Emergency Service Planning
Emergency Medical Services

Niagara EMS

Ten Year Facilities Master Plan

Final Report

ORH/NEMS/2
March 14, 2024

PLAN. PREPARE. **PERFORM.**

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Other than data provided by Niagara EMS, this report also contains data from the following sources:

EXECUTIVE SUMMARY

i. The Regional Municipality of Niagara (Niagara Region) engaged Operational Research in Health Limited (ORH) to develop a Ten Year Facilities Master Plan for the delivery of Niagara Emergency Medical Services (NEMS) across the period 2023 to 2033. This is the Final Report for the review.

ii. A five-year sample of workload and resourcing data (January 2018 to December 2022) was collected by ORH to examine and analyze trends in demand and performance. ORH was also provided with a range of qualitative and quantitative information relating to Niagara Region's EMS facilities.

iii. Daily demand (incidents responded to by a NEMS vehicle) increased across the sample period, from 164 incidents per day in 2018 to 181 in 2022, which is equivalent to an average of 2.5% per year. Average occupied time per Priority 1 to Priority 5 (P1 to P5) incident, measured from vehicle mobilized to clear, has also increased across the sample period, from 86 minutes in 2018 to 98 minutes in 2022. Time at hospital accounts for a significant percentage of occupied time.

iv. Across the sample, response performance targets were close to being met for each priority. However, due to increasing demand and increasing time on task, P1 and P2 performance slowly declined from above target levels to below target levels over the course of 2021 and 2022. As of 2023, NEMS planned to deploy 4,704 ambulance (transport unit) hours per week, along with a range of Mobile Integrated Healthcare teams. Average ambulance utilization for 2021 and 2022 was 42%.

v. ORH conducted a review of the Region's EMS facilities and evaluated a range of different metrics. The facilities that have concerns in multiple areas, and are therefore deemed to be the highest risk, are Abbey Rd, Niagara Falls, St Paul Av, Niagara-on-the-Lake, Grimsby, and Vineland.

vi. However, almost all the facilities in the Region have no spare capacity. This means that, under a traditional facilities model, it will not be possible to deploy additional resources when required without new or expanded facilities in the future.

vii. ORH uses sophisticated predictive modelling tools that have been developed in-house to assist with the development of master plans for paramedic services. ORH validated its EMS simulation model, AmbSim, against analyzed NEMS performance, utilization and hospital flows, which showed that the model replicated historical operations accurately and therefore was appropriate to use for different 'what if' modelling scenarios. A 2023 Base Position was then created to provide a basis for comparison with future scenarios.

viii. To understand facility and resource requirements for the next ten years, a demand projection was required. Demand projections were created using a population-based projection method with the underlying hypothesis that demand is strongly related to the population age profile.

ix. Total population for Niagara Region is expected to reach 589,000 by 2033, an increase of 15% from 2023. The population is projected to continue to age during this period. For example, the percentage of the population aged 65 and over is 23% in 2023 compared to 26% in 2033.

x. The predicted increasing and ageing population, coupled with increasing demand rates, suggests that demand on NEMS will continue to increase significantly to 2033. P1 to P5 demand in Niagara Region is expected to increase by 40% between 2023 and 2033, from 179 incidents per day to 242 incidents per day. This equates to a 3% increase year-on-year Region-wide.

xi. To highlight the impact on performance if no investment is made to NEMS frontline operations, the demand projections were applied to the Base Position in AmbSim. No other operational changes were made (a 'Do Nothing' scenario). In this scenario, P1 8-minute response performance for Niagara Region falls significantly from 79% in 2023 to 71% in 2033, well below target levels.

xii. The main aims of the facility optimization were to identify facility locations that would best improve equity of coverage across Niagara Region and/or resolve existing facility issues (for example, lack of spare capacity for the future, condition risks, or lease risks). Following a highly iterative process, supported with input from the Steering Committee, the location optimization outcomes were as follows (see map in Figure **I**):

- Ten facilities were identified as being already optimally located, or not worth moving to a slightly more optimal location
- Two facilities were recommended to be moved to a new optimal location: Abbey Rd and Port Colborne
- Glendale and Niagara-on-the-Lake resources are recommended to be consolidated to a single facility near Virgil
- Grimsby resources are recommended to be divided between two new facilities, one in Beamsville and one more centrally located within Grimsby
- Niagara Falls/St Paul Av resources are recommended to be divided between three new facilities in the municipality

xiii. An increase of 1,764 weekly ambulance hours, from 4,704 in the 2023 Base Position to 6,468 in 2033, is recommended to improve performance in every municipality in 2033. This is equivalent to a 38% increase in resource hours, compared to the 40% increase projected in demand.

xiv. Crucially, these resources and facilities would allow the P1 8-minute response performance target of 80% to be to be exceeded in overall Niagara Region terms and in six municipalities. Furthermore, the remaining municipalities would either have maintained the same performance as recorded in the Base Position or have substantially improved.

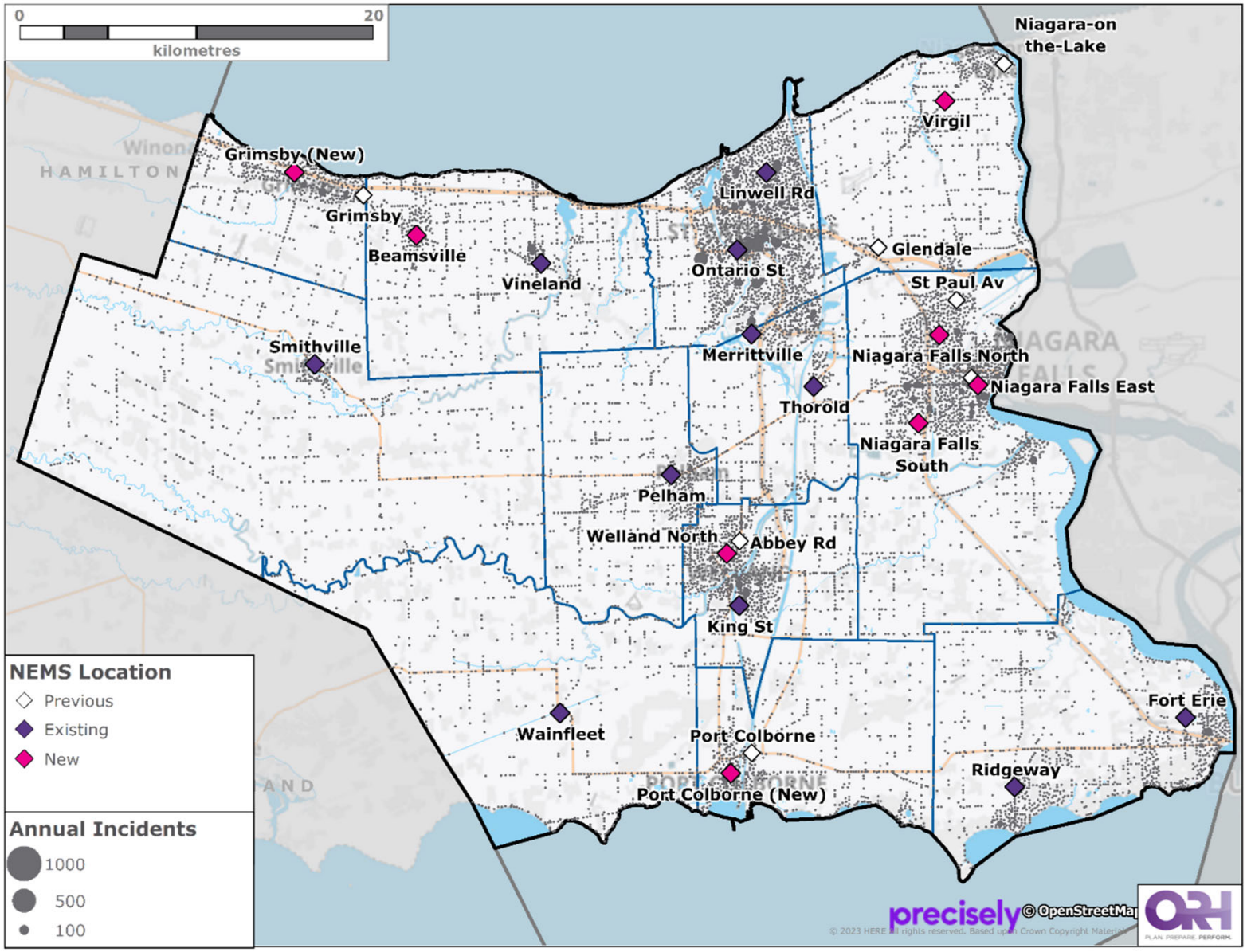


Figure I: Recommended Facility Configuration (excluding Hubs)

xv. The majority of the recommended resource investment would be required to offset the demand increases, even if the only criteria for response performance was to ensure no degradation from the Base Position.

