000	$3,557,600	$0	$0	$4,557,600
Station 54	$0	$0	$0	$2,000,000	$3,240,000	$5,240,000
Total	**$3,000,000**	**$7,570,000**	**$3,557,600**	**$2,000,000**	**$3,240,000**	**$21,667,600**

[29] This figure is based on information provided by TFD from information they have received from an architectural firm.

The timeline for construction shown above is an example of potential expenditures by year. The actual timeline may change, as TFD requirements are defined and implemented. However, due to the disruption of the construction process, it is recommended that a staged implementation schedule be adopted to reduce the impact on TFD service delivery.

The City of Tukwila funds reserve accounts for the funding of major capital purchases. Projects include water and sewer lines, facilities, and apparatus. One such fund (Special Revenue Funds, 303 funds) is dedicated to fire department capital. In 2006, the fire equipment cumulative reserve fund for the year ending December 31, 2006 had an ending balance of $320,095. Expenditures for the year were $1,469,400 on revenues of $1,014,641.

Recommendation:

Fund the fire department Special Revenue Fund in anticipation of capital facilities and apparatus purchases.

Revenue

A series of tax referendums initiated by voters has altered funding mechanisms in Washington. The most recent initiative was adopted in 2001. Earlier laws limited a public agency's ability to collect increase property tax no more than six percent per year. Initiative 747 imposes an annual one percent cap on the increase in tax revenue. New construction is valued at time of construction. With annual increases averaging three to four percent, expenditure growth is exceeding revenue in most areas of the state.

With application of limitations, Tukwila receives a one percent annual increase in tax revenue, plus new construction, to a maximum levy rate of $3.50. The tax revenue is allocated the City's operating departments.

Fire agencies derive their operating revenue from a limited number of sources, with tax monies being the primary source. In the municipal environment, a fire agency will typically receive an allocation or share of the city's general fund, which in turn, receives revenues from a variety of sources. TFD must compete with other City departments for sources of revenue that are finite.

The City does maintain a Capital Improvement Fund (CIP) to fund replacement of apparatus, and minimal building improvements, therefore the recommended facility improvements discussed are not included in the CIP and alternative forms of revenue would be required.

Retail sales tax is Washington's principal tax source. Businesses making retail sales in Washington collect sales tax from their customer.

Generally, a retail sale is the sale of tangible personal property. It is also the sale of services such as installation, repair, cleaning, altering, improving, construction, and decorating. Other services include: improving real or personal property, amusement and recreational activities, lawn maintenance, and physical fitness activities.

Retail sales tax includes the state and local components of the tax. Collected sales taxes are considered trust funds and are remitted to the Department of Revenue with the seller liable to the Department of Revenue for sales tax, whether or not it is collected. Use tax is the responsibility of the consumer when the sales tax was/is not collected by the seller/service provider.

Businesses that make a purchase for resale must provide a resale certificate to the seller. If not, the seller must charge the buyer retail sales tax on the total purchase. Businesses are not exempt; they also pay the retail sales tax on purchases of items for their own use (such as supplies or equipment) that will not be resold in the regular course of business. Similarly, when a business purchases a retailing service for its own use, it must pay sales tax on the purchase.

There are exemptions to the sales tax. Common exemptions include:

- Groceries and Prescription Drugs
- Sales to Nonresidents
- Federal Government Sales
- Interstate and Foreign Sales
- Manufacturers' Machinery and Equipment Exemption
- Sales to Indians or Indian Tribes
- Newspapers

A change in reporting of sales tax is set to become effective July 1, 2008. Know as streamlined sales tax, is better described as a destination-based sales tax. Prior to July 1, all sales tax collected by an appliance store located in unincorporated King County would forward all monies to the County. Under the new system, the same business would collect sales tax based on the destination of the shipment or delivery. Located in unincorporated King County, the merchandise may be received at the store, or the store may make delivery to the customer's home. For a given month on sales of $1,000,000, the breakdown of the sales is:

- $450,000 over-the-counter sales and deliveries to King County
- $200,000 in deliveries to Bellevue
- $100,000 in deliveries to Redmond
- $250,000 in deliveries to Seattle

Local sales tax revenue will now go to King County, Bellevue, Redmond, and Seattle. The state anticipates that some jurisdictions will see a gain, and some a loss, in sales tax revenue. The impact on the City sales-tax revenue while unknown, a decrease in revenue is expected. Net losses to local governments due to destination-based sales tax will be mitigated by the state.

Funding Options

Included in ESCi's recommendation is to provide an aid car for all shifts. Partial facilities improvement funding could be available from recent state action regarding EMS funding. The Washington State Legislature passed legislation which allows cities and fire protection districts to collect an additional $0.25 property tax on all properties (improved and unimproved), exclusively for the provision of EMS services. Authorization of this property tax levy requires a super majority voter approval to renew every six years. This legislation was followed by an additional tax authority of $0.25, on the assessed valuation of property with a maximum taxing authority for EMS of $0.50.

More recent legislation has renewal options for an EMS levy. Voters may approve a six-year, a ten-year, or a permanent EMS levy (supermajority voter requirements apply).

An income option open to the City to supplement funding of EMS services is to seek voter approval of an additional tax authority of $0.25 for EMS services. For the current fiscal year, the City would receive approximately $1.1 million in additional revenue. In 2008, the City budget

lists the Taxable Assessed Value (TAV) to be $4,437,373,744; an increase of 12.40 percent over 2007's actual TAV.

Because of the differing taxation methods for fire (on improved property) and EMS (on all property), a city may annually receive official notice from its county assessor of two different assessed valuations for its jurisdiction.

Sales Tax

The next two tables show the sales and use tax rates for King County and the City of Tukwila effective for the Month of August 2008. Figure 88 shows the tax rate for general items.

Figure 88: Sales and Use Tax Rate, King County/City of Tukwila

Retail Sales/Use Tax	
Effective Dates	08/01/08 - 08/31/08
Location Code	**1729**
State Sales and Use Tax	.065
Local City/County Sales and Use Tax	.025
Total Tax Rate	**.090**

The next table, Figure 89 is the sales tax rate for food and beverages purchased at restaurants and taverns in King County and the City of Tukwila.

Figure 89: Sales Tax Rate, King County/City of Tukwila

Sales of Food & Beverages by Restaurants and Taverns	
Effective Dates	08/01/08 - 08/31/08
Location Code	**1729**
State Sales and Use Tax	.065
Local City/County Sales and Use Tax	.025
King County Food & Beverage	.005
Total Tax Rate	**.095**

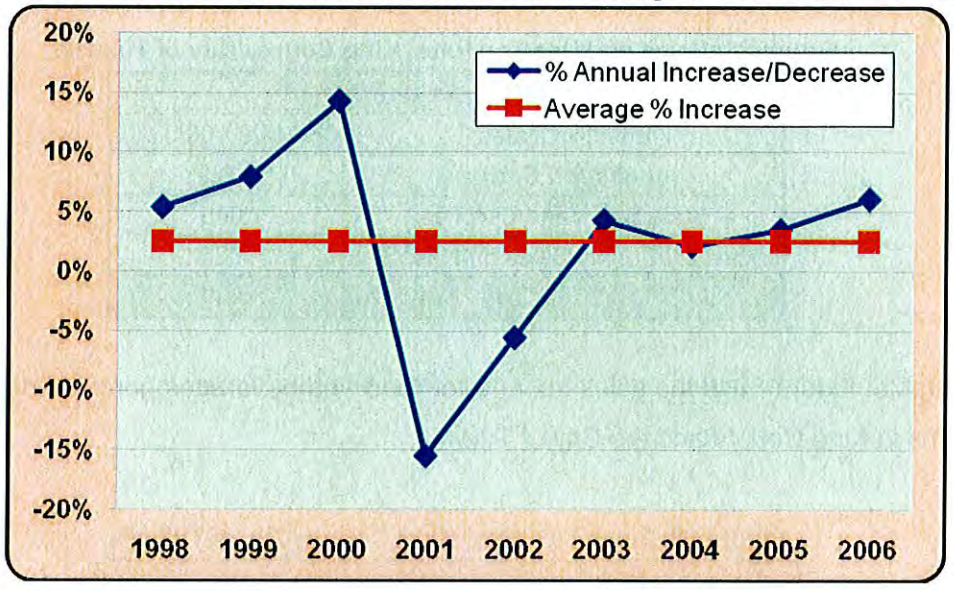
Sales taxes for King County range from 0.086 to 0.090, with a majority of the cities in the county collecting 0.025 total between the two governments. Revenue is split between the City of Tukwila, which gets 85%, and King County, which gets the remaining 15%.

Counties and cities in Washington have varying sales tax rates; in addition to the state general sales tax of 6.5 percent, (The county sales tax rate for King County is 2.5 percent). Tukwila enjoys one of the largest sales tax bases in the State of Washington, with $17.6 million in

revenue for 2006. The total combined retail sales activity amounted to approximately $2.95 billion in 2006.[30] At the center of this strength is the Westfield Shoppingtown, Southcenter, and Parkway Plaza retail development, which combine to create one of the largest retail concentrations on the west coast. This strength has attracted new retail establishments to locate in Tukwila.

A review of the annual increase/decrease and ten-year average increase in sales tax revenue is shown in the following figure (Figure 90).

Figure 90: Annual Percent Increase/Decrease and Average in Sales Tax, 1997 – 2006



Revenue from sales tax has increase approximately 2.5 percent annually over the last ten years. Total local retail sales and use tax revenue in 2006, excluding criminal justice, was $17,847,930.[31]

The property tax rate for the City of Tukwila general operations is limited to $3.60 per $1,000 of assessed value. Of this amount, up to $.45 per thousand may be designated for contribution to the Firemen's Pension Fund, if a report by a qualified actuary indicates that additional funds are required.

[30] Source: City of Tukwila, Washington, Comprehensive Annual Financial Report, For the Year Ended December 31, 2006, page 2.
[31] Ibid.

The payment of principal and interest on Limited Tax Bonds (non-voted) issued by cities in Washington are made from the general levy. Accordingly, the issuance of Limited Tax GO Bonds has the net effect of reducing property taxes available for the general operations of a city government. State law also provides that a city's operating levy may not exceed 101% of the largest single levy of the past three years. The State Constitution provides that the total of all taxes upon real and personal property by the State and all taxing entities, including a city, shall not in any year exceed 1% ($10 per $1,000) of the true and fair monetary value of such property. An exception to this limitation is approval of by 1) 60% of a city's voters, 2) at an election in which the total vote exceeds 40% of the votes cast at the last general election.

