

A GIS Analysis Fire Stations & Resources Modeling City of Pawtucket, Rhode Island



Submitted by:

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Mayor Donald R. Grebien
City of Pawtucket
137 Roosevelt Avenue
Pawtucket, Rhode Island 02860

Dear Mayor Grebien:

I am pleased to submit with this letter our GIS Analysis Report on Fire and Rescue Stations and Resources Modeling for the City of Pawtucket, Rhode Island.

The Analysis Team would like to acknowledge the excellent cooperation that we received from City and Fire officials. If you have any questions relative to this GIS modeling analysis of fire and rescue stations, please contact my office.

Sincerely,



Leslie D. Adams
President

FIRE STATION AND RESOURCES OPTIONS

In 2012, Public Safety Solutions, Inc., completed a comprehensive evaluation of the Pawtucket Fire Department (PFD) that provided several recommendations including options for deployment. This document analyzes the impact of the requested scenarios using the same data for comparison as little to no significant residential/commercial development or change in population has occurred to change the parameters measured¹.

SERVICE AREA DESCRIPTION

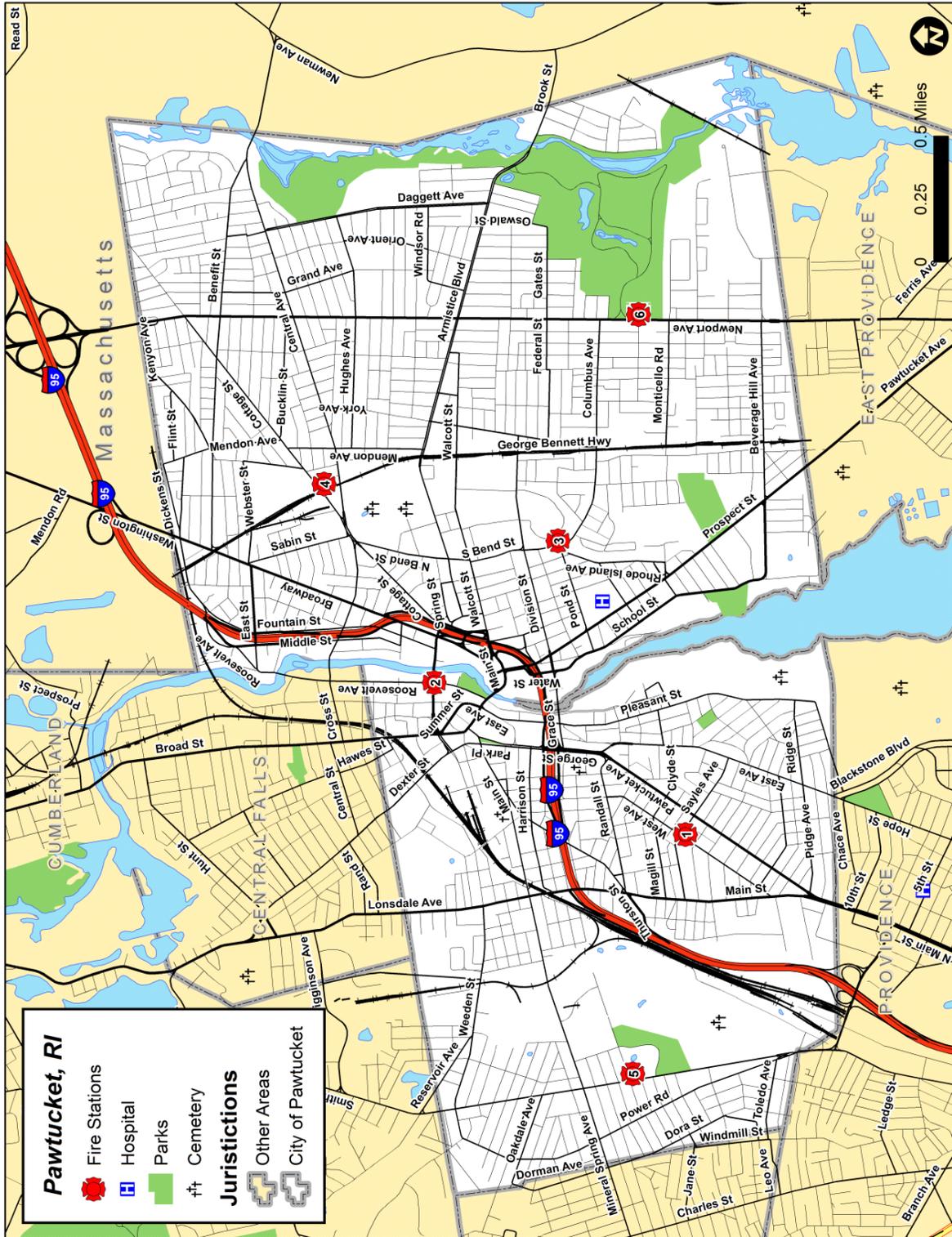
The City of Pawtucket is just northeast of Providence, the capital of Rhode Island. It is home to many industries, most notably Hasbro Toys. Located along the state border with Massachusetts, the city encompasses less than 10 square miles of mostly urban and industrial development scattered in different areas of the city. A major interstate (I-95) and several state highways traverse through the city along with several major rail routes. The Seekonk River also splits the city and flows into the Narraganset Bay on the south side of town. Bridge crossings of these barriers can be limiting especially for the river as it widens toward the bay.

The Pawtucket Fire Department operates out of six fire stations with an engine out of each station; truck apparatus in two stations (Stations 2 & 4); and rescue ambulance units in two stations (Stations 1 & 4). The duty battalion chief responds from the station adjacent to City Hall (Station 2), where the fire administrative offices are located. Reserve apparatus is stored in available space in four of the six fire stations. Below is a listing of the stations. Figure 1 illustrated the station locations within the city limits.

Number	Address	Year Built	Notes
1	West Ave / Sayles Ave.	1912	Historic Community Structure
2	Roosevelt St / Exchange St	1937	Attached to City Hall
3	2 Columbus Ave	1958	McCoy Stadium
4	385 Cottage St.	1974	Largest Facility
5	Smithfield / Grotto Ave.	1956	Near Elementary School
6	385 Newport	1948	Near Park

¹ Reported only a new 120-unit apartment complex with river views.

Figure 1
CITY FIRE STATIONS



POPULATION & HOUSING

In 2010, the U.S. Census Bureau reported Pawtucket's population to be 71,148. This is an estimated .2% decrease since the last decennial census in 2000 when the population of the city was 72,958 persons. According to the latest 2013 U.S. Census estimates, Pawtucket is populated by nearly 71,500 residents. Essentially, the population has not grown for several decades, as can be seen in Figure 2.

