Barnstable Fire Department

Massachusetts

Emergency Services Facility Location Study

Summer 2012

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Executive Summary

To be completed upon review of the draft document by client representatives.

Evaluation of Current Conditions

Emergency Services Consulting International (ESCI) was engaged by Barnstable Fire Department (BFD, District, or Department) to conduct an Emergency Services Facility Location Study. This document serves as a report of that project and begins with a general overview of the organization, its facilities, and the services it provides.

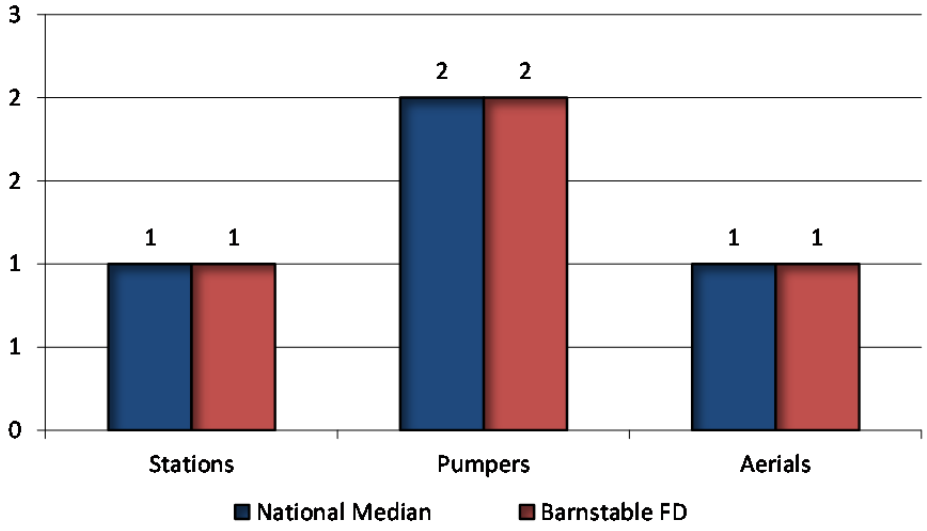
Organization Overview

Formed in 1927, Barnstable Fire Department (BFD) is located within the Town of Barnstable, Barnstable County, Massachusetts, and provides fire suppression, Advanced Life Support (ALS) transport ambulance, marine response, technical rescue, and code enforcement/public education services to the Village of Barnstable and the surrounding area, including the peninsula Sandy Neck, totaling approximately 14 square miles plus an underdetermined amount of shoreline and marine area in and about Cape Cod Bay and Barnstable Harbor. The population of the service area is not tied to a Census Designated Place (CDP); therefore, no precise population can be determined. The estimated population served is reported to be 3,500 permanent residents with a significant influx of population during seasonal and normal business hours due to the coastal location and the commercial and industrial occupancies scattered throughout the District.

The Department provides services from a single facility located in the heart of the Village's downtown core and utilizes a fully career staff to accomplish its mission. The apparatus complement of the Department includes two engines, one aerial ladder, one ambulance, two boats, and several support vehicles. One boat is docked at the Barnstable Marina between April and November for rapid response to marine incidents or other responses to Sandy Neck, a narrow strip of land containing 30 seasonal cottages without electricity or running water.

In comparison to other departments across the Northeastern U.S. serving similar populations, the Department fares well in regard to stations, engines and aerial apparatus as illustrated in the following figure.

Figure 1: Comparison of Physical Resources



Although it appears as though the department is resourced exactly as it should be, it should also be noted that the comparisons provided above are gleaned from National Fire Protection Association (NFPA) data that does not differentiate between those departments that do or do not provide EMS services to their respective communities. The data also compares populations and does not consider geography or the unique nature of coastal communities as exists within BFD's primary response area. A more detailed analysis of resources will be discussed later in this report.

Current Facilities

The primary purpose of this study was to evaluate the current placement of the BFD facility and to determine if the current location is suitable for both current and future service demand across the response area. To begin this process, ESCI first evaluated Station 1.

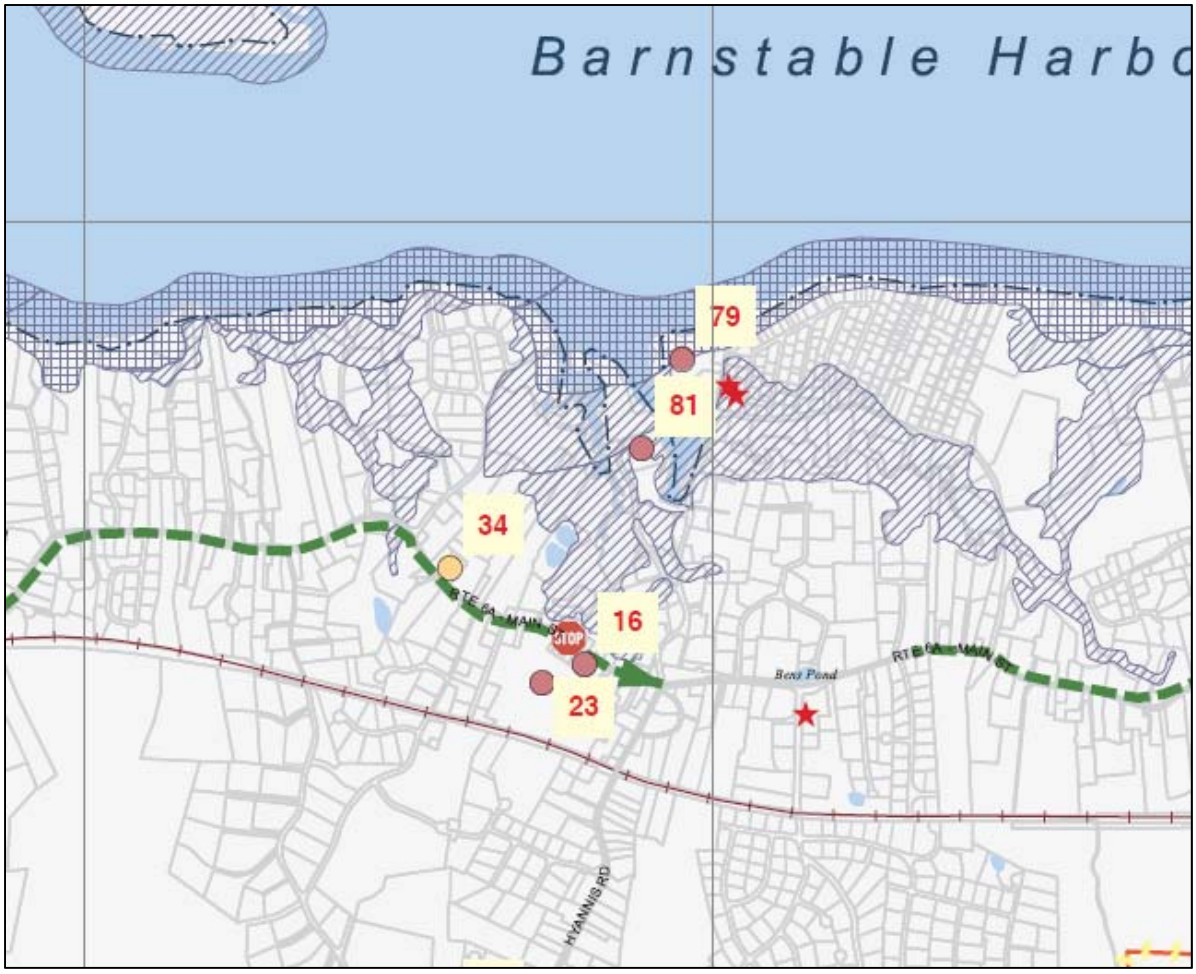
Station 1
3249 Main Street
Built in 1935 with renovations in 1974 and 2000, this facility consists of five back-in apparatus bays, four of which face to the side of the building and one faces to the rear, typically used for boat storage.

Design:	*Two-story community fire station with administrative offices facing Main Street and side-facing apparatus bays. Crew quarters are on the second floor as is a combination training/exercise room.*
Construction:	*Typical Cape Cod construction with gabled shingle roof replaced in 2000. Siding is a combination of cedar shake and vinyl.*
Safety:	*No automatic doors stops on four of the five bay doors. Exit onto Main Street is suitable but turning radius from station onto drive is tight.*
Environment:	*Plymovent exhaust removal system installed in apparatus bays with evidence of regular use. Turnout gear stored in apparatus bay without separate ventilation. Central air conditioning provided to all living areas with separate systems for training/exercise room. Natural gas heating throughout.*
Code Compliance:	*Second floor is not ADA compliant but ground floor is handicap accessible.*
Staff Facilities:	*Accomodations made for dual gender staffing with separate sleeping facilities and dual restroom facilities on both floors.*
Efficiency:	*Space is limited, reducing ability to work on or around apparatus. Office space is cramped but useable. Storage spaces have been constructed throughout in any open space. No room for expansion without purchase of adjoining property.*

The current facility blends well with the surrounding area. Access to the primary roadway is acceptable but the tight radius from the apparatus bays to the side drive is marginal. Overall, the station is in good condition; however, as with any structure originally built nearly 100 years ago, maintenance issues are common, particularly with the HVAC system.

Due to the station's close proximity to the inner harbor, the facility is located within the Sea, Lake, and Overland Surges from Hurricanes (SLOSH) zone as indicated in the map below and designated at item 16.[1]

Figure 2: SLOSH Zone and Evacuation Route



Based on 100-year flood data and projections, the station could be inundated and rendered unusable. In addition, the primary hurricane evacuation route follows Route 6A, which crosses directly in front of the station. As indicated on the map by the 'stop sign', this is an area of the evacuation route that is also located within the SLOSH zone. How this facility fits in with the deployment and distribution of service demand is described in more detail in a later section of this report.

[1] Cape Cod Commission. http://www.capecodcommission.org/resources/coastalresources/BarnstablePDM.pdf. Accessed 15 August 2012.