xvi. Under a hub, spoke and post model, the recommended facilities would operate as posts, reducing the footprint of future builds and alleviating the remaining capacity pressures at facilities to be retained. Ambulances associated with these facilities would book on and off at a primary location or locations.

xvii. A three-hub solution (one primary hub plus two spokes) was found to best meet the geographical coverage needs of Niagara Region. Potentially suitable land near to each of the optimal sites has already been identified. Based on the recommended vehicle requirements outlined, this means that hub facilities would need to accommodate 22 peak ambulances plus spares at the Primary Hub (at Westwood Court), 9 peak ambulances plus spares at the North West Spoke (at the optimal new Grimsby facility), and 18 peak ambulances plus spares at South Spoke (at approximately Morris Rd and Netherby Rd).

xviii. There is a small response performance improvement of moving to the hub, spoke and post facilities model when compared with the traditional facilities model. There are also many other potential benefits of a hub, spoke and post model that are not captured within response time metrics, for example:

- Minimized footprint for the post facilities, which are often in high-population areas where land prices are expensive; this also reduces energy requirements
- Centralized supplies, cleaning, and maintenance, reducing the logistics mileage impact, supplies wastage and vehicle downtime
- Focus for frontline staff on patient care rather than stocking and cleaning
- Increased equity in workload by shift, with opportunities for improved skills retention and reduced WSIB incidents
- Opportunity to consolidate administration, dispatch, dispatch training, and quality assurance functions alongside the primary hub

xix. The recommended facility and ambulance requirements are suggested to be introduced over the next ten years according to the trajectory outlined in Figure **II**. The process for determining an appropriate trajectory aimed to address high risk facilities as quickly as possible. However, the trajectory also needed to reflect budget cycles, follow a sensible construction schedule, stagger ambulance increases so that the financial impacts are as evenly spread across the ten years as possible, and balance this with the need to improve performance.

xx. Sensitivity modelling was also undertaken to test assumptions about parameters incorporated into the core modelling scenarios, including: building optimal sites at potential alternative locations, opening the new South Niagara Site hospital, variations to time at hospital, and variations to demand projections.

Figure II: Recommended Trajectory Implementation

Year	Facilities Opened			Facilities Closed	Ambulance Requirements			Notes
	1-bay Post	2-bay Post	Hub		Shifts		Peak Ambulances	
2025	*None*	*None*	*None*	*None*	Ontario St Smithville Fort Erie	24/7 12/7 12/7	1 1 1	No space for any spare vehicles at Smithville, Fort Erie or Ontario St
2026	*None*	*None*	*None*	*None*	Abbey Rd Niagara-on-the-Lake	12/7 12/7	1 1	No space for any spare vehicles at Abbey Rd or NOTL
2027	Niagara Falls North*	Niagara Falls East* Virgil*	*None*	Niagara Falls St Paul Av Niagara-on–the-Lake	Niagara Falls East* Linwell Rd*	12/7 12/7	1 1	*Shifts associated with the opened posts and the additional Linwell Rd shift will now forward deploy from Westwood Court as a temporary hub. Glendale technically won't close, but shifts will forward deploy to Virgil
2028	*None*	Welland North*	North West Spoke	Abbey Rd	North West Spoke Welland North*	12/7 + 12/7 (Night) 12/7 (Night)	1 0	North West Spoke will open as a fully operational spoke, with Grimsby, Smithville and Vineland used as posts. *Shifts associated with the Welland North post will forward deploy from King St temporarily, supervisors will need to be temporarily relocated (Fitch St?)
2029	Niagara Falls South*	*None*	*None*	*None*	Merrittville* North West Spoke	12/7 24/7	1 1	*Shifts associated with the Niagara Falls South post and the additional Merrittville shift will forward deploy from Westwood Court as a temporary hub
2030	*None*	*None*	Primary Hub	Glendale	Primary Hub	12/7 (Night)	0	Primary Hub will open as a fully operational hub, with Niagara Falls, NOTL, St Catharines and Thorold facilities all used as posts
2031	*None*	Beamsville	*None*	Grimsby	South Spoke	12/7	1	
2032	*None*	Port Colborne (New)	South Spoke	Port Colborne	South Spoke	24/7	1	South Spoke will open as a fully operational spoke, with Fort Erie, Pelham, Port Colborne and Welland facilities all used as posts
2033	*None*	*None*	*None*	*None*	North West Spoke South Spoke	12/7 2 x 12/7	1 2	

Contents

1 INTRODUCTION

1.1 The Regional Municipality of Niagara (Niagara Region) engaged Operational Research in Health Limited (ORH) to develop a Ten Year Facilities Master Plan for the delivery of Niagara Emergency Medical Services (NEMS) across the period 2023 to 2033.

1.2 The Master Plan was required to:

(a) Review current service operations and the facilities portfolio.

(b) Through predictive modelling, determine locations and vehicles required for the future under a traditional model.

(c) Through predictive modelling, determine locations and vehicles required for the future under a hub, spoke and post model.

(d) Determine the feasibility of the current facilities portfolio to suit the needs of either model.

(e) Develop a series of prioritized recommendations based on the recommended option.

1.3 A Steering Committee was formed to support ORH during the course of the review, in particular to compile data, check analysis outputs, agree demand projection and modelling scenario assumptions, facilitate stakeholder consultation, and provide feedback on emerging results.

1.4 ORH collected and analyzed detailed NEMS workload, resourcing and facility data to enable a review of the current service and facilities profile (Section 2).

1.5 Location optimization and simulation models reflecting NEMS frontline operations were built and validated, and used to create a Base Position for modelling (Section 3).

1.6 Using historical demand population data, a demand projection was made to 2033. The simulation model was used to understand the impacts of the future projections as a 'do nothing' scenario (Section 4).

1.7 ORH's location optimization model was used to identify optimal facility locations (Section 5). Vehicle requirements for the future were identified using ORH's simulation model under a traditional facilities model (Section 6), as well as for a hub, spoke and post facilities model (Section 7).

1.8 Finally, a trajectory of prioritized recommendations has been provided (Section 8) along with a series of sensitivity modelling scenarios (Section 9).

1.9 **This is the Final Report for the review**.

2 CURRENT SERVICE AND FACILITIES PROFILE

A five-year sample of workload and resourcing data (January 2018 to December 2022) was collected by ORH to examine and analyze trends in demand and performance. ORH was also provided with a range of qualitative and quantitative information relating to Niagara Region's EMS facilities.

Daily demand (incidents responded to by a NEMS vehicle) increased across the sample period, from 164 incidents per day in 2018 to 181 in 2022, which is equivalent to an average of 2.5% per year. Average occupied time per Priority 1 to Priority 5 (P1 to P5) incident, measured from vehicle mobilized to clear, has also increased across the sample period, from 86 minutes in 2018 to 98 minutes in 2022. Time at hospital accounts for a significant percentage of occupied time.

Across the sample, response performance targets were close to being met for each priority. However, due to increasing demand and increasing time on task, P1 and P2 performance slowly declined from above target levels to below target levels over the course of 2021 and 2022.

As of 2023, NEMS planned to deploy 4,704 ambulance (transport unit) hours per week, along with a range of Mobile Integrated Healthcare teams. Average ambulance utilization for 2021 and 2022 was 42%.

ORH conducted a review of the Region's EMS facilities and evaluated a range of different metrics, the key findings of which are presented in Figure **3-6**. The facilities that have concerns in multiple areas, and are therefore deemed to be the highest risk, are Abbey Rd, Niagara Falls, St Paul Av, Niagara-on-the-Lake, Grimsby, and Vineland.

However, almost all the facilities in the Region have no spare capacity. This means that, under a traditional facilities model, it will not be possible to deploy additional resources when required without new or expanded facilities in the future.

Data Collection

2.1 A five-year sample of workload and resourcing data (January 2018 to December 2022) was collected by ORH to examine and analyze trends in demand and performance. For example:

- Medical Priority Dispatch System (MPDS) workload data
- Resource data (planned and actual deployments)

- Geographical data (station and hospital locations)
- Operational policies and procedures (deployment protocols, meal break policies)
- Vehicle unavailability data

2.2 To create a facilities profile, ORH was provided with a range of qualitative and quantitative information relating to building conditions, leasehold details (if applicable), site costs, and station capabilities or limitations of the Region's EMS facilities.

