HEALTHANALYTICS

EVALUATION AND RECOMMENDATIONS FOR CAPITAL PLANNING AND DEVELOPMENT OF THE PEEL REGIONAL PARAMEDIC SERVICE

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I. EXECUTIVE SUMMARY

HealthAnalytics (HA) was engaged by the Region of Peel to evaluate the response time performance and station facility needs of the Peel Regional Paramedic Service (PRPS) as a part of its efforts in capital planning through the year 2025. HA met with various stakeholder groups for their feedback and ideas, analyzed available response data from the Centralized Ambulance Communications Centre (CACC), and had several meetings with the Region's Emergency and Protective Services Committee (EPSC). This led to the presentation of four broad models for deployment of ambulance resources – the fire department model; ambulance station model; fluid deployment model; and the hybrid model. After presentation of the general pros and cons of each of these models to the EPSC, the list was narrowed to the fire and hybrid models for further detailed operational and financial modeling with recommendations and supporting information.

The fire department model assumes that local fire departments would assume complete responsibility for EMS. Fire department staffing is based on fixed station locations with 24 hour shift coverage, hence the number of units in the system would be held constant on a 24/7/365 basis. A fire department EMS model would have its ambulance crews on the same 12 hour shifts as the firefighters. The fire department model also assumes that ambulances would be located at most all of the existing or planned fire stations. Presently, there are 42 fire stations and several others are already planned for construction.

In its favor, the fire department model offers many of the resources that would be helpful in running an ambulance service; it provides a blanket of geographic coverage; can use existing stations which can be more readily modified to allow more personnel to work from each location; and has less turn-over in the workforce with its generally higher wages, better benefits and working conditions.

Its disadvantages include that fact that existing stations would have to be modified to add vehicle bays for ambulances, that male/female facilities need to be added, and that there is a need for additional administration, supply and support resources. EMS calls make up the overwhelming majority (typically over 70%) of the total number of calls in fire departments that take on the main EMS role. Consequently, there would also be extremely significant changes in fire department culture to deal with. More significantly, fire department station locations and deployment planning is based on fire protection and demand – not emergency medical incidents. Buildings do not move, so fire department station locations and demand patterns remain the same at any time of day or day of week. EMS deployment needs to focus on people – who are located in different, but reasonably predictable patterns at different times of day and days of the week. As a result, the fire department coverage model poorly distributes call volume among all available units – the busier areas have most of the calls. This leads to excessive workloads for the busy crews and a decrease in skill set retention for the less busy crews. This places a significant economic burden of inefficiency on the overall EMS system. Severe organizational integration problems have been very common throughout Canada and the US when communities try to merge fire and EMS agencies after they have been separately managed for a significant period of time.

The hybrid model takes compatible strengths from the various models and tries to avoid their weaknesses. The hybrid model features what could be referred to as a flexible deployment strategy that determines where available ambulances are positioned at any given time of day and day of week. The post locations are primarily restricted to police, fire and the existing set of ambulance stations. Posting ambulances at strategically selected intersections rather than stations is very limited. Instead of going inside the quarters of the fire crews, a co-location strategy would be employed where an ambulance facility would be constructed as an adjoining structure to a selected set of existing or planned fire and police stations. In those rare cases when there is an abundance of idle ambulances, some may be positioned in places where no station of any sort exists. Crews would then have the option of standing by in their vehicles or parking at a nearby coffee shop, restaurant, store, or at a government or healthcare facility such as a library, clinic, hospital, etc. Scheduling would be such that the number of crews brought on-duty is designed to match the patterns of ambulance demand. Book-on and book-off times would be scattered as appropriate throughout the day so that coverage does not drop to dangerously low levels may happen with a simultaneous system-wide shift change.

The northern areas of the Region of Peel are much more rural and as a consequence of their low population density, there are relatively few ambulance calls. By choosing ambulance locations strictly in an effort to optimize response time interval statistics for the entire Region, these more rural areas would be left without consistent coverage. With the frequent depletion of ambulances in the more urban areas, pulling ambulances out of the Caledon area has become all too common. This sets up two significant problems. Mutual aid is frequently required from neighboring EMS providers (Dufferin County, York EMS). Second, the citizens in the Caledon area have to wait much longer for ambulance service. Therefore, the hybrid model uses a flexible deployment strategy in the urban areas (Brampton and Mississauga) and uses a geographic coverage model for the Caledon area. The net result is that Caledon locations are placed much higher on the priority list of where available ambulances are positioned.

The advantages of the hybrid model include lower construction and operational costs than those associated with the fire station model. It offers a better quality of worklife for field crews than offered by the fluid deployment model. The fire department and flexible deployment models are very similar in that crews are usually standing by for their next call at a station, although a limited amount of street–level posting is utilized with a flexible deployment strategy.

The primary disadvantage is that it has higher construction and operational costs than those associated with an aggressively implemented fluid deployment model.

Somewhat separate from the fire and hybrid model issue was consideration of options for how crews are booked on and off-duty. There are two general options – central and station-based. The station-based model is integral to the fire department model. A hybrid model could use either one. In the central model, paramedics book on at the 'central' station to find a vehicle that has been cleaned and fully equipped by specialized make-ready staff. In a station based book-on and book-off model, on-coming paramedic crews report directly to a duty station where they meet up with an off-going crew and take charge of a vehicle. This latter model is most prevalent in systems that utilize fixed station locations – such as the fire and ambulance station models. The advantages of the station model are that there are no lost unit hours as a result of crews having to drive from a centralized facility to their response district and that crews may be able to report for work to a station closer to their residence. The station model also minimizes the potentially crippling effects of traffic congestion on a major roadway near the central station. By dispersing stations throughout the coverage area, there is inherently better geographic coverage. The big disadvantage of this model is that on-coming crews could (and often do) arrive at a station in which the off-going crew is still engaged on a call or has not yet arrived back at their 'home' station. In this situation, there can be added personnel cost as you have two crews that are being paid and only one that can provide response capabilities. It also presents the possibility for crew members to be 'orphaned' if their partner calls in sick – and more unit hours are lost trying to match any orphaned crew members together to make a complete crew. It also adds costs by not being able to centralize and specialize the support service functions as described in the central station model. Regardless of which book-on model or deployment model is chosen, PRPS needs a administrative support facility or a significant addition to current EMS facility to accommodate a greatly expanded EMS role.

Some of the fire or police station sites may not be able to accommodate additions to existing buildings. In those cases, it may be necessary to consider other nearby sites. Some sites may have construction site and/or parking space limitations. Therefore, some of these sites may not be suitable for crews to park their cars and conduct book-on / book-off activities. Alternatively, 4-5 larger stations could be built to serve as centralized book-on / book-off stations and one of those could also serve as an administration building. This scenario would probably involve land purchases, but if land purchases are found to be necessary regardless, this would be a viable option.

In terms of cost, the hybrid model is far less expensive and requires fewer resources than the fire department model. It would require 48 units on a 24 hour a day basis to provide adequate coverage utilizing the static fire deployment model. For the hybrid model during the time frame from 01:00-08:00, it requires 21 units; 08:00-19:00 requires 34 units and from 19:00-01:00 requires 30 units. The need for fewer units, personnel and facilities will have a dramatic impact on cost.

The following cost table shows both the fire and hybrid model costs in gross dollars. While it is anticipated that MOHLTC will make financial contributions to the PRPS budget, the % amount of those contributions are uncertain. The MOHLTC has stated that it plans to works towards subsidization at a 50% level.

Total Operational Cost Estimates					
		Hybrid	Fire Model		Difference
2006	$	32,665,590	32,665,590		
2007	$	41,173,354	48,904,810	$	7,731,456
2008	$	41,228,623	49,646,718	$	8,418,096
2009	$	43,733,590	52,837,518	$	9,103,928
2010	$	47,671,886	57,979,435	$	10,307,549
2011	$	48,841,209	56,546,148	$	7,704,939
2012	$	48,797,246	58,975,841	$	10,178,595
2013	$	50,780,714	61,429,248	$	10,648,534
2014	$	52,917,811	64,082,959	$	11,165,148
2015	$	55,066,186	66,796,309	$	11,730,123
2016	$	57,310,366	69,575,817	$	12,265,451
2017	$	59,737,948	72,592,309	$	12,854,361
2018	$	61,810,444	75,178,239	$	13,367,795
2019	$	64,120,455	78,019,943	$	13,899,488
2020	$	66,288,134	80,717,208	$	14,429,073
2021	$	69,112,167	84,232,292	$	15,120,125
2022	$	71,147,609	86,731,938	$	15,584,328
2023	$	73,456,111	89,534,722	$	16,078,611
2024	$	75,855,700	92,511,186	$	16,655,486
2025	$	78,119,602	95,229,821	$	17,110,219

This hybrid model shows savings of approximately 7 million dollars annually early on and as much as 17 million in the later years of the projections when compared to the cost of the fire department model.

The higher costs and workforce assimilation issues associated with the fire department model were major factors leading to the recommendation from HA that the hybrid model be implemented by the Region of Peel.

The ability of PRPS to respond in a timely fashion to emergencies is severely hampered by hospital off-load delays – where the receiving emergency department (ED) does not have a bed readily available for the ambulance crew to transfer its patient to. As a result, ambulances are tied up waiting in the ED. This requires PRPS to put more ambulances on the road to try to compensate for the hospital off-load issue. This burden is estimated to cost PRPS at least 2 million but may approach upward of 4.3 million dollars annually. It is therefore recommended that there is:

- strict application of the measures called for in the MOHLTC Hospital Off-Load Task Force recommendations, especially those pertaining to close monitoring and public reporting of hospital off-load delay statistics.

- an implementation of a 'hospital paramedic' program in which low acuity patients are transferred from the PRPS field paramedics to other PRPS paramedics assigned to the three local hospital emergency departments. This will allow the ambulances to return to duty sooner. This should be used as a temporary measure while longer term solutions as suggested by the task force report are put into place. The total hospital turn around time would still be considered the time from arrival of the patient at the hospital to turn over of the patient to official hospital personnel.

- The MOHLTC and/or the local hospitals should reimburse PRPS for the cost for the hospital paramedic program so that MOHLTC and the hospital remain incentivized to fix the off-load delay problem in spite of the temporary relief that will be provided by this effort. If they fail to fix the problem, at least the cost will not be borne by the PRPS budget.

Other major recommendations include:

- Set a *Region of Peel EMS System* unit response time standard of 6:00 (Six minutes, zero seconds) on highest priority (Code 4 tiered response calls) emergency calls (both fire first response and ambulance units dispatched with red lights and sirens) with at least 90% reliability. This would be calculated from the time interval starting at the time of first crew notification to arrival of first unit on-scene (regardless if it is a fire unit or ambulance).
    - It is important to note that it not necessary to send both fire and ambulance units to all emergency calls. Tiered response should be reserved for time critical situations such as VSA, shortness of breath, unconscious and MVC responses.
    - There isn't any clinical evidence to support use of a 6 minute emergency response time standard on any but the most life threatening and time sensitive of cases, such as those with information obtained during telephone triage of a patient not breathing or without a pulse.
    - A formal agreement should be developed by EMS and Fire Administrations in conjunction with local medical control to outline exactly which responses will receive tiered response.

- Set a *Region of Peel EMS System* unit response time standard of 12:00 (twelve minutes, zero seconds) on the non-tiered response emergency calls (code 4; ambulance only is dispatched and it responds with red lights and sirens) with at least 90% reliability, based on the time interval from time of first ambulance crew notification to arrival of the first ambulance on-scene.

- Fire department arrival on-scene time should be formally measured and shared with the Region and should be included in calculation of *Region of Peel EMS System* response time performance.

- These *system* standards would result in the following agency response interval standards for emergency (red lights and sirens) calls:

  - *Ambulance* emergency response time interval standard of 1200 (Twelve minutes, zero seconds) (using red lights and sirens) with a least 90% reliability

  - *Fire department* first response emergency response time interval standard of 6:00 (Six minutes, zero seconds) (using red lights and sirens) with at least 90% reliability (recognizing that FD is only sent on a small number of the highest priority Code 4 tiered response cases). This equates to approximately 23% of all responses and approximately 30% of urgent responses.

- Establish external accountability for EMS system response time performance in the form of a monthly EMS system performance report that goes to the Peel Regional Council and the local media on a monthly basis.

II. METHODS

A. GENERAL APPROACH

Our approach to this project started with a thorough assessment process that included interviews with key managers and stakeholders, review of key documents, open employee meetings, and review of key data files (e.g., CAD records, EMS reports, financial statements, etc.). This information gathering phase was followed by a refining of the originally stated problems and needs with Region of Peel staff. This paved the way for development of a list of potential options to consider that were consistent with the direction and feedback we received from Region of Peel staff and the Emergency and Protective Services Committee (EPSC). Major pros and cons for each of the preliminary options were outlined for review by Region staff and the EPSC. HA made recommendations for a 'short list' of options to take forward for more detailed analyses. After completion of these more detailed analyses, the facts, figures and our recommendations pertaining to the 'short list' options were presented to Region staff, EPSC and the full Region of Peel Council with the filing of this report that includes relevant details.

B. DEPLOYMENT ANALYSIS

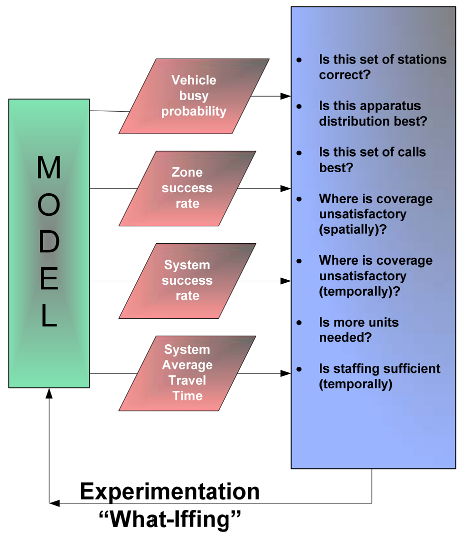
HA's deployment review utilized operations research methods with detailed statistical analyses and computer modeling to provide insight into critical system design issues for optimizing the number and location of stations/posts, the number of crews to deploy, and crew scheduling. HA worked closely with the Department of Systems and Industrial Engineering at the University of Arizona to conduct many aspects of these analyses.

Our deployment modeling work was conducted in three major steps:

- Developed a clear understanding of the PRPS current system's performance;
- Developed a model of the operations of the PRPS based on the their business rules; and
- Made iterative adjustments to the model to enhance its effectiveness at predicting performance accurately and then using the model to give insight on the impact of different decisions.

We used data from the current system including the zone structure, ambulance demand, travel times, service times, and transport times to build a computer model for PRPS. The model was then capable of predicting system performance using measures such as vehicle utilization, response times, and fractions of calls that do not meet the service level criterion. We paid particular attention to the validation of the output to ensure that the model was predicting reliably and accurately.

Model Outputs



In a final step, we carried out iterative tests with the model as a means to rapidly investigate a wide range of scenarios and various strategies to optimize performance – something that would be impractical to do with the actual system. This iterative process is depicted in the figure labeled 'Model Outputs'.

1. CREW CAPACITY PLANNING AND SCHEDULING

Our software models were used to make recommendations for staffing decisions. Our demand analysis assumes that calls come to the system based on a Poisson process. *(A Poisson process is a standard method used to model arrivals to a system. It is the result of having a large number of potential customers, N, where each has a small probability, p, of using the system in a short time interval. The product N*p, denoted by λ, is called the "intensity of the process" and is the average number of arrivals per unit time.)* For various crew numbers and any service time means and distributions, we computed the probability distribution on the number of busy crews. For example, if we consider a case where we want to deploy 15 crews, then we can easily compute the probability of 0, 1, 2, … 15 busy crews. We were then able to estimate the tradeoffs in performance for adding or subtracting crews from the schedule. Our approach was interactive in that it is a simple matter of experimenting with different numbers of crews, check resulting performance figures, and then try different values for the variables to find the optimum combination. This is a far stronger approach than the "single value" that comes from a traditional system status management method of analysis.

Once the number of crews was determined, we worked with crew schedule options to best meet system needs. We used mathematical programming to model the scheduling problem. We scheduled 2 weeks at a time and allowed for a variety of shifts (for example, 24 on-24 off, 4 10-hours days, 12 hour shifts) and a variety of starting times. To our knowledge, this is the only software and modeling approach that integrates the crew capacity decision with the scheduling decisions.

2. LOCATION MODELING

At a very detailed level, the model simulated the operation of a spatially distributed queuing system. These systems have been used to model the performance of a wide variety of systems such as emergency vehicle systems, mobile repair systems, distributed database systems, and weapon fire control systems. The models have been shown to be valid when applied to specific systems[1].

To implement the model, we partitioned the service area into zones. For each zone, past data was used to estimate demand, call service time (including possible hospital and transport times), and turnout times. Also, for each station-zone pair, the travel time and the probability that a call is answered within a set time standard (9:32 or 12:00 minutes for example) was estimated. The model then estimated performance of the system by estimating the following statistics:

- Fraction of time that each vehicle is busy
- Number of calls that each vehicle answers
- Fraction of answered calls that meet the time standard (by vehicle)
- Fraction of calls that meet the time standard (by zone and system wide)
- Fraction of calls that go to a system operating in parallel (e.g., mutual aid being called upon when all vehicles are busy)
- Average travel time for each vehicle (based on the calls it answers)

Our model used is based on the "Hypercube Approximation Model" (developed by Dr. Richard Larson at M.I.T. in 1975 and extended by Dr. James Jarvis at Clemson in 1985 and Dr. Jeff Goldberg at the University of Arizona in 1990). Each call was assumed to require one vehicle and it was assumed that each zone has a unique preference ordering of the available vehicles/stations. This unique preference order simply implies that for any call, there is a vehicle preference order. The dispatcher then goes down the order and dispatches the first idle vehicle on the list. The model simulates this process by computing the probability that each vehicle/station on the dispatch list actually gets the call.