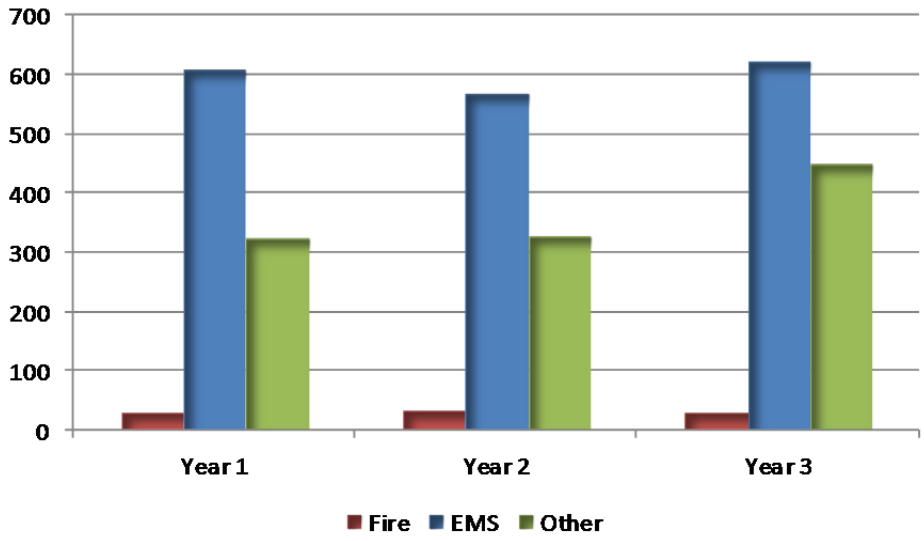
Service Delivery and Performance

Service delivery and performance are among the most visible components of a fire department's operations to the public. Thus, it is vitally important that a department routinely evaluate its delivery of core services and monitor performance to dictate changes where necessary. The three primary components of service delivery and performance for this study are demand, distribution and response performance.

Demand

Service demand can be defined as any workload experienced by the department that impacts its ability to provide other services. This is commonly referred to as incident load or workload. Service demand can be analyzed in a variety of ways to uncover trends in usage rates or other issues that impact service delivery and efficiency. ESCI received three years of data from the department's National Fire Incident Reporting System (NFIRS) software for demand analysis. The analysis begins with a view of overall workload for the three-year period that ranges from July 1, 2009, to June 30, 2012. For this reason, yearly data is grouped into 12 periods rather than calendar year.

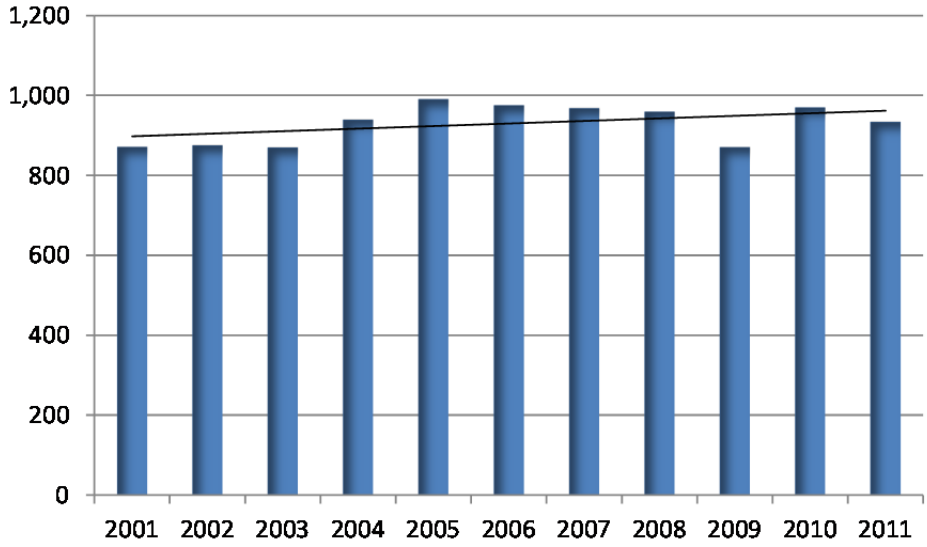
Figure 3: Overall Service Demand by Type



A vast majority of the department's service demand is medical in nature. This is not uncommon for those departments participating in emergency medical services (EMS) and even more common for those agencies providing transport services. Based on information obtained from the department's annual

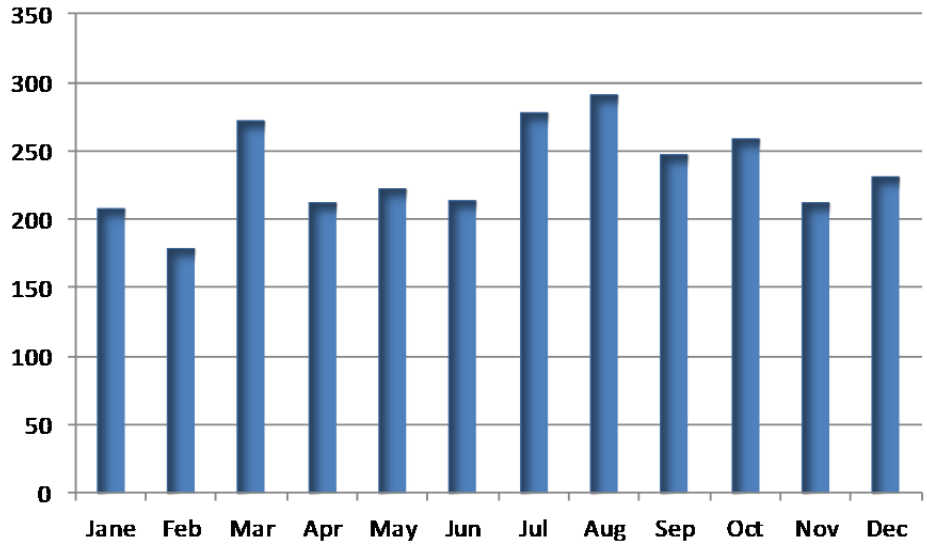
reports, service demand has fluctuated over the last ten years but has been on a gradual increase throughout the decade of about 1 percent annually as illustrated below.

Figure 4: Ten-Year Historic Service Demand



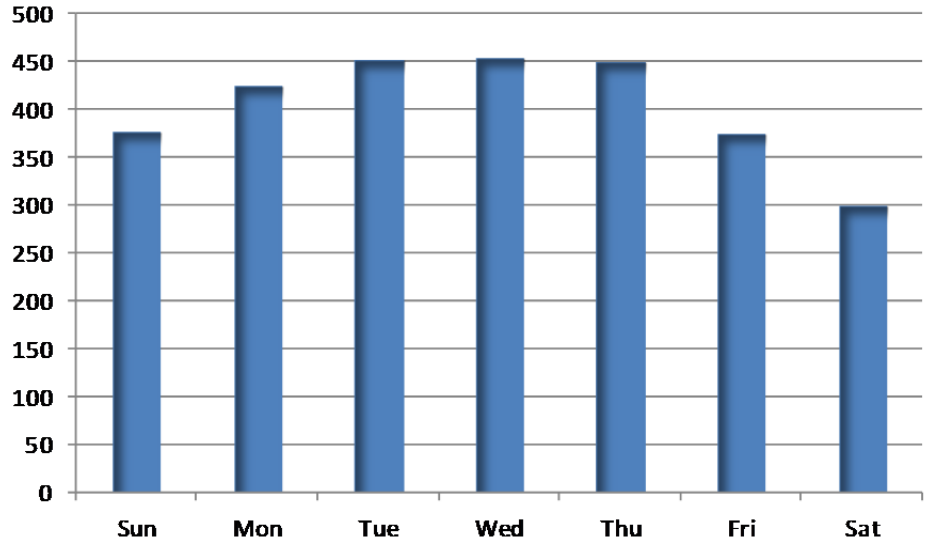
The annual reports also identified the types of calls responded to by the Department over the last decade. Based on that information, incidents involving fire (of any type) have increased 17.9 percent; medical responses (including motor vehicle crashes) have increased less than 1 percent; and all other incident types have increased 2.6 percent. Further analysis was completed on the response data based on temporal variations. This analysis begins with service demand by month.

Figure 5: Service Demand by Month



As would be expected in a coastal area, highest service demand typically occurs when human outdoor activities are at their highest, although March and October also have relatively high service demand. Analysis continues with an evaluation of service demand by day of week.

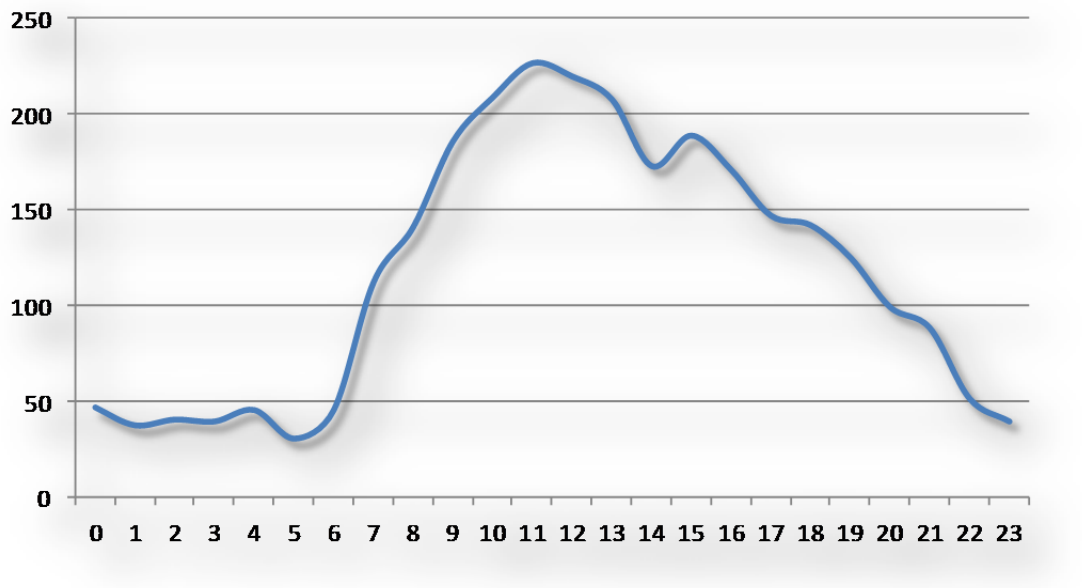
Figure 6: Service Demand by Day of Week



Based on the Department's data, the highest day for service demand is Wednesday, following closely by Tuesday and Thursday. This is contrary to what is normally seen in emergency services agencies. Typically, service demand is higher on weekends when outdoor activities are greater. This elevation in

weekday service demand is more than likely due to the high influx of population into the Department's response area during normal working hours. The final method of temporal analysis evaluates service demand by hour of day.

