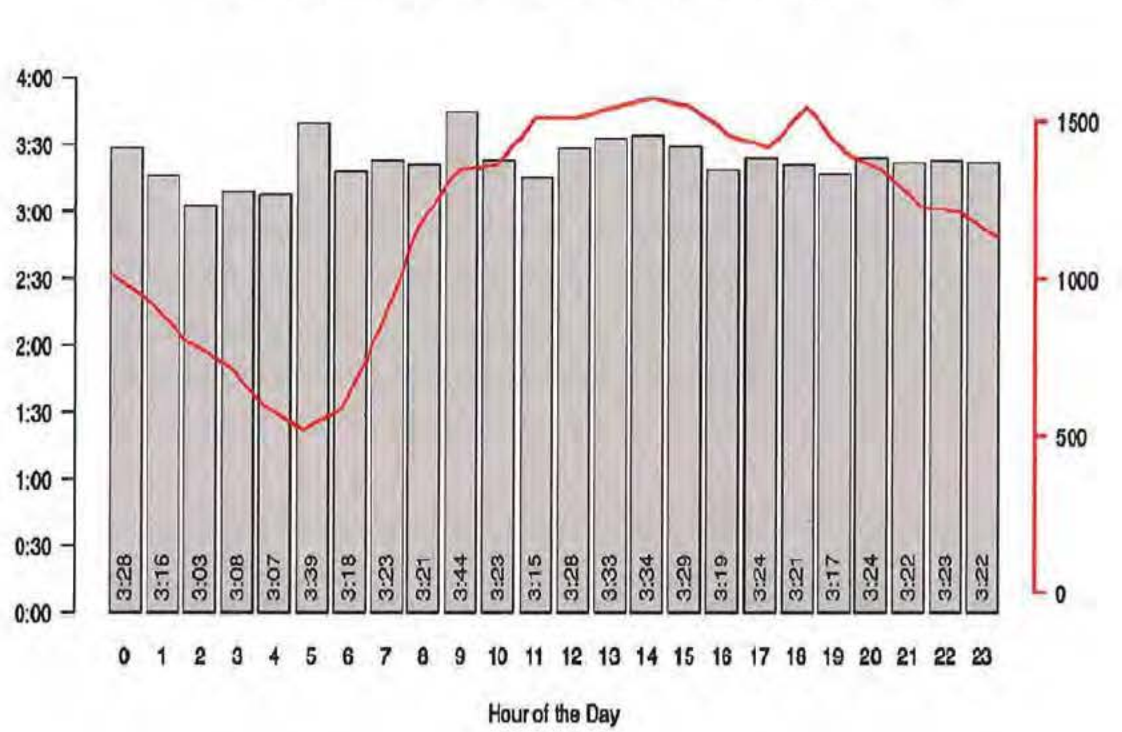
Figure 18: Call Processing Time by Hour of Day, 2008



Note: The red line in Figure 18 depicts the call volume for a 24-hour period.

During the study we discussed the issues of dispatch times with the fire department and it was aware that problems did exist. However, plans by E-COMM for a new CAD system were underway so it was decided to assess dispatch times again when the new CAD system was installed and working. At the end of this section we discuss the analysis of call-taking and dispatch times using one month of CAD data in 2009.

Turnout (or Reaction) Time – Turnout time is the second segment in total response time. It begins when personnel are alerted at the station for the emergency until the crew is aboard the apparatus and ready to respond. If data collection is accurate, it can be calculated as the difference between the en route time and the unit dispatch time. The goal for turnout is one minute, 90 percent of the time. However, this goal is also difficult to achieve for most departments and a more realistic goal is one minute for daytime calls and one and one-half minutes for calls occurring during times when firefighters are not awake. Turnout times for non-emergency calls also need to be eliminated from the data set since firefighters do not react as quickly if the call is not an emergency.

Even when a more realistic goal of 90 seconds is considered, VFRS still exceeds the goal considerably. Other than hazmat incidents, all the incident types had similar turnout times.

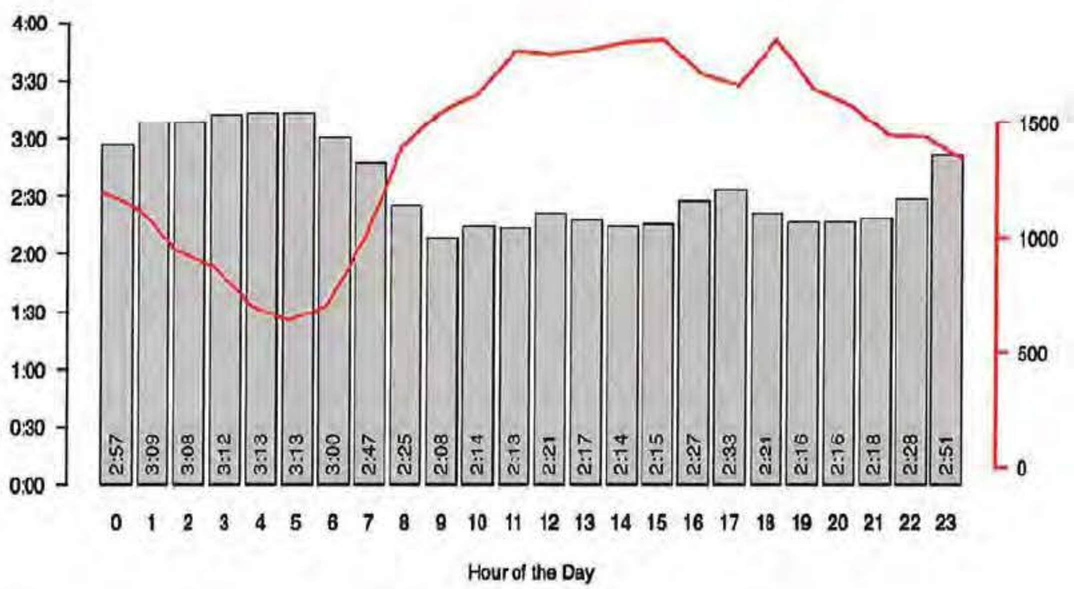
Table 24 shows the reaction time for the emergency call types for 2008.

Table 24: Turnout Time by Incident Type, 2008

Incident Type	80th Percentile	90th Percentile
Emergency Medical Service	2:32	2:59
False Alarm	2:39	3:07
Fire	2:53	3:23
Hazmat	3:27	4:27
Hazardous Condition	2:58	3:35
Motor Vehicle Accident	2:27	2:50
All	2:36	3:04

Figure 19 shows the turnout time by time of day. As expected turnout times during night time hours were longer.

Figure 19: Turnout Time by Time of Day, 2008



Note: The red line in Figure 19 depicts the call volume for a 24-hour period.

Findings of excessively long turnout times led to our having doubt as to the accuracy of the data since the turnout time for firefighters in Vancouver significantly exceeds those found in the analysis of other communities. For this reason, the fire department should revisit the data and conduct more study. It should consider disaggregating the results by fire hall (and shift). In this way it could determine if there are problems at a particular hall. Longer turnout times can sometimes be related to the layout of a particular fire hall more so than to a particular crew, but crews also need encouragement to respond more quickly too.

Ultimately, the issue of long dispatch and turnout times need to be addressed since it is these times that can be improved most easily and with little expense by the fire department (and E-COMM). Once the apparatus leaves the fire hall, response times are more difficult to improve since the speed is related to the type of roads traveled, weather, and traffic.

Recommendation 14: Revisit the analysis of dispatch and turnout times and take the necessary steps to improve them where possible. At the same time, establish a performance goal for each time segment and assess them monthly. For turnout times, evaluate the performance by fire hall (and shift).

Travel Time by Hour of the Day and Incident Type – Travel time starts when a unit begins its response from the fire hall until it arrives at the scene. Travel times are a function of geography, road conditions, traffic/congestion, and the number of and location of fire halls with respect to the location of actual calls. A travel-time goal of four minutes is suggested by NFPA. Later in this section we discuss in more detail the location of fire halls and the performance of the current layout of halls.

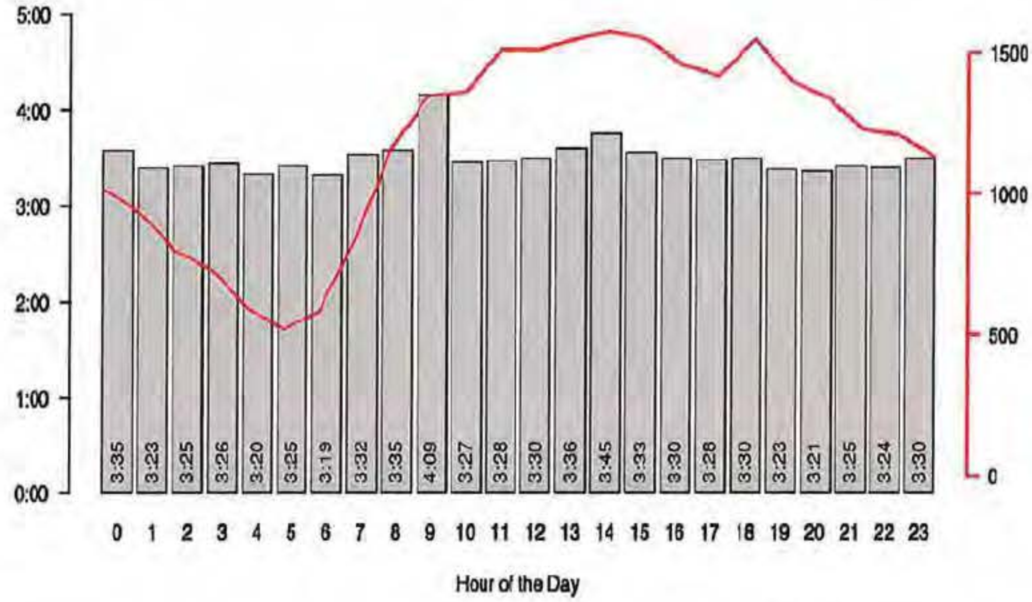
Unlike the call processing and turnout times discussed earlier, travel times in most parts of the city are good. Most incident types had 80th percentile travel times under 4:00. Fires had an 80th percentile travel time of 4:11 which is just slightly above the standard. Interestingly, for a large urban city like Vancouver, there was little difference in travel times during different times of the day.

Table 25 and Figure 20 show the travel time for the first unit to arrive at an incident during 2008. Table 25 depicts the travel time categorized by incident type. Figure 20 shows the travel time by hour of day with the call volume shown for reference.

Table 25: Travel Time (First Unit Arrival), 2008

Incident Type	80th Percentile	90th Percentile
Emergency Medical Service	3:19	4:06
False Alarm	3:48	4:47
Fire	4:11	5:34
Hazmat	5:17	7:22
Hazardous Condition	4:54	6:48
Motor Vehicle Accident	3:27	4:27
All	3:30	4:27

Figure 20: 80th Percentile Travel Time (First Unit) by Time of Day, 2008



Note: The red line in Figure 20 depicts the call volume for a 24-hour period.

Total Response (Reflex) Time – As discussed earlier, total response time is measured from the time the call is received by the dispatch center until a unit arrives on scene. Total response time is, for most citizens, the most important time element and the measure they use to evaluate the effectiveness of fire and EMS service.

A review of the total response time for each of the city's 23 planning areas was also conducted using NFPA 1710, which recommends a six minute total response time. Again, this is based on one minute for call processing, one minute for turnout, and four minutes for travel time.

VFRS is considerably above the six-minute goal mostly because dispatch and turnout times far exceed the recommended one minute. It is unusual that a community's response time is so much above the recommended times such that dispatch and turnout times are the primary culprit. Problems with response time, when they are found, are usually with station locations, or not having enough stations to cover the area. Such is not the case in Vancouver.

However, there are problems with units being unavailable because of training requirements. The problem manifest itself when fire units are transferred to cover units at training and this results in higher response times, particularly for structure fires where multiple units are dispatched from several stations.

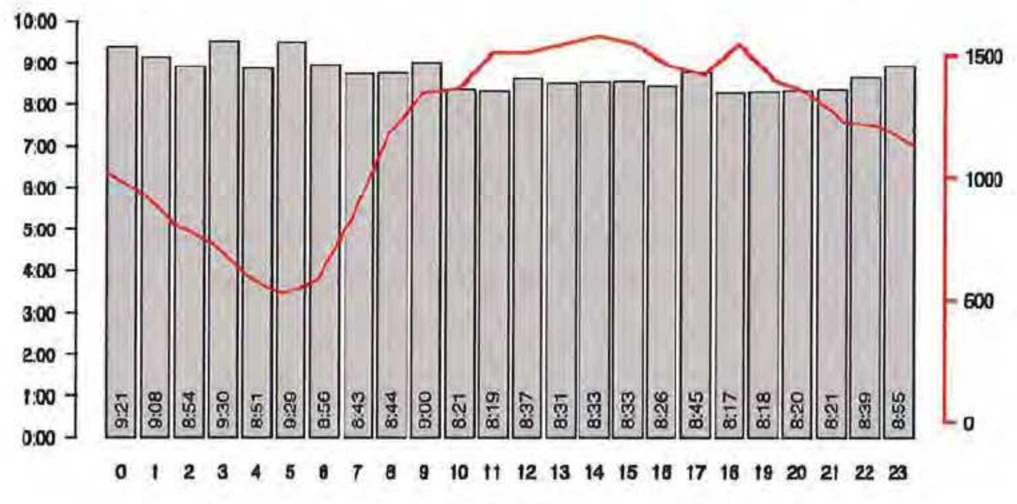
Table 26 shows the total response time for the first unit to arrive at an emergency during 2008.

Table 26: Total Response Time by Call Type, 2008

Incident Type	80th Percentile	90th Percentile
Emergency Medical Service	8:45	10:09
False Alarm	8:39	10:21
Fire	8:27	10:11
Hazmat	10:18	11:48
Hazardous Condition	9:58	11:57
Motor Vehicle Accident	8:10	9:40
All	8:42	10:14

Figure 21 shows total response time by time of day. As can be seen there is little difference in total response time between daylight and night time hours, which is unusual for a large city.

Figure 21: Total Response Time by Time of Day, 2008



Note: The red line in Figure 21 depicts the call volume for a 24-hour period.

Table 27 shows the total response time for the city's planning areas. As can be seen, travel times are fairly good. Thirteen planning areas are less than the four minute NFPA 1710 goal while 10 exceed the four-minute goal; the highest is Dunbar-Southlands at 4 minutes 54 seconds. The citywide average of 3 minutes 47 seconds is very good.

Table 27: Total Response Time by Planning Area, 2008

Planning Area	Call Processing	Turnout	Travel	Total Reflex
Arbutus Ridge	3:06	2:56	4:13	9:43
Downtown	3:29	2:32	2:50	8:14
Dunbar Southlands	3:07	2:35	4:54	9:24
Fairview	3:21	2:30	3:34	8:52
Grandview-Woodland	3:18	2:29	3:27	8:27
Hastings-Sunrise	3:22	2:34	4:08	9:35
Kensington-Cedar Cottage	3:18	2:29	3:21	8:26
Kerrisdale	3:05	2:32	4:09	8:50
Killarney	3:16	2:33	3:44	8:55
Kitsilano	3:16	2:42	3:58	9:04
Marpole	3:10	2:37	3:50	8:58
Mount Pleasant	3:28	2:48	3:27	8:58
Oakridge	3:30	2:41	3:59	9:10
Renfrew-Collingwood	3:21	2:39	4:00	9:12
Riley Park	3:20	2:39	3:50	8:54
Shaughnessy	3:28	2:35	4:04	9:08
South Cambie	3:21	2:34	4:21	9:46
Strathcona	3:37	2:30	2:34	7:56
Sunset	3:14	2:35	4:03	9:04
University Endowment Lands	3:15	2:53	4:33	9:38
Victoria-Fraserview	3:14	2:31	3:29	8:36
West End	3:14	2:32	2:41	8:01
West Point Grey	2:44	2:40	4:14	8:36
NFPA Standard	1:00	1:00	4:00	6:00
Average	3:17	2:36	3:47	8:55

Response Time Analysis with New CAD System Data – Following the installation of a new CAD system in late 2008 by E-COMM, it was requested that we analyze data from January 2009 to determine if improvements have been made in call processing times. One aspect of the new CAD system was that it would allow medical calls to be routed simultaneously to BCAS and the fire department. Under the previous system, medical calls went to BCAS and then returned to E-COMM if the call necessitated a first responder unit from VFRS. The result was a longer dispatch time for medical calls answered by VFRS.

To determine the extent of change, if any, we analyzed data from January 2009 both for fire and medical calls. The results of the analysis found that while dispatch times did improve, turnout and travel times both increased. In fact, travel times increased by almost two minutes. Again, there appears to be a problem in data collection (or retrieval) and the travel time findings do not coincide with the other aspects of this study. We examined the new data thoroughly to make sure a mistake was not made by us in the calculation. Following the review, we contacted VFRS officials and made them aware of the findings.

Findings of the new CAD data are shown in Table 28.

Table 28: Response Time Analysis (Using New CAD System Data), January 2009

	Call Processing	Turnout	Travel	Total Reflex
Emergency Medical Service	1:27	4:16	6:29	11:33
Fire	1:37	3:56	6:42	11:44
NFPA Standard	1:00	1:00	4:00	6:00

Workload and Performance Measurement

The second aspect of evaluating performance was to analyze the workloads and performance of the various fire halls and units. For this we also used 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.*

As the 'de-facto' standard to assess response time and deployment, NFPA 1710 is a reasonable guide because it was developed based on industry-accepted principles of fire development and medical outcomes. However, we are not aware of any study that validated NFPA 1710 by showing a correlation between lower response times and an equivalent reduction in fire loss. Still, the standard is a useful framework to evaluate coverage and the city should consider NFPA 1710 a useful tool.

The first look at incident data showed that central Vancouver had a much larger number of calls and there were more resources to handle the call volume. If the city-wide performance standard was to achieve a certain response time 90 percent of the time and the central area accounted for the largest portion of calls, performance in other areas of the system could well be substandard. For this reason a higher level of analysis was needed as opposed to a smaller community where call volumes and incident types are often homogenous across the entire system.

In Chapter III, we used the city's planning areas to conduct the risk and demand analysis. In discussions with city planners and fire officials, it was agreed to use this approach because planning areas run along neighbourhood boundaries and both risk and demand are influenced by neighbourhood characteristics. Also, using planning areas helps non-fire department officials and the public better understand the results (because people are typically much more familiar with neighbourhood boundaries than fire districts or first-due boundaries).

The analysis of fire hall and apparatus locations was based on overall deployment performance (workload, travel times, and performance reliability). Planning areas in Vancouver are sometimes protected from several fire halls and the areas covered by individual fire halls do not match exactly the city's 23 planning area boundaries. If deployment performance was measured using planning areas, it would be difficult to attribute problems to a particular fire hall. For this reason, the analysis looked at workload and deployment performance by fire halls and the first-due areas they covered.

In addition to performance and travel times, we also analyzed the workload for each fire hall and each unit. This determined whether particular units could handle more calls without compromising the overall performance of the area. It also showed the fire halls with the longest travel times. One of the most important factors we looked at was the location of calls whose response time was outside of the NFPA's response time standard.

Performance Goals – As part of the planning process, VFRS will have to decide the performance goals it considers right for the city overall and for each planning area. It will also need to find a reasonable response time and a reliability goal for each planning area (and each incident type).

Setting performance goals by planning area is one way to do this because risk factors can be matched with travel time and reliability goals. Then, if analysis shows a problem with response times (or reliability), further analysis can be done to determine the problem. Another way is to create demand zones across the city. However, the planning areas already used by the city appear to be a good framework. Ultimately, fire leaders need to understand why the desired goals are not being achieved in a particular area and the response situation for each fire hall protecting that area before it makes changes to the system.

As stated earlier, the NFPA 1710 response time standard is based on typical fire growth rates and patient outcomes, primarily those involving cardiac arrest. The recommended time for the first unit to arrive under the standard for both fire and EMS incidents is six minutes (four minute travel time plus two minutes for call processing and turnout time). The time is based on research showing that a structure fire begins to grow exponentially after six minutes and individuals in cardiac arrest need defibrillation within six-minutes.

The problem with using standards 'carte-blanche' is that they are sometimes overkill for the particular situation. For example, an area with a very young population might be okay with an eight-minute medical response time since the more serious and time-sensitive EMS calls occur very infrequently. Likewise, an area with a large percentage of sprinklered buildings might not require as fast of a response as those in unprotected buildings. Since 2006, over 8600 sprinkler permits have been obtained, each of which contributes to improved fire safety.

- 2006 – 2547 permits
- 2007 – 2249 permits
- 2008 – 2375 permits
- 2009 – 1446 permits[18]

As more residential structures are sprinklered each year, planning areas where a majority of structures are equipped with sprinklers, can have a lower performance goal (80 percent or even 75) applied as the acceptable goal. This is not the case now, but the goal should be revisited as more sprinklers are installed.

Appropriate performance levels are very much based on the characteristics of individual planning areas. Fire department personnel are very good at determining appropriate response time and reliability goals. For its part, VFRS should have its strategic planning team, and others within the fire department familiar with the various planning areas, recommend the response time goals for each of the city's 23 planning areas.

Recommendation 15: Use NFPA 1710 (and other standards) to develop performance goals, but consider each planning area on the merits of its particular situation.

Assessing Deployment Performance – Assessing fire department deployment is a difficult task because of the many factors that affect performance. A simplistic way of determining fire hall locations would be to use a GIS program to map out four minute coverage areas to make sure there are no coverage gaps. This method focuses entirely on the location of the fire hall and would work well if the fire department only answered one call at a time. The problem of this approach for a large city like Vancouver is that many halls are very busy and concurrent calls are common. Using the performance analysis method, we could determine whether response time goals were being met regardless of which fire hall or unit may have responded to the call. This permitted us to consider unit workloads and whether particular halls could handle more calls before performance was affected.

Standard of Cover Evaluation – For this study we used the Center for Public Safety Excellence (CPSE) Standard of Cover process to evaluate the overall performance in Vancouver.

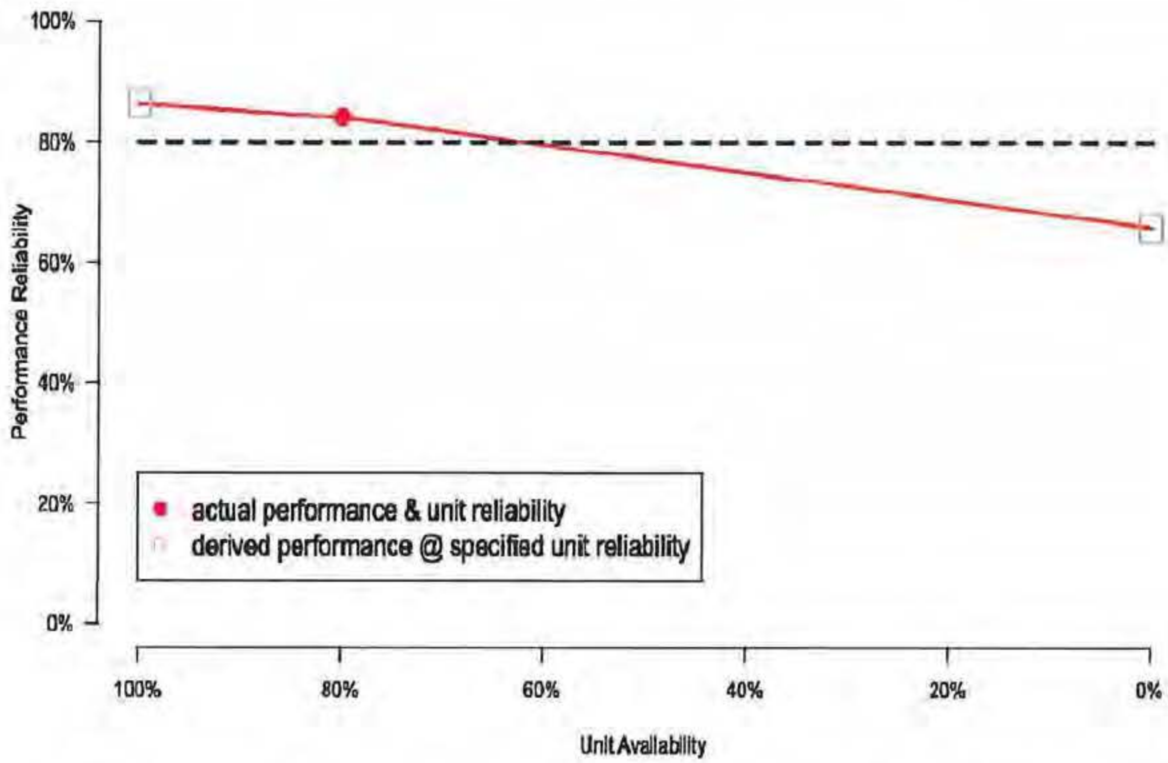
[18] Through October 7, 2009.

The premise of this assessment method is that for each analysis area, there is a trade off between unit availability and performance. Unit availability is defined as the percentage of incidents where the closest unit was available to handle the call and did so. Performance is defined as the percentage of incidents where the travel time for the particular incident was responded to within the desired response time.

NFPA 1710 recommends a travel time of four minutes 90 percent of the time. Although 90 percent reliability is an appropriate threshold for city-wide performance, it is a very difficult to meet this goal in every area of the city. In fact, the very low call volumes in some areas make it unrealistic that the city would want to achieve such a standard since it would be inefficient to provide enough fire halls to meet the standard all of the time.

All things considered, we suggest 80 percent compliance with the response time as a more realistic goal. That means that first-due areas where less than 80 percent of calls are reached within a 4:00 travel time should be considered problem areas. The red line plotted on the example (Figure 22) and the following similar graphs represents the actual performance and unit availability. The dashed black line marks the 80 percent performance threshold. If the dot for a particular station falls below that dashed line, response travel time performance is being affected and changes may need to be taken. A station with the dot shown in Figure 22 would have satisfactory performance.

Figure 22: Example of Response Time Performance



In addition to showing whether performance is being achieved, the performance graph can also show workload sensitivity or fire hall location problems. This is done by diagnosing unit availability versus performance. In the example figure, the red line has a red dot and two black squares. The dot represents the actual unit availability and performance and the squares represent theoretical data points. The square at 100 percent unit availability is placed by calculating performance for only those incidents where a unit from the correct station responded. The square at 0 percent unit availability is placed by calculating performance for only those incidents where a unit from a fire hall other than the first-due hall responded because the first-due unit was busy. The red line is then interpolated between these three data points to give the unit availability vs. performance line.

The slope of the line assesses workload sensitivity. A nearly horizontal line indicates that unit availability has little impact on performance, meaning that the area in question has low workload sensitivity. Fire halls with low workload sensitivity typically have many nearby fire halls that can cover their calls if they are unavailable. A line that slopes strongly downwards indicates that performance is heavily dependant on unit availability. These areas are very workload sensitive because second-due units are generally unable to achieve travel time goals when the first-due unit is unavailable.

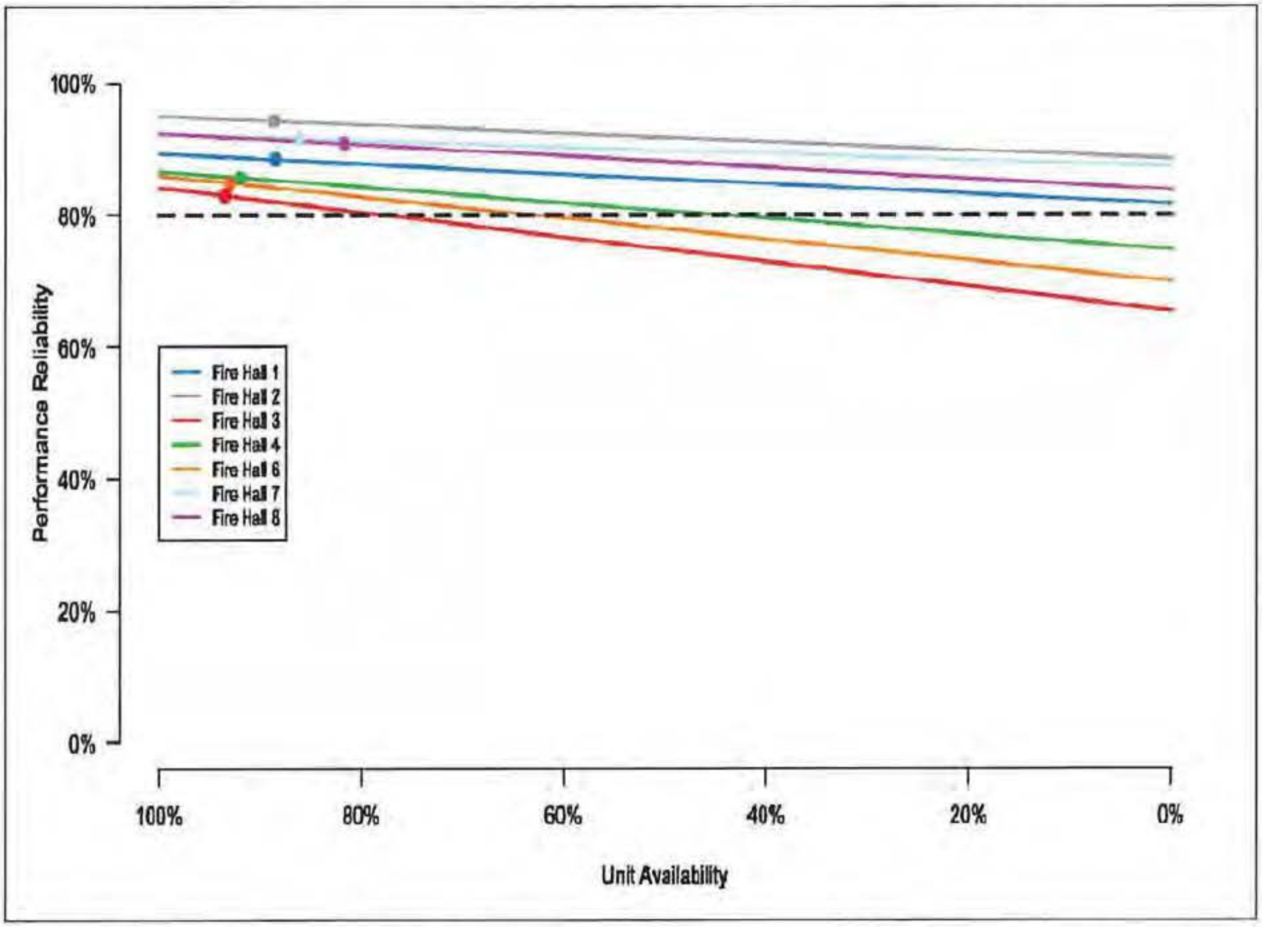
The location of the line at 100 percent unit availability assesses fire hall location problems. If this part of the line is under the 80 percent performance threshold it means that, even when the correct unit responds, travel time goals are not being met 20 percent of the time. This means that the station is not well located to reach all parts of its first-due area. This problem can be fixed by relocating the current station, building a new station, or (perhaps the best solution) re-evaluating first-due boundaries to make sure that the most appropriate hall is responding.

For this report we grouped the city's fire halls into three areas for the performance analysis: central Vancouver, eastern Vancouver, and west-side of Vancouver. In the following section we present the graphs and discuss the analysis for each grouping.

Central Vancouver Performance Analysis – The analysis of central Vancouver includes Fire Halls 1, 2, 3, 4, 6, 7, and 8. These fire halls protect the central core (Downtown) and busiest area of Vancouver.