Service Profile Overview

Demand

2.3 Unless otherwise specified, demand is defined in this report as NEMS-responded incidents, where a vehicle(s) arrives on scene; if two vehicles mobilize to or attend the scene of the same incident, this unique incident is only counted once. This includes out of area incidents. Demand is grouped into the five priority categories (Priority 1 through Priority 5) plus an 'Other' category which includes mostly mobile integrated healthcare (MIH) incidents as well as miscellaneous incidents such as courtesy calls.

2.4 NEMS responded to an average of 169 incidents per day during the five-year sample. Daily demand increased across the sample period, from 164 incidents per day in 2018 to 181 in 2022, which is equivalent to an average of 2.5% per year (see Figure **2-1**). Demand fell to its lowest levels between March and June 2020, strongly influenced by the COVID-19 pandemic.

2.5 Over half (57%) of P1 to P5 demand is in St Catharines and Niagara Falls municipalities, with 57 and 37 incidents per day respectively (see Figure **2-2**). Municipalities in the west of the Region generally have the lowest demand, for example, Wainfleet and West Lincoln with 1 and 2 incidents per day respectively.

2.6 Across the week hourly demand peaked between 10:00 and 13:00, with around 10.5 incidents per hour occurring during this time (see Appendix **A1**). Demand gradually decreases through the evening and night time hours, except for the weekend at 18:00 when demand peaks again.

2.7 The majority of patients transported to hospital by NEMS ambulances (a total of 117 per day) were taken to hospitals within the Region, all of which are operated by Niagara Health with the exception of West Lincoln Memorial Hospital. St Catharines Site was the most frequent destination for patients, at 49 per day (see Appendix **A2**). Fort Erie and Port Colborne Urgent Care Centres are now closed as a destination for EMS patients.

Figure 2-1: Demand by Month and Category

Average Daily Responded Demand (P1 to P5 & Other)

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Overall
2018	164.7	163.0	163.5	158.2	162.4	168.1	171.9	168.2	165.5	158.5	162.4	163.1	**164.1**
2019	163.9	158.2	164.3	162.9	162.1	172.2	175.6	167.2	166.9	157.8	154.1	157.4	**163.6**
2020	158.5	159.0	139.5	132.1	146.3	157.6	170.0	166.8	168.4	158.4	160.1	163.5	**156.7**
2021	160.7	160.8	169.3	171.7	174.3	181.5	195.2	198.5	190.9	181.5	177.6	173.8	**178.1**
2022	168.7	165.3	165.5	173.8	181.7	187.9	188.1	186.8	185.0	187.6	188.3	191.2	**180.9**

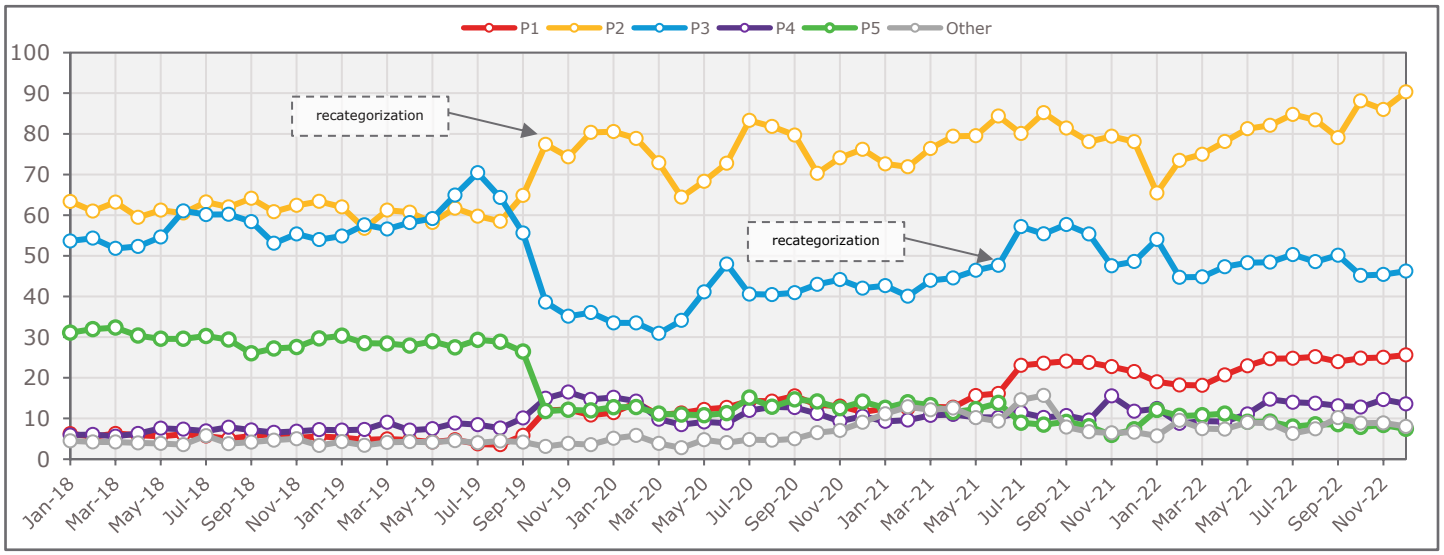
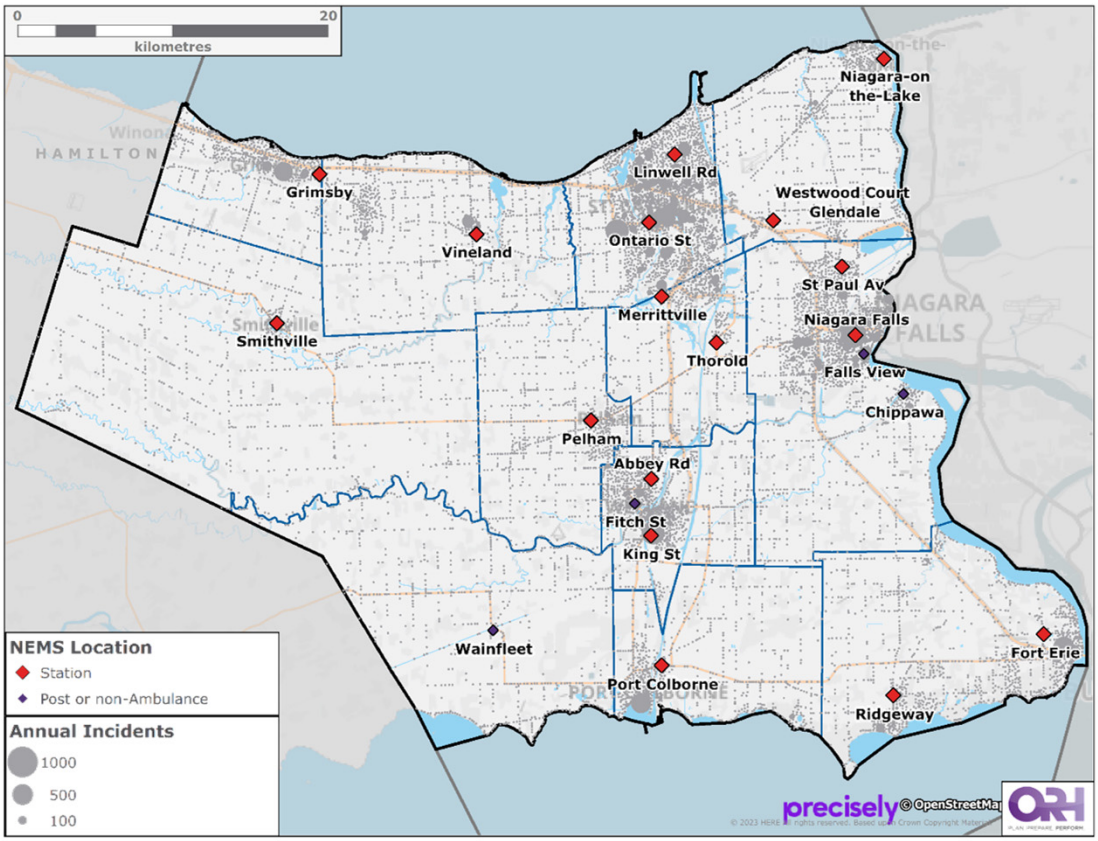


Figure 2-2: Priority 1 to 5 Demand by Municipality



Municipality	Daily Demand	% of Demand
Fort Erie	10.4	6.4%
Grimsby	6.7	4.2%
Lincoln	5.7	3.5%
Niagara Falls	36.5	22.5%
Niagara-On-The-Lake	5.4	3.3%
Pelham	3.5	2.2%
Port Colborne	6.9	4.3%
St Catharines	57.4	35.4%
Thorold	6.0	3.7%
Wainfleet	1.1	0.7%
Welland	19.9	12.3%
West Lincoln	2.3	1.4%
Out-of-Area	0.4	0.2%
Total	162.3	100.0%

2.8 This is equivalent to an 70% average conveyance rate for Priority 1 to 5, which varies by category and has reduced during the sample period (see Appendix **A3**). As is expected, the conveyance rate for Other patients is very low.