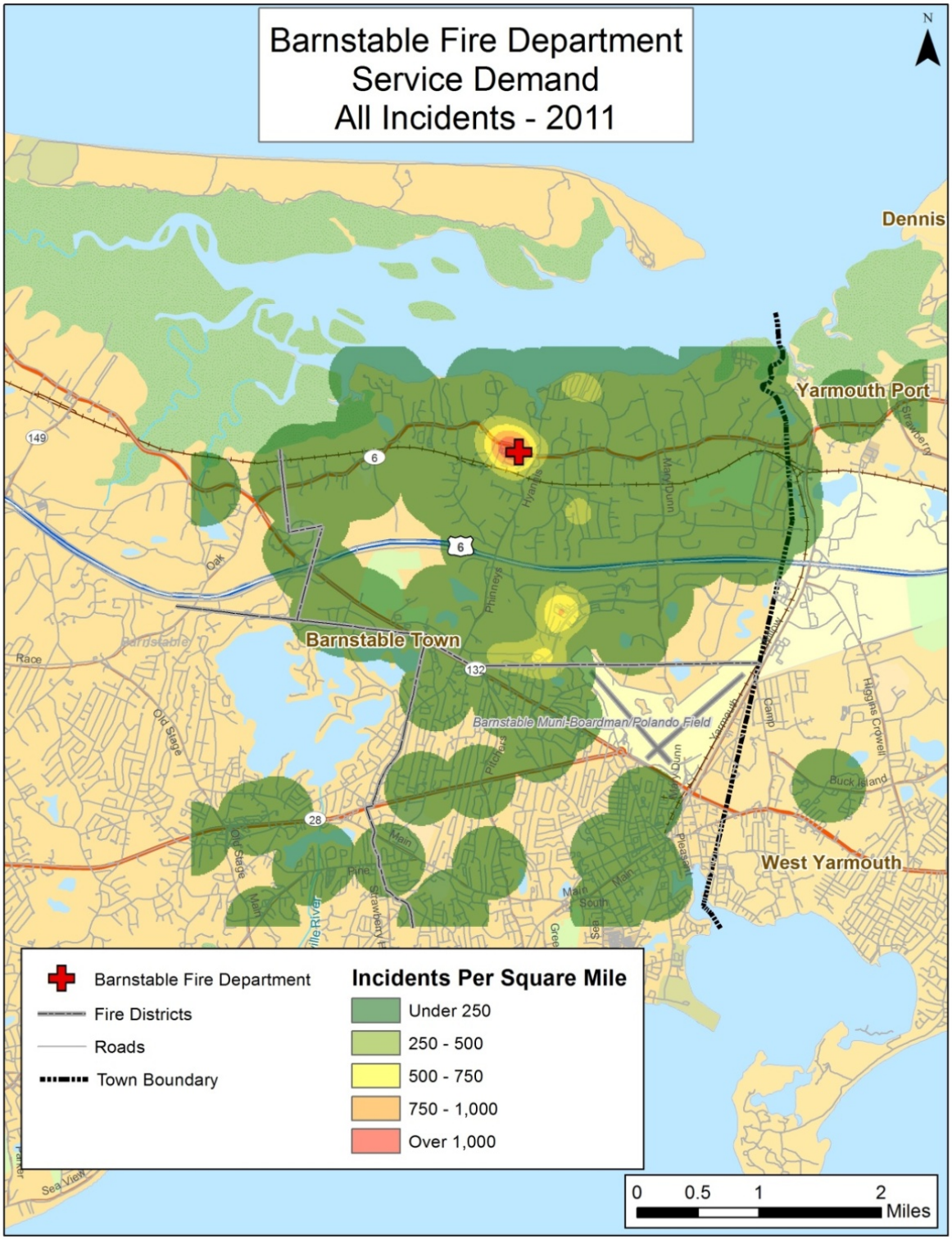
Figure 7: Service Demand by Hour of Day



The Department's service demand by hour of day resembles the normal bell curve for emergency services organizations across the country. As human activity begins to increase, around 0600, so does service demand. As human activity declines into the evening hours, service demand declines proportionately.

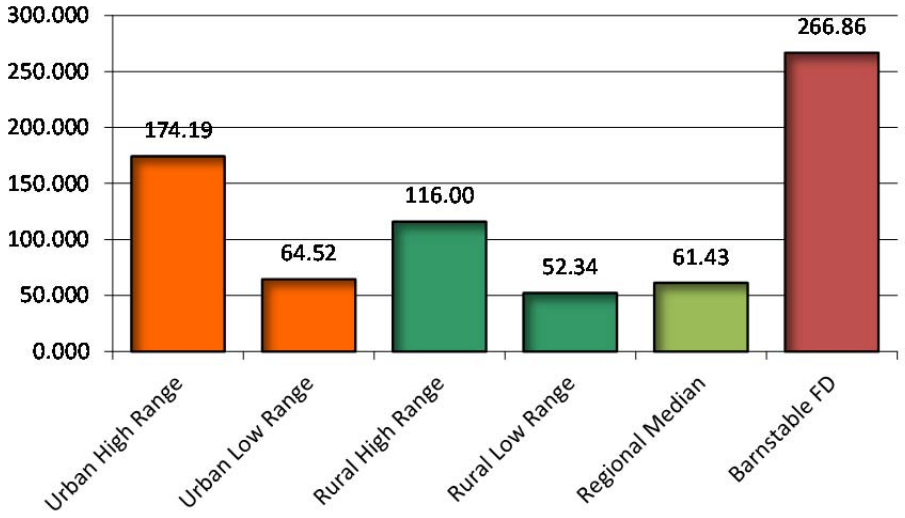
Aside from aggregate and temporal analysis of service demand, it is important for an organization to know where service demand is occurring within the community. This is known as geographical service demand analysis and is displayed in the following figures, first for all service demand and then for EMS and fire incidents separately.

Figure 8: Geographic Service Demand (All Incidents) - 2011



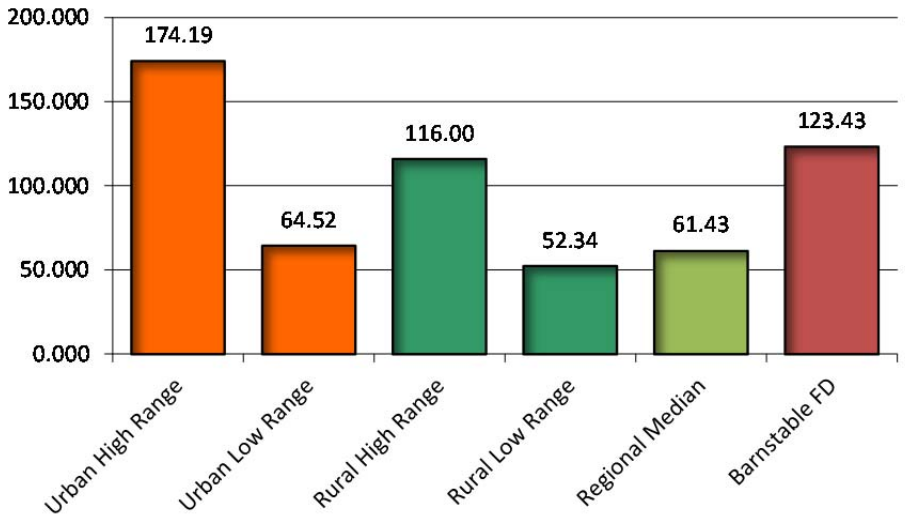
Based on an aggregate of all incident types, BFD is responding to a much higher number of incidents when compared against data provided by the National Fire Protection Association (NFPA) for departments serving similar populations.