Performance in the downtown area is good. All the first-due areas are meeting the four minute travel time goal over 80 percent of the time. First-due areas for Fire Halls 2, 7, and 8 are meeting the goal over 90 percent of the time. Although the stations here have the highest workloads, the stations are spaced close enough that they can achieve travel time goals into each others areas. For the most part, this is how performance should look in a high demand downtown.

Figure 23: Reliability and Performance Analysis, Central Vancouver



	Unit Availability	Overall Performance	1st-Due Performance	2nd-Due Performance	Responses
FH1	89%	88%	89%	82%	1226
FH2	89%	94%	95%	88%	3837
FH3	94%	83%	84%	65%	1973
FH4	92%	86%	87%	75%	2082
FH6	93%	85%	86%	70%	1685
FH7	86%	92%	92%	87%	2270
FH8	82%	91%	92%	84%	2446

There are some things to keep an eye on. Fire Hall 3 is the most workload sensitive of the stations and will drop below the 80 percent performance reliability goal with increased workload. This is very likely to happen soon because of the development of False Creek South. Fire Hall 3's unit availability might be maintained by giving some of its workload to Fire Hall 13, which can reach some of 3's first due areas, or by adding an additional unit to Fire Hall 3.

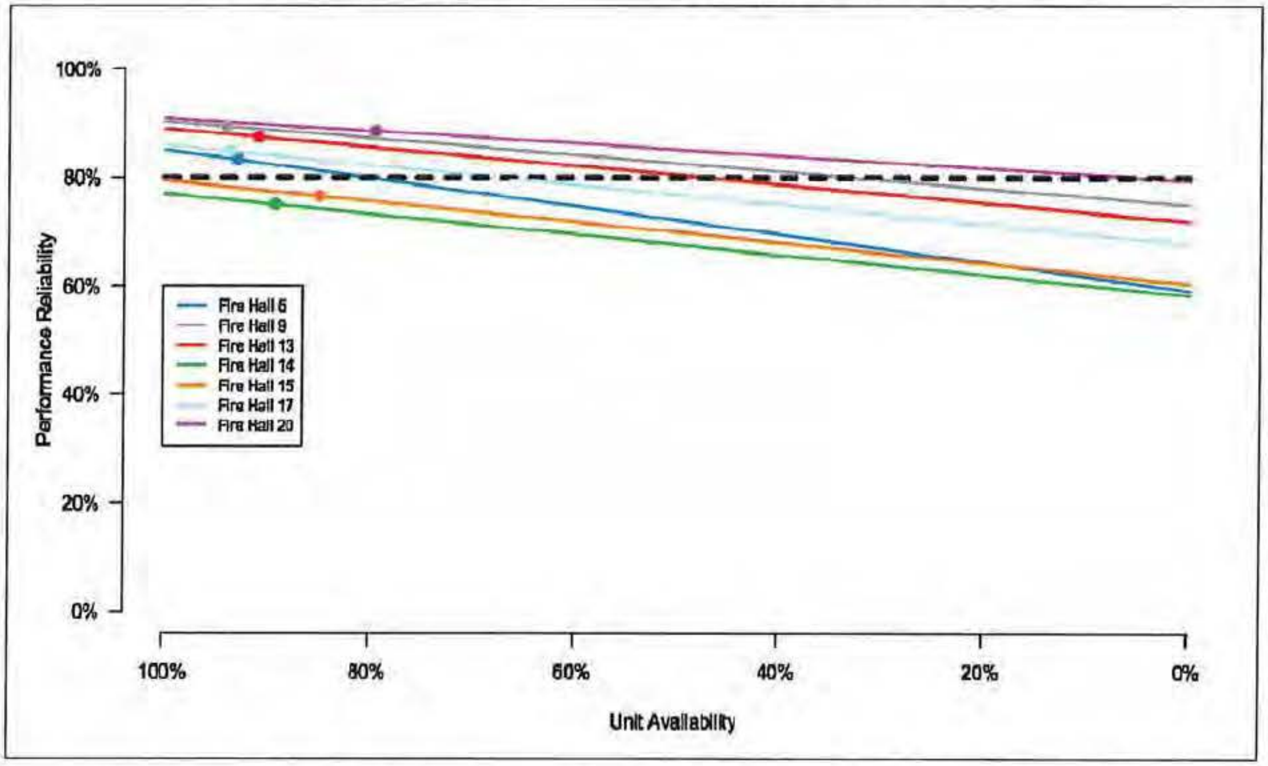
Fire Hall 2 has a much higher workload than any other station in the downtown area. When stations are close together, first-due boundaries can be moved around substantially while still ensuring that all areas are covered within four minutes. Efforts should be taken to balance workload as much as possible between stations and units in the downtown area.

There are also problems in 2's area during peak-load times, particularly weekdays, when the call volume is the highest. To address this issue and improve reliability, we recommend the creation of additional rescue units to handle medical calls. This is discussed later in the report.

Eastern Vancouver Performance Analysis – The analysis of eastern Vancouver includes Fire Halls 5, 9, 13, 14, 15, 17, and 20.

The analysis of eastern Vancouver shows two problem areas: Fire Halls 14 and 15. Both of these halls are already under the 80 percent performance reliability goal. Even when the home unit from one of those stations responds (100 percent unit availability), the performance goal is still not being met. More than likely, this means that there is a station location issue going on where there is high demand in a part of their first-due area that they cannot reach in four minutes. We investigated this situation and discuss it and our recommendation to address it later in the chapter.

Figure 24: Reliability and Performance Analysis, Eastern Vancouver



	Unit Availability	Overall Performance	1st-Due Performance	2nd-Due Performance	Responses
FH5	93%	83%	85%	59%	1247
FH9	94%	89%	90%	75%	2571
FH13	91%	87%	89%	72%	1010
FH14	89%	75%	77%	58%	1355
FH15	85%	76%	79%	60%	1522
FH17	94%	85%	86%	68%	1646
FH20	80%	88%	91%	79%	1100

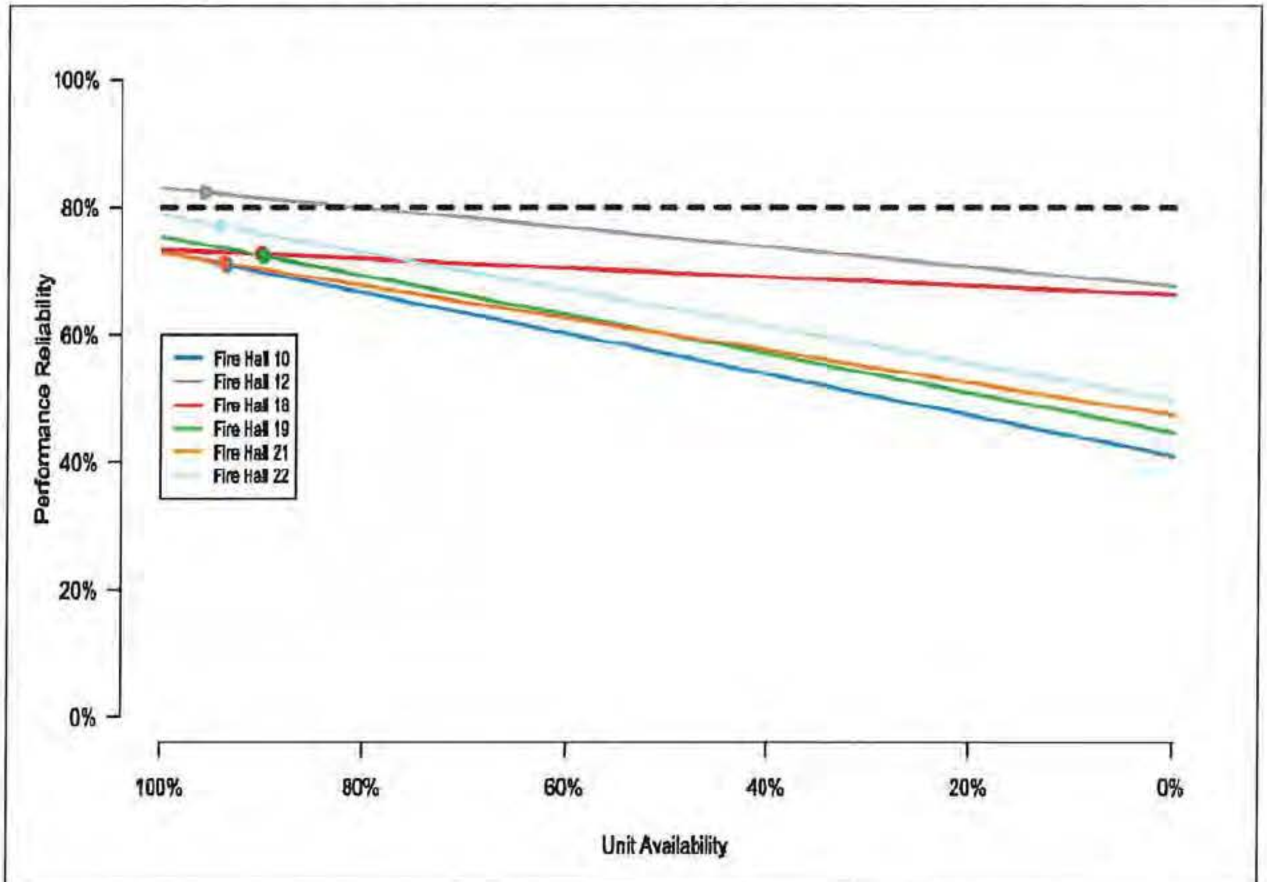
Fire Hall 5 also poses some concern. Although this station is not very busy, other stations surrounding Fire Hall 5 (15, 17, and 20) are unable to reach this area within four minutes. The performance versus unit availability graph shows that Fire Hall 5 is a workload sensitive and a slight increase in workload for this area will decrease performance under the 80 percent reliability goal. This is likely to occur when the additional development planned along the river in this area is completed. Also, the current location of Fire Hall 15, which is being rebuilt now, and Fire Hall 17 does not appear to allow for redrawing first-due boundaries to shift the demand from Fire Hall 5. We do discuss another option later, which is to move Fire Hall 20 slightly since Fire hall 20 is recommended for replacement. We discuss this situation later in the chapter as well.

West-Side of Vancouver Performance Analysis – The analysis of the west-side of Vancouver includes Fire Halls 10, 12, 18, 19, 21, and 22.

While performance and reliability downtown and in eastern Vancouver was reasonably good, the west-side of Vancouver is more problematic. Only one fire hall (12) is above the 80 percent performance reliability goal. The other fire halls do not meet the performance reliability threshold when a unit from the first-due station responds (has 100 percent availability). This means that the problem is either a station location issue or a workload issue.

When looking at a map of fire halls in the area, it is clear that the stations are spaced out more than in other parts of the city. Likely, this is leading to the missed travel times throughout this area of the city. The current policy where units from Fire Halls 12 and 18 are used to fill other halls to backfill for training is compounding the problem. Recommendations to remedy the situation are discussed later.

Figure 25: Reliability and Performance Analysis, West-Side of Vancouver



	Unit Availability	Overall Performance	1st-Due Performance	2nd-Due Performance	Responses
FH10	94%	71%	73%	41%	867
FH12	96%	82%	83%	68%	1395
FH18	90%	73%	73%	66%	1180
FH19	90%	72%	75%	45%	509
FH21	94%	71%	73%	47%	1102
FH22	94%	77%	79%	50%	1396

Detailed Workload Analysis – For the analysis we also looked at the call volume and workload for each fire hall and unit. As explained in previous section, these factors affect performance and reliability. For example, a fire hall with a high workload (such as Fire Hall 2) might continue to meet its goals because other nearby halls can also cover the area adequately. Other areas however, (Fire Hall 5) are more susceptible to workload increases because of the larger distance between stations.

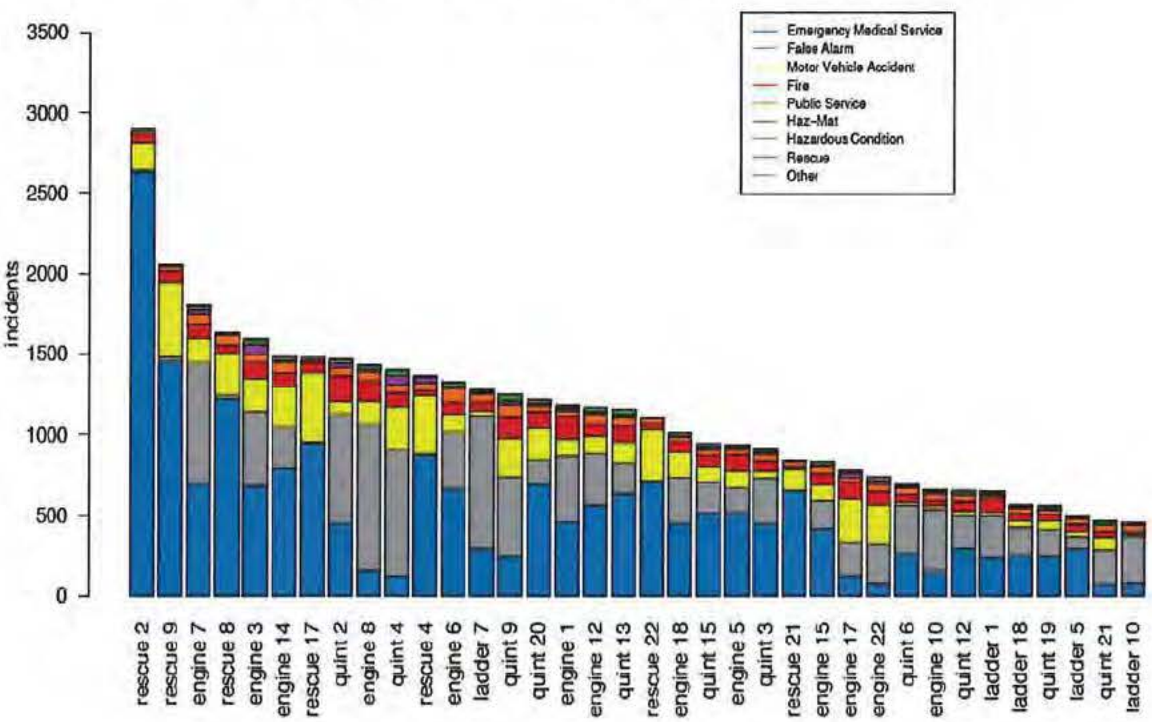
In the following section we show the call volume followed by the workload comparisons for each unit and fire hall. Charts depicting workload also show the type of calls handled. Data from 2007 and 2008 were used for the comparisons.

Table 29: Responses by Station and Unit, 2007–2008 Average

	engine	ladder	quint	rescue	station total
1	1180	646	0	0	1826
2	0	0	1466	2899	4365
3	1592	0	912	0	2504
4	0	0	1399	1360	2759
5	935	497	0	0	1432
6	1324	0	691	0	2015
7	1804	1275	0	0	3079
8	1428	0	0	1632	3060
9	0	0	1247	2051	3298
10	655	454	0	0	1109
12	1168	0	652	0	1820
13	0	0	1157	0	1157
14	1482	0	0	0	1482
15	831	0	940	0	1771
17	778	0	0	1476	2254
18	1011	566	0	0	1577
19	0	0	557	0	557
20	0	0	1213	0	1213
21	0	0	468	834	1302
22	737	0	0	1108	1845

With two units, Fire Hall 2 is the busiest in the city followed by Fire Hall 9. Fire Hall 19, which has only one unit, was the least busy during the period 2007–2008.

Figure 26: Responses by Station and Unit, 2007–2008 Average



Rescues 2 and 9 were the busiest units in the city during this period. Next to medical calls, false alarms accounted for a high number of responses in many areas of the city. For example, in Figure 27, Figure 28, and Figure 29 we show the average workloads and responses by unit and fire hall.

Figure 27: Workload (Unit Hours) by Unit, 2007–2008 Average

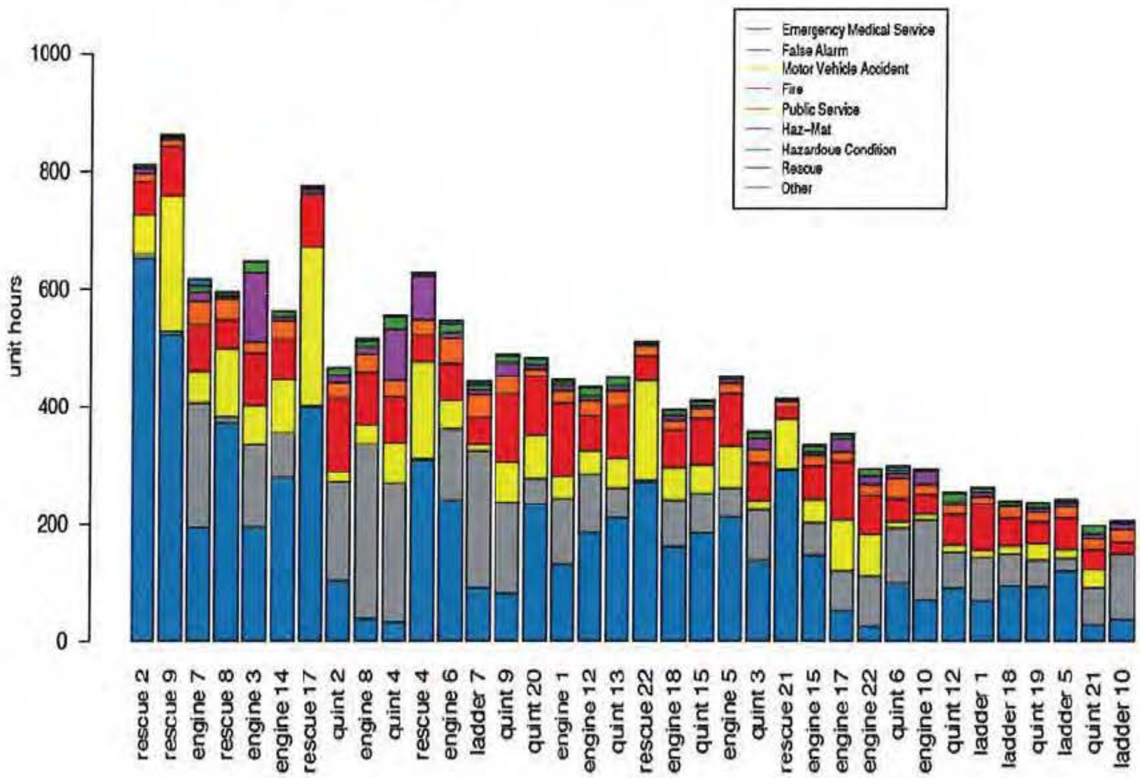


Figure 28: Workload (Responses) by Station, 2007–2008 Average

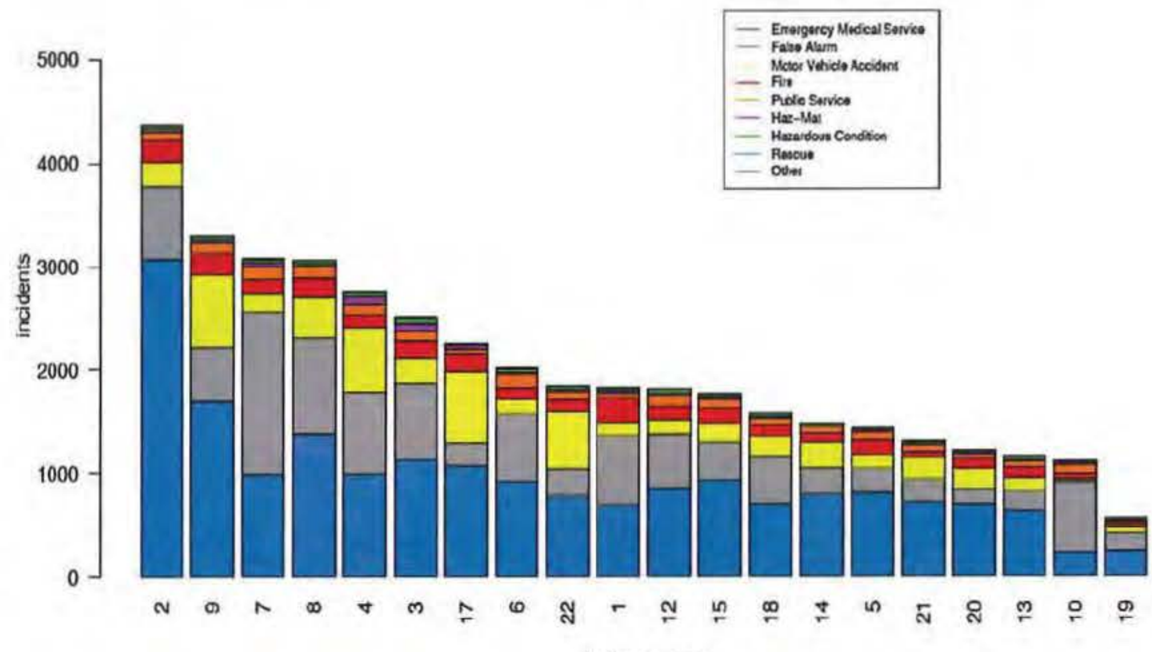
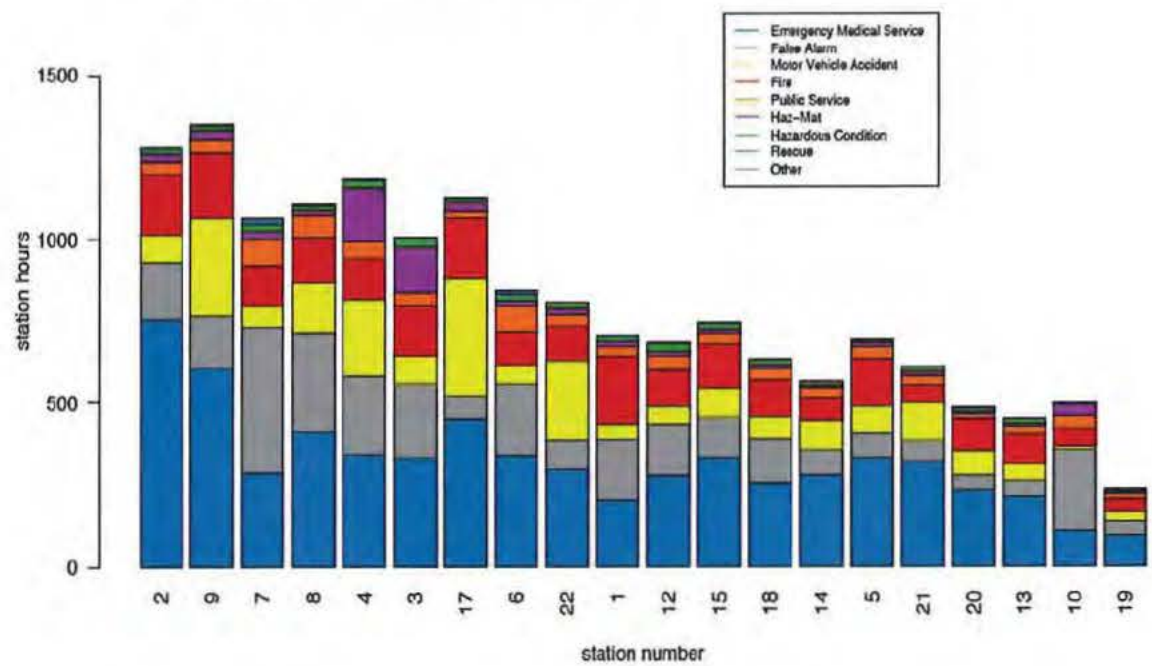


Figure 29: Workload (Unit Hours) by Station, 2007–2008 Average



In Figure 30 and Figure 31 the density of fire and medical incidents are shown by planning area.

Figure 30: Fire Incidents by Planning Area

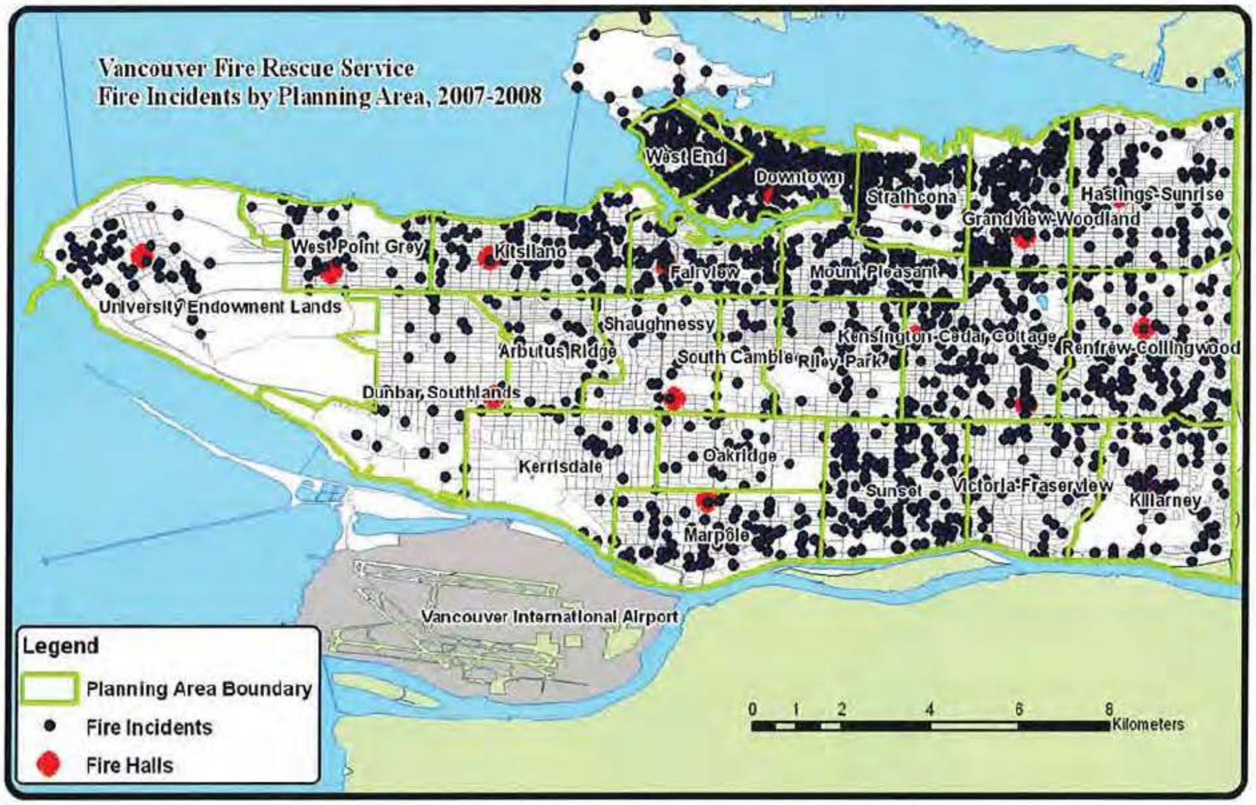
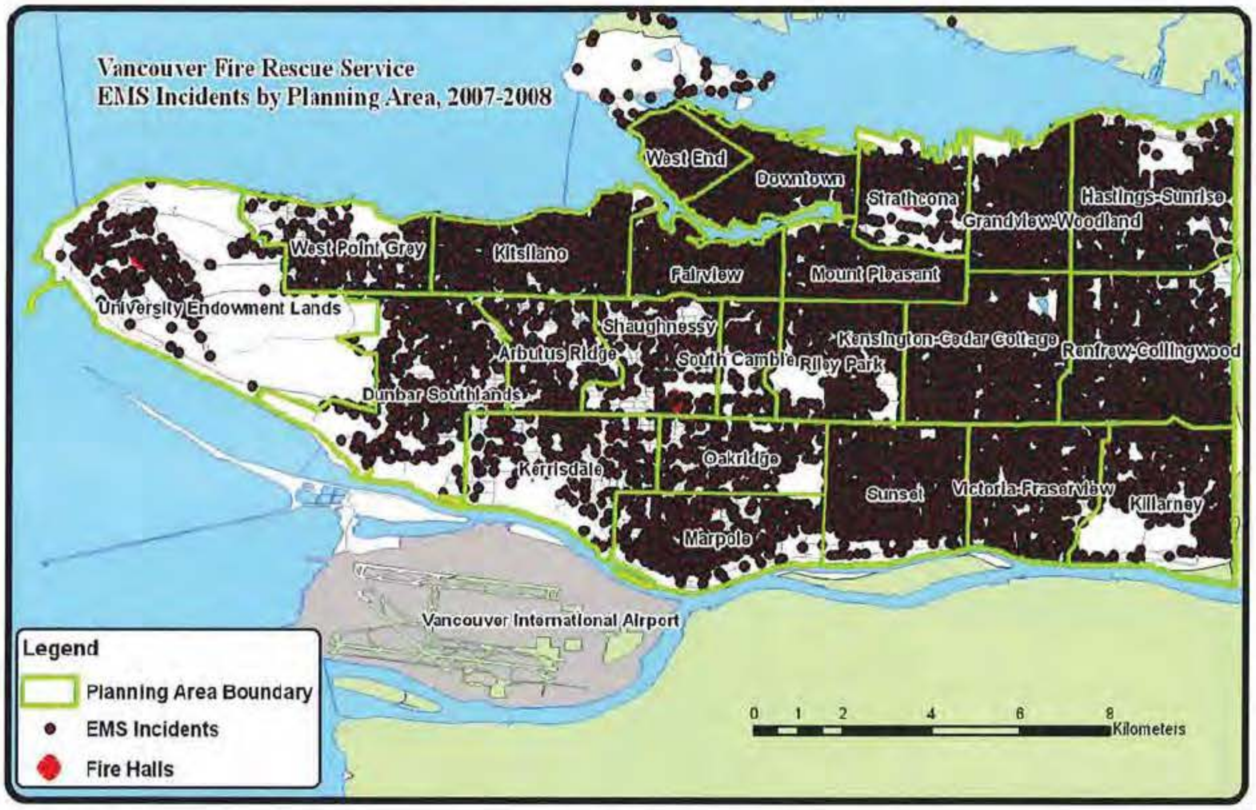


Figure 31: EMS Incidents by Planning Area



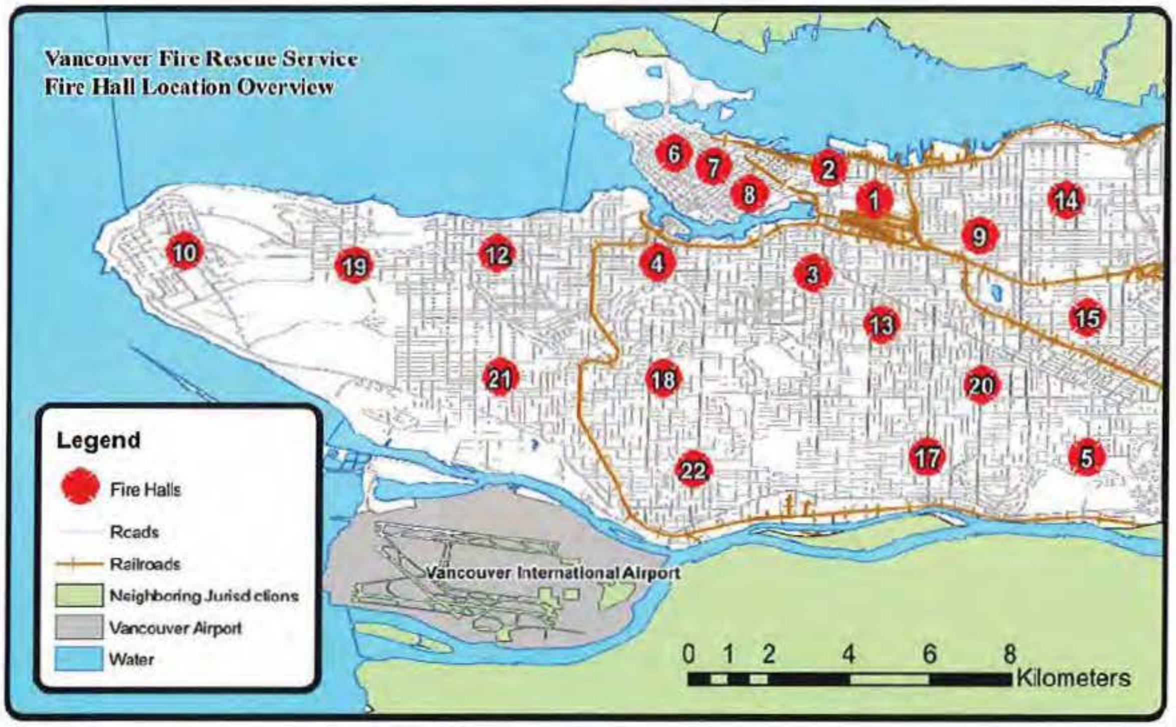
Clearly, the highest densities of fire incidents occur in the Downtown area and planning areas adjacent to it. Medical incidents are more evenly distributed but less dense in the south western portion of Vancouver.