The model consists of a set of nonlinear equations that represent the workload of each vehicle. The total work assigned to each vehicle is calculated based on the availability of the other vehicles. A call is then taken only if the assigned vehicle is idle. This process

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[1] Goldberg J: Operations Research Models for the Deployment of Emergency Services Vehicles. 2004 Jan-Mar EMS Mgmnt J 1(1):20-39.

was replicated for each zone and then summed to estimate the total workload for the vehicle. The process was then repeated for each vehicle and we arrived at a system of workload equations. These equations were then solved iteratively until a consistent set of vehicle busy probabilities were obtained. Once the busy probabilities were determined, we were able to estimate all of the above performance statistics. The results from the model were exported into mapping software to create color-coded maps.

Our approach to deployment analysis was used for calculating many of the statistics requested in the RFP including:

- 90^{th} percentile reaction and response time thresholds
- 90^{th} percentile call volumes
- Unit Hour Activity and Utilization levels
- Spatial (geographic) and temporal (time) mapping of response performance patterns stratified by time of day, day of week, etc.

III. FINDINGS

The following section summarizes our findings for the current status of EMS in the Region of Peel.

A. SYSTEM DESIGN

EMS system design describes the way in which all of the components of an EMS system are interconnected, managed, and funded. Of all the things that a community can change to affect EMS performance, system design is widely considered to be the most powerful[2]. Most aspects of system design are determined at a political / legislative level. It determine what aspects of EMS are provided by government, private or volunteer entities, what levels of service are permitted, how it is funded and how the different entities are held accountable for their performance. A 'system' in this context, consists of all the resources in a community that are used to address the needs for prehospital emergency medical services.

- Prehospital care is provided in the Region of Peel by several different entities serving different roles

[2] Overton J: System Design (Ch. 4). In Kuehl A (Ed.): *Prehospital Systems & Medical Oversight*. 3rd Edition. National Association of EMS Physicians / Kendall Hunt 2003.

- Peel Regional Paramedic Service (PRPS) – Provision of emergency ambulance services and some types of non-emergency ambulance services

- Centralized Ambulance Communications Centre (CACC) – Processing of incoming requests for service; delivery of pre-arrival instructions; deployment of ambulance resources; workload balancing between ambulances; Management of field communications.

- Municipal and volunteer fire departments – Provision of non-transport 'first responder' services, primarily at a 'basic' level with first aid trained firefighters, many of whom are progressing to EMR level training

- Private patient transfer services – Provision of scheduled non-emergency medical transport services

- Transhelp – Provision of non-medical transportation services to the physically handicapped

- Sunnybrook – Osler Centre for Prehospital Care – Provision of physician-level oversight / quality management of clinical activities as well as provision of clinical training and continuing education services.

* The various entities which provide different components of EMS do not work together as a 'system' with coordinated processes of funding, planning, operations, measurement, regulation, and medical oversight.

* While there is some interagency coordination at a political level with the Emergency and Protective Services Committee (EPSC), operational level coordination is very limited.

* Each entity carries out their roles separately and have completely separate accountabilities that do not 'roll-up' to a system level.

  - Example: The combined effects of call processing, fire response and ambulance response times are not evaluated at an overall 'system' level (e.g. time interval from call received at CACC until first unit arrival [be it an ambulance or fire unit] 'on-scene' or 'at patient').

* A provincial-level task force investigated ambulance off-load delays, which have a significant and deleterious impact on ambulance response times and availability. This is a complex multi-faceted problem that is symptomatic of broader issues in the healthcare system. Consequently, the task force recommendations did not offer any near-term solutions.

- PRPS often relies upon Dufferin EMS to cover calls in the northern area of Peel since PRPS often pulls units down into the more densely populated areas in Brampton and Mississauga to cover calls. Dufferin has to absorb the additional costs for providing mutual aid services in Peel and while decreasing their availability for their own calls. Seldom does Peel have to respond into Dufferin's area in return. While it is our understanding that there is a funding mechanism that is designed to address such issues, it is not utilized locally or in most of the Province because of inequities in the underlying funding formula. Dufferin could insist on payment but doesn't.

- Caledon FD
    - Caledon Fire Chief estimates that there is now a population of 57K in their service area, and they expect it to grow to 120-130K in next 10-20 years; Most of this growth is expected to be south of Old School Rd.
    - 45% of their runs are EMS related
    - CFD crews will have completed Emergency Medical Responder (EMR) training by 2007
    - No radio interoperability between FD and EMS

- Brampton FD
    - A consultant did a feasibility study on co-housing with PRPS approx. one year ago
        - Recommended separate but adjoining facilities
        - If done, suggested that it be piloted first in their larger stations that already have male and female facilities
    - BFD Response Times (on the highest priority Code 4 tiered response cases only, which are just a small percentage of the cases that PRPS responds to)
        - 4:58 average (50% reliability)
        - 7:05 at 90% reliability
    - BFD crew training at the EMR level to be completed by end of 2007
    - They have interest in putting one paramedic on each truck; they already have several paramedics in their employ

    - No radio interoperability w/ambulances

- Mississauga FD
    - EMR training for MFD crews is 50% completed
    - Response times to EMS incidents (on the highest priority Code 4 tiered response cases only, which are just a small percentage of the cases that PRPS responds to)
        - <4 min. with approx. 70% reliability
        - <5 min. with approx. 90% reliability
    - Interest in having an ACP level paramedic on each fire truck

- Fire chiefs from both Mississauga and Brampton met with their respective union presidents regarding PRPS access to fire stations shortly after the launch of PRPS' new deployment plan in December 2005. The ideas and concerns expressed included:
    - The employee groups (EMS and FD) are not in the same collective bargaining unit, which raises issues over workplace supervision, responsibilities and discipline.
    - Station visitor policies:
        - Ambulance crews should not come after or stay past 10 PM
        - Ambulance crews must leave station if the FD crews leave the station
    - Increasing risk of FD staff exposure to bio-hazards brought back to FD stations by ambulance crews inadvertently through clothing or vehicle contamination
    - Having PRPS crews stop by fire stations informally is OK

B. FINANCE

- The failure of the Ministry of Health and Long Term Care (MOHLTC) to meet its 50% funding obligation has lead to increased financial pressures over recent years. While the recent announcement that the Ministry is committed to a 40%

funding match in the 2006 operating budget and 50% match in the 2007/2008 budget should provide some level of financial relief to the Region, it is still Council's desire for PRPS to operate as efficiently as possible. The deployment and operational recommendations set forth in this document will allow PRPS to continue to provide clinically appropriate care in a timely manner to the rapidly growing population of the region in as financially sound a manner as possible. The exact level of funding from the MOHLTC is still uncertain. It is not known whether MOHLTC will increase the base budget calculation from year to year or by how much. Given that PRPS may need to increase resources and costs, PRPS could still be under funded as system costs grow if the MOHLTC does not adjust its subsidy accordingly.

- While the overall financial management of PRPS appears to be very sound, we noted two areas that may deserve some attention. First is the current method of cost accounting. From our analysis, it appears that an attempt is made to assign costs to various station units. This will result in varied use of posts and will make it difficult to assign costs. The second is overtime variance. The 2005 actual overtime variance was 7% for salaried employees and 14% for wage employees.

C. DEPLOYMENT

1. CURRENT DEPLOYMENT STRATEGY

On December 1, 2005, the Region of Peel initiated a new deployment strategy with 'flexible' deployment components in an attempt in an attempt to reduce response times and to address increases in emergency call demand. This new strategy was in contrast to their prior 'static' deployment process. In this plan, PRPS has divided its geographical area in to North and South segments as prescribed by the MOHLTC. Nine posts (6 station based and 3 mobile) are located in the North segment and eight posts (5 station based and 3 mobile) are located in the South segment. Each post location is detailed with a north, south, east, and west boundary and is also assigned mandatory coverage times.

Under their new plan, PRPS staffs to a maximum of 32 units during a 24 hour period. Of these 32 vehicles, they staff 18 of these vehicles 24 hours a day and the remaining 14 are deployed for 12 hours during the peak demand times (08:00 to 01:00 hours daily).

2. RESPONSE TIME INTERVALS

- MOHLTC has established a 9 minute 32 second (9:32) emergency (code 4 red lights and siren) response time interval standard with 90% reliability for the Region of Peel.
  - A non-emergency response time standard is not specified. While non emergency responses of PRPS ambulances are dispatched by the CACC, these calls only represent about 3% of their call demand.
  - The 9:32 standard is based on a historical precedent and does not have any apparent clinical rationale.
  - Compliance to this response time standard does not exist at a 'system' level whereby units other than those from a Provincially recognized delivery agency (i.e. PRPS) may be used to 'stop the clock', If a non-transport unit from PRPS with PCP or ACP staffing and equipment arrived on-scene, it would be recognized by the MOHLTC to 'stop the clock' for compliance to the MOHLTC standard. However, arrival of a fire department unit would not be recognized per MOHLTC standards.
  - MOHLTC has not imposed any penalties to date for failure to comply with this standard. However, the MOHLTC expects that the agencies it certifies will have strategies in place to address their performance standard.
- The clinically relevant response time interval for patients experiencing a truly time sensitive emergency medical condition begins at the onset of the condition and ends with the time of patient contact. However, the overall EMS system which includes the CACC, PRPS and the fire services, can only be held reasonably accountable for the time interval from when a call for aid is received at the CACC to when patient contact is made by the crew of an ambulance or first responder unit. PRPS can only be held accountable for the time they are notified of the call by the CACC until patient contact is made. Accountability for the overall performance, encompassing that of the CACC, fire department responders, and PRPS, has to be at a 'system' level.
  - For most conditions, there is a lack of a reliable processes for capturing the time of onset of a medical problem, so the time of initial contact to the CACC is the first timing milestone that can be used consistently in measuring system performance.

3. *CENTRAL AMBULANCE COMMUNICATION CENTRE*

- As the entity providing emergency medical dispatch services, the CACC has a pivotal operational role with PRPS.
- CACC is operated by the MOHLTC. PRPS does not have any direct operational control over how its ambulance resources are deployed in its efforts to comply with the Provincially imposed response time standard.
    - PRPS is completely dependent upon the CACC to correctly and consistently operationalize any deployment plan that it may want to implement – now or in the future
- CACC uses locally developed software for guiding caller interrogation, triage and delivery of pre-arrival instructions
- CACC process and policy does not attempt to discriminate between calls requiring emergency responses (with red lights and sirens) from those that require immediate but non-emergency responses (without red lights and sirens).
    - It does attempt to identify which calls meet criteria for tiered dual response (Code 4 non-tiered reponse) – sending both ambulance and fire department units
- Does employ a quality manager, but does not appear to have a process for quality assurance or improvement of its implementation of the PRPS specified deployment plans.
- There does not appear to be an accountability for the performance of the CACC to the EMS provider organizations it dispatches, since it is operated by the regulatory agency (MOHLTC).
- To facilitate implementation of the deployment plan, it may be helpful to temporarily place a PRPS supervisory staff in the CACC to aid in interpretation of the deployment plan and to assist in dealing with associated staffing/schedule issues.

D. FACILITIES

Current PRPS utilizes 11 stations to support its book-on and deployment process:

- Strengths:
    - Many of the facilities are capable of housing several vehicles

- Many of the lease agreements include utilities and taxes
- Some of the leases are month to month

- Weaknesses
  - The facilities are the source of recurrent costs, such as lease costs, that could fluctuate greatly if a given facility's property value changes significantly – which could lead to unbudgeted increases in leasing costs
  - The current number of facilities is insufficient to support the number of units and deployment model that is required to meet the growing demand for service.
  - Many of the facilities are poorly located to facilitate rapid deployment (e.g., the stations are located deep inside industrial parks, thereby impairing their rapid access to the surrounding areas). In addition, most of the current stations require extensive leasehold improvements.

IV. DEPLOYMENT AND FACILITIES OPTIONS

A. APPROACH

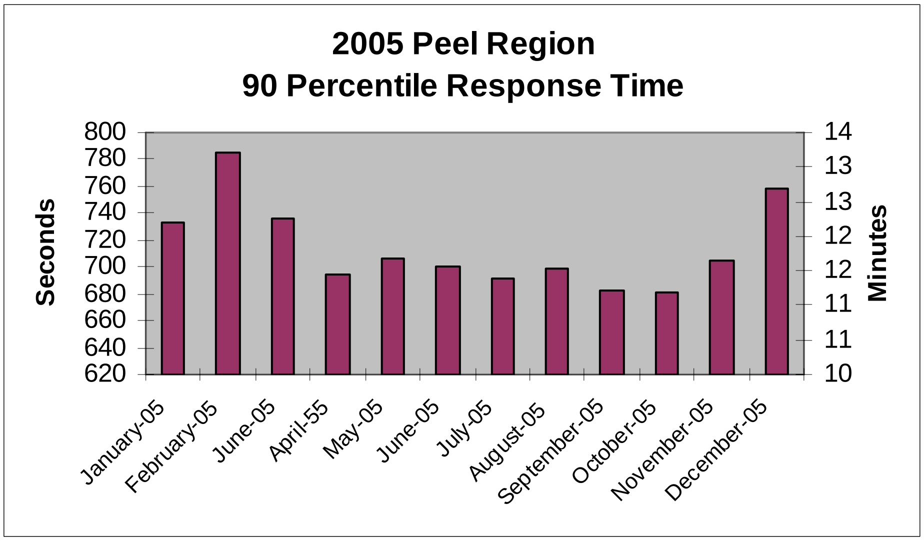
HA used the following general approach to its consideration of deployment options for PRPS:

- Start with blank piece of paper
- Conduct stakeholder interviews
- Conduct data gathering and perform analyses
- Consider broad range of potential options
- Narrow the options list based on feasibility from an operational, financial, human resource, and political perspective
- Provide our expert professional opinions for recommendations that are based on careful analyses of the available information.

B. ANALYSIS OF CURRENT AND PRIOR DEPLOYMENT

1. PRIOR DEPLOYMENT ANALYSIS

- Response times for January – November, 2005 were
    - Average (50% reliability) at 7:05
    - 90% reliability at 11:50
    - 77.4% reliability at 9:32 MOH Standard



	Code 1	Code 2	Code 3	Code 4	Code 8	Acitivity With Standbys	Demand Excluding Standbys	UHU	UHP
2000	1,781	1,117	6,895	32,574	41,039	83,406	42,367	0.19	0.38
2001	1,010	1,331	9,056	38,740	32,885	83,022	50,137	0.23	0.38
2002	629	1,175	10,020	41,531	32,203	85,558	53,355	0.24	0.39
2003	769	1,233	10,528	43,637	26,626	82,793	56,167	0.26	0.38
2004	688	1,295	11,523	45,306	23,116	81,928	58,812	0.27	0.37
2005	934	1,521	9,953	49,877	21,642	87,203	65,561	0.30	0.40

---- Through December 12, 2005

To help clarify terminology, the Unit Hour Production (UHP) ratio refers to the number of calls divided into the number of unit hours for a given time frame. If 5 calls for service were answered during a 1 hour time frame in which 20 units were in the field, that would equate to 5/20 or a unit hour production ratio of 0.25.

The Unit Hour Activity (UHA) ratio shows the number of tasks, which might include transports as well as post to post moves and non-transport responses, divided into the number of unit hours put into the field for a given time frame. If there were 5 transports, 3 non-transport responses, and 2 post to post moves during a 1 hour time frame in which there were 20 units in the field, this would equate to 10/20 or a unit hour activity ratio of 0.5.

For the purposes of our analysis and planning Unit Hour Production (UHP) was used in place of Unit Hour Activity. While UHA does represent overall activity, it can inadvertently support inefficient operations with excessive post-to-post moves and other non-productive activities. Such activities could lead to an increase in the reported UHA which could then be used to inappropriately support the need for more resources. UHP provides a better measure of efficiency, effort and supports demand based resource utilization.

C. INITIAL OPTIONS LIST

Several major options were initially considered as deployment / facility options. These options included:

- Fire Department Model
- Ambulance Station Model
- Fluid Deployment Model
- Hybrid Model

1. FIRE DEPARTMENT MODEL

The fire department model assumes that local fire departments would assume ***complete*** responsibility for EMS – if not now, then perhaps sometime in the future. The interest in exploration of this option was made very clear in the EPSC meeting when the consultants made their initial presentation.

Fire department staffing is based on fixed station locations with 24 hour shift coverage, hence the number of units in the system would be held constant on a 24/7/365 basis. A fire department EMS model would have its ambulance crews working the same 12 hour shifts as the firefighters. The fire department model also assumes that ambulances would be located at most all existing or planned fire stations. Presently, there are 42 fire stations in the Region and several others are already planned for construction.

a) Advantages

- Many resources are already in place that would be helpful in running an ambulance service, such as stations, administration, and other infrastructure
- Fire department coverage models are designed to provide a blanket of geographic coverage. Therefore, using a fire department coverage model that puts ambulances in most every fire station provides geographic coverage for ambulance service delivery.
- Existing stations can be more readily modified to allow for more personnel to work from each location – without the encumbrance of separating ambulance from FD crew quarters or other issues associated with having two separate organizations and labor forces working from the same location
- Less turn-over in the workforce that is generally associated with the higher wages, better benefits, better working conditions, better community standing, and stronger political support for fire department personnel

b) Disadvantages

- Existing stations would have to be modified to add vehicle bays for ambulances, adding male/female facilities where not already in place, and additional administration, supply and support resources would be needed to accommodate an expanded fire department EMS mission.
- In fire departments that also run an ambulance service, the EMS calls make up the overwhelming majority (typically over 70%) of their total runs, so there would be a significant change in fire department culture.
- Fire department station locations and deployment planning are based on fire protection and demand – not emergency medical incidents. Buildings do not move, so fire department station locations and demand patterns remain the same at any time of day or day of week. That may be a sound basis for fire protection planning, but is not the best for EMS. EMS deployment needs to focus on people – which are located in different, but reasonably predictable patterns at different times of day and days of the week (e.g., morning commute traffic from suburbs to urban core and back to the suburbs in the late afternoons on weekdays). As a result:

- The fire department coverage model poorly distributes call volume between all available units – the busier areas have most of the calls. This leads to excessive workloads for the busy crews and a decrease in skill set retention for the less busy crews.