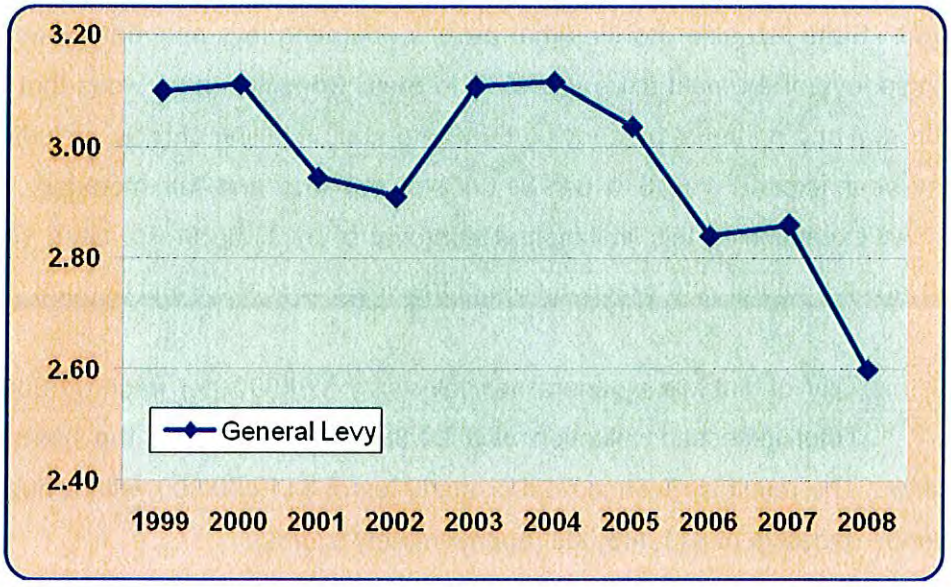
For 2008, the City of Tukwila's general tax levy was $2.6000 per each $1,000 of assessed valuation.[32][33] Total assessed valuation was $4,385,613,904 and is the basis for the 2008 assessments. The result is revenue from property tax of $11,400,000, with a budgeted amount in the revenue narrative of $11,145,000 (approximately 97.7%).

The City is restricted from increasing 2008 collections by Initiative 747 to the 1% growth allowed by law because the combined rate of $3.60 per thousand has been reached. New construction valuation is included in the amount to be collected in 2008.

[32] Ibid.
[33] Actual, $2.56911, King County, Department of Assessments.

A look at the general levy rate over the past ten years gives an indication of the rapid decrease in the mill rate.[34]

Figure 91: Historical City of Tukwila Property Tax Levy, 1999 – 2008



If the city were to go for a lid lift, based on the 2008 assessed valuation of $4,385,613,904, each $0.10 of increase in property tax results in $438,561 of revenue. A table illustrating the revenue generated from a lid lift is below.

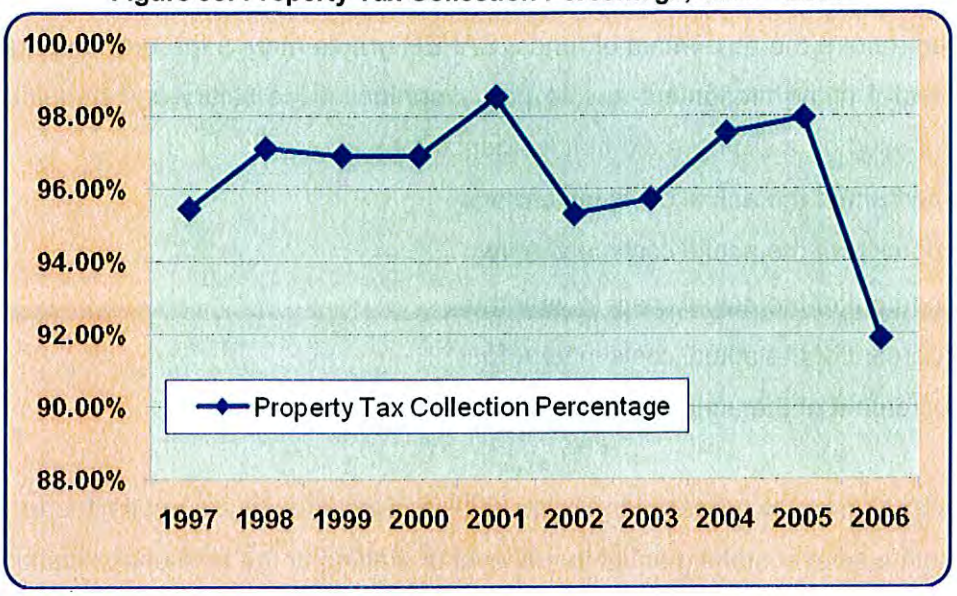
Figure 92: New Revenue Generated from "Lid Lift"

Amount of Lid Lift	New Levy Amount	Additional Revenue
$0.05	2.6500	$219,281
$0.10	2.7000	$438,561
$0.15	2.7500	$657,842
$0.20	2.8000	$877,123
$0.25	2.8500	$1,096,403
$0.30	2.9000	$1,315,684
$0.35	2.9500	$1,534,965
$0.40	3.0000	$1,754,246
$0.45	3.0500	$1,973,526
$0.50	3.1000	$2,192,807
$0.55	3.1500	$2,412,088
$0.60	3.2000	$2,631,368

[34] Ibid.

A review of the property tax collection rate is in Figure 93.[35]

Figure 93: Property Tax Collection Percentage, 1997 – 2006



A significant decrease in the percentage of property tax collected occurred in 2006. Each tenth of one percent equals approximately $110,000 in revenue.

Washington Business and Occupation Tax

The State of Washington levies a tax on business activity measured by gross proceeds from sales, gross income of the business, or the value of products resulting from activities conducted within the state. This tax, known as the Business and Occupation (B&O) Tax, is imposed only on gross receipts generated in the state. Washington's business and occupation (B&O) tax is the second leading tax source for the state.[36]

The B&O tax rates are: 0.0471 percent for retailing, 0.484 percent for manufacturing, wholesaling, and most other business, and 1.5 percent for selected business services. For manufacturing, $4.84 is collected for every $1,000 of gross sales. Businesses with gross receipts of less than $1,000 per month are exempt from B&O tax payments. Some cities also apply a B&O tax to sales made by businesses physically located within the city, and on sales to customers located in cities that have a B&O tax. The City does not collect a local B&O tax.

[35] Ibid.

[36] Note: Under the B&O tax, a number of exemptions and deductions are permitted.

Grants

Grants can provide funding to cover expenses; however, they often have conditions (strings attached) that may dilute their value. If not followed, these conditions could put the recipient in default and require the repayment of funds. SAFER grants require the recipient agency to share in the costs of hiring firefighters and to pay a portion of the salary and benefits. The shared amount is based on a sliding scale that is equal to at least:

- 10 percent of the actual costs in year one
- 20 percent of the actual costs in year two
- 50 percent of the actual costs in year three
- 70 percent of the actual costs in year four
- 100 percent of the actual costs in year five

Other grantee (grant award recipient) responsibilities include but are not limited to:

- Retain a level of staffing equal to the level of staffing at the time of application
- Incur operating expenditures greater than the operating expenditures for the two preceding years
- Retain documentation following the grant period
- Provide periodic performance reports in conjunction with quarterly payment requests
- Follow government audit requirements
- Meet training requirements for all existing and newly hired personnel

Federal grants are available to fire departments under a program of the Preparedness Directorate's Office of Grants and Training in the U.S. Department of Homeland Security. Grants are awarded to fire departments to enhance their ability to protect the public and fire service personnel from fire and related hazards. Three types of grants are available - Assistance to Firefighters Grant (AFG), Fire Prevention and Safety (FP&S), and Staffing for Adequate Fire and Emergency Response (SAFER).

General Obligation Bonds

Washington State law provides that a debt cannot be incurred in excess of the following percentages of the value of the taxable property of the city - 1.5 percent without a vote of the people, or 2.5 percent with a vote of the people.[37]

The City, on December 31, 2007, had approximately $22 million is outstanding GO (General Obligation) bonds. With a TAV (Taxable Assessed Value) for 2008 of approximately $4.4 million, maximum debt without a vote of the people is approximately $66 million. Based on the current debt load, the City could issue general obligation bonds to finance improvements to their fire stations.

Cost Recovery – Billing Insurance Carriers

Billing for emergency services has been a topic of public discussion for many years. In some areas of the United States billing for emergency response is a way to pay for the costs involved in responding to incidents. While taxes pay for the *ability* to respond to an incident (standing army), billing the user helps cover the *cost* of responding. Revenue is then used to directly offset the cost of providing specialty equipment and training personnel to respond on MVA (motor vehicle accidents).

The intention of a MVA user fees is to offset the costs of responding to motor vehicle related incidents. Specialty training and added equipment caches are maintained by a fire department to safely and professionally mitigate vehicle incidents.

With the large volume of traffic moving through the Tukwila response area on the Interstate highway systems, many MVA involve non-residents. This suggests that city residents are shouldering much of the cost of providing this service to non-residents.

The Institute of Public Affairs at the University of Iowa has compiled a report assessing fees for service. The report titled, "*Assessing Fees for Fire and Emergency Services*" published in March 1999 provides further rational and sample fee schedules.[38]

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[37] Source: Tukwila's 2005 CAFR, page 63.

[38] Source: www.dps.state.ia.us/fm/stb/PDF/assessingfees.PDF.

Impact Fees

The City is able to collect impact fees; something fire districts cannot do. Funds are directed to capital purchases. We believe the inclusion of this funding source is a valuable tool for the current and any successor organization.

Impact fees are charges assessed by local governments against new development projects attempting to recover the cost incurred by government in providing the public facilities required to serve the new development. Impact fees are only used to fund facilities, such as roads, schools, and parks, that are directly associated with the new development. They may be used to pay the proportionate share of the cost of public facilities that benefit the new development; however, impact fees cannot be used to correct existing deficiencies in public facilities.