Call Components and Performance

2.9 ORH calculates each component of the incident cycle separately and analyzes these to understand how they may vary (see Figure **2-3**). Average occupied time for P1 to P5 incidents, measured from vehicle mobilized to clear, was around 87 minutes, with time at hospital accounting for 69 minutes of this on average.

2.10 Occupied time has generally increased across the sample period, from 86 minutes in 2018 to 98 minutes in 2022. Assignment times, time to scene and time at scene have all increased by more than 15 seconds year-on-year.

2.11 Time at hospital varies considerably across the five-year sample period (see Figure **2-4**), with most of this variation being attributed to the arrival to handover component. Across 2018 and 2019 time at hospital was relatively stable with an average of 64 minutes, however, in April 2020 this rapidly declined along with the number of patient journeys due to the initial stages of the COVID-19 pandemic. By the second half of 2021, patient journeys and time at hospital had increased back to pre-pandemic levels, with time at hospital continuing to increase and reaching an average of 96 minutes for 2022.

2.12 For P1 and P2 incidents, response times are measured from the time the vehicle is notified to the time the vehicle arrives at scene for the first vehicle arriving at scene. For P3 to P5 incidents, response times are measured from the time the call was answered. Across the sample, P1 and P2 response performance targets were close to being met[1] (see Figure **2-5**).

2.13 However, due to increasing demand and increasing time on task, P1 and P2 performance slowly declined from above target levels to below target levels over the course of 2021 and 2022 (see Appendix **A4**).

2.14 ORH also evaluated performance at station catchment level; station catchments are geographical boundaries which divide up Niagara Region into the areas which are closest to each station based on drive times (see Appendix **A5**). Niagara-on-the-Lake station catchment had the lowest P1 response performance (30%), and Ontario St station catchment had the highest (88%). The lower performance in Niagara-on-the-Lake is most likely a product of the vehicle (there is only one vehicle deployed here) being unavailable either on a call or having been moved elsewhere for coverage, and the area being isolated such that it cannot then be easily covered by other vehicles. Similar comments can be made about the Vineland station catchment.

[1] The P1 response target is 80% within 8 minutes. The P2 to P5 response targets are 90% within 15, 30, 60, and 120 minutes respectively.

Figure 2-3: Call Component Averages

Calculated for First Responding Vehicle to Priority 1 to 5 Incidents

Call Answered to Vehicle Assigned (Priority 1)	01:28			02:22		02:20
Vehicle Assigned to Mobilized	00:53	00:55	01:04	00:57	01:01	00:58
Time to Scene	08:58					09:50
Time at Scene	20:05					22:32
Time to Hospital	12:58	13:13	13:05	13:00		13:06
Arrival to Handover	52:00					55:30
Handover to Clear	13:45	13:39				12:57
Time at Hospital	65:20					68:32
Occupied Time (Mobilized to Clear)	85:31					87:07

Increase from previous year by 15seconds

Decrease from previous year by 15seconds

Figure 2-4: Time at Hospital Variation

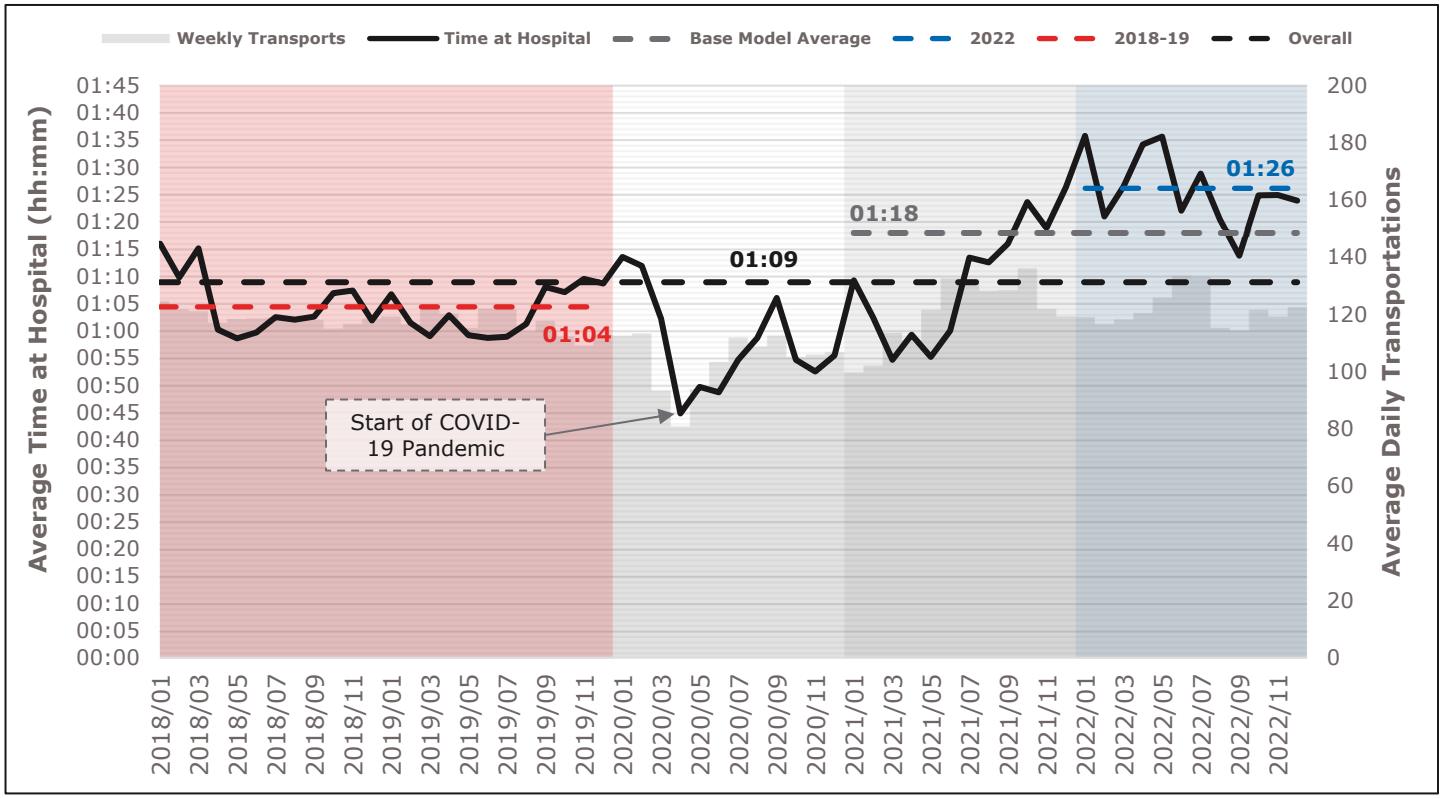
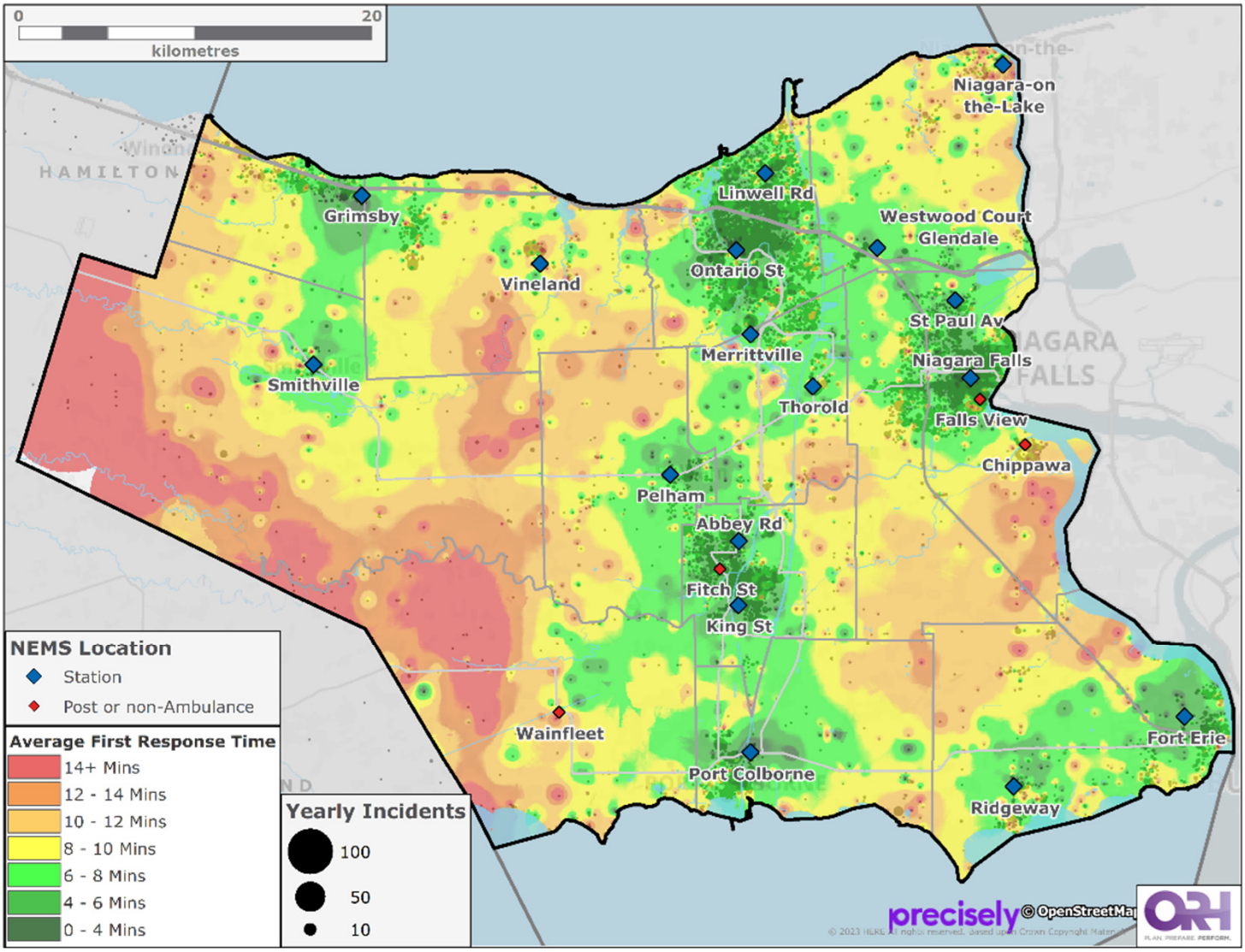