- The low-productivity crews in less busy stations place a significant economic burden of inefficiency on the overall EMS system

- Many of the objections raised in a consultant's report commissioned by the City of Brampton for co-habitation of PRPS crews in Brampton fire stations would also apply to a scenario in which ambulance staff were members of the fire department .

- Severe organizational integration problems have been very common throughout Canada and the US when communities try to merge fire and EMS agencies after they have been separately managed for a significant period of time. Some more recent examples of such problems in Canada include Calgary, Edmonton and Owen Sound.

- There are issues in wage parity. Firefighters are generally paid at a higher level than non-fire department paramedics. Between the additional units, additional hours and higher wage levels, the costs for operating fire-based EMS systems are generally much higher.

2. AMBULANCE STATION MODEL

The ambulance station model is very similar to the fire department model, except that entirely separate facilities are used. You do not typically see police and fire stations merged into a co-habitation or co-location[3] arrangement – which raises the question of why EMS, a 'third' public safety agency, should be handled any differently. In this model, when additional locations are needed for an ambulance, a new ambulance station would be built.

a) Advantages

- The ambulance station model has been employed by PRPS in most of their locations to date and is the model often promulgated by the Ministry of Health.

[3] In this context, co-location refers to the staff of two different public safety agencies sharing the same land but having *separate* but adjoining facilities with *separate* sleeping quarters, bathrooms, kitchen, vehicle bays, offices, etc.

- Ambulance facilities can potentially be placed deep within industrial zones, where facility lease costs are lower – in contrast to the more accessible and higher visibility types of locations used for fire and police stations. However, the consultants would recommend that locations with better accessibility and visibility be used, even though the costs may be higher if the ambulance station model is implemented.

- The paramedic union, the paramedic professional association and front line field staff who met with the consultants expressed a strong preference for this model. They want to have the same level of independence, community visibility and community respect that fire and police officers have. They feel that the community presence of an ambulance station in prominent locations throughout the community, just like fire and police stations, is an important step in that direction.

b) Disadvantages

- The ambulance station model is much like the fire department model – the locations of calls change with time of day and day of week while stations remain in the same location. Unlike police departments, where between calls police officers are mobile and patrol their coverage area, the ambulance station model, like the fire station model, has crews returning to a station between calls.

- Very expensive – with purchase of land and construction of new facilities, particularly if the selected building sites are not deep within industrial parks. Unlike a fire station, the ambulance is not intended to be at the station most of the time – the units should ideally be engaged on a call for a reasonable percentage of their time and the overall call load should be distributed on a reasonably even basis between available units. This means that the ambulance stations would be empty much of the time – very much like police stations and very different from fire stations.
  - The exception to this would be the units in the Caledon area, which would be held in reserve as much as possible to compensate for the greater distances involved in covering that part of the Region.

3. FLUID DEPLOYMENT MODEL

Many ambulance services in the United States , especially those managed by the private sector, have embraced a fluid deployment model, and its more aggressive forms are sometimes referred to as 'system status management'. This model involves carefully mapping the geographic and temporal (time) patterns of EMS calls and then positioning ambulances and adjusting staffing levels to match those patterns as closely as possible. A single central station is often used and units are then strategically dispersed from that location throughout the community. The ambulances usually do not have stations – they stand-by at strategically chosen intersections, referred to as 'posts', when waiting for their next call. Ambulances may be moved from one post to another as the total number of units available in the system goes up and down in response to calls coming in and as units become available after completing their calls. Consequently, sleep time is not practical and longer shifts are avoided. Crews can expect to remain busy for most of their shift.

a) *Advantages*

- Lower operational costs because units are used more efficiently and therefore fewer units are needed
- Faster response times with the almost complete elimination of the time delays from crew notification to crew en route because the crews are already inside the ambulance
- Faster response times because ambulance positioning between calls can be fine tuned to better match predictable patterns of demand with unit availability and positioning.
- Lower facilities costs because ambulances do not work out of stations
- Crews have more opportunities to stay proficient in skills since there are fewer total numbers of paramedics for the finite number of opportunities to use those skills.

b) *Disadvantages*

- An aggressive fluid deployment strategy provides a lower quality of worklife for the ambulance crews. This, as expected, is a model that the field staff has strong objections to.
- Aggressive fluid deployment requires an extremely high level of operational skill, sophistication and continuous adjustment and improvement to do even a minimally acceptable job of execution. Given that PRPS does not control its own resources – this is something done by the MOHLTC's CACC - it would not be realistic to consider a fully fluid deployment strategy for PRPS under these circumstances. Fully fluid deployment is better left out of consideration unless the responsibility for resource control / dispatching is taken away from the CACC and put completely in the hands of PRPS.

- In a pure and aggressive application of the fluid deployment model, ambulances are posted with crews remaining inside their vehicles. However, this restriction has been observed to be one of the biggest factors in employee dissatisfaction with the fluid deployment method in the consultant's experience.
    - After PRPS management sought input from the field staff and their union, a flexible deployment strategy was implemented by PRPS in December of 2005 out of economic and logistical necessity. PRPS was faced with the compounding issues of increasing call demand, long response times and longer hospital off-load times. The flexible deployment model for the PRPS was considered in context of allowing crews to 'stand-by' at various public safety facilities, to include fire, police and the existing set of ambulance stations, but still giving the communications center the latitude to move the crews between these facilities as much and as often as needed to optimize coverage. Crews would be allowed to go inside these facilities while waiting for their next call or to be assigned to a new location – and thereby make use of rest rooms, have a place to relax, eat, study, do paperwork, etc.

4. HYBRID MODEL

Each of the models described above has strengths and weaknesses. The hybrid model attempts to take compatible strengths from the various models and avoid the weaknesses. The EPSC committee made it very clear to the consultants that they were most interested in models which minimized land acquisition and construction costs. With these factors in mind, the hybrid model has the following features:

- A flexible deployment strategy is used for determining where available ambulances are positioned at any given time of day and day of week. For the most part, post locations are restricted to police, fire and the existing set of ambulance stations. When an ambulance is needed at a given location and no station is at that location, some posting at strategically selected intersections may be utilized. The deployment plan used by the CACC is dramatically simplified with only three plans instead of the 168 plans used in some aggressive fluid deployment systems that use a unique plan for each hour of the day and day of the week

- Instead of going inside the quarters of the fire crews, a co-location strategy would be employed where an ambulance facility would be constructed as an adjoining structure to a selected set of existing or planned fire and police stations where ambulance positioning rates are expected to be at high levels. Where it makes sense to do so, existing ambulance stations could also be utilized. However, in those rare cases where there is an abundance of idle ambulances, flexible deployment allows for some ambulances to be positioned in places where no station of any sort exists. In those cases, crews would have the option of standing by in their vehicles or parking at nearby coffee shop, restaurant, store, or at a government or healthcare facility such as a library, clinic, hospital, etc.

- When ambulances are posted at fire stations or police stations with less frequent utilization, it may not make sense to build an ambulance bay and other crew amenities. In these situations, ambulances should be allowed by fire and police department policy to 'stand-by' at their facilities. This 'stand-by' status must not be confused in policy or interpretation as ambulance crews 'visiting' these stations. Unlike visitors, the ambulance crews are there for a specific business purpose in serving the needs of the community. Therefore, fire and police policies and procedures should be adjusted accordingly to allow ambulance crews to be inside the stations even when police and fire crews are not there at the same time.

- Scheduling would be such that the number of crews brought on-duty is designed to match the patterns of ambulance demand. Book-on and book-off times would be scattered as appropriate throughout the day so that coverage does not drop effectively to near zero levels can happen with a simultaneous system-wide shift change (i.e. all units booking on at 6:00 am)

- The northern areas of the Region of Peel are much more rural and as a consequence of their low population density, there are relatively few ambulance calls. By choosing ambulance locations strictly in an effort to optimize response time interval statistics, these more rural areas would be left without consistent coverage. We see that now quite often with depletion of ambulances in the more urban areas leading to pulling ambulances out of the Caledon area. This sets up two significant problems. Mutual aid is frequently required from neighboring EMS providers (Dufferin County, York EMS). Second, the citizens in the Caledon area may have to wait much longer for ambulance service. This problem was also highlighted to the consultants in the EPSC meeting. Therefore, the hybrid model uses the flexible deployment strategy in the urban areas (Brampton and Mississauga) and uses a geographic coverage model for the Caledon area. The net result of this is that Caledon locations are placed much higher on the priority list of where available ambulances are positioned.

a) Advantages

- Lower construction and operational costs than those associated with the fire or ambulance station models

- Better quality of worklife than offered by the fluid deployment model

b) *Disadvantages*

- Higher construction and operational costs than those associated with the fluid deployment model
- Slightly lower quality of worklife than offered by the fire or ambulance station models

5. BOOK-ON AND BOOK-OFF OPTIONS

In context of the deployment and hybrid models, consideration was also given to use of 'centralized' and 'station' models for crews to book on and off duty.

In a centralized book-on model, all on-coming paramedic crews report to duty at a centralized location. This model is most advantageous in systems that utilize completely fluid deployment strategies. In these types of system designs, paramedics book on at the 'central' station to find a vehicle that has been cleaned and fully equipped by specialized make-ready staff. This decreases the need for paramedics (at higher hourly wage rates) to have to stock or clean units. This can drastically decrease the number of unit hours that are 'lost' to these functions.

In a station based book-on and book-off model, on-coming paramedic crews report directly to a duty station where they meet up with an off-going crew and take charge of a vehicle. In this model, paramedic crews stock and clean their own ambulances at their 'home' station. This model is most prevalent in systems that utilize fixed station locations – such as the fire and ambulance station models. The advantages of this model are that there are no lost unit hours as a result of crews having to drive from a centralized facility to their response district and that crews may be able to report for work to a station closer to their residence. This model also minimizes the potentially crippling effects of traffic congestion on a major roadway near the central station. By dispersing stations throughout the coverage area, there is inherently better geographic coverage. The big disadvantage of this model is that on-coming crews could (and often do) arrive at a station in which the off-going crew is still engaged on a call or has not yet arrived back at their 'home' station. In this situation, there can be added personnel cost as you have two crews that are being paid and only one that can provide response capabilities. It also presents the possibility for crew members to be 'orphaned' if their partner calls in sick – and more unit hours are lost trying to match any orphaned crew members together to make a complete crew. It also adds costs by not being able to centralize and specialize the support service functions as described in the central station model. In light of these disadvantages, station-based book-ons is still the optimal method for the recommended deployment plan

To help offset some of the negative effects associated with a station-based book-on model, PRPS has several options. In the deployment and financial modeling, an extra 10% is added into staffing levels for the hybrid model to help offset the effects of absenteeism and orphaned crews. PRPS also has a large number of extra units, which could be positioned at the busier stations, thereby enabling crews to get into the system if their off-going crew is delayed returning to the station. To reduce the potential for that scenario, a special unit status could be implemented whereby units are taken out of their normal deployment status 30 minutes prior to the end of their shift to help them getting back to their station. The only time a unit in this pending end of shift status would be for assignment to a very high acuity (code 4 tiered responses) call, such as a cardiac arrest. In conjunction with implementation of the Hospital Medic Program, this strategy should drastically reduce late starts and overtime.

D. FINAL OPTIONS SELECTED FOR FURTHER ANALYSES

The key features of the option set just described in Section C were presented as preliminary findings to the EPSC with Regional Staff and the Fire Chiefs in attendance. On the basis of their feedback, the option set was narrowed down to the fire department model and the hybrid model (using the 'station' based book on/off model). These two models were then more fully developed and subjected to detailed deployment planning and financial modeling.

E. FIRE DEPARTMENT MODEL – DETAILED ANALYSIS RESULTS

A detailed analysis of the fire based model, as outlined above, produced the following results. The major items of interest in the analysis were the number of ambulances required to provide a 90% reliability coverage of projected call demand, the number of paramedic FTE's needed to support this model and finally, the number of facilities that would be required.

1. UNIT REQUIREMENTS

The number of ambulances required to provide a 90% coverage reliability was evaluated for a 24 hour time frame. As is demonstrated by the table below, it would require 48 units on a 24 hour a day basis to provide adequate coverage utilizing a static fire deployment model.

The following table outlines the number of ALS vehicles needed to provide close to 90% reliability in coverage. The third column in the table provides a projected probability (ρ) of utilization or workload. As shown in the table below, the fire model will require a large number of vehicle that are not very busy in order the have close to 90% reliability for the response time goal.

48 vehicles		
Fire Station	**ALS** *Vehicles*	*ρ*
B205	1	0.285992
B201	2	0.162303
B202	2	0.117802
B203	1	0.261107
B204	2	0.149129
B206	2	0.114645
B207	2	0.0688
B208	2	0.117128
B210	1	0.169109
B213	1	0.21268
B217	1	0.207572
B218	1	0.111843
B219	1	0.238955
C2	1	0.358936
M101	2	0.201736
M111	1	0.321775
M116	1	0.236967
M105	1	0.352511
M121	1	0.321652
M108	1	0.185751
M119	1	0.319722
M114	1	0.268272
M122	1	0.226756
M118	1	0.223075
M117	2	0.071456
M115	2	0.105137
M112	2	0.063778
M107	1	0.317529
M110	2	0.160928
M102	2	0.037554
M104	2	0.0558
M103	1	0.339028
M106	2	0.165383
M108	1	0.309732
Total		48

Reliability = 0.891087

2. *PERSONNEL REQUIREMENTS:*

Using the assumption of 42 hour work weeks, it would take 423 paramedics and 35 staff positions for a total of 462 FTE's to implement the fire department model. The additional positions are needed to provide coverage for vacation leave, sick leave and to provide the current span of control.

3. *FACILITY REQUIREMENTS:*

To house and deploy 48 units in a manner that would provide 90% reliability coverage of the Region, it will require 33 facility additions. It would be necessary for at least 14 of these facility additions to be able to accommodate at least 2 ambulances.

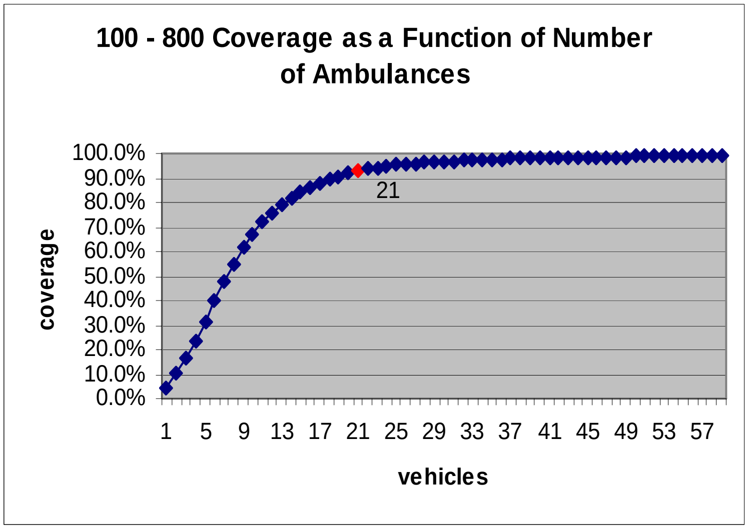
F. HYBRID MODEL – DETAILED ANALYSIS RESULTS

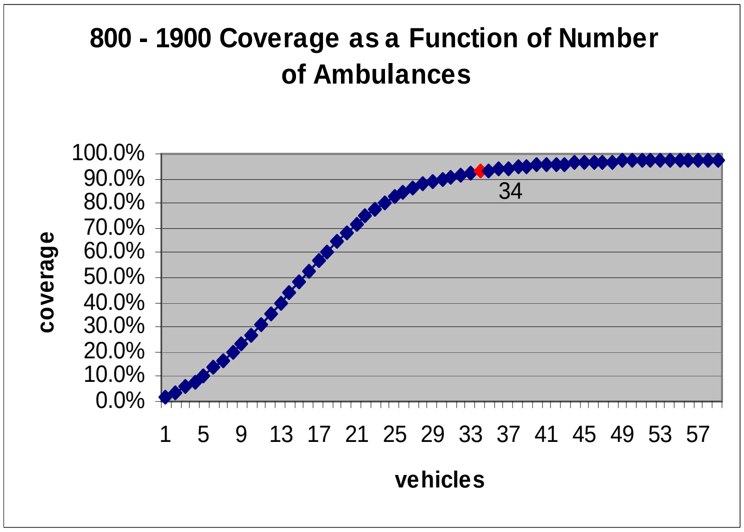
A detailed analysis of the hybrid based model produced the following results. As with the fire model, the major items of interest in the analysis were the number of transport ambulances required to provide a 90% reliability coverage of projected call demand, the number of paramedic FTE's needed to support this model and finally the number of facilities that would be required to support this model.

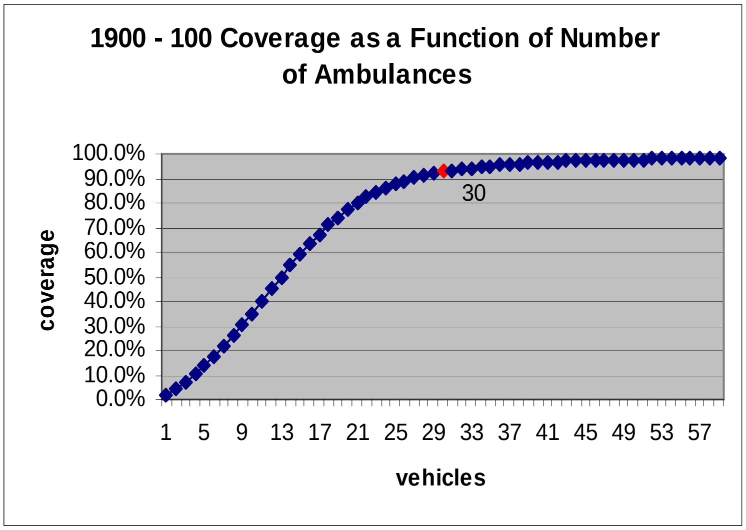
1. UNIT REQUIREMENTS:

The number of units required to provide a 90% coverage reliability was evaluated for each of 3 specific time intervals. As is demonstrated in the illustrations below, the time frame from 1:00-8:00am requires 21 units, 8:00-19:00 requires 34 units and from 19:00-1:00 requires 30 units to reach 90% reliability.