In Washington, impact fees are authorized for those jurisdictions planning under the Growth Management Act (GMA) (RCW 82.02.050 - .100), as part of *voluntary agreements* under RCW 82.02.020, and as mitigation for impacts under the State Environmental Policy Act (SEPA – Ch. 43.21C RCW). GMA impact fees are only authorized for public streets and roads; publicly owned parks, open space, and recreation facilities; school facilities; and fire protection facilities in jurisdictions that are not part of a fire district. Setting fee schedules for impact fees is a complex process typically involving rate studies; generally, impact fees do not recover the full cost of a new facility, since these fees must be directly and proportionately related to impacts associated with new development.

Three statutes provide the primary authority for impact fees imposed by cities and counties:

- RCW 82.02.050 - .100 - Impact fees authorized under the Growth Management Act
- RCW 82.02.020 – Voluntary agreements
- Ch. 43.21C RCW - State Environmental Policy Act (Mitigation Measures) RCW 43.21C.060 and RCW 43.21C.065

Property Tax

With the growth of fire-based emergency medical services systems in Washington, the State Legislature passed legislation which allows cities and fire protection districts to collect an additional $0.25 property tax on all properties (improved and unimproved), exclusively for the provision of EMS services. Authorization of this property tax levy requires a super majority voter approval to renew every six years. This legislation was followed by an additional tax authority of

$0.25 on the assessed valuation of property with a maximum taxing authority for EMS of $0.50. In King County, this money is used to fund the Medic One program (South King County Medic One, Kent).

More recent legislation has renewal options for an EMS levy. Voters may approve a six-year, a ten-year, or a permanent EMS levy (supermajority voter requirements apply).

Because of the differing taxation methods for fire (on improved property) and EMS (on all property), a fire district may annually receive official notice from its county assessor of two different assessed valuations for its jurisdiction.

While the concept of funding fire protection services by imposing an annual tax on the assessed valuation of improved properties is correlative, there is no identifiable relationship between taxing property and the demand for emergency medical services. As such, EMS - a service that places high demand on most fire departments - is considered to be inadequately funded.

A series of tax referendums initiated by voters has altered the funding mechanisms in Washington. The most recent initiative was adopted in 2001. Earlier laws limited a public agency's ability to collect increase property tax no more than six percent per year. Initiative 747 imposes an annual one percent cap on the increase in tax revenue. New construction is valued at time of construction. With annual increases averaging three to four percent, expenditures are exceeding revenue in rapidly growing areas of the state.

The aggregate regular levy rate of all senior and junior taxing districts (not including the state, port districts and public utility districts, emergency medical levies, and conservation futures) cannot exceed $5.90. RCW 84.52.043.

The aggregate of all regular levies (not including port and public utility districts) shall not exceed one percent of true and fair value. Washington 1972 Amendment State Constitution, Article VII, Sec. 2 and RCW 84.52.050.

Recommendations:

- Continue with efforts to secure grants to offset increased cost.

- Fund future building renovation/construction projects with GO bonds.

Summary

This Comprehensive Master Plan is indented to answer three questions:

- Where are we now?
- Where do we want to be?
- How do we get there?

TFD like many emergency providers across the nation is providing a high level of service now, but the ability to continue current levels of service are a huge challenge to local governments struggling to fund and provide a wide array of municipal services.

To address where TFD is now is based on an analysis of services, programs, and emergency response currently being provided. In determining where we want to be is based on historical data looking for trends that will impact the future. Additionally, planning, zoning, and land use is widely viewed as an indicator on where the community is going in terms of growth, and future needs in all community services including emergency fire and EMS protection. Not only growth, but the community risk assessment, is considered when determining where the department needs to be.

Finally, how do we get there depends on several factors including, financial abilities of the community, political environment, planning process, and a clear understanding between the providers and the community being served.

ESCi conducted a comprehensive review of current delivery systems of the TFD. We found that TFD is a highly motivated, well managed emergency provider. Positive relationships between TFD and the City appear to be collaborative and geared toward the best interest of the citizens being served. However, in order to maintain *current levels of programs, and delivery of emergency services* now enjoyed by the citizens of Tukwila, we have recommended the following:

Maintaining Current Levels of Service

Staff a 24-hour aid car - Several benefits is derived from implementation of this recommendation. First, calls for EMS related calls have grown significantly over the years and now accounts for TFD's largest workload factor. Based on current conditions, we believe the following benefits will be realized by staffing 24 hour aid car.

- Staffing an aid car will reduce station failure rates caused by multiple calls for service (concurrency).
- Unit hour utilization will drop on Ladder Truck 54, extending the service life of the apparatus.
- Maneuverability and access is improved using a smaller response vehicle.
- Staffing an aid car will support the unofficial response time goal of five minutes and thirty-three seconds.
- Less usage of the ladder truck will provide savings on fire apparatus maintenance and reduce diesel fuel costs.

Impact of Growth and Annexation

Implementation of this recommendation will require additional personnel to staff the aid car and, if annexation growth occurs in the south area, since we have recommended that Ladder Truck 54 be relocated to Station 51, to cover the development risk located to the south. This will require an additional engine company and personnel to be assigned to Station 54 to provide emergency response and maintain the current response time standard of five minutes and thirty-three seconds.

Non-implementation of Recommendation

If this recommendation is not adopted, we believe the following negative impacts will be realized.

Ladder Truck 54 will continue to experience the most UHU of the TFD apparatus fleet, resulting in shorter life expectancy of the vehicle, and increased failure rate at Station 54 due to the high call load experienced due to EMS related calls. Non-implementation will negatively impact response times because stations that are not the closest unit available to the incident will have to respond.

Additional Personnel Recommendations

Besides the delivery of emergency services is on the streets, it is essential that management and program delivery is viewed as just as critical as fire stations and apparatus. TFD must maintain training programs for emergency personnel, and provide fire and life safety services and inspections to very complex and diverse commercial and industrial facilities.

ESCi's review of the current program delivery in training, prevention, and administration found a high degree of competency and innovation. However, as with emergency response, TFD is struggling to maintain critical programs that affect employee training and safety, as well as community fire safety inspections and involvement in new construction. Additionally, the administrative function is operating over capacity and will require additional personnel resources if critical functions such as planning, oversight, and public management are to be maintained and improved.

Current Staffing Needs

Our recommendations include the following positions and are based on ***current needs***, and are discussed in detail beginning on page 155.

- Assistant Chief of Planning and Logistics
- Deputy Fire Marshal
- Inspectors (two civilian)
- Public Education/PIO
- Training Captain
- Firefighters to Staff Aid Car (7.8)

Should the personnel recommendations be deferred or not approved at all, we predict that TFD will continue to find it harder to maintain fire inspections, plan reviews, and pre-incident planning functions. The development community may experience longer review and plan check times. No public education program within the City will continue, leaving a void in one of the most critical elements of fire prevention, which is public education and outreach.

The training division will continue to struggle to maintain and implement mandated training standards and implement career and officer development programs vital to the organization's future. Future personnel additions will require additional training capacity as well.

Potential Future Staffing Needs

If growth due to annexation occurs, ESCi has recommended relocating the ladder truck to Station 51. This move will leave a void at Station 54 that will need to be staffed with an engine company consisting of anywhere between 18 and 24 personnel based on staffing agreements with labor.

Facility Needs

Several facility needs and relocations are recommended and discussed beginning on page 159. Currently, station locations are enabling adequate coverage, but need to have building renovations to meet *current* needs. If growth/development occurs due to annexations, in order to maintain the *current level* of response, relocations will be necessary. If no action is taken to relocate facilities to meet future demands, travel time will fall below the current response of five minutes and thirty-three seconds.

ESCi's primary review of facilities is based on the ability of the station to continue to meet the response objective, 90 percent of the time, and to determine what changes or relocations would need to take place to meet current response goals and move toward the stated response goal of TFD - four minutes (240 seconds) or less for the arrival of the first arriving engine company at a fire suppression incident, and/or eight minutes (480 seconds) or less for the deployment of a full first alarm assignment at a fire suppression incident, 90 percent of the time, and four minutes (240 seconds) or less for the arrival of a unit with first responder or higher level capability at an emergency medical incident, 90 percent of the time. Another consideration regarding facilities is the livability and physical conditions of the station.

Financial Analysis

Development of the TFD Master Plan includes a discussion of relocating several fire stations and additional apparatus. Options were analyzed for viability and a cost projection developed for each.

The Influence of Economic Factors on Future Cost

Retail uses and retail sales tax plays a very significant role in the economy of the City and King County. Other import economic factors include enplanement activity at SeaTac Airport, guests at lodging establishments, and business/commercial activities. These factors all contribute to the overall TFD workload. We presuppose that the area's transient population shapes not only the number of calls for service, but impacts revenue as well.

Two measurements are available to illustrate the impact on the local economy and emergency services of the City. They are the revenue from transient occupancy taxes (hotel/motel taxes) and enplanements at SeaTac Airport.

The historical 2006 and 2007 revenue amounts from transient occupancy tax are shown in the following table (Figure 94).[39]

Figure 94: Transient Occupancy Revenue, 2006 – 2007

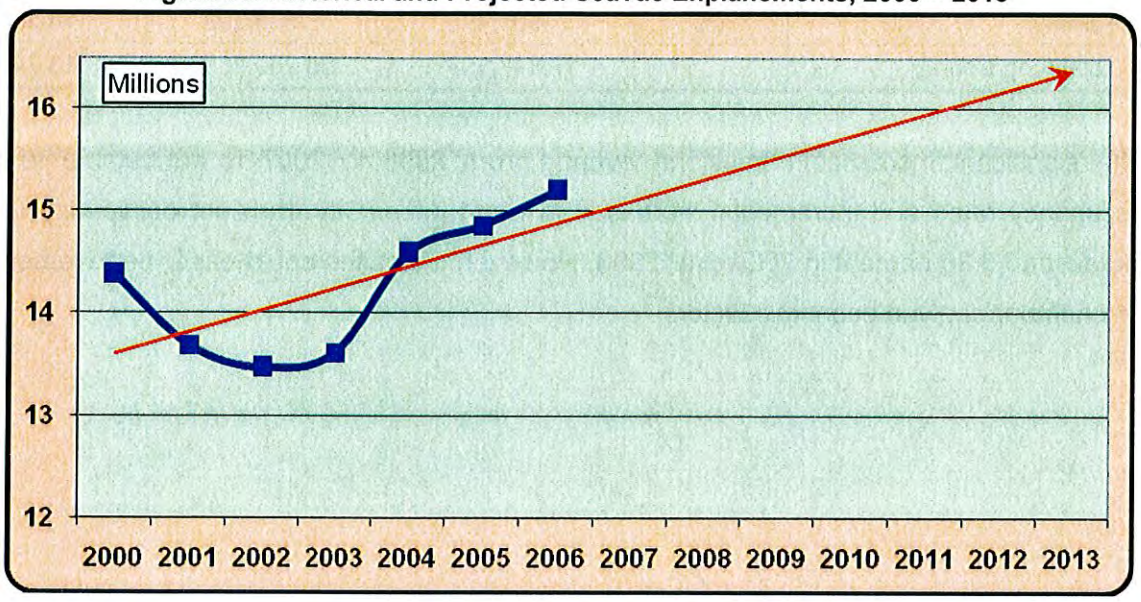
Municipality	Shared %	2006	2007	% Change
SeaTac	1%	1,067,453	1,203,953	12.79%
Tukwila	1%	501,478	583,232	16.30%
Total King County		17,847,198	20,299,205	13.74%

The significant increase in transient revenue from 2006 to 2007 is attributable to strong occupancy rates and incremental increases in room price. City transient occupancy revenue increased 16.30 percent in 2007 over 2006. However, increases could easily be reversed given any number of given economic factors.