Figure 2-5: Performance Summary



Municipality	% within X Mins				
	P1 in 8	P2 in 15	P3 in 30	P4 in 60	P5 in 120
Fort Erie	71.7%	87.4%	82.9%	75.5%	96.6%
Grimsby	57.0%	89.6%	84.1%	79.0%	97.1%
Lincoln	50.4%	82.5%	82.4%	87.9%	97.6%
Niagara Falls	80.3%	91.8%	85.0%	84.7%	98.4%
Niagara-on-the-Lake	52.2%	77.4%	80.4%	83.2%	98.1%
Pelham	61.1%	86.1%	83.9%	88.8%	99.2%
Port Colborne	79.0%	90.9%	84.3%	71.2%	96.6%
St Catharines	86.3%	91.4%	84.9%	86.2%	98.3%
Thorold	66.1%	87.4%	85.7%	90.1%	98.8%
Wainfleet	26.6%	72.0%	82.8%	95.3%	98.9%
Welland	88.7%	92.9%	85.2%	81.7%	97.9%
West Lincoln	34.7%	75.8%	83.2%	89.4%	99.0%
Overall	**77.7%**	**89.8%**	**84.5%**	**82.7%**	**98.1%**

Target	**80%**	**90%**	**90%**	**90%**	**90%**

Resourcing and Resource Use

2.15 As of 2023, NEMS planned to deploy 4,704 ambulance (transport unit) hours per week, with a mix of Advanced Care Paramedic (ACP) and Primary Care Paramedic (PCP) led crews. MIH teams are also deployed, including a Community Paramedic (CP) for Wainfleet, the Falls Intervention Team (FIT), the Mental Health and Addictions Response Team (MHART), the Street Outreach team, the Palliative Care team, and the Community Assessment and Referral Team (CARE).

2.16 In 2021 and 2022 an average of 194 responses were undertaken by NEMS vehicles per day, which is equivalent to 1.1 responses per incident (see Appendix **A6**). As expected, for P1 to P5 incidents, the majority of responses are made by ambulances, and for the Other incidents by MIH teams.

2.17 Broadly the hourly profile of resource deployment aligns well with demand. There are, however, limitations as to how well NEMS can match demand levels since the collective agreement means the service only deploys 12-hour shifts, and a certain level of coverage must always be maintained, even in rural areas.

2.18 In evaluating the current use of resources, it is of interest to measure how well frontline resources are utilized. Utilization here is defined as the proportion of a vehicle's planned shift time that is spent responding and dealing with patient care (measured from time of mobilization to posting clear). This therefore excludes time spent on rest breaks, returning to base, and other duties such as completing paperwork.

2.19 Average ambulance utilization for 2021 and 2022 was 42%. Ambulance utilization reaches its highest level of just under 50% from around 11:00 and stays at approximately this level until around 15:00 (see Appendix **A7**); this is slightly later than the peak in demand. After this, utilization starts to reduce until a secondary peak of approximately 45% between 20:00 and 22:00.

2.20 The most common reason for ambulance unavailability for 2021 and 2022 was meal breaks, which are equivalent to an average unavailability of 30 minutes per vehicle per shift, or approximately 30 hours per day in total (see Appendix **A8**). NEMS plans to put out 630 ambulance vehicle hours per day, so this is equivalent to approximately 5% of the potentially available hours in the day.

2.21 There is also an average of 20 hours per day unavailability due to end of shift unavailability (23 minutes per occurrence), 18 hours of vehicle service[2] unavailability (10 minutes per occurrence), 13 hours of out of service unavailability (47 minutes per occurrence), and 13 hours of shift start unavailability (15 minutes per occurrence). The remaining reasons each only account for under 10 hours per day of unavailability.

[2] Vehicle service unavailability is applied after completion of transfer of care unless the crew indicates they are immediately ready to respond, followed by a further 10 minutes of stretcher clear time.

Facility Analysis

2.22 ORH conducted a review of the Region's EMS facilities and evaluated metrics such as:

- Age and condition: construction year, last major refurbishment year, condition rating
- Value and costs: land value, building value, net rental, expected remedial costs
- Size: land size, building size, number of floors, number of bays and their current usage, ability for expansion
- Location: local area response times, demand coverage, population coverage
- Tenure: freehold/leasehold, lease end date (if applicable), owner
- Access/egress: access to highways and service roads
- Resources: number of staff and number of vehicles allocated to the station
- Utilization: staff, bay, and vehicle utilization rates
- Amenities and support spaces: types and sizes of amenities (toilets, kitchen, offices, etc)
- Inventory: current requirements, wastage

2.23 The key findings are summarized in Figure **2-6** and discussed in more detail below. The facilities that have concerns in multiple areas, and are therefore deemed to be the highest risk, are Abbey Rd, Niagara Falls, St Paul Av, Niagara-on-the-Lake, Grimsby and Vineland.

2.24 Response performance by municipality and station catchment has already been discussed in an earlier sub-section. However, poorer response performance is not necessarily always directly related to the facility location, as it may instead be related to insufficient resource availability even if a facility is well located. ORH has therefore also calculated the station 'coverage' by station catchment. Coverage is calculated as the percentage of incidents within a station's catchment that are within a certain drive time of the station, under the assumption that a vehicle would always be available at the nearest station.

2.25 The majority of facilities can provide 5-minute drive time coverage for more than 60% of the incidents within their catchment; the higher the percentage, the more well located a facility is within its local area. The lowest performing stations in catchment terms are Grimsby, Merrittville, Niagara-on-the-Lake, Smithville, and Glendale. For example, the Grimsby facility can only reach 41% of incidents in its catchment within 5 minutes.