Figure 2
POPULATION GROWTH HISTORY

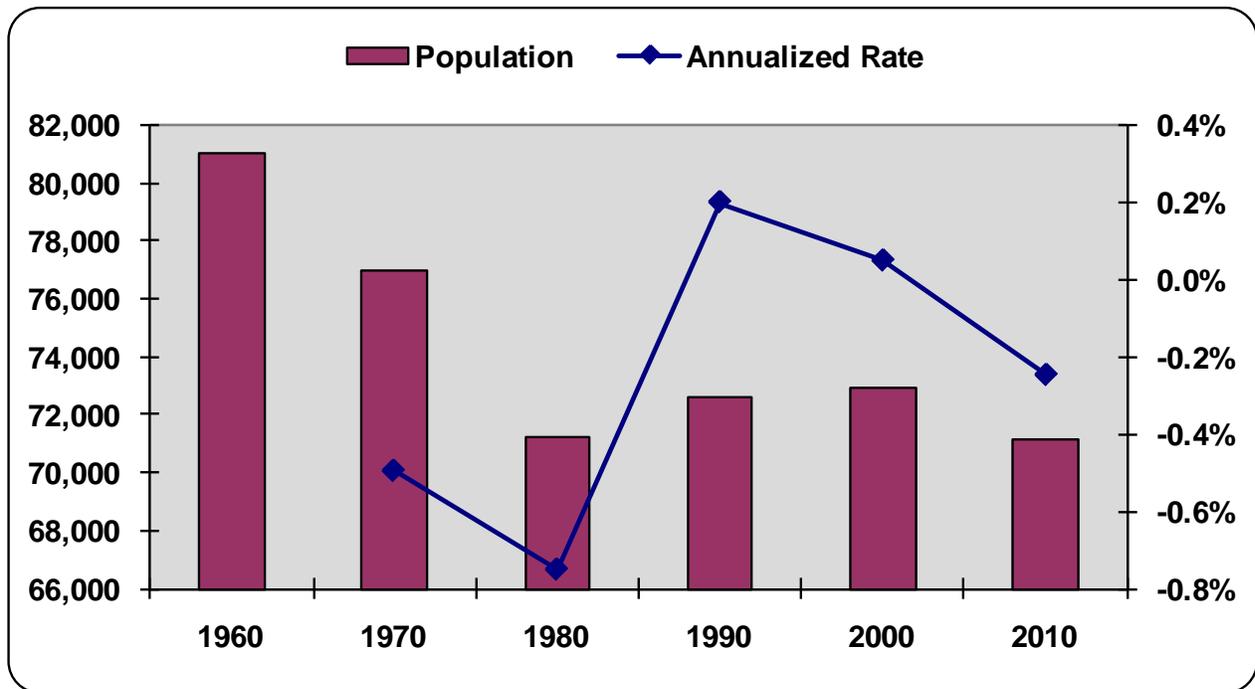
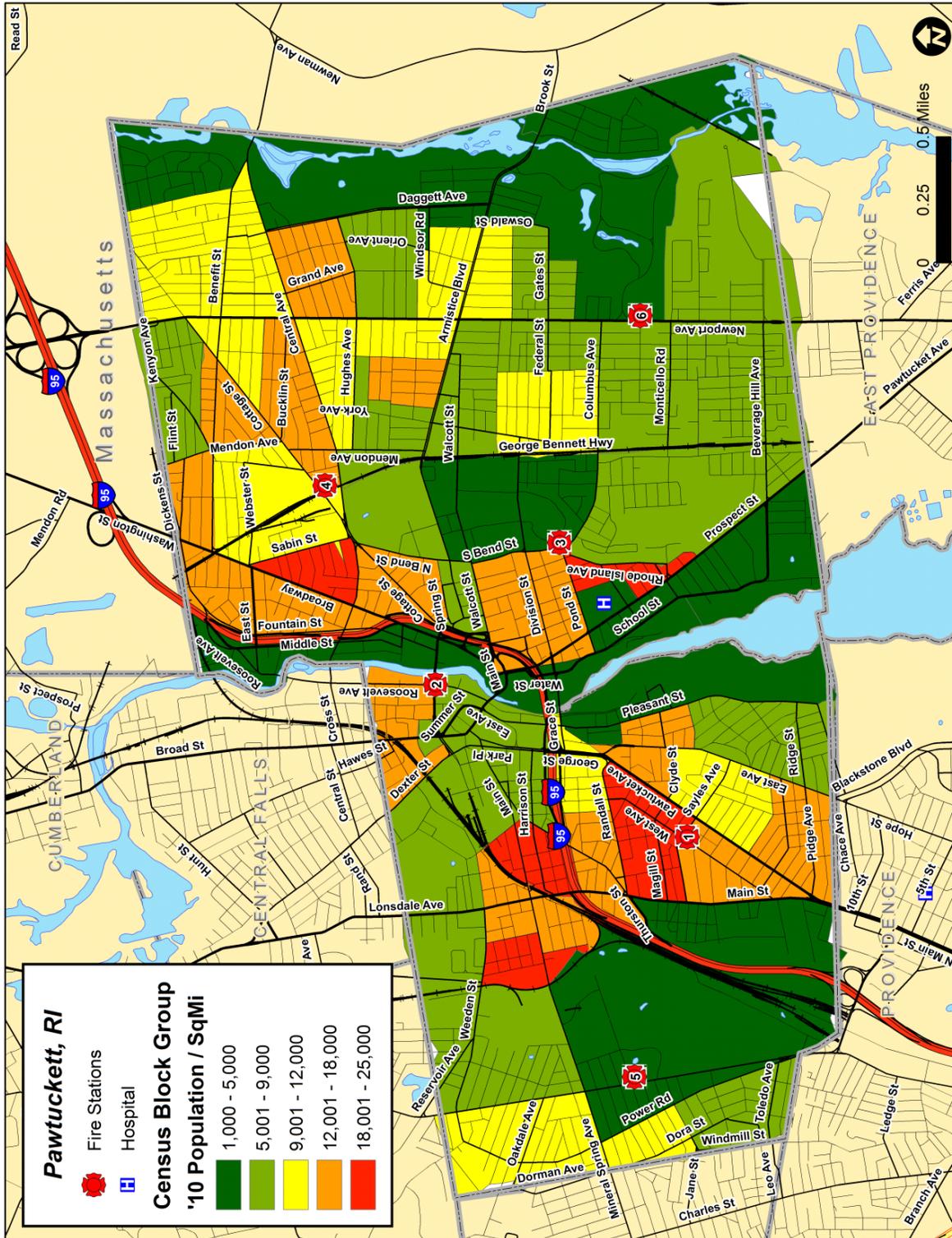


Figure 2 represent residential population and does not account for the variation during the daytime hours for commuters, shoppers, and out-of-area employees. Also the residential population is not evenly distributed. It is well understood that demand for emergency services correlates with areas of higher population. Figure 3 shows the concentration of residential population by census block group areas.

Figure 3
 POPULATION DENSITY



It can be seen from Figure 3 that the city is decidedly urban with higher population concentrations near Stations 1, 3, and 4.

STATION COVERAGE

The geographic extent of a fire apparatus that can be reached within a certain travel time exists from each a station regardless of staffing patterns. Figure 4 illustrates the travel-time capability of emergency apparatus when it leaves each respective firehouse. Adjustments to speed capability of the streets were made to account for negotiating turns and intersections. This travel time can be affected negatively by traffic, construction, weather, design, connectivity, and speed limit, to name a few. In addition, each station's apparatus was delayed departure based upon the recommended 80-second turnout time for fire apparatus.