[39] Source: *Local Tax Distribution Calendar Year 2007*, Washington State Department of Revenue, Compiled by: Matthew J. Bryan, Research Analyst & Thomas Christensen, Research Analyst, December 2007.

Of the passengers traveling to SeaTac, many are only making connections to other flights. The airport is also the terminus for business and leisure travelers. In either case, there is a direct impact on the community. To gauge the trend of airport activity, ESCi looked at historical enplanement activity and projected future growth (Figure 95).[40]

Figure 95: Historical and Projected SeaTac Enplanements, 2000 – 2013



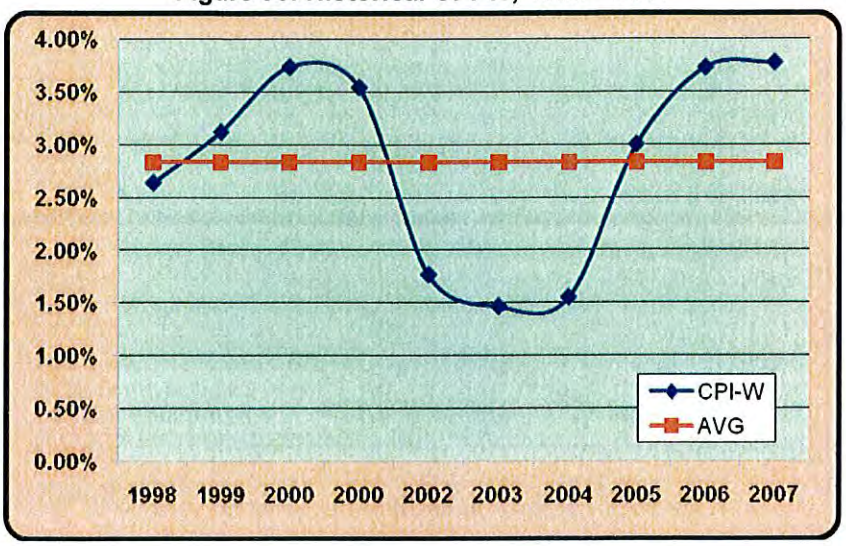
With the exception of a downturn following the events of September 11, 2001, enplanements are trending upward and are forecast to reach approximately 17 million by 2013.

[40] Source: Passenger and All-Cargo Statistics, FAA (Federal Aviation Administration), 2000 – 2006.

Annual Inflation Rate

Historical CPI-W data from 1998 to 2007 was used to develop an inflation forecast through 2027.[41] The information is displayed in table and graphical format (below).

Figure 96: Historical CPI-W, 1998 – 2007



The historical 10-year CPI-W for the Seattle, Tacoma, and Bremerton region has averaged 2.84 percent per year.

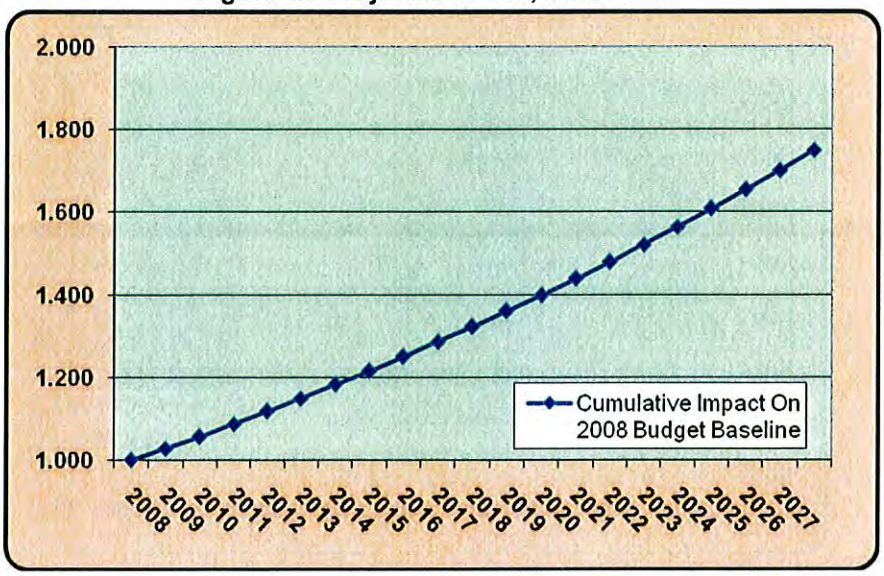
Figure 97: Historical Table of CPI-W, 1998 – 2007

Year	CPI-W	AVG
1998	2.64%	2.8379%
1999	3.13%	2.8379%
2000	3.74%	2.8379%
2000	3.55%	2.8379%
2002	1.77%	2.8379%
2003	1.47%	2.8379%
2004	1.55%	2.8379%
2005	3.01%	2.8379%
2006	3.74%	2.8379%
2007	3.78%	2.8379%

[41] Source: Consumer Price Index-Urban Wage Earners and Clerical Workers, Series ID: CWUSA423SA0, Not Seasonally Adjusted, Area: Seattle-Tacoma-Bremerton, WA, Item: All items, Base Period: 1982-84=100, U.S. Department of Labor, Bureau of Labor Statistics, website http://www.bls.gov/cpi/.

The following graph uses the historical CPI-W data to forecast the impact on the TFD budget through 2027. This rate was used for analyses purposes during this review and the actual CPI-W for any given year could be higher or lower.

Figure 98: Projected CPI-W, 2008 – 2027



The CPI-W average increase was applied to each category of the 2008 approved budget to develop a forecasted impact on the City's future financial stability.

Required Investments In Existing Facilities, Apparatus, and Staffing

The Fire Master Plan reviews the Tukwila Fire Department, as it exists in 2008. It identifies the existing informal LOS (level of service) provided by the fire department as responding to a call within 5 minutes and 34 seconds 90% of the time.

To continue this LOS to the existing "effective population" (residents and workers), ESCi examined the capital facilities, operations and maintenance requirements of the fire department. To maintain the existing LOS and eliminate further service degradation, ESCi makes the following recommendations:

Capital Facilities and Operations:

1. Increase the Aid Car to a 24-hour unit
2. Use the ladder truck at Fire Station No. 54 for responses requiring a truck-company
3. Remodel Fire Station No. 51
4. Replace Fire Station No. 52
5. Complete seismic upgrades, if needed, for Fire Station No. 53
6. Replace Fire Station No. 54

Personnel and Maintenance:

1. Hire 7.8 FTE personnel to staff the Aid Car
2. Hire an assistant fire chief – logistics and strategic planning
3. Hire a training captain
4. Hire a deputy fire marshal
5. Hire two civilian fire inspectors
6. Hire a public educator/public information officer

Funding Source Options:

1. Increase EMS levy to full rate allowable (additional $.20/$1,000AV)
2. Increase annual property tax increase of 1% of AV (assessed valuation) to 1.25% of AV (levy lid lift)
3. Increase (transient occupancy tax) hotel/motel tax
4. Establish cost recovery fees for annual commercial fire inspections
5. Increase sales tax (public safety sales tax)
6. Provide non-emergent medical transportation services for a fee using Aid Car

Projected Investment Requirements related to New Construction and Population Growth

The City of Tukwila population and the workforce are anticipated to sustain the growth now occurring for the next 15 years. According to the King County – *Buildable Lands Report for 2007*, the City is expected to provide capacity for as many as 3,035 new homes (both single and multi-family) and as many as 16,000 new workers. The "effective population" that will be served by the Tukwila Fire Department is projected to increase to approximately 157,740.

If the Tukwila South Project develops as projected in the Environmental Impact Statement (EIS), an estimated additional 22,427 workers and 700 new homes (1,505 residents) would be added to the City's "effective population." The Tukwila Fire Department would then be serving a daily population of approximately 180,000.

The City has the choice to maintain, to increase or decrease the existing level of service as growth and new development occur. ESCi recommends that the City maintain the current level of service to existing and annexed areas of the City which are developed or redeveloped. It is critical that the City plan and adopt how it will provide service to the existing and new populations and not continue to "play catch-up."

The following items were identified as needed in order to continue the existing level of service to serve the City's projected effective population between 2008 and 2022:

Capital Facilities and Operations:

1. Move the ladder truck to Fire Station No. 51
2. Purchase a new engine for Fire Station No. 54
3. Relocate Fire Station No. 51, if Tukwila South Project annexes and develops
4. Relocate Fire Station No. 52, if Fire Station No. 51 is relocated

Personnel and Maintenance:

1. Hire 18-24 firefighters to staff new fire engine at Fire Station No. 54

Funding Source Options:

1. Charge fire impact fees (funding directed to capital facilities)
2. Increase EMS levy to full rate allowable (additional $.20/$1,000AV)
3. Increase annual property tax increase of 1% of AV (assessed valuation) to 1.25% of AV (levy lid lift)

Appendix

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A: Additional Financial Information

The following table depicts the CPI-W budget impact in each year through 2027.

