2

YORK REGION EMERGENCY MEDICAL SERVICES 10-YEAR RESOURCES AND FACILITIES MASTER PLAN

The Community and Health Services Committee recommends:

1. **Receipt of the presentation by Norm Barrette, Chief and General Manager, Emergency Medical Services; and**

2. **Adoption of the recommendation contained in the following report dated August 22, 2012, from the Commissioner of Community and Health Services.**

1. RECOMMENDATION

It is recommended that:

1. Council approve the 10-year Emergency Medical Services Resources and Facilities Master Plan.

2. PURPOSE

This report seeks approval of a 10-year plan to allocate personnel, vehicles and stations for York Region in order to maintain a high level of service and meet performance time standards. This report will also provide Council with detailed information regarding anticipated Emergency Medical Services (EMS) patient call volumes to 2021 and outline all the variables associated with optimizing resource and station placement.

3. BACKGROUND

Planning for human services is critical in a fast growing diverse region

As identified in the publication *Economic Analysis of Human Service Costs to 2031, Recommendations for Enhancing Human Services Planning in The Regional Municipality of York* completed by the Centre for Policy and Program Assessment School of Public Policy and Administration at Carleton University, growth, intensification and changes in demographics expected in the Region will necessitate a key focus on human services planning. Emergency Medical Services was identified as one of the fastest growing sub-sectors of human services along with Long-Term Care, Seniors Program Services and Transit.

Planning for EMS future resource needs has been based on a traditional historic-retrospective approach

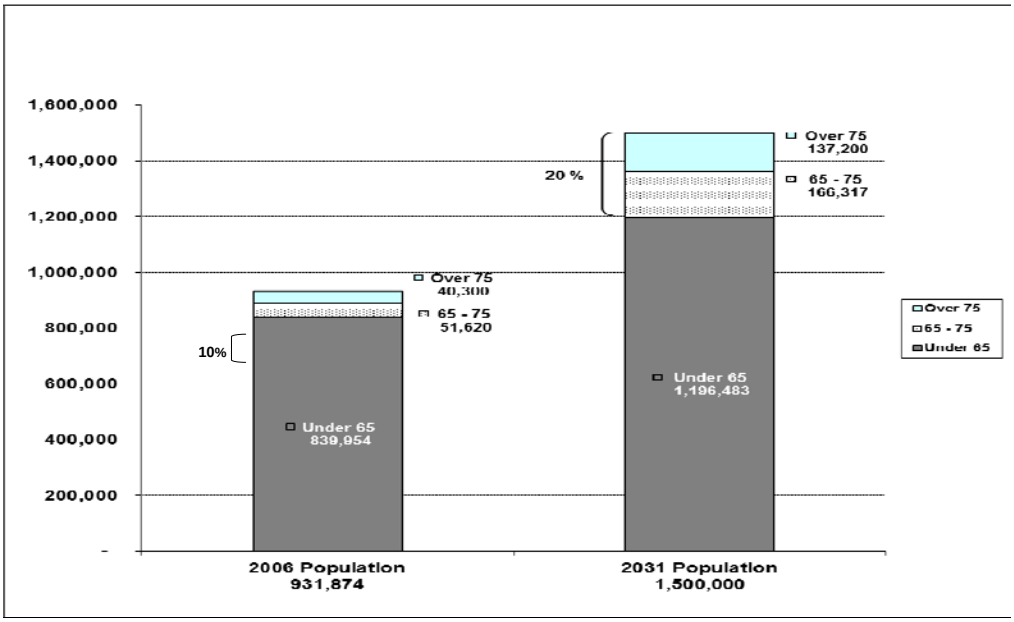
As in most EMS systems, York Region EMS has traditionally based station and resourcing needs on historical trends. In other words, planning requirements were defined by past performance to past demands. It is best described as a reactive process, where demand must first exist and then a resource planning process is developed.

Preliminary analysis points to substantial increases in patient demand through 2031 primarily resulting from demographic shifts

EMS transport demand between 2011 and 2031 is expected to increase by 100 per cent. Optimizing resource levels to meet demand is going to be critical to maintain response time performance. Station locations, vehicle placement and personnel composition must be better planned and modeling be more sophisticated.
In 2006, there were 91,920 seniors living in York Region, representing 10 per cent of the Region's population. By 2031, the Region's population is projected to be 1.5 million people, and the number of seniors living in York Region is expected to be approximately 303,517 or 20 per cent of the total population. As of 2006, there were approximately 40,300 people aged 75 and over living in York Region and this is expected to increase to 137,200 people by 2031. In 2011, York Region EMS made 13,754 transports for people 75 years and above.

Figure 1 details the expected changes in population from 2006 to 2031.

Figure 1
Changes in Population from 2006 to 2031

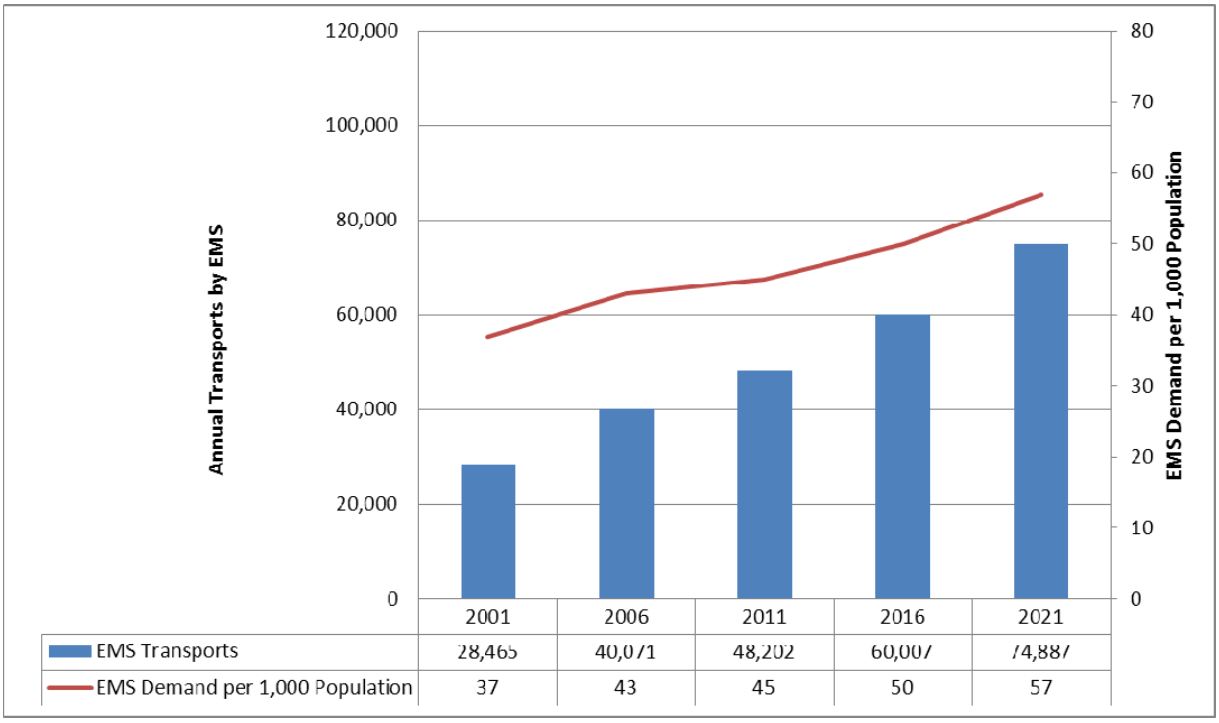


Demand for paramedic services is increasing at a faster rate than population growth

EMS patient call volume, otherwise referred to as "demand", is driven by demographic composition, health status, economic determinants and public expectations. Since the formation of York Region Emergency Medical Services, demand for paramedic services has grown at a faster rate than population growth.

Figure 2 outlines the increase in demand per population and the resulting number of patients requiring transport by paramedics.