Figure 4
TRAVEL-TIME EXTENT CAPABILITY

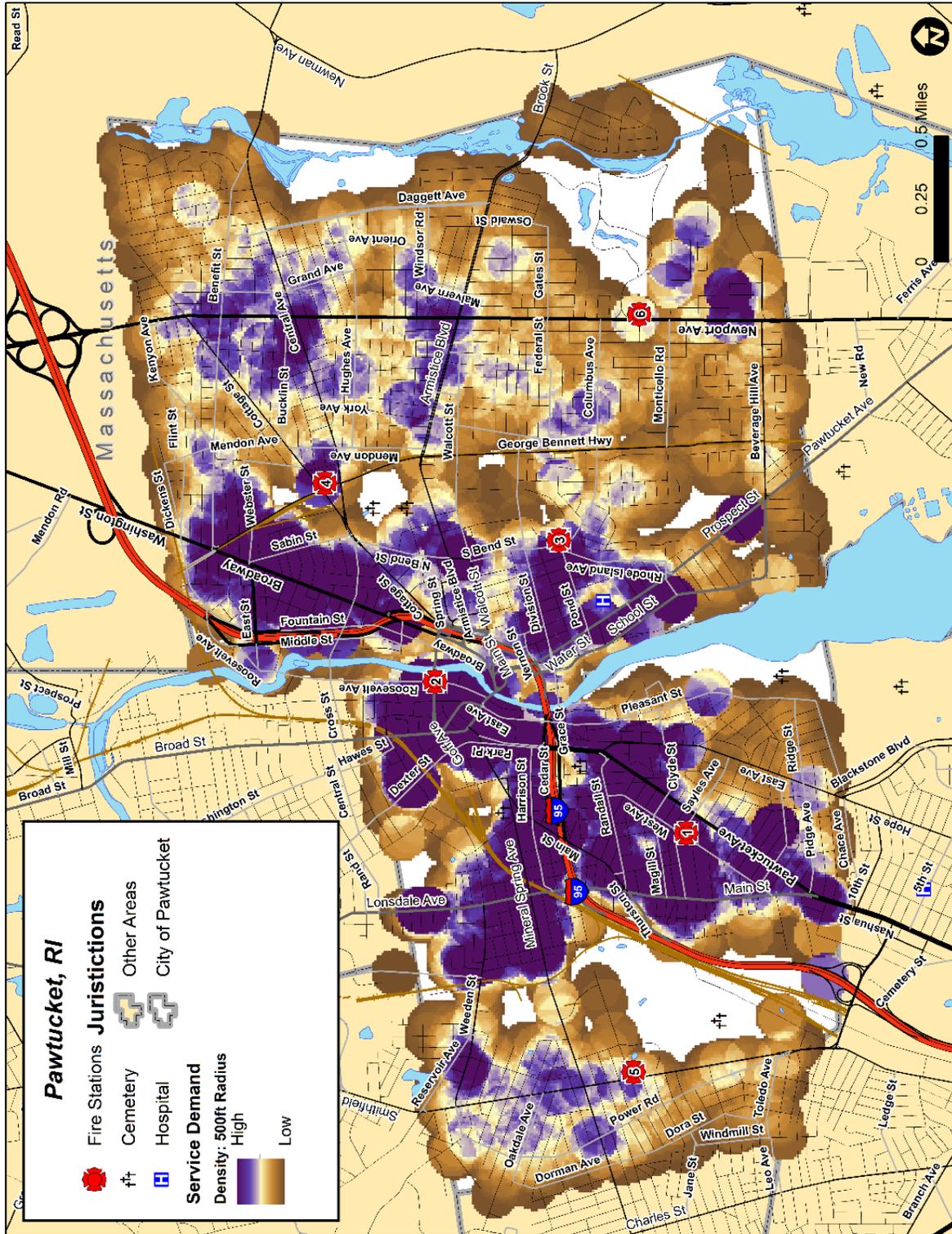


The first arrival apparatus from the closest station provides the city with blanketed coverage except for the extreme northeast and southeast residential areas. Available ambulance coverage from either Station 1 or Station 4 in eight minutes of travel also provides the city with adequate coverage. Fortunately for Pawtucket, a hospital exists near the geographic center of town, and many times a rescue ambulance may be responding from there and the travel-time capability for the city is unhindered.

SERVICE DEMAND

It can be seen in Figure 5 that the demands for services are not evenly distributed geographically. The PFD provided an incident database of several call types with address information utilized to plot service demand. Non-emergency calls and mutual aid calls to other jurisdictions were removed from consideration. In Figure 6, service demand points were measured for density comparison utilizing a 500-ft radius around each point and classified utilizing the standard deviation of the resulting density dataset. It can be seen that the highest concentration of incidents is found in the central area of the city. The remainder of the district reflects more moderate concentrations of service demand.