The decision on how to divide the time of day requirements is based on two factors. First, current service time exceeds one hour, making it impractical to simply use the base supply of units calculated from the average number of calls that originate within a specific time frame. Instead, it requires the use of queuing analysis which incorporates service time in the equations. More importantly, the implementation of an aggressive deployment plan that is based on data for each day of the week and hour of the day yields to total 168 different deployment plans (7 days x 24 hours/day=168). With dispatch services being provided by the CACC, for which PRPS has no administrative control, it would be an unmanageable challenge to implement a deployment strategy with that level of operational complexity.


100 - 800 Coverage as a Function of Number of Ambulances
coverage
100.0%
90.0%
80.0%
70.0%
60.0%
50.0%
40.0%
30.0%
20.0%
10.0%
0.0%
21
1 5 9 13 17 21 25 29 33 37 41 45 49 53 57
vehicles


800 - 1900 Coverage as a Function of Number of Ambulances
coverage
100.0%
90.0%
80.0%
70.0%
60.0%
50.0%
40.0%
30.0%
20.0%
10.0%
0.0%
34
1 5 9 13 17 21 25 29 33 37 41 45 49 53 57
vehicles



2. *PERSONNEL REQUIREMENTS:*

Using the assumptions of a field personnel working a 42 hour work weeks and using an FTE factor of 1.1 to accommodate vacation and sick leave, it would take 282 FTEs in the first year to staff the hybrid deployment model. This number includes only one additional support position. In HA's calculations, all field staff were assumed to be full-time, even though PRPS actually employs a mix of full and part-time field staff.

3. *FACILITY REQUIREMENTS:*

To house and deploy the varied number of units required by the hybrid model in a manner that would provide 90% reliability coverage of the Region, it would require 24 facility additions. Optimally, all of these facility additions would support housing of two vehicles to support future growth and optimization of deployment.

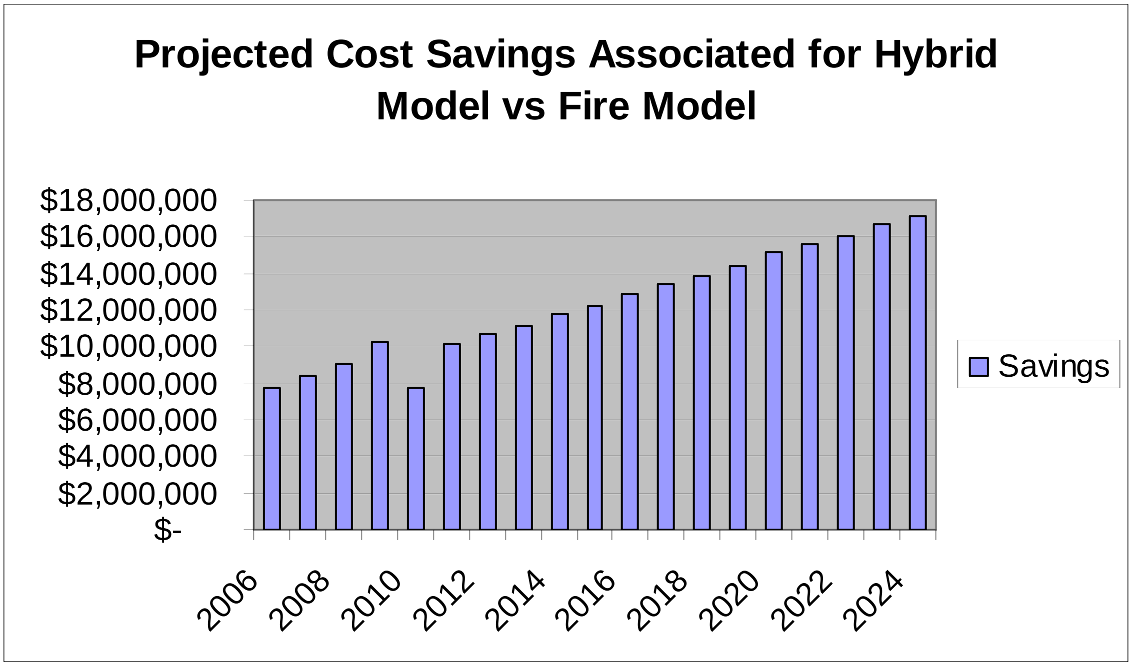
G. *COMPARISON OF FIRE AND HYBRID MODEL COSTS*

The following table summarizes costs for the fire and hybrid models respectively for each year from 2007 through 2025.

Total Operational Cost Estimates				
		Hybrid	Fire Model	Difference
2006	$	32,665,590	32,665,590	
2007	$	41,173,354	48,904,810	$ 7,731,456
2008	$	41,228,623	49,646,718	$ 8,418,096
2009	$	43,733,590	52,837,518	$ 9,103,928
2010	$	47,671,886	57,979,435	$ 10,307,549
2011	$	48,841,209	56,546,148	$ 7,704,939
2012	$	48,797,246	58,975,841	$ 10,178,595
2013	$	50,780,714	61,429,248	$ 10,648,534
2014	$	52,917,811	64,082,959	$ 11,165,148
2015	$	55,066,186	66,796,309	$ 11,730,123
2016	$	57,310,366	69,575,817	$ 12,265,451
2017	$	59,737,948	72,592,309	$ 12,854,361
2018	$	61,810,444	75,178,239	$ 13,367,795
2019	$	64,120,455	78,019,943	$ 13,899,488
2020	$	66,288,134	80,717,208	$ 14,429,073
2021	$	69,112,167	84,232,292	$ 15,120,125
2022	$	71,147,609	86,731,938	$ 15,584,328
2023	$	73,456,111	89,534,722	$ 16,078,611
2024	$	75,855,700	92,511,186	$ 16,655,486
2025	$	78,119,602	95,229,821	$ 17,110,219

1. TOTAL ANNUAL OPERATING COST ESTIMATES FOR FIRE AND HYBRID MODELS

Based on the figures in the 'Difference' Column above, the following graph plots the cost savings offered by the hybrid model over the fire model:



V. *RECOMMENDATIONS*

A. *DEPLOYMENT*

1. *DEPLOYMENT PLAN*

It is recommended that the deployment for PRPS include the following components:

a) Emergency Mode Response Time Standards and Reporting

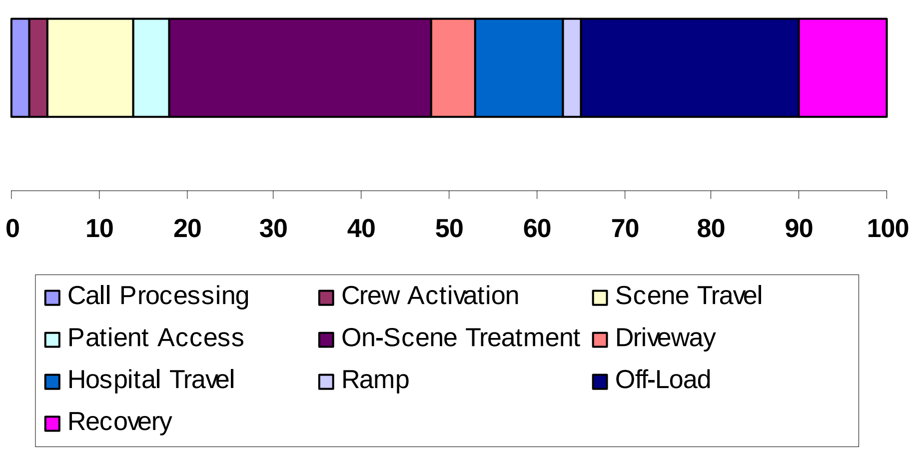
- Compliance to standards specified below should be at a minimum level of 90% reliability
- For its highest priority of emergency calls where both ambulances and fire rescue first response units are dispatched using red lights and sirens (i.e. Code 4 tiered response):

- *Region of Peel EMS System* unit response time standard of 6:00 (Six minutes, zero seconds)
  - Time of first crew notification to arrival of first unit on-scene, regardless if it is a fire unit, ambulance, or other paramedic staffed and equipped vehicle
- *Ambulance* response time interval standard of 12:00 (Twelve minutes, zero seconds)
- Fire department *first response* time interval standard of 6:00 (Six minutes, zero seconds)
  - It is important to note that fire department first response units are not needed on all emergency (red lights and sirens) responses. In the absence of clinical evidence to support the need for responses of 6 minutes or less - aside from the highest priority category of calls where there is evidence that the patient is pulseless, not breathing, or in other similarly dire and time sensitive circumstances (i.e. Code 4 tiered response). This equates to approximately 23% of overall responses and approximately 30% of code 4 responses. The following table shows the number of calls that fell into this category in 2005.

Jan-Nov 2005 Dispatch Complaint	Count
Altered LOC	493
Cardiac/Medical Arrest	705
Drowning	5
Head/Brain Trauma	546
Hemorrhage/Hypovolemia Major	141
Inhalation Injury	31
Near Drowning	2
Paralysis/Spinal Trauma	13
Post Arrest	1
Resp. Arrest	10
Resp. Distress	6538
Seizure/Post Ictal	1793
Trauma Unknown (Dispatch Only)	740
Traumatic Arrest	44
Unconscious	1558
Tiered Responses Needed	12620
Total EMS Responses	53427
Total Code 4 Responses	41715

- For all other emergency responses of the next lower level of priority where only an ambulance is dispatched using red lights and sirens (code 4 non-tiered response):
  - *Region of Peel EMS System* and *Ambulance* unit response time standard of 12:00 (12 minutes, zero seconds)
    - Time of first crew notification to arrival of first unit on-scene, regardless if it is an ambulance or other paramedic staffed and equipped vehicle
- PRPS and fire departments should strive to improve system and their respective response time interval reliability towards 100% using process improvement methods on items such as:
    - Decreasing the call received to crew notification time interval in the CACC
    - Develop an internal mechanism to capture key performance indicator data (such as response time data) independent of the CACC. This may involve use of data from the patient care reports.
    - Create a new 'Response Analyst' position at PRPS that would facilitate the capture and analysis of data on a daily basis. This would include collection of Fire response time data.
    - Making refinements to the deployment plan using statistically oriented process improvement methods
    - Finding ways to decrease off-load times
    - Reducing the crew notification to en route time interval
    - It may not be possible or practical to actually achieve 100% reliability, but the idea is to constantly try to improve this core, mission-critical operational process.
- Diligently measure the ambulance and fire department emergency response time intervals using several types of statistical formats and methods to facilitate detailed operational process monitoring and targeted improvements. The processes used should be the same for PRPS, FD and CACC for consistency and transparency. Measures should include:
  - Average response time (50% reliability)

- Response time at 90% reliability
- Tracking response time performance for specific cases using statistical process control charts ('X bar' and 'S' chart types)
    - Investigation of process improvement opportunities for responses identified as possible sources of 'special cause' variation
- Tracking response time performance over time using a process capability indices (Cp and Cpk) based on the 12:00 and 6:00 standards for emergency calls
- In order to facilitate improvements in overall response time interval performance, it will be necessary to break time interval data down into very detailed components that are subjected to the type and detail of statistical analyses described above. These component time intervals should include:



Call Time Intervals

1. CALL PROCESSING INTERVAL:
   CACC call received time to CACC unit notification time

   a. Fire, ambulance, system*
   (*'system' in this context refers to whichever combination of system resource responses resulted in shortest calculated time interval)

2. CREW ACTIVATION INTERVAL:
   Unit notification time to unit en route time

   a. Fire, ambulance, system

3. SCENE TRAVEL INTERVAL:
   Unit en route time to unit on-scene time

   a. Fire, ambulance, system

4. PATIENT ACCESS INTERVAL:
   Unit on-scene time to first patient contact time

   a. Fire, ambulance, system

5. SYSTEM OPERATIONS RESPONSE TIME INTERVAL:
   CACC call received time to first unit on-scene time

   a. As above for fire and ambulance respectively

6. SYSTEM CLINICAL RESPONSE TIME INTERVAL:
   CACC call received time to first crew patient contact time (fire or ambulance)

   As above for fire and ambulance respectively

7. ON-SCENE TREATMENT INTERVAL:
   Ambulance patient contact time to en route to ambulance time

8. DRIVEWAY INTERVAL:
   Patient at ambulance time to en route hospital time

9. HOSPITAL TRAVEL INTERVAL:
   En route hospital time to hospital arrival time

10. RAMP INTERVAL:
    Hospital arrival time to ED staff contact time

11. OFF-LOAD INTERVAL:
    ED staff contact time to hospital transfer of care time

12. RECOVERY INTERVAL:
    Hospital transfer of care time to ambulance available time

13. AMBULANCE MISSION INTERVAL:
    Ambulance crew notification time to ambulance available time

14. FIRE MISSION INTERVAL:
    Fire unit notification time to fire unit available time

- Measurement of some of these times and intervals will require processes to be established which:
    - Integrate data from the CACC, fire departments, and PRPS
    - Establish new event times to be recorded, such as:
        - Patient contact time
        - En route ambulance time
        - Patient at ambulance time
        - ED staff contact time
        - Hospital transfer of care time
    - Managers should anticipate it will take significant process performance improvement efforts to:
        - habituate both PRPS and FD crews in reporting times for these new incident milestones in the same manner
        - Adopting paper and electronic recordkeeping systems to accommodate capture of these times
            - Tracking CACC staff performance in capturing these times into the CAD when reported by crews via radio, if that option for time stamping is chosen (e.g., radio reporting by crews of their 'at patient' times)
        - Performance improvement projects to establish acceptable levels of compliance to capture of these (and other currently tracked) times
            - Regular feedback to crews and agencies on their compliance to reporting each of these time intervals
- Establish external accountability for the EMS system in the form of a monthly EMS system performance report that includes (among other items) call volume and the following time intervals – on average and at 90% reliability levels:
    - SYSTEM CALL PROCESSIONG INTERVAL:
      CACC call received time to CACC first unit notification time

- SYSTEM OPERATIONS RESPONSE TIME INTERVAL:
  CACC call received time to first unit on-scene time
  - As above for fire and ambulance respectively
- OFF-LOAD INTERVAL:
  ED staff contact time to hospital transfer of care time

- The System Operations Response Time Intervals should be reported at a system level and at a community-level (to include Brampton, Caledon and Mississauga, respectively)
- The monthly EMS performance report should be sent to, at minimum:
  - PRPS Base Hospital Medical Director (and the Region of Peel EMS System Medical Director, if that position is established)
  - Region of Peel Chief Administrative Officer
  - Region of Peel Emergency and Protective Services Committee
  - Local hospital administrators and emergency department directors
  - EMS Office at the Ontario Ministry of Health and Long Term Care
  - Local print and electronic media outlets

There may be issues with significant time delays getting data from the CACC to PRPS and the fire departments. Any bottlenecks in this process should be fixed as a high priority item.

b) Deployment Method

- Deploy ambulances using the 'Hybrid Model'
- Analysis of demand distribution by time of day and day of the week suggested that planning for three daily time frames provided adequate differentiation while not making the deployment plan overly complex to manage. This was especially important since PRPS does not have direct oversight of the dispatch function. Therefore, we recommend that specific deployment plans be used for each of the following three time intervals.
  - 01:00 – 08:00

  - 08:00 – 19:00
  - 19:00 – 01:00

- Ambulances should be deployed from a combination of fixed station locations that include existing EMS stations, existing and planned fire stations and existing and planned police stations.

- We recommend that ambulances be redeployed between locations, based on the enclosed plan, to optimize coverage of high demand areas and meet response time goals

- We recommend that geographical coverage be provided on a continual basis in the Caledon area, which means that placing units in those locations will have a high priority in the hierarchy of unit assignments

- We recommend staffing 10% more than the minimum number called for in our analysis. The models that were used to provide these estimations are based on instantaneous deployment and redeployment of resources. Since relocation between deployment locations is not instantaneous and considering the CACC's relative inexperience in aggressive dynamic deployment we think that this is the number of resources that will be needed in the immediate future to achieve the 12 minute response time standard with a high degree of reliability. This number of units should ensure appropriate temporal and geographical coverage, while at the same time keeping the number of post-to-post moves within reason to provide for a reasonable quality of work life for field crews.

- In order to reduce hospital off-load delays and its devastating impacts on ambulance availability, we recommend:

  - Strict application of the measures called for in the MOHLTC task force recommendations, especially those pertaining to close monitoring of hospital off-load delay statistics.

    - Implement a sound (and ideally and automated) process for logging event times that will facilitate appropriate monitoring of the off-load process, to include discrimination between intervals that are under the control of the ED versus those under the control of EMS (e.g., time from unit at hospital to the patient physically enters the ED is controlled by EMS, while the time of patient entry into the ED unit the patient is placed into the care of the ED staff is controlled by the ED). It is our understanding that software being used by Toronto EMS has been somewhat helpful in this regard, but without automation in event logging, the time stamping is prone to error

- In addition, we recommend that PRPS investigate implementation of a destination software package such as that utilized in TEMS. This system could potentially improve hospital turn around time by more efficiently distributing patient among hospital.

o Hospital off-load delay statistics should be internally and publicly reported

  - Regional Council and EPSC
  - Local print and electronic media

(1) Specific deployment plans:

Units should be deployed and redeployed based on the following deployment plans. The probability of having no calls during a given period of time is relatively low. Therefore, as a means of further decreasing post-to-post moves, we have cut off the plans at 20 available units. Any additional available units should be placed at the highest priority post. In this instance, post 31, post 91 and post 42.