Figure 2
EMS Demand per 1,000 Population and Patients Transported by Paramedics



Source: Operational Research in Health Limited (ORH) full report, Appendix D2

A municipally-set response time performance plan must be approved by October 1, 2012

Not only are growth factors necessitating a better approach to resource planning, amendments to a regulation under the *Ambulance Act* now require Council to approve and implement a response time performance plan. That plan, referenced elsewhere in this agenda, establishes response time commitments for EMS and requires a reporting on whether these commitments were met.

Experts in EMS planning were hired to develop a 10-year resources and facilities master plan

In order to anticipate the future demands for EMS while supporting response time performance, a request for proposal was sought that could factor in:

- Future EMS demand distribution
- Roadway development and travel time
- Optimal station locations
- Staffing and vehicle resourcing requirements

A United Kingdom-based firm, with 26 years of Emergency Medical Services planning and modeling experience, was retained to complete the project

Operational Research in Health Limited (ORH) was retained through a competitive request for proposal process. ORH is a management consultancy based in Reading, England. The company specializes in operational planning for the emergency and health services. The company uses analytical and modeling techniques to address resource planning problems for EMS, fire, police, health and other public sector bodies. ORH was established in 1986 and has undertaken over 500 studies for over 100 clients around the world.

The objective of the project was to develop a comprehensive 10-year master plan to:

- Plan for the optimal location and size of paramedic response stations
- Anchor resourcing plans based on performance targets
- Inform resource utilization of EMS units and paramedics

The project required the completion of detailed analysis and modeling to support the recommendations.

4. ANALYSIS AND OPTIONS

A detailed approach to completing the analysis accounting for development, new roads, travel speeds and population growth was undertaken by Operational Research in Health Limited

The modeling assumptions to develop the master plan analysis included:

- Dispatch and deployment processes continuing, in their current form
- Paramedic time at hospital continuing within its current range
- Paramedic scope of practice continuing in it is current form
- Patient transport rates to emergency departments continuing at their current rate

The modeling process is detailed as follows:

Step 1: A detailed data collection process took place capturing EMS response data, road network data, vehicle travel speed data, and population demographic data.

Step 2: Analyses to define key characteristics of EMS response were determined. Some of these characteristics included determining the frequency of responses where a vehicle is at a station or mobile, the frequency that patients are transported to hospital, the frequency that more than one EMS vehicle responds to an incident and the call demand by hour of day and day of the week.

Step 3: The data elements such as the road network, travel speed, incident information coupled with characteristic information were inputted to create a computer-based simulation model. The model was adjusted so that the results of the model matched the actual results of York Region EMS, thus validating the predictive ability of the model.

Step 4: Future EMS demand for 2016 and 2021 were predicted. Calculations per capita of demand rates for 2001, 2006 and 2011 were calculated by local municipality and linearly projected forward and modified by age demographics. The demand was then distributed by travel zone within each local municipality.

Step 5: Changes in the road network in 2016 and 2021 were made. New major roadways were added along with new residential and commercial developments. Travel time speeds for emergency response were maintained, while non-emergency response was slightly degraded to account for traffic conditions.

Step 6: The current 10-year capital plan identifying the location and vehicle capacities of replacement and new paramedic response stations was added to the model.

Step 7: Staffing and vehicle resources were added into the model in the most cost-effective way to maintain current performance, taking account of capacity constraints at each site.

Step 8: A range cover optimization identified new locations for paramedic response stations.

Step 9: Staffing and vehicle resources were added into the model in the most cost-effective way to maintain current performance.

Step 10: From the range cover and vehicle resources, future station locations were sized to ensure sufficient capacity for demand and growth.

Step 11: Cost estimates for staffing resource models and capital plans were completed.

Step 12: Optimization recommendations were identified.

KEY RESULTS FROM THE ANALYSIS PROCESS

Response time improvements and resource efficiencies will be achieved over time with the strategic placement of new staffing resources and stations while meeting growing call demand

Underpinning the analysis and planning process was the focus on maintaining and improving response time performance, while making optimal use of resources. Essentially, the project has identified steps to achieve “more with less “while responding to increases in patient calls. The results of this project will, over time, support improvement of targets set in the Region’s EMS Response Time Performance Plan.

Future demand projections identified a 47.8 per cent demand increase in Emergency Medical Services responses from 2011 to 2021

Population projections at the local municipal level and split by age and gender for every 5 years from 2001 to 2021 were analyzed. Population projections were further broken down by traffic zones for the same set of years. This information was used to distribute projected demand at a local municipal level into each zone.

The total demand and population by municipality were used to produce an overall demand per capita for 2016 and 2021 based on linear projections. The projection methodology projected a demand increase of 47.8 per cent from 2011 to 2021.

Table 1 summarizes the current EMS demand and the predicted changes in demand through 2021 by local municipality.

Table 1
Predicted Increases in Emergency Medical Services Calls
from 2011 to 2021 by Local Municipality

Local Municipality	2011 Calls	2021 Increase in Calls from 2011	2021 Per cent Increase in Calls from 2011
Aurora	2,744	1,202	43.8%
East Gwillimbury	1,551	2,100	135.4%
Georgina	3,478	1,551	44.6%
King	1,122	321	28.6%
Markham	10,978	5,500	50.1%
Newmarket	5,364	1,840	34.3%
Richmond Hill	8,271	4,210	50.9%
Vaughan	14,378	6,082	42.3%
Whitchurch-Stouffville	1,963	1,001	51.0%
York Region	49,849	23,807	47.8%

The current 10-year EMS capital plan, developed by staff prior to the study, had identified six paramedic response station replacement projects and four new station projects to be developed through 2021

EMS currently maintains 20 paramedic response stations in the Region. Prior to the ORH analysis, the staff-developed capital plan included six new stations to replace existing leased stations and four brand new stations, bringing the total EMS stations to 24.

Operational Research in Health Limited utilized a "range-cover" model to optimize the required station locations to meet future demands

The objective of range-cover modeling is to identify the exact number and location of paramedic response stations to ensure that responding vehicles from any location are within a given travel time in 95 per cent of all cases region-wide. Range-cover is a function of location, not the number of vehicles or level of staffing.

From the range cover analysis completed by ORH, five new replacement sites and five new growth related sites were identified. This would mean that EMS would keep 15 stations, replace five leased stations and build five new stations thus giving a total of 25 stations. The optimized plan produced a range cover of 10 minutes or less in 97 per cent of the cases. Every municipality in York Region, by 2021, would have between one and five EMS stations.

Table 2 outlines the improvements in range cover when optimizing all new and replacement stations and increasing the total stations by 1.

Table 2
Range Cover Performance Improvements from the Optimized Plan
Compared to the Staff-developed Plan

	Range Cover in Minutes					
	4	**6**	**8**	**9**	**10**	**12**
Existing Capital Plan	13.7%	38.8%	67.3%	80.1%	88.6%	96.9%
ORH Optimized Plan	18.0%	54.0%	85.4%	93.7%	97.0%	99.0%

Staffing and vehicle resources were modeled for 2016 and 2021 with the current capital plan while maintaining response performance at the current level

ORH loaded the 2016 and 2021 demands and the paramedic response stations according to the Region's existing capital plan. Staffing and vehicle resources were added to the model in the most efficient manner in order to maintain the current level of response time performance.
The results of the analysis indicated that a 24 per cent increase in weekly staffing hours from 2011 staffing levels was needed to meet the 2016 demand, and a 43.3 per cent increase in weekly staffing hours from 2011 staffing levels was needed to meet the 2021 demand; this, despite the 47.8% increase in call volume.

Paramedic response stations and vehicle housing capacities

From the results of the response modeling, ORH assessed the vehicle housing capacities of the optimized locations to ensure that the required number of vehicles can be staged in the required areas in the Region and accommodate some growth capacity beyond 2021. An assessment was completed between the existing capital plan and the ORH optimized plan.

The comparison of the current capital plan to the optimized plan is further detailed in the Financial section of the report.