Figure 2-6: Facility Analysis Summary

Risk Type	Measure	Abbey Rd	Fitch St	Glendale	King St	Niagara Falls	Niagara-on-the-Lake	St Paul Av	Thorold	Vineland	Westwood Court	Fort Erie	Grimsby	Linwell Rd	Merrittville	Ontario St	Pelham	Port Colborne	Ridgeway	Smithville
Location & Coverage	P1 to P5 5-minute Coverage in Catchment	82%	Not included in Catchment Analysis	55%	85%	64%	52%	73%	79%	75%	Not included in Catchment Analysis	81%	41%	82%	51%	80%	67%	62%	74%	52%
	P1 8-minute Performance in Catchment	82%		74%	84%	78%	30%	74%	54%	36%		73%	56%	78%	70%	88%	60%	75%	53%	34%
	Co-Location			Fleet	Hospital Site	Hospital Site			Firehall	Firehall	Glendale	Police			Region HQ	Training Space	Water Tower			
	Other Access Issues	Bay Doors	Within Plaza				Parks Land										Firehall			
	Region's Location Rating																			
Call Components	Time to Scene	09:31	Not included in Catchment Analysis	09:37	09:03	09:19	13:17	09:33	10:40	12:36	Not included in Catchment Analysis	10:15	10:26	10:27	10:13	08:52	10:36	10:08	10:56	11:39
	Time to Hospital	10:04		14:40	11:05	09:46	24:54:00	10:21	14:53	15:34		23:36	12:14	13:18	13:01	11:04	16:20	16:45	25:44	20:07
	Time at Hospital	67:47		69:40	62:05	61:40	69:31	65:18	67:12	70:00		57:13	48:39	86:59	80:03	77:31	70:10	61:25	57:14	45:19
Condition & Capacity	Region's Condition Rating																			
	Capacity (Ambulance Bays)	2	7	2	4	4	2	1	2	1	16	4	2	2	3	4	2	3	2	2
	Peak Vehicles	1	0	1	2	4	1	1	2	1	-	3	2	2	3	3	2	3	2	1
	Potential for Expansion																			
	Inventory	Janitorial	Bi-weekly	Bi-weekly	Weekly	Weekly	Bi-weekly	Janitorial	Bi-weekly	Janitorial		Weekly	Weekly + Hosp Stock	Bi-weekly	Bi-weekly	Weekly	Bi-weekly	Bi-weekly	Bi-weekly	Bi-weekly
Lease Details	Lease Expiry	Jun-24	Jul-26	Jul-25	Dec-24	Dec-24	Dec-21	Jun-25	Dec-23	Apr-24	Feb-25	-	-	-	-	-	-	-	-	-
	Region's Termination Clause Rating																			
	Region's Landlord & Option to Negotiate Rating																			
Cost	2022 Operating Costs / sqf	$20.52	$9.88	$15.58	$5.60	$5.63	$8.04	$18.70	$3.61	$13.24	$15.58	$8.51	$11.28	$13.43	$8.91	$5.49	$6.38	$3.56	$6.40	$6.46
	Current Annual Rent / sqf	$14.40	$16.13	$7.96	$0.00	$0.00	$0.00	$12.31	$0.00	$16.98	$7.96	-	-	-	-	-	-	-	-	-
	Region's Operational Costs Rating																			
	Region's Capital Costs Rating																			
	Region's Lease Cost Rating																			

Notes:

Fitch St and Westwood Court excluded from Catchment and Call Component calculations (as no ambulances deployed here)

Coverage calculated based on drive times assuming vehicle available at station

Region's Location Rating 1: in the perfect location for call volume and regional coverage, 2: meets regional and call volume with minor issues (i.e. egress), 3: location does meet regional coverage meets call volume, 4: location does not meet call volume meets regional coverage, 5: location does not meet call volume and regional coverage

Call Component calculations are averages for incidents occurring within the station catchment (the station is not necessarily the one responding)

Region's Condition Rating 1: No issues or new, 2: "Good": FCI <5%, 3: "Fair": FCI ≥5%-<10,: "Poor": ≥10%-<30%, 5: "Critical": FCI ≥30%

Lease Expiry/Term End varied slightly between data sources

Region's Termination Clause Rating 1: Tenant has option to terminate; Landlord does not have option to terminate, 2: If EMS exercises, provide less than 6 months notice. Tenant and Landlord both have an option to terminate., 3: Tenant and Landlord have an option to terminate upon 6 months notice., 4: If Landlord exercises, provide less than 6 months notice. Tenant and Landlord both have an option to terminate., 5: Only Landlord has option to terminate; or, Tenant does not have an option to terminate.

Region's Landlord & Option to Negotiate Rating 1: Auto renewal, 2: Good landlord; favourable terms with previous negotiations, 3: Adequate landlord; mostly favourable terms with previous negotiations, 4: Difficult landlord; unfavourable terms with previous negotiations, 5: None

Square footage varied depending on data source (used the source that had calculated Operating Costs / sqf)

Region's Operational Costs Rating 1: $0 to $5/SF, **2**: $5.01 to $10/SF, **3**: $10.01 to $15/SF, 4: $15.01 to $20/SF, 5: $20.01 and up

Region's Capital Costs Rating 1: The Landlord is responsible for all capital repairs and replacement costs, 2: The Niagara Region is responsible for roof, HVAC and electrical repair costs, but not replacement., 3: The Niagara Region is responsible for some or part of capital replacement costs through Common Area Maint., 4: The Niagara Region is responsible for HVAC & Electrical replacement and repair costs., 5: The Niagara Region is responsible for all capital replacements costs.

Region's Lease Cost Rating 1: Nominal Rent or no cost; Decrease of rental rate, 2: Insignificant increase being less than CPI (2021 CPI=2.4%), 3: CPI increase 2.4% and ≤5% increase, 4: >5% increase and ≤20% increase, 5: >20% increase

2.26 In addition, several of the facilities have other access issues. For example, at Abbey Rd the bay doors are only just wide enough for ambulances to fit through (side mirrors have to be folded inwards), there is a firehall between the facility at Pelham and the main access road, and the Niagara-on-the-Lake facility has access via Parks Canada land.

2.27 Generally, the nine owned facilities are in a better condition than the ten leased facilities, except for Fitch St and Glendale leased facilities. Abbey Rd and Niagara-on-the-Lake are in a particularly poor condition, with King St, Niagara Falls, St Paul Av, and Smithville also in a relatively poor condition.

2.28 Almost all the facilities in the Region have no spare capacity when comparing the number of ambulance bays and the number of peak ambulances from the planned deployments. Even when there appear to be spare bays (for example, where the capacity is greater than the peak ambulances), these are often being used to store spare ambulances (to help manage incidences of vehicle unavailability) or for other vehicles (for example, admin or supervisor vehicles).

2.29 This means that, under a traditional facilities model, it will not be possible to deploy additional resources when required without new or expanded facilities in the future. There is a particular concern for the Niagara Falls, Grimsby, and Lincoln municipalities as there is currently no spare capacity at any of the stations in these areas (Niagara Falls, St Paul Av, Grimsby, and Vineland). Pelham and Port Colborne municipalities also have no spare capacity.

2.30 Even if spare bays exist to deploy ambulances from in the future, there are several facilities that are already fully utilizing the existing crew quarter space: Abbey Rd, St Paul Av, Ontario St, Thorold, and Vineland. In addition, Abbey Rd, St Paul Av, and Vineland only have inventory storage space for janitorial items.

2.31 With inventory supplies needing to be delivered to 17 distinct facilities (excluding Glendale and Westwood Court) and three hospitals (excluding West Lincoln Memorial Hospital), significant logistics travel is generated. Maintaining the required supplies at every facility also leads to waste as a result of products expiring.

2.32 Of the nine owned facilities, only two (Fort Erie and Merrittville) have a high potential for expansion. The remaining facilities, including Grimsby and Port Colborne, have medium or low potential for expansion. While coverage analysis indicates that Ontario St and Linwell Rd in St Catharines are well located, there is limited scope to add ambulances in this area in the future under a traditional facilities model.

2.33 Ten out of 19 of the Region's EMS response facilities are leased, which leaves the Region open to inherent risk. The facility that houses administration, dispatch, dispatch training and quality assurance (QA) is also leased and due to expire in 2024.