(i) 01:00 AM – 08:00 AM Deployment Plan

Based on the historical call demand, service time and call distribution, the number of units needed to provide various levels of coverage during this time interval were calculated. To reach 90% reliability at the 12:00 response time standard coverage, it will be necessary to staff 19 units during this time interval. We recommend that PRPS actually staff 21 units, which is 10% more than the minimum number revealed in our analysis. The models that were used to provide these estimations are based on instantaneous deployment and redeployment of resources. Since relocation between deployment locations is not instantaneous and considering the CACC's relative inexperience in aggressive dynamic deployment, we think that this is the number of resources that will be needed will be in the immediate future to achieve the 12 minute response time standard with a high degree of reliability. This number of units should ensure appropriate temporal and geographical coverage, while at the same time minimizing post-to-post moves to a tolerable level to provide for a reasonable quality of work life for field crews.

Time Frame: 1:00-8:00

Available Units																					
21	30	31	91	23	42	2	15	35	4	24	51	1	49	20	52	90	47	34	16	43	*
20	30	31	91	23	42	2	15	35	4	24	51	1	49	20	52	90	47	34	16	43	
19	30	31	91	23	42	2	15	35	4	24	51	1	49	20	52	90	47	34	16		
18	30	31	91	23	42	2	15	35	4	24	51	1	49	20	52	90	47	34			
17	30	31	91	23	42	2	15	35	4	24	51	1	49	20	52	90	47				
16	30	31	91	23	42	2	15	35	4	24	51	1	49	20	52	90					
15	30	31	91	23	42	2	15	35	4	24	51	1	49	20	52						
14	30	31	91	23	42	2	15	35	4	24	51	1	49	20							
13	30	31	91	23	42	2	15	35	4	24	51	1	49								
12	30	31	91	23	42	2	15	35	4	24	51	1									
11	30	31	91	23	42	2	15	35	4	24	51										
10	30	31	91	23	42	2	15	35	4	24											
9	30	31	91	23	42	2	15	35	4												
8	30	31	91	23	42	2	15	35													
7	30	31	91	23	42	2	15														
6	30	31	91	23	42	2															
5	30	31	91	23	42																
4	30	31	91	23																	
3	30	31	91																		
2	30	31																			
1	30																				

* Represents a floating vehicle

(ii) 08:00 AM – 19:00 PM Deployment Plan

To reach 90% reliability at a 12:00 response time standard, it will be necessary to staff 31 units during this time interval. We recommend that PRPS actually staff 34 units, which is 10% more than the minimum number revealed in our analysis.

Time Frame 8:00-19:00

Available Units	Posts																															
34	30	31	9	24	42	2	35	4	23	51	1	90	21	49	52	47	34	17	43	16	15	36	50	86	12	41	10	5	29	32	40	39	*
33	30	31	9	24	42	2	35	4	23	51	1	90	21	49	52	47	34	17	43	16	15	36	50	86	12	41	10	5	29	32	40	39	
32	30	31	9	24	42	2	35	4	23	51	1	90	21	49	52	47	34	17	43	16	15	36	50	86	12	41	10	5	29	32	40		
31	30	31	9	24	42	2	35	4	23	51	1	90	21	49	52	47	34	17	43	16	15	36	50	86	12	41	10	5	29	32			
30	30	31	9	24	42	2	35	4	23	51	1	90	21	49	52	47	34	17	43	16	15	36	50	86	12	41	10	5	29				
29	30	31	9	24	42	2	35	4	23	51	1	90	21	49	52	47	34	17	43	16	15	36	50	86	12	41	10	5					
28	30	31	9	24	42	2	35	4	23	51	1	90	21	49	52	47	34	17	43	16	15	36	50	86	12	41	10						
27	30	31	9	24	42	2	35	4	23	51	1	90	21	49	52	47	34	17	43	16	15	36	50	86	12	41							
26	30	31	9	24	42	2	35	4	23	51	1	90	21	49	52	47	34	17	43	16	15	36	50	86	12								
25	30	31	9	24	42	2	35	4	23	51	1	90	21	49	52	47	34	17	43	16	15	36	50	86									
24	30	31	9	24	42	2	35	4	23	51	1	90	21	49	52	47	34	17	43	16	15	36	50										
23	30	31	9	24	42	2	35	4	23	51	1	90	21	49	52	47	34	17	43	16	15	36											
22	30	31	9	24	42	2	35	4	23	51	1	90	21	49	52	47	34	17	43	16	15	36											
21	30	31	9	24	42	2	35	4	23	51	1	90	21	49	52	47	34	17	43	16	15												
20	30	31	9	24	42	2	35	4	23	51	1	90	21	49	52	47	34	17	43	16													
19	30	31	9	24	42	2	35	4	23	51	1	90	21	49	52	47	34	17	43														
18	30	31	9	24	42	2	35	4	23	51	1	90	21	49	52	47	34	17															
17	30	31	9	24	42	2	35	4	23	51	1	90	21	49	52	47	34																
16	30	31	9	24	42	2	35	4	23	51	1	90	21	49	52	47																	
15	30	31	9	24	42	2	35	4	23	51	1	90	21	49	52																		
14	30	31	9	24	42	2	35	4	23	51	1	90	21	49																			
13	30	31	9	24	42	2	35	4	23	51	1	90	21																				
12	30	31	9	24	42	2	35	4	23	51	1	90																					
11	30	31	9	24	42	2	35	4	23	51																							
10	30	31	9	24	42	2	35	4	23	51																							
9	30	31	9	24	42	2	35	4	23																								
8	30	31	9	24	42	2	35	4																									
7	30	31	9	24	42	2	35																										
6	30	31	9	24	42	2																											
5	30	31	9	24	42																												
4	30	31	9	24																													
3	30	31	9																														
2	30	31																															
1	30																																

* Represents a floating vehicle

(iii) 19:00 PM – 08:00 AM Deployment Plan

To reach a 90% level of reliability to a 12:00 response time standard, 27 units will be needed during this time interval. We recommend that PRPS actually staff 30 units, which is 10% more than the minimum number revealed in our analysis.

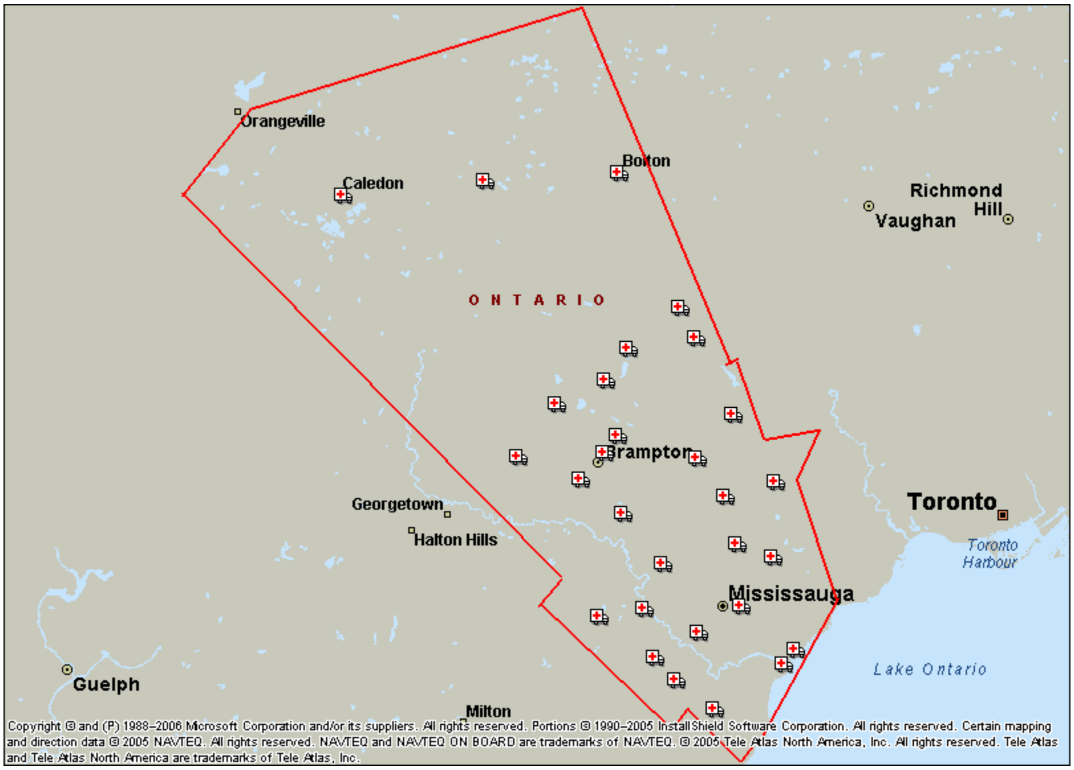
Time Frame 19:00-1:00

Available Units																														
30	30	9	31	24	42	2	35	23	1	4	21	51	90	49	52	88	34	20	15	43	16	36	86	12	50	41	10	22	39	*
29	30	9	31	24	42	2	35	23	1	4	21	51	90	49	52	88	34	20	15	43	16	36	86	12	50	41	10	22	39	
28	30	9	31	24	42	2	35	23	1	4	21	51	90	49	52	88	34	20	15	43	16	36	86	12	50	41	10	22		
27	30	9	31	24	42	2	35	23	1	4	21	51	90	49	52	88	34	20	15	43	16	36	86	12	50	41	10			
26	30	9	31	24	42	2	35	23	1	4	21	51	90	49	52	88	34	20	15	43	16	36	86	12	50	41				
25	30	9	31	24	42	2	35	23	1	4	21	51	90	49	52	88	34	20	15	43	16	36	86	12	50					
24	30	9	31	24	42	2	35	23	1	4	21	51	90	49	52	88	34	20	15	43	16	36	86	12						
23	30	9	31	24	42	2	35	23	1	4	21	51	90	49	52	88	34	20	15	43	16	36	86							
22	30	9	31	24	42	2	35	23	1	4	21	51	90	49	52	88	34	20	15	43	16	36								
21	30	9	31	24	42	2	35	23	1	4	21	51	90	49	52	88	34	20	15	43	16									
20	30	9	31	24	42	2	35	23	1	4	21	51	90	49	52	88	34	20	15	43										
19	30	9	31	24	42	2	35	23	1	4	21	51	90	49	52	88	34	20	15											
18	30	9	31	24	42	2	35	23	1	4	21	51	90	49	52	88	34	20												
17	30	9	31	24	42	2	35	23	1	4	21	51	90	49	52	88	34													
16	30	9	31	24	42	2	35	23	1	4	21	51	90	49	52	88														
15	30	9	31	24	42	2	35	23	1	4	21	51	90	49	52															
14	30	9	31	24	42	2	35	23	1	4	21	51	90	49																
13	30	9	31	24	42	2	35	23	1	4	21	51	90																	
12	30	9	31	24	42	2	35	23	1	4	21	51																		
11	30	9	31	24	42	2	35	23	1	4	21																			
10	30	9	31	24	42	2	35	23	1	4																				
9	30	9	31	24	42	2	35	23	1																					
8	30	9	31	24	42	2	35	23																						
7	30	9	31	24	42	2	35																							
6	30	9	31	24	42	2																								
5	30	9	31	24	42																									
4	30	9	31	24																										
3	30	9	31																											
2	30	9																												
1	30																													

* Represents a floating vehicle

(2) Proposed Post Locations:

The following map and locations table depicts post locations throughout the Region. The table below provides detailed locations of each of the proposed post locations. The post locations are broken into two categories - high and 2nd priority posts.


Orangeville
Caledon
Bolton
Richmond Hill
Vaughan
ONTARIO
Brampton
Georgetown
Halton Hills
Toronto
Toronto Harbour
Mississauga
Lake Ontario
Guelph
Milton
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High Priority	Long	Lat	Street Location	City
31	-79.6273	43.5889	15 Fairview Rd. West.	Mississauga
42	-79.7071	43.5541	4595 Glen Erin Dr	Mississauga
2	-79.6681	43.6881	1900 Boylen Rd	Mississauga
35	-79.6995	43.6169	6745 Mavis Road	Mississauga
4	-79.6526	43.5197	1578 Finfar Ct	Mississauga
9	-79.7419	43.7034	8 Rutherford Rd. S.	Brampton
1	-79.7978	43.7247	91 Sandalwood PkWY E	Brampton
51	-79.5981	43.6212	3461 Dixie Road	Mississauga
23	-79.74	43.87965	28 Ann Street	Caledon
49	-79.759	43.5822	6677 Meadowvale Town Centre Circle	Mississauga
90	-79.7363	43.6511	499 Ray Lawson Blvd.	Brampton
52	-79.5956	43.6719	2951 Convair Drive	Mississauga
21	-79.7318	43.7619	51 Mountainash Road	Brampton
15	-79.752	43.7405	120 Fernforest Dr.	Brampton
34	-79.6344	43.7176	7101 Goreway Drive	Mississauga
16	-79.8335	43.6893	10530 Creditview Rd.	Brampton
43	-79.6676	43.5714	4090 Creditview Rd	Mississauga
47	-79.5883	43.5494	62 Port St. West	Mississauga
36	-79.6419	43.6624	1735 Britannia Rd. East	Mississauga
24	-79.8644	43.8743	6085 Old Church Road	Caledon

2nd Priority	Long	Lat	Street Location	City
20	-79.6838	43.7893	9756 The Gore Road	Brampton
86	-79.6881	43.5391	3476 Glen Erin Drive	Mississauga
91	-79.7538	43.6919	148 Queen St. E.	Brampton
50	-79.7178	43.5867	85 Queen Street South	Mississauga
12	-79.7758	43.6735	657 Queen St. W.	Brampton
17	-79.6688	43.769	4075 Ebenezer Road	Brampton
30	-79.982	43.8746	3611 Charleston Sideroad	Caledon
88	-79.5777	43.5591	230 Lakeshore Rd. E.	Mississauga
41	-79.6313	43.6306	1090 Nuvik Court	Mississauga

Red entries in the post location tables above indicate facilities that can already accommodate EMS units – and therefore will not require modifications. Finfar and Boylen are exception as they have limited space.

To put the above listed location recommendations into proper context, it is important to understand how they were chosen and what the limitations are of the underlying computer modeling.

- HA received very specific direction from the EPSC that they strongly preferred scenarios that did not involve purchase of new property for construction of PRPS stations. They also expressed a preference for leveraging existing public safety resources, the fire stations in particular, for use as potential EMS stations. Therefore, HA and its strategic partners at the Department of Industrial Engineering at the University of Arizona began with the locations of all existing and planned EMS, fire and police stations as potential locations. The process then identified which of these locations would be the most useful from the standpoint of providing an overall probability of coverage with 90% reliability within the response time interval target.

- The modeling aggregated all calls within 1 KM square grids together into a single group and established a 'centroid' location at the center of the grid from which drive times were calculated to all other centroids. Making smaller grids and centroids risks not having a sufficient number of calls in all grids to make appropriate estimates of drive time averages and other factors. This is a fundamental issue that has to balance precision with practicality - and both are needed to construct a good model for deployment planning and probability calculation purposes.

Some of these locations may not be able to accommodate construction of appended facilities due to any number of factors (e.g. insufficient space, site soil and drainage issues, zoning restrictions). If any of the sites are excluded, there are some options to consider:

- Use the location as a post where crews would co-habitate with the fire crews

- Consider a nearby alternative location. The computer modeling that drove the statistics behind the deployment plan are based on 1 KM square grids. The further an alternate location is selected from the target location listed in the table, the greater the risk that the probabilities for successful coverage will suffer. Therefore, should an alternate construction site be sought, it should be as close as possible to the original target site. A 1 KM radius may be a reasonable working guideline to use.

- If a given location cannot be used for book-on and book-off purposes for a lack of parking space, etc., another nearby fire, police or EMS facility could be used for that purpose. The on-coming crew would then simply drive to their prescribed stand-by station. These alternate book-on a book-off sites could be other types of public facilities (e.g. libraries, government administration offices, etc.). Any unit cleaning and restocking could be done by the off-going crew before shift change or after book-on of the new crew when they get back to their 'base' location. It is not absolutely necessary to have cleaning and re-stocking facilities at the book-on / book-off location. Alternatively, 4-5 larger stations could be built to serve a centralized book-on / book-off stations and one of those could also serve as an administration building. This scenario would probably involve land purchases, but if land purchases are found to be necessary regardless, this would be an acceptable option.