Link to key Council-approved plans

This report directly contributes to the 2011-2015 Strategic Plan objectives to "optimize the health of the community for all ages and stages through health care delivery, protection, prevention and promotion", supporting the completion of the indicator of success: *Consistently met regulated response time standards for paramedic services.*

As well this report contributes to supporting the Plan objective to "continue to prioritize new capital infrastructure projects to support managed growth and optimize community benefit", supporting the indicator of success: *Development and approval of Master Plan for EMS Stations.*

5. FINANCIAL IMPLICATIONS

Upon Council approval of the master plan, staff will revise the annual operating business plan and budget and the 10-year capital business plan to reflect the plan recommendations for Council consideration in 2013 through 2021. There are no new funds required in 2012. Funding for the growth components of the plan may be funded from the EMS Development Charges Reserve Fund.

Response modeling summary of required staffing

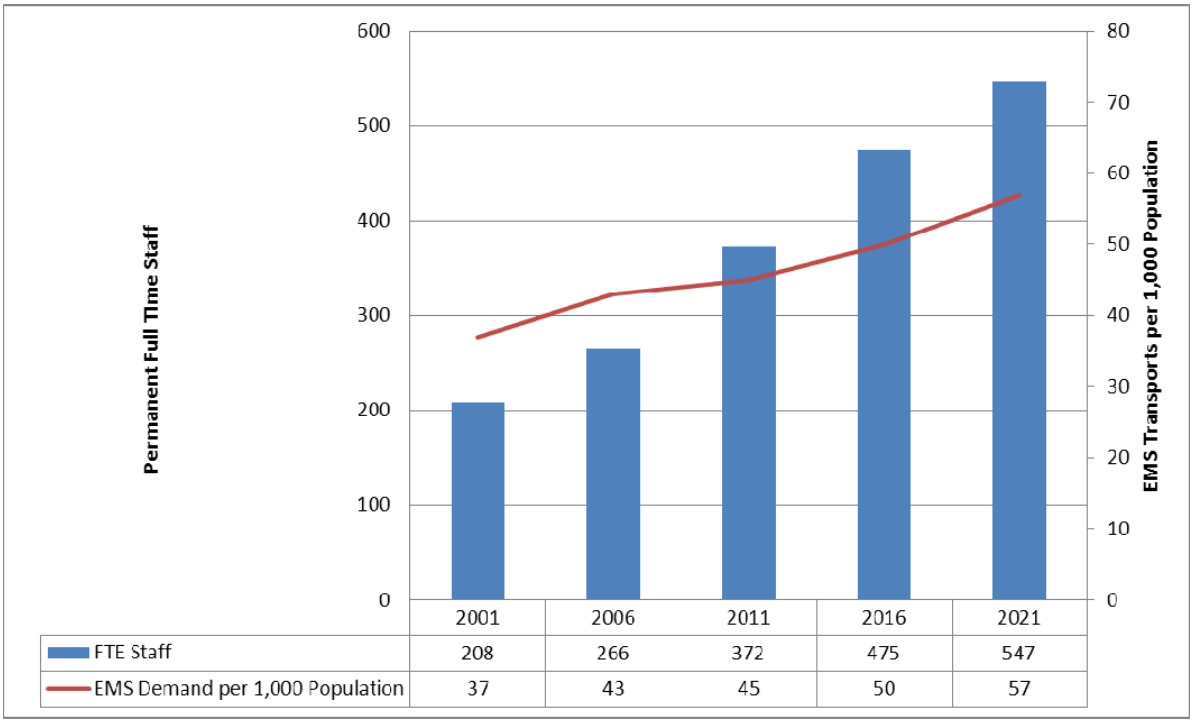
Table 3 summarises the results of the modeling iterations completed to maintain response performance with the most efficient staffing resources.

Table 3
Modeling Results to Meet Future Demand

	Current	2016 Staffing Increases from 2011	2021 Staffing Increases from 2016
Weekly Staffing Hours	9,571	11,872	13,968
Required Percent Increase in Weekly Staffing Hours		24%	18%
Paramedics Required	295 Permanent Full Time 50 Full-Time Equivalent Casual Staff 345 Full-Time Equivalent (FTE) Staff	71 FTEs	64 FTEs
Support Staff Required	43	16	8
Average Number of Additional Paramedics per Year		17.8	12.8
Average Number of Additional Support Staff per Year		4	1.6
Total Full Time Equivalent Staff	388	475	547

Figure 3 outlines the relation in EMS calls per capita and the total full time equivalent staffing requirements.

Figure 3
EMS Calls per 1,000 Population and Total Full Time Staff Required



Source: Operational Research in Health Limited (ORH) full report, Appendix D2

Staffing requirements to maintain response time performance with the increasing demand are outlined in Table 4. The cost per staff per emergency call remains within a consistent range with improved cost fractions in later years resulting from resource optimization.

Table 4
Future Staffing Requirements to Meet Increasing EMS Demand

	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021
Full Time Paramedics	295	313	330	349	366	379	392	405	417	430
Full Time Equivalent Casual Paramedics*	50	50	50	50	50	50	50	50	50	50
Total Paramedic FTEs	345	363	381	399	416	429	442	455	468	480
Support Staff	43	45	49	54	59	61	62	64	65	67
Total FTEs	388	408	430	453	475	490	504	519	533	547
Estimated Incremental Staffing Costs(000's)*		$2,023	$2,023	$2,023	$1,921	$1,513	$1,513	$1,513	$1,513	$1,411
Estimated Staff Cost per Emergency Call	$664	$665	$667	$669	$670	$665	$660	$655	$650	$650

**Average Paramedic annual salary and benefits calculated at $102,000 and average EMS Support Staff annual salary and benefits calculated at $93,600*

The long term capital plan will ensure the required vehicle housing capacity through 2021

ORH determined that the current capital plan does not have enough bay capacity in order to meet future demand levels. ORH determined that 30 new vehicle bays would be required by 2021; however, the current capital plan calls for only 18 new vehicle bays. As the current capital plan is over 50 per cent undersized, resources would need to be housed in sub-optimal locations resulting in lower response efficiency.

If EMS was to follow the existing capital plan, projects would require the addition of more vehicle bays than planned in order to add sufficient vehicle storage capacity. This would increase the cost of the existing capital plan to be in line with the optimized plan identified by ORH.

The current 10-year capital plan has identified replacement, renovation and growth projects, time frames and estimated costs.

Table 5 outlines the relevant details of the current capital plan.

Table 5
Current EMS Capital Plan

Facility	Number of New Vehicle Bays from Current	Project Type	Targeted Completion Year	Total Project Cost (000's)
Queensville	1	Replacement	2013	$ 1,450
Newmarket - North West	2	Replacement	2013	1,510
Newmarket - South East	2	Replacement	2013	1,510
Vaughan - Maple	1	Replacement	2013	1,692
Vaughan - West	2	New - Growth	2013	1,910
King City	0	Demo & Rebuild	2014	1,160
Markham - Hwys 14 & 48	2	New - Growth	2014	1,600
Thornhill - Central	1	Replacement	2015	1,660
Richmond Hill - North East	2	New - Growth	2015	1,560
Ballantrae	1	Replacement	2017	1,326
Sutton	0	Demo & Rebuild	2018	1,160
Vaughan - Kleinburg	2	New - Growth	2020	1,760
Holland Landing	2	New - Growth	2021	1,660
Total	**18**			**$19,958**

The optimized capital plan identified by ORH ensures that vehicle capacity issues are addressed in the required areas of the Region. This will ensure that the required EMS vehicles are stationed in the right areas of the Region to maintain response performance through 2021 and beyond.

Table 6 outlines the details of the optimized capital plan developed by ORH.