Figure 9: Comparison of Service Demand per 1,000 Population - 2011



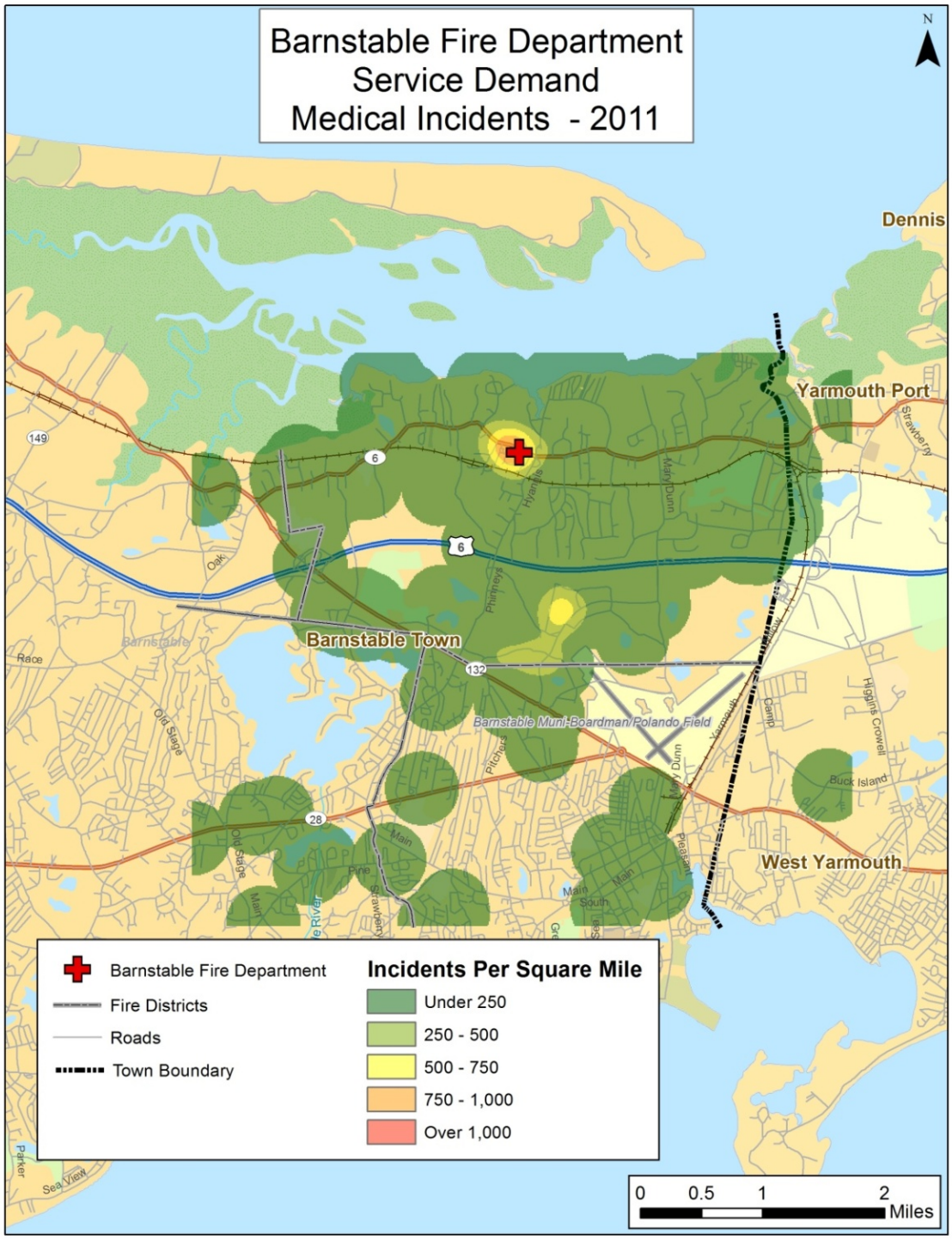
Based on the fact that BFD is heavily involved in EMS by providing transport ambulance services to the response area, it is useful to note that many organizations serving similar populations do not participate in these services. If the EMS component were removed from the comparison above, the service demand per 1,000 population would be much more similar to the expected ranges, as shown below.

Figure 10: Comparison of Service Demand per 1,000 Population (without EMS) - 2011



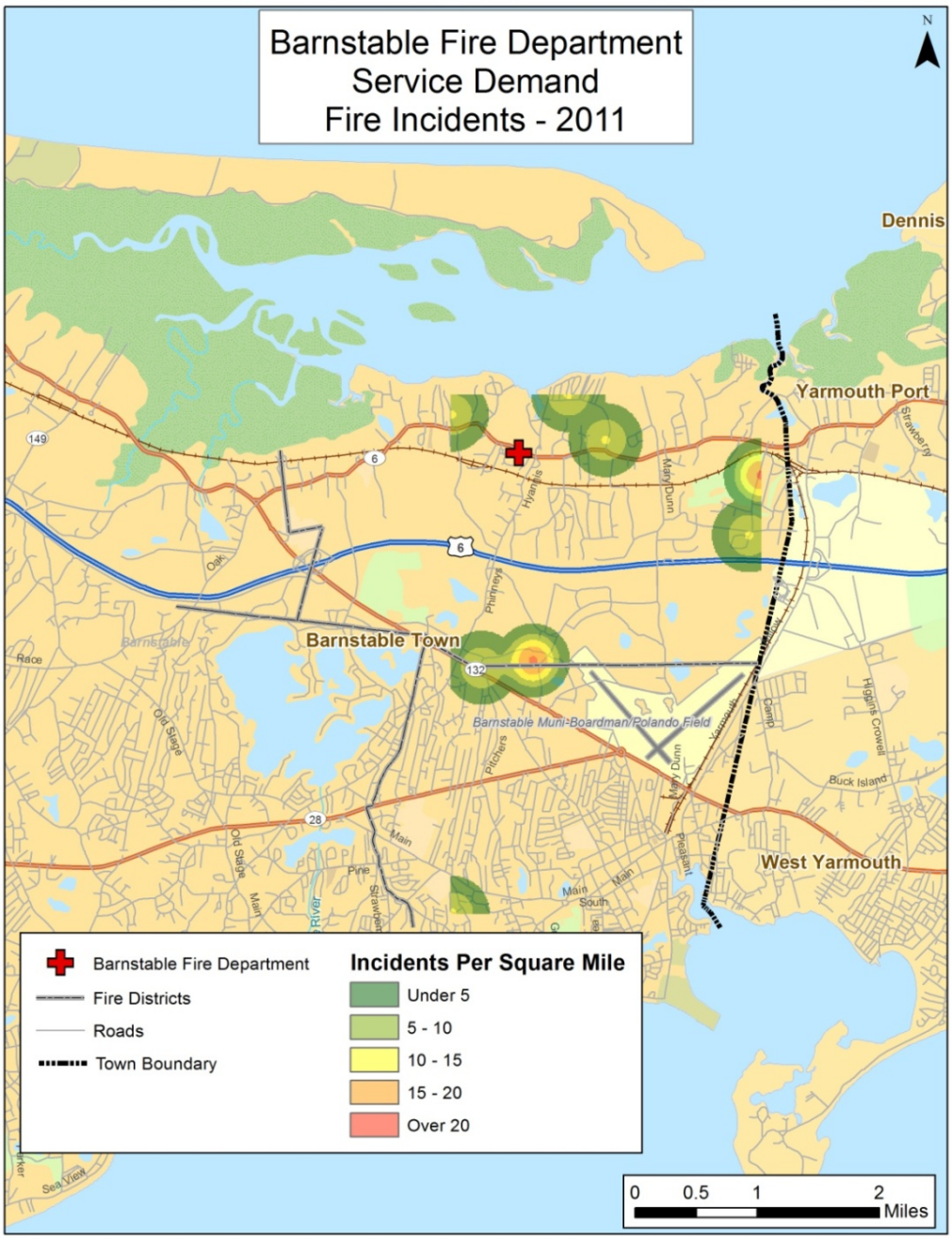
Since medical incidents constitute a majority of the department's workload, it is critical that medical service demand be plotted against actual deployment. Medical service demand is illustrated in the map below.

Figure 11: Geographic Service Demand (Medical Incidents) - 2011



The entirety of the response area is composed of a mix of historical properties as well as modern commercial spaces that each pose a differing fire risk. Unlike medical responses that are based solely on human activity, fire risk is static in that the structural fire protection risk remains even if humans are not present. This risk is widely distributed throughout the department's primary response area. The 2011 historical service demand for structure fires is illustrated in the following figure.

Figure 12: Geographic Service Demand (Structure Fires) - 2011



The geographic distribution of service demand is important because it is directly connected to the department's ability to effectively respond to those incidents. This is known as distribution and is analyzed in the following section of this report.

Distribution

Regardless of staffing patterns or service demand, emergency services providers are able to reach a certain portion of their primary response area on the existing street network. The amount of area that can be covered is evaluated during distribution analysis. If a department's resources are well distributed, chances are that a high percentage of both area and service demand can be reached within a reasonable amount of time. Conversely, if a department's resources are poorly distributed, then the agency's ability to provide service in a timely manner is degraded. As already discussed, BFD provides services from a single station located within the village as illustrated in the following figure.

Figure 13: BFD Facility Base Map

Using Geographic Information Systems (GIS) software, ESCI was able to map the department's travel time based on both four and eight-minute models. Both are provided on the following map.

Figure 14: Four and Eight-Minute Travel Models

Based on this analysis, BFD is distributed in relation to service demand such 59 percent and 92 percent of service demand is within four and eight minutes of travel, respectively.

NFPA 1710: Standard for the Organization and Deployment of Fire Suppression Operations, Emergency Medical Operations, and Special Operations to the Public by Career Fire Departments recommends career fire department should be able to reach 90 percent of service demand within five minutes of total response time (turnout and travel time combined). The distribution analysis for BFD indicates that a large portion of BFD's geocoded incidents for 2011 fell within the four-minute travel model. In fact, 59 percent of service demand should be able to be reached within four minutes of travel from the current station location. Future development and projections as to the department's ability to continue this level of response performance or better will be addressed later in this document.

Response Performance

Response performance can and is measured in a variety of ways. For the purposes of determining how well a department is performing at delivering services to a high percentage of the population, the 90th percentile measure is commonly used. The 'average' measure is a commonly used descriptive statistic also called the mean of a data set. It is a measure which describes the central tendency, or the center of a data set. The average is the sum of all the points of data 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, this skewing can be either very large or very small.

As an example, assume that a particular fire station with a response time objective of six minutes or less had five calls on a particular day. If four of the calls had a response time of 8 minutes while the other call was across the street and only a few seconds away, the average would indicate the station was achieving its performance goal. However, four of the five calls, or 80 percent, were beyond the stated response time performance 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 time have a direct impact on the total performance measurements and the farther they are from the desired performance, the greater the impact.

The reason we do compute the average is because of its common use and ease of understanding that is associated with it. The most important reason for not using the average for performance standards is that it does not accurately reflect the performance for the entire data set. As illustrated above, one

extremely good or bad call skewed the entire average. While it does reflect all values, it does not really speak to the level of accomplishment in a strong manner.

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 measure which simply arranges the data set in order and finds the value in which 50 percent of the data points are below the median and the other half are above the median value. This is also called the 50th percentile.

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

Higher percentile measurements are normally used for performance objectives and performance measurement because they show that the large majority of the data set has achieved a particular level of performance. This can then be compared to the desired performance objective to determine the degree of success in achieving the goal. BFD does not currently have formally adopted response performance objectives, thus all comparisons will be made against *NFPA 1710* or *NFPA 1221* where appropriate.

Total response time for any emergency services agency actually begins when the incident occurs. In some cases, it may be an extended period of time before 911 is called and in others it may occur instantly. From this point, the notification of the emergency, providers must be able to respond quickly and efficiently. The emergency services 'clock' typically starts when a call is received by the primary Public Safety Answering Point (PSAP) and continues until personnel arrive on scene. This is known as the response time continuum. The first component of this continuum is call processing time by the PSAP.