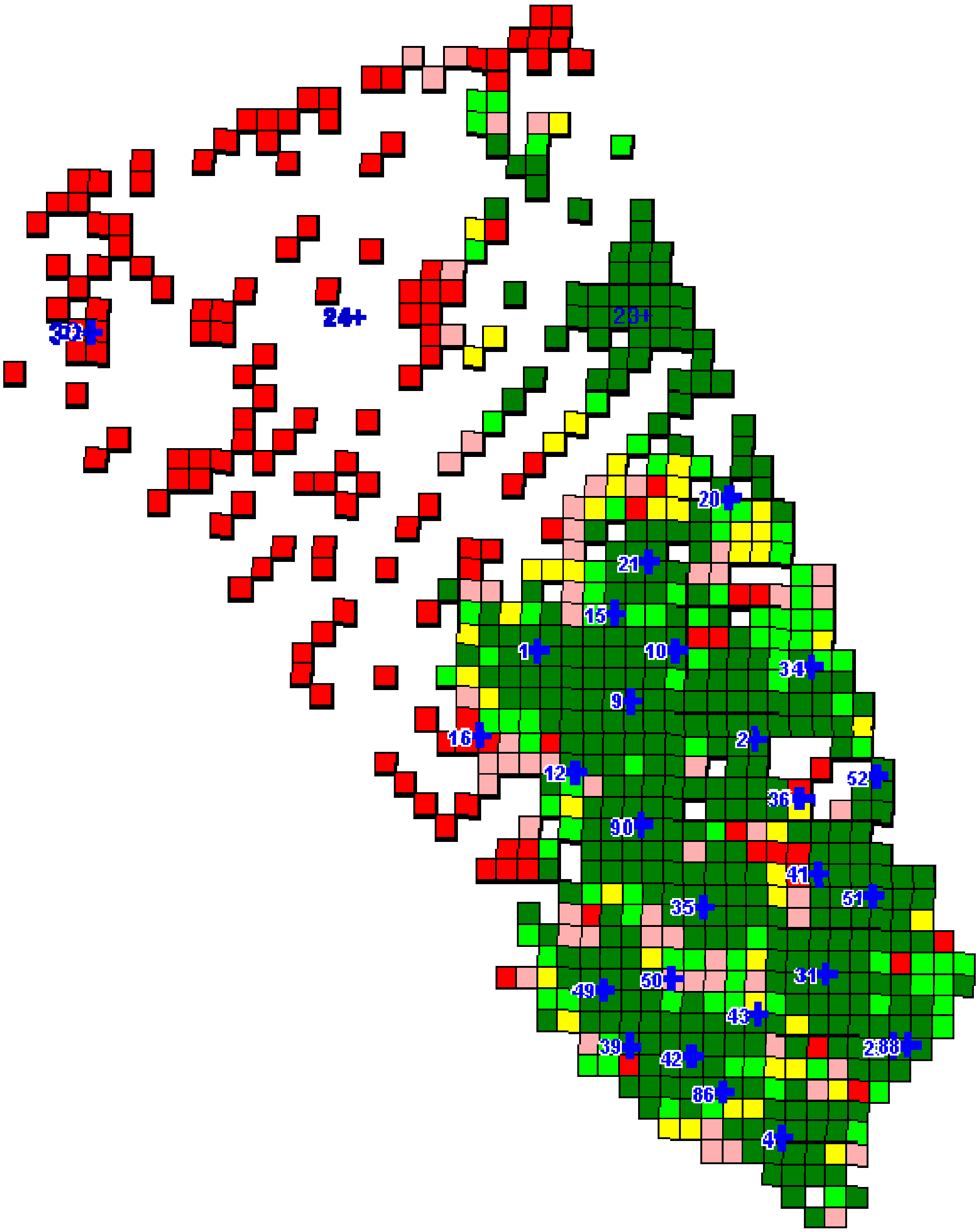
While it would be ideal to have all the post modifications made as soon as possible, the high priority posts are would be occupied more frequently and should therefore be given priority.

Regardless of when any new construction is completed as an addition to existing fire stations, there will be a transition period during which ambulance crews will need to use the fire stations as stand-by locations until such construction can be completed. In order to make this work, strong leadership and determination will be needed from the elected city officials, fire and EMS managers, union officials, and the medical directors. If there is a will to make this work successfully by all parties involved, it can work. If any of these parties decides it has an agenda to undermine these efforts, the plan might be derailed.

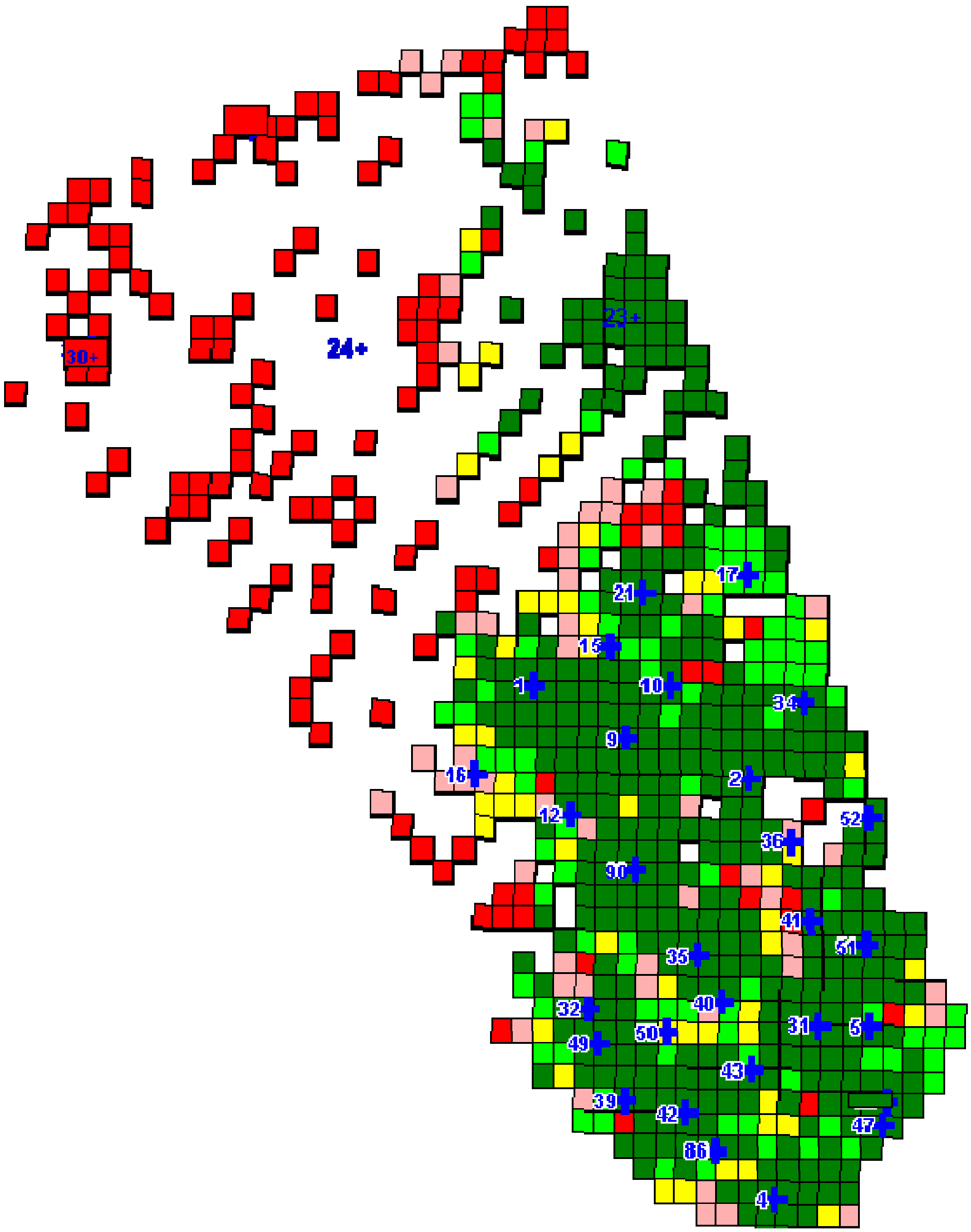
(3) Coverage Probability

The following maps provide a picture of expected coverage probability utilizing the recommended deployment plan. Areas highlighted in green will have the highest probability of responses within the 12:00 response time standard. However, the red areas in the northern portion of the Region do not necessarily mean that coverage is poor in the northern portion of the Region. Instead, it signifies areas that historically have had very low call volumes. Therefore in these areas, it is hard to *predict* a high probability of coverage regardless of the number of resources that are provided.

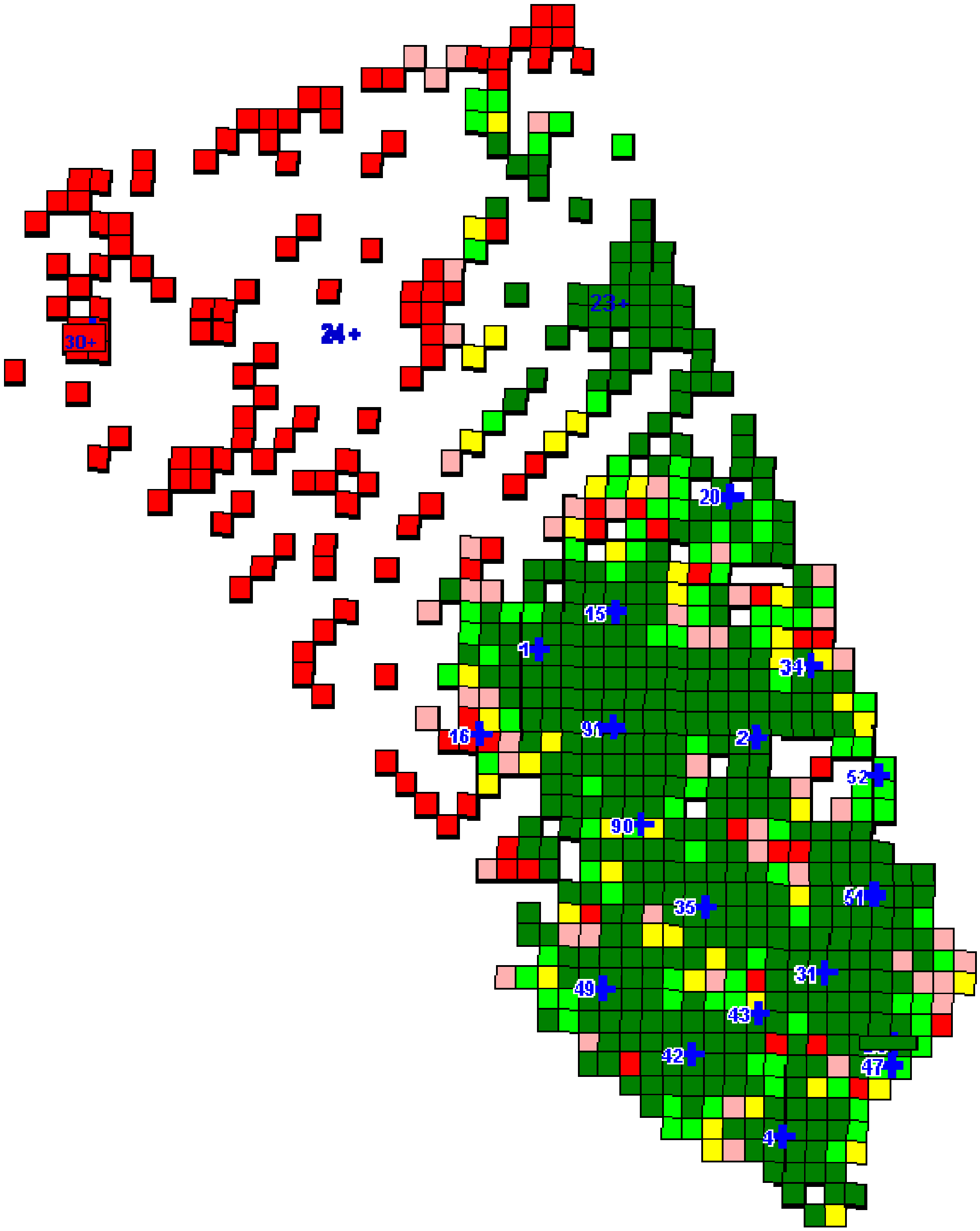
To ensure adequate coverage of these areas the deployment plan, we are calling for placement of an additional unit in the Caledon area to provide geographic coverage. The recommended deployment plan provides both for temporal and geographic coverage of the Region of Peel.



Coverage Probability - Hybrid Model for 1:00–8:00



Coverage Probability - Hybrid Model 8:00-19:00



Coverage Probability - Hybrid Model 19:00-1:00

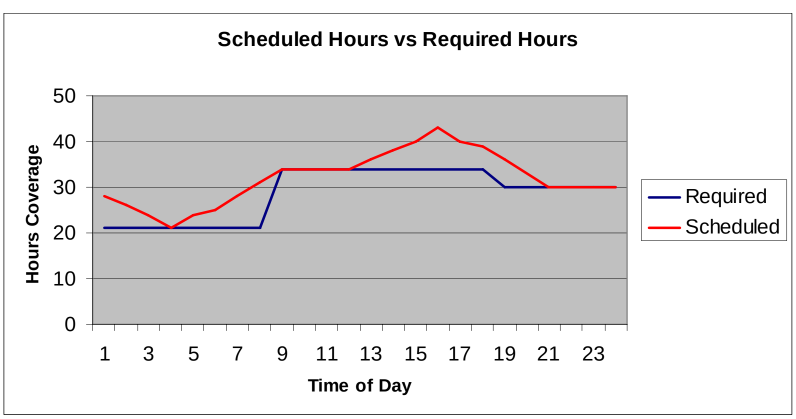
2. PROPOSED SCHEDULE AND PLATOON ASSIGNMENTS

a) Proposed Schedule

The use of three distinct groupings of hours for deployment analysis, as opposed to a separate deployment plan for each hour of the 168 hours in a week, dramatically decreases the complexity of scheduling. The follow proposed schedule optimizes the use of the proposed deployment plan.

		Shift	Hour of Day																							
	Start time	Starts	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
12 Hour Shifts	1am	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	2am	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	3am	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	4am	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	5am	7	0	0	0	0	1	1	1	1	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0
	6am	5	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0
	7am	6	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1	1	1	0	0	0	0	0	0
	8am	6	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1	1	1	0	0	0	0	0
	9am	7	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1	1	1	0	0	0	0
	10am	3	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1	1	1	0	0	0
	11am	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1	1	1	0	0
	12pm	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1	1	1	0
	1pm	2	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1	1	1
	2pm	2	1	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1	1
	3pm	2	1	1	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1
	4pm	3	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1
	5pm	4	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1
	6pm	4	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1
	7pm	3	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1
	8pm	3	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1
	9pm	4	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1
	10pm	3	1	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1
	11pm	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	12am	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

The following graph contrasts the number of unit hours called for in the demand forecast (the blue 'Required' line) and the number of unit hours that are scheduled in the table above (the red "Scheduled' line).



b) Platoon Assignment

The shift schedule outlined in 2a would facilitate maintaining four platoons as exist today.

28 Day Work Cycle		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28
Staff Required		128	128	128	128	128	128	128	128	128	128	128	128	128	128	128	128	128	128	128	128	128	128	128	128	128	128	128	128
Platoon Assignment																													
A	64	1	1	1	1								1	1	1	1				1	1	1		1	1	1			
B	64		1	1	1				1	1	1	1								1	1	1	1				1	1	1
C	64	1				1	1	1		1	1	1				1	1	1	1								1	1	1
D	64					1	1	1	1				1	1	1		1	1	1				1	1	1	1			

3. REDUCING HOSPITAL OFF-LOAD DELAYS

Most EMS systems strive for a hospital turn-around time of 20-30 minutes. This allows crew sufficient time for transfer care, compete necessary paper work and clean the unit prior to redeployment. The average hospital off-load time for PRPS appears to be 63 minutes. 90% of the time, it takes 1 hour and 54 minutes. Fifty percent of the time there are more than 4 crews waiting with patients in local emergency department hallways. This amounts an expense of at least $2 million and upward of $4.3 million annually or over $12,000 per daily in wasted unit hour costs (when contrasted with the costs associated with 20 minute off-load times).

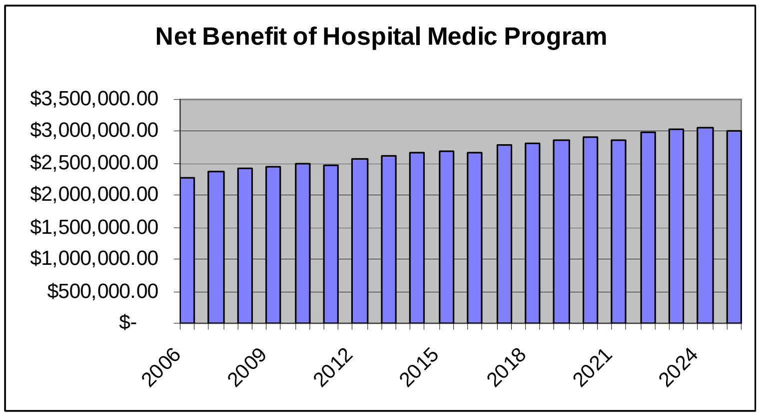
This expense could be drastically reduced by implementing a Hospital Medic Program. The Hospital Medic Program would involve placement of a PRPS paramedic in local emergency departments to accept and care for transported patients from PRPS crews until care of the patient can be transferred to the emergency department. This will facilitate faster return of crews with ambulances to service – and thereby make dramatic reductions in the number of unit hours lost to hospital off-load delays.

This program may not require any additional allocation of space by the emergency departments – that space is now being occupied by the waiting crews – although some space for the extra stretchers may be needed, perhaps on the ED ramp if it is a covered area. The cost of implementing this program would be minimal in comparison to the possible gains. Since patients that are having to wait for care are lower in acuity, one paramedic stationed in an emergency department should be able to reasonably handle at least 4-6 patients. To facilitate movement of these patients, it is recommended that each hospital be asked to provide 4-6 additional rolling hospital gurneys. If an arrangement can not be reached with the facilities, PRPS should invest in purchasing the same rolling gurneys that are currently used by each hospital. This should minimize any concerns of patients tipping over on ambulance stretchers. Since these patients are of a lower acuity, it should not be necessary to supply the paramedics with a lot of extra equipment.

We recommend that a policy be developed that clearly communicates which patients should be turned over to the Hospital Medic and which patients should continue to be cared for by the transporting crew until care is transfer to the emergency department. CTAS category 3 and 4 patients might qualify for care by the Hospital Medic while CTAS 1 and 2 cases could remain in the care of the transporting crew.

Since care continues to be provided by PRPS throughout this relay process and since the patient is physically in the hospital, with immediate back-up resources available in the event of change in patient condition, there should minimal clinical and legal risk associated with this program.

The following graph highlights potential conservative estimates for savings that could be realized by implementing the Hospital Medic Program. The net benefit of this program depends on many factors, such as the number of patients that a individual medic is allowed to monitor, acuity of patients, and the efficiency of the transfer process between medics. Even the worst case scenario still provides for significant potential cost savings that can be used to increase deployed unit hours and decrease overall employee workload.