Table 6
Optimized EMS Capital Plan 2013 to 2021

Facility	Number of New Vehicle Bays from Current	Action	Targeted Construction Year	Total Project Cost (000's)
Newmarket - North West	4	Replacement	2013	$3,425
Newmarket - South East	4	Replacement	2014	$3,331
Vaughan - South Woodbridge	2	New - Growth	2014	$1,535
Vaughan - Maple	3	Replacement	2015	$2,726
Markham - South Markham	4	New - Growth	2015	$2,726
Holland Landing	3	Replacement	2016	$2,226
Richmond Hill - Oakridges	2	New - Growth	2017	$1,485
Richmond Hill - South East	4	New - Growth	2018	$2,726
Ballantrae	1	Replacement	2019	$1,285
Thornhill	3	Replacement	2019	$2,726
King City		Demo & Rebuild – Defer to 2022	-	-
Sutton		Demo & Rebuild – Defer to 2023	-	-
Vaughan - Kleinburg		Growth – Defer to 2024	-	-
Queensville		Replaced by New Holland Landing Station	-	-
Total	**30**			**$24,191**

The proposed changes for the affected projects between the current 10-year capital plan and the optimized 10-year capital plan is a difference of 4.23 million dollars, however, the new plan will provide more than one third of additional vehicle capacity than the current capital plan, ensuring optimal response performance through 2021 and beyond.

Table 7 summarizes the final capital station inventory of existing and proposed new facilities that will exist in 2021. Figure III found on page 4 of the accompanying Executive Summary provides a detailed map of the 2021 capital inventory.

Table 7
2021 Station Capital Inventory

Station	Vehicle Bay Capacity
Section A – Stations existing in 2012 that will continue to operate	
Aurora	2
Keswick	2
King City	4
Markham-Church	4
Markham-Riviera	4
Markham-Unionville	1
Mount Albert	2
Nobleton	4
Pefferlaw	2
Richmond Hill	6
Schomberg	2
Stouffville	2
Sutton	2
Vaughan-Racco	6
Woodbridge	6
Section B – Stations existing in 2012 that will be discontinued and be replaced with new builds (vehicle capacity in this section is not included in the total)	
Ballantrae	(1)
Newmarket-Cane Parkway	(8)
Queensville	(1)
Thornhill	(1)
Vaughan Maple	(1)
Section C – New builds that will replace stations from Section B	
Ballantrae - Hwy 48 & Vandorf Sideroad	2
Newmarket – Davis & Green Lane	6
Newmarket – Leslie Street & Mulock	6
Holland Landing – 2nd Concession & Doane Road	4
Thornhill - Clark Avenue West & Hilda Avenue	4
Maple – Rutherford Road & Hwy 400	4
Section D – New builds to address growth	
Richmond Hill – Stouffville Road & Bayview Avenue	2
Richmond Hill – 16th Avenue & Valleymede Drive	4
Vaughan – Martingrove Road & Hwy 7	2
Markham – McCowan Road & Denison St	4
Total – 25 Paramedic Response Stations	**87**

Supplies needed for the provision of patient care are expected to increase five per cent per year

Other incremental costs resulting from growing call demand are anticipated for supplies necessary for the provision of patient care. These items include oxygen, linen, disposable medical supplies and medication. It is expected that the requirement for these items will increase about five per cent per year in line with call demand increases. The annual cost for patient care supplies in 2012 is $838,000 and will gradually increase to $1,300,000 by 2021.

6. LOCAL MUNICIPAL IMPACT

The EMS 10-year resources and facilities master plan will support future staffing and capital development to provide equitable and consistent EMS response time performance in all local municipalities.

7. CONCLUSION

The 10-Year Resources and Facilities Master Plan for Emergency Medical Services will serve as a strategic tool to align resource requirements with patient demand and ensure optimal investments in capital projects to support response time effectiveness through 2021.

For more information on this report, please contact Norm Barrette, Chief and General Manager, Emergency Medical Services at Ext. 4709.

The Senior Management Group has reviewed this report.

(The attachment referred to in this clause is attached to this report.)

THE REGIONAL MUNICIPALITY OF YORK

York Region EMS 10-Year Resources and Facilities Master Plan Study

EXECUTIVE SUMMARY

ORH Limited
19-23 Queen Victoria Street
Reading
Berkshire
RG1 1SY, UK
www.orhltd.com

e-mail: orh@orhltd.com
tel: +44 (0) 118 959 6623
fax: +44 (0) 118 959 6626

ORH/YRE/1
27th July 2012

Figure I CURRENT SERVICE PROFILE

Sample Period: January 2010 to December 2010

Average Daily Demand

Priority	Daily Demand
4	101.8
3	33.1
2	46.9
1	134.9
All	181.8

Priority 4 Response Performance

Time Target	Percentage within Target
4 mins	8.6%
6 mins	27.3%
8 mins	52.2%
9 mins	63.4%
12 mins	85.7%
15 mins	94.6%

Average Hourly Demand (lines) and Planned Deployments (bars) by Hour of Day

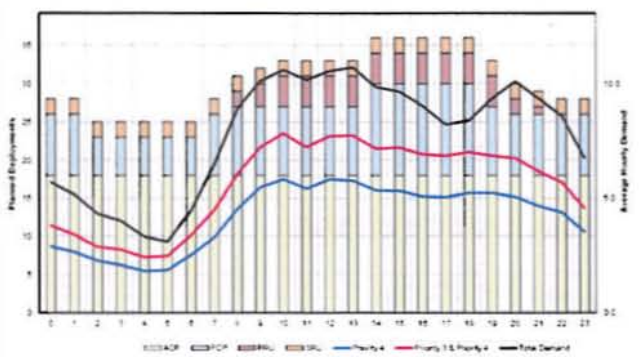


Figure II CURRENT STATIONS AND CAPITAL PLAN

Current Code	*Station Name*	*Vehicle Capacity*	*Capital Plan Intention*
10	Pefferlaw	2	**Fix** – new site nearby secured
11	Sutton	2	**Fix** – rebuild near current site
12	Keswick	2	**Fix** – new station soon online
14	Queensville	2	**Move** – to new Queensville site
15	Mount Albert	2	**Fix** – no plans to change
17	Newmarket-Cane Parkway	8	**Move** – to Newmarket NW & SE
18	Aurora	2	**Fix** – no relocation planned
20	Ballantrae	1	**Uncertain** – rebuild near current site
21	Stouffville	2	**Fix** – recently built station
23	Markham-Church	4	**Fix** – to be purchased
24	Markham-Unionville	1	**Uncertain**
26	Markham-Riviera	4	**Fix**
28	Richmond Hill	6	**Uncertain**
30	Woodbridge	6	**Uncertain**
32	Maple	1	**Move** – to new Maple Teston site
34	Vaughan-Racco	6	**Fix**
36	Thornhill-Vaughan	1	**Move** – to new site
37	Nobleton	4	**Fix** – renovation and rehab only
38	Schomberg	2	**Fix** – just built
39	King City	2&2RRU	**Uncertain** – rebuild near current site
New	New Maple	2	
New	New Thornhill Vaughan	2	
New	Newmarket NW	2	
New	Newmarket SE	2	
New	Holland Landing	2	
New	South of Aurora	2	
New	South Markham	2	
New	North Woodbridge	2	

Fix – Assume location stays
Move – Close and find optimum replacement site (or sites)
Uncertain – Test whether current location optimal

Executive Summary

Background

1. In October 2011 ORH was commissioned to undertake a modelling study of York Region EMS (YREMS) aimed at projecting the resource and facility requirements for the Service over the next 10 years.

2. During the first nine months of 2009, York Region grew by approximately 16,200 people, reaching a total estimated population of 1,028,159. The estimated population by 2022 will be of the order of 1.2 million.

3. Current response performance for Code 4 ('life-threatening') patients is around 90% within 12.5 minutes. Significant use is made of 'co-response', with Fire Department crews attending around one-third of Code 4 calls.

4. The objective of this project was to develop a comprehensive 10-year master plan for York Region Emergency Medical Services so as to:

    a) Inform current and future planning for the optimal location of stations and EMS staff resource requirements.

    b) Inform Service plans for timely access to emergency response.

    c) Inform resource utilisation of EMS units.

5. A detailed data collection and analysis process was undertaken for the calendar year 2010, to gain an understanding of how the Service operates and to produce inputs for ORH's optimisation (OGRE) and simulation (AmbSim) models (see Annexes **A1** and **A2**). Figure **I** opposite summarises some of the main analysis outcomes.

6. Figure **II** opposite lists the current capacities for vehicles at each of the current stations and whether or not each station is expandable. Each station was set in the context of the Region's current capital plan, and any relevant comments are also quoted in the figure. New locations to be built in the current capital plan are also shown with their proposed capacities.