Call Processing

Call processing is the time period between which the 911 operator (dispatcher/telecommunicator) answers the 911 call and dispatches the appropriate resources. In most cases this is outside the control of the fire department, as is the case in Barnstable. For BFD, Barnstable County Sheriff's Office (BCSO) is the responsible dispatch agency. All emergency calls are received through this center and appropriate resources are dispatched.

ESCI received two years of Computer Aided Dispatch (CAD) data from the BCSO from which to perform response performance analysis. This data was cleaned and non-emergency incidents were removed as were those incidents determined to be outliers within the dataset. The call processing performance is detailed in the figure below.

Figure 15: Call Processing Performance – 2011

Measure	Minutes:Seconds
Average	00:46
95th %	01:48

NFPA 1221: Standard for the Installation, Maintenance, and Use of Emergency Services Communications Systems recommends that emergency communications centers receive and dispatch providers within 60 seconds when measured at the 95th percentile. Based on the information provided by the communications center the BCSO performance is 48 seconds greater than the NFPA recommendation. It should be noted that the times generated by the communications center for call processing analysis were estimates based on call transfer time or call enter time and no actual call received time was available, thereby skewing the analysis somewhat. The next phase of the response time continuum is turnout.

Turnout

Turnout time is the amount of time it takes for emergency personnel to become en route to an incident after being notified. This is the single component within the response time continuum that is in almost complete control of the response personnel. Turnout time can, however, be affected by several factors including time of day, volume of service demand, efficiency of station layout, etc. The overall turnout time performance for BFD is provided below.

Figure 16: Overall Turnout Time Performance – 2011

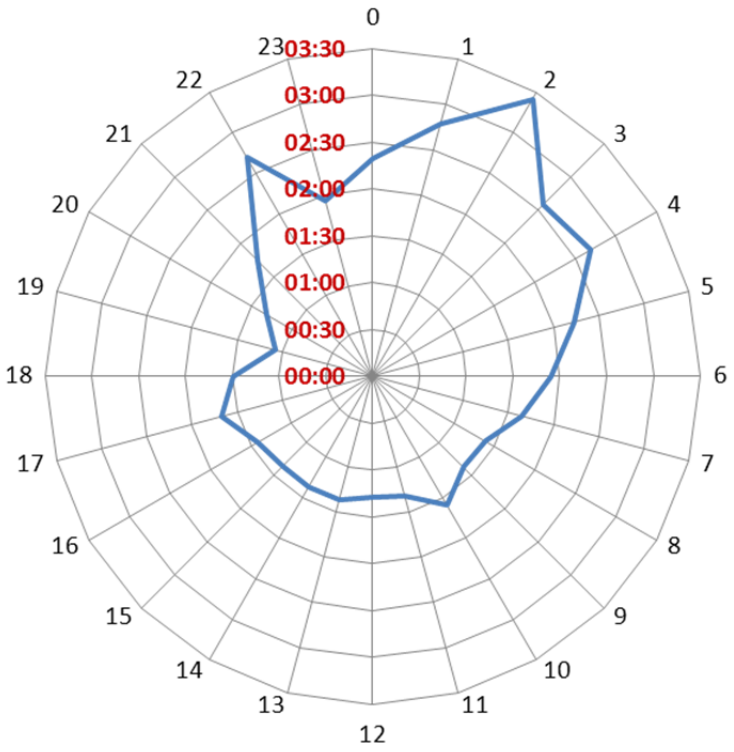
Measure	Minutes:Seconds
Average	01:34
90th %	02:44

NFPA 1710 recommends that career fire departments be en route to fire incidents within 80 seconds and medical incidents within 60 seconds. As illustrated in the figure above, BFD's performance is above

the NFPA recommendation by 1:44 overall. The department should work to identify areas that are slowing turnout performance.

It is also useful to evaluate turnout time by hour of day in order to determine if any trends can be identified that can potentially improve performance. The figure below illustrates the department's turnout time by hour of day.

Figure 17: Turnout Time Performance by Hour of Day – Average



The department's turnout time performance is longer during the overnight hours as personnel working 24-hour shifts must be awakened and make their way to the apparatus bay from the station's living quarters. This is common in career organizations. The next component of analysis is that of first unit arrival.

First Unit Arrival

The arrival of the first unit at an incident scene is the most common measure by which departments report their response performance. While it is significant, it is also important to understand the capabilities of that unit. For instance, if a chief officer arrives at the scene of a structure fire without the resources to affect an initial attack, the arrival of that unit as an indicator of response performance has

little value. Conversely, the arrival of that same chief officer to the scene of a medical emergency may mean the difference between life and death to the caller. For this reason, ESCI typically approaches response performance of the first unit from the aspect that the unit will be able to either advance a line and perform an initial fire attack or provide the department's standard level of medical care. For this reason, response measures are reported based on the first arriving apparatus as illustrated below.

Figure 18: First Arriving Response Performance

Measure	Minutes: Seconds
Average	05:12
90th %	07:53

NFPA 1710 recommends a five-minute response by career fire departments to all incidents when measured at the 90th percentile. BFD is above the NFPA recommendation by 2:53. Based on the distribution analysis discussed previously, the department should be able to meet the NFPA recommended response performance but is still falling short. One aspect to consider is the lengthy turnout time when measured at the 90th percentile. The department should be proactive in ensuring that resources are en route to emergency incidents within an acceptable amount of time, thereby reducing the overall response performance.

Patient Contact

Although the arrival of the first unit in a medical situation is important, the more critical time is when care is initiated during a life-threating situation. For example, if a unit arrives at the entrance to a hotel within three minutes of being dispatched but then takes an additional five minutes to reach the patient's room and begin treatment, the actual response time would effectively be eight minutes. For this reason, ESCI usually reports on the department's response performance based on arrival at the patient's side when that data is available. Unfortunately, BFD only recorded nine instances within the CAD data where personnel made patient contact. The department should consider instituting a policy that mandates personnel record with the communications center a patient contact time in order to more accurately evaluate medical response performance in the future.

Effective Response Force Assembly

As with arrival at a patient's side during a medical emergency, the ability of a department to assemble an effective response force during a fire incident is also critical. The Center for Public Safety Excellence (CPSE) recommends that departments assemble at least 12 firefighters for the effective mitigation of a

moderate risk single family structure fire. Since BFD only has four personnel on duty at any given time (minimum of three) the remainder of those 12 personnel must be assembled through mutual aid companies and/or call back personnel.

ESCI evaluated the response data to determine how often the department experiences actual structure fires that require the assembly of an effective response force. For calendar year 2011, BFD experienced six instances where more than two apparatus responded in the case of a reported fire. Although staffing data was not captured in CAD, that dataset was utilized to determine how quickly the department was able to assemble three or more apparatus on the scene of a fire. That analysis is provided below.

Figure 19: Effective Response Force Assembly – Three or More Apparatus

Measure	Minutes: Seconds
Average	18:52
90th %	25:47

Given that BFD is only staffed with a minimum of three personnel, it is understandable that the arrival of call-back personnel, as well as the dispatching of mutual aid departments, takes longer than the NFPA recommendation of 12 minutes.

Staffing

Regardless of physical resources, without appropriate staffing, any emergency services organization will fail. The staffing of a department charged with providing critical and potentially life-saving services to the community requires organizations to seek out the most qualified individuals, provide them with additional training, engage them in the organization, and maintain morale. BFD provides these components with a career workforce in both administrative/support and operational roles.

Administrative and Support Staffing

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

Analyzing the administrative and support positions of a fire department facilitates an understanding of the relative number of resources committed to this important function. The appropriate balance of the administrative and support components to the operational component is critical to the success of a department's mission and responsibilities. The following figure outlines the administrative and support complement of the fire department.

Figure 20: Administrative and Support Positions

Position	Number
Fire Chief	1.0
Deputy Chief*	1.0
Clerk	0.5
Total	**2.5**

* Currently vacant

The fire chief (recently promoted) serves as the agency head and reports to the prudential committee that oversees the operations of the fire district. In most organizations that do not provide transport EMS services, it has been ESCI's experience that the ratio of administrative and support personnel to total department staff typically falls within the range of 10 to 15 percent. Based on the total number of BFD staff (not including the prudential committee) the department's ratio is calculated to be 13.5 percent. It should be noted, however, that the current deputy chief position is vacant and the department is

actively recruiting to fill this position. Those duties are currently being absorbed by the chief and other department staff. Departments that participate in transport EMS tend to have a higher ratio of administrative and support staff. Typical ratios for these departments range from 15 to 20 percent depending on medical service demand. Although BFD's ratio is slightly below the expected range, mechanisms are currently in place to ensure that medical records are accurate and patient care reports are submitted electronically to an external billing company.

Although not included in the administrative and support complement of the department, the individual assigned as the EMS officer does not hold rank and is a line firefighter within the operational staff. This position is assigned and receives a stipend by contract. This added responsibility should be evaluated for the potential of creating a rank and assignment specifically for the roles this position fulfills, potentially a position that is not tied to regular shift work, as was the case previously when the department maintained an EMS Captain that worked normal business hours.