Figure 99: CPI-W Budget Impact Forecast 2008 – 2027

	Forecast CPI-W	Cumulative Impact on 2008 Budget Baseline
2008	0.00%	1.000
2009	2.84%	1.028
2010	2.84%	1.058
2011	2.84%	1.088
2012	2.84%	1.119
2013	2.84%	1.150
2014	2.84%	1.183
2015	2.84%	1.217
2016	2.84%	1.251
2017	2.84%	1.287
2018	2.84%	1.324
2019	2.84%	1.361
2020	2.84%	1.400
2021	2.84%	1.440
2022	2.84%	1.481
2023	2.84%	1.523
2024	2.84%	1.566
2025	2.84%	1.611
2026	2.84%	1.656
2027	2.84%	1.703

City of Tukwila Taxable Accessed Value

Taxable Assessed Value (TAV)

Projected TAV growth is calculated as follows:

- Property on the current tax rolls will increase at one percent per year. This is not the projected actual rate of growth, but is the maximum increase allowed for property tax charges to taxpayers by initiative 747.
- New construction added to the tax roll is taxed at full value. The population growth was extrapolated using the increase (A basis of one percent of the population is used as the factor) to forecast TAV growth over the planning period. With the planned new construction of high-rise buildings in the City, the actual TAV will most likely be higher

than the population factor. The factor, we believe, provides a conservative approach to TAV increase.

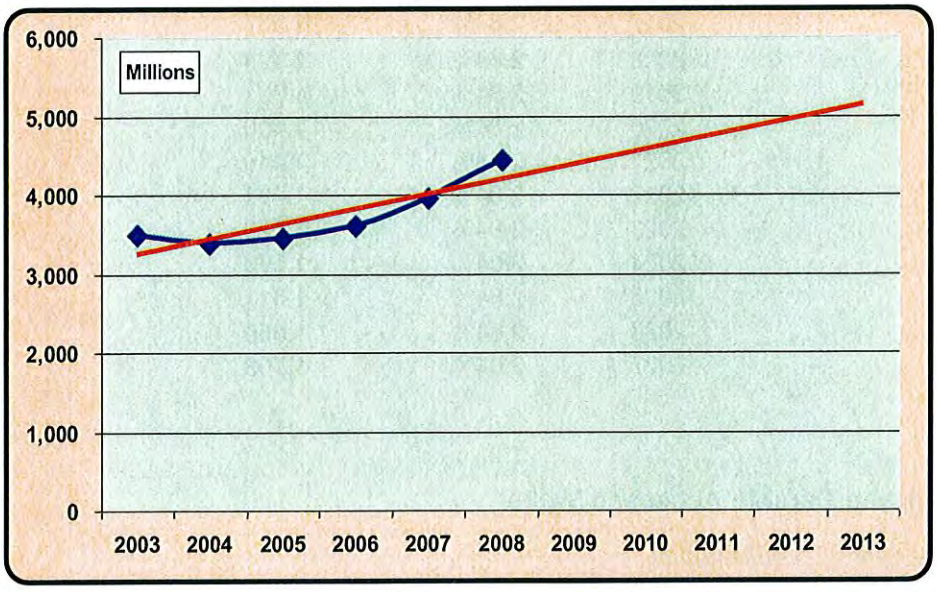
A historical comparison of the year to year grow of TAV from 2003 to 2008 is shown in the following table.

Figure 100: Historical TAV Growth, 2003 – 2008

	2003 Actual	2004 Actual	2005 Actual	2006 Actual	2007 Actual	2008 Budget
Assessed Value	3,489,704,657	3,384,090,709	3,441,123,525	3,610,558,767	3,947,933,512	4,437,373,744
Growth %		-3.03%	1.69%	4.92%	9.34%	12.40%

The average TAV growth from 2003 to 2008 was 5.06 percent. The following graph shows the historical and trendline of TAV growth from 2003 through 2013.

Figure 101: Historical TAV and Trendline, 2003 – 2013



The forecasted TAV growth is shown using the one percent factor for new construction and a one percent increase for those properties currently on the tax rolls.

Figure 102: Forecast TAV, 2008 – 2027

Year	TAV	New Construction	Total TAV
2008 Budget	4,437,373,744	0	4,437,373,744
2009	4,481,747,481	44,817,475	4,526,564,956
2010	4,571,382,431	45,713,824	4,617,096,255
2011	4,662,361,905	46,623,619	4,708,985,524
2012	4,754,703,830	47,547,038	4,802,250,868
2013	4,848,426,357	48,484,264	4,896,910,621
2014	4,943,547,865	49,435,479	4,992,983,344
2015	5,040,086,960	50,400,870	5,090,487,830
2016	5,138,062,482	51,380,625	5,189,443,107
2017	5,237,493,506	52,374,935	5,289,868,441
2018	5,338,399,345	53,383,993	5,391,783,338
2019	5,440,799,550	54,407,996	5,495,207,546
2020	5,544,713,920	55,447,139	5,600,161,059
2021	5,650,162,497	56,501,625	5,706,664,122
2022	5,757,165,575	57,571,656	5,814,737,230
2023	5,865,743,697	58,657,437	5,924,401,134
2024	5,975,917,666	59,759,177	6,035,676,842
2025	6,087,708,539	60,877,085	6,148,585,625
2026	6,201,137,639	62,011,376	6,263,149,015
2027	6,316,226,549	63,162,265	6,379,388,815

The TAV forecast is used when calculating the adequacy of funds for fire department operations.

Operating Expense – Maintaining Status Quo

The 2008 approved budget was used as the baseline for calculating future cost projections. Budget expense categories were calculated using the 10-year historical average CPI-W index and forecast to predict year-to-year increases.

The table below shows the 2008 budget as a basis for determining the expense projections from 2009 to 2027.

Figure 103: Expenditure Projection, 2009 – 2027

Year	Salary & Wage	Fringe Benefits	Supplies & Expense	Inter-Gov't Services	Departmental Allocations	Capital Outlay	Total
2008 Budget	5,987,924	2,257,635	819,149	328,475	2,159,535	583,611	12,136,329
2009	6,158,155	2,321,817	842,437	337,813	2,220,929	600,202	12,481,353
2010	6,333,225	2,387,824	866,386	347,417	2,284,068	879,766	13,098,686
2011	6,513,272	2,455,708	891,017	357,294	2,349,001	904,776	13,471,068
2012	6,698,438	2,525,521	916,347	367,451	2,415,781	667,998	13,591,537
2013	6,888,868	2,597,319	942,398	377,897	2,484,459	686,989	13,977,931
2014	7,084,711	2,671,158	969,190	388,641	2,555,090	706,519	14,375,309
2015	7,286,123	2,747,097	996,743	399,689	2,627,729	726,605	14,783,985
2016	7,493,260	2,825,194	1,025,079	411,052	2,702,433	747,262	15,204,279
2017	7,706,286	2,905,511	1,054,221	422,738	2,779,260	768,506	15,636,522
2018	7,925,368	2,988,112	1,084,192	434,756	2,858,272	790,353	16,081,052
2019	8,150,678	3,073,061	1,115,014	447,116	2,939,529	812,822	16,538,220
2020	8,382,394	3,160,425	1,146,713	459,827	3,023,097	835,930	17,008,386
2021	8,620,697	3,250,273	1,179,313	472,899	3,109,041	859,695	17,491,917
2022	8,865,775	3,342,675	1,212,839	486,343	3,197,428	884,135	17,989,195
2023	9,117,820	3,437,704	1,247,319	500,169	3,288,327	909,270	18,500,609
2024	9,377,030	3,535,434	1,282,779	514,389	3,381,811	935,120	19,026,563
2025	9,643,610	3,635,943	1,319,247	529,012	3,477,953	961,704	19,567,469
2026	9,917,768	3,739,309	1,356,752	544,051	3,576,828	989,044	20,123,753
2027	10,199,720	3,845,614	1,395,323	559,518	3,678,513	1,017,162	20,695,851

Required Operational Revenue – Maintaining Status Quo

The table below projects the revenue and millage required to fund the Tukwila Fire Department through 2027.

Figure 104: Revenue and Millage Requirements – Maintaining Status Quo

Year	Total TAV	Projected FD Cost	Calculated Millage Rate
2008 Budget	4,437,373,744	12,136,329	2.74
2009	4,526,564,956	12,481,353	2.76
2010	4,617,096,255	13,098,686	2.84
2011	4,708,985,524	13,471,068	2.86
2012	4,802,250,868	13,591,537	2.83
2013	4,896,910,621	13,977,931	2.85
2014	4,992,983,344	14,375,309	2.88
2015	5,090,487,830	14,783,985	2.90
2016	5,189,443,107	15,204,279	2.93
2017	5,289,868,441	15,636,522	2.96
2018	5,391,783,338	16,081,052	2.98
2019	5,495,207,546	16,538,220	3.01
2020	5,600,161,059	17,008,386	3.04
2021	5,706,664,122	17,491,917	3.07
2022	5,814,737,230	17,989,195	3.09
2023	5,924,401,134	18,500,609	3.12
2024	6,035,676,842	19,026,563	3.15
2025	6,148,585,625	19,567,469	3.18
2026	6,263,149,015	20,123,753	3.21
2027	6,379,388,815	20,695,851	3.24

Required Operational Revenue – Implementing Recommendations

The 2008 approved budget is used as the baseline for calculating future cost projections. Budget expense categories were calculated using the 10-year historical average CPI-W index and forecast to predict year-to-year increases.

The following table shows the expenditure and required revenue for the staff and operational personnel recommendations.

Figure 105: Cost and Revenue Requirements of Recommended Positions

Position	Title	Number of FTEs	Monthly Wage	Annual Wage	Fringe Benefits	Total Cost	Millage Rate Impact 2008
Admin Staff							
Assistant Chief - Logistics & Planning	Assistant Chief	1	7,917	95,000	35,818	130,818	0.029
Deputy Fire Marshal	Captain	1	6,740	80,880	30,494	111,374	0.025
Public Educator/PIO	Captain	1	6,740	80,880	30,494	111,374	0.025
Training	Captain	1	6,740	80,880	30,494	111,374	0.025
Civilian Inspectors	80% of Captain	1	5,392	64,704	24,395	89,099	0.020
Civilian Inspectors	80% of Captain	1	5,392	64,704	24,395	89,099	0.020
Total Admin Increase		6	38,921	467,048	176,090	643,138	0.144
Operation FTE Increase							
Staffing Aid Car							
	Captain	0	0	0	0	0	
	Firefighter/EMT	7.8	5,275	63,300	23,866	679,895	
	Overtime @ 7.18%					48,816	
	FLSA Overtime @ 0.5%					3,399	
		7.8				732,111	0.165
Total recommended manpower Increase		12.8				1,375,249	0.309
Non-manpower cost increase						180,945	0.041
Total Cost Increase						1,556,194	0.350

Implementing the recommended changes in one year is considered expensive and impractical.