Demand Projections

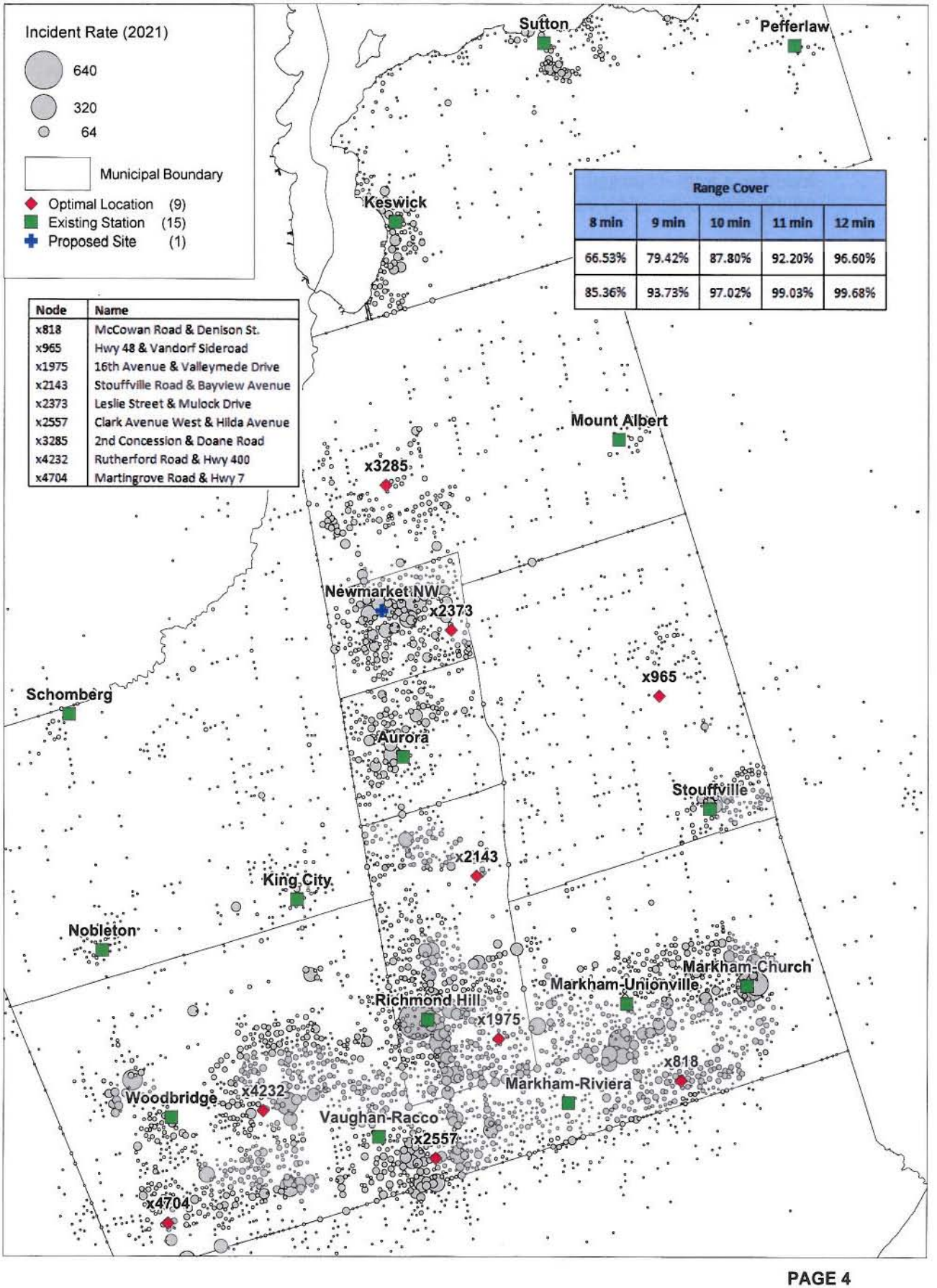
7. Demand projections for this study were based on projections of Priority 3 and 4 demand combined. The goal was to project demand annually up to 2021 in as detailed a manner as possible, taking into account sub-regional variations.

8. Population projections, at municipality level and split by age and gender for every 5 years from 2001 to 2021, were supplied to ORH. In addition, ORH was supplied with total population projections in each traffic zone for the same set of years. These were used to distribute projected demand at municipality level into each zone on a pro-rata basis.

9. The total demand and population by municipality were used to produce an overall demand rate per head of population by municipality for 2001, 2006 and 2011. These rates were then linearly projected forward to 2016 and 2021. These projected rates were used with their respective projected populations to provide total demand by municipality for 2016 and 2021.

10. The overall population increase from 2001 to 2011 was found to be 40.8%, compared with a projected population increase of 22.9% from 2011 to 2021. Code 3 and 4 demand levels combined rose from 2001 to 2011 by 53%. The projection methodology applied

Figure III *OPTIMAL 25 LOCATIONS AND RANGE COVERAGE*



Range Cover				
8 min	9 min	10 min	11 min	12 min
66.53%	79.42%	87.80%	92.20%	96.60%
85.36%	93.73%	97.02%	99.03%	99.68%

Node	Name
x818	McCowan Road & Denison St.
x965	Hwy 48 & Vandorf Sideroad
x1975	16th Avenue & Valleymede Drive
x2143	Stouffville Road & Bayview Avenue
x2373	Leslie Street & Mulock Drive
x2557	Clark Avenue West & Hilda Avenue
x3285	2nd Concession & Doane Road
x4232	Rutherford Road & Hwy 400
x4704	Martingrove Road & Hwy 7

here projected a demand increase of 47.8% over the next 10 years. This is shown by municipality in the table below.

AREA	Change in annual incidents from 2011	% Increase from 2011
Aurora	1202	43.8%
East Gwillimbury	2100	135.4%
Georgina	1551	44.6%
King	321	28.6%
Markham	5500	50.1%
Newmarket	1840	34.3%
Richmond Hill	4210	50.9%
Vaughan	6082	42.3%
Whitchurch-Stouffville	1001	51.0%
TOTAL	23808	47.8%

Travel Times

11. Information on additional roads was also incorporated into the model and travel times along these and existing roads were calibrated to be in line with future developments. To assist with the calibration, ORH was provided with isochrone maps showing travel times from existing station locations in both 2011 and as projected for 2021.

12. In addition to collecting and analysing these data, ORH developed a detailed travel time model of the Service area using commercially available software calibrated against information on travel times from the ambulance workload (ADDAS) data.

Optimum Location Modelling

13. Following an initial assessment of range cover using ORH's optimisation program (OGRE), it was concluded that modelling should be based on the optimum required sites to meet a 90th percentile 10-minute target, but that resources deployed at those sites should be modelled to meet an 11-minute 90th percentile target as well. This allows for a potential future transition to a 10-minute target, since appropriate estate will have already been identified and developed.

14. Using the projected 2021 demand, range cover modelling was undertaken, fixing those stations the Service definitely wanted to retain, to identify the optimal future response locations. A series of iterative modelling runs was undertaken based initially on the preliminary assessment of which stations should definitely be retained and those where there was a potential to relocate. A number of optimum sites were located near to existing locations; these were fixed into the modelling after consultation with the Service, and the optimisation re-run.

15. Figure **III** opposite shows the final set of 25 sites recommended, as a conclusion to the iterative modelling described above, and shows the resulting range cover.

Resource Requirement and Phasing

16. ORH's EMS simulation model (AmbSim) was populated using parameters derived from the Service data analysis. Analysis of the ADDAS data provided information on demand, call locations and job cycle times to use in the modelling. The results of the calibration process indicated that the model could be used with confidence to examine future changes.