Operational Staffing

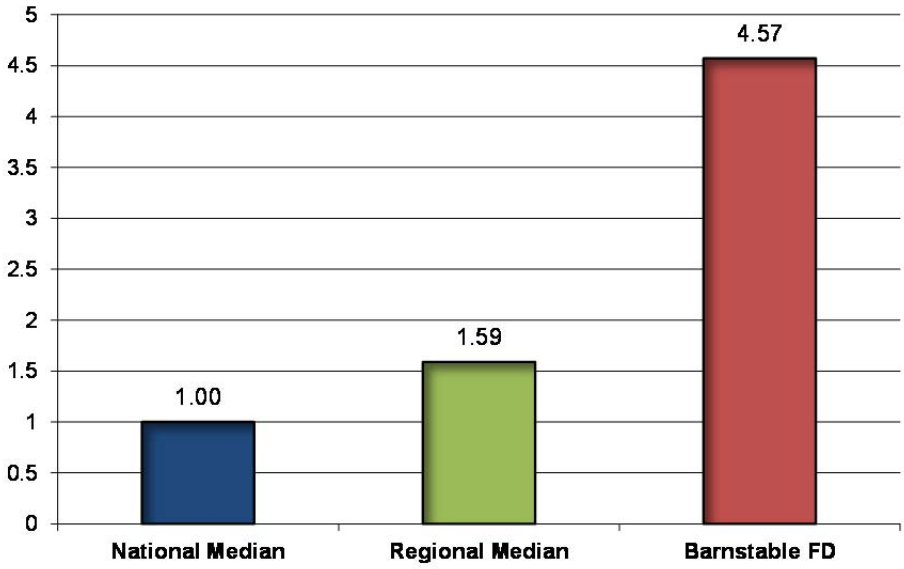
It takes an adequate and well-trained staff of emergency responders to put the appropriate emergency apparatus and equipment to its best use in mitigating incidents. Insufficient staffing at an operational scene decreases the effectiveness of the response and increases the risk of injury to all individuals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

Figure 21: Operations Positions

Position	Number
Lieutenant	4.0
Firefighter	12.0
Total	**16.0**

The department has 16 career emergency response personnel. The resident population of the area is estimated to be 3,500. The ratio of firefighters per 1,000 population is 4.57 including all career operations personnel. The firefighters per 1,000 population is significantly above the regional median based on NFPA statistics.

Figure 22: Comparison of Career Personnel per 1,000 Population



It should be noted, however, that the NFPA ratios do not differentiate between those departments that do or do not provide transport EMS. As discussed previously, BFD is the sole provider of EMS transport services throughout the District, therefore, it would be expected to have a higher than average ratio of career personnel per 1,000 population.

Allocation of Staff

In departments that maintain more than one facility, how on-duty staff are distributed across those facilities is critical in the evaluation of how service demand is distributed. Since all BFD personnel are assigned to a single response, however, that allocation is considered mildly less important. What does remain is the utilization of personnel based on incident type.

Based on the current minimum staffing of three personnel, BFD has a minimal number of personnel that can be available for the various incidents types to which it is dispatched. With three personnel, a single medical response will occupy all personnel, leaving no one available for a secondary response. For this purpose, the department relies on 'call-back' personnel to fill in for the on-duty crews until sufficient personnel are available for a concurrent call.

Under existing circumstances and a full staffing of four, all four personnel respond to medical incidents (three on the ambulance and one in a chase vehicle). Once the ambulance is committed to the call or it

is determined that the scene time will exceed 20 minutes, four off-duty personnel are called back to the station. This methodology has worked well for the department and further modification and enhancement of the policy is currently underway.

Staff Scheduling Methodologies and Alternatives

Departments across North America have been extremely creative in developing alternative staff scheduling models. Historically, emergency services agencies (primarily fire services) worked 24-hour shifts with 48 hours off. This is commonly known as a 24/48 schedule. Today, however, organizations have created alternative schedules of containing a variety of variables. In ESCI's experience in working with over 800 emergency services providers across the U.S. and Canada, some examples of alternative schedules include:

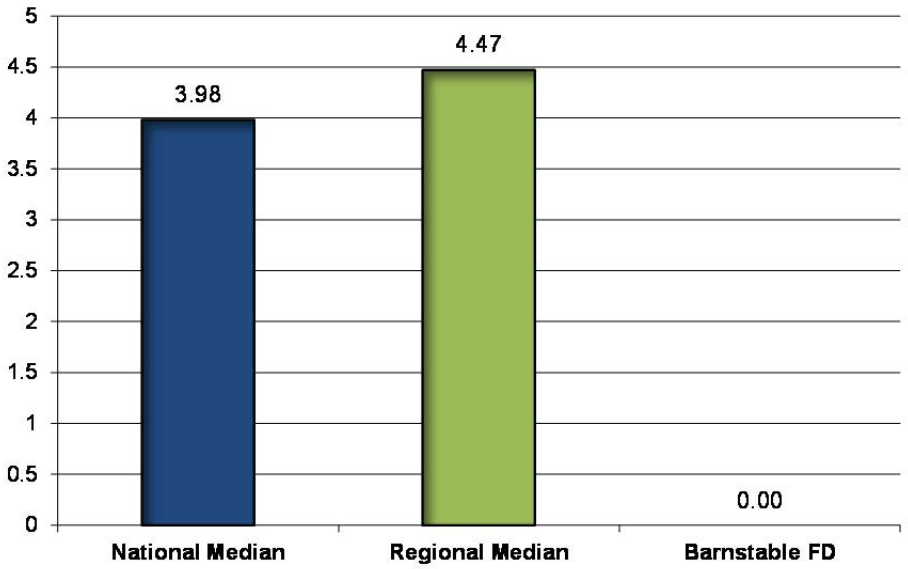
- 8-hour shifts
    - Typical 40-hour workweek
- 10-hour shifts
    - Usually limited to daytime hours
- 12-hour shifts
    - Consists of four shifts working a variety of schedules
- 14-hour shifts
    - Usually limited to nighttime hours
- 24-hour shifts (In use by BFD)
    - Consists of a variety of schedules
    - Can be 24/24, 24/48, 24/72, 24/96, or otherwise
- 48-hour shifts
    - Limited use but typically follows a 48/96 pattern

BFD staff work a rotating schedule consisting of several 24-hour shifts separated by time off. The typical schedule following a 1-1-1-5 pattern with one day on, one day off, one day on, then five days off. This creates a 42-hour workweek based on an eight-week rotation for most personnel but does not include any overtime or callback time that may be accumulated. Personnel scheduling is a contractual issue and requires bargaining to modify. Although there are pros and cons to each schedule type, the current schedule is working well for the department and is not problematic.

Utilization of Career and Volunteer Personnel

BFD is staffed with a full complement of career personnel. Paid-on-call (POC) or volunteer personnel have not been utilized within the BFD system since January 2006. Based on population alone, similar departments would routinely utilize POC resources as illustrated in the figure below.

Figure 23: Comparison of POC/Volunteer Personnel per 1,000 Population



This is not always true in systems that also provide EMS transport services. In addition, the current environment within the District is such that the current population has come to expect the existing level of service and modifying the model from career to volunteer would likely fail. However, there may be an opportunity within the District to supplement the career personnel with POC or assigned duty personnel in the future. The demographics of the community will play a significant role in the success of such a program.

Deployment Methods and Staffing Performance

Since the department operates from a single facility, the deployment of personnel resources throughout multiple locations is not an issue. Staffing of apparatus, however, does come into play and is dependent upon staffing levels and incident type dispatched. For example, if a medical incident is dispatched and the department is at minimum staffing, no personnel are immediately available for another incident (medical or fire). Likewise, if a structure fire incident is dispatched and the department is at minimum staffing, all personnel respond in the primary engine and call-back personnel respond to the station in

order to respond the aerial apparatus. Additional call-back personnel respond either the second engine or the support vehicle to provide personnel for the units already on scene.

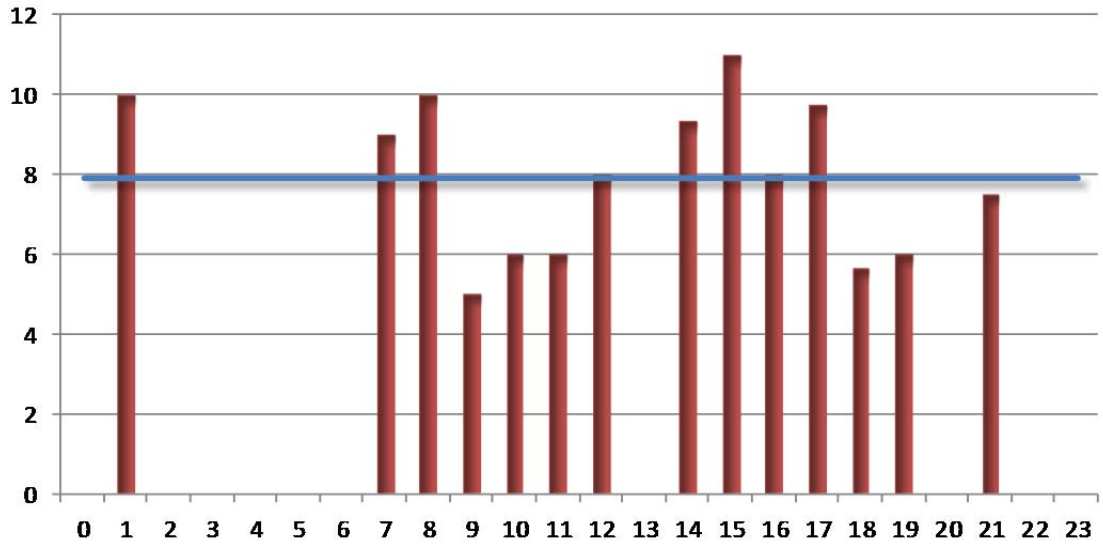
Although all alarms other than 'still' alarms receive a department-wide call, which could potentially produce as many as 12 additional firefighters, the likelihood that all off-duty personnel would be available to respond is low. In order to evaluate the department's capability of generating its own personnel, NFIRS staffing data was reviewed for structure fires over the last three years.

Figure 24: Staffing Performance for Structure Fires

	2009	2010	2011	2012
Average Staffing	7.3	6.2	8.2	8.8

Analysis of staffing data for structure indicates that, overall, the department has been able to average 7.6 suppression personnel per structure fire over the last four years.

Figure 25: Structure Fire Staffing by Hour of Day



It is apparent from the figure above that the department's ability to staff for structure fires using its own resources varies by the hour of day. Those periods without data indicate that no structure fires occurred during that hour of the day over the four-year period. Responding to call-back is not required of off-duty personnel and, in most cases, mutual aid personnel supplement the on-duty crew and those call-back personnel that *do* respond.

Based on the amount of workload and the temporal variations by hour of day noted in the service delivery section of this report, it is easy to see where the department's primary staffing problems lie. The amount of EMS workload is directly influenced by human activity, which is higher during daytime hours within the District. This also corresponds to the time during which the Department has the most difficulty in producing its own resources. One method to combat this issue is to consider daytime staffing, either with part-time personnel or additional career personnel working a shift that differs from the remainder of the career staff.