Assessment of Fire Hall Locations

In the following section we review the analysis of fire hall locations using Geographic Information Technology (GIS). For the analysis we used ArcGIS 9.3. Layers for the analysis were provided by the city's planning department. In addition to the GIS analysis, we also visited each fire hall at least once to get a feel for its location and overall condition. This allowed us to understand the location of the fire halls relative to the area protected, not just from a GIS map.

Figure 32 shows the current location of Vancouver's 20 fire halls.

Figure 32: Current Fire Hall Locations

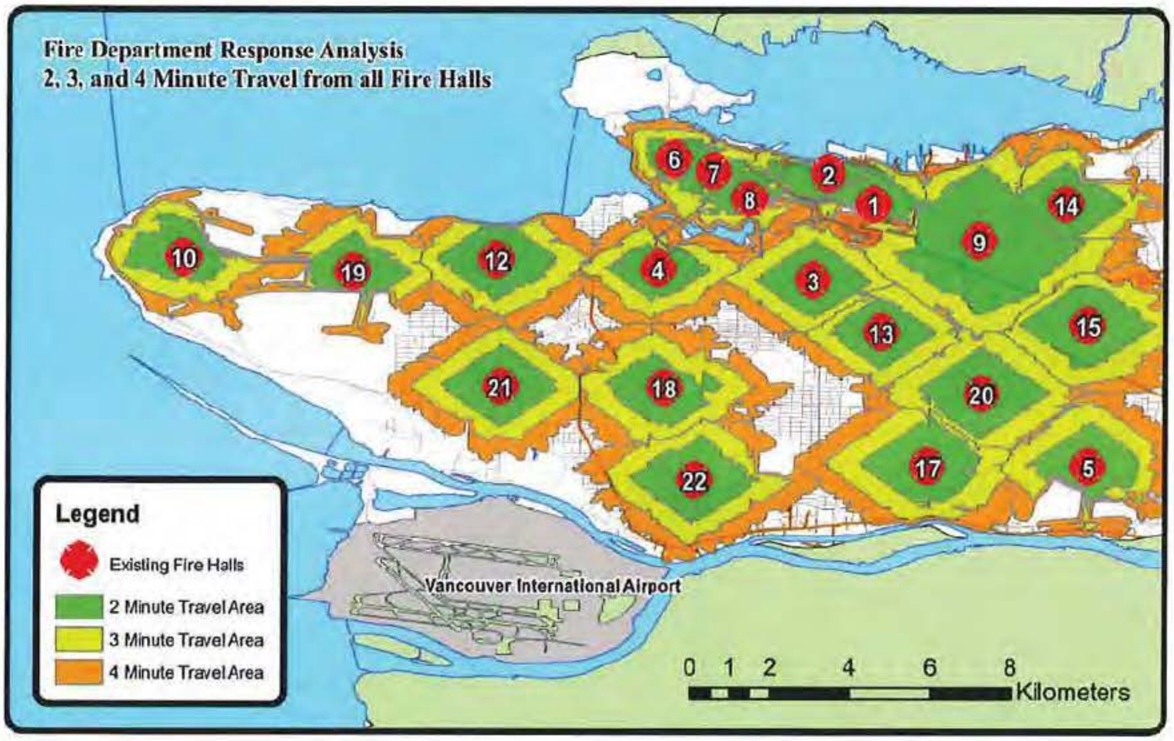


As stated at the outset of this chapter, the overall configuration of fire halls is fairly good. The higher density of fire halls within the downtown is appropriate considering the higher population and call density and greater risks requiring multiple unit responses. In most areas of the city, a fire hall is within four-minutes of another fire hall, thus providing an overlap of coverage, which is appropriate. The exceptions are the area bordered by Fire Halls 10, 19 and 21 and a small area between Fire Halls 13 and 18.

The higher density of fire halls downtown is justifiable because fire risk and call volumes are higher. The analysis shows that downtown has a theoretical response time of three-minutes at the 80 percentile travel time. A "theoretical" response time is based only on the location of the fire hall and not on the workload (busyness factor) of the units assigned to the hall.

Figure 33 shows the theoretical travel time from each of the city's 20 fire halls. Areas in green can theoretically be reached in two minutes, yellow in three minutes, orange in four minutes. Areas depicted in white are beyond a four-minute travel time of a fire hall. If an area has few calls or a majority of calls in the area beyond a four-minute reach are usually minor in nature, longer travel time may be justifiable. In the sections that follow, we discuss particular areas with coverage gaps.

Figure 33: Two, Three, and Four-Minute Travel Time Analysis



Gaps in Fire Hall Coverage: The analysis resulted in four key findings regarding fire hall coverage:

1. Grid-based fire hall locations found on the west side of Vancouver do not produce the best coverage when multiple fire halls are considered. Fire halls including 4, 12, 18, and 21 are almost in a perfect straight-line grid. Although the grid pattern is sometimes assumed to be good, a better pattern is a triangular or 'spoke and hub' pattern. This can be seen on the east side with Fire Halls 5, 13, 15, 17, and 20.

2. A change in the spoke and hub pattern on the east side to the grid-based pattern on the west side has produced a transition gap. As can be observed in Figure 33, a particularly large gap is evident between Fire Halls 22, 18, 4, 3, 13, and 17. This area should be addressed at some point in the future as fire halls are rebuilt. The slightly longer response time and lower demand found in this area does not justify adding a new facility to cover the gap in coverage.

3. Low demand in areas around Fire Halls 10, 19, and 21 do not warrant additional facilities to cover the response time gap. Demand in these areas is sparse and a new station is not needed now. However, the situation should be monitored in the years to come.

4. There are small coverage gaps along the city's border. These are typical for most communities because having enough fire halls to provide total coverage would be inefficient. The gaps are mostly around Fire Halls 5, 14, and 15. One way to improve coverage in these areas is to use automatic aid from a neighbouring jurisdiction able to cover the area from an existing fire hall.

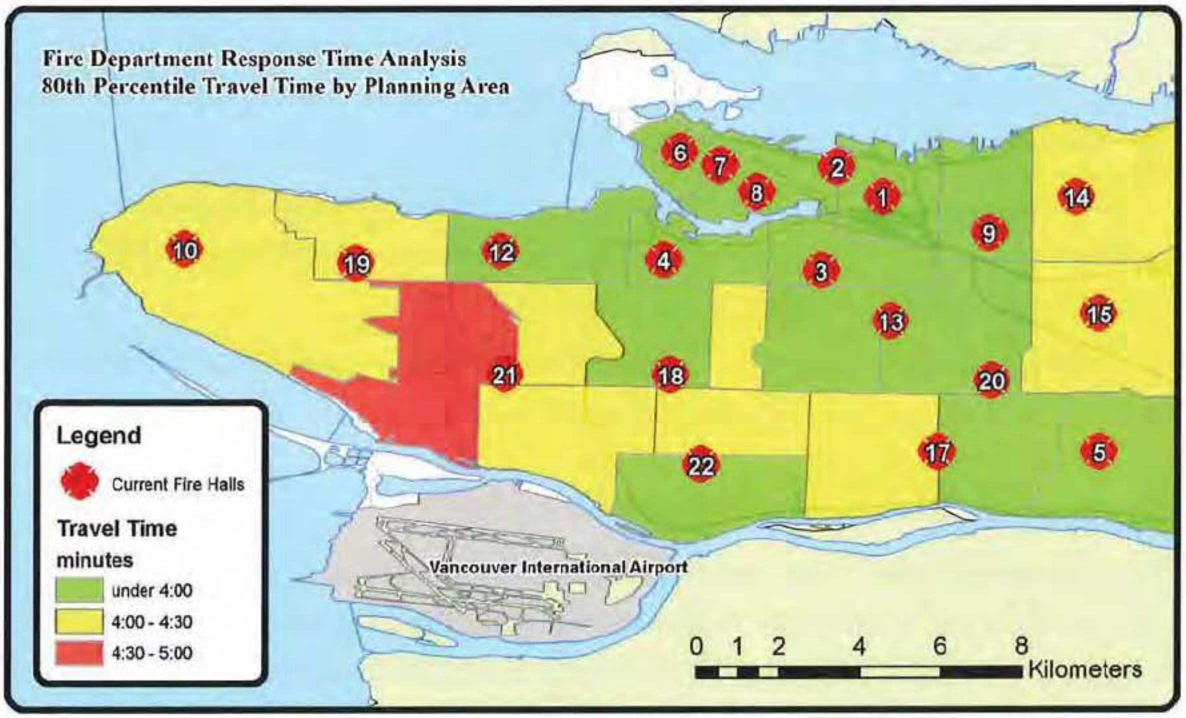
Demand and Fire Hall Coverage – As discussed, a four-minute travel time recommended by NFPA 1710 is a reasonable standard. However, the standard should not be adopted blindly without considering other factors.

Fire brigades in England have moved away from rigid standards of cover towards making deployment decisions for individual neighbourhoods or areas based on risk rather than just standards. Likewise, the CPSE recommends that communities develop performance goals for individual planning areas since each situation is different.

For example, the coverage gap located in the middle of Vancouver may make it unreasonable to move a fire hall or build a new one if the improvement is only by 30 seconds. We found this to be the case during this study and only the Dunbar Southlands planning was above the 80th percentile four-minute travel goal by more than 30 seconds.

Figure 34 shows the theoretical 80^{th} percentile travel times for each of the city's 23 planning areas.

Figure 34: Travel Time by Planning Areas, 2007–2008



Fire and EMS Call Density and Travel-Time Gaps: We also looked at call densities for both fires and medical calls. In Figure 35 and Figure 36, we show the coverage gaps overlaid on the call density maps. The grey shape with darkened border shows those areas where travel times from a current fire hall are over four minutes.

Figure 35: Fire Density and Travel-Time Gap Analysis, 2007–2008

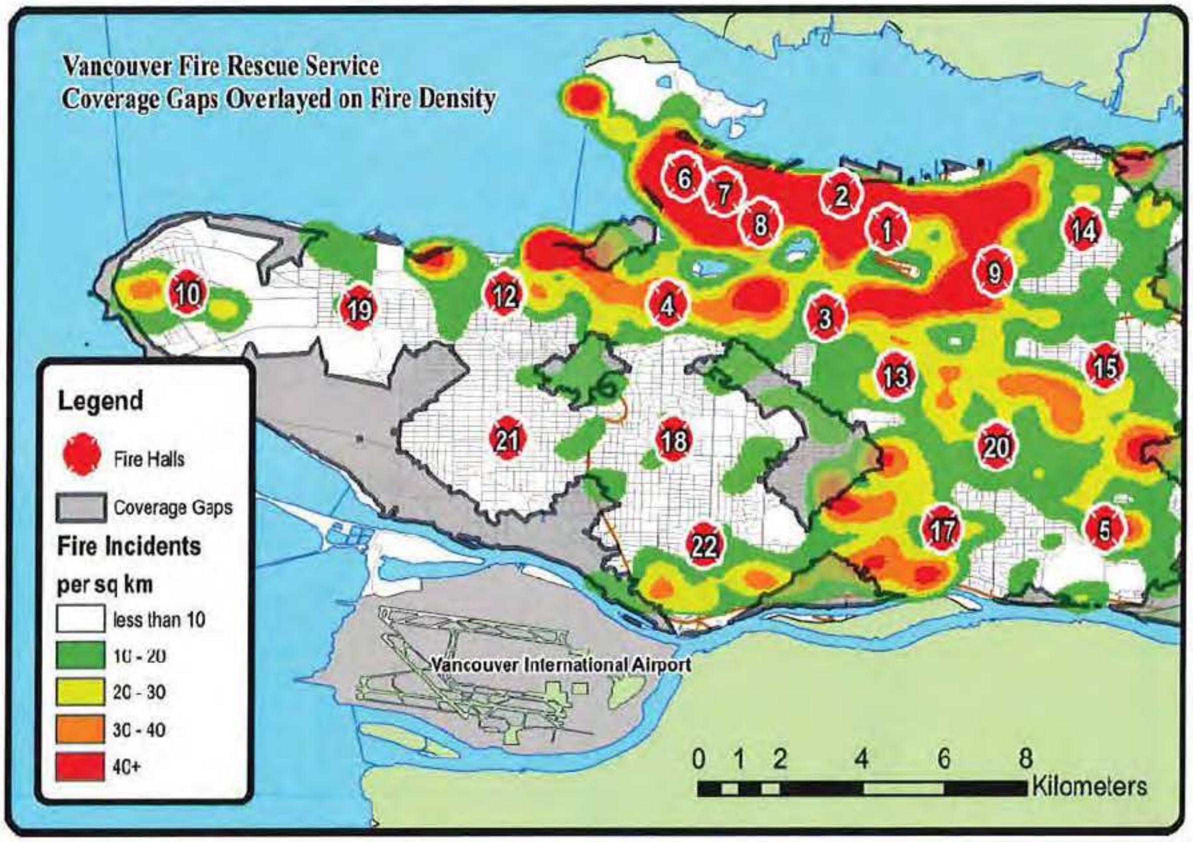
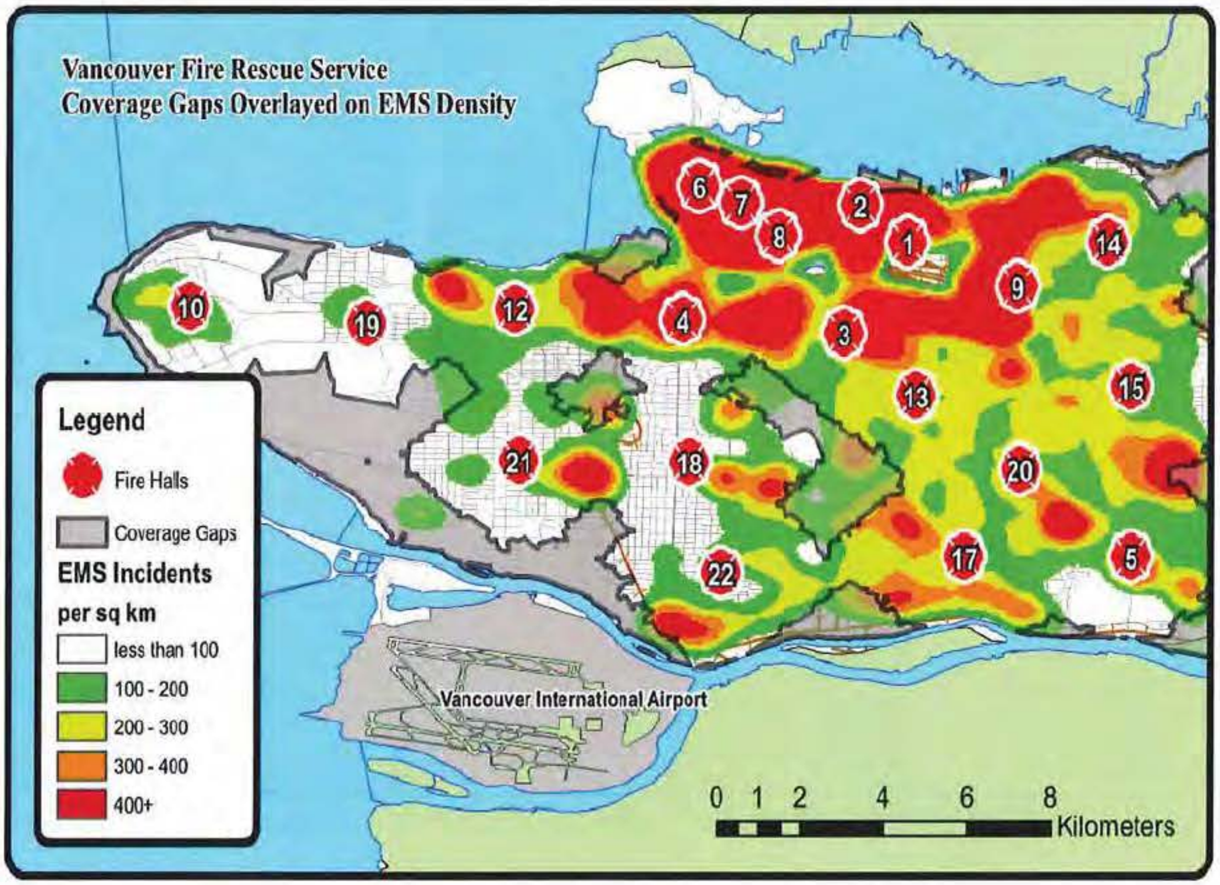


Figure 36: EMS Call Density and Travel-Time Gap Analysis, 2007–2008



Three areas of concern were found during the analysis. These should be considered by VFRS as part of it future planning efforts.

1. The coverage gap between Fire Halls 22, 18, 4, 3, 13, 20, and 17 is fairly considerable with fire and EMS demand being particularly high in the area adjacent to Fire Hall 13. The gap in coverage is also in the Sunset planning area which was found to be a high fire and EMS risk area. Planning efforts should include ways to address this area.
2. A demand hotspot exists in southeastern Vancouver between Fire Halls 5 and 15. However, the coverage gap here is very small and most incidents will be handled within a reasonable response time from Fire Halls 5 and 15. The situation should be monitored closely.
3. There is a demand hotspot located between Fire Halls 12, 18, and 21. The coverage gap here is fairly small but the demand is high. Although a new fire hall to cover this

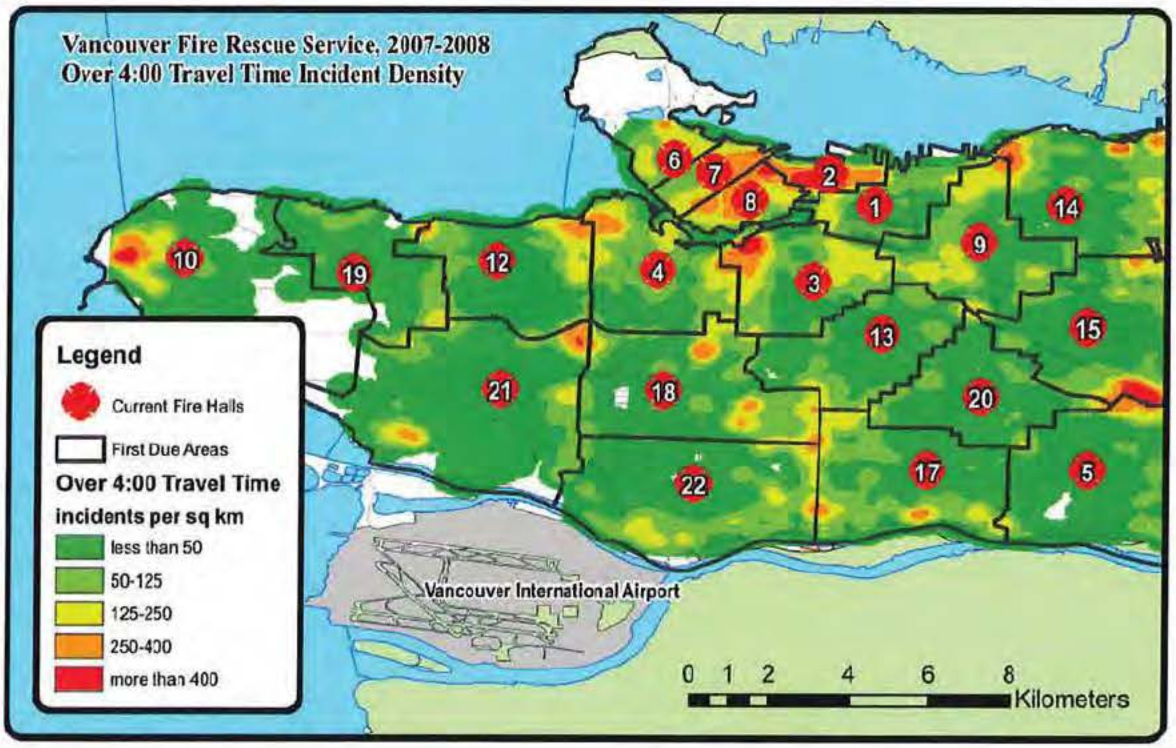
area is not immediately needed, planning should include possible changes to the location of Fire Halls 18 and 21 and adding a new hall (23). This change is discussed later.

Missed Travel Time: We also evaluated the planning areas to determine where a four-minute travel time goal was not achieved.

The area northwest of station 17 has some widespread issues with missed travel times, but no extreme hotspots (in red). The big problem areas are the eastern Vancouver city limit between Station 5 and 15, the False Creek South, west of Station 10, and the area around Station 2. The Station 2 and Station 10 hotspots are likely the result of simultaneous calls rather than station location; very high call volumes during peak-load times of the day. This situation occurs mostly during weekdays.

Figure 37 shows the density of incidents by planning area.

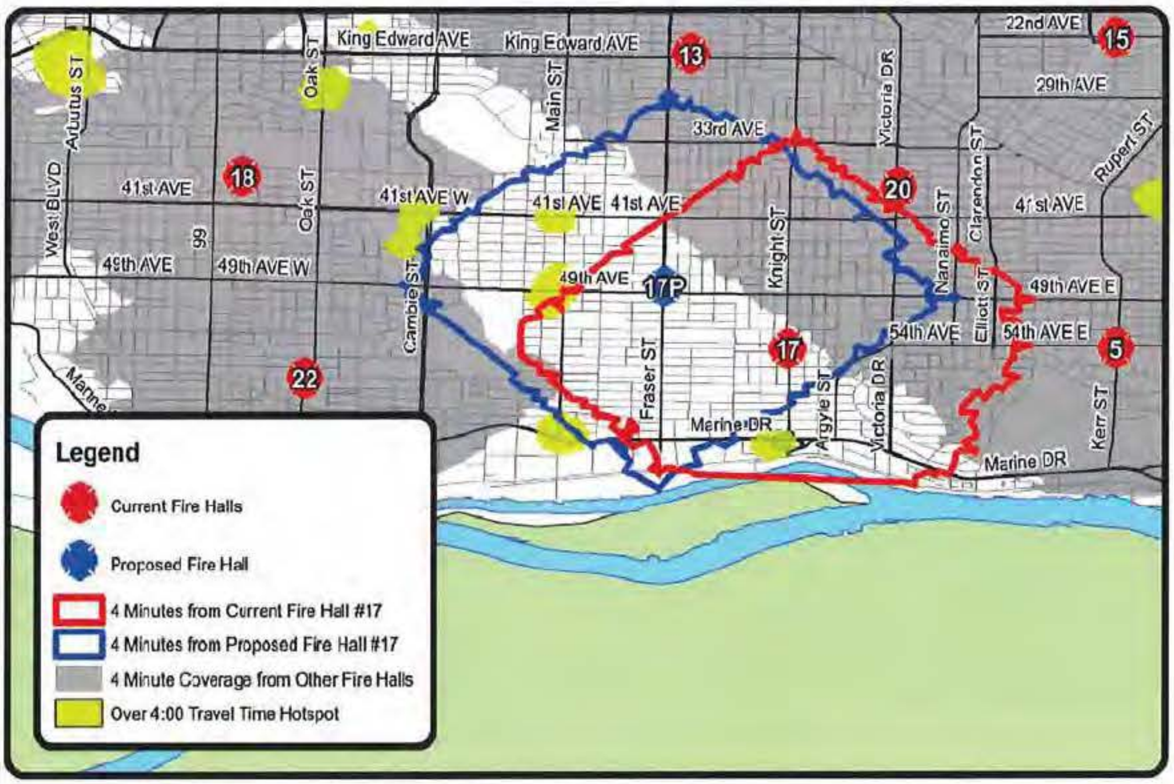
Figure 37: Density of Incidents Where Four-Minute Travel Time Goal Was Not Achieved



Proposed Fire Hall Location Changes – The analysis suggest the following changes to future fire hall locations.

Move Fire Hall 17: The first of these changes is to move Station 17 to the middle of the Sunset planning area. This move would serve to slightly close the large, central coverage gap while and provide a higher level of coverage to EMS and fire hotspots in the high-risk Sunset planning area. Station 17 is recommended in this study for replacement, so this could be done at that time. Figure 38 shows the general area for a better location.

Figure 38: Current and Proposed Locations, Fire Hall 17

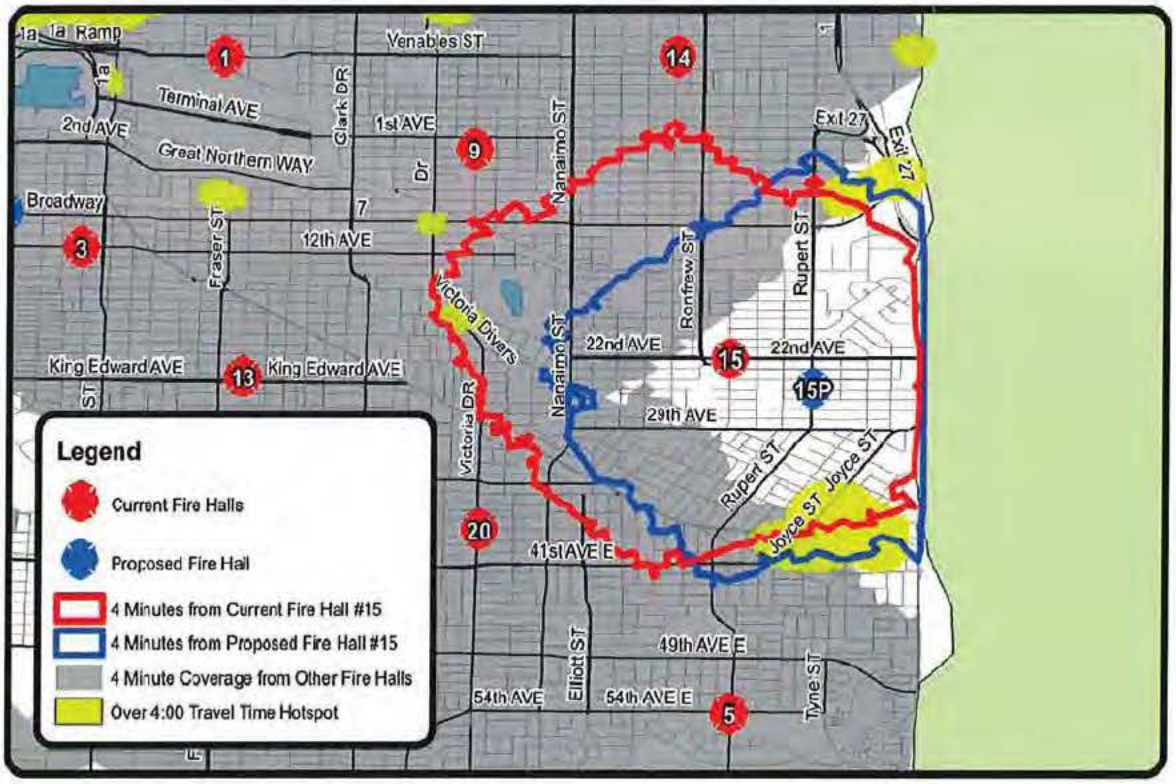


Move Fire Hall 15 or Change Fire Hall 5's First-Due Area: Fire Hall 15 is not in the best location, coverage wise for the calls and hot spots in the district. However, the facility was already being rebuilt on its present site, so it does not make sense to move it. Another option is to look at changing the response area such that Fire Hall 5 covers more of the area currently covered by 15.

The GIS analysis shows that 15 is not far from the problem area, but the streets here switch from a north–south, east–west grid where Fire Hall 15 is located to a diagonally oriented grid where the fire and EMS hotspot is located. Using major roads from Fire Hall 15 to this area would require a large zigzag pattern that would keep speed up, but increase travel distance. You could take smaller neighbourhood roads, but we were informed that this area has very tight streets. In order to improve Fire Hall 15's travel times to the problem area you really have to move it slightly southeast.

Figure 39 shows how the move of Fire Hall 15 would improve coverage. It also reduces overlap between it and adjacent fire halls 9 and 20.

Figure 39: Current and Proposed Locations, Fire Hall 15

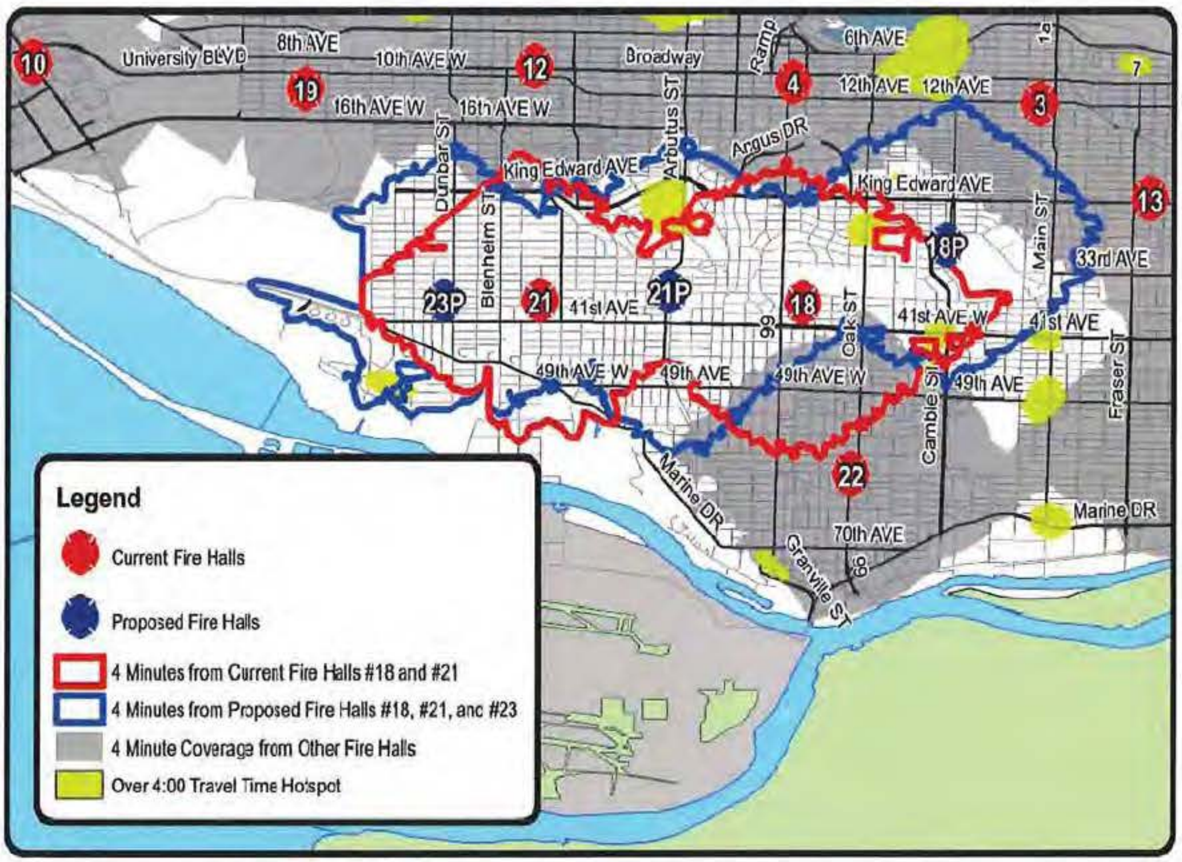


Major roads in the problem area are oriented in such a way that Fire Hall 5 has more of a straight shot into the problem area. Although Fire Hall 5 is close to falling under the 80 percent performance reliability level, it still might more sense to adjust the first-due boundaries so that Fire Hall 5 is responsible for the hotspot area. Using this option, it may be necessary to try and pass some workload off to Fire Hall 20.