Figure 5
SERVICE DEMAND

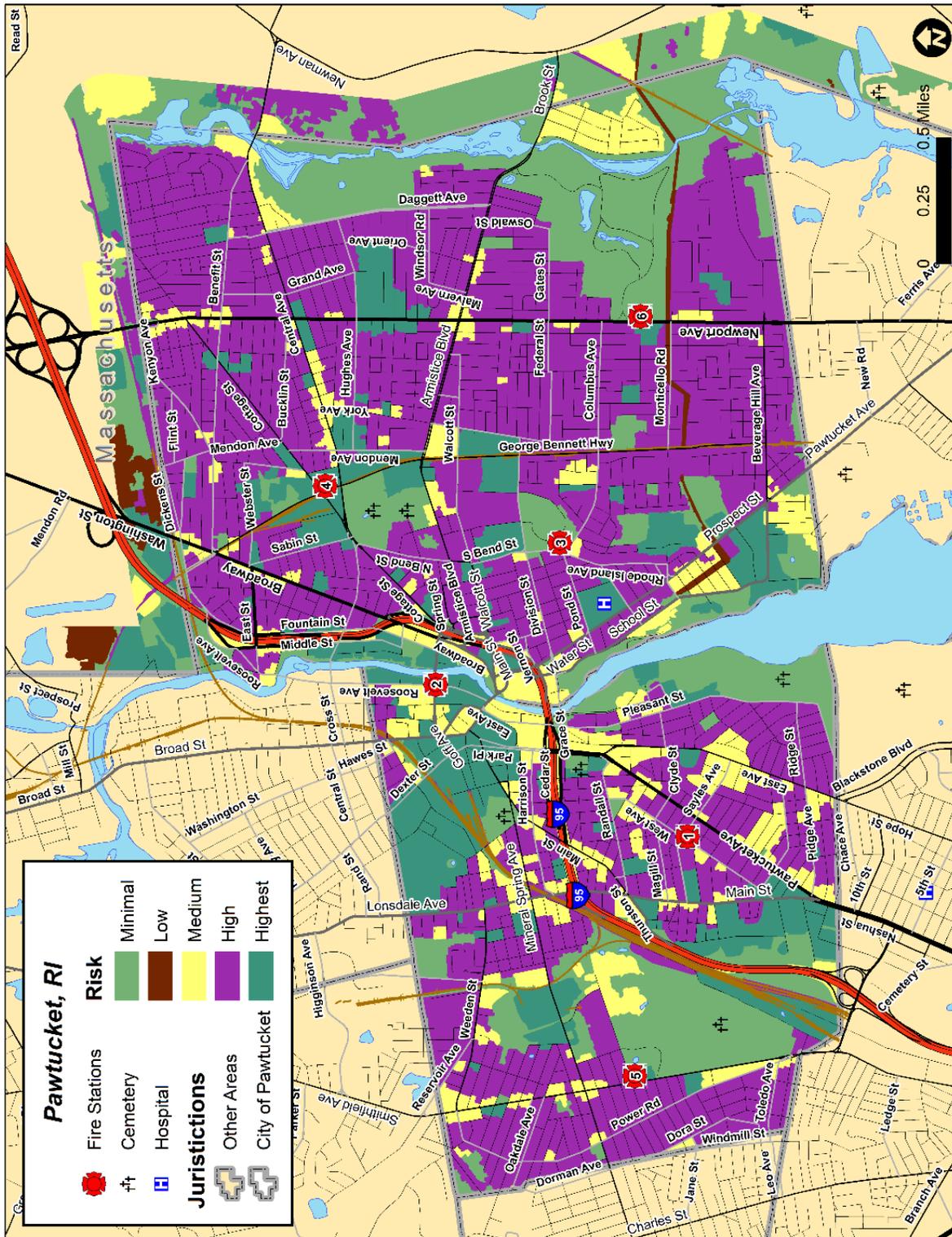


STRUCTURAL AND LAND-USE RISK

Another important aspect of appropriate deployment and coverage for the PFD is the risk associated with certain types of structure and land use. Using the following scale, properties within the city were classified according to a level of risk.

1. Highest — Refineries, large industry, hospitals, school dormitories, lumber yards, and propane storage facilities without built-in suppression or detection systems;
2. High — High-rise hotels and residential buildings, large shopping centers, and industrial complexes;
3. Medium — Commercial and industrial facilities with sprinkler systems, small shopping centers, and high-density, low-rise residential buildings;
4. Low — Single-family dwellings with a separation of at least 100 feet between buildings; and
5. Minimum — Wide separation of single family dwellings and farm land.

Figure 6
 STRUCTURAL & LAND-USE RISK



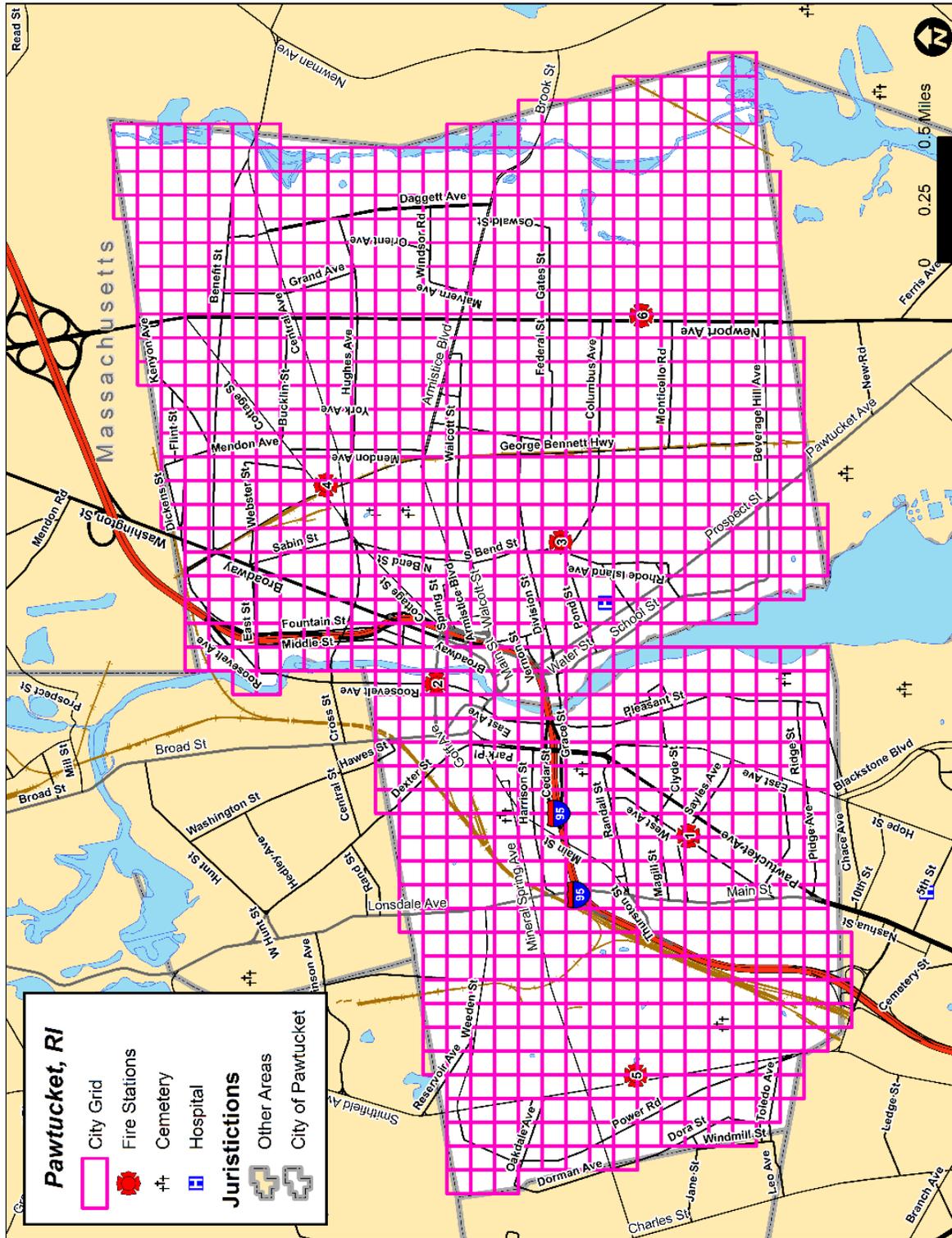
DEPLOYMENT SCENARIOS

The following sections are the requested scenarios to be examined; the impacts of which are comparative in the form of charts, tables, and map representations.

Clean Slate Analysis

The first scenario requested is “A fresh look at the distribution of fire resources throughout the city without taking into consideration present locations.” This is referred to as a “clean slate” scenario by PSSi. It is often the most expensive and difficult scenario to implement because current locations are rarely selected and new station sites require suitable land availability, design, and construction, which is expensive. In addition there may be neighborhood resistance to both the new station and to the closure of an existing station. To begin this analysis, a half-mile grid was plotted on a city map whose centroids become candidates for fire stations (see Figure 7).

Figure 7
CITY GRID



The goal was to determine where the best locations are in relation to service demand, population, and structural risk considerations; all important to fire service delivery. Each of these criteria have differing levels of intensity using unique values. These criteria values were converted (unweighted) into a single measure from 0 to 5. They are then combined to achieve a vulnerability risk index score (VRI). For example, in a single grid box on the map, if:

**High Structural Risk (5) + High Demand Area (5) + High Population Density (5) =
Vulnerability risk index score (VRI) of 15**

Of the 987 grids, the lowest score was zero², while the most vulnerable grid measured 12 out of possible 15³. The total vulnerability risk index score in this methodology was 6,370. See Figure 8.

² Area of no development/water

³ The most frequent score (mode) was 7.

The goal of the number and placement of stations is to reach 90%⁴ of the total VRI value scores within the travel-time measure used in the previous report. The current station deployment can reach 95% of the VRI value score within three minutes and forty seconds (3:40). The analysis selected three sites that expectedly do not correspond to current fire station locations to reach a similar level of protection as the current deployment (see Figure 9).

In this configuration of station deployment, 96% of the total vulnerability index score can be reached within the travel time goal. A two station site selection reached 89%, close to the scenario coverage goal, with just two stations as shown in Figure 10.