2.34 With the exception of Fitch St, all leases are due to expire by 2025. If leases are renewed or renegotiated and have similar conditions to the existing leases, then six of the ten leases have no option for the Region to terminate (Abbey Rd, Glendale, King St, Niagara Falls, Vineland, and Westwood Court). In general, this gives the Region limited flexibility in the future to terminate if a better alternative location was found, while the landlord has the option to terminate the lease at their discretion.

2.35 For the Niagara-on-the-Lake facility, the municipality has already indicated that they would like EMS to vacate. Similarly, Niagara Falls will need to be vacated due to the future closure of the Niagara Health hospital site.

2.36 The facilities with the highest operating costs per square foot (based on 2022 data) are Abbey Rd and St Paul Av. The facilities with the highest annual rental costs per square foot (based on current rent) are Abbey Rd, Fitch St, and Vineland.

2.37 In addition, at Abbey Rd, St Paul Av and Vineland, the Region is responsible for all capital replacement costs.

3 PREDICTIVE MODELLING INTRODUCTION

ORH uses sophisticated predictive modelling tools that have been developed in-house to assist with the development of master plans for paramedic services.

ORH validated its EMS simulation model, AmbSim, against analyzed NEMS performance, utilization and hospital flows, which showed that the model replicated historical operations accurately and therefore was appropriate to use for different 'what if' modelling scenarios. A 2023 Base Position was then created to provide a basis for comparison with future scenarios.

Predictive Modelling Capabilities

Simulation

3.1 ORH has developed a sophisticated simulation model, AmbSim, for modelling the operations of emergency medical services. AmbSim is a discrete event simulation model that replicates the key characteristics of an emergency medical service and can be used to predict future behaviour under a variety of different scenarios when run by ORH's experienced modelling consultants.

3.2 AmbSim can be described as 'off-the-shelf', as it has been developed by ORH and is used both by ORH and our clients. It does, however, require customization to reflect the geography, demand and operations of the service in which it is to be used.

3.3 Once customized and validated, AmbSim can provide evidence-based answers to a wide range of 'what if' questions. The model can assess the impact of changes to several factors, such as station locations and resource deployments, dispatch protocols and resource use, or demand increases or decreases. AmbSim reports operational performance in terms of response times, resource workload and utilization. It can simulate multiple vehicle types and incident types with specified response rules.

Location Optimization

3.4 ORH can also utilize 'Auto Add' functionality within the Demand Coverage Model (DCM), a powerful model that evaluates response time coverage and optimizes the locations of emergency service resources. Auto Add uses a substitution algorithm to assess millions of options in minutes, quickly identifying optimum solutions. The optimization criteria are carefully agreed with the client to ensure that solutions meet an individual client's needs.

3.5 DCM is a flexible model, ideally suited to identifying the scope for operational efficiencies, improving service delivery, and optimizing the use of resources. Only travel time to incidents is accounted for in the optimization process; the exact impact of changing resource deployments within a changed station configuration is therefore fully evaluated in AmbSim to check that optimal locations deliver service improvements.

Predictive Model Setup and Base Position

3.6 A virtual replica of NEMS operations was created within AmbSim by populating inputs using parameters derived from the analysis referenced in Section 2. In addition to this data, ORH developed a detailed travel time model of the Region using commercially available data calibrated against information on journey times from activity data.

3.7 The model was validated by comparing a wide range of outputs from the model, such as response performance, vehicle workload (utilization) and hospital workload, to the corresponding analyzed figures for these factors based on actual data (see an examples in Figure **3-1** and Appendix **B**). The comparison of outputs, including others not listed here, showed that the model replicated historical operations accurately and therefore was appropriate to use for different 'what if' modelling scenarios.

3.8 The model was initially set up to reflect NEMS operations during the 2021 to 2022 sample period to provide a robust sample for model validation; however, it was then possible to switch to a more up-to-date Base Position for 2023.

3.9 In line with projections, demand was uplifted slightly in the model and the vehicle shift pattern was updated to reflect the latest 2023 position. In addition, the Fort Erie and Port Colborne Urgent Care Centres (UCCs) were permanently closed as EMS destinations. All other model parameters were assumed to remain at analyzed levels, although variations to this assumption have been tested through sensitivity modelling in Section 9.

3.10 In the Base Position, P1 8-minute response performance, when measured from time assigned, was 78.9%, just shy of the 80% target (see Figure **3-2**). P1 performance varies by municipality, with:

- Niagara Falls, Port Colborne, St Catharines, and Welland achieving over 80% in 8 minutes
- Fort Erie and Pelham achieving over 70% in 8 minutes
- Thorold achieving over 60% in 8 minutes
- Grimsby and Niagara-on-the-Lake achieving over 50% in 8 minutes
- Lincoln, Wainfleet and West Lincoln achieving under 50% in 8 minutes