A significant concern surrounding this idea is the potential for it to exacerbate hospital off-load delays by reducing the pressure on hospitals to fix their patient throughput issues. A task force recommendation on the hospital off-load delay problem recommended several steps be taken to address this issue, including establishing some level of accountability on the hospital by requiring that they track and report their hospital off-load delay times. These and the other steps suggested in the task force report are implemented simultaneously or in advance of the Hospital Medic Program, it should help mitigate the potential for exacerbation of the problem. As a further safeguard, it is suggested that a mechanism be developed whereby the hospitals reimburse PRPS for the cost of the Hospital Medic Program. This would provide a very direct incentive for the hospitals to resolve the problem so that this cost could ultimately be eliminated.

- Patients with CTAS level 3 and 4 acuity levels are transferred from the PRPS field paramedics to PRPS paramedics assigned to the three local hospital emergency departments so that field crews and the ambulances may return to duty sooner.

- Implementation of this program will involve formally developing a standard operating procedure and clinical protocol to address issues such as break times, what to do when a patient condition declines from CTAS 3 to CTAS 1 or 2, how patient care and monitoring is documented, etc.

- A hospital paramedic to patient ratio should be established by the PRPS Base Hospital Medical Director. It should model nurse to patient ratios used in the ED or waiting room areas for similarly low acuity cases.

- This transfer of care should not count towards the calculation of the hospital off-load delay time, since the patients are still in the care of PRPS.

- The MOHLTC and/or the local hospitals should reimburse PRPS for the cost for the hospital paramedic program so that MOHLTC and the hospital remain incentivized to fix the off-load delay problem in spite of the temporary relief that will be provided by this effort. If they fail to fix the problem, at least the cost will not be borne by the PRPS budget. The financial projections provided in this report do not include or account for the FTE's needed to initiate the 'Hospital Medic Program.' It is our belief that even if you divert FTE's from vehicle staffing to this program it will improve overall unit hour productivity and response time compliance.

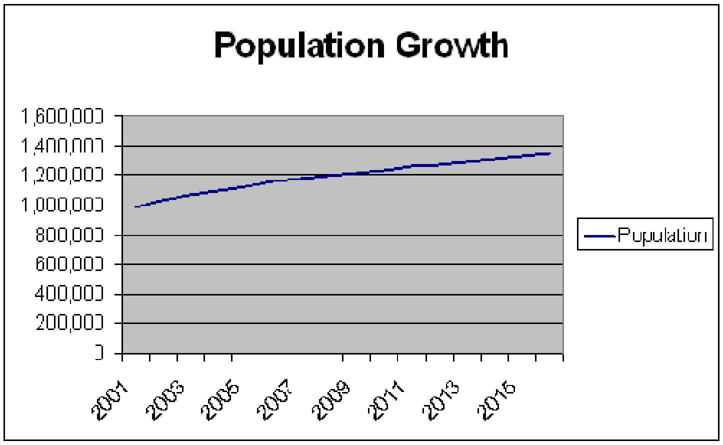
- Paramedic staffing of the "Hospital Medic Program' could follow one of two paths.

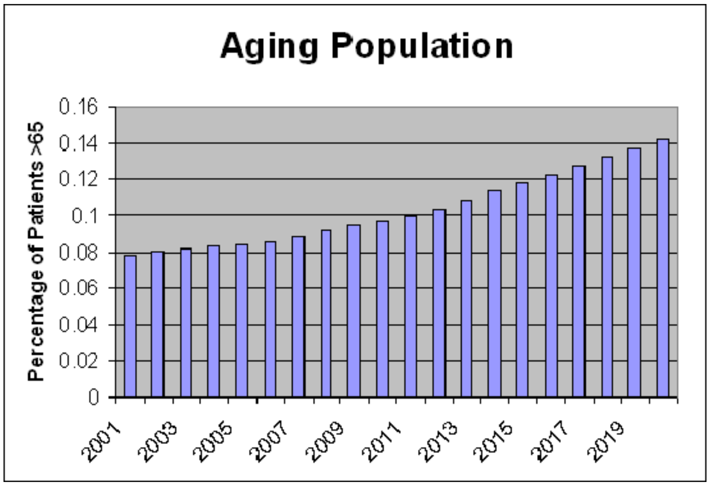
    - Paramedics could be rotated through the position or

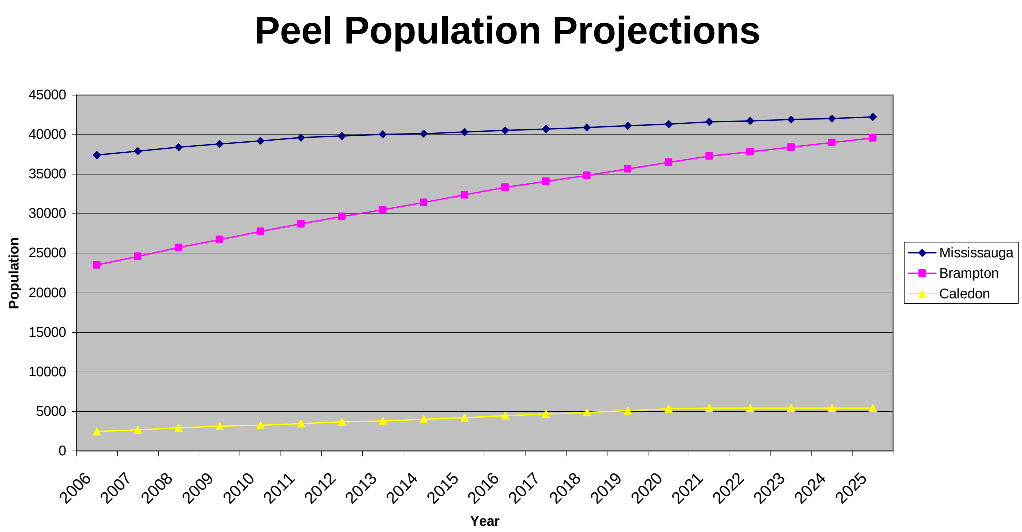
    - If you have staff that are interested in alternative duties you may bid or assign them to these positions.

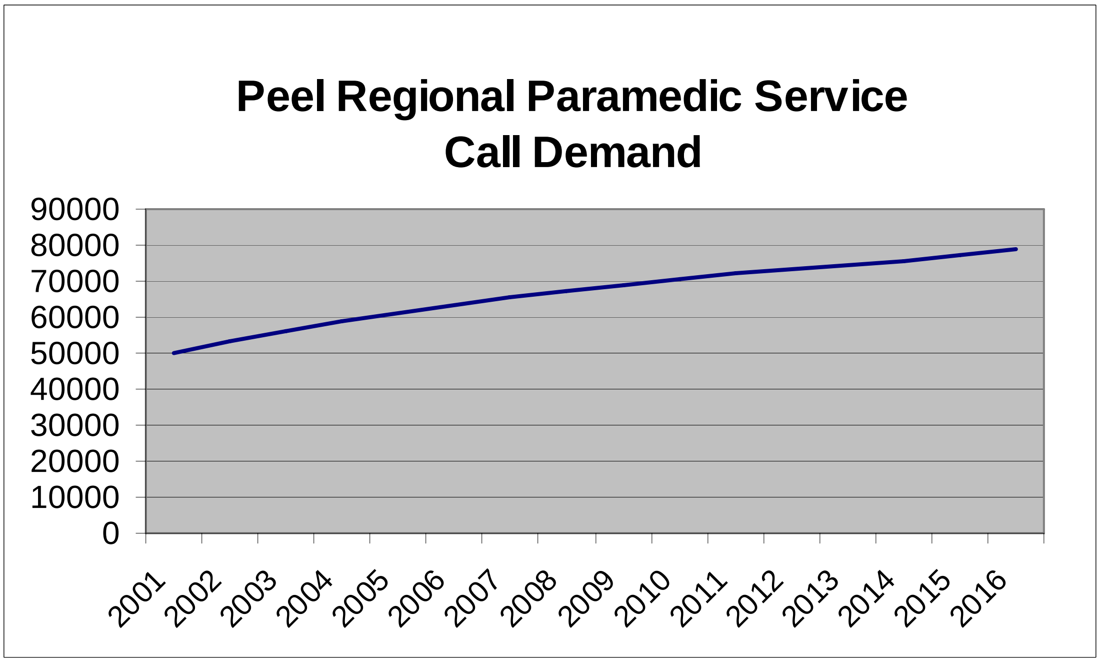
4. ADJUSTMENTS FOR PROJECTED GROWTH

The following graphs depict the projected population, aging and demand growth for the Region of Peel and its major municipalities.


Population Growth
1,600,000
1,400,000
1,200,000
1,000,000
800,000
600,000
400,000
200,000
0
2001
2003
2005
2007
2009
2011
2013
2015
Population

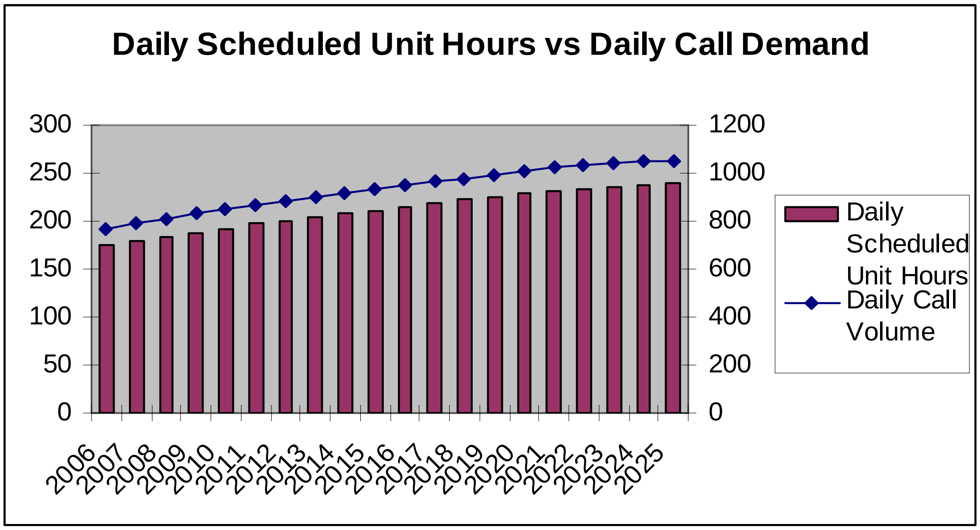

Aging Population
Percentage of Patients >65
0.16
0.14
0.12
0.1
0.08
0.06
0.04
0.02
0
2001
2003
2005
2007
2009
2011
2013
2015
2017
2019





5. FUTURE PERSONNEL NEEDS

Future year personnel requirements were based on maintaining a targeted Unit Hour Productivity ratio of 0.23. The graph below demonstrates this relationship by comparing proposed daily scheduled unit hours to projected average daily call.



The following table outlines the number of unit hours and personnel need to supply a given number of unit hours.

	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025
Projected Yearly Demand	63543	65312	67124	68775	70301	72052	73347	74536	75741	77114	78645	79858	81032	82247	83533	84782	85429	86195	86956	87240
Projected Daily Demand	174	179	184	188	193	197	201	204	208	211	215	219	222	225	229	232	234	236	238	239
Projected Yearly Transport Demand	40110	40992	41894	42816	43758	44721	45704	46710	47738	48788	49861	50958	52079	53225	54396	55592	56816	58065	59343	60648
Projected Daily Transport Demand	110	112	115	117	120	123	125	128	131	134	137	140	143	146	149	152	156	159	163	166
Targeted Unit Hour Productivity	0.23	0.23	0.23	0.23	0.23	0.23	0.23	0.23	0.23	0.23	0.23	0.23	0.23	0.23	0.23	0.23	0.23	0.23	0.23	0.23
Unit Hour Utilization	0.14	0.14	0.14	0.14	0.14	0.14	0.14	0.14	0.14	0.14	0.14	0.14	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.16
Total Daily Unit Hours Needed	768	788	810	830	848	870	885	900	914	931	949	964	978	993	1008	1023	1031	1040	1049	1053
Shift Length	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12
12 hour shifts needed	64	66	68	69	71	72	74	75	76	78	79	80	81	83	84	85	86	87	87	88
Daily Personnel Needed	128	131	135	138	141	145	148	150	152	155	158	161	163	165	168	171	172	173	175	175
Daily Personnel Hours	1536	1577	1620	1660	1697	1739	1770	1799	1828	1861	1898	1928	1956	1985	2016	2047	2062	2081	2099	2106
Weekly Personnel Hours	10752	11036	11342	11621	11879	12175	12393	12594	12798	13030	13289	13494	13692	13897	14115	14326	14435	14564	14693	14741
Weekly Personnel Needed	256	263	270	277	283	290	295	300	305	310	316	321	326	331	336	341	344	347	350	351
Total FTE's	**282**	**289**	**297**	**304**	**311**	**319**	**325**	**330**	**335**	**341**	**348**	**353**	**359**	**364**	**370**	**375**	**378**	**381**	**385**	**386**

6. FUTURE FLEET NEEDS

Fleet requirements for future years are greatly dependent on the access to and efficiency of fleet services. A commonly used ambulance industry standard is to maintain a 25% fleet surplus to facilitate servicing and repair of units, although it our understanding that many other Canadian services maintain a 50% fleet surplus for servicing and repair. Currently PRPS maintain a surplus of 50%. We do *not* recommend a decrease to the current surplus. Instead, we recommend working to improve the efficiency of the current fleet maintenance process. The current Regional plan calls for use of dedicated service technicians within the current corporate fleet services structure. As maintenance and timely repair are crucial to the recommended deployment model, if efficiencies are not achieved rapidly with this change, we recommend that a dedicated fleet services division be established under the direct management of PRPS.

The current fleet surplus should support implementation of the recommended deployment plan without any additional capital investment. A table outlining projected fleet requirements is available in the Appendix.

B. POSTING POLICIES AND FACILITIES

- Be creative in designating any street-level posting locations so that crews have the option of getting out of their vehicles (but in close proximity) while on stand-by
    - Crews should remain close enough to their vehicle so that they can be en route to an emergency call within 90 seconds
    - Must remain in areas that have reliable portable radio contact so they do not miss call notifications
- If a co-location strategy is implemented with construction of PRPS quarters on FD station properties, there will be a period of time where it will be appropriate to consider some level of co-habitation arrangements. The following suggestions are offered to make this process easier for all parties concerned:
    - FD managers, union officials and crews should look at the presence of PRPS crews in their stations as a normal part of their operations - not as visitors – but as public safety colleagues there on official interagency business. In that context, PRPS managers, FD managers and union officials should work together to develop policies and procedures for workplace conduct and supervision.
        - Example: Ranking FD station officer has authority to ask PRPS crews to leave the station if their conduct is creating problems. Such incidents would mandate investigation by both FD and PRPS managers to identify issues and determine means for resolution
        - Change the policy which requires PRPS crews to leave the station if fire crews leave.

1. BUILDING DESIGN

The following facilities are recommended for 'post' stations:

- Drive-through vehicle bays for 2 ambulances with consideration for automatic opening
- Garage door space large enough to accommodate larger paramedic ambulances
- Two door vestibule between the vehicle bay and the post interior (to reduce the entry of vehicle fumes into the living spaces)
- Separate Male / female restrooms with showers
- Lounge area with amenities, including television
- Small office with desk, computer and telephone
- Janitorial / supply closet
- Kitchen with amenities
- Security
- Comfortable furniture

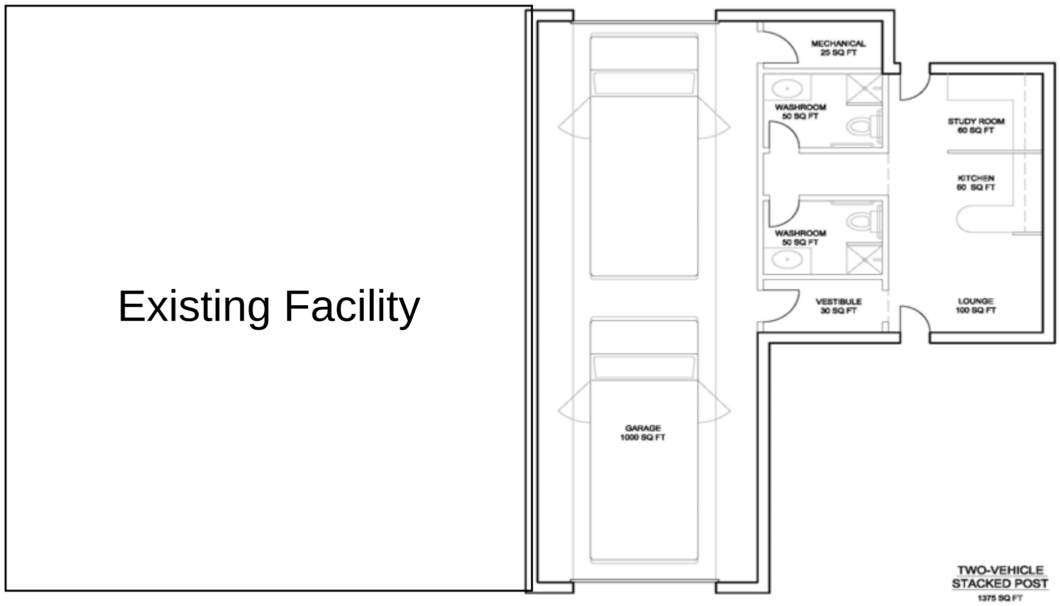
a) *Post Size and Layout*

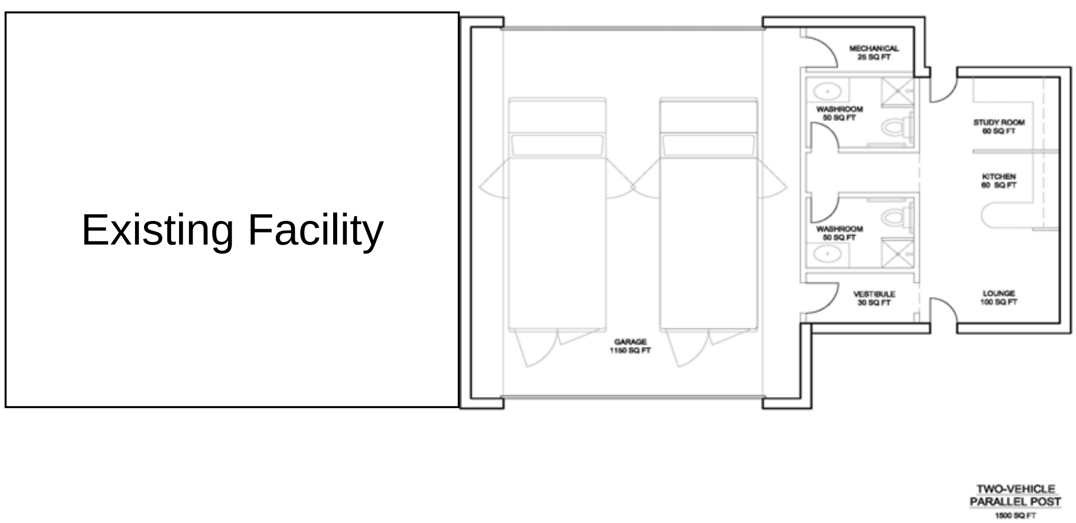
In general these facilities should be something on the order of a small apartment. The actual size of the post is depends on whether the service area dictates a one vehicle postor a two vehicle post, available land and the current facility.