⁴ This is the percentile coverage promulgated by NFPA 1710 Response Guidelines for career staffed fire agencies.

Figure 9
“CLEAN SLATE” DEPLOYMENT SCENARIO PART I

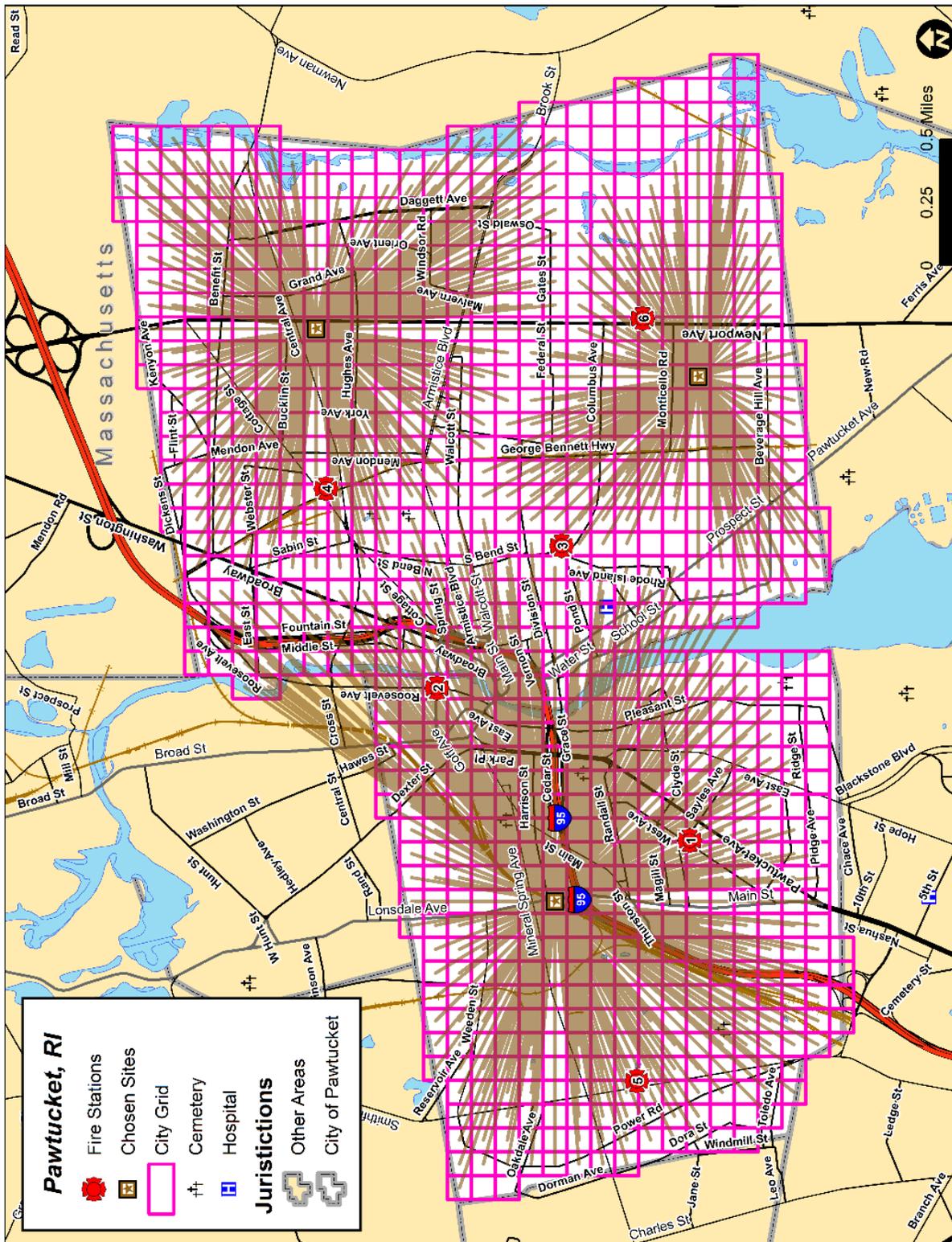
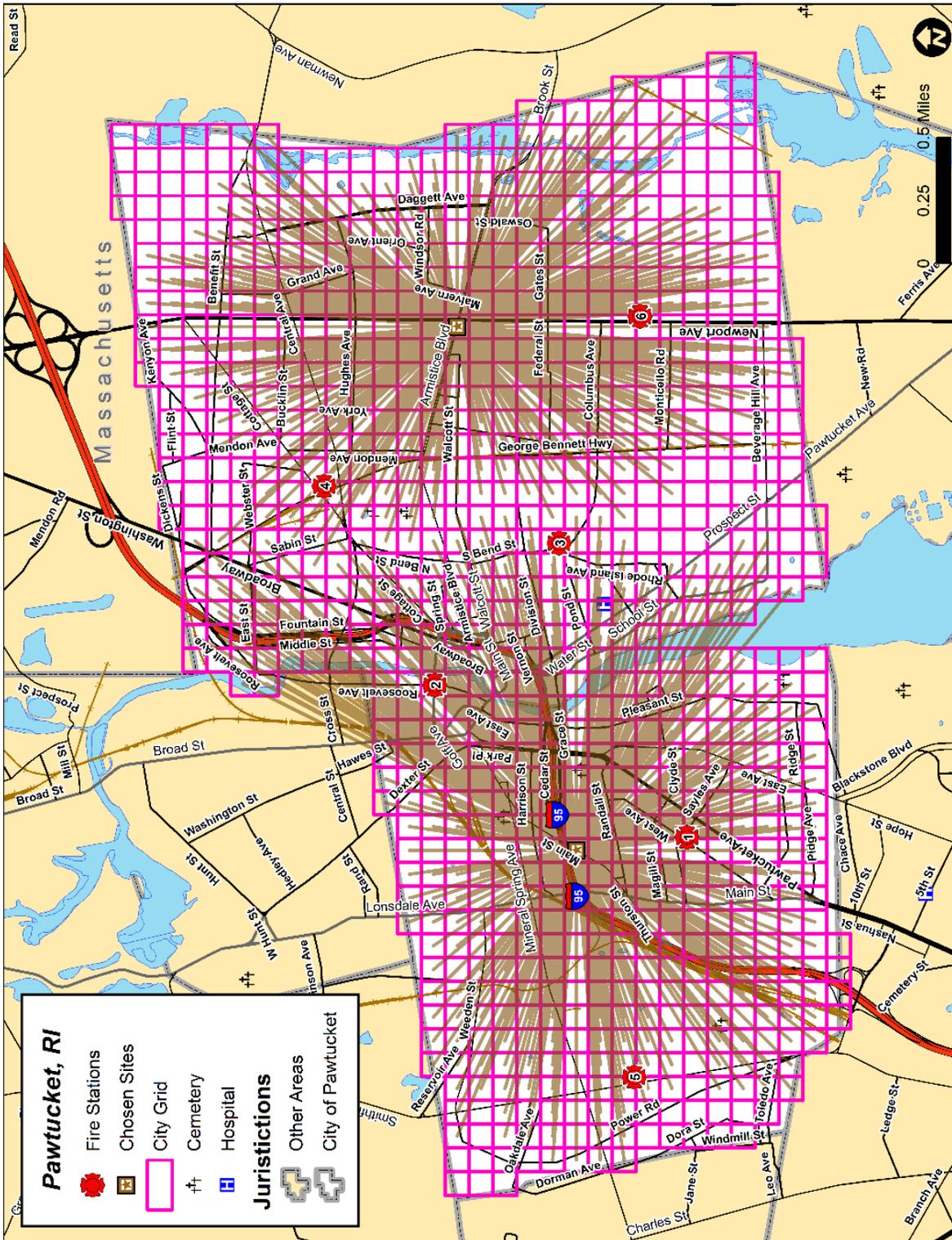