Add a New Station and Reconfigure Fire Hall Locations on the west-side of Vancouver: In the future the city may need to consider adding a new station on the west-side of Vancouver and change the pattern of fire hall locations. Adding a new station would not require additional personnel because an existing unit from one of the current stations could be placed in the new facility.

The proposed plan would move Fire Halls 18 and 21 and then add a new hall (23), which would be located west of the current Fire Hall 21. Figure 40 shows the approximate location of the new stations and the triangular pattern created if the plan were implemented.

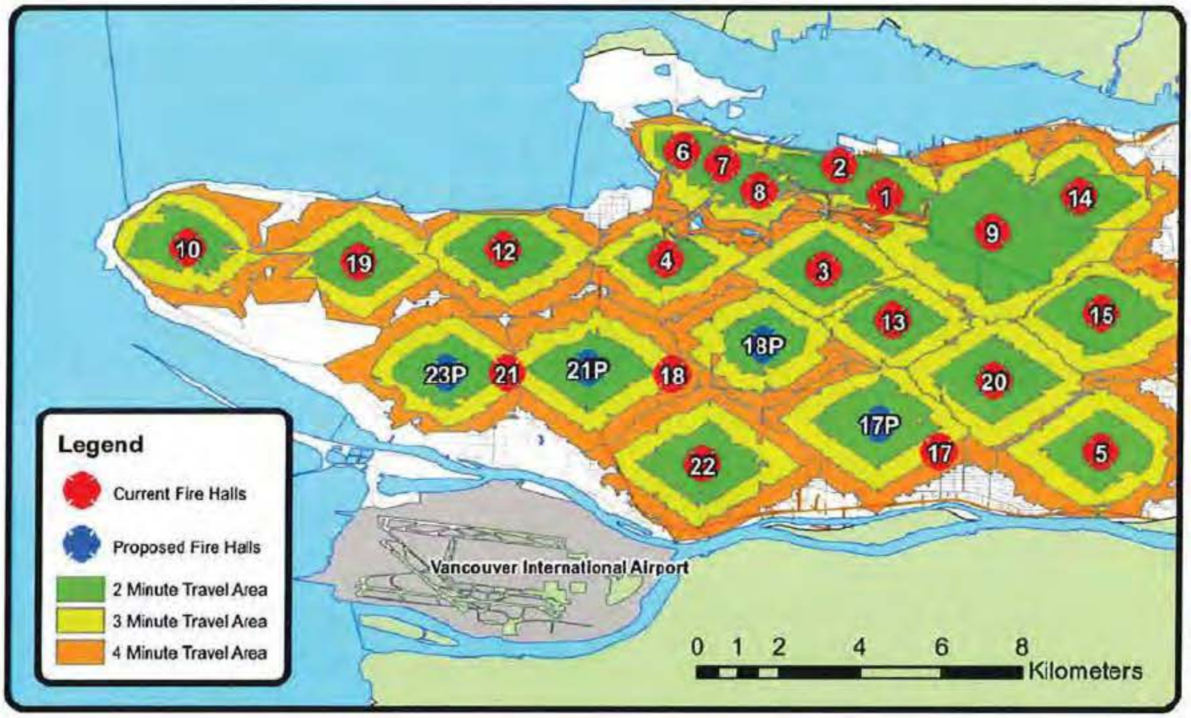
Figure 40: Current and Proposed Locations, Fire Halls 18 and 21



Summary of Proposed Fire Hall Location Changes – Overall Vancouver has reasonably good coverage from its fire halls; however, the analysis shows a few areas where fire hall locations can be improved for better coverage and response time. In several instances however, these affect new stations such as Fire Hall 18. For this reason the city will probably want to retain the location of newer facilities, and then address any problem areas as fire halls are replaced.

Figure 41 shows all the proposed changes along with the theoretical travel times from these stations.

Figure 41: Proposed Fire Hall Locations



The one change the city should consider now in terms of fire hall locations is to relocate Fire Hall 17. The large area of demand in the middle of the Sunset planning area and 17 is too far east to provide really good service to this area. Fire Hall 17 is recommended for immediate replacement in the facilities review portion of this study and it makes a lot of sense to go ahead now with its relocation.

Recommendation 16: Relocate Fire Hall 17 slightly north and west of its present location.

Recommendation 17: Evaluate whether Fire Hall 5's area can be extended to improve performance in 15's area since Fire Hall 15 is already being renovated on its present site.

Recommendation 18: If future demand warrants, consider adding a new station (23) west of Fire Hall 21. At the same time plan for 21 and 18 to be moved eastward to cover a gap that exists between 18 and 13.

Apparatus Location Analysis

At the time of this study 36 units were deployed to the 20 fire halls. Included were 13 engines, 5 ladders, 11 quints, and 7 rescues. To handle the additional volume of calls, of which medical calls will be the majority, this study recommends three additional rescues and three fire units during weekday periods when call volumes and training activities are the highest. The primary need for these units is to improve service reliability and response times, particularly in busy areas of Vancouver.

In addition to fire hall locations, the consideration of what types of units should be located also comes into play. There are no perfect apparatus deployment plans and the final decision of where to place units has many variables, including whether the hall can accommodate the unit and its personnel.

In the following section we review the location of major apparatus, including engines, ladders, and rescues. For the purpose of our review we did consider quints primarily as engines even though they are also used as ladders during operations. Likewise we only analyzed major apparatus such as engines, quints, ladders and rescues and not supplemental equipment like wildland firefighting vehicles or hazmat units. The reason is that these units do not have dedicated staffing and they can be located at any number of stations depending on the prevailing need.

Aerial Ladder Placement – Ladder companies are typically considered part of the complement when responding to fires and other multi-unit emergencies. According to NFPA 1710, the complement should arrive within 10 minutes of the initial emergency call. In this section, we have mapped out 8 minute travel areas which allows for a one minute call processing time and a one minute turnout time to achieve the desired 10 minute response

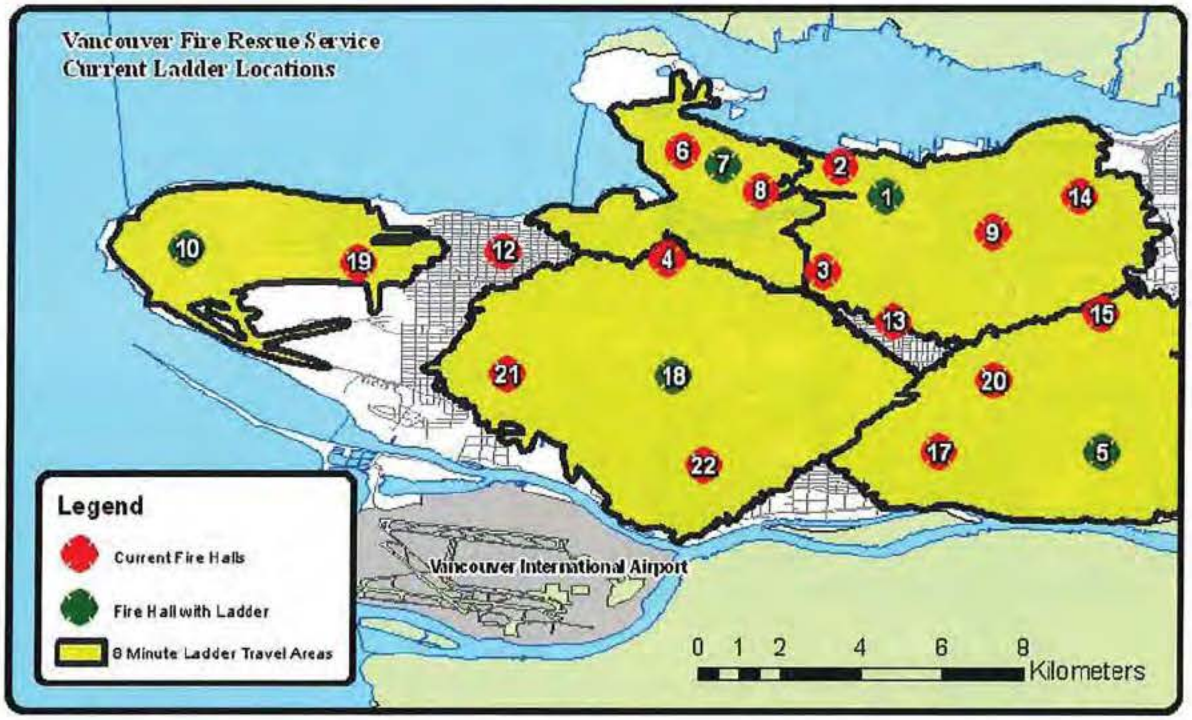
VFRS has many quints that can operate both as a pumper or an aerial unit. We have chosen not to include the quints in the ladder placement analysis because they are not a dedicated ladder company and, based on when they arrive at a fire, might be committed to pumper operations. The ultimate goal was to have one of the city's primary ladder companies arrive within the prescribed 10 minute travel goal. Where quints are co-located with engines, these units provide extra ladder coverage. The placement of quints will be discussed later in the chapter.

Aerial Ladder Locations – Aerial ladder units are currently assigned to five halls: 1, 5, 7, 10, and 18 and most areas of the city are well covered.[19] There are small areas near Fire Halls 13 and 14 with small areas beyond the eight minute travel-time goal. A much larger gap is found between Fire Halls 12, 19, and 21. However, there are quints located at Fire Halls 9, 12 and 13 which can cover these areas within the eight-minute goal.

[19] At the time of this study, VFRS also placed a ladder at Fire Hall 14. This aerial ladder will be moved to Fire Hall 15 when that hall's renovation is complete.

Figure 42 shows this arrangement of aerial ladders and their eight-minute theoretical coverage according to the GIS analysis.

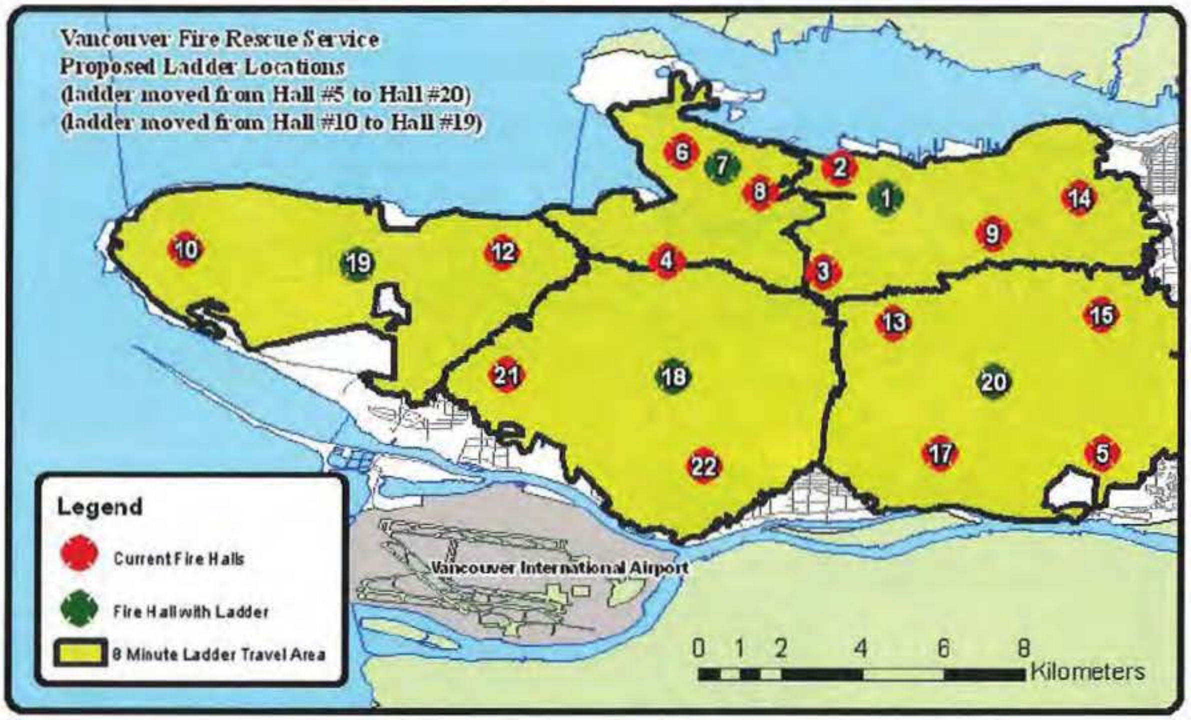
Figure 42: Current Ladder Locations



To provide adequate aerial ladder coverage and lower the number of quints, the analysis shows that the ladder from Fire Hall 10 can provide better coverage from 19. At 19, the area around UBC would still get an aerial ladder within eight minutes and the gap between 19 and 21 is significantly reduced.

Another option is to move the aerial from Fire Hall 15 to 20 and eliminate the ladder from 5. However, this move will require a renovation to Fire Hall 20, a recommendation that is made in our facilities review for this study.

Figure 43: Proposed Ladder Locations

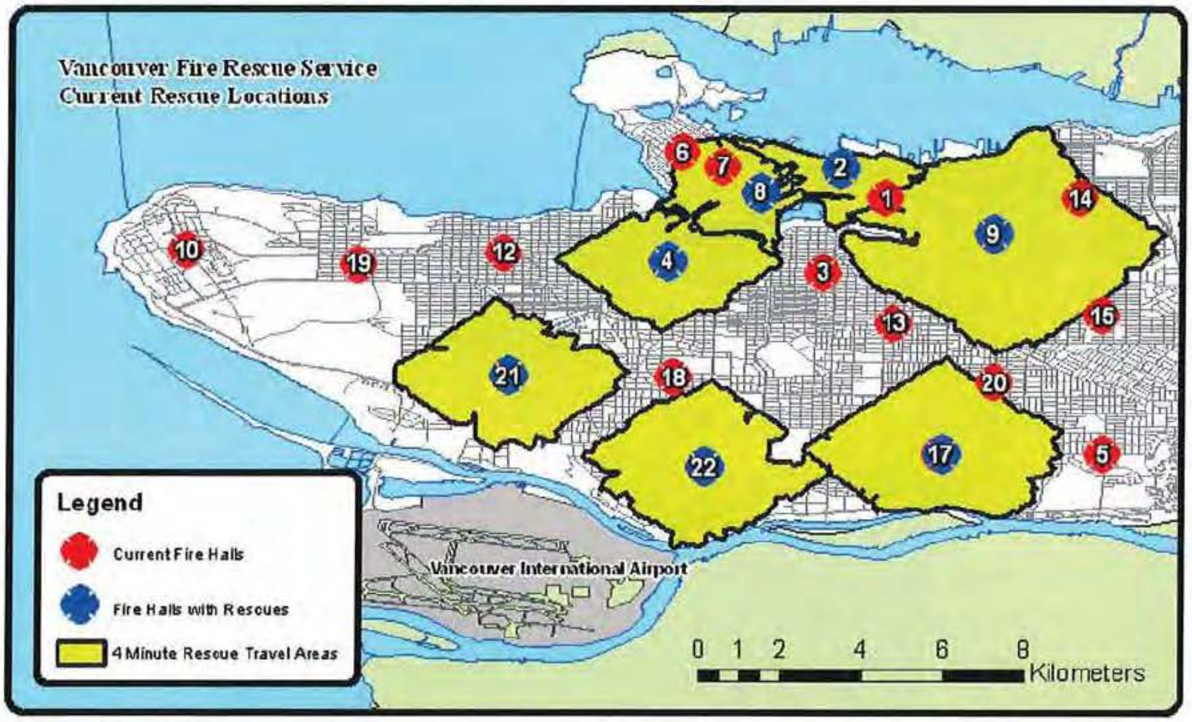


As can be seen in Figure 43, moving aerial ladders from Fire Hall 15 to 20 and 10 to 19, the city is almost entirely covered within the suggested goal. Quints at Fire Halls 3, 5, 6, 9, 12, 13, and 21 would augment these aerial ladders.

Recommendation 19: Deploy five aerial ladders city-wide, one each at Fire Halls 1,7,18, 19, and 20. Until Fire Hall 20 is rebuilt, maintain the aerial ladder at Fire Hall 5.

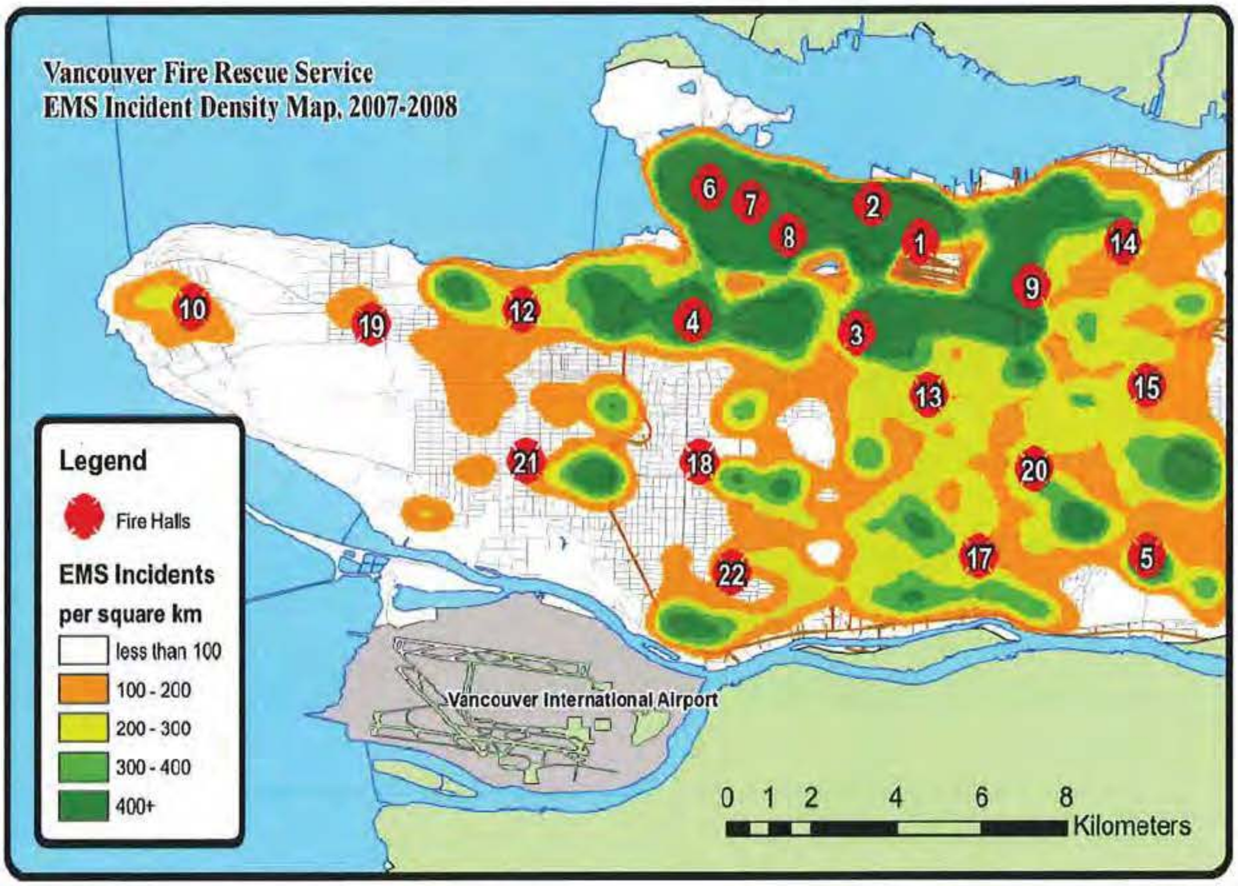
Rescue Locations – Rescues are specifically equipped and staffed to provide medical first response. For that reason, it makes the most sense to place the rescues in areas where medical incidents are highest. VFRS currently has seven rescues; one each assigned to Fire Halls 2, 4, 8, 9, 17, 21, and 22. Figure 44 shows the current location of rescues and the recommended four minute travel time.

Figure 44: Current Rescue Locations



For the analysis we considered whether rescues are in the optimal locations considering medical calls and the performance of the particular area with respect to reliability. To do this we looked at the density of medical calls which can be seen in Figure 45.

Figure 45: EMS Incident Density



Rescues at Fire Halls 2, 4, 8, and 9 are located in areas with very high medical call demand. Rescue 17 is not in an EMS hotspot, but covers an area where medical calls are moderate.

Rescues at Fire Halls 21 and 22 are another story. These units are not located in areas of high EMS demand. However, these stations are under the 80 percent performance reliability goal, which means they often do not meet the four minute travel goal within their area. If the engine at 21 or the quint at 22 is busy, a unit from another hall would be unable to get to the scene within the desired goal.

We also conducted an analysis of how often simultaneous calls occur in each of the first-due areas. Fire Hall 2 has almost 600 simultaneous calls a year which works out to 2–3 calls per day. For such an area, multiple rescues make sense to handle the call load. On the other hand, Fire Halls 21 and 22 had 68 and 110 simultaneous calls respectively. The combination of one simultaneous call every three days and the longest distance to a second station means that a rescue at 22 makes sense. However, Fire Hall 21 only has one simultaneous call every five days and the area is a low fire and EMS risk. For these reasons VFRS should evaluate whether the rescue is needed at 21, or if the unit would be more effective elsewhere. One possibility is Fire Hall 3 which is an area of high demand.

The operation section of this report recommends three additional rescues be deployed during weekdays to handle peak-load demand. The locations for these units are Fire Halls 1, 2, and 7. However, we also recommend these units be 'dynamically deployed' e.g., moved where most needed as the situation warrants.

The performance improvement realized by adding the extra rescue units is difficult to measure because the units are slated to move around the city based on demand hot spots and as the situation dictates. For this reason we did not analyze the impact of the additional rescues, but the fire department should if they implement the recommendation. We discuss these peak-load units and the staff required for them later in this report.

Recommendation 20: Deploy seven rescues 24/7 at Fire Halls 2, 4, 8, 9, 17, 21, and 22. For weekday periods add three rescues, one each at Fire Halls 1, 2 and 7. As an alternative, the rescue at 1 might be located at 3.

Hall-by-Hall Summary Review

In the following section we provide a hall-by-hall review of our analysis and we summarize the rationale for the fire hall location or apparatus changes recommended by this study.

Fire Hall 1 – The workload for this hall is moderate and the engine and ladder truck here provide good coverage. The coverage in Fire Hall 1's area is not only good from the units from this hall but also from the second-due units as well (9 and 2). The ladder provides good coverage for northeast Vancouver including the areas covered by Fire Halls 9 and 14. The ladder also provides good coverage to parts of downtown as a second ladder in support of Ladder 7. No changes are recommended for Fire Hall 1; however, we do recommend a peak-load rescue here because of the high volume of medical calls downtown and nearby areas covered by 3 and 9. An alternative is to locate the peak-load rescue at 3 instead of 1.

Fire Hall 2 – The workload of Fire Hall 2 and the demand in its first-due area is extremely high. Currently assigned a quint and a rescue, the rescue is the city's busiest unit and the quint is not far behind. Service reliability in this area is very good and the theoretical response-time coverage is good not only from 2 but also from Fire Hall 8, which is usually second-due. The quint at this hall can be replaced by an engine since aerial ladders at Fire Halls 1 and 7 can easily cover this area. To improve service reliability downtown, a peak-load rescue is suggested here, partly because the hall should be able to accommodate the extra unit, especially if an engine replaces the existing quint. Adding the extra rescue should also reduce the number of medical calls handled by the quint (or engine) thereby making it more available for fire calls in this high-risk area of the city.

Fire Hall 3 – This fire hall is currently assigned one quint and one engine. Although service reliability in this area is good now, second-due units from surrounding fire halls are unable to reach this area within the four minutes which makes the area sensitive to periods when high demand occurs. With a performance reliability of 83 percent, additional calls will probably put this hall under the 80 percent performance threshold. The addition of the peak-load rescue at Fire Hall 1 should help, especially since development in False Creek South is expected to increase medical calls. Another option is to locate the peak-load rescue slated for Fire Hall 1 at 3, because of the high EMS demand in 3's area. The staffing plan depicted later in this report shows the staffing for the additional rescue to be at Fire Hall 1, however.

Fire Hall 4 – With one quint and one rescue, this hall has good reliability performance and second-due halls into this area can achieve a four-minute travel time goal 75 percent of the time if units at Fire Hall 4 are busy. The workloads for quint and rescue 4 are only moderate and ladder coverage for this area is available from Fire Halls 7 and 18. Therefore, the quint at this hall could be replaced by an engine. If the ladders from 7 or 18 are unavailable, quints at the adjacent halls of 3 and 12 can also cover 4's area within the recommended time.

Fire Hall 5 – One engine and one ladder are assigned to this fire hall, which has a low workload. The second due halls into the response area include 15, 17, and 20. Of these, Fire Hall 15 also has two units (engine and ladder). Performance reliability for this area is currently 83 percent but with additional demand it could fall below the 80 percent threshold. Our analysis shows that Fire Hall 5 could probably handle its present workload with one unit; however, the area is sensitive since surrounding halls are unable to meet the 80 percent reliability factor if Fire Hall 5 is unavailable. Workload for this area is not very high now, but significant high-rise development is planned along Marine Drive and this will increase calls, primarily medical.

Everything considered Fire Hall 5 can operate with one unit instead of two, if current workload levels are maintained or reliability is increased. To improve reliability, moves to other halls for training purposes (secondary responses) should be minimized. Another option is to expand the first-due area of Fire Hall 20 to cover portions of Fire Hall 5's first due-area (where the two halls have overlapping four minute travel times. This would improve the situation because Fire Hall 20 is less workload sensitive. The staffing analysis included in the operations chapter of this report shows Fire Hall 5 with one unit (quint).

Fire Hall 6 – The performance in this area, which is covered by one engine and one quint, is good for first-due units, but second-due units are only able to achieve the response time goal 70 percent of the time. As a result this hall is also workload sensitive and it should have two units. The quint here also allows another aerial ladder to support the primary ladders in the downtown area (7 and 1). The quint at this fire hall is therefore needed in addition to the engine. No apparatus changes are recommended for this hall.

Fire Hall 7 – This hall is also located downtown and it is the primary special operations station. The performance reliability in Fire Hall 7's area is very good and it can be covered by one of several surrounding halls (4, 6, or 8) if units at 7 are busy. The location of one engine and one ladder at this hall is appropriate considering its location in an area of high-risk and high workload. The engine at this hall does respond to a very high number of medical calls; therefore, locating one of the three peak-demand rescues here should reduce its call load and increase its availability to handle fire-related calls.

Because it is a very busy hall and its location is strategically important, we also recommend moving special operations from this hall to another, less busy location such as Fire Hall 18. This is discussed in the chapter 5.

Fire Hall 8 – Fire Hall 8 is also located in the busy downtown area and has one engine and one rescue. Its location in close proximity to surrounding Fire Halls 2, 4, and 7 also make it less sensitive to performance issues. The area covered by this hall has seen much growth over the past 15 years and additional growth is expected. Combined, engine and rescue 8 have the fourth highest workload; however, the other units in the area can reach 8's first-due area also within the four minute travel-time goal. Everything here seems to be working well; therefore no changes are recommended.

Fire Hall 9 – Fire Hall 9 has one quint and one rescue and its combined workload is the second highest in the city (Fire Hall 2 is first). The rescue is the busiest unit and the quint is moderately busy. The overall performance for this area is very good (89 percent). The location of this hall provides good support for the surrounding halls and the quint here is appropriate since it can provide aerial ladder capabilities to Fire Hall 14, which is a single-engine fire hall adjacent to 9. Our recommendation is to maintain the present quint and rescue at this hall.

Fire Hall 10 – Located on the campus of UBC this hall has one engine, one tower ladder, and one ambulance. The ambulance is cross-staffed, meaning that two personnel from the engine (or ladder) also handle the ambulance calls. Even with two staffed units and a low overall workload (1100 calls combined), performance reliability for this response area is not very good. The analysis shows a reliability of 71 percent with most of the travel times above the four-minute goal occurring east of the fire hall (see missed travel time incident density map). That there were so many calls above the travel-time goal of four minutes are likely due to the campus road structure which has many circles instead of the usual grid fashion found elsewhere in Vancouver. VFRS should check its response time data for the UBC area.

As might be expected where the buildings are almost entirely sprinkled, the majority of calls are of the automatic alarm variety where there was no emergency. This area had a lower percentage of fires and medical calls than other areas in the city.

Even with the expected growth at UBC, one unit could handle the workload. Analysis also shows that better ladder coverage could be achieved for the entire area if Ladder 10 were relocated to 19. However, UBC would have to agree to such a change since the city is under contract to maintain the current level of service at the university. For this reason, we show the ladder moved from 10 to 19 for the better coverage. However, the staffing recommendation in chapter 5, *Fire Operations, EMS, and Training*, continues to have the staffing for this ladder at 10. If Ladder 10 were moved, the engine at Fire Hall 10 should probably be changed to a quint for better versatility.

Fire Hall 12 – One engine and one quint are assigned to this hall. The workload analysis shows that one unit would probably suffice here, although the reliability analysis shows that it is barely achieving the desired response-time goal (82 percent). Likewise, there is limited capacity to handle more calls even with two units because the next closets halls have long second-due response times. Therefore, we recommend the engine and quint remain at Fire Hall 12. The quint at 12 also provides the additional aerial coverage for the primary ladders located at 10 and 18.

Fire Hall 13 – This fire hall is assigned one quint. Workload for this area is low, but because there is only one unit stationed here, 13 is moderately busy. Performance for this area is good with an overall performance reliability of 87 percent. This hall should continue to operate with one quint, but the first-due area should be expanded slightly to include some of the area covered by 9 and 20, where it appears that Quint 13 could get to faster.

Fire Hall 14 – Located in northeast Vancouver, one engine is assigned to this fire hall. This engine is the second busiest of the city's 24 engines and quints. Performance for this hall is sub-par with only a 75 percent performance reliability level. Even though its call volume is high, its workload is low; the engine at 14 has a high number of calls, but the total time spent handling calls is low). The area served by 14 is difficult to reach from the adjacent stations (9 and 14) within four minutes, so this area is susceptible to problems if demand increases.

This study recommends adding two engines and one quint during weekdays with the quint located at this fire hall. These units are needed to backfill fire halls during periods of high demand and to backfill fire halls when other fire units are unavailable because of training requirements. Because space is available at 14 to accommodate a quint, we suggested this location for it and the personnel working weekdays to staff the unit. The quint (weekdays) along with the engine (24/7) will also improve performance reliability in this area, albeit the quint will moved to other fire halls as the particular situation warrants.