Building Size: approx. 1200-1500

- Vehicle Allocation: approx. 1200-1400 square feet (Includes office spaces)
- Response Personnel Space: approx. 300 square feet (Includes: bathrooms and lounge, kitchen, study room).
- Parking: approx. 1800-2000 square feet
  - 8 parking spots.
- Approx. Total Developed Space: 2000-3500 square feet

The following design depicts two possible floor plans. These examples are provided as model for the actual station modifications.





b) Administrative Support Facility

In addition to modification of various post locations we recommend that a headquarters facility be constructed to centrally locate all PRPS administrative personnel. While the immediate need is administrative space at some point in the future it may become valid to consider centralized book-ons and book-off. For this reason it is important that the facility be centrally located at site that could accommodate expansion. The administrative support facility should contain space for training functions, central inventory, office area, crew area and kitchen facilities.

C. SYSTEM DESIGN

- By formally incorporating fire department first response units into a systems approach to develop a true *Region of Peel EMS System*, both PRPS and fire departments should be held accountable for their clinical and operational performance, including response time interval performance.
    - While it would be politically and financially impractical to impose financial penalties on PRPS or fire departments that fall out of compliance with response time interval standards, establishing a standard report on EMS related performance statistics that is sent on a mandatory basis to the following entities would establish public accountability and political incentives:
        - Region of Peel Council and the Chief Administrative Officer
        - Municipal councils and city managers for each respective fire department
        - Local print and electronic media
        - Local hospitals
        - MOHLTC
- 12:00 (twelve minutes, zero seconds) at 90% reliability for PRPS ambulance should be considered to be the absolute minimum level of acceptable performance
    - No clinical evidence to support current 9:32 standard from MOHLTC
    - It would be extraordinarily expensive to have ambulances there within 6 min. per OPALS research data[4]. Therefore, use of fire department first

[4] De Maio V, et al: Optimal Defibrillation Response Intervals for Maximum Out-of-Hospital Cardiac Arrest Survival Rates. Ann Emerg Med. 2003;42:242-250

response program limited to the highest severity cases (e.g. pulseless, not breathing) will to help meet that goal.

- PRPS has been performing at 11:50 with 90% reliability – aggregating all their code 4 emergency responses.
- Brampton and Mississauga FD has been performing near 6:00 with 90% reliability – which encompasses only the small percentage of all emergencies that are triaged for a Code 4 tiered response.
- Upgrade PRPS infrastructure, using process management methods to refine deployment and resource utilization to maintain and improve performance below 12 min at 90% reliability in the face of population growth, trends of increasing hospital delays, etc.
- While 12 min at 90% reliability is the *minimum*, the goal is 12 min with essentially 100% reliability (excluding 'special cause' variation cases as revealed by statistical process control analyses; Special cause cases might include instances such vehicle crashes on access routes and ambulance mechanical failures resulting in a need to reassign the call to a different unit)
- Educate the EPSC, media, and other stakeholders to recognize that:
  - The highest priority of calls are those with specific evidence of life threatening and time sensitive emergencies (i.e., Code 4 tiered response; patients not breathing or without a pulse). On that small subset of all emergency cases, the 12 and 6 minute response time interval performance with 90% reliability means that the ambulance and fire units are there *sooner* than 12 and 6 minutes, respectively, 90% of the time
  - On the next lower level of priority cases (i.e., Code 4; patients with potential serious but less time sensitive emergencies), there isn't any clinical evidence to justify a higher response time standard.

- As efficiencies are gained to ensure that 12:00 and 6:00 reliability is maintained with a comfortable margin and as managers strive in earnest towards achieving a 100% reliability level, there may be a temptation for the Region to cut back on funding and be satisfied with only 90% reliability. Unless a mechanism is established ahead of time to protect against this, a disincentive exists for PRPS managers to further improve their operational efficiencies to avoid risking the loss of budget allocations. Therefore, we recommend that policies be established to recognize this potential and safeguard against it.

- The overall system is fractionalized with low levels of accountability for performance. Steps need to be taken to correct this situation. There are many options for how this may be done, one approach could include creation of an EMS *System* Board that oversees the entire prehospital care system. This may be a role formally taken on by the EPSC or a new entity that might report to the EPSC. Its scope should be inclusive of:
  - Prevention and public education
  - Access to care
  - Triage, deployment planning, dispatch and pre-arrival instructions
  - Ambulance care and transport
  - Non-emergency care and transport
  - Hospital and receiving facility transfer of care and information
  - First responder care
  - Medical oversight
  - Equipment and supply
  - Facilities
  - Certification, training and continuing education of field and dispatch clinicians
  - Performance standards / requirements and data system integration for participating 9-1-1 communications centres, ambulance services and first responder agencies
  - Performance monitoring and associated research / improvement efforts
  - Financial management and planning
- Additional steps toward reducing system fractionalization and improving accountability could include:
  - Establishment of a System Medical Director position that oversees:
    - Medical direction for all of the individual services (PRPS and each of the three fire departments)

        - Clinical processes (protocols)
        - Clinical performance monitoring / improvement
        - Clinical certification standards
        - Clinical continuing education
        - Is a formally designated advisor to the EMS System Board
    - Establishing a System *Medical* Oversight Board that:
        - Approves appointment of the System Medical Director
        - Serves as an advisory body to the System Medical Director
        - Approves clinical policy and procedure proposed by the System Medical Director
        - Provides clinical specialty input on clinical policy and protocols

- Establish a process for consolidating data from PRPS, CACC and local fire department first response agencies for performance reporting at system, municipality, and response agency levels. This reporting may be inclusive of clinical and operational performance measures.

- Establish internal standards (set by the Region of Peel) for response intervals, time definitions, and corresponding processes to routinely monitor them
    - Example – FD arrival can stop the system response time clock; ambulance to arrive within a specified time frames with 90% reliability

- While PRPS or a fire department cannot be held accountable for the time from onset of the clinical condition to the time when their agency is contacted, PRPS and fire departments should be held accountable for the time from when they are respectively notified of an assigned call to the time their unit arrives on-scene. The following events should start and stop the response time interval clock at a system and agency level:
    - System
        - Start: Call received at CACC
        - Stop: Arrival of first unit on-scene

        - This would be the 'System Operations Response Time Interval'
    - PRPS and fire departments
        - Start: Call received from CACC
        - Stop: Ambulance or fire unit arrives on-scene
        - These would be the Ambulance and Fire Operations Response Time Intervals, respectively

- Establish a management agreement between CACC and PRPS that gives PRPS the ability to design the dispatch and deployment process for PRPS units and how CACC personnel are trained, supervised, and evaluated relative to their role in the operational control and deployment of PRPS resources.
    - Measures of CACC performance should be established that reflect on how well they are operating the deployment plan specified by PRPS.
    - Should CACC fail to meet reasonable standards of performance for operation of the deployment plan, the Region of Peel should revisit the issue of taking over their own dispatch operations from the CACC.

- Appropriate triage of patient by the CACC is a critical issue for both PRPS as well as each of the fire departments who provide EMS first response services on high severity cases. If cases are over-triaged, FD units are sent out unnecessarily and add unwarranted risk to FD crews and the general public as a consequence of the red lights and siren responses, as well as taking units away from coverage of an appropriate EMS or fire call that could come while engaged on an over-triaged call. Under-triage is even worse, with patients subjected to potentially longer response times in the face of potentially life threatening time sensitive emergencies. HA did not undertake a performance study to measure how well the CACC triages cases between the highest priority (both FD and PRPS units dispatched with red lights and sirens) and second highest priority level (PRPS alone dispatched with red lights and sirens) of emergency cases. However, we did not find evidence of diligent testing or monitoring of the accuracy of the call triage process by the CACC. We strongly recommend that MOHLTC and the medical direction group at Sunnybrook Osler Centre for Prehospital Care closely examine and monitor this issue, with adjustments / refinements in the protocols as appropriate.

- It is our understanding that features exist in the ARIS CAD system used by the CACC which would help facilitate the flexible deployment plan recommended for PRPS and the overall system. We are told by PRPS staff, that CACC does not have clearance from the MOHLTC to enable these features. It is our understanding that these features are enabled at the CACC serving Niagara and that these features are working well for them in management of their own flexible deployment plan. We recommend that these features of the ARIS CAD be enabled to help the CACC serving Peel properly administer the deployment plan.

- The implementation of a flexible deployment plan is more labor intensive for the staff in any dispatch center from both an operations, training a d quality control standpoint. We therefore recommend that the CACC:

    - take steps to correct the staffing deficits that have resulted from a hiring freeze or restriction that has resulted in understaffing. The CACC should be brought up to full staffing and additional positions should be considered to help ensure a successful implementation of the flexible deployment plan.

    - Reconsider its operational workflow to match the needs and logistics of a flexible deployment plan and the somewhat different strategies that will employed for the upper tier area around Caledon.

- Fire departments have expressed interest in adding some personnel with ACP capabilities, at some point in the future, to augment their existing PCP/EMR level of staffing. We would not recommend this for several reasons:

    - Adding ACP capabilities to fire first response units risks an overall decline in ALS skill levels for all system ACPs as the finite number of advanced skills events is diluted into a larger pool of ACPs.

    - The skills provided by EMR level personnel will address the needs for the overwhelming majority of patients in the first 12 minutes of care.

- Enter into discussions with Dufferin EMS and MOHLTC to address this situation so that if it makes sense to formally include the Dufferin EMS unit positioned near Orangeville in the PRPS deployment plan; and see to it that Dufferin EMS is treated fairly in that arrangement. From a policy development standpoint, addressing this issue with between Peel and Dufferin will set precedent and likely lead to having to deal with this in a broader context throughout the Province.

- Make changes / enhancements to the call triage process/software used in the CACC to enable call takers to reliably discriminate between cases that warrant an emergency (red lights and sirens) response mode from those that do not. With that process validated and in place, implement policies to assign appropriate response modes to responding units.

- From a system design standpoint, it is very undesirable to hold PRPS accountable for their response time performance when they are not in direct control of their ambulances. There is also an apparent lack of accountability for CACC performance because it is operated by the regulatory agency. Therefore, we recommend that PRPS be given the ability to control its own ambulance resources – not by CACC personnel.

VI. APPENDICES

A. Glossary

B. Fleet Projection Tables

A. GLOSSARY

Static Deployment – a deployment method where a fixed number of units are deployed on a 24/7/365 basis and each unit has a designated base where they return after an assignment to await their next call, regardless of the time of day, day of week, or status of the EMS system; Commonly used by fire departments and many publicly administered ambulance services

Fluid (or Dynamic) Deployment – a deployment method where the number and location of units deployed varies with predictable temporal and geographic patterns of demand and where ambulances are primarily positioned at strategic selected intersections to stand by for their next call, rather than standing by in a station.

System Status Management (SSM) – This is a phrase commonly used to describe more aggressive forms of fluid deployment in which as many as 168 different deployment place are used and ambulances stand-by for their next call by parking at strategically located intersections rather than stations in an effort to optimize the ability of the system to reduce response times.

Flexible Deployment – a deployment method where the number and location of units deployed varies with predictable temporal and geographic patterns of demand and where ambulances are primarily positioned at strategic selected station locations to stand by for their next call, rather than standing by at an intersection, although some limited amount of intersection stand-by posting may be used where an ambulance is needed to post, but no station exists at that location (as may occur from time to time with lower priority locations where it may be financially impractical to build a station).

Emergency Medical Responder (EMR) – an intermediate level of prehospital emergency medical training used in Ontario that is beyond that received by standard firefighters but less than that of a primary care paramedic

Vehicle Busy Probabilities – A number that indicates the probability of specific vehicle being busy at any point in time.

Starting and Stopping the Clock – The times used for calculating a response time interval for compliance to a response time standard; Also referred to in the context of the arrival of units from what agencies are and are not allowed to start and stop the clock used for calculation of response time compliance (e.g., fire department units might not be allowed to start or stop the clock for calculation of response time compliance)

Central Ambulance Communications Centre (CACC) – The communications and dispatch facilities across the Province manned and operated by the Ontario Ministry of Health and Long Term Care.

Unit Hour Utilization Ratio (UHU) – Number of units deployed divided by the number of transports in specified time frame

Unit Hour Production (UHP) – Number of units deployed divided by the the total number of calls

Unit Hour Activity Ratio (UHA) – Number of units deployed divided by the number of unit activities (responses, post-to-post moves and other assignments) in a specified time frame

Co-habitation – In the context of this report, co-habitation refers to the staff of two different public safety agencies sharing the same facilities, including sleeping quarters, bathrooms, kitchen, vehicle bays, offices, etc.

Co-location – In the context of this report, co-location refers to the staff of two different public safety agencies sharing the same land but having separate but adjoining facilities with separate sleeping quarters, bathrooms, kitchen, vehicle bays, offices, etc.

Emergency and Protective Services Committee (EPSC) – a committee of the Peel Regional Council charged with oversight of EMS and other public safety activities

Posts – a location where an ambulance is placed on stand-by waiting for its next assignment

Service Time – The time from initial notification to clearing a call.

Statistical Process Control; X Bar and S Charts – types of graphical statistical analysis tools that help managers differentiate between normal ranges of variation in a process from truly unusual variations that warrant further investigation

Capability Indices; Cp and Cpk – Statistical tools that help mangers appropriately measure how well a process is performing within the goals or standards established for that process

EMS System Board – a regulatory or oversight body that has stewardship for all of the components of an EMS system within a community of other designated area; includes the components of system design, funding, medical oversight, governance, prevention, public and professional education, access to care, dispatch and communications, first response, ambulance response, interfaces to receiving facilities, research, and evaluation.

Response Intervals – the amount of elapsed time between two events, such as from the time a call for help is received in the CACC to the time when the first unit makes contact with the patient.

B. FLEET PROJECTION TABLES

	Fiscal Year 2006	Fiscal Year 2007	Fiscal Year 2008	Fiscal Year 2009	Fiscal Year 2010	Fiscal Year 2011	Fiscal Year 2012	Fiscal Year 2013	Fiscal Year 2014
New Units									
Max Staffed	33	33	35	37	39	40	41	43	44
Units Req	41	41	44	46	48	50	52	53	55
Added Vehicles	0	0	0	0	0	0	0	0	2
Unit Cost	114000	117420	120943	124571	128308	132157	136122	140206	144412
Equipment Cost	51000	52530	54106	55729	57401	59123	60897	62724	64605
Projected Cost/Unit	165000	169950	175048.5	180299.955	185708.9537	191280.2223	197018.6289	202929.1878	209017.0634
Net	$ -		$ -	$ -	$ -	$ -	$ -	$ -	$ 418,034
Replacement Cost									
Replacements	8	8	9	9	10	10	10	11	11
Projected Unit Cost	165000	169950	175049	180300	185709	191280	197019	202929	209017
Net	$ 1,361,250	$ 1,405,487	$ 1,533,425	$ 1,664,169	$ 1,801,377	$ 1,930,017	$ 2,039,143	$ 2,157,137	$ 2,284,557
Total Fleet Cost	1361250	1405487	1533425	1664169	1801377	1930017	2039143	2157137	2702591

	Fiscal Year 2015	Fiscal Year 2016	Fiscal Year 2017	Fiscal Year 2018	Fiscal Year 2019	Fiscal Year 2020	Fiscal Year 2021	Fiscal Year 2022	Fiscal Year 2023	Fiscal Year 2024	Fiscal Year 2025
Max Staffed	45	46	47	48	49	50	50	51	52	52	53
Units Req	56	58	59	60	61	62	63	64	65	65	66
Added Vehicles	1	2	1	1	1	2	1	1	1	1	1
Unit Cost	148744	153206	157803	162537	167413	172435	177608	182937	188425	194077	199900
Equipment Cost	66543	68540	70596	72714	74895	77142	79456	81840	84295	86824	89429
Projected Cost/Unit	215287.5753	221746.2026	228398.5887	235250.5463	242308.0627	249577.3046	257064.6237	264776.5625	272719.8593	280901.4551	289328.4988
Net	$ 293,275	$ 334,966	$ 245,823	$ 272,972	$ 248,278	$ 407,312	$ 172,445	$ 213,427	$ 266,255	$ 163,022	$ 275,791
Replacements	11	12	12	12	12	12	13	13	13	13	13
Projected Unit Cost	215288	221746	228399	235251	242308	249577	257065	264777	272720	280901	289328
Net	$ 2,411,221	$ 2,552,299	$ 2,676,831	$ 2,811,244	$ 2,946,466	$ 3,114,725	$ 3,244,156	$ 3,383,844	$ 3,537,177	$ 3,677,000	$ 3,842,282
Total Fleet Cost	2704496	2887265	2922655	3084215.53	3194743.611	3522036.814	3416600.608	3597271.838	3803431.52	3840021.952	4118073.671