Figure IV PERFORMANCE AND RESOURCE SUMMARY

2016

Scenario	Total Priority 4 Incidents per Year	Response Performance						Transport Performance	Average Response Time (mins)	Total Vehicle Hours per Week		Average Vehicle Utilisation		Max on road		Min on road	
		8-min	9-min	10-min	11-min	12-min	15-min	15-min		AMB	RRU	AMB	RRU	AMB	RRU	AMB	RRU
Base Position	49230	50.9%	62.3%	72.2%	79.2%	84.9%	94.1%	93.3%	8.4	4434	336	35.6%	20.1%	30	4	23	0
90% in 11-mins	61886	68.6%	78.3%	85.9%	**90.3%**	93.3%	97.8%	96.2%	7.0	5595	951	35.3%	28.3%	36	9	27	0
90% in 10-mins	61886	75.5%	84.4%	**90.6%**	93.8%	95.8%	98.5%	97.3%	6.5	6359	1405	30.9%	24.1%	40	11	35	4

2021

Scenario	Total Priority 4 Incidents per Year	Response Performance						Transport Performance	Average Response Time (mins)	Total Vehicle Hours per Week		Average Vehicle Utilisation		Max on road		Min on road	
		8-min	9-min	10-min	11-min	12-min	15-min	15-min		AMB	RRU	AMB	RRU	AMB	RRU	AMB	RRU
Base Position	49230	50.9%	62.3%	72.2%	79.2%	84.9%	94.1%	93.3%	8.4	4434	336	35.6%	20.1%	30	4	23	0
90% in 11-mins	73652	70.8%	80.4%	87.4%	**91.2%**	93.8%	97.9%	96.1%	6.9	6223	951	37.9%	30.2%	40	9	30	0
90% in 10-mins	73652	75.7%	84.7%	**90.8%**	93.8%	95.7%	98.6%	96.6%	6.5	6596	1528	35.7%	25.6%	43	11	31	7

Notes

The 'Base Position' refers to performance in 2010; Schomberg station has been added since then (168 vehicle hrs/wk)
All performance figure refer to Priority 4 incidents
Response performance refers to AMB and RRU performance
Transport performance refers to AMB only
Vehicle Hours and max/min on road exclude allowance for rostering restrictions and breaks

17. The ambulance simulation model was first used to project the resources required to maintain current response standards using the regions current capital plan.

18. The model was then used to identify the resources required at each location in both 2016 and 2021 to meet targets of 90% at both 10 and 11 minutes.

19. The modelling assumed that not all of the optimal new sites required by 2021 would have been constructed by 2016; a ranked list of new sites was produced in order of importance based on performance impact. Initial modelling indicated that it would be necessary to build four of the proposed new stations; these would be x4704 (Martingrove Road & Hwy 7), x2143 (Stouffville Road & Bayview Avenue) and both Newmarket sites (Newmarket NW and Leslie Street & Mulock Drive). Without these locations it would not be possible to reach either the 10- or 11-minute targets.

20. It was assumed that RRUs can be stationed at existing sites and patrol around the new site areas where proposed stations have not yet been built.

21. Achieving the 10-minute target by 2016 is very resource intensive since not all the new sites will have been constructed, and therefore range cover from the available sites will be sub-optimal. It was necessary to include some 24/7 provision of RRUs with four running through the night and seven operating until 2am.

22. Figure **IV** opposite summarises the resourcing requirements and performance impacts in 2016 and 2021 for the current capital plan, maintain current performance and for the optimal station locations and meeting a 90% in 10 or 11 minute standard.

Sensitivity

23. Although given a 90% 11-minute target, the resulting response performance at 8 minutes might appear relatively low at about 70% to 75%, there is the potential to allow for cover from fire crews to high priority calls. The table below shows range cover from the 25 proposed paramedic response stations and range cover from both these and the 38 fire stations:

	Minutes						
Sites	4	6	8	9	10	12	15
Optimum 25	18.0%	54.0%	85.4%	93.7%	97.0%	99.0%	99.7%
25 plus fire	32.2%	74.3%	93.5%	96.9%	98.2%	99.3%	99.8%

24. It can be seen that this improves range cover at 8 minutes by approximately 8%.

25. It was noted that the Service's hospital turnaround time (offload delay) is very high in comparison with other Services where ORH has worked. Should the offload delay be reduced, then response performance would be expected to improve. However, this is not directly within the Service's control.

26. An increase in the use of alternative hospital pathways could also improve response times. Under this model not all patients would go to main emergency departments, but use of other receiving facilities would increase. This would improve performance by shortening transport journeys and by potentially reducing time lost due to offload delays.

27. Sensitivity modelling was then undertaken around the introduction of a new prioritisation system. It was found that adopting a prioritisation system that produced a 45% hot response proportion, rather than the current 75-80%, improved response performance to around 92% in 10 or 11 minutes in both 2016 and 2021. This is equivalent to a reduction of 592 RRU hours per week in 2021 at the 10-minute target.

Figure V STAFFING SUMMARY

		2016			2021		
		Current Capital Plan	Optimal Capital Plan		Current Capital Plan	Optimal Capital Plan	
	Current	12.5-minute	11-minute	10-minute	12.5-minute	11-minute	10-minute
Weekly Staff Hours	**9571**	**11872**	**12992**	**15064**	**13720**	**13968**	**15680**
Total Paramedics	**335**	**416**	**432**	**527**	**480**	**490**	**551**
Support Staff:							
Superintendents	12	15	16	19	18	18	20
Lead Paramedics	10	13	13	16	15	15	17
Data Analysts	1	2	2	2	2	2	2
Team Leads, Scheduling and Deployments	1	2	2	2	2	2	2
Scheduling Clerks	5	7	7	8	8	8	9
Administrative Assistants	1	2	2	2	2	2	2
Administrative Clerk/Secretaries	5	7	7	8	8	8	9
Fleet technicians	2	3	3	4	3	3	4
Logistic Technicians	6	8	8	10	9	9	10
Total Support Staff	**43**	**59**	**60**	**71**	**67**	**67**	**75**

Average Paramedic cost per annum	$102,000
Average Support Staff cost per annum	$93,600

Paramedic Staff Costs	$34,170,000	$42,383,040	$44,064,000	$53,754,000	$48,980,400	$49,980,000	$56,202,000
Support Staff Costs	$4,024,800	$5,522,400	$5,616,000	$6,645,600	$6,271,200	$6,271,200	$7,020,000
Total Staff Costs	$38,194,800	$47,905,440	$49,680,000	$60,399,600	$55,251,600	$56,251,200	$63,222,000
Staff Cost per Code3/4 Incident	$664	$670	$695	$845	$650	$662	$743

Vehicle hours per week	4956	6440	6980	8330	7364	7488	8680
Cost per vehicle hour	$175	$175	$175	$175	$175	$175	$175
Total cost to service	$44,108,400	$57,316,000	$62,122,000	$74,137,000	$65,539,600	$66,643,200	$77,252,000

Total-Staff=Other running costs	$5,913,600	$9,410,560	$12,442,000	$13,737,400	$10,288,000	$10,392,000	$14,030,000

Figure VI CURRENT AND REQUIRED STATION CAPACITIES

Location	District	Current/Required Capacity	Max Vehicles	Spare Capacity
Aurora	North	2	2	0
Keswick	North	2	2	0
King City	South West	4	2	2
Markham-Church	Central East	4	3	1
Markham-Riviera	Central East	4	2	2
Markham-Unionville	Central East	1	1	0
Mount Albert	North	2	1	1
Newmarket NW	North	6	6	0
Nobleton	South West	4	1	3
Pefferlaw	North	2	1	1
Richmond Hill	Central East	6	5	1
Schomberg	South West	2	1	1
Stouffville	Central East	2	1	1
Sutton	North	2	1	1
Vaughan-Racco	South West	6	2	4
Woodbridge	South West	6	5	1
16th Avenue & Valleymede Drive (x1975)	Central East	4	3	1
Stouffville Road & Bayview Avenue (x2143)	Central East	2	2	0
Leslie Street & Mulock Drive (x2373)	North	6	5	1
Clark Avenue West & Hilda Avenue (x2557)	South West	4	3	1
2nd Concession & Doane Road (x3285)	North	4	3	1
Rutherford Road & Hwy 400 (x4232)	South West	4	4	0
Martingrove Road & Hwy 7 (x4704)	South West	2	2	0
McCowan Road & Denison St. (x818)	Central East	4	4	0
Hwy 48 & Vandorf Sideroad (x965)	Central East	2	1	1
Total		87	63	24

New build

Rostering

28. The increase in on-the-road hours described above and in Figure **IV** does not take account of meal breaks or rostering constraints such as shift lengths and permissible start and finish times. Figure **V** opposite summarises the average weekly vehicle hours required to include both of these.