These personnel could work during daytime hours only and allow the department to maintain a minimum of two personnel on the primary engine while still responding three personnel to EMS incidents, if at full staffing. If at minimum staffing, EMS calls could be triaged such that low priority incidents could be responded to with two personnel while the remaining two personnel staffed the primary engine.

Regardless of how the scheduling of these personnel is determined, there are obvious advantages to this type of dynamic staffing system, particularly in regard to EMS service demand.

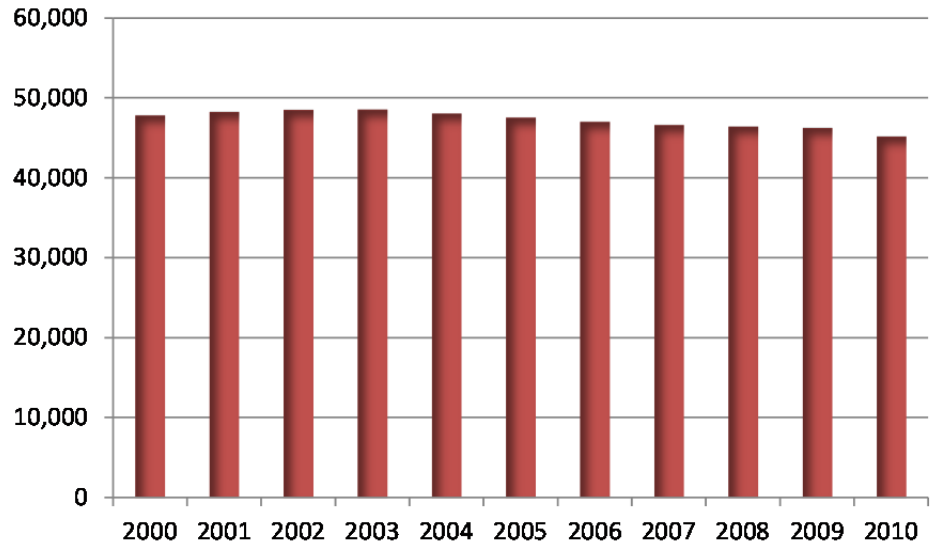
Future System Demand Projections

The process of forecasting growth within the community begins with an overview of current demographic and risk categories.

Population Growth Projections

In most circumstances, ESCI is able to identify census or other local data to evaluate population histories for study communities. Unfortunately, neither the District nor the Village of Barnstable are Census Designated Places (CDP). The Village was last reported separately from the Town of Barnstable in 1990 when the population was recorded to be 2,790. This makes population projections for the District difficult. Understanding that the Village is somewhat different than the Town as a whole, the information presented in this section is based on data obtained from the U.S. Census Bureau for the Town and differentiations are made where appropriate. This section begins with a review of the Town's historic populations.

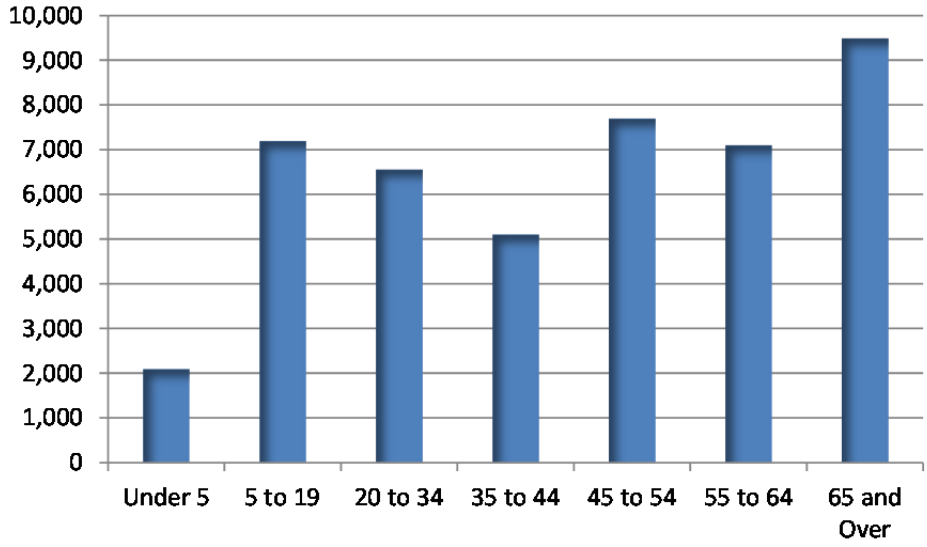
Figure 26: Population History - Town of Barnstable



Although the population has varied, the overall trend has been downward over the last decade. In fact, the overall population within the Town decreased a total of 5.5 percent since the 2000 Census. It is also useful to evaluate how the population is distributed by age since it is known that those under the age of five as well as those above the age of 65 tend to use emergency services more frequently and have

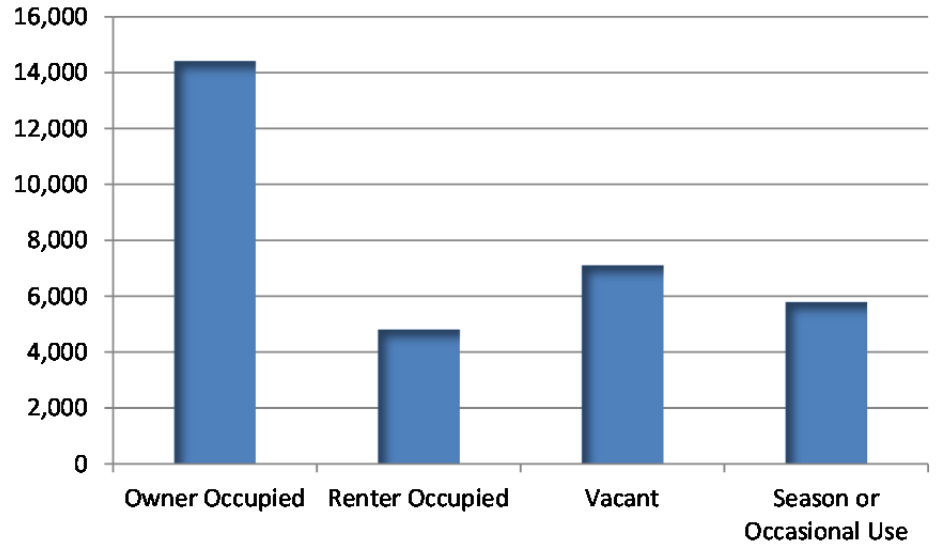
morbidity and mortality rates in residential fires. As can be seen in the following figure, a large portion of the Town's population falls within the 65 and older age group.

Figure 27: Population Age Distribution - Town of Barnstable



The final piece of population analysis involves housing occupancy. Research has shown that areas with high rates of vacant and/or renter occupied properties tend to use emergency services more frequently due to perceived depressed socioeconomic conditions. In addition, resort areas and communities with high populations of college students typically do not fall into this generalization. The general housing occupancy data for the Town as a whole is illustrated below.

Figure 28: Housing Tenure 2010 - Town of Barnstable



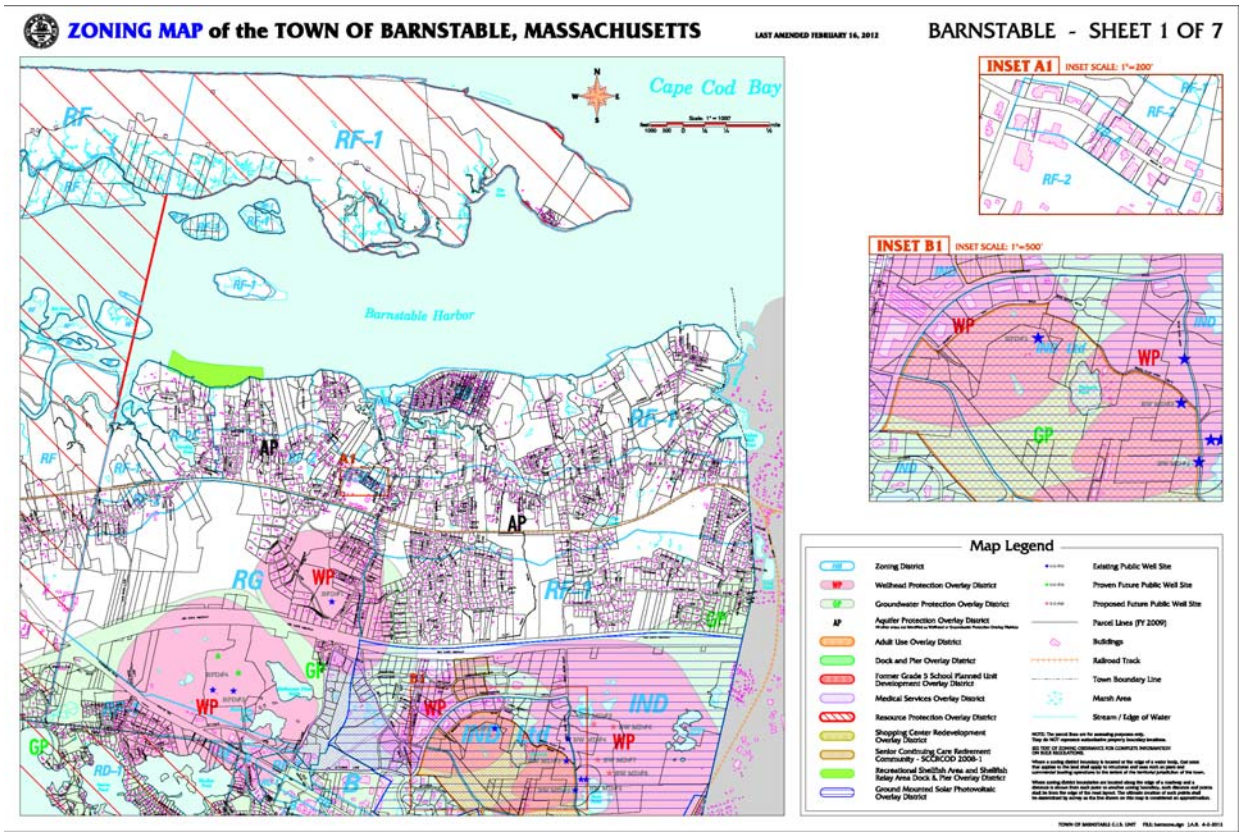
In general, a vast majority of residential occupancies within the Town of Barnstable are owner occupied. The vacancy rate, however, is unusually high for an area of this type. This is explained by the high rate of seasonal or occasional use properties given the resort nature of the coastal areas of the community. Aside from population, the next most critical component to consider in developing future service delivery strategies is the nature of the fire risk within the community. This is provided in the following section.