Figure 10
“CLEAN SLATE” DEPLOYMENT SCENARIO II

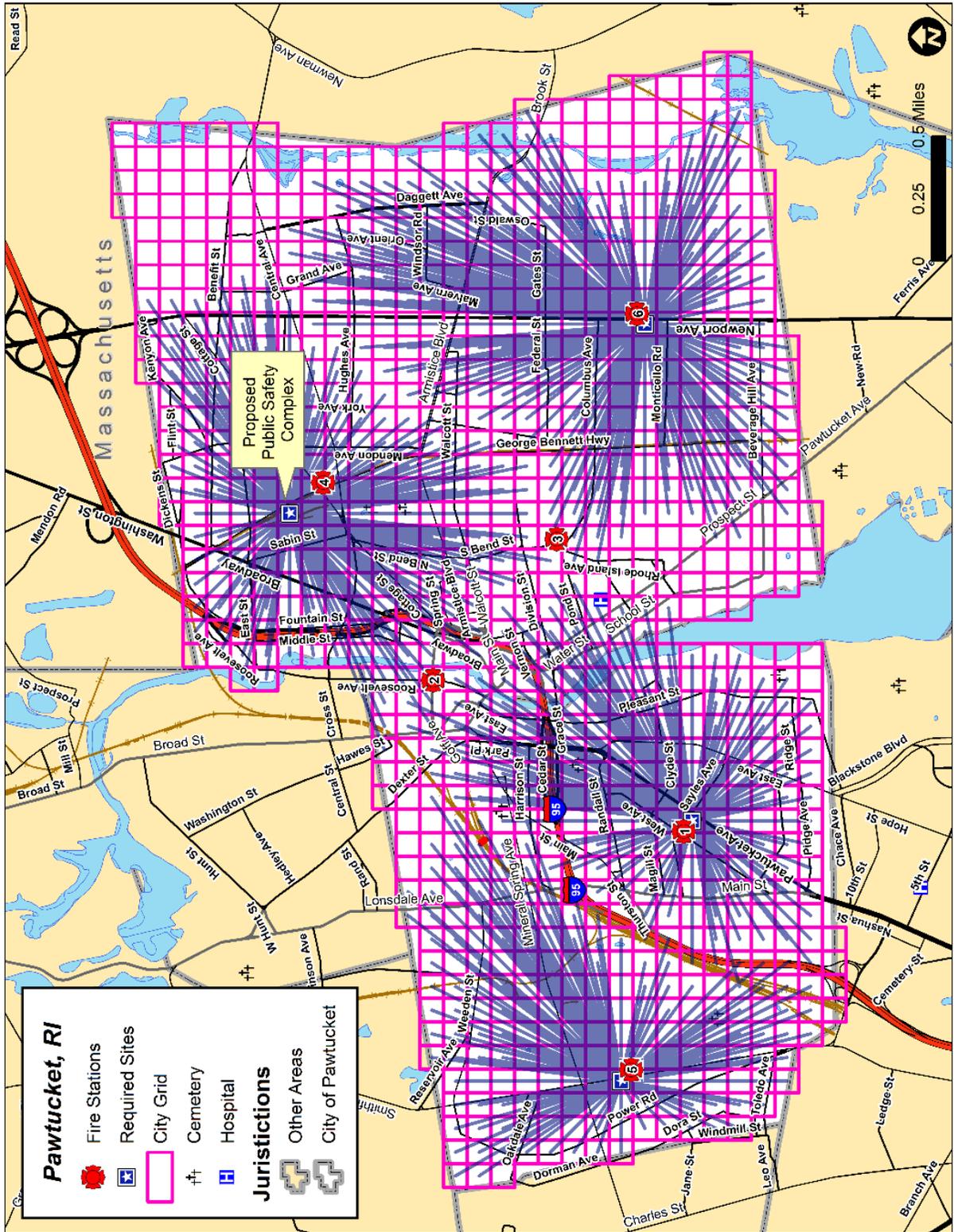


Impact of a Public Safety Complex

Currently, Pawtucket has a proposal for the building of a new Public Safety Complex at 1-93 Freight Street. The query from the city was: “If this complex is built, could the city expect to close the Downtown (Station 2), Cottage Street (Station 4) and McCoy Stadium Fire Stations (Station 3)?” An analysis was conducted using the same methodology, but required keeping select current stations rather than allowing the software to choose the best location(s). This is represented Figure 11.

The result of this analysis was that 90% of the vulnerability index score total can be reached within this scenario, meeting the requirement of the scenario result parameters.

Figure 11
PUBLIC SAFETY COMPLEX DEPLOYMENT SCENARIO



STATION CLOSURE ANALYSIS

It has been shown that stations can be reduced to three if money, land, and resident sentiment are not taken into account. It was also shown that the city could reduce the number of fire stations to four if a new Public Safety Complex was constructed near Station 4. Both of these scenarios may not occur, more likely the former versus the latter given the higher cost of several new stations. This brings up an additional scenario posed by the city: “Given the current distribution of fire resources, what stations could the city close and still meet the minimum response times?”

Certainly from the immediately preceding scenario, it may be reasonable to presume that Station 2 and Station 3 are expendable. Once again, using the same analysis technique, two stations are closed at a time and the protected coverage of the vulnerability index scores is evaluated. Figure 12 shows the result of this analysis.

**Figure 12
DEPLOYMENT OPTIONS VRI COVERAGE TABLE**

Stations Closed		Coverage
1	2	83%
1	3	89%
1	4	84%
1	5	79%
1	6	83%
2	3	92%
2	4	85%
2	5	80%
2	6	87%
3	4	87%
3	5	83%
3	6	83%
4	5	78%
4	6	74%
5	6	77%

Indeed, the acceptable coverage was found with the closure of Station 2 and Station 3. However, the age, conditions, and capacity of the existing stations must be kept in mind when ultimately considering the decision to close one station over the other.

Relocation of Apparatus Post Station Closure

An additional query was posed by the city in relation to apparatus redeployment: “If the city were to close the McCoy Stadium Fire Station (Station 3), where would the current apparatus be relocated to meet the city’s needs?” Currently, Station 3 houses an engine company, but also stores the marine rescue unit. The city has six active engine companies; if the number of stations was reduced, the engine in Station 3 becomes a reserve piece or eligible for resale depending upon condition. The marine unit would need to be housed in either the new Public Safety Complex in that scenario or within another remaining station that has room. Alternatively, the PFD could rely on neighboring resources, if such an asset is available within proximity.

Station 2 has three bays and currently houses an active Engine and Ladder. The Engine would also become a reserve unit stored at the new Public Safety Complex or eligible for resale.