No other changes are recommended for Fire Hall 14.

Fire Hall 15 – One engine and one quint (the quint was recently replaced with an aerial ladder) are located here. Even though this hall has only a moderate workload, it is achieving only 76 percent reliability which points to a problem with the station's location since these units are not overly busy (combined about 1700 calls per year). One reason appears to be the high demand in one particular area of the district where a large number of calls where the first arriving unit does arrive within the desired four minute travel-time goal, according to the incident data we analyzed.

As this study progressed, Fire Hall 15 was being rebuilt on its present site with its engine and ladder temporarily located at 9 and 14, respectively. Plans are to move the engine and ladder back to 15 when the station is completed.

The analysis shows that ladder coverage for the area could be improved if the ladder at 15 were relocated to 20. However, Fire Hall 20 will not accommodate the aerial ladder. Fire Hall 20 is recommended for renovation by this study and if it were done, the ladder could be moved from 15 to 20. Until then, Fire Hall 15 should continue to have one engine and one ladder.

Fire Hall 17 – One engine and one rescue are located at 17. Performance reliability for this station is 85 percent; however, the hall is on the border of a very large coverage gap. There is also an area of high fire and EMS demand in the middle of the Sunset planning covered by 17. Fire Hall 17 is recommended for replacement by this study and when it is, consideration should be given to relocating it slightly to the north and west from its present location.

This study also recommends that one of the two additional engines staffed during weekdays be located at 17. However, as we discuss in the operations' section of this report, this unit (and its personnel) are needed to cover other stations and it is assigned to 17 for administrative purposes only. Also the fire hall will accommodate the extra engine.

No other changes are needed and one engine and one rescue are sufficient to handle the calls in this area.

Fire Hall 18 – Fire Hall 18 has one engine and one ladder. Combined, these units handle about 1600 calls annually and workload is not a problem. However, 18 and the hall adjacent to it (21) are in a grid pattern with other fire halls unlike other parts of the city which have a triangular pattern. For this reason there is a coverage gap that could be eliminated if 18 (and 21) were relocated. However, the station is fairly new so relocating it is probably not an option. The ladder at 18 provides good coverage for central Vancouver with Ladder 15 to east and Ladder 10 at UBC.

A major recommendation of this study is to move special operation activities from Fire Hall 7 to 18. Fire Hall 18's location in the center of Vancouver, and its low workload (half that of 7), make 18 a good choice.

In addition to special operations, Fire Hall 18 should continue to have one engine and one ladder.

Fire Hall 19 – One quint is located at this hall which responds to the fewest number of calls of any VFRS unit. Even with its low call volume, performance reliability in this area is lower than the 80 percent goal because response times for many of the calls exceed four minutes. Two fire halls adjacent to 19 (12 and 21) both have quints and Fire Hall 10 has an aerial. The response time analysis shows that the ladder at 10 can provide better coverage to the area if it were located at 19. However, because of an agreement with UBC, it may not be possible to move the aerial to 19 unless the agreement is changed. We recommend that 19 be assigned an engine not a quint, even if the aerial is not relocated from Fire Hall 10. If it is moved, then 10 should have the quint.

Fire Hall 20 – One quint is currently assigned to 20. The workload for Quint 20 is low to moderate and the performance for this area is good at 88 percent. The analysis shows that 20's area could possibly be expanded somewhat into the neighbouring fire hall's area (5) to reduce some of the calls that 5 cannot reach in the prescribed time.

Fire Hall 20 is also one of the oldest stations and it recommended for replacement by this study. When it is, the hall could be relocated slightly eastward to provide better coverage with 5 and 15 and the ladder at 15 could be relocated to 20. The GIS analysis shows that a ladder at 20 is better than at 15. If this move were made, the ladder at 5 could possibly be eliminated and one unit (a quint) located at 5.

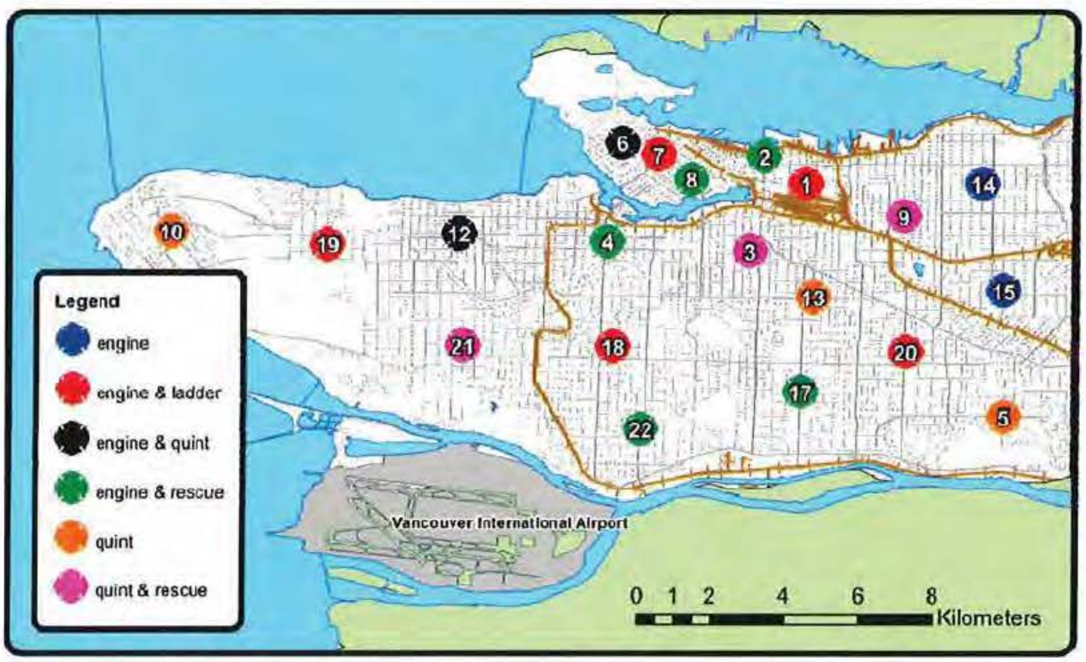
The review also shows that an engine would serve this area just as effectively as the quint here now. Therefore, the quint should be replaced by an engine at a future point.

Fire Hall 21 – One quint and one rescue are presently assigned to Fire Hall 21. This fire hall also has problems reaching a majority of its calls within the four minute travel-time goal. With a combined call volume for the quint and rescue of only 1300 calls annually, it may appear that a rescue is not needed here. However the other closest halls (12, 18, and 22) cannot reach the calls in this area at or near the travel-time goal if Quint 21 is busy, so the rescue does help. The analysis also shows that better coverage can be achieved if Fire Halls 21 and 18 were moved eastward and a new station (23) built west of 21. The low call volume in the region and 18 being a new facility are the two factors that do not make this move a necessity now. For the immediate future, 21 should continue to have one quint and one rescue.

Fire Hall 22 – One engine and one rescue are located at Fire Hall 22. Slightly busier than 21, this hall should also have a rescue in addition to a fire unit for reasons of response time and performance reliability. No changes are recommended for this fire hall.

The map in Figure 46 shows the location of halls and apparatus if the preceding recommendations were implemented in their entirety.

Figure 46: Proposed Location of Fire Halls and Apparatus



Weight-of Response Analysis

A necessary component of a deployment analysis is to evaluate whether the system is able to deliver an adequate response of apparatus and personnel, often referred to as 'weight of response'. NFPA 1710 provides guidelines for weight of response but professional judgment is also required.

For this project we evaluated whether VFRS can achieve the recommended threshold for the initial first alarm assignment to arrive at a reported structure fire. In Vancouver there are several dispatch protocols for fires reported in structure. The one most used for a confirmed structure fire is to dispatch four fire units, one of which must be an aerial ladder. The total response time recommended by NFPA is 480 seconds for the entire first alarm assignment to arrive. As stated earlier, the standard is used because it approximates fire development in structures.

The response time analysis of whether VFRS can meet the 480 second goal was problematic because data from the fire department was unreliable. Data provided and analyzed by us determined that some neighbourhoods had no times when a full first-alarm assignment reported on-scene. In other cases there were extremely high on-scene times for the full first alarm assignment, some exceeding 18 minutes. Based on the location of fire halls in Vancouver and the reliability analysis performed, an 18 minute response time fort a first alarm does not appear to be correct. However, VFRS is not dispatching a full assignment on certain calls (e.g. smoke in the structure) initially and some of these calls actually turn out to be structure fires in which case other units are then sent. This probably explains why many of the calls greatly exceed the 480 second time. Until better data is available, it is not possible to determine with any degree of certainty when the VFRS is meeting NFPA's standard of 480 seconds for the fire alarm assignment to arrive at a structure fire.

Without the data we then conducted a GIS analysis to assess the current system of fire halls and units as compared to the model proposed by this study. The following two GIS maps show the number of fire units (engines, quints, ladders) that can reach certain parts of the city. The maps do show that our proposed changes maintain the weight or response capability throughout the city. There is a slight difference on the city's west end which could be improved by adding a new station at some point in the future, which we recommend.

Figure 47: Current Weight of Response Capability

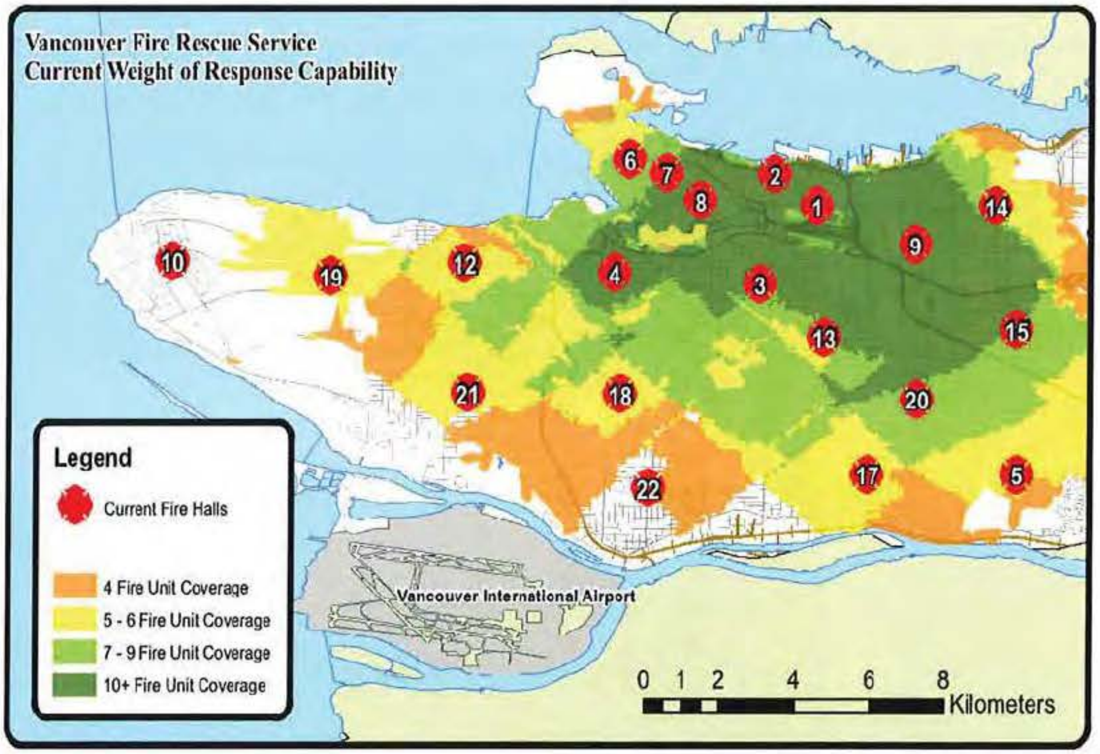
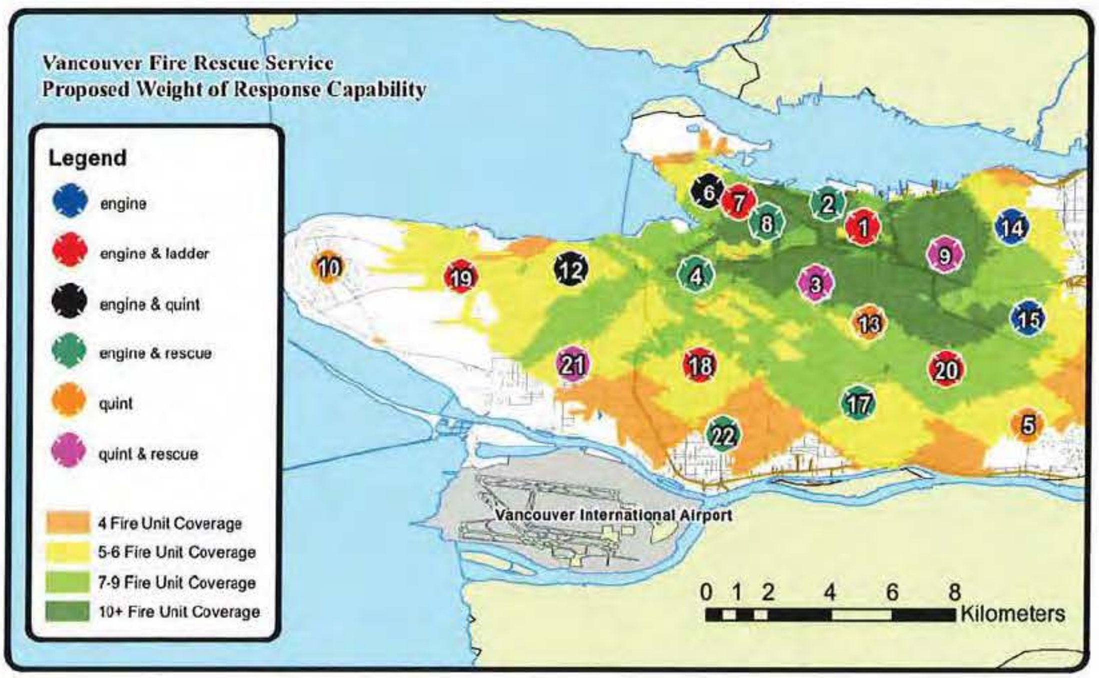


Figure 48: Proposed Weight of Response Capability



Clearly, in the most densely populated areas of the city and those with the highest risk factors, at least 5 and in some areas more than 10 fire units are within the 480 second response time threshold. The problem becomes when fire units are unavailable because of training (secondary response). Following is a summary table of fire hall and unit location changes.

Table 30: Summary Table – Fire Hall and Apparatus Locations

Fire Hall	Change
1	Add one peak-load rescue (another option is to add the rescue to Fire Hall 3).
2	Add one peak-load rescue.
3	No change (unless the peak-load rescue recommended for Fire Hall 1 is located here, instead).
4	Replace the quint with an engine.
5	Eliminate one unit from Fire Hall 5 and operate one quint from this station.
6	No change.
7	No change.
8	No change.
9	No changes.
10	Move the ladder from 10 to 19 and operate one quint from Fire Hall 10.
12	No change.
13	No change.
14	Add one quint (weekdays) and maintain the current engine.
15	No immediate changes. When Fire Hall 20 is renovated, move the ladder currently assigned to Fire Hall 15 to Fire Hall 20.
17	Add one engine (weekdays) in addition to the engine and rescue already assigned; also move Fire Hall 17 slightly north and west of its present location.
18	If a new Fire Hall 23 is constructed, considered moving Fire Hall 18 slightly eastward. Maintain one engine and ladder at 18.
19	Assign one engine at 19 instead of the current quint; also move the ladder at Fire Hall 10 to this station.
20	Replace the quint at 20 with an engine. When Fire Hall 20 is renovated, move the ladder at Fire Hall 15 to 20.
21	Maintain the existing quint and rescue at 21. If a new Fire Hall (23) is constructed, consider moving Fire Hall 21 slightly eastward along with Fire Hall 18.
22	No changes.
23	New fire hall.

V. FIRE OPERATIONS, EMS AND TRAINING

Fire and Rescue Services provided to the citizens of Vancouver overall are very good. VFRS is a quality-minded organization and it has a well-trained staff. The department's leadership has been good overall and responders take pride in their profession.

Although service levels are good, medical calls are expected to increase and the fire department must prepare for the higher demand unless a much greater prevention effort is made to reduce injuries and EMS calls as the population continues to grow. To meet the likely increase in demand, additional rescues will be needed, especially during peak demand hours. There is also a need to increase the number of fire units (and personnel) dispatched initially for fires in high-hazard occupancies such as high-rise buildings.

To their credit previous fire leaders recognized the benefit of sprinklers and worked hard to require them in residential properties. As a result, the city's fire losses have declined over the years but losses in some planning areas are still high. The same leaders also recognized that medical first-response calls would be the area of highest demand and they took steps to improve medical response capabilities by creating two-person rescue units to handle the calls. Combined, these two changes have benefited the city. Fire leaders in other North American cities have not been as proactive, and Vancouver is better off because its leaders demonstrated initiative in these important areas. As noted also in the prevention chapter, TriData and the Center for Disease Control (CDC) have included Vancouver's sprinklering as an international best practice, and the best among large cities in North America and probably the world.

A key aspect of this study was to determine whether the current deployment of resources is adequate for current demand and to make recommendations for future resource allocations based on projected call volumes and incident types. British Columbia has not formally adopted response time or weight of response standards or goals. For this project we considered 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.

In the previous chapter we discussed fire hall locations and response times. In this section we discuss the allocation of personnel and apparatus to those halls and we discuss the organization of the operations division. We also review specialized services such as hazmat and medical first-response capabilities. A review of the department's training division is also included in this section.

Situational Overview and Strategic Goals

As it exists, the fire department is still fire suppression oriented even though it has assumed a broader role in EMS. Another problem is the undercurrent of mistrust between those in the union and management that affects the department's ability to make changes in deployment.

Although management and labour are generally amicable toward each other, fire department operations are not 'firing on all cylinders' because management and labour do not communicate regularly. Field personnel are provided information from management about current events taking place in the department; however, they rely mostly on union officials to keep them abreast of changes. As a result, line firefighters usually get second-hand information.

Changes made by the fire chief in the selection process for assistant chief now provides additional 'exempt' positions on the command staff. The five exempt assistant chief positions at the time of this study were:

1 – Emergency Medical Services

1 – Special Operations

1 – Communications

1 – Occupational Safety/ Health

1 – Fleet Maintenance

Assistant chiefs (and deputy chiefs) are clearly management positions and the chief made the right decision by making the change. Going forward, the fire department will benefit by having a cohesive management team.[20]

To improve operations upper management must also do a better job communicating directly with personnel assigned to the fire halls rather than relying on field battalion chiefs. Taking time to get into the stations more where they can articulate the department's initiatives and rationale for major decisions directly with firefighters would go a long way toward improving relations. Firefighters would also have a better understanding of their organization, and the rationale for decisions that may not have understood.

Particular areas where improvements are necessary to improve operations include:

[20] To its credit VFRS has initiated steps to involve battalion chiefs in more management-related activities, a process that should also help improve the cohesiveness of the management team.

- **Training** – While training is mostly adequate, there are too few opportunities for personnel to get live firefighting experience. Likewise, there are not enough live-fire training opportunities for new recruits. There are problems with the driver training program because of inadequate resources and new emergency vehicles drivers are not getting enough training. Adequate space is reported as one problem with driver training; albeit there are probably open spaces the department could find to accommodate the required training.

- **Planning** – As mentioned in an earlier chapter, VFRS does not conduct sufficient planning and there is not a central function where planning is conducted. Data collection for incident response activities is poor and there are inconsistencies in the data that is collected.

- **Staffing** – The fire department needs to change how it delivers services and provide more units during busier periods. In addition, the department does not have a clear understanding of how many FTE personnel it needs to provide services under the current work schedule and sick leave use is a problem. Four-person staffing currently assigned to each of the city's fire suppression units is appropriate and should be continued.

- **Rescues** – The fire department made the right decision to implement a recommendation from TriData's previous study to deploy smaller units to respond on medical calls. However, rescue units have 'morphed' from the original intent of smaller vehicles for medical calls (as used in most cities) into larger units equipped with pumps and extrication equipment. More rescues are needed during periods of increased demand and they should return to the original concept of smaller units.

- **Apparatus** – Fire apparatus has become very large and the fire department can probably buy less expensive units; therefore, it should re-evaluate the apparatus being purchased. The passage of recent legislation to allow residential construction that will front alleys will mean that future fire units must be able to operate in smaller confines, which the current fleet will probably have trouble doing.

- **On-scene Complements** – In some cases the fire department is sending too few units (and personnel) to be effective initially. As a result, many fires require commanders to call for additional assistance, often piecemeal. On high-risk properties the fire department should increase the on-scene complement of personnel (weight of response).

- **Incident Command and Safety** – With three on-duty battalion chiefs the city does not enough command officers on each shift. Only one chief officer is sent on each incident initially. However, the city has over 600 high-rise buildings and the downtown area is one of the most complex environments in the world. For these reasons the fire department should dispatch two chief officers on many of its incidents, even initially. Two chief officers responding initially will also improve incident-scene safety.
- **Special Operations and USAR** – The coordination of urban search and rescue (USAR), which is a higher level of planning and response for major incidents, and those for special operations, which includes hazmat, is not good and there is too much overlap in responsibility between managers responsible for these two programs. To its credit the city began preparations several years ago for large-scale incidents by creating the USAR team and special operations. However, while the department has most of the equipment it needs and personnel are trained for these types of situations, if a major event were to occur, it is doubtful the incident would go smoothly.

To improve services and meet future demand, the operational component of VFRS should adopt the following strategic goals.

1. Improve the organizational structure by realigning the command structure of operations and modify the budget to reflect actual costs.
2. Add rescues during weekdays to handle the growing number of medical calls and add fire units to replace those that are unavailable because of training.[21]
3. Improve incident command, incident-scene safety, and increase the response complements sent on high-risk hazards.
4. Improve hands-on and live-fire training and increase the capacity to conduct training on each of the four shifts.
5. Reorganize the training division to include EMS and fire training programs.
6. Strengthen emergency preparedness, USAR, and special operations by reorganizing the management structure; at the same time change the fire hall responsible for

[21] Fire units that are temporarily unavailable because of a scheduled training exercise are referred to as being in 'secondary response'. While in secondary response, fire units can be activated quickly by radio; however, they reduce the number of fire units and other companies are moved to cover their assigned area.

technical rescue and expand technical rescue capabilities to include confined space and collapse rescue.

In the sections that follow, we provide specific recommendations in support of the strategic goals.

Organization

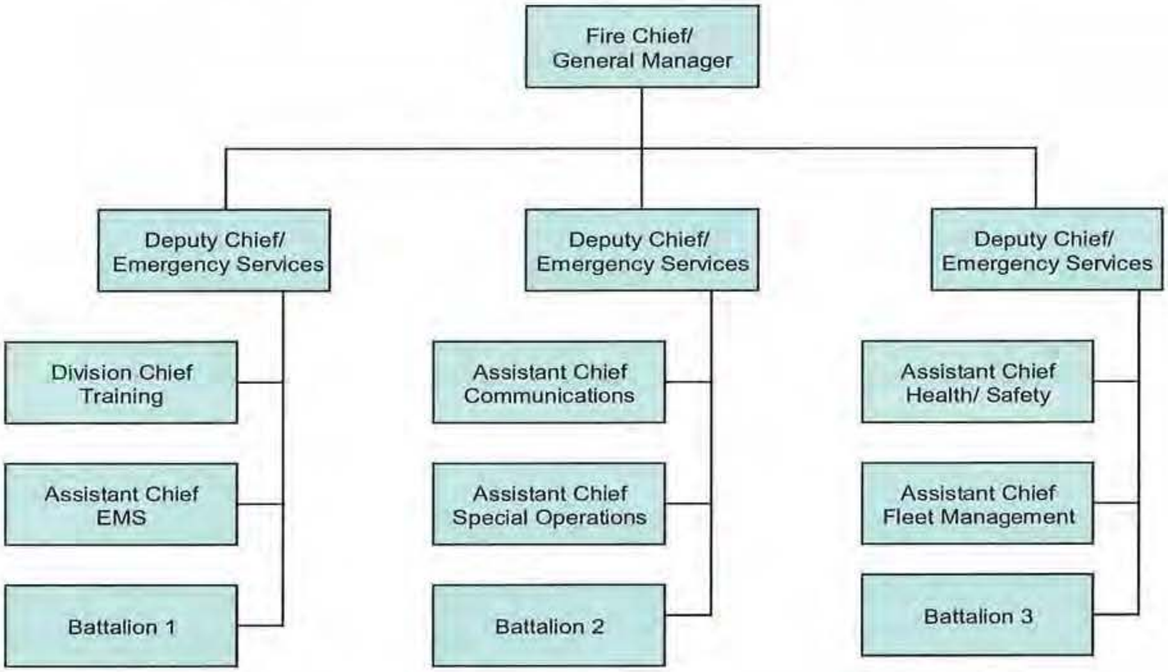
Fire services are provided from 20 strategically located fire halls. Apparatus and personnel are assigned to the halls based on the risks found in various areas of the city. The command structure for operations is similar to that of other, metro-size communities. A little unusual for a city the size of Vancouver is that the three top commanders (deputy chiefs) responsible for operations all work weekdays. Reporting to the three deputy chiefs are twelve battalion chiefs; three battalion chiefs on each of the four shifts. Each deputy chief is responsible for one of three battalions. The deputy chiefs report directly to the fire chief.

Line firefighters and officers work an average of 42-hours each week on a four platoon schedule and these personnel are assigned to one of four shifts (A–D). The platoon system used by VFRS is common among fire departments, albeit the 42-hour workweek is on the lower end of the number of hours worked per week.

In addition to suppression, each deputy is also responsible for various support activities. These include training, special operations, EMS, communications, fleet management, and health/safety. In an earlier section we recommended a different organizational structure to improve accountability and reduce the number of senior command positions.

Figure 49 depicts the organization of emergency services at the time of this review.

Figure 49: Organization of VFRS Emergency Services Division



Each battalion chief manages the fire halls assigned to their geographical area. Battalion 3 is the largest of these geographically. Battalion 3 also has the most number of halls and personnel to manage.

The span-of-control for each battalion chief, although reasonable, is on the high end. To maintain a reasonable level of safety and accountability the typical span of control is for a battalion chief to manage five to seven fire units. Battalion chiefs in Vancouver command more units than is typical in urban cities.

Battalion 1 – 6 fire halls; 11 units; 42 personnel[22]

Battalion 2 – 6 fire halls; 10 units; 37 personnel

Battalion 3 – 8 fire halls; 15 units; 55 personnel

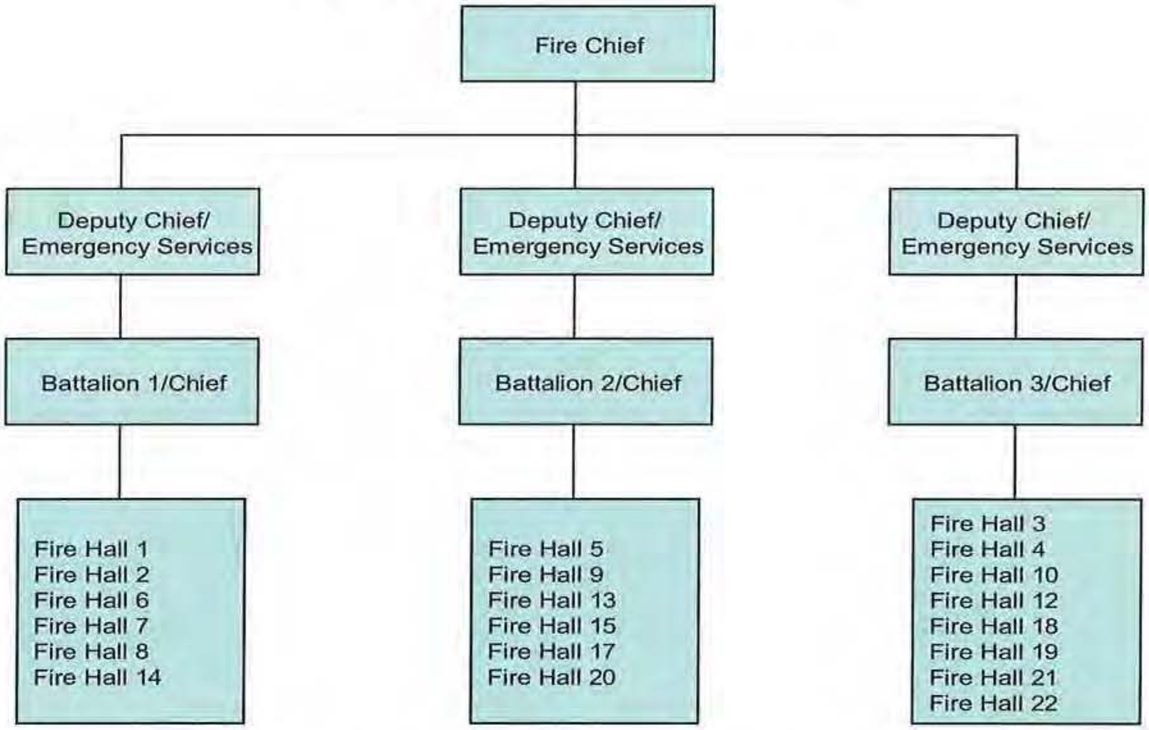
Adding another commander to oversee each shift will improve the span-of-control and it will improve incident management because two chief officers can then respond to high-hazard incidents where greater control is needed. Although not a critical issue, increasing the number of chief officers on each platoon from three to four would improve operations because it would

[22] Includes one fire investigator at Fire Hall 1.

allow two chiefs to be dispatched initially on calls like those in high-rise structures. It would also reduce the span of control, which is important for day-to-day management.

Figure 50 shows the current organization of three battalions.

Figure 50: Organization of VFRS Battalions



Currently, 746 personnel are allocated for operations. The minimum required daily staffing of 134 includes one fire investigator. Four captains are assigned to each fire hall with one on each of the four shifts. When two staffed fire units are located at the same hall, a lieutenant commands the second unit. Rescues are staffed with one firefighter and a rescue officer. Rescue officers and lieutenants are compensated at the same pay grade. Each shift also has extra lieutenants who fill in when a regular captain or lieutenant is off on vacation or for other reasons.

Table 31 depicts the FTE positions at the time of this study and the minimum number of positions needed per shift.

Table 31: Positions Assigned to VFRS Operations

Rank	Authorized/FY08	Minimum Required/Shift
Battalion Chief	12	3
Captain	80	20
Lieutenant	60	9
Rescue Officer	28	7
Firefighter	555	93
Fire Investigator	4	1
Total	**739**	**134**

Operational Budget – Eighty-one percent of the total fire department budget goes toward salaries and benefits for personnel assigned to operations. Salaries make up the largest portion of the budget ($52.4M). The training division budget is next highest ($.98M). However, a significant portion of the training budget is actually transferred to the 'Fire Hall – General' account where it is used to pay overtime for operational staff shortages to maintain minimum staffing of 133 personnel on each shift. The FY08 operations' budget is depicted in Table 32.