Community Risk Analysis and Future Development Issues

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

The community's risk assessment has been developed based on potential land use within its boundaries. These potential uses are found in the county's zoning designations and land use plans. The following map illustrates how land use (potential scale and type of development within geographic sub-areas) is distributed throughout the District.

Figure 29: Barnstable Zoning Map[2]



While a majority of the structures within the BFD primary response area are residential, there is a scattering of commercial and light industrial occupancies, particularly to the southwest in the vicinity of Independence Drive. These occupancies include a number of auto repair businesses that contain various hazardous processes and materials. Given that Barnstable Village is one of the oldest communities on Cape Cod, the types of construction and age of some of the structures within the community make the BFD response area an overall moderate to high risk community regarding fire protection.

Aside from existing populations, demographics, and occupancies, the District is facing some potential if not definite changes in the makeup of the community. A large mixed use property is planned for an area to the west of Independence Drive in the area of Mary Dunn Road, near Trinity Academy. This planned development is projected to contain a mixture of low income housing and assisted living and skilled nursing facilities.

[2] Town of Barnstable Planning Department.

The intent of this study was to evaluate the current deployment of BFD resources and determine if any additional stations or relocations of the current station would be necessary to accommodate future growth and development. The following section of this report uses the preceding information and evaluates several potential scenarios for future service delivery.

Future Delivery System Models

This section identifies strategies and recommendations for future resource deployment changes that would maintain or improve the Department's response capabilities and performance as growth and development continue at the projected levels.

Response Standards and Targets

The process of setting response time performance objectives will include two primary considerations:

1. *What are the expectations of the community in regard to initial response time of the fire department to an emergency incident? What is the public's perception of quality emergency service where response time is concerned?*
2. *What response time performance would be reasonable and effective in containing fire, reducing damage, and saving lives when considering the types of incidents and fire risks faced by BFD?*

To initiate the process of considering the expectations of the customer, the historical travel time is examined from the incident records. Turnout time, the time for personnel to begin responding after alarm, has an effect upon overall response time but does not bear (nor should it) an effect upon station location analysis since it has no geographic impact. The figure below compares the *NFPA 1710* standard to the current performance of the department.

Figure 30: Response Performance Objective Recommendations

Predominant Density	Actual 2011 Performance	NFPA 1710 Objective	Percentile
Urban	7:53	5:00	90th

The figure above details BFD's performance with regard to first unit arrivals while NFPA recommendations are intended to portray an initial alarm assignment, such as two engines and a third apparatus, regardless of type. Although BFD is not currently meeting the *NFPA 1710* response performance recommendation with first arriving unit response times, ESCI recommends that policymakers adopt formal initial alarm force response performance objectives based on this standard and begin a process of periodic review and evaluation of performance improvement.

Alternative Long-Term Strategy

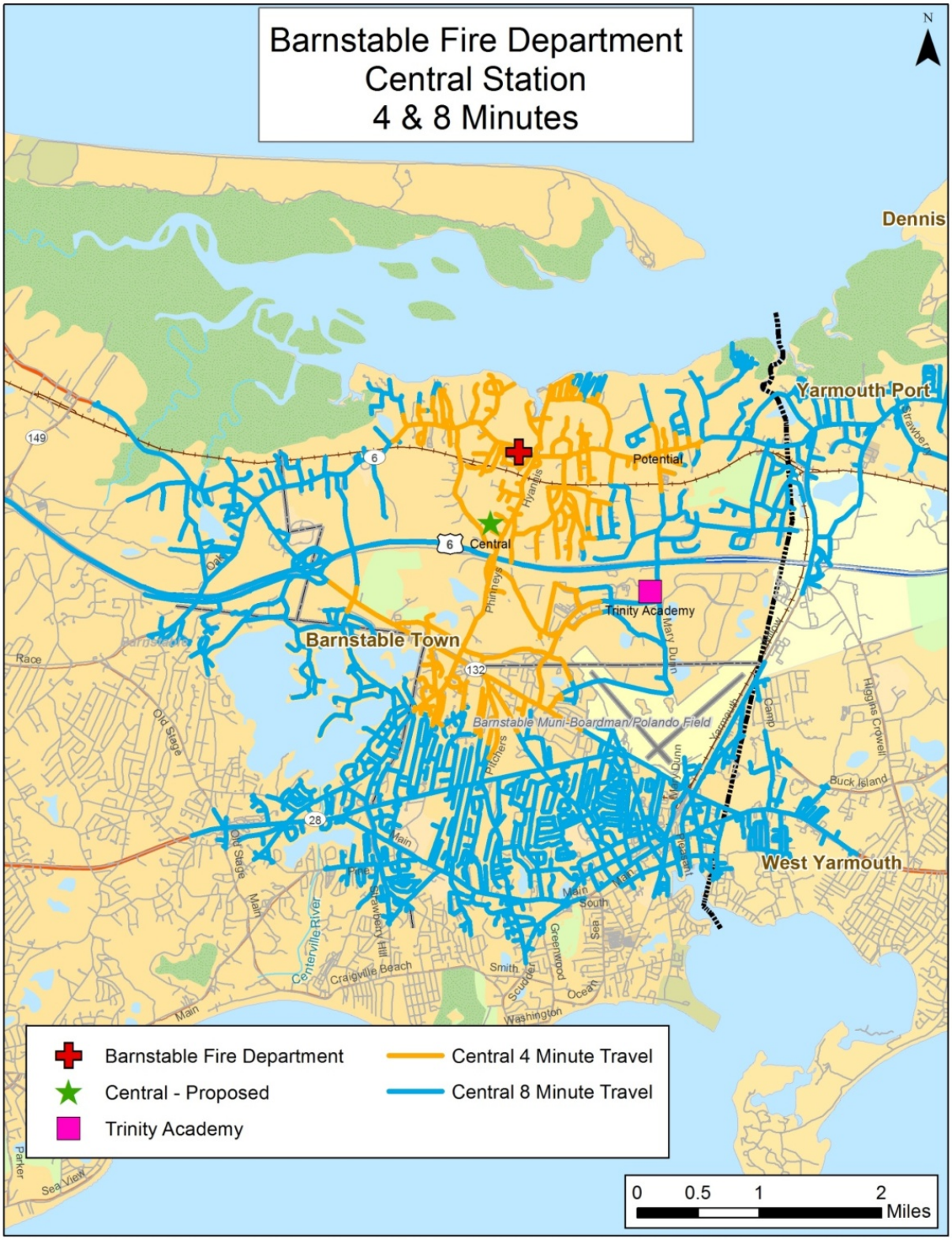
Given ESCI's recommendation to adopt *NFPA 1710* response performance objectives, analysis was performed on several deployment scenarios to determine the most appropriate deployment of physical

resources for BFD. This analysis includes consideration of the future development along Independence Drive in the vicinity of Trinity Academy as well as the location of a proposed central station, as illustrated on the following figure.

Figure 31: Current Response Capability to Future Development

Based on the travel model illustrated above, BFD cannot reach the area of future development within four minutes of travel from its existing location. It should be noted, however, that a majority of the Department's service demand is currently concentrated in the core of the Village. Moving the station simply to accommodate the development to the southwest would increase travel times to existing service demand. In order to evaluate alternatives, ESCI analyzed the potential of planning a single station in a more central location. This analysis is presented in the following figure.

Figure 32: Central Station Alternative



The location of the existing water services office was used to evaluate this scenario since the department already owns that property and it is centrally located. While this location would allow BFD to continue a rather rapid response into the core of the Village as well as extend the four-minute travel model to the south, the future development area remains outside the four-minute model. Given the nature of the future development, ESCI evaluated a third option for future deployment of resources that would provide a four-minute travel to the planned development.

Figure 33: East Station Alternative

If BFD wishes to provide a four-minute travel (five-minute response objective) to the area of future development behind Trinity Academy, the most appropriate location for a single station deployment model would be at the intersection of Route 6 and Mary Dunn Road. This location would allow for a quick response to the area of future development along with a continued quick response into the core of the Village where a majority of the service demand currently occurs.

Conclusion

Based on the analysis, the District should evaluate the current community expectations in regard to service delivery. While the travel modes indicate that only 59 percent of existing service demand can be reached within four minutes of travel, future development is outside that objective but within an eight minute travel model. The following figure summarizes the service demand coverage of each alternative as compared to current coverage.

Figure 34: Service Demand Coverage Summary

Alternative	Four-Minute Coverage	Eight-Minute Coverage	Four-Minute Coverage to Future Development
Current	59	92	No
Central Station	61	95	No
East Station	62	94	Yes

As can be seen from the summary above, if the District's firm response objective is to reach at least 90 percent of the overall service demand throughout the entirety of the District within four minutes of travel, relocation of the existing station would be necessary as well as a new station to the east to provide coverage to the planned development.

The ESCI project team began collecting information concerning the fire services for Barnstable Fire Department in August 2012. The team members recognize that the report contains a large quantity of information and ESCI would like to thank the elected and appointed officials as well as the officers and staff of Barnstable Fire Department for their tireless efforts in bringing this project to fruition. ESCI would also like to thank the various individuals and external organizations for their input, opinions, and candid conversations throughout this process. It is ESCI's sincere hope that the information contained in this report is utilized to its fullest extent and that the emergency services provided to the citizens of Barnstable are improved by its implementation.