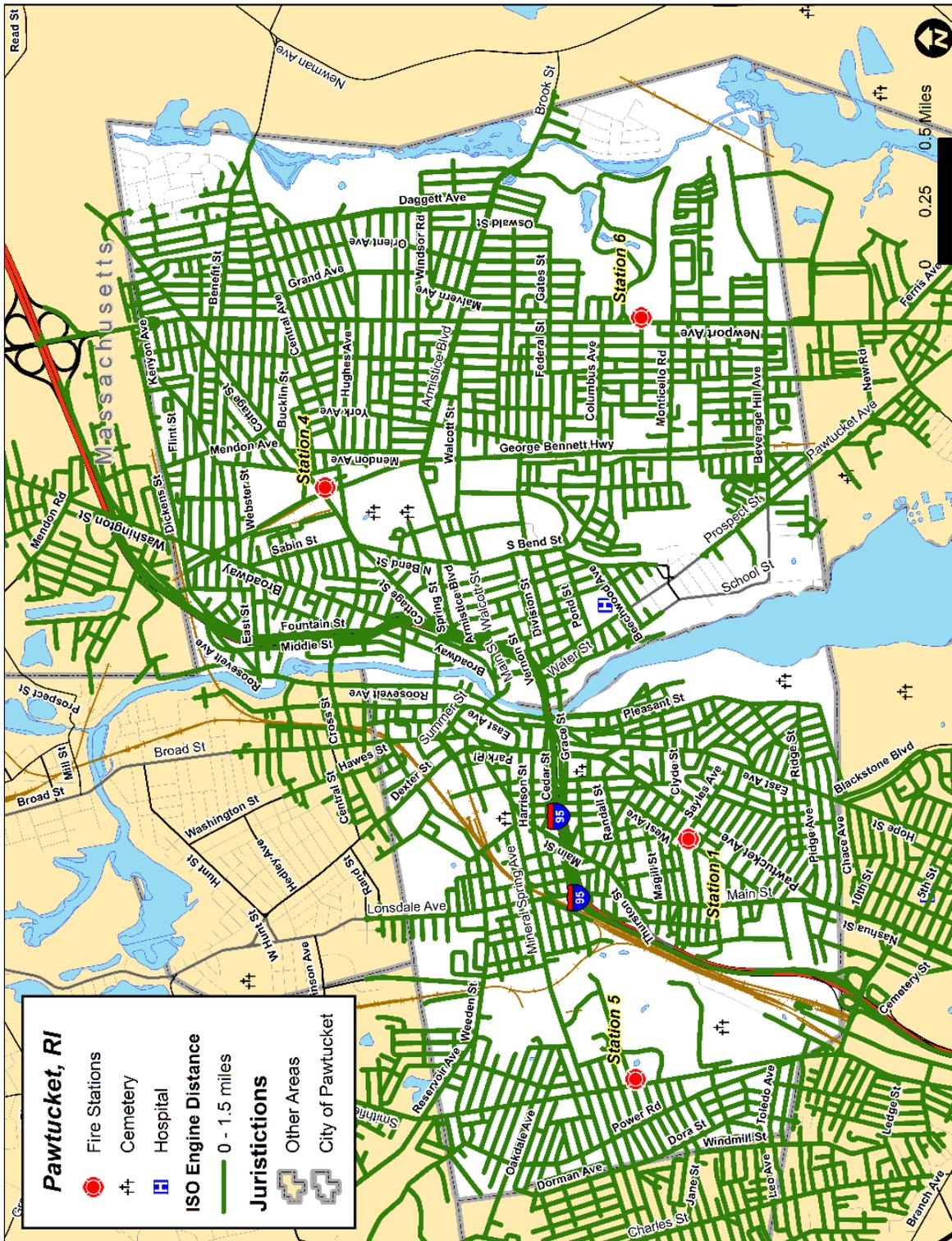
Due to the fact that the remaining fire stations are otherwise full with active and reserve units, storage elsewhere of reserve equipment must be addressed in order to open potential space for the second Ladder Company. There is a Ladder Company east of the river and the interstate (physical barriers). The second Ladder ought to be placed west of these physical barriers, but Station 1 cannot accommodate the Ladder due to its size. It can only be placed in Station 5. Note that Station 6 (east of the river) could not accommodate the Ladder due to size as well.

When considering the closure of stations, two important factors must be kept in mind: (1) the effect on the community’s insurance rating as determined by the Insurance Services Office (ISO) and (2) the effect on the first alarm assembly in terms of manpower and apparatus.

Station Closure Effect on Community Insurance Rating

The rating in 2010 of a Class 3 community, suggests five engine companies to be considered for *maximum* credit in the category, three for the determined fire flow rating, and two additional to provide coverage to built-upon areas not serviced within a 1.5 mile distance. Unless one engine company of Station 2 or Station 3 is kept in service, the ISO rating of the community may degrade. With two station closures, doubling Engines in one station with limited space will be a challenge. However, as seen in Figure 13, the city is still well protected overall under ISO guidelines despite the loss of two engine companies.