Table 32: VFRS Operational Budget Overview, FY08

Budget Category	Total $$	% of Total FD Budget	Salaries/ $$	% for Salaries
Fire Hall – General	$63,830,376	81	$52,368,106	82
Fire Hall – Supplies	$1,214,209	2	$0	0
Rescue & Safety	$623,964	<1	$107,164	17
Urban Search & Rescue	$180,540	<1	$104,340	58
Hazmat/ Tech Rescue	$182,045	<1	$93,945	52
EMS	$364,440	<1	$191,840	53
Training	$979,000	1	$449,800	46
Sub-Total/ Operations	**$67,374,574**	**85**	**$53,315,195**	**79**
Other (Non-Operational Budget Categories)	$11,638,692	15	$4,435,314	38
Total Fire Budget	**$79,013,266**	**100**	**$57,750,509**	**73**

Of the total budget in 2008, 85 percent is used to provide staffing for the 38 units in the fire halls and direct support activities such as training, EMS, and special operations. As compared with other departments, 85 percent for operational activities is low; 88–94 percent is typical. The remaining budget amount of $11.6M (15 percent) is used for support activities such as administration, fleet services, and prevention activities.

Personnel cost allocations within the current budget system are shown for each cost center, including operations. However, overtime reported in the training budget is often transferred to the operations budget. The overtime is being used when shift staffing shortages occur and firefighters are being called in to work extra shifts.

The FY08 budget had $281,000 in the training budget for operational overtime for use of operations personnel as training instructors. There may be other accounts like this elsewhere in the budget. These are direct service costs, which should depicted in the operational budget. In an earlier chapter we made a recommendation to change the budget such that each cost center reflects the actual level of service provided.

Salaries – Current salaries are competitive and there were no concerns expressed about turnover related to low salaries. Entry-level salaries for new firefighters also appear to be competitive. Firefighters typically remain in Vancouver and do not leave for jobs in other fire departments after they have been hired. A full retention study was not within the scope of this project.

Table 33 shows the average salary and benefit costs for each rank. Those identified in bold are non-exempt positions covered by the labour agreement.

Table 33: Average Salary/Benefits, 2008

Rank	Average Salary	Benefits @ .28	Total Cost
Deputy Chief	$140,985	$39,476	$180,461
Assistant Chief	$111,163	$31,126	$142,289
Division Chief[23]	$111,372	$31,184	$142,556
Battalion Chief	$106,517	$29,825	$136,342
Captain	$92,684	$25,952	$118,636
Lieutenant	$85,097	$23,827	$108,924
Rescue Officer	$85,097	$23,827	$108,924
Firefighter	$73,809	$20,667	$94,476

Salary compression does not appear to be a problem and the promotional process, predicated almost entirely on seniority, ensures that there are always enough candidates for officer vacancies. The exceptions are vacancies for assistant and deputy chief. Because these are exempt positions, few individuals compete for these positions because they often desire to remain in the union. It was also reported that non-exempt positions offered better work-life balance than exempt management positions.

[23] During this study the incumbent retired and the department has plans to eliminate the position of division chief.

Concept of Operations

Undoubtedly, VFRS was at the front of the class when it began to change the role of firefighters and focus more attention on EMS and special services. Most personnel are now cross-trained to perform multiple functions such as hazmat and technical rescue. This approach benefits the city economically because dual-roll firefighters are more efficient than having fully staffed specialty units, particularly when specialized calls are infrequent as they are in Vancouver.

To aid in understanding the discussion in this chapter we provide a brief tutorial below for those who need it on the response units used by the fire department:

Engines – Engines are the primary units used to extinguish fires. Engines are staffed with four personnel, including one officer and three firefighters. Engines are equipped with hose and their primary role is to provide the necessary water to extinguish a fire. The most recent engines purchased by VFRS are equipped with large-capacity pumps (8,000 LPM) and compressed-air-foam systems.

Ladders – VFRS has five aerial ladders, each staffed by one officer and three firefighters. Two of the city's five aerial ladders are located downtown, which is appropriate. One of the five ladders is equipped with a basket (tower). The typical aerial ladder on these units reaches 30–38m. Each ladder unit also has a pump (7,000-8,000lpm); however, the ability to pump is typically considered secondary to the aerial ladder.

Quints – Quints have both the pump and hose typically carried by engines and an aerial ladder. The name refers to five functions they can do. Quints are particularly well suited for suburban areas where demand is low and the flexibility to conduct engine or aerial operations is desired. Few cities have adopted quints as their primary unit though more could, especially since fires are decreasing. Like engines and aerials, quints are staffed by four personnel; one officer and three firefighters. Vancouver quints are typically equipped with 7,000 lpm pumps and a 23m aerial ladder.

Rescues and Heavy Rescues – Seven two-person rescues are used primarily for medical calls and for auto extrication. EMS rescues were recommended by an earlier TriData study to reduce the wear on fire apparatus due to the increased number of medical calls. The original vision was that rescues would be 'light-duty' vehicles equipped almost entirely with medical equipment. Although minimum staffing is considered two, current policy is to increase rescue staffing to three when extra personnel are available.

Table 34 shows the existing deployment of units and personnel by fire hall and the minimum staffing required for each shift.

Table 34: Apparatus Resources and Minimum Staffing Requirements by Fire Hall

Fire Hall/Planning Area	First-Line Units	Special Services	Minimum Staffing
1 Strathcona	1 Engine 1 Ladder 1 Fire Investigator 1 Battalion Chief	Fireboat	1 Captain 3 Firefighters 1 Lieutenant 3 Firefighters 1 Fire Investigator 1 Battalion Chief **Total = 10**
2 Downtown East	1 Quint 1 Rescue		1 Captain 3 Firefighters 1 Rescue Officer 1 Firefighter **Total = 6**
3 Mount Pleasant	1 Engine 1 Quint	Hazmat Unit and Tender	1 Captain 3 Firefighters 1 Lieutenant 3 Firefighters **Total = 8**
4 Fairview	1 Quint 1 Rescue	Hazmat (Reserve)	1 Captain 3 Firefighters 1 Rescue Officer 1 Firefighter **Total = 6**
5 Champlain	1 Engine 1 Ladder	Wild-land Unit	1 Captain 3 Firefighters 1 Lieutenant 3 Firefighters **Total = 8**
6 West End	1 Engine 1 Quint	Tech Rescue (Backup to Fire Hall 7)	1 Captain 3 Firefighters 1 Lieutenant 3 Firefighters **Total = 8**

Fire Hall/Planning Area	First-Line Units	Special Services	Minimum Staffing
7 Downtown	1 Engine 1 Ladder	Tech Rescue Unit	1 Captain 3 Firefighters 1 Lieutenant 3 Firefighters **Total = 8**
8 Yale Town	1 Engine 1 Heavy Rescue	Wild-land Unit	1 Captain 3 Firefighters 1 Rescue Officer 1 Firefighter **Total = 6**
9 Grandview/ Woodlands	1 Quint 1 Heavy Rescue	Incident Command Unit	1 Captain 3 Firefighters 1 Rescue Officer 1 Firefighter **Total = 6**
10 University	1 Engine 1 Tower	Ambulance Hazmat Unit and Tender	1 Captain 3 Firefighters 1 Lieutenant 3 Firefighters **Total = 8**
12 Kitsilano	1 Engine 1 Quint	Fire Boat	1 Captain 3 Firefighters 1 Lieutenant 3 Firefighters **Total = 8**
13 Riley Park	1 Quint		1 Captain 3 Firefighters **Total = 4**
14 Hastings Sunrise	1 Engine		1 Captain 3 Firefighters **Total = 4**
15 Renfrew	1 Engine 1 Ladder		1 Captain 3 Firefighters 1 Lieutenant 3 Firefighters **Total = 8**

17 Fraserview	1 Engine 1 Rescue		1 Captain 3 Firefighters 1 Rescue Officer 1 Firefighter **Total = 6**
18 Shaughnessy	1 Engine 1 Ladder 1 Battalion Chief		1 Captain 3 Firefighters 1 Lieutenant 3 Firefighters 1 Battalion Chief **Total = 9**
19 West Point Grey	1 Quint	Wild-land Unit Hose Tender for DFPS	1 Captain 3 Firefighters **Total = 4**
20 Victoria	1 Quint 1 Battalion Chief		1 Captain 3 Firefighters 1 Battalion Chief **Total = 5**
21 Kerrisdale	1 Quint 1 Rescue		1 Captain 3 Firefighters 1 Rescue Officer 1 Firefighter **Total = 6**
22 Marpole	1 Engine 1 Heavy Rescue	Air-light Unit	1 Captain 3 Firefighters 1 Rescue Officer 1 Firefighter **Total = 6**
20 Fire Halls	13 Engines 10 Quints 6 Ladders 3 Heavy rescues 4 Rescues 1 Fire Investigator 3 Battalion Chiefs		3 Battalion Chiefs 20 Captains 9 Lieutenants 7 Rescue Officers 93 Firefighters 1 Fire Investigator **Total = 134**

The use of quints by the fire department has mostly been successful in that it provides deployment flexibility. For example, quints allow the fire department to maintain one fire unit at many fire halls during times of busy activity such as when training or serious fires occur.

Under the quint concept, one unit capable of performing multiple functions is deployed rather than having an engine and a ladders staffed by separate crews in the same hall. The use of quints in Vancouver, although not perfect, does improve the fire department's flexibility. However, quints are being used in some areas where an engine, which is less expensive, could be just as effective. The type of buildings and density in Vancouver still make it necessary to deploy engines and ladders in the traditional sense and the city could not possibly eliminate all of its ladders and rely solely on quints.

Recommendation 21: Eliminate quints and replace them with engines in some halls throughout the city. The response time and operational review shows that in a number of locations quints can be replaced by engines without a negative impact on service delivery. In fact, efficiency would improve because the cost of a quint is approximately $100,000 more per unit than that of an engine, according to the price estimates provided to us by fleet maintenance staff. The cost factor of quints versus engines is discussed in more detail in the fleet review section of the report.

Staffing Analysis – Current Operations

As shown in the previous table, not including the fire investigator, 133 personnel are needed to staff the city's suppression and rescue units. The fire department does not formally compute the number of personnel it takes to staff these units considering vacation, sick, or other leave. Consequently administrators are relying mostly on 'rules of thumb'. They acknowledged that a complete staffing analysis had not been conducted in a number of years. Therefore, an important deliverable during this project was to determine whether the current level of staffing (by rank) is about the right number needed considering the average hours worked each week per employee.

Staffing Factor – To conduct the analysis we reviewed the fire department's leave data for personnel assigned to operations. We also considered the minimum required staffing level for each rank and for each battalion. At currently authorized levels, the staffing factor for officers is 4.5. This means there is .5 FTE's above the minimum needed to operate on the four-platoon shift schedule. With approximately 45 officers on each shift, 5 officers could be absent before a shortage occurs. Table 35 shows the currently authorized staffing levels by rank.

Table 35: Current VFRS Staffing Factor/Rank

Position	Minimum Required/ Shift	Currently Authorized FTE's	Current Staffing Factor
Battalion Chief	3	12	4.0
Captain	20	80	4.0
Lieutenant	9	60	6.8
Rescue Officer	7	28	4.0
Sub-Total/ Officers	39	180	4.6
Firefighter	93	555	6.0
Investigators	1	4	4.0
Total Staffing	**134**	**739**	**5.5**

Unlike the staffing level for officers, which appears about right, the total authorized staffing level of 6.0 for firefighters appears to be high. The lower factor for officers is believed to be a result of their using less sick time, which was confirmed by a review of the sick leave used by each rank.

Also analyzed were the staffing levels for each of the three battalions. This was done to determine whether current staffing levels were reasonable considering the number of positions that are required to be staffed during each shift. Table 36, Table 37, and Table 38 show the analysis for each battalion.

Table 36: Current Staffing – Battalion 1

Stations	Battalion Chief	Captain	Lieutenant	Rescue Officer	Firefighter	Total	Minimum Required/ Shift
1	4	4	4		36	48	9
2		4		4	31	39	6
6		4	4		34	42	8
7		4	4		38	46	8
8		4		4	28	36	6
14		4			20	24	4
Captain's Pool		1	23			24	0
Total	**4**	**25**	**35**	**8**	**187**	**259-18 = 241**	**41**

Note: Total staffing (259-18=241) was used because the captain's pool includes the extra officers for each of the four shifts. Thus, only two of the officers assigned to the pool on one shift would typically be used to fill in at battalion 1.

Battalion 1 is currently staffed with approximately 60 positions per shift, including officers from the captain's pool. With a minimum staffing level of 41 positions for battalion 1, a vacancy rate of 32 percent (19/60) is possible with the current level of staffing before overtime is needed to fill positions for minimum staffing. Staffing to allow a vacancy rate of 32 percent is considered high.

A similar finding was determined in battalion 2, which has a minimum staffing requirement of 37.

Table 37: Current Staffing – Battalion 2

Station	Battalion Chief	Captain	Lieutenant	Rescue Officer	Firefighter	Total	Minimum Required/ Shift
5		4	4		34	42	8
9		4		4	26	34	6
13		4			20	24	4
15		4	4		28	36	8
17		4		4	24	32	6
20	4	4		1	23	32	5
Total	**4**	**24**	**8**	**9**	**155**	**200 + 6 (from captain's pool)**	**37**

Including the pool captains, 206 personnel are presently assigned to battalion 2; about 52 on each of the four shifts (206/4). With a minimum staffing requirement of 37, a vacancy rate of 33 percent (17/52 is possible before overtime is paid—again high).

As the largest battalion staffing-wise, 55 personnel are required for each shift in battalion 3. Battalion 3 has 72 positions assigned to each shift. This means 24 percent of those assigned on a typical shift could be off before overtime is needed or another person must be detailed in from one of the other two battalions. The staffing level for battalion 3 is better in that it allows one person off on leave for every five persons assigned with some extra to cover unanticipated absences such as sick leave.

Table 38: Current Staffing – Battalion 3

Station	Battalion Chief	Captain	Lieutenant	Rescue Officer	Firefighter	Total	Minimum Required/ Shift
3		4	4		36	44	8
4		4		5	25	34	6
10		4	4		32	40	8
12		4	3		33	40	8
18	4	4	4		28	40	9
19		4			15	19	4

Station	Battalion Chief	Captain	Lieutenant	Rescue Officer	Firefighter	Total	Minimum Required/ Shift
21		3	2	2	26	33	6
22		4		4	25	33	6
Total	**4**	**31**	**17**	**11**	**220**	**283 + 6 (from captain's pool)**	**55**

On the whole, fire department staffing is such that it allows a very high absence rate. Because unanticipated absences such as sick leave can fluctuate greatly from day to day, extra personnel above the minimum occur very often throughout the year.

A benefit of the current staffing level is that the fire department can use the extra firefighters to increase the staffing on its seven rescues from two to three personnel, which it tries to do whenever possible. Extra personnel are also being reassigned to augment other, non-operational functions such as training, public education, fleet and building maintenance, particularly when special projects arise or when vacancies within these areas are left unfilled.

Leave-Use Analysis – To provide VFRS with an accurate picture of how many responders are needed to staff operations, we analyzed three-years of leave data. The analysis included only those personnel assigned to operations and it included annual leave such as vacation (anticipated leave) and other leave such as sick leave, WorkSafe BC time, medical leave and bereavement leave (unanticipated leave). Leave is currently tracked by hours, which is good.

The analysis shows that the fire department must cover approximately 341,000 hours of vacancies each year. And it was determined that a typical firefighter will work an average of 33 hours per week or 1720 hours per year after leave is subtracted. Based on the average of three years, VFRS needs about 200 FTE positions (50 on each shift) just to cover leave (1720 times 200), according to the analysis.

Table 39 shows the leave used by category for the period 2006–2008.

Table 39: Leave Hours Analysis, 2006–2008

Classification	2006	2007	2008	Average	Percent of Total
Bereavement	1,022	1,187	1,445	1,218	< 1.0
Gratuity Leave	5,114	6,998	7,059	6,390	1.8
Medical Appointment	257	827	962	682	<1.0
Time Owing	3,967	3,664	4,595	4,075	1.2
WCB	27,054	23,624	15,298	21,992	6.4
Band/ Performance	208	188	453	283	<1.0

Classification	2006	2007	2008	Average	Percent of Total
Jury Duty	55	48	158	87	<1.0
Military Leave	192	132	240	188	<1.0
Training	682	705	161	516	<1.0
Deferred Vacation	2,015	2,476	2,749	2,413	<1.0
Sick Leave	60,637	61,635	58,939	60,404	17.0
Vacation	244,568	246,243	237,974	242,928	71.2
Total	**345,771**	**347,727**	**330,033**	**341,177**	**100.0**

The average hours used by each person from 2006 through 2008 is 462 hours per year (341,177/739) or 11 weeks per year (462/42)! When vacation only is considered, the average time off per person for those assigned to operations from 2006 to 2008 is 329 hours per year. The average sick leave for each person is 82 hours per year or almost 6.7 shifts.

During its review of this report, fire officials commented that other absences that are not tracked by the payroll system were not reported and thus the actual absences were higher. The additional absences also impacted staffing and must be included in the analysis. Absences not included in payroll data included leaves for paternity and secondment, accommodation, and vacant positions because of retirements.

On average, 11 firefighters are off during each shift for the reasons just mentioned. Multiplied by the total hours needed to cover one minimum position for a full year (24 times 365 = 8760), the total impact on the system for these vacancies is approximately 96,000 hours. When the additional hours (96,000) are added to the average total hours in Table 39, the additional un-tracked hours combine for 437,177 total hours for which personnel do not report for their assigned shift.

The additional time off reduces even more the average time worked per year by firefighters, which can be computed using the following method: scheduled hours per year minus payroll tracked leave minus untracked leave = average annual hours worked. For VFRS this becomes 2184 hours – 457 hours – 129 hours = 1598 average annual hours worked per person. Based on the additional data, the average hours worked for those assigned to operations is 30.7 hours each week. This figure is used later to determine the number of personnel needed to staff VFRS units under the existing leave use scenario.

Overtime – Between 2006 and 2008, VFRS spent an average of $449,315 on overtime, a majority of which was used to bring minimum staffing up to the required 133 positions when personnel are off sick, away for training, or used to support training or maintenance activities. Very little of the overtime was paid to officers. At first this seemed odd because the staffing ratio for officers is lower than that for firefighters. However, since the fire department fills its shift vacancies with firefighters and then assigns their more senior personnel as acting officers, the practice is reasonable—in fact, it is a best practice.

Table 40 shows the overtime hours and cost for officers and firefighters from 2006–2008.

Table 40: VFRS Overtime, 2006–2008

Year	Total Hours	Hours/ Firefighters	Hours/ Officers	Cost
2006	8,059	7,894	165	$365,565
2007	10,124	9,951	173	$466,744
2008	10,652	10,238	414	$515,637
Average	**9,612**	**9,361**	**215**	**$449,315**

A contributing factor to the problem of sick leave that requires overtime is related to the vacation selection process. Currently policy requires personnel to be assigned their vacation time during certain periods of the year based on a group plan. Each person assigned to operations is assigned a vacation period and leave must be taken during the period unless another person can be found to work for them. This is an unusual policy and probably too restrictive.

The leave policy appears to be causing firefighters to call in sick instead of getting someone to work for them. A better approach is to devise a process that has personnel taking vacations in tour-long blocks or even leave for individual shifts.[24] If management and labour work together and revise the policy, the city is likely to see a reduction in sick leave use.

Recommendation 22: Consider revising the vacation and leave selection policy to provide greater flexibility for shift personnel as a way to reduce sick leave use.

Regardless, managers and supervisors such as battalion chiefs and station officers must be part of the solution and should be expected to address abuse situations when they occur.

Lowering sick leave and WorkSafe BC time off by 20 percent would be the equivalent of saving 4.0 FTE positions or $360,000, based on the average salary and benefit costs of a firefighter.

Recommendation 23: Evaluate the cause of the high sick leave use. Another strategy may be to backfill sick leave absences up to a certain level and then begin to reduce the number of units deployed. Although we do not suggest this to be an optimal solution it should at least be considered, especially in light of the city's budget situation.

[24] A tour is considered four consecutive duty shifts of two, 10-hour days and two, 14-hour nights.

Revised Staffing Factor – Using actual leave data we calculated the staffing level necessary to staff operations considering the existing leave situation. To check accuracy, two methods were used.

Method 1:	Hours worked per person/ year – the average hours off/ year divided by the hours needed per year for minimum staffing.
Hours worked per year =	2184 – 586 = 1598
Units deployed =	3 BC's x 1 x 24 x 365 = 26,280 hours/ year
	13 engines x 4 x 24 x 365 = 455,520
	5 ladders x 4 x 24 x 365 = 175,200
	11 quints x 4 x 24 x 365 = 385,440
	7 rescues x 2 x 24 x 365 = 122,640
Hours Required =	1,165,080
Personnel Needed =	1,165,080 / 1,598 or 729 FTE positions

Method 2:	Work hours/ week – Average hours worked x positions to be filled
Work Hours/ week =	42 – 11.3 =30.7 hours/ week worked (average)
	168 hours coverage/ 30.7 = 5.47
Staffing Factor =	5.47 x 133 positions = 728 FTE positions

The two approaches agreed within one the number of personnel necessary to staff the current deployment model. A question for the city now is to determine: What is the 'break-even point' where overtime is less costly than hiring more personnel? This can be determined by a financial analysis, which is not part of this project.

At its current level, the fire department could decrease FTE positions on each shift by about two FTE's and still have enough personnel. If sick leave and other absences were reduced, fewer firefighters would be needed to staff each shift. Overtime would still be necessary when extra persons are off sick or off for other unanticipated absences.

With a staffing factor of 5.47, 728 FTE positions are required to staff the current 133 positions (not including four fire investigators) on the four shifts with 182 FTE positions assigned to each shift. At this level, 49 individuals could be off before overtime is required, allowing a vacancy of 27 percent of the assigned shift. This is reasonable because the department currently allows 17 percent of shift personnel to be off on vacation under current policy. The remaining 10 percent, on average, should be sufficient to cover unanticipated absences.

Recommendation 24: Consider 5.47 to be the department's staffing factor until such time as updated leave data is available, then revise the factor accordingly.

The FTE positions which are saved can then be used to improve weekday capacity by adding rescues. Doing so however, would require the fire department to change its policy of moving personnel from their assignment in operations to support positions which it often does now to augment activities such as training that are presently understaffed. These situations are discussed in the sections that follow.

Command and Incident Safety

A battalion chief is dispatched to every reported structure fire and other calls to which multiple fire units are dispatched. The call volume for battalion chiefs is not high and they could handle more calls.

Over the past few years, the fire chief began a process of removing some chief officers from the union. Initially, the fire chief removed deputy and assistant chiefs from uniform to civilian attire and identified them as assistant general managers and managers. The fire chief then placed these officers back into uniform when the culture of management improved. This was an innovative move which has improved the management team. The fire chief also improved the selection process for assistant chief as a way to improve the management team. However, the problem of management accountability still exists below deputy and assistant chief because most battalion chiefs do consider themselves to be management, even though their position descriptions clearly say they are. This is a common problem in many other Metro fire departments in North America.

As front-line managers responsible for implementing department policy, battalion chiefs need to be more accountable for the management of their personnel and should be given more management responsibility. The battalion chiefs we met were very articulate and they were quite experienced. However, they are underutilized managerially and their status as non-exempt employees is contributing to the situation of the communication gap between upper management and line staff. Being willing to take on managerial responsibilities should be part of the selection criteria for promotion to battalion chief; if you don't want to be a manager, you don't get promoted.

Another way to improve the situation and get the benefit of their experience is to expand the role of battalion chiefs to be the 'risk managers' for their geographical area. As risk managers battalion chiefs would work with support areas in the fire department like public education, other city agencies like police, and with community groups where they would implement risk reduction strategies. Using data supplied by the fire department's planning section, battalion chiefs could easily see where problems are occurring and then take steps to address the problem. In effect, this is the concept of 'Community Policing' applied to the fire department. Whether battalion chiefs should be exempt is, in our opinion, secondary to the question of how to get them more involved in planning (and policy)?

Recommendation 25: Increase the value and contribution of battalion chiefs and have them become the risk managers for their geographical area.

Unlike other major cities of its size, Vancouver does not have a shift commander on duty but rather has elected to have a deputy chief responsible for each shift working weekday. The advantage of this system is that it gives the fire chief a core management team at headquarters. The downside is the absence of management oversight on each of the four shifts. Inconsistency among the shifts is a problem under the present arrangement, again partly because the battalion chiefs are considered 'non-exempt' employees.

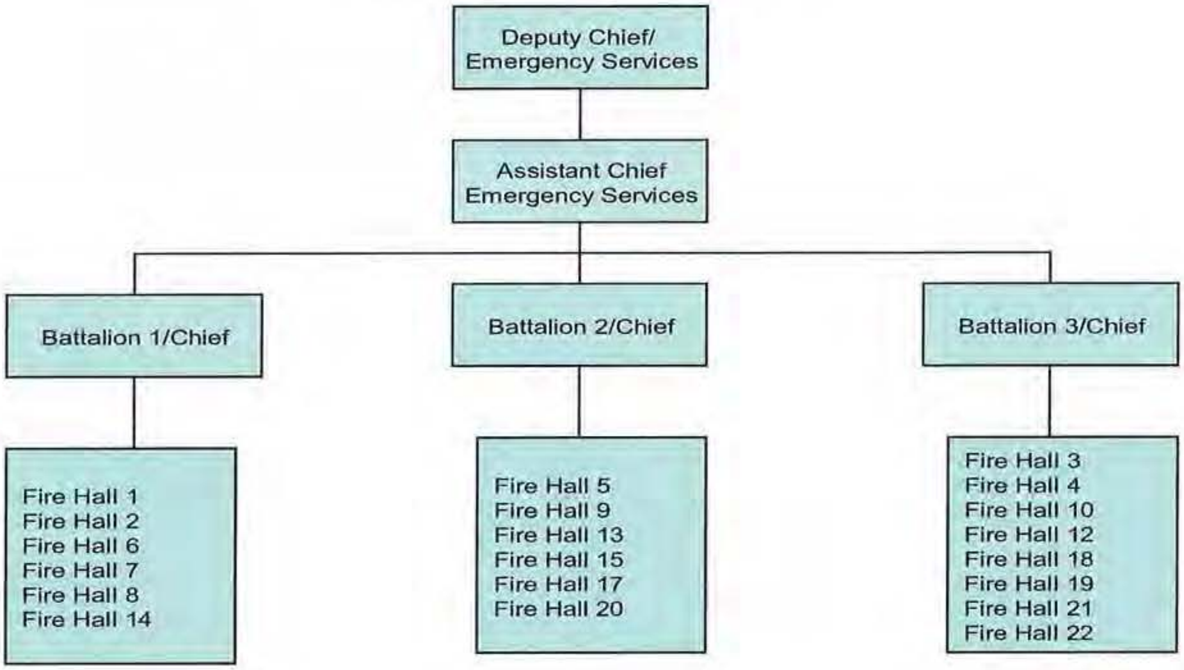
Vancouver is one of the most densely populated cities in North America (and the world). It is also a vertical city, which makes firefighting and other incidents difficult to manage. Most incidents require a minimum of two battalion chiefs to successfully manage. The problem is there are only three battalion chiefs on duty at one time. Also, current protocols call for only one battalion chief to be dispatched initially even when the incident involves a high-rise structure. If the second battalion chief is requested, only one chief remains to cover an entire city of almost 600,000 residents! With only three shift battalion chiefs, the fire department's ability to implement the nationally recognized incident command system required by today's standards, is somewhat marginalized because of the time delay waiting for a deputy or assistant chief who may be responding from home.

To increase the number of chief officers' on-duty and improve coordination between administration and operations, an assistant chief could be assigned to each shift. Doing so would improve oversight for the battalion chiefs and there would be enough commanders to dispatch two chief officers on the high-risk incidents such as those found downtown. The current organization has sufficient commanders to accomplish such a change. If this were done, the promotion from battalion to assistant chief might also be more attractive to battalion chiefs, who have thus far been reluctant to move out of the union.

Recommendation 26: Consider reassigning four assistant chief positions from their weekday assignments to command each of the four shifts. In addition to the stated improvements in oversight of each shift and better coordination of the battalion chiefs, incident command and safety will also be improved.

The revised organizational chart for operations would appear as follows:

Figure 51: Revised Organization of Operations



If the change were implemented, the four assistant chiefs could continue to work out of headquarters with battalion chief 1 also remaining at that facility.

Incident Safety and Accountability – Incident safety and accountability also need to be improved as does command support for major incidents.

The current policy is to have a rescue officer assist the incident commander with safety and accountability or get an officer from one of the other responding units. The problem is, the number of units responding is already low and splitting crews to provide command support is not a good idea. The fire department does have a safety officer but he does not typically respond to incidents, at least not early on.

The primary safety standard for the fire service, NFPA 1500, is very clear that incident safety is a priority and it articulates that an incident safety officer is required on every fire incident. Likewise, the incident management system (IMS) used by Vancouver and other departments is very detailed and there are important roles which must be filled, including safety and accountability. In Vancouver the IMS system is being used; however the chiefs we spoke to acknowledged that they were often overwhelmed early on during an in an incident, particularly by the radio traffic, and the IMS system is not being used as it should. Although chief officers in the past had drivers (aides), it is not necessary to return to them, but there is need to provide better incident management support in a city as complex as Vancouver.

An effective way to improve the situation is to staff each shift with a person who has a dual-role as command adjunct and safety officer. During times when these individuals are not actively responding to calls, they could be used to evaluate and correct other safety problems. They also could be the lead individuals for incident pre-planning activities, which are in serious need of updating, and need to be electronically maintained.

Recommendation 27: Create a safety/ command adjunct position for each of the four shifts. This position should work from the headquarters station and report primarily to the department's safety and health officer. Given the level of responsibility, these positions should probably be lieutenants, although a senior firefighter could also fulfill the role.

Pre-Incident Planning – Preplanning activities are fundamental to effective operations and VFRS falls well short in this area. There is little preplanning being done and most of the activities are simple building familiarizations, not detailed planning. Secondly, the information being collected by one shift is generally not made available or shared with other shifts or other fire halls in any consistent manner.

There are many excellent templates available to collect preplan information on building hazards and fire suppression capabilities. The CAD system and new FDM system also has a platform to collect information that can be made available to crews when an incident occurs at a particular address. As we reported earlier, Vancouver is one of the most complex operating environments in North America and VFRS should take the necessary steps and immediately begin preplanning activities on a regular basis. In fact, responders should use a large portion of their available work time in preplanning activities, particularly downtown.

Recommendation 28: Develop and implement a standardized preplan policy that is available electronically, and train all personnel on its use. Require every major hazard, including high-rise structures to have a preplan. Mandate that all pre plans must be reviewed at least annually.

Weight of Response

Earlier in this report we discussed the concept of 'weight of response'. Equally important to the speed with which units arrive at the scene, enough personnel must arrive to handle the emergency as quickly as possible. In so doing incidents do not escalate beyond the level encountered by the first units on arrival and responders are not overextended because the initial staff on-scene was too lean. On the other end, sending too many units (and personnel) is not a good idea since resources can become quickly depleted, particularly when demand peaks because of medical calls. Too often planners and administrators do not consider the importance of weight of response during their assessment of resources. Firefighters however, know how important this factor is, particularly as it related to personal safety.

Weight of response standards such as the one developed by the National Fire Protection Association are considered guidelines and there is no legal requirement for the city to meet them. However, these standards were developed by benchmarking the actual tasks that firefighters must perform initially during a fire incident; therefore, the standard is considered valuable.

In Vancouver, too few units (and personnel) are being dispatched initially to confirmed emergencies, in particular major hazards such as high-rise buildings and other locations such as industries with hazardous processes. Based on essential tasks required initially at an incident scene, our belief is that fire crews are likely to be overwhelmed initially until other units are called and arrive. As a result, a greater number of resources will be needed to mitigate the incident. Based on our conversations with battalion chiefs, it appears they are requesting additional equipment so they will have sufficient resources to control the incident, maintain reserves for unexpected situations, and to relieve first-in crews which are tired.