29. Staff currently work a 42-hour working week. Therefore the staff required to fill the rosters, assuming no absences, training or leave, is equal to the total staff hours rostered divided by 42. However, an allowance needs to be made for cover due to absences. On average the relief rate (percentage of staff required to cover absences from the core roster) is equal to 47%.

30. Figure **V** uses this staff calculation for the current (2011) level of deployed hours, for the current capital plan and for all four options for future staffing (2016 and 2021 10- and 11-minute targets). The current number of paramedics required to cover the core roster without overtime or dropped shifts is 335. By 2021 this needs to increase to 490 for an 11-minute target and 551 for a 10-minute target.

Costs

31. The average cost of a paramedic is given in the figure along with the current number of support staff and their average cost (note these costs include salaries and employers on costs). The total support staff will need to increase in line with the number of paramedics. The total staffing required under each option and staffing costs associated with them are highlighted in Figure **V**.

32. The total paramedic cost increases from a base position of $34 million to $49 million to maintain current performance with the current capital plan in 2021. This compares to $50 million to implement an 11-minute target in the same year using the optimised capital plan; this is combined with a support staff cost increase from $4 million to $6.2 million.

33. A total of ten new locations need to be built by 2021 in the optimal capital plan. Based on the resource modelling above and the weekly staffing numbers in Figure **V**, capacities for vehicles were associated with each of the new sites for each year, and these are shown in Figure **VI** opposite.

34. The Service provided ORH with costs of land, buildings, project management, etc. The total capital costs associated with building the ten optimal new locations, at the sizes quoted above, totals $24.1 million, this compares to the current capital plan expenditure of $19.8 million. The broad plan will be to purchase as much of the land as possible in the next few years and then to develop the sites in line with the order derived in this study.

Summary

35. To summarise, a detailed analysis of Service and regional data was undertaken and used to set up and calibrate ORH's suite of software programs. This analysis also allowed demand projections to be undertaken for 2016 and 2021.

36. The models, input with the projected demand data, were then used to calculate the station location requirements, including capacities and staffing to meet both a 90% in 10- and 11-minute standard in 2016 and 2021. These outcomes were compared with maintaining current performance levels utilising the services current capital plan. These numbers were then used to estimate the capital and recurrent costs to the Service.

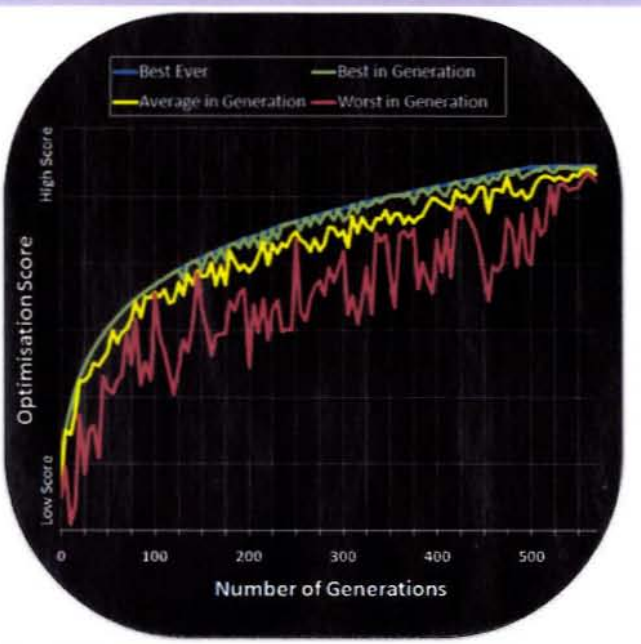
ORH
Established 1986

A1
MODEL PROFILE

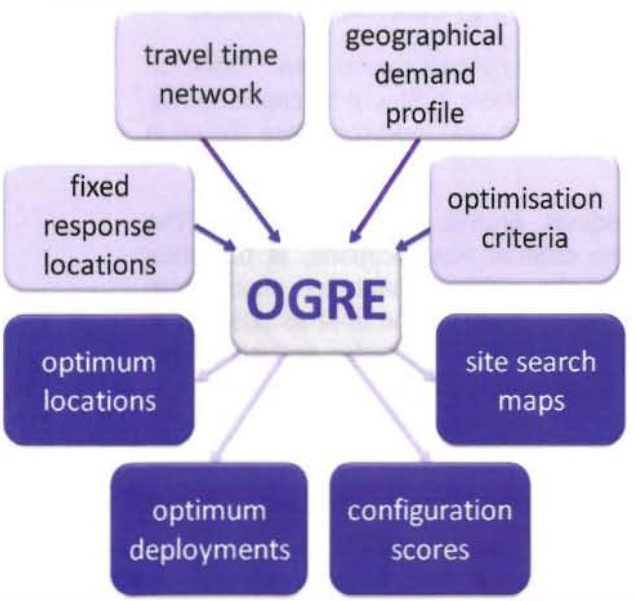
OGRE - Optimising by Genetic Resource Evolution

What is OGRE?

- OGRE is a unique program that is used to optimise ambulance resource deployments.
- A sophisticated genetic algorithm assesses millions of options, quickly identifying optimal deployment solutions.
- The model can incorporate different vehicle types and call categories.
- OGRE was specifically developed by ORH for use within the emergency services.



Millions of Ambulance Deployment Options Processed in Minutes



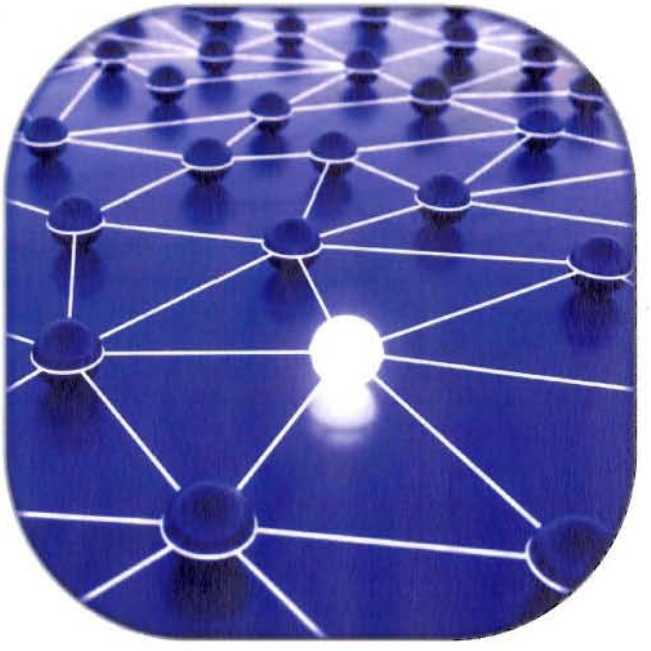
How is OGRE used?

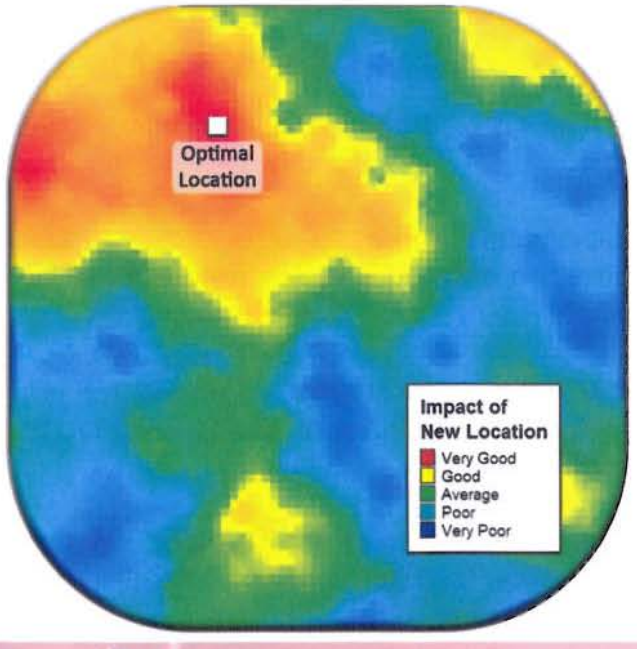
- OGRE is fully customisable and can be tailored to the specific needs of the individual Ambulance Service.
- Optimisation criteria are determined through consultation and experimentation.
- OGRE identifies optimal solutions that minimise response times by call type.
- Optimisation modelling is undertaken alongside simulation modelling to ensure that deployment solutions are fit-for-purpose.