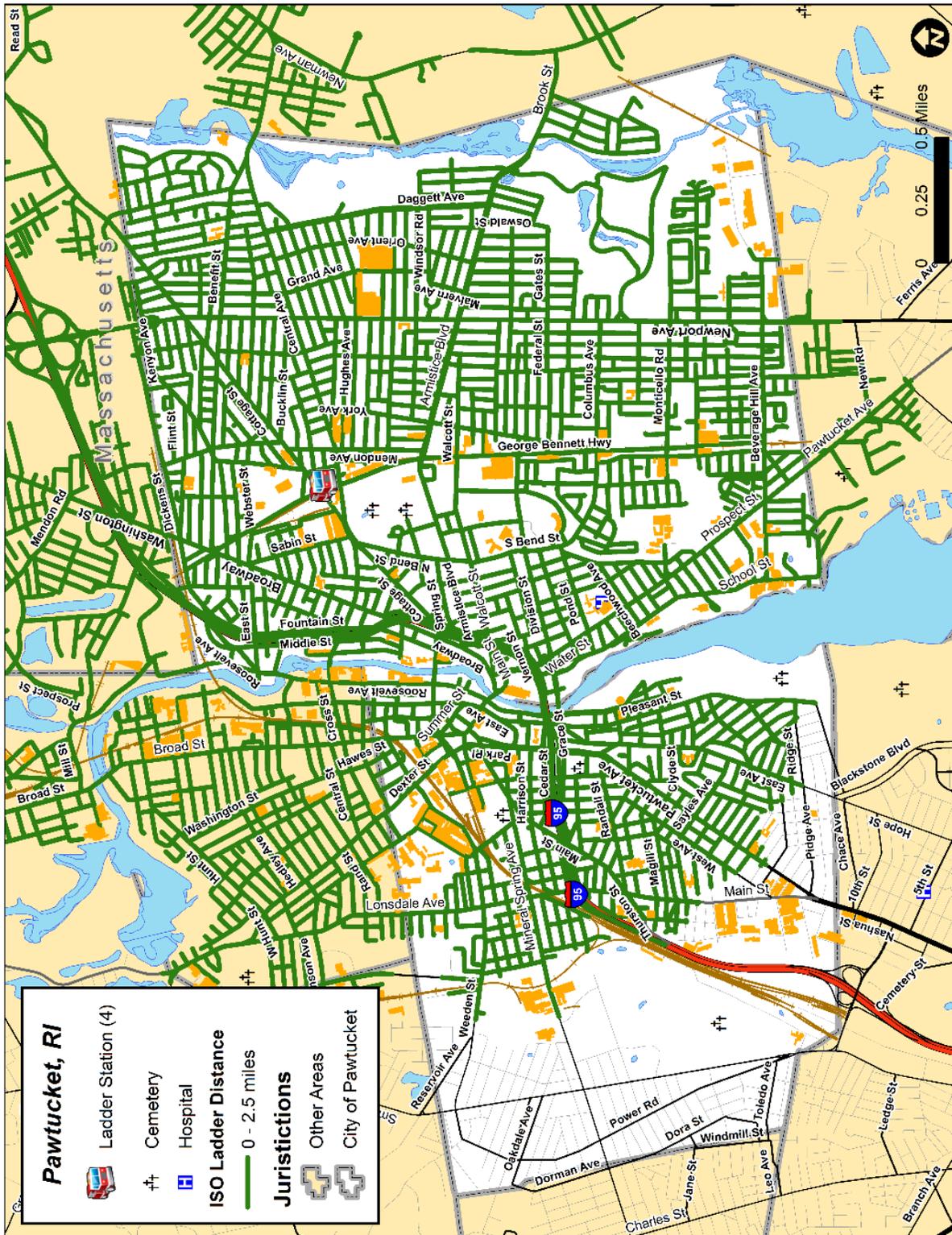
Figure 13
ISO ENGINE CREDIT IMPACT



The amount of ladder units (2) had been suggested by the Insurance Services Office (ISO) in the latest rating in 2010, but a new rating schedule allows for automatic aid consideration, if it is within five miles of a jurisdiction borders. It based this recommendation on the number of buildings over the basic fire flow rating and the number that are three floors or higher. These should be within 2.5 miles of the station housing the Ladder Company.

The current ladder unit in Station 4 is within the distance requirement except for the very west side near Station 5, as seen in Figure 14. However, the second ladder company, if not from PFD, must be able to come from a nearby jurisdiction such as Central Falls or East Providence. There will be a question of fire ground competency, which can be addressed through joint training events.

Figure 14
ISO LADDER CREDIT IMPACT



Station Closure Effect on First Alarm Apparatus Assembly and Effective Firefighting Force

For PFD's three-man crews, a first alarm assignment dispatches three engines, a ladder truck, and the duty battalion chief for a total of 13 firefighters. For a high-risk structure, such as a multi-storied building, elderly housing, or a school, PFD send four engines, two ladder trucks, a rescue ambulance, and the duty battalion chief for a total of 21 firefighters. The same level of firefighters can be achieved with less units using a four-man crew configuration: a first alarm assignment of **two** engines, a ladder truck, and the duty battalion chief for a total of 13 firefighters. For a high-risk structure, PFD can send four engines, just **one** ladder truck, a rescue ambulance, and the duty battalion chief for a total of 23 firefighters. However, it must be understood that with closing two stations and not using automatic aid, this deployment exhausts the Engine Company supply in the city. It would also utilize the only Ladder Company within the city. This becomes an issue if a subsequent incident occurs while the units are responding to the first one. In 2011, there were 249 dispatches for structure fires out of 12,379 emergent events (2%). Of these structure fire dispatches 21 (8.4%) occurred during the time between when the event was recorded as created and when the event was reported as closed. It must also be understood that these are dispatched as structure fires; what was actually found may not have been what was initially reported.

SUMMARY

The city can achieve adequate coverage of its combined risks (VRI) with two less current stations regardless if the Public Safety Complex is built. However, this complex may be needed for storage of reserve and unmanned equipment if two stations are closed.

If two stations are closed, it would be difficult for PFD to achieve its critical tasks during a structure fire with less manpower. This manpower can be supplemented by using four-man apparatus and automatic aid with neighboring communities. A significant issue is the level of training and competence of outside jurisdictional departments, which can be overcome through regional training events.

The city's ISO rating may be affected by the loss of apparatus and manpower, but this can be overcome with automatic aid agreements and performance reporting according to the recently (2012) updated classification evaluation survey.

OPTIONS & RECOMMENDATIONS

1. Pawtucket can consider closing two stations. Closing station 2 and 3 would still provide adequate coverage of combined risks with the remaining stations.
2. Pawtucket can consider closing two stations. Closing station 2 and 3 would still provide adequate coverage of combined risks with the remaining stations.
3. If the city reduces stations, it should strongly consider utilizing four-man units to achieve an effective firefighting force.
4. PFD should implement automatic aid for additional apparatus when needed and especially if a city ladder company is eliminated.
5. PFD is encouraged to participate and sponsor regional training events for fire ground operations.

IMPLEMENTATION CONSIDERATIONS

The following section details a recommended implementation strategy for the relocation of resources after the closure of fire station 2 and fire station 3.

1. Construct Public Safety Complex (0-5 years)

It is evident that there is a lack of climate-controlled space for reserve apparatus once the station closures take effect. While the larger apparatus such as engine and trucks may replace older units at other stations, there may be an excess in reserve units. This may be sold, but if they are retained; a larger facility is needed.

In addition to these units, the marine reserve unit in Station 3 (if a local alternative is not adequate) and the on-duty chief's vehicle will also require stationing and there does not appear to be room at a planned remaining station. Furthermore, the administrative and dispatch center at Station 2 are cramped quarters and could benefit from more spacious accommodations within a public safety complex. Should this facility be built, resources can be relocated from fire station 4 to this location.

2. Close Station 3 (6th-7th year)

Relocate the marine reserve unit to available space either in the new public safety complex or, if room can be accommodated, fire station 4. Transfer the three firefighters to other stations. Two should be considered for Station 4 for each the engine and truck crews to bring them to four each. The remaining firefighter should be considered for the engine in Station 1.

3. Close Station 2 (7th to 8th year)

Relocate administrative and dispatch center functions to the new public safety complex. Utilize station's apparatus as replacements to other stations if appropriate, otherwise either retain at the Public Safety Complex or sell at auction.

Transfer two firefighters to each Station 5 and Station 6 to bring the apparatus to 4-man crew strength. The remaining four firefighters can continue to man the ladder truck housed at Station 5. This would require a building addition to accommodate the apparatus and additional firefighters.

4. Consider One Ladder Company (7th to 8th year)

The analysis has shown that geographically, one ladder company within Station 4/Public Safety Complex is sufficient. This does not correspond to the fire department's critical tasking on High Risk Alarms that requires two ladder companies or the ISO evaluation under an earlier version of their rating system.

While automatic aid with surrounding municipalities, notably Central Falls and North Providence, may be considered; this does not account for manning capabilities, sufficient training, or fire ground experience. All these factors should weigh in this important decision.

There was an expressed concern that a single ladder on the eastside of the city that is separated by a physical barriers such as the river and the interstate highway may increase the risk in a High Risk Alarm event. The probability of all crossings over the river or interstate being impassable is very low and in that event, it would be reasonable to request outside assistance from neighboring fire departments. Occasional events such as a snowstorm or hurricane might create a scenario that make some crossings impassable. Therefore, perhaps this argues for the initiation of regional training and practice rather than a fully funded yearlong, 24 hour per day apparatus in service.

The four firefighters could man two additional rescue ambulances. According to the service demand of the fire department, an increasingly likely number of events that will expand into the future due to an aging populous. They can be housed in the remaining stations when reserve apparatus in Stations 5 and 6 are maintained at the public safety complex.



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