The following table provides a timeline for implementation.

Figure 106: Timeline for Implementing Recommendations

Position	Projected Data of Implementation
Assistant Chief Logistic and Planning	January 2009
Deputy Fire Marshal	January 2009
Civilian Inspectors (2)	January 2009
Captain Public Education/PIO	January 2009
Captain Training	January 2010
Aid Car Staffing	January 2010

The table below uses the 2008 budget as a basis for determining the expense projections of implementing the recommendations through 2027.

Figure 107: Cost Projection of Recommendations, 2009 – 2027

Year	Salary & Wage	Fringe Benefits	Supplies & Expense	Inter-Gov't Services	Department Allocations	Capital Fund Outlay	Total
2008 Budget	5,987,924	2,257,635	819,149	328,475	2,159,535	583,611	12,136,329
2009	6,368,443	2,401,095	891,341	337,813	2,220,929	600,202	12,819,823
2010	7,352,205	2,752,294	1,052,475	347,417	2,284,068	879,766	14,668,225
2011	7,561,221	2,830,539	1,082,396	357,294	2,349,001	904,776	15,085,228
2012	7,776,179	2,911,008	1,113,168	367,451	2,415,781	667,998	15,251,586
2013	7,997,248	2,993,765	1,144,814	377,897	2,484,459	686,989	15,685,173
2014	8,224,602	3,078,875	1,177,360	388,641	2,555,090	706,519	16,131,087
2015	8,458,419	3,166,405	1,210,831	399,689	2,627,729	726,605	16,589,677
2016	8,698,883	3,256,422	1,245,254	411,052	2,702,433	747,262	17,061,305
2017	8,946,184	3,348,999	1,280,655	422,738	2,779,260	768,506	17,546,341
2018	9,200,515	3,444,208	1,317,063	434,756	2,858,272	790,353	18,045,166
2019	9,462,076	3,542,123	1,354,505	447,116	2,939,529	812,822	18,558,172
2020	9,731,074	3,642,822	1,393,013	459,827	3,023,097	835,930	19,085,762
2021	10,007,718	3,746,384	1,432,615	472,899	3,109,041	859,695	19,628,352
2022	10,292,228	3,852,890	1,473,342	486,343	3,197,428	884,135	20,186,366
2023	10,584,826	3,962,424	1,515,228	500,169	3,288,327	909,270	20,760,244
2024	10,885,742	4,075,072	1,558,304	514,389	3,381,811	935,120	21,350,437
2025	11,195,212	4,190,922	1,602,606	529,012	3,477,953	961,704	21,957,409
2026	11,513,481	4,310,065	1,648,166	544,051	3,576,828	989,044	22,581,636
2027	11,840,798	4,432,596	1,695,022	559,518	3,678,513	1,017,162	23,223,609

Required Operational Revenue – Implementation of Recommendations

The table below shows the projected revenue and millage requirements to fund the TFD through 2027 including the recommendations.

Figure 108: Revenue and Millage Requirements – Implementation of Recommendations

Year	Total TAV	Projected FD Cost	Calculated Millage Rate
2008 Budget	4,437,373,744	12,136,329	2.74
2009	4,526,564,956	12,819,823	2.83
2010	4,617,096,255	14,668,225	3.18
2011	4,708,985,524	15,085,228	3.20
2012	4,802,250,868	15,251,586	3.18
2013	4,896,910,621	15,685,173	3.20
2014	4,992,983,344	16,131,087	3.23
2015	5,090,487,830	16,589,677	3.26
2016	5,189,443,107	17,061,305	3.29
2017	5,289,868,441	17,546,341	3.32
2018	5,391,783,338	18,045,166	3.35
2019	5,495,207,546	18,558,172	3.38
2020	5,600,161,059	19,085,762	3.41
2021	5,706,664,122	19,628,352	3.44
2022	5,814,737,230	20,186,366	3.47
2023	5,924,401,134	20,760,244	3.50
2024	6,035,676,842	21,350,437	3.54
2025	6,148,585,625	21,957,409	3.57
2026	6,263,149,015	22,581,636	3.61
2027	6,379,388,815	23,223,609	3.64

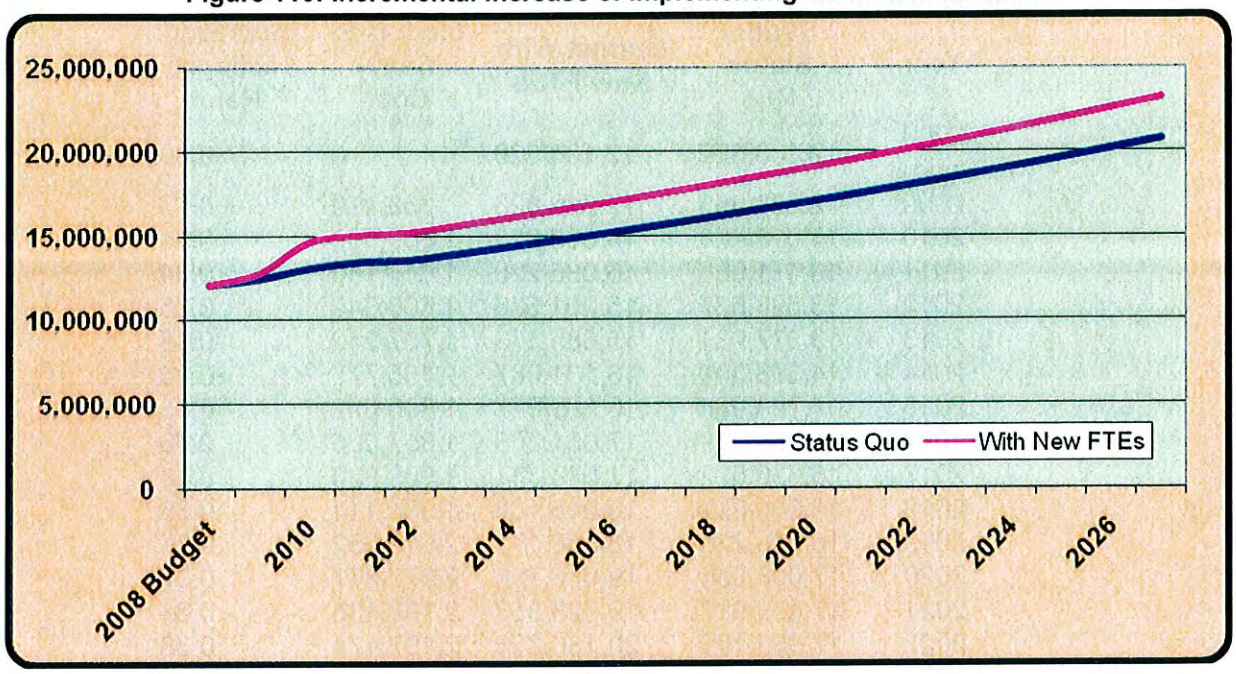
The table below depicts the total cost increase to the City by year, from the status quo approach to adopting the recommendations of ESCi.

Figure 109: Incremental Increase of Implementing Recommendations

Year	Budget Status Quo	Budget With New FTEs	Increased Yearly Cost	Increased Millage Rate
2008 Budget	12,136,329	12,136,329	0	0.00
2009	12,481,353	12,819,823	338,470	0.07
2010	13,098,686	14,668,225	1,569,539	0.34
2011	13,471,068	15,085,228	1,614,160	0.34
2012	13,591,537	15,251,586	1,660,049	0.35
2013	13,977,931	15,685,173	1,707,242	0.35
2014	14,375,309	16,131,087	1,755,777	0.35
2015	14,783,985	16,589,677	1,805,692	0.35
2016	15,204,279	17,061,305	1,857,026	0.36
2017	15,636,522	17,546,341	1,909,820	0.36
2018	16,081,052	18,045,166	1,964,114	0.36
2019	16,538,220	18,558,172	2,019,952	0.37
2020	17,008,386	19,085,762	2,077,377	0.37
2021	17,491,917	19,628,352	2,136,435	0.37
2022	17,989,195	20,186,366	2,197,171	0.38
2023	18,500,609	20,760,244	2,259,635	0.38
2024	19,026,563	21,350,437	2,323,874	0.39
2025	19,567,469	21,957,409	2,389,939	0.39
2026	20,123,753	22,581,636	2,457,883	0.39
2027	20,695,851	23,223,609	2,527,758	0.40

The chart below represents a graphical presentation of the total cost increase to the City by year from the status quo approached to adopting the recommendation of ESCi.

Figure 110: Incremental Increase of Implementing Recommendations



B: Summary Table of Recommendations

The following is a compilation of recommendations and strategies designed to improve the efficiency and/or effectiveness of TFD. The suggestions offered by ESCi associates are derived from the analysis of the existing emergency system. Recommendations and comments are based on experience with similar fire and emergency medical agencies and categorized in accordance with the Current Service Delivery Analysis tasks.

This is intended as a management reference to be used by TFD leaders to aid in forthcoming planning and management activities. Because of that, the discussion and rationale behind each of the recommendations is not included here; that information may be found in the appropriate section of this report as referenced below.

In keeping with the advisory nature of most of these comments, none is listed in order of importance or priority.

Summary Table of Organizational Recommendations		
Objective Reference	Page Number	Recommendation

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C: Response Time Thresholds and Triggers

Introduction

When a community creates a fire department and builds its first fire station, a response time criterion is usually established. This response time anticipates that it applies to 100 percent of the area covered by the boundaries of that fire station. This is especially true when there is only one fire station and a small area to cover. Simply speaking, a central fire station is among the first public buildings created in most communities, no matter how small. As the community grows away from that station in incremental steps, the expectation is that the original fire station will still provide adequate coverage.

However, that expectation is fraught with many problems. In the simplest of terms, the total area covered by a fire department may or may not be initially highly developed; and even if a crew from the fire station responds, it may not do so in a timely manner. Most fire departments begin as totally volunteer. They usually are operated with volunteer staffing for economic reasons. When population and service area increases, there is often pressure to add full-time staff and to consider adding additional fire stations.

In fact, there are many variations on this theme. Older, established cities tended to be denser and smaller in dimension, but they often annexed new areas. Newer communities may be created from a much larger area than the first fire station could cover. Urban sprawl, which is an active topic of discussion in areas of public policy, has resulted in the timing for construction of additional fire stations and staffing.