ORH

The Optimisation Process

- Comprehensive workload analysis is undertaken to provide operational modelling inputs alongside detailed and carefully calibrated travel times.
- The Ambulance Service specifies any locations and deployments that are to remain fixed in the model runs, optimising around these.
- A series of OGRE modelling runs then identify candidate optimum configurations.
- OGRE is used alongside **AmbSim** in an intensive and iterative manner to develop optimum future deployment solutions.





Modelling Outcomes

- Provisional solutions found through using OGRE are discussed with the client around a series of iterative modelling runs, before finalising results.
- OGRE can be used to produce a ranked list of options for appraisal.
- Results are presented in a clear and concise manner to support planning and consultation.
- Optimisation modelling outcomes can identify the scope for operational efficiencies.

Email: [illegible]@orhltd.com
Telephone: +44 (0)118 959 6623

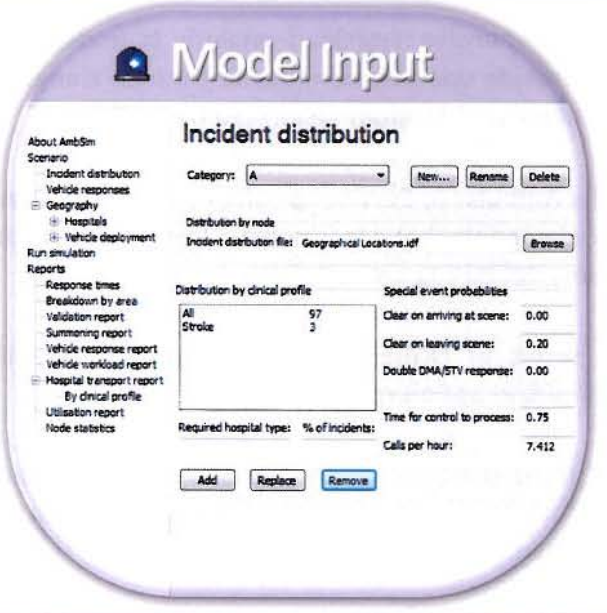
ORH
Established 1986

A2
MODEL PROFILE

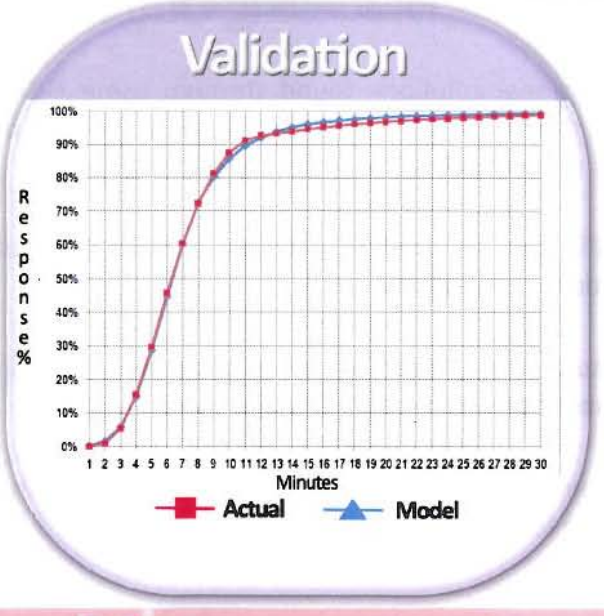
AmbSim - The Ambulance Simulation Model

What is AmbSim?

- **AmbSim** - the Ambulance Simulation Model - is a discrete event simulation model designed and operated by ORH specifically for emergency medical services.
- Logical rules based upon actual operational practice govern the response to an incident. The model is sufficiently flexible to allow for different methods of operation.



Rapidly Evaluate Multiple Options for Future Changes



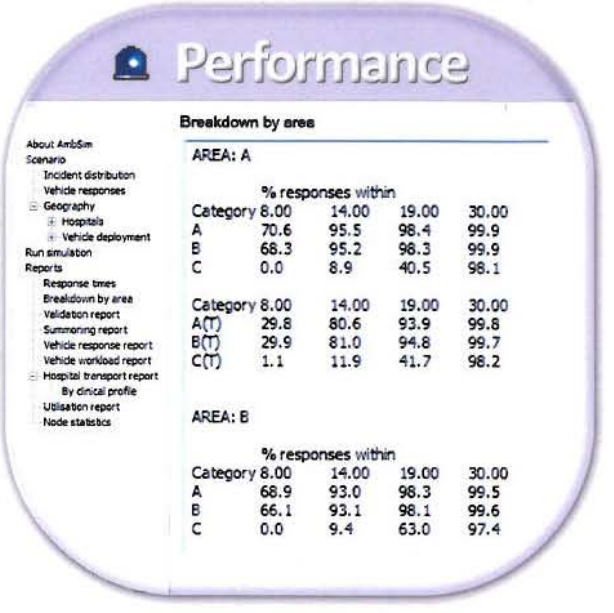
How is AmbSim Used?

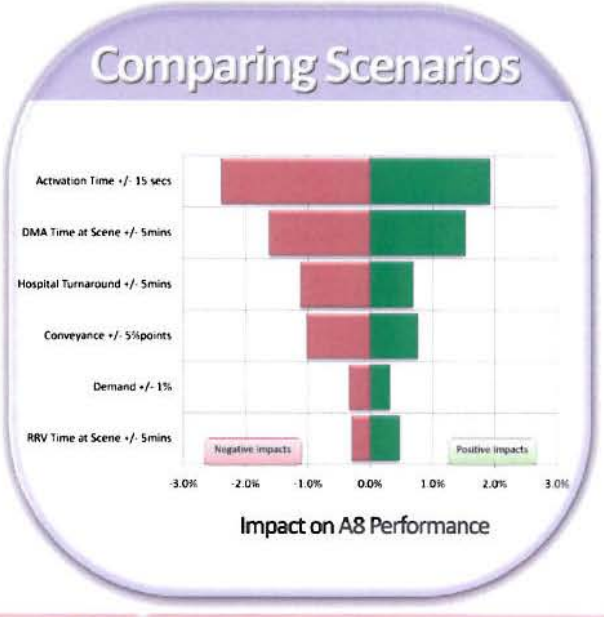
- The model is validated against the existing service profile.
- Comprehensive workload and resource analysis is required in order to provide accurate modelling inputs.
- The model will simulate years of data in minutes, allowing a large number of options to be considered quickly.
- Detailed model outputs are produced including performance, vehicle utilisation, hospital and vehicle workload.

ORH

The Modelling Process

- **AmbSim** can be tailored to a service's planning requirements.
- The current method of operation can be compared against alternatives.
- **AmbSim** outputs can be both at service level and also by client specified sub-areas (e.g. dispatch areas, zones etc).
- Batch processing allows the impacts of resource changes to be assessed rapidly.
- Outputs can be integrated with GIS or spreadsheet packages to enhance presentation or to enable further analysis.





Benefits

- A transport model validation phase gives confidence in using **AmbSim** for planning resource.
- Simulation modelling enables many 'what if' scenarios to be assessed in order to enable reliable forward planning.
- Clear supporting evidence means that results can be used with confidence.
- Sensitivity modelling tests the robustness of the solution given uncertainty in future uncontrollable factors.

Email: info@orhltd.com
Telephone: +44 (0)118 959 6623