Table 41 compares the weight of response guidelines recommended by NFPA as compared to those used by VFRS.

Table 41: Response Level Comparisons, VFRS vs. NFPA

Type of Occupancy	VFRS Complement	NFPA Guidelines
High-Hazard	4 Suppression units; one of which must be a quint of ladder 1 Rescue 1 Battalion Chief 18 Firefighters 1 Chief Officer	4 Engines 2 Ladder Trucks 24 Firefighters 2 Chief Officers
Total Responders	**19**	**26**
Medium-Hazard	4 Suppression units; one of which must be a quint of ladder 1 Rescue 1 Battalion Chief 18 Firefighters 1 Chief Officer	3 Engines 1 Ladder Truck 16 Firefighters 1 Chief Officer
Total Responders	**19**	**17**
Low-Hazard	4 Suppression units; one of which must be a quint of ladder 1 Rescue 1 Battalion Chief 18 Firefighters 1 Chief Officer	2 Engines 1 Ladder Truck 12 Firefighters 1 Chief Officer
Total Responders	**19**	**13**

Under current guidelines, the fire department is also dispatching more units on the initial call to low-hazard occupancies such as single-family residential structures than are probably necessary. These are often residential structures already protected by sprinklers.

When first-arriving units find a serious fire or emergency and request additional resources (second alarm), current dispatch protocols require only two more suppression units be dispatched (eight personnel). Similar to the light response of a first alarm, this is also less than desirable. After-action reviews of major incidents often find that greater losses result when sufficient resources were not called early in the incident. The new CAD system has the capacity to tailor the weight of response for various property types and additional alarms can be tailored to the particular structure (or event).

Recommendation 29: Increase the weight of response for confirmed incidents at high-hazard occupancies; also when the incident requires a second or greater alarm.

Policies & Procedures – VFRS has developed policies for the most important functions and internal processes related to administration. However, many have become outdated. Part of the problem is that policy review and writing new policies falls almost exclusively on exempt managers (assistant and deputy chiefs) who already have high workloads.

There is also a problem with personnel not being familiar with important policies such as the department's high-rise procedure. During our informal meetings with station personnel it became evident that many individuals did not know the policies well enough to understand basic procedures for high-rise incidents. With over 600 high-rise structures in the city, Vancouver has a serious risk of a major high-rise incident. Knowing theses procedures and being able to implement them successfully should be a major priority.

In addition to outdated operational policies and procedures, important personnel documents such as position descriptions are also outdated. In fact, the department's position descriptions for captain and lieutenant appear not to have been updated in 50 years! Following are the last review date for VFRS uniformed position descriptions:

Fire Chief – 1984	Deputy Chief – 1984[25]
Assistant Chief – 1978	Battalion Chief – 1988
Fire Captain – 1959	Fire Lieutenant – 1959
Firefighter – 1959	

[25] A memo to advertise the position was distributed in 2006; however, the official position description reviewed by us is dated 1984.

At the time of this study attempts were being made to update polices and to get them automated on-line for personnel to access. The process is lengthy and will take time to complete. The important thing is not to have a 'one-time' review process but an on-going review process for all policies and procedures. It is also important that policy development and review include line officers and firefighters, not just exempt managers. A best practice is also to have the union review policies before they are officially adopted.

Recommendation 30: Revise the policy-writing and review process. Assign battalion chiefs and even captains to coordinate the review and update of some policies; also include the union in the review process. Up-to-date policies and HR documents contribute to a better organization and improve consistency. This is very important for large decentralized organizations such as VFRS.

Mutual Aid and Regional Cooperation – There are five fire departments with response areas contiguous to the city. Vancouver has mutual aid agreements with them, but mutual aid is rarely requested by VFRS. It relies almost exclusively on the recall of off-duty personnel when a major incident occurs.

Departments bordering Vancouver include Burnaby; North Vancouver Fire District; City of North Vancouver; Richmond; and the City of West Vancouver. Of these, VFRS coordinates its activities mostly with Richmond, primarily because of the bridges which connect Vancouver with Richmond that facilitates a better response from both jurisdictions. The mass transit system, 'Canada-Line', also runs through both communities.

The pros and cons of relying on off-duty personnel versus more mutual aid can include:

Pros	Cons
• Better familiarity with VFRS operations • Ease with which personnel integrate into the system	• Slower reaction time • Additional reserve units needed Overtime for VFRS personnel

Although mutual aid has not been used much in the past, its potential use is highly important. While Vancouver can rely on off-duty personnel when a major incident occurs, it does not have enough apparatus to handle large incidents occurring simultaneously or a catastrophic incident and still cover the remainder of the city. To be most effective in risk management, the region should develop a move-up system to cover each of the five communities in the event of a catastrophic incident. An important lesson from 9-11 is that even the largest cities need to have such plans, and not just for fire but also for police and other city services such as public works.

Recommendation 31: Develop a comprehensive move-up system for each department in the region. Consider renumbering apparatus in the region so operations can easily be integrated without confusion.

Another area where regional cooperation can be improved is special operations (hazmat and technical rescue). Currently, each department provides its own capabilities, though they sometimes coordinate special operations' training. The frequency of events requiring special operations is such that not every department needs to maintain these capabilities at a high level. A recent review of the region's hazmat capabilities showed that over a thousand personnel were certified at a high level of hazmat responder, which is inefficient. The initial training for these certifications is expensive as is the cost for recertification.

A more efficient approach would be for Vancouver to provide technical rescue and hazmat services under contract to the region, perhaps supplemented by one or two units elsewhere in the region. Each community would not need to duplicate the purchase and maintenance of high-cost apparatus. Also, training requirements could be reduced with smaller communities providing 'first-response' level training for hazmat and technical rescue.

Regionalizing special services like hazmat and technical rescue make sense financially and operationally. Politics of such a move may be involved, but it is at least worth getting the communities together to discuss alternatives. One alternative, for example, may be for Vancouver, which has a top-notch hazmat program, to provide hazmat regionally while another department with a strong technical rescue program provides these services to Vancouver.

Recommendation 32: Work toward eliminating the duplication of special services in the region. Develop a plan for certain cities to provide the nucleus of hazmat and technical rescue services to other communities. Communities on the receiving end for special services should pay a reasonable fee, that when combined among the five communities, covers the total cost minus the amount covered by the Province. A similar arrangement already exists to some degree with the fireboat consortium, a program that is working well.

Deployment Modifications for Fire and Rescue Units

The fire department has 36 first-line suppression and rescue units deployed city wide. Of these, 29 are primarily for fire suppression: 13 engines; 10 quints; 6 ladders.[26] The seven rescues respond primarily on medical calls but also handle motor vehicle accidents and other calls where people need to be extricated.

The distribution of apparatus and personnel is adequate *most of the time*. The exceptions are certain times on weekdays when medical calls are high, particularly downtown, and when up four fire units are taken off-line for training, which also occurs primarily during weekdays. The number of fire suppression units also can be short when two incidents occur simultaneously.

[26] During the time of this study VFRS changed the quint at Fire Hall 15 to a ladder.

When these situations arise, fire units from halls with two units are moved to fill in the gaps. As move-ups occur, fire halls with two units assigned will have only one unit.

These situations arise on such a regular basis that additional units are needed to cover the peak periods; this can be accomplished efficiently by adding peak-load rescues and fire units.

With only seven rescues, VFRS is still sending fire units to many EMS calls to ensure prompt response, and this is depleting the already thin fire suppression capabilities. Adding a few more rescue units will help. The rescue units can be smaller, lighter, and less expensive than current units. There are also quints deployed where engines, which are considerably less expensive, can provide adequate service.

VFRS equips its fire apparatus with a large assortment of tools and appliances to cover a wide variety of contingencies. As a result, apparatus are sometimes carrying too much equipment and this is contributing factor to oversized apparatus. Although the department has the right idea on cross-staffing specialty services like technical rescue and hazmat, it is attempting to cover every contingency from each fire hall and thus fire units are becoming over-equipped. A better approach is to provide the necessary services based on the needs of each community with specialized resources strategically located throughout the city instead of equipping each fire unit with everything. For example, only a few units need to have rescue equipment. Alternatives are discussed later in this section.

Rescues – The fire department made the right decision when it implemented rescues to handle medical calls. However, the seven rescues currently deployed are not sufficient to handle the medical call load, which already exceeds 70 percent of the department's responses. Three weekday-only units could be added downtown to efficiently handle the workload. Newly purchased rescues should be smaller units and they should not be equipped for vehicle extrication or heavy rescue. While based downtown, the peak-load units should be considered dynamic assets and moved to those areas where the highest concentrations of medical calls are occurring during a particular time period.

For personnel administrative purposes, the additional rescues are recommended for Fire Halls 1, 2, and 7; however, other locations may be preferable when space is considered. In the Downtown and nearby Strathcona planning areas where three 24/7 rescues are already located, and where medical call volume is the highest, adding three rescues (weekdays) will increase the capacity to handle medical calls by 10 percent (3 rescues x 40 hours x 52/7 rescues x 24 hours x 365). Making this change would increase the number of medical calls handled by rescues and increase the availability factor of fire units.

Quints/ Engines – Quints and engines are used interchangeably and some halls have both. The transition to start using quints was reasonable; however, decisions about where quints should be located progressed without adequate analysis. Quints cost about 1/3 more than engines and the annual maintenance costs are also considerably higher. But they provide flexibility and can reduce the total number of apparatus needed.

Quints are particularly useful when a single company is assigned to a fire hall and where a larger aerial ladder and tower capabilities are not required very often, and not close enough at other stations. This is the situation in many Vancouver neighbourhoods outside of the downtown area.

Our analysis shows that there are locations with quints where engines would be adequate. Aerial ladder coverage overall can still be adequate with fewer quints. Quints could be replaced by engines at Fire Halls 2, 4, 19, and 20. Staffing (four) is the same on quints and engines.

Ladders – Ladders and quints are used interchangeably as ladders in Vancouver, which is a good concept. Fire ground tasks are assigned based on personnel availability and specific functions and tasks are not assigned to engines and ladders based purely on the function of the unit the way some metro fire departments do. Fire ground tasks are assigned based on need and unit availability.

Currently ladders are assigned to six Fire Halls: 1, 5, 7, 10, 15, and 18. This includes a ladder that replaced a quint at Fire Hall 15. This ladder is temporarily assigned to Fire Hall 14 while Fire Hall 15 is being rebuilt, and would remain a ladder when Fire Hall 15 is completed. The new fire hall will accommodate a ladder whereas the current facility does not. Changing to a ladder at Fire Hall 15 is appropriate; however, the response time analysis determined that a ladder at Fire Halls of 5 and 15, which are adjacent, is not really necessary. The ladder at Fire Hall 5 could be eliminated and replaced with a quint. The analysis also shows that the best location for ladder 15 is to move it to Fire Hall 20 when that hall is rebuilt.

The overall plan reduces by one total number of suppression units from 29 to 28. This includes the reduction in quints from 10 to 7. However, 12 of the city's 20 fire halls (60 percent) will still have aerial ladder capabilities under the proposed realignment. Engines increase by three from 13 to 16. Following is the proposed apparatus distribution by fire hall.

16 Engines – 1, 2, 3, 4, 6, 7, 8, 10, 12, 14, 15, 17, 18, 19, 20, and 22

7 Quints – 3, 5, 6, 9, 12, 13, and 21

5 Ladders – 1, 7, 10, 15, and 18

Under the proposed plan, three stations will continue to have an engine and a quint (3, 6, and 12). Along with four other quints in single-unit halls, quints are strategically located to support the five ladders, two of which are located downtown. Only one suppression unit from Fire Hall 5 is slated for elimination under this plan. However, three additional suppression units are added during weekdays in addition to the three peak-load rescues we discussed earlier. These are discussed later.

Recommendation 33: Modify the fire suppression resources to include 16 engines, 7 quints, and 5 ladders (this is a change from the current deployment of 13 engines, 10 quints and six ladders). Each of these units should be staffed 24/7.

Vehicle Extrication and Heavy Rescue – Situations in which people are trapped as a result of motor vehicle accidents and other incidents occur frequently and in different parts of the city. Extrication service is mostly provided by the seven rescues, though each of the city's fire units are also equipped with a few rescue tools. Three of the rescues are equipped as heavy-rescue units, which mean they have additional equipment such as air bags. The problem is that the primary responsibility for the seven rescues is medical first response. Where a patient must be extricated, rescue crews are in a difficult spot because they must simultaneously address the patient's medical care and vehicle extrication. This is not a good approach and is not working particularly well. Pittsburgh, PA is another metro city where EMS rescues handle both patient care and extrication, and they are having similar problems.

A better approach is to provide heavy rescue capabilities from the five ladder units instead of from rescues. Ladder units have a much lower call volume and their locations make them a good choice strategically. In addition to equipping ladders as heavy rescues, quints and engines (located in single-unit halls) could be equipped with basic rescue tools such that most patient extrication calls could be easily handled by the first unit on scene. For situations where heavy rescue capabilities are needed, the ladders equipped with heavy rescue tools would respond. The response time analysis (in Chapter V) for the five ladders shows that they could be on-scene within a reasonable time to begin extrication.

Making such a change will result in improvements in several areas. First, rescue equipment, which is very expensive, would not be needed on every fire vehicle. Also, ladders trucks have more compartment space are they are capable of carrying rescue tools and the extra weight they bring. In addition, all eight of the city's rescue vehicles are due for replacement and the new units can be smaller, lighter, and less expensive. Finally, rescue crews can focus on patient care while rescue-equipped ladders focus on extrication.

Recommendation 34: Change the responsibility for vehicle extrication and heavy rescue from the rescues to the ladders and quints. Under the proposed plan ladders 1, 7, 10, 15, and 18 would be heavy-rescue capable. Quints 3, 5, 6, 9, 12, 13, and 21 would have basic rescue tools. Stations with a single engine could also be equipped with a few basic extrication tools, albeit not a necessity because a quint or ladder would be on scene quickly.

Recommendation 35: For calls with confirmed patient entrapments, a minimum response should be three units including one engine (or quint), one ladder, and one rescue. If, upon arrival, the patient can be extricated using light rescue equipment, the rescue ladder can be sent back immediately.

Later we discuss a new approach for special operations that includes expanding the role of ladders as technical rescue satellite units. Adding the responsibility for extrication and heavy rescue to the ladders works well with the concept of using ladders as the primary technical rescue satellite units.

Staffing – Using the staffing factor devised earlier, staffing requirements by rank for the 29 fire units, 7 rescues and 3 battalion chiefs are shown in Table 42.

Table 42: Proposed VFRS Staffing

Shift	Battalion Chiefs Staffed	Captains Staffed	Lieutenants Staffed	Rescue Officers Staffed	Firefighters Staffed	Total Staffed	Net Increase (Decrease)
A	3	20	15	7	137	182	(2)
B	3	20	15	7	137	182	(3)
C	3	20	15	7	137	182	(2)
D	3	20	15	7	137	182	(3)
Total	**12**	**80**	**60**	**28**	**548**	**728**	**(10)**

Note: The total number of officers is equal to the same number of number allocated now. The change is in the number of firefighters assigned to each shift.

If the schedule in Table 42 were used, 10 personnel could staff the additional rescues for the weekday shift discussed previously. As also mentioned however, there is a downside in that the fire department would lose the flexibility of using the extra personnel for important support functions such as training which are presently understaffed. If the fire department were to use the positions to staff the much needed rescues, support areas such as training and public education should be provided with adequate staff without using line personnel. In so doing, budgets would more accurately reflect the level of service being provided instead of being augmented by personnel from operations'.

Adding a Peak-Load Shift – As discussed above, the city needs additional capacity, particularly for the rising number of medical calls in the Downtown, Downtown, East Yale Town, and Strathcona corridor. The problem is how to handle the increased medical call volume and keep its limited fire suppression resources from becoming overused on medical calls.

Even in these areas there is not an over abundance of fire suppression resources relative to the city's risk factors. If the city does not add rescues, fire suppression units will have to handle more of the medical calls, which would make them less available for fire responses. To address the situation we developed a peak-load shift arrangement to use the extra personnel presently on each shift to add the needed rescues and extra suppression units.

Under the plan, the fire department would assign officers and firefighters to a fifth shift. The shift would work five days per week; however, each person on the shift would work four, 10-hour days, with a rotating day off each week. In this way, each person's day off moves back one day each week. To achieve a seamless integration with the four-shift schedule, work hours on the 'peak-load shift' should probably mirror that of the day-work schedule (0800–1800). This would allow those on A–D shift and those of the peak-load shift to be used interchangeably depending on staff needs. However, if future analysis shows a change in the time for peak-load, the weekday shift could be changed to meet the time when demand is highest.

To provide the staffing for the additional three rescues, two engines and one quint recommended by this study, five responders are needed for each of the 18 positions staffed, plus some overage to cover anticipated and unanticipated absences. Just as a staffing factor is included in the calculation for 24-hour shifts, a similar factor is needed for the additional, peak-load shift. The break out of personnel needed by rank to implement a peak-load shift arrangement is depicted in Table 43.

Table 43: Proposed Staffing – Peak Load Shift

Units	Lieutenants Staffed/ Minimum Required Per Shift	Rescue Officers Staffed/ Minimum Required Per Shift	Firefighters Staffed/ Minimum Required Per Shift	Total Staffed/ Minimum Required Per Shift
Rescue (3)	0/0	3/3	6/3	9/6
Engine (2)	3/2	0/0	8/6	11/8
Quint (1)	3/1	0/0	4/3	7/4
Total	**6/3**	**3/3**	**18/12**	**27/18**

Note: In the above plan, lieutenants are used to fill in for rescue officers. A variation could be to have extra rescue officers to fill in for lieutenants.

By assigning nine officers to the peak-load shift, one extra will be available four days of each week to cover leave or other vacancies. Coupled with the 10/14 schedule of A–D shift, total staffing for suppression and rescue operations will look as follows:

Table 44: Staffing Requirements for a Five-Shift Configuration

Shift	Battalion Chiefs Staffed/ Minimum Required Per Shift	Captains Staffed/ Minimum Required Per Shift	Lieutenants Staffed/ Minimum Required Per Shift	Rescue Officers Staffed/ Minimum Required Per Shift	Firefighters Staffed/ Minimum Required Per Shift	Total Staffed/ Minimum Required Per Shift
A	3/3	20/20	15/10	7/7	137/93	182/ 133
B	3/3	20/20	15/10	7/7	137/93	182/133
C	3/3	20/20	15/10	7/7	137/93	182/133
D	3/3	20/20	15/10	7/7	137/93	182/133
Peak-Load	0/0	0/0	6/3	3/3	18/12	27/18
On-Duty Weekday	3	20	13	10	105	151
Night/ Weekends	3	20	10	7	93	133
Total FTE's Required	12	80	66	31	566	755
Currently Authorized	12	80	60	28	555	739
Difference	0	0	+6	+3	+11	+16

Under the realignment, the combined fire and medical response units available increase from 36 to 41 during weekdays. To add the extra units, weekday staffing would be increased from 133 to 151 (14 percent). The analysis of FTE staff discussed earlier shows that these units can be staffed by hiring 16 additional personnel. The staffing calculation of 755 FTE's needed to operate the proposed 29 fire units, 7 rescues and 3 battalions 24/7 plus add the weekday units (3 rescues, 2 engines, 1 quint) is based on the staffing factor analysis previously discussed.

For reasons of flexibility the five additional units and 18 personnel should be 'moveable assets', and thus be able to relocated to areas of high demand or backfill empty fire halls. For example, VFRS could locate the additional rescues to major commuter routes during the morning and evening hours and then locate downtown during weekdays. Because they are considered dynamic resources, these extra units do not need to be in fire halls and could be stationed at a hospital, community center, or police station.

Recommendation 36: Consider adding a weekday 'peak-load shift' with a five-shift configuration. Although the extra shift could work any 10-hour period, its best for leave and detailing purposes to mirror the weekday shift schedule to that of the other four shifts, e.g., change shifts at 0800 and 1800 hours each day.

For the Olympics, VFRS has plans to increase the operations' staff by approximately 25 percent. Planning for the Olympics will be a major initiative for VFRS, thus we suggest that changing to the five-shift (peak-load) arrangement be implemented after the Olympics. However, it could conduct a pilot with one or two rescues to see how the arrangement works.

Special Operations, Urban Search and Rescue and Emergency Preparedness

The fire department has a critical planning role for major emergencies and it is the lead agency when out-of-the-ordinary incidents occur. Such incidents can include tornadoes, floods, airplane crashes, structural collapse, or terrorist-related events. Generally, the fire department is prepared for these situations. However, the organization of these functions within the fire department structure and its coordination with other agencies need improvement.

From the perspective of USAR and special capabilities within the fire department, there are six major risks that the fire department should be prepared for, both in planning and actual response. In no particular order, these include:

- Seismic event
- Hazmat incident
- Port incident
- Natural disaster
- Terrorist event (CBRNE)
- Structural collapse, confined space, or high angle rescue event

Although the fire department has many resources and special equipment at its disposal, internally it does not have the training or capabilities to handle all of these incident types. On the positive side, the cross-staffing approach used by VFRS for special operations is efficient because the number of technical rescue and hazmat calls do not justify stand-alone hazmat and technical rescue units.

Organization – The responsibility for coordinating special operations, USAR, and Emergency Preparedness is presently assigned to two individuals: an assistant chief of special operations and a manager for emergency preparedness.

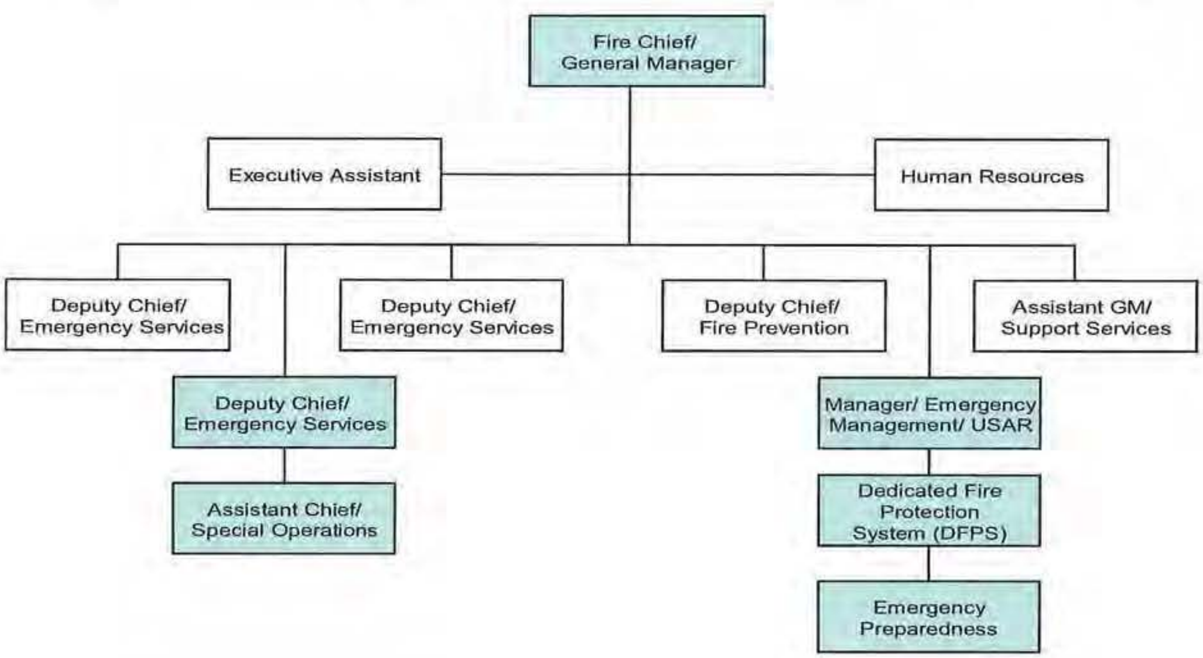
Under the current table of organization the chief of special operations reports to a deputy chief while the emergency preparedness manager, who is a civilian, reports directly to the fire chief. Each individual has responsibility for parts of the department's resources but neither is coordinating the entire effort. That the functions are separate organizationally and the individuals responsible for them report to separate individuals is hurting day-to-day program coordination. When an actual event does occur, the same duality will hinder the effectiveness of the response.

Responsibilities for the chief of special operations include the oversight of all technical rescue activities assigned to various fire halls. This includes technical rescue, the fire department's hazmat program, marine firefighting and wild-land firefighting. Combined, over 100 personnel are trained for hazmat and technical rescue. The current chief of special operations is well qualified and has served previously in other VFRS management positions including chief of training. He is also certified as a USAR task force leader.

A civilian manager is responsible for emergency preparedness, which includes the oversight responsibility for USAR. USAR has approximately 72 members including 16 from Vancouver police; 15 from British Columbia Ambulance Service (BCAS); 24 from VFRS, and several from public works. USAR was created in 1995 and officially activated in 1997. Selected by USAR team members, the USAR team leader is appointed by the city manger and confirmed by the city council. Headed by a civilian, the current team is unique in the USAR community. Ninety-percent of the team leader's time is devoted to USAR activities.

Following is an organization chart showing the alignment of special operations and emergency preparedness.

Figure 52: Current Organization of Special Operations and Emergency Preparedness

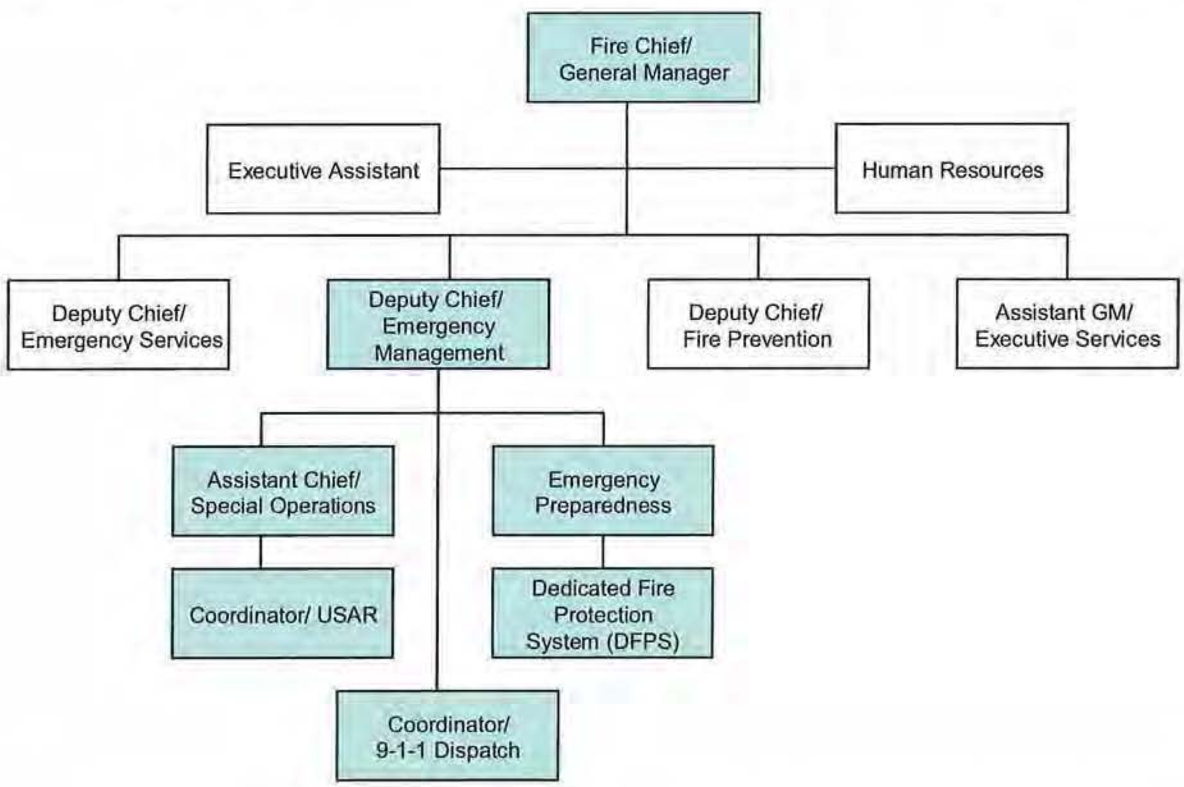


Having a civilian responsible for USAR is unusual and although the arrangement appears to be working, it is untested during an actual emergency. It is likely to be problematic during a major incident when there is a large contingent of firefighters accustomed to working under a uniformed commander. Evidence of the potential problem occurred just prior to this study when a scheduled training exercise for USAR and special operations personnel was cancelled, reportedly because the exercise was not being managed by a uniformed commander.

To improve coordination and overall command we recommend combining special operations and USAR under the same individual. A workable scenario would be for the current chief of special operations to assume the lead role with the civilian emergency preparedness/ USAR coordinator assisting the commander in a support capacity. The workload is amply high to have a senior-level support person within the unit.

Figure 53 depicts the proposed new table of organization with USAR under the chief of special operations.

Figure 53: Proposed Organization of Special Operations, USAR, and Emergency Preparedness



The proposed realignment of special operations and USAR are assigned to one deputy chief with overall responsibility for emergency management. Although there are many ways to realign these functions, a key concept should be to improve the continuity of command and to improve program coordination. Effective command at a major incident using the fire department's already existing command structure should also be a consideration.

Emergency preparedness, which encompasses mostly the planning and policy development for large-scale incidents, could remain under a civilian manager with the actual operations (USAR and special operations), which are tactical, should be under the assistant chief.

Recommendation 37: Reorganize special operations and USAR under one of the deputy chiefs, with an assistant chief being responsible for both functions. Include other related functions such as the DFPS and emergency preparedness, which are mostly planning and education. The coordination of activities with E-Comm should also be located under this deputy chief. Staffing for the proposed area appears to be adequate to support each of the programs identified. However, a part-time administrative support person is probably needed.

As the largest city in British Columbia, Vancouver is a good choice to coordinate USAR activities. However, USAR is a much larger expense than most realize and the city has assumed much of the financial obligation to maintain its force of trained responders from various city agencies. The Federal government currently pays $197k for USAR but this is not nearly enough to cover the full cost. In fairness, since 1995 the federal government also has contributed $3.7M in grants for equipment. The city paid $.73M in matching funds plus an unknown amount for training.

While a USAR team is needed; the entire program should be reviewed with particular attention to cost, and whether the Federal Government (and Province) should be paying the entire cost for the program. Because USAR responds nationally (and internationally) it should be cost-neutral for the city.

Recommendation 38: Conduct a full review of the USAR program, including its total cost, with an eye on having more of the cost transferred to the federal government and Province.

At the time of this study, the technical rescue component of special operations included high-angle rope rescue with some fire personnel also having received training in confined space rescue. However, responsibility for confined space rescue does not fall on VFRS. Also, structural collapse and trench rescue, which are typically performed by specially trained fire personnel in most other communities, come under USAR (and public works) in Vancouver. VFRS also has several wild-land firefighting units.