Fire Station Siting

Usually when a fire department constructs its first fire station in the area, the values at risk and hazards to be protected are within a close driving distance. In effect, the first fire station in a community is a centroid. That is, the local fire station is the center of the response capacity of the jurisdiction. Earlier in the 20th century, fire stations were often characterized on maps by having a circle drawn around the fire station with an l.5 mile radius. This was sometimes used to describe the area of coverage. However, fire apparatus responds using the roadbed that consists of angles and distances that did not result in the circle being the true description of the coverage. Not only that, but one cannot place fire stations exactly three miles apart and have

the two circles overlap. When they are placed closer together than the 1.5 radius, there is not only overlap, but also gaps where there does not appear to be coverage.

Later, the circle was replaced by diamond-shaped templates that could be overlaid over the fire station and rotated to estimate the relative advantage of road distances. The contemporary method used to evaluate fire stations is based on using the actual road-network in a computer model. This system uses time and distance to create a network that more closely represents how far the company can respond from its fire station, using an adopted response time standard. A few years ago, the method that was in vogue was called FLAME; Fire Station Location and Mapping Environment. From the time the first fire station is built, it creates an expectation that the facility can and will provide a timely response to calls for service in an area surrounding that facility.

When the original criterion was set for response time from that facility, there is an immediate location – allocation created by that fire station. The fire station provides a response to a given area within a reasonable time in a pattern that essentially is an overlay on the streets and highways that radiate outward from that location. Even before any incidents occur in a community, the road-network geography and the topographical attributes of a community create a dynamic segmentation that results in the ability of fire professionals to reasonably predict what areas can be and those that will not be covered. Today the preferred tool for conducting this type of analysis is through Geographical Information Systems (GIS).

There are many infrastructure components that have an effect on the location allocation concept. Among these are road and highways networks, impedance factors such as traffic patterns and processes (stoplights and signs), and turn impedance, i.e.: roadbed configuration and elevation impedance (slope). It is axiomatic that there is an inverse distance-weighting factor that results in longer response times to areas further away from the centroid of the station; called distance decay. The manner and means of response involve the use of the roadbed, but also involve dealing with differences in elevation and competing vehicles on the roadbed. In short, the further away from the location of an incident and the higher the impedance for response, the less effective any specific resource is in dealing with the initial stages of an emergency event as you move away from the fire station's location.

The use of the concept of using travel time itself is not exactly new. However, for many years the basic criterion was road mileage only. The standard that was normally applied was that fire apparatus or an engine company was expected to be able to reach any incident within 1.5 miles of the fire station within five-minutes of driving time. Time was a secondary consideration. That standard was based upon data from the 1940s with respect to road conditions and traffic patterns. A lot has changed since then. For decades, the Insurance Services Office (ISO) has based fire station locations on a 1.5-mile separation. In general, this has served as rule of thumb, but it does not deal with the vagaries of physical response (such as geography, transportation, and weather). Secondarily, it does not place any emphasis on response needed for emergency medical service (EMS) incidents, such as basic life support (BLS) or advanced life support (ALS).

The concept of using actual travel time today is based on a more accurate representation of the level of service for an all-risk approach. It is more performance-based. Today, most fire agencies set a time standard that includes three elements, two of which were missing from the strict use of mileage for station location; specifically, alarm processing time and turnout time. The actual time of road travel has often been used to set the communities expectation of performance.

Using this approach, stations are seldom located in a linear fashion. This concept is based on the time intervals identified in the Standards of Response Coverage section of the Self Assessment Manual published by the Commission on Fire Accreditation International. This process leads to the development of a standard of response cover, or a time and level of staffing designed to control an emergency at a minimum level of loss. The process is however, a policy choice based on risk and local conditions.

The basic performance standards for time goals are based on the rapid speed of fire growth and consequences of emergency medical situations over a short time frame. It has been determined that both fires and medical emergencies can gain a foothold that result in excessive losses when the times are excessive. The most common benchmark time standards used are:

- Alarm processing time — 60 seconds
- Turnout time — 60 seconds
- Travel time, fire response — five minutes, 90 percent of the time, BLS response — five minutes, 90 percent of the time, and ALS response — eight minutes, 90 percent of the

time

The contemporary method of measuring performance looks at response time on incidents as an indicator of levels of service. The way this is done is two-fold. The first is to measure the actual performance during emergencies; the second is to monitor the system to determine when the system fails to achieve the performance goals.

One point of caution — Response time criterion should only be applied to calls that are emergency calls. When incidents are analyzed, the data should be reviewed to assure that non-emergency calls are not used when calculating performance. There are many calls for service that fire departments log as incidents that are non-threatening scenarios and the responding companies will handle them on an as–needed basis. To include these times in the analysis of emergency services tends to skew the outcome, leading to a false service indicator.

Options for Improving Call Processing Time

Recommendations for improving call processing time include:

- Update existing SOGs for call taking
- Review current standard for dispatch processing time
- Require a performance level
- Recommended standard of call processing time of; less than one minute, 90 percent of the time on priority assignments
- Benchmark and monitor call processing time

Response Failure

To understand when response failure occurs, we must define first what is being measured and how we measure the performance goal. For example, a basic question to be answered is whether a department is protecting the dirt or the incidents? Are we going to measure percentage of performance by first-due district, or department wide? Generally, fire protection practitioners try to position stations to cover 90 percent of the ground in each first-due district, to provide overlap for concentration, redundancy for multiple calls, and for equity of access for customer service. It is economically impossible to cover 100 percent of the ground. Based on actual call loading, we could strive for 80 to 90 percent of the calls within first-due and concentration total reflex measures.

If the measure for either area or incidents is set at 80 to 90 percent effectiveness, how much slop over the performance measure is acceptable? For example, if an historical incident measure is at the 85 percentile, BUT the other five percent are covered in the next 60 seconds, is that acceptable? Maybe yes, maybe no. It is important to understand that values at risk, type of unmet calls and the total number of calls can combine to create a need. If the deficiency is only five percent or 25 calls out 500, depending on the size of the measurement area the gap may or may not be significant.

For example, if the performance requirement was to arrive at the scene of an emergency within five minutes of travel time, 90 percent of the time, this criterion could be applied to one year of response data to see if the goal was achieved. It should be noted that this criterion allows for ten percent of the calls to be beyond the five minutes traveling time over a given reporting period. This provides flexibility in the assessment of coverage to cope with anomalies such as extra-ordinary response conditions such responding from out of district, or for delays caused by simultaneous alarms.

This raises an additional question: Of the 10 percent overage, how many of the incidents are covered within the next 30 to 60 seconds? The first indication of a problem of providing service is when a number of alarms that exceed the performance standard are documented. This may or may not be function of new growth. It could be the result of in-fill that causes a higher number of alarms for the company than it can service. This is especially true when alarms come in simultaneously.

Moreover, when areas are being developed that begin to extend travel times, they do not automatically become the source of new alarms. In fact, new construction often has a period of several years before adding to fire service demand. The same is not necessarily true from the perspective of emergency medical service.

When a New Station is Needed

The question that many communities have to address is when is a second or third fire station required to meet time goals? Obviously, this has been answered in any community that has more than one fire station. The problem comes in finding a quantifiable threshold to determine that point for each specific situation because it varies from community to community and even within a specific jurisdiction. The overall answer is part financial and part professional judgment.

In fact, in the literature of the fire service today, there is very little definitive guidance on how this should be accomplished.

There are several steps that can be identified. They consist of:

- Identifying areas with minimum coverage
- Identifying feasible locations for a new facility
- Evaluating those locations using specific criteria

The description in this document is based on a growing body of knowledge aimed at quantifying this process. It is unfortunate that there is no universally acceptable algorithm. The fire protection planning process does allow for an evaluation of potential loss as a result of deteriorating response times. One form of measurement is to assess the road and transportation network to ascertain the percentage of road mileage that theoretically is covered by the time criterion. This is done using computer-based modeling to create a polygon that describes the areas of coverage. In fact, this process will also identify gaps and deficiencies where response time is not adequate.

It should be noted that as long as a department operates a totally volunteer force, the time established as a turnout time will be a factor. Generally speaking, volunteers take more time to get out of a station than a permanent crew. This statement does not place any prejudice on the use of volunteers. This is mentioned only to remind the readers that total response time must be considered when evaluating alternatives.

As growth and development extends beyond the range of travel time of one station, the percentage of calls that exceed the performance requirement should begin to increase. It should be noted that growth, in and of itself, does not create an instantaneous demand. New construction has the advantage of better codes, a higher level of owner interest, and limited deterioration of fire-breeding conditions.

A more subtle difference in today's fire service is the fact that community demand for medical services exists almost from day one of occupancy. In short, this means that new construction may place more values and lives at risk, but the demand for service will be incremental. When demand for service does begin, it will be based upon two factors - nature of the occupancy and hazards that are present.

Incident increase may first appear as a change in the performance of an existing company in the annual analysis of emergency calls. For example, if a station has 1,000 alarms and a 90 percent compliance rate with the response standard, there would be about 100 alarms per year that were beyond the goal. This would be the baseline for existing response performance. If the following year, the number of alarms was 1,200 and percentage dropped to 85 percent, this would indicate that the department is losing ground on response performance. If the change in the number of alarms had merely increased because of more calls in the same area, the response time percentage should have remained fairly similar. (One exception to this rule is when a single company has such a high call volume that it cannot handle all calls without call queuing.)

However, since the alarm rate went up and the performance went down, the failure threshold may be approaching. The change in alarms that were not met may now go to 180 (15 percent of the overall). As stated earlier, analysis needs to be performed on the deficiency to determine how many of those incidents were handled in the increment of 60 seconds beyond the performance time.

Based on actual response time analysis, one threshold that needs to be considered is the increase in alarms and the percent of calls handled under the criterion adopted. Anything more than a 10 percent increase in call and a 10 percent reduction in performance is a signal to evaluate the level of service being provided.

In larger departments, most practitioners are factoring out non-emergency calls and, for actual incident performance, only looking at core emergencies. The definition of core emergencies can be made locally based on risk and importance to the community, but they are usually structure fires and moderate to severe status EMS calls.

In general, if more than one measure must be slipping, an evaluation of all Standards of Coverage factors, along with the reason why the data is slipping, is required. A one-year snapshot may not be valid if the agency had a big storm event, a catastrophic weather event, a major wildland fire, and stacked a bunch of calls for just a month or the year.