Following are the technical rescue capability locations by fire hall:

- **Fire Hall 1** – Marine firefighting; engine and ladder crews at this station are cross-trained to operate Fireboat 1 located at the Main Street dock; a minimum of two fireboat operators must be on-duty at Fire Hall 1

- **Fire Hall 3** – Hazmat; engine and ladder crews are both cross-trained as the primary hazmat responders during for a hazmat incident
- **Fire Hall 4** – Hazmat support; one quint and rescue units with crews trained to provide hazmat support such as decontamination
- **Fire Hall 5** – Wild-land firefighting; engine and ladder crews are cross-trained
- **Fire Hall 6** – Technical rescue backup; engine and quint crews are cross-trained in high-angle rescue; this station is back up to the primary technical rescue team at Fire Hall 7
- **Fire Hall 7** – Technical rescue (high-angle and confined space); engine and ladder crews are cross-trained
- **Fire Hall 8** – Wild-land firefighting; engine and rescue crews are cross-trained in wild-land firefighting
- **Fire Hall 10** – Hazmat; engine and aerial tower crews are cross-trained in hazmat; also mobile nuclear detection lab
- **Fire Hall 12** – Marine firefighting; engine and rescue crews cross-staff the fireboat located at False Creek; minimum of two fireboat operators must be on-duty at Fire Hall 12
- **Fire Hall 19** – Wild-land firefighting; quint crew is cross-trained

In addition to concerns about the overall coordination of technical rescue and USAR programs, it is our opinion that the fire department is spreading itself too thin by requiring so many responders to be trained at such a high level for rope rescue and hazmat. The required training for responders to earn (and maintain) their certifications in these areas is a big commitment, and the department struggles to maintain the required training.

For the two-year period of October 2006 through 2008, VFRS responded to only 13 technical rescue calls, 8 of which were for high-angle rescue. Even though the number of technical rescue calls is low, special services provided by the fire department are still needed. In fact, the fire department should expand its capabilities to include collapse and trench rescue. Collapse and trench rescue are currently provided under the USAR with public works having the lead role. During a major incident involving a collapsed structure or trench rescue, VFRS will provide the lion's share of labour and probably command the incident, so it should be the lead agency.

Strengthening the technical rescue program and broadening its capabilities can be achieved by taking several steps. First, the primary responsibility for technical rescue should be moved from Fire Hall 7 to a less-busy hall. Fire Hall 7, which is located downtown, is one of the city's busiest fire halls. And while its central location is good for a potential response to a high-angle rescue call, it is not a good location to reach other areas of the city. The call volume at Fire Hall 7 will also make it difficult to train in all of the technical rescue specialty areas if the program were expanded. A more centrally located hall that has two units and has a lower call volume would be a better choice.

Recommendation 39: Transfer the responsibility for technical rescue from Fire Hall 7 to a less busy and more centrally located hall. Because of its low workload and location, we suggest Fire Hall 18 as a prime location; it is also a two-piece station (engine and ladder) with eight personnel assigned.

In addition to changing the primary location from which special operations are delivered, technical rescue can also be strengthened by incorporating the aerials into the program. Even with eight highly-trained personnel at Fire Hall 18 (or 7 if it remains there), there would not be enough technical support to handle a major collapse incident. Just as Fire Hall 6 is the current backup for high-angle rescue in Vancouver, other large departments find it useful to identify several of their aerial (truck) companies as support units and train their personnel in one of the specialty areas.

For example, if technical rescue were moved to 18, Fire Hall 7 could remain as the high-angle support unit and respond with 18 on such incidents. Other fire halls with aerials could then be trained in trench or collapse rescue. Such a program also works well because the personnel at the support halls accumulate advanced training which prepares them for a future assignment to the primary technical rescue hall. The proposed change also fits well with the previously proposed recommendation that aerials assume the greater role for rescue and extrication.

Recommendation 40: Assign each of the five ladders to be a technical rescue satellite company and dispatch them with 18 on the appropriate calls. At the same time, identify Ladder 7 as the high-angle satellite company and continue to train the personnel at this station in high-angle rescue; Quint 6 could continue to be the back-up. Ladders 10 and 15 could be assigned as trench/ confined space satellite units.

It is recognized that expanding the current high-angle rescue program to include other services, moving technical rescue to a new hall, and incorporating support units with other aerials would be a major undertaking. However, it is our opinion that such a move in conjunction with the reorganization of special operations and USAR will benefit the city over the long term by making it better prepared.

Other findings regarding technical rescue and USAR include:

- The effectiveness of a hazmat response is being compromised because the engine and quint crews at Fire Hall 3 are being split up during the day to backfill other stations; our recommendation to staff three weekday suppression units will provide relief to this situation.
- VFRS often fills vacant positions under the USAR team leader such as the person responsible for the Dedicated Fire Protection System (DFPS) and emergency preparedness with personnel who are on light duty rather than hiring/ promoting individuals with a particular skill set. Civilians should also be considered to fill these positions.
- Grant writing is a major responsibility of the USAR team leader. There is a coordination gap between grants written by the fire department and those written by other city agencies.
- Support functions within USAR such as logistics, communications, and planning are not being filled. During a deployment these are important positions but few responders take the necessary training to serve in these capacities.
- Emergency Management comes under the city's Human Resources Director, which is unusual. Reportedly, there have been no major training exercises in recent years and there are concerns that most of the major response organizations including BCAS, police, fire, and public works will not be able to operate within a unified command framework, which is essential.
- There is no back-up person to the assistant chief of special operations. At the same time, field battalion chiefs are sometimes reluctant to assume command at calls involving special operations.
- Like other department procedures, the operating procedures and SOG's for USAR and special operations are not up-to-date. This is mostly a problem with workload such that managers do not have enough time to manage the special operations and USAR and write policies.
- The current high-angle rescue vehicle is a used vehicle that is not adequate to support the expansion of technical rescue. In fact, the current vehicle is not authorized as part of the department's vehicle inventory but it should be.

To improve these areas the following recommendations are offered:

Recommendation 41: Review whether Emergency Management should be reorganized, possible under the mayor's office. Evidenced by multiple comments we received there does not appear to be enough oversight or coordination among the various city departments and within the Emergency Planning Group. In fact, some members may not even be attending meetings of the Planning Group.

Recommendation 42: Consider consolidating the grant-writing process under one agency in central government. Use subject matter experts from the fire department to assist in grant writing but do not have the fire department write its own grants.

Recommendation 43: Maintain the hazmat deployment model used now but keep the units at the specialty fire halls together whenever possible. Adding three weekday fire units should help in this regard.

Recommendation 44: Conduct a thorough review of all special operations/ USAR procedures. Identify the most outdated procedures and prioritize them for review. Assign those to be updated to company officers and battalion chiefs for the initial review.

Recommendation 45: Identify a backup person for the special operations chief. Preferably, this individual should be a chief officer; however, a captain could also 'act' in the capacity when the battalion chief is unavailable. We suggest that a civilian not be in-charge of special operations or USAR activities where they may be required to command uniformed personnel. Although the incumbent appears well qualified, legal issues might arise if the current system is continued.

Recommendation 46: Replace the current technical rescue vehicle. Although the vehicle is above the number of fleet units authorized by the city for the fire department, this vehicle is needed and its eventual replacement is justified.

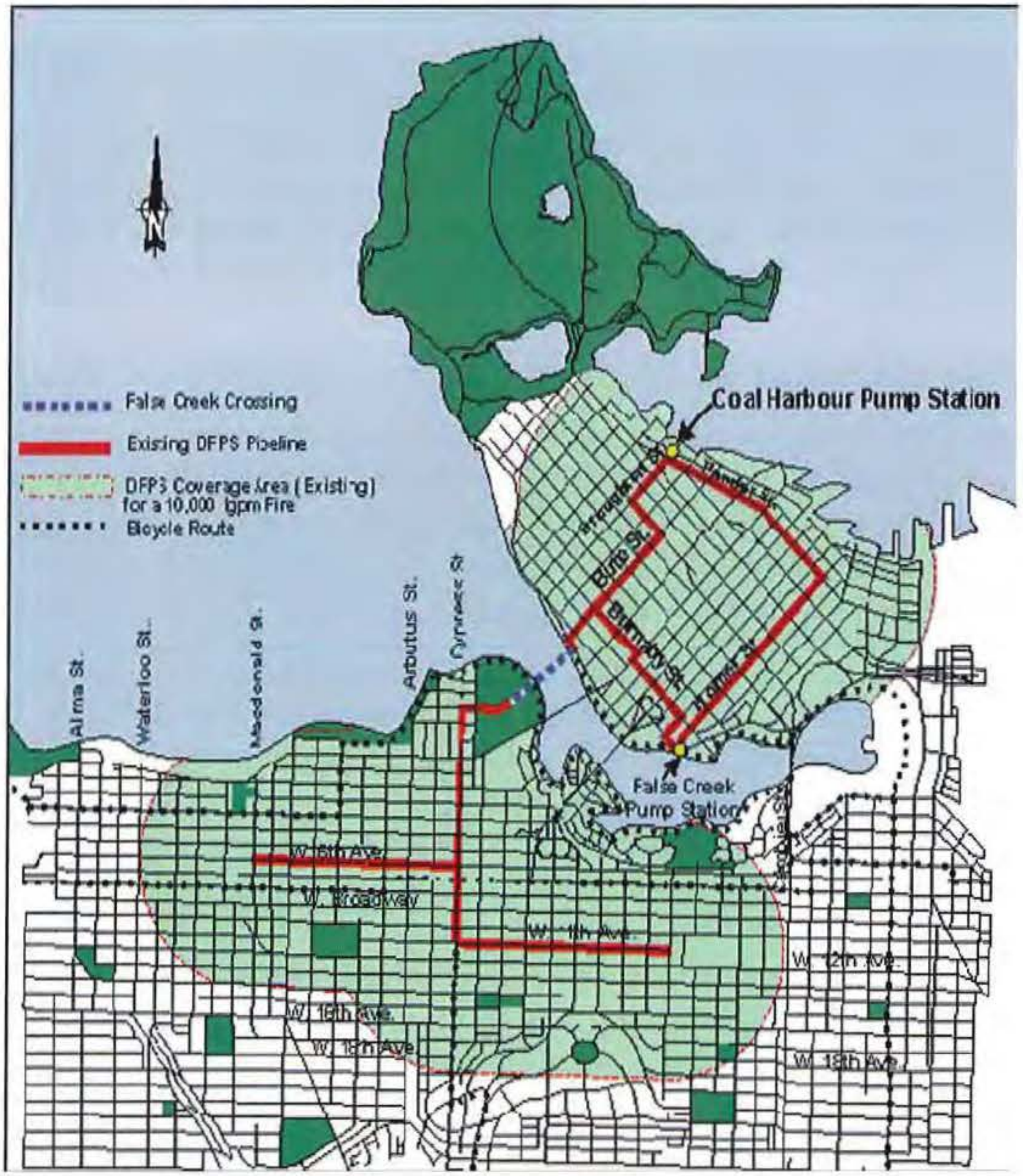
Dedicated Fire Protection System – Vancouver has one of the most impressive fire protection systems in the world in the DFPS. "Following the October 1989 San Francisco earthquake, Vancouver reviewed methods of providing an alternative water supply for fire protection and a concept report recommended a high-pressure saltwater pumping station and dedicated distribution system."[27] The system is considered a model and other communities around the world are considering systems similar to Vancouver's. Phases of the project were completed in 1995 and 1997 with the full system becoming operational in 2003.

The DFPS has been used during one major incident and there were others where the high-pressure system could have been used but wasn't. In addition to two redundant pumping stations, each with independent "fuel and drive systems", the DFPS is capable of complimenting or replacing the city's municipal water system by supplying salt water from the bay at up to

[27] http://vancouver.ca/engsvcs/watersewers/dfps.htm

"20,000gpm at 200psi".[28] The DFPS coverage area depicted in Figure 54 is manned 24/7 by personnel from Engineering Services.

Figure 54: DFPS Pump Stations, Water Main Locations, and Coverage Area[29]



As impressive as it is, the system is only as good as the training of the personnel who may be required to operate it. A fire lieutenant is presently assigned to coordinate with

28 Ibid.

29 http://vancouver.ca/engsvcs/watersewers/dfps.htm

Engineering Services and provide training to the fire department. However, training has been inconsistent at best and many fire personnel still do not have an adequate understanding of how the system operates. Although the lieutenant assigned to the DFPS is, by all accounts, doing an excellent job, the position could be filled by a civilian when the incumbent retires.

Recommendation 47: Consider replacing the current DFPS coordinator, who is a lieutenant, with a civilian position when the incumbent retires.

During its review process, fire personnel suggested that the DFPS coordinator position might also be moved to the training division. Although this could work, we think a move to training would require the incumbent to devote more time on other training areas and less on emergency management planning for large incidents, which is the reason for constructing the DFPS in the first place.

Emergency Medical Services

Medical response provided by VFRS is a non-transport, first responder, basic life level with transportation and advanced care provided by the BCAS. BCAS is the exclusive provider of EMS transportation within the province. During this study the analysis was confined to the medical care provided by VFRS; a study of BCAS was not included in the scope of work. However, we did meet with BCAS officials to understand the capabilities of the whole system.

The Provincial EMS System – The provision of healthcare in Canada is the responsibility of Provincial government.[30] The Constitution Act of 1982 solidified the provincial government's responsibility for EMS when it charged the Parliament and Provincial governments, under the Equalization and Regional Disparities section, with promoting the health and welfare of Canadians, reducing disparity of opportunities, and providing essential public services to all Canadians.[31] In British Columbia, the Medical Practitioners Act restricts the practice of medicine to a physician registered under Section 81 of this Act. Section 82 of this Act allows those certified to practice under the Health Emergency Act such as paramedics and first responders to provide emergency medical care. Non-physicians are not permitted to provide care in violation of Section 81 of the Medical Practitioners Act.[32]

The Emergency and Health Services Commission (EHSC) is responsible for regulating the provision of EMS in British Columbia. EHSC comes under the BC Ministry of Health Services, which oversees all aspects of public health. A panel that includes representatives from

[30] *The Constitution Act, 1867;* Department of Justice, Canada.

[31] *Constitution Act, 1982*; Department of Justice, Canada.

[32] Cameron, P., *First Responders, Fire Services and Pre-Hospital Care in British Columbia: A Report to the Emergency Health Services Commission.* 2007, The Emergency Health Services Commission.

the Ministry of Health and other governmental agencies oversees the EHSC. The EHSC has two primary responsibilities: 1) direct oversight of pre-hospital care; 2) management of Health-Lines Services BC, the tele-health care program providing assistance to citizens and medical professionals.

British Columbia Ambulance Service – British Columbia Ambulance Service (BCAS) provides service to most of British Columbia and covers 929,739 sq. km. It serves 4.3 million people and has an operating budget of $283 million. Leadership is provided by a Chief Operating Officer (COO), who oversees an executive team assigned to corporate headquarters or at regional offices. BCAS is organized into two main divisions: operations and corporate services. The operations division oversees the actual delivery of EMS field services, while corporate services provide administration and support.

As one of the largest EMS organization in North American, BCAS employs 3,471 field paramedics (1,427 full-time and 2,044 part-time), with an administrative and support staff of 352 personnel. The BCAS can staff up to 470 ambulances, 41 support vehicles (heavy rescue, hazardous materials, etc.), 9 aircraft (3 helicopters and 6 fixed-wing aircraft), 16 EMS bikes, and 17 medical support units. Units are deployed from 187 stations.

Of the 187 ambulance stations, 106 are in rural or remote areas, 35 in urban centers, and 36 in metropolitan areas.[33] During FY 2007/2008, BCAS responded to 526,015 requests for service; 373,728 for pre-hospital service and 152,287 for inter-facility transfers. Service requests have increased significantly over the past decade with an increase in call volume of 0.9 percent in FY 2007/2008. Aero-medical transport services have also increased but at a slower rate (4.5 percent) with 8,673 calls in 2007/2008. The number of fixed-wing miles has reached over 2.5 million annually, while rotary hours have levelled off to 2,421.

The response area of BCAS is extremely diverse. In addition to the rural areas of the northern Province, BCAS also covers the highly populated Vancouver metro area. To manage such a large area, four regions have been created: Vancouver Island, Lower Mainland, Interior, and Northern. The city of Vancouver is located in the Lower Mainland District, where the BCAS responded to 90,647 calls, 71,806 pre-hospital and 18,841 inter-facility transfers in FY 2007/08. The Lower Mainland District has 45 ambulance stations and covers 71,020 sq. km. The Lower Mainland is also covered by jet, turboprop, and helicopter aero-medical services.

[33] BCAS. *BC Ambulance Service (BCAS) Statistics*. 2008 [cited 2009 February 17]; Available from: http://www.bcas.ca/EN/main/about/statistics.html.

The current Unit-Hour-Utilization (UHU) for the Lower Mainland is .55 (i.e., 55 percent of the time they are unavailable for a call), which is considered high within the industry. To improve medical service availability and lower the UHU, plans are to increase the number of vehicles serving the Lower Mainland to 85.

EMS Provider Levels: Within the British Columbia system there are 12 unique EMS provider levels, but these can be grouped into six licensure levels:

1. Critical Care Paramedic (CCP)
2. Infant Transport Team (ITP)
3. Advanced Care Paramedic (ACP)
4. Primary Care Paramedic (PCP)
5. Emergency Medical Responder (EMR)
6. Emergency Medical Assistant (EMA).

Each level, except for EMA is restricted to BCAS ambulance and aero-medical providers. Within EMA there are three additional levels:

- EMA-FR – The basic first responder level (AED and Spinal Immobilization optional)
- EMA-FR (w/Class 2 Endorsement) – Includes additional basic airway skills and oxygen
- EMA-FR (w/Class 3 Endorsement) – Includes Level 2 endorsement plus oral glucose administration

Since our study concerns only VFRS medical first-response, the review here was limited to the EMA level of service. Currently, most provincial fire department first responder programs are limited to providing the EMA level of care. The exception is Kitmit, which is now permitted to provide EMR level service.

EMS Medical Direction: Medical direction for British Columbia (and Vancouver) is the responsibility of the EHSC's Provincial Medical Leadership Committee. The Committee provides its direction through each of the BCAS regions, which also has a physician medical director reporting to the Vice President of Medical Affairs. Regional EMS medical directors have authority over the scope of practice for all EMS providers. They are not officially the medical directors for fire first responder programs, but they approve any requests to expand provider scope of practice or service. Regional directors also decide which medical calls first responders will be dispatched to and until recently, VFRS had little input on these policies, which was major concern.

At the local level fire departments that provide medical first response also have a physician medical director. This individual is responsible to oversee the program's quality, typically through the fire department's EMS officers. Because there are varied levels of EMS services provided within British Columbia, the level of responsibility and interactivity of medical directors with BCAS vary with level of service provided in their area.

During our discussion with BCAS and others within the system, there was general agreement that the level of care provided by VFRS could possibly be elevated if there was a desire to do so since BCAS is already taxed and their response times are high. However, the medical director cannot make such a change due to the extensive laws and policies that regulate medical response practices. In Vancouver, new protocols must be approved by the regional medical director and ultimately EHSC.

Medical Priority Dispatch System (MPDS): Recently, BCAS and the provincial emergency dispatch system implemented a medical priority dispatch system (MPDS). The system prioritizes EMS calls based on information about the patient's condition. Determining the patient's condition and the desired response is based on a strict protocol implemented by trained call-takers and dispatchers. MPDS systems allow for the determination of who should respond (i.e. fire, EMS, rescue, supervisory personnel, etc.), response condition (emergency or non-emergency), and provides protocol-driven pre-arrival instructions.

Success factors for MPDS include: the use of a validated program, medical oversight of procedures and personnel, quality management, case review, and executive-level input as the efficiency of the program. The VFRS has been involved with the MPDS process and should continue being actively involved. The success or failure of MPDS will directly impact the VFRS' ability to execute its first responder program. Failure to stay actively involved with the management of MPDS may lead to inappropriate and untimely dispatch of first responder companies.

Recommendation 48: VFRS should continue its active involvement with the management of the province MPDS program.

EMS Operations within VFRS

EMS is commanded by an assistant chief who is responsible for EMS training and policy. Because Vancouver does not provide transport capabilities, the level of managerial oversight is not nearly as high as for departments that do offer transport. It is also not as high because advanced life support (ALS) service is provided by BCAS.

With the recent retirement of the training chief, who was a non-exempt division chief, there is an opportunity to combine training and EMS. Making such a change makes sense organizationally as those currently responsible for EMS training would join the fire training staff. There is also a need to improve EMS quality management and the consolidation of EMS and training would allow such an improvement since training and QA go hand-in-hand.

Recommendation 49: Combine the EMS chief and training chief into one assistant fire chief for Training and EMS.

The primary response for medical calls are seven, two-person, rescue units located throughout the city. However, standing policy is to dispatch the closest fire or rescue unit to medical calls. Rescue units, which are smaller than fire suppression units were implemented in the 1990's following an earlier TriData study. The change was made in response to the city's growing EMS call volume as a way to lessen the responses for larger fire apparatus and get smaller, two-person units responding to medical calls. Since its inception the number of rescues has not increased despite the increased number of medical calls being handled.

During 2008, the VFRS responded to 28,595 EMS related incidents, representing over 70 percent of the services provided. Exact figures on first-in percentage and time on scene prior to BCAS arrival were not available from either BCAS or the regional dispatch services. Specific types of responses for 2007 and 2008 describe the services generally provided.

Table 45: VFRS EMS Responses

Type of EMS Response	2007	2008
Medical – Emergency Response	22,367	23,011
Medical – Vehicle Incident	4,607	4,042
Medical – Cardiac Systems/ Related	712	662
Medical – Unclassified (remarks req)	440	323
Medical – Cardiac Arrest	277	241
Medical – Home Accident	204	262
Medical – Industrial Accident	49	42
Medical – Fire Fighter Injury	10	12
Total VFRS EMS Incidents	**28,666**	**28,595**

As mentioned earlier, VFRS personnel are certified to the EMA-3 level. This allows them to provide basic medical assessment, defibrillation, oxygen administration, spinal immobilization, administration of oral glucose to patients with low blood sugar, and child birthing. In British Columbia, EMA-3s do not measure blood pressures. Patient care appears to be good, with the city making a concerted effort to improve cardiac arrest survival. The current cardiac arrest survival rate is over nine percent, which is good for a large urban community.

The VFRS' increased success in cardiac arrest resuscitation is likely due, in part, to their aggressive community CPR training program. VFRS firefighters who are certified CPR instructors teach CPR to approximately 4,000 citizens annually. Every high school senior in Vancouver completes a three hour citizen CPR program taught by a VFRS firefighter.

Firefighter/CPR instructors teach all programs off-duty and are provided a stipend for their services. They provide a variety of CPR courses including basic CPR, pediatric CPR, CPR for professional responders, and similar programs. There are anecdotal reports that citizens taught CPR by VFRS personnel have assisted with successful resuscitation. The department needs to collect data on each incident where one of their trainees performs CPR, especially when it is part of a successful resuscitation. When responding on a call where citizen CPR was performed, VFRS company officers should ask if the citizen performing CPR was trained by a VFRS firefighter.

Recommendation 50: Continue the excellent citizen CPR program already in place and collect data on its overall success.

Based on the response data, city firefighters could provide additional interventions to improve patient care and medical outcomes. In addition to possible changes to Provincial legislation, an upgrade for some responders from EMA-3 to Emergency Medical Responder (EMR) would also be necessary. With some additional training, interventions including: blood pressure measurement, administering bronchodilators to asthma patients, administering aspirin to suspected cardiac patients, and administering sublingual nitroglycerin to suspected cardiac patients will speed critical intervention to patients.

Increasing the scope of practice would allow BCAS personnel to concentrate on advanced skills including identification of STEMI patients, advanced assessment of stroke patients, complex airway management, and the administration of advanced therapies. Providing these skills also decreases the criticality of faster ambulance response, because first responders can provide more critical care interventions can be quickly provided.

The operational changes recommended by this study include having rescue units return to their original reason for creation, which is to handle medical calls. In so doing, the vast majority of medical calls should be handled by rescues. Upgrading the skill level of the rescue lieutenants would be an efficient way to increase the level of care without additional EMS training for most of the 700 responders assigned to operations.

Recommendation 51: Upgrade the current scope of EMS practice to include blood pressure assessment, administration of inhaled bronchodilators, aspirin, and sublingual nitroglycerin. If the EMR licensure level were implemented, the fire department's medical director would have more day to day input.

With the decision to upgrade the level of care provided for medical calls VFRS must consider whether it is advantageous to upgrade some or all of their firefighters from EMA-3 to EMR. Bridge training to EMR requires 60 hours of training, with over 50 hours involving simulator/laboratory exercises. Upgrading providers to EMR may help the city convince the provincial medical advisory council to consider expanding the firefighter first responder scope of practice.

At a minimum VFRS would benefit by upgrading rescue personnel to EMR and expanding the scope of practice for personnel on these units. For example, the rescue lieutenant position, which is already a separate classification, could be expanded to require EMR. Upgrading the skill level of rescue lieutenants will be less expensive than upgrading the skill levels for the many firefighters who staff the rescues from time to time.

Recommendation 52: Consider upgrading rescue lieutenants from EMA-3 to EMR providers. Making this change would also require that the medical priority dispatch system be upgraded to reflect the higher level of care.

Training – The EMS training staff consists of two full-time training officers and one non-uniformed EMS clerk. These personnel report to the Assistant Chief of EMS, and work closely with the Fire Academy staff. Full-time EMS training officers work a daylight schedule and receive 128 percent of a 10-year firefighter pay (5 percent above captain). The full-time EMS instructors manage the EMA program, conduct recruit orientation, instruct rescue training, and help the assistant chief with EMS quality management.

The full-time training staff is assisted by 80 uniformed personnel who are certified as EMA-3 instructors; eight of them also are certified as instructor-trainers. The support instructor cadre occupy positions throughout the ranks and the fire department attempts to staff at least one instructor in each hall to assist with training. In addition, there are 40 firefighters certified as CPR instructors and these personnel assist with firefighter and citizen training.

Over 700 firefighters are trained as EMA-3s and they are required to attend 16 hours of continuing education every three years. Training is provided on-duty with most being conducted by the EMA first-responder instructors assigned to individual halls. Every three years, each EMA-3 must successfully pass a written and practical examination that is administered by the British Columbia Ministry of Justice Authority. The written exam is in two parts, one covering basic EMA skills and the other AED protocols.

Also included is a practical examination that includes basic EMA skills, AED, and spinal immobilization procedures. The written and practical examinations are administered and graded by VFRS instructors. The instructor who evaluates the practical examination must be different from the course instructor. Firefighters who fail either the written or practical examination must go through remedial training. Maintaining EMA-3 certification is a condition of employment for uniformed personnel below battalion chief.

Recommendation 53: VFRS should work with the Ministry to combine the basic EMA and modular written recertification exam into a single examination.[34]

Response – EMS demand constitutes over 70 percent of the fire department's call volume and, based on our analysis, future EMS calls are expected to increase more than fire calls. To handle medical calls the fire department has deployed seven rescue units. However, these are not nearly enough to handle the call load and fire units, which are already in short supply, are responding on most of the city's medical calls. In addition, current policy is to dispatch the closest unit, whether rescue, engine, quint, or ladder regardless of the severity of the call. This means that since there are far more fire units than rescues, the likelihood is that a fire unit will respond.

To address the increased demand and reduce the number of medical calls responded to by fire units, VFRS should add capacity during the peak periods which are generally weekday hours (downtown). These units can be located in the area of highest demand but they should also be considered dynamic and moved to locations where high call volumes are occurring or where rescues are tied up.

Going forward VFRS should also continue its current delivery model of non-transport EMS. At the same time it should really consider enhancing the level of care provided since it is unrealistic that BCAS will ever be able to provide a response time equal to that already available from the city's fire and rescue units.

Another option is to change the medical response protocols within the MPDS such that the closest fire unit (and rescue) are dispatched on the most serious emergencies with rescues responding to routine medical calls where response times are not as critical. By using a tiered-response protocol fire units would respond to fewer medical calls (since most are minor) and be available for more serious medical calls and for fire response. Such a protocol could be designed as shown in Table 46 below:

[34] Reportedly, the exams have now been combined.

Table 46: MPDS Tiered-Response

MPDS Priority	Weight of Response
Level A Calls	Non-Emergency – No VFRS Response (sometimes requested by BCAS, however.
Level B Calls	Urgent – VFRS Response only if BCAS ETA greater than 8 minutes
Level C Calls	Emergency – Closest VFRS Rescue responds. Engine or ladder responds only if a rescue in unavailable
Level D Calls	Emergency – Closest VFRS Unit responds
Level E Calls	Critical Emergency – Closest VFRS Unit and closest Rescue responds[35]

Recommendation 54: When peak-load rescues are added to high-demand areas downtown, consider using a "rescue first" policy for MPDS Level C and D calls. The personnel deployment analysis discussed earlier in this chapter included the required personnel for three additional rescues as part of the peak-load staffing. It is envisioned that a "rescue first" policy would initially be limited to the downtown district. Then, if the program were successful, might be expanded to other areas of the city.

Future EMS Role and Resources – As this study concluded the city was considering whether it could eliminate its seven rescue units and rely solely on BCAS for EMS service. The question is complex since VFRS uses the rescues not only for medical calls but also to augment on-scene staffing for other incidents such as structure fires. Rescue units are also equipped with specialized tools to handle vehicle extrication calls. VFRS rescues augment the services provided by BCAS and it delivers a faster response time because there are more units, thus the medical first response delivered by the rescues is probably considered very important to city residents. Whether they could be eliminated, and at what savings, is a question beyond the scope of this study; however, if the city is serious about such a move, the question should be studied. The study should also consider the cost for the city to augment the BCAS services and whether the Province should possibly pay for the rescues.

Recommendation 55: Initiate a future study to determine the full cost of delivering medical service by the city's seven rescues and the extent to which VFRS services would need to be altered if rescues were eliminated. The study should also consider whether the Province should pay for the medical service provided by rescue units since bylaws mandate that EMS service is a Provincial responsibility.

Training and Professional Development

The fire department's training division has responsibility for the implementation, coordination, and oversight of fire training programs and fire officer development. Programs include recruit fire and EMS training, fire officer training, special operations' training, and marine fire suppression training. The division also coordinates the City-Learn program for the

[35] A Level E response would be implemented only if the VFRS upgrades the scope of practice for rescues.

fire department. City-Learn is the coordinated training calendar that lists the training programs sponsored by each city agency.

Despite lean resources, the training division is effective, in part because it has an excellent staff of dedicated instructors. However, the role for training has increased dramatically over the years and a result is that training staff have too much on their plate. Without additional staffing the quality of training is likely to diminish since instructor workloads are already very high.

Scheduling is also a problem for the reason that many of the training programs require up to five response units to be taken 'offline' during weekdays. This is a result of the fire department's changing mission which requires more training in areas such as hazmat and technical rescue. The benefit of using cross-trained firefighters able to perform any number of roles has a downside—the need for intensive training in specialty areas.

To improve the future delivery of VFRS training, four strategies should be considered:

- Expand the availability of training and change the department's culture such that training is also delivered during non-weekday hours
- Merge fire and EMS training
- Improve live fire training and vehicle operator training
- Increase instructional capacity
- Improve the use of technology for training program delivery

Organization – Fire training is conducted at the city's fire training center or at individual fire halls. At the time of this study the training academy was under command of a division fire chief.

Staffing to provide fire training (and EMS) is austere. In addition to a division chief, there are four full-time training officers (TO), and 10 acting training officers (ATO).[36] ATOs are detailed from their positions on shifts when they are needed to teach. The use of acting instructors is good because these individuals also have specialized skills or certifications needed for special programs.

Full-time fire instructors are paid at 128 percent of a 10-year firefighter rate (5 percent above captain). Acting fire instructors are paid at the instructor rate when they are assigned to teach specific programs.

[36] During this project the division chief of training retired and the position was replaced by an assistant chief.