Incident analysis approach depends on having emergencies, which does not address what is at risk. That is where the mapping technology applies. As structures and different types of fire problems are constructed on the ground, they may represent additional lives and property that are at risk that deserve equity in protection. One of the elements for creating a governmental entity is to control land use and to create mechanisms for collecting taxes and determining ownership. Furthermore, these same individuals and properties are paying the taxes, fees, and permits for the level of service being provided. In one sense when growth occurs, the new properties are usually safer than the older part of the community because they are constructed to a higher standard. What is clear to almost any community is that being slightly out of the response standard range does not trigger a new facility.

One threshold that needs to be carefully monitored is the revenue stream that accrues from development. That revenue stream should provide a threshold when different elements of future fire stations can be determined. For example, it takes several years to evolve a location into a fire station site. As the revenue stream proceeds, funds could be available for site acquisition, initial plans and specifications, site treatment, and construction. This may be a multi-year process.

The threshold for construction should be to provide a new fire station into any zone in the city that has more than 35 to 50 percent of its parcels developed. Some of the secondary measures currently being used are 300 to 500 calls for service for any individual fire company or a service population of 10,000 to justify a full-time paid company. The following criterion grid illustrates a series of measures that may be useful deciding when a new fire station should be deployed within a city. Similar grids could be developed to help establish triggers for the deployment of additional emergency equipment and personnel.

Figure 111: New Station Criterion Matrix

Criterion Matrix to Determine When a New Station is Needed				
Action Choices	**Travel Distance**	**Criteria**		
		Response Time Parameter	**Out of Area Calls**	**Building/Risk Inventory**
Maintain status quo	Enter local information	1st due company Enter local response time	Enter existing out of area calls	Enter local building/risk inventory
Temporary facilities and minimal staffing	Risks 1.5 to 3.0 miles from existing station	1st due company Exceeds 5-minute travel time 10% of the time, but never exceeds 8 minutes.	More than 10% of calls are in adjacent area	New area has 25% of same risk distribution as in initial area
Permanent station needed	Risk locations exceeding 4.0 miles from the station	1st due company Exceeds 5-minute travel time 20-25% of the time. Some calls <8 minutes.	More than 20-25% of calls are in outlying area	New area has 35% of same risk distribution as in initial area of coverage
Permanent station essential	Outlying risk locations exceeding 5.0 miles from the 1st station	1st due company Exceeds 5-minute travel time 30% of the time. Some calls <10 minutes.	More than 30% of calls are in outlying area	New area has 50% of same risk distribution as in initial area

The decision process has to be placed into the context of staffing pattern decisions. It is not uncommon to have a station constructed, and have the staffing pattern evolve over years from one system to another. In the case of a station under consideration, it should be anticipated that a policy decision needs to be made with respect to the staffing system to be used as soon as possible. It is anticipated that a completely volunteer system would not be viable for this type of facility. Conversely, a fully staffed paid company has a significant price tag to it. A combination staffing system would seem to be the most practical for the first five years of consideration. These are the staffing configurations used in the matrices developed to describe thresholds and triggers that should be evaluated in the future.

This observer's experience has been that it takes a multiple elements of the Standards of Coverage to be out of balance along with having additional economic resources to justify an additional paid company or staffing increase on one or more companies.

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D: Remodeling and New Construction of Stations

The following information is provided as guidance should the department embark on future remodeling or new construction. It is important to point out that this information is a snapshot in time, and may dramatically change due to inflation or other adverse economic factors. The process and methodology used for identifying improvements, quantifying their magnitude, and projecting reasonable budgets is only a preliminary step in an ongoing capital facilities planning process the department should develop. The findings are based largely on generally accepted rules of thumb. For this reason, this guidance is expected to frame reasonable expectations for required improvements for facilities and the potential corresponding costs to undertake future improvements. It is not intended to be the final blueprint - the reader is cautioned against assuming such.

Anticipated Seismic Structural Upgrades

The following assumptions are made in determining the seismic upgrade costs as part of a deferred maintenance program for those stations needing such upgrades.[42]

Level of Seismic Upgrade

Basic life safety is the minimum standard of retrofit considered. This addresses the most serious life-safety concerns by correcting those deficiencies that could lead to serious human injury or total building collapse. Upgrades include bracing and tying the most vulnerable elements of the building, such as parapets, chimneys, and projecting ornamentation, or reinforcing routes of exit. It is expected that if an earthquake were to occur, the building would not collapse but could be seriously damaged (requiring major repairs).

Basic/Traditional Measures

The following list illustrates that most measures to reduce life-safety risks rely on using mechanical fasteners to tie a building together. Incorporating these measures can be done incrementally without waiting for extensive rehabilitation. An engineering survey can identify what is needed on a project-specific basis, and a precise document and resultant costing can be developed.

[42] Assumptions developed by Rice, Fergus and Miller, Planners and Architects, Bremerton, WA.

Costs for Seismic Upgrades

Based on upgrade criteria for budget purposes only, a square foot construction cost multiplier of *$35* per square foot has been established as a benchmark for seismic upgrades. We note that this figure is a construction cost estimate and represents only an average cost for an average complexity of seismic improvements. A full building lateral engineering assessment, design, and resultant cost estimate would be required to develop a complete and accurate construction cost estimate.

These seismic improvements should be seriously considered, regardless of any other remodeling or building improvements; and are, therefore, separate and in addition to the other estimated construction costs noted in this report.

Estimated Construction Costs

In projecting reasonable construction costs for remodeling and/or building additions on to fire stations, four categories of improvement have been established (together with anticipated costs-per-square-foot to undertake those improvements). They are New Construction, Station Additions, Station Remodels, and Cosmetic Improvements.

New Construction

For the purpose of developing a realistic construction cost for new construction, a square foot multiplier of up to *$400* per square foot has been established. This figure is determined after review of bid results from a number of Washington fire stations and from discussions with several professional cost consultants. Based on the date of bidding, these costs have been escalated to reflect today's market value. Similarity of project size, regional location, and level of execution of building detailing were all considered in utilizing past projects as comparables.

Figure 112: Cost Comparison for Recently Constructed Fire Stations[43]

Project	Bid Amount Escalated to 12/2007	Station Square Footage	$/SF Escalated to 12/2007
Warm Beach Fire Station	$ 1,971,116	10,083 sf	$195.49
Bremerton Fire Station	$ 2,910,600	15,350 sf	$215.23
Edmonds Fire Station 16	$ 2,067,025	10,740 sf	$218.46
Fire Station 6-5 and 6-8	$ 4,077,596	20,992 sf	$220.48
Snoqualmie Fire Station	$ 3,265,058	16,557 sf	$223.84
Shoreline North Facility	$ 2,734,028	11,752 sf	$232.64
Marysville Fire Station	$ 2,574,045	11,000 sf	$234.00
Camas Fire Station	$ 2,793,356	11,800 sf	$236.73
Shoreline South Station	$ 2,781,993	11,752 sf	$236.73
Issaquah Highlands Station	$ 2,860,183	11,945 sf	$239.45
Maple Valley Fire Station 80	$ 2,179,503	9,000 sf	$242.17
Renton Fire Station 12	$ 3,470,853	15,800 sf	$249.35
Mercer Island Fire Station 91	$ 3,025,782	11,830 sf	$255.77
Des Moines Fire Station	$ 4,298,342	16,370 sf	$262.57
Snohomish Fire Station 12	$ 2,458,034	10,500 sf	$265.72
Poulsbo Fire Station	$ 1,559,920	6,214 sf	$284.94
Port Townsend Fire Station	$ 2,331,788	9,230 sf	$286.76
Bellingham Fire Station	$ 2,674,993	8,700 sf	$307.47
		Average:	**$264.05**

Note: *Costs are calculated as of December 2007 for comparison purposes only.*
Costs are based on low bids and do not include contracted bid alternates or change orders during construction or property acquisition.
Cost data has been obtained from a variety of sources. ESCi and Rice Fergus Miller do not warrant their accuracy.

Fire Station Additions

Additions made to existing facilities are often times more difficult and costly than new construction for several reasons. The integration required with existing structural, mechanical, and electrical systems usually requires additional work beyond the immediate area of new construction. Depending on the size, location, and utilization of the space, existing systems outside the footprint of the addition often require an increase in capacity to make the building functional. Additionally, these facilities are typically occupied, or partially-occupied, during construction, making it more challenging for the contractor to keep building systems continuously operational, drives and roadways clear, and property access unencumbered. This is particularly important in fire station projects where emergency responders and apparatus

[43] Cost projections provided by Rice, Fergus, Miller, Bremerton, WA.

need quick and efficient access in and out of the station. These challenges in station additions are reflected in a multiplier of *$315* per square foot to account for these complexities.

Fire Station Remodels

Remodeling within the envelope of the existing structure and reliance on the existing physical plant (electrical/mechanical) to service the reconfigured space is how this effort is described. It may or may not require extensive structural revisions and will always be inclusive of new finishes on all surfaces. Shoring of existing structure and capping off of utilities can be a part of this effort. A cost of *$200* per square foot is reflected in our analysis as a multiplier for this scope.

Cosmetic Improvements

For existing fire stations undergoing some level of interior remodeling, a square foot construction cost multiplier of *$15* per square foot has been established as a benchmark for replacing carpeting, repainting, and replacing other worn and deteriorated interior finishes. It should be noted that this figure is a construction cost estimate only and represents only an average cost to replace these interior materials and finishes with average quality materials.

Site Improvement Costs

An average cost of *$3* per square foot should be applied over the entire site (minus the new building footprint configuration) for each remodel project. This benchmark amount is intended to cover the costs for new paved parking areas, re-landscaping disturbed portions of the site, and upgrading the septic systems of those facilities not provided with municipal sanitary service. It is important to recognize that sites vary dramatically in their soils type, existing grade configuration, and ease of access. With this in mind, site improvement costs vary dramatically from one project to the next. Given the absence of a developed building layout, soils information, and landscape design approach at this early stage, this figure is only approximate and should be considered strictly a preliminary budget amount.

For the new construction projects, a benchmark of *$6* per square foot has been established for site development. This higher figure allows for the installation of site utilities to the new building and a more comprehensive program of site preparation and execution for paving, stripping, and landscaping. Again, a cautionary note—new sites differ dramatically in the need for clearing, grubbing and import/export of material, and the figures used here are a *best assumption* based on prior experience.