Figure 3-1: Model Validation Example, Response Performance

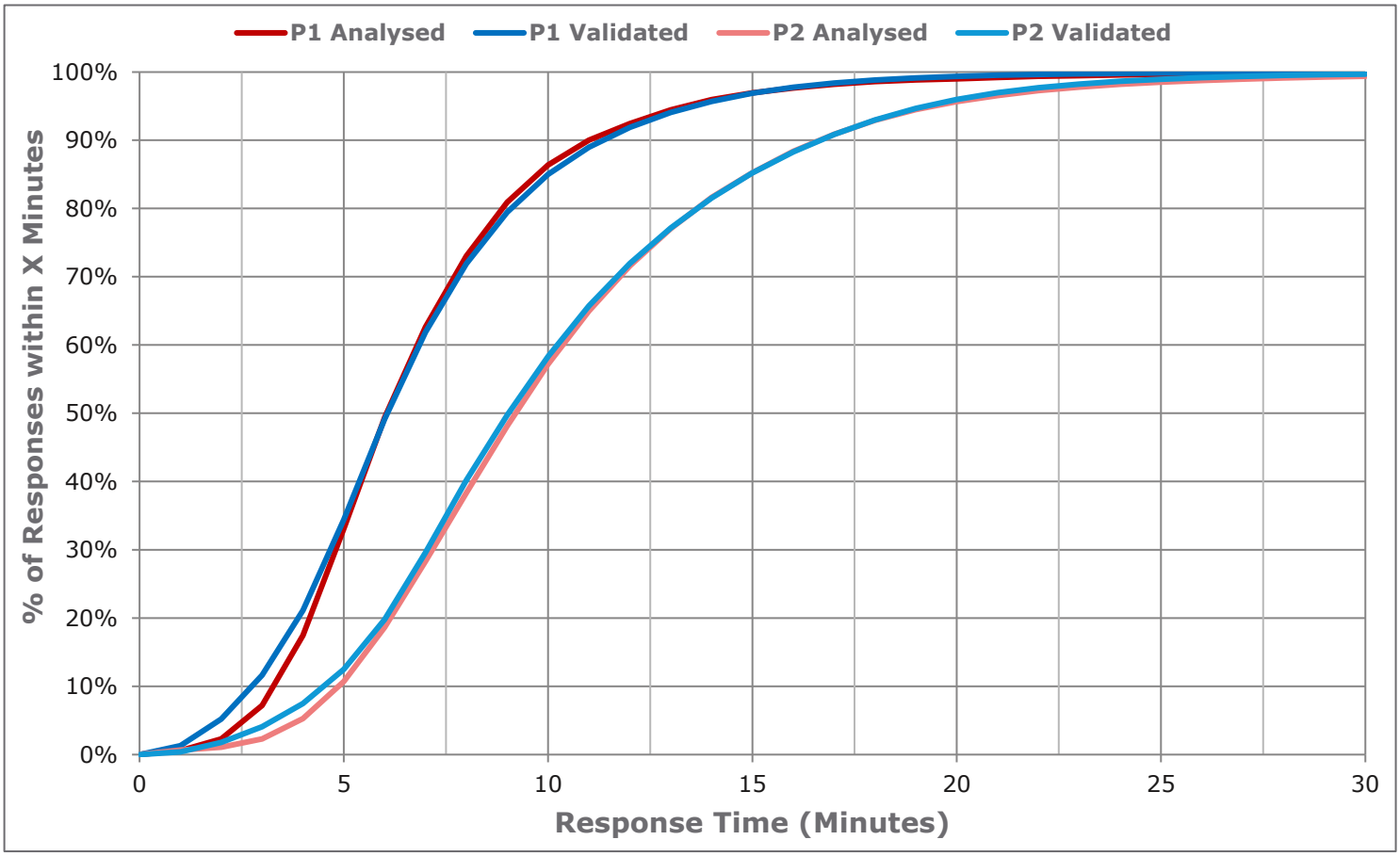


Figure 3-2: 2023 Base Position Response Performance

Municipality	P1 8-minute	P2 15-minute	P3 30-minute	P4 60-minute	P5 120-minute	P1 Mean	P2 Mean
Fort Erie	73.4%	86.8%	80.1%	81.1%	96.0%	07:04	09:49
Grimsby	58.4%	91.2%	80.0%	82.4%	94.2%	07:41	09:06
Lincoln	46.0%	76.7%	76.0%	88.7%	95.7%	08:55	11:25
Niagara Falls	81.5%	91.9%	80.2%	86.6%	97.1%	05:58	09:07
Niagara-on-the-Lake	51.8%	73.6%	76.5%	82.4%	95.6%	08:17	11:57
Pelham	72.1%	87.8%	83.6%	90.7%	98.5%	06:31	09:27
Port Colborne	82.1%	90.1%	81.7%	78.5%	97.4%	06:06	09:04
St Catharines	86.6%	92.3%	80.7%	85.8%	96.3%	05:36	09:02
Thorold	68.6%	88.3%	78.7%	89.7%	97.4%	07:01	10:05
Wainfleet	28.7%	70.8%	78.1%	98.5%	97.8%	10:43	12:31
Welland	93.7%	94.0%	86.2%	86.4%	97.3%	05:00	08:02
West Lincoln	49.1%	79.9%	81.9%	90.8%	99.5%	08:31	09:49
Overall	**78.9%**	**90.0%**	**80.8%**	**85.2%**	**96.6%**	**06:14**	**09:18**
Target	**80%**	**90%**	**90%**	**90%**	**90%**	**-**	**-**

4 THE 'DO NOTHING' SCENARIO

To understand facility and resource requirements for the next ten years, a demand projection was required. Demand projections were created using a population-based projection method with the underlying hypothesis that demand is strongly related to the population age profile.

Total population for Niagara Region is expected to reach 589,000 by 2033, an increase of 15% from 2023. The population is projected to continue to age during this period. For example, the percentage of the population aged 65 and over is 23% in 2023 compared to 26% in 2033.

The predicted increasing and ageing population, coupled with increasing demand rates, suggests that demand on NEMS will continue to increase significantly to 2033. P1 to P5 demand in Niagara Region is expected to increase by 40% between 2023 and 2033, from 179 incidents per day to 242 incidents per day. This equates to a 3% increase year-on-year Region-wide.

To highlight the impact on performance if no investment is made to NEMS frontline operations, the demand projections were applied to the Base Position in AmbSim. No other operational changes were made (a 'Do Nothing' scenario).

In this scenario, P1 8-minute response performance for Niagara Region falls significantly from 79% in 2023 to 71% in 2033, well below target levels.

Demand Projections

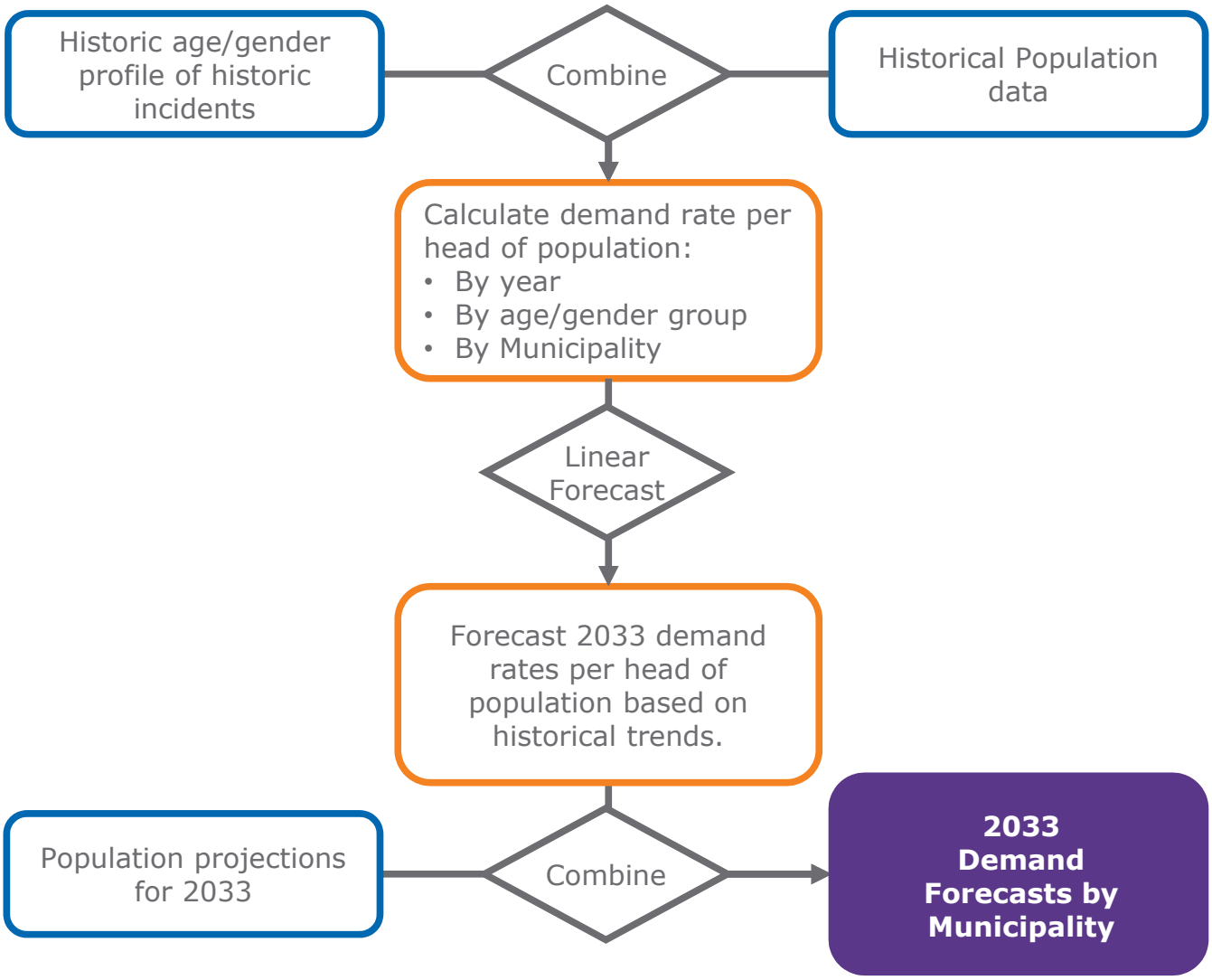
Methodology

4.1 To understand facility and resource requirements for the next ten years, a demand projection was required.

4.2 Demand projections were created using a population-based projection method (see Figure **4-1**). This method is based on the hypothesis that demand is strongly related to the population age profile and that there is an underlying trend for increased demand at all age groups due to unquantifiable factors such as the overall level of health provision and public expectation, which, it is assumed, will continue into the foreseeable future.

4.3 Historical population is compared with historical demand to calculate demand rates per head of population for different age and area combinations. These are then investigated to understand how they have changed over time and combined with future population projections to calculate expected future demand levels. This method captures three factors that impact demand:

Figure 4-1: Population-based Projection Method



- Changes to the population size
- Changes to the age profile of the population
- Changes to the base demand rates per head of population

Population

4.4 Population figures by year, age, and municipality for each year from 2013 to 2033 were required to feed into the demand projection calculation. ORH was provided with several datasets regarding the historical and projected population of Niagara Region (see Appendix **C1**); no single dataset contained every element required.

4.5 In agreement with the Steering Committee, the Ministry of Health (MoH) historical data was used for 2013 to 2021, and Ministry of Finance (MoF) projection data was used for 2022 to 2033. Given that the MoF data was only given for Niagara Region as a whole, the MoH data was used to generate assumptions for breaking down the data by municipality; it was assumed that each age group could be broken down by municipality according to the proportions observed from 2021. This was agreed to be a sensible approach given that the proportions had not changed significantly between 2013 and 2021.

4.6 Population in 2013 was around 447,000 across Niagara Region, increasing to 510,000 by 2023 (a 14% increase over 10 years), and to 589,000 by 2033 (a further 15% increase over 10 years). The population is projected to continue to age between 2023 and 2033 (see Figure **4-2**). For example, the percentage of the population aged 65 and over is 23% in 2023 compared to 26% in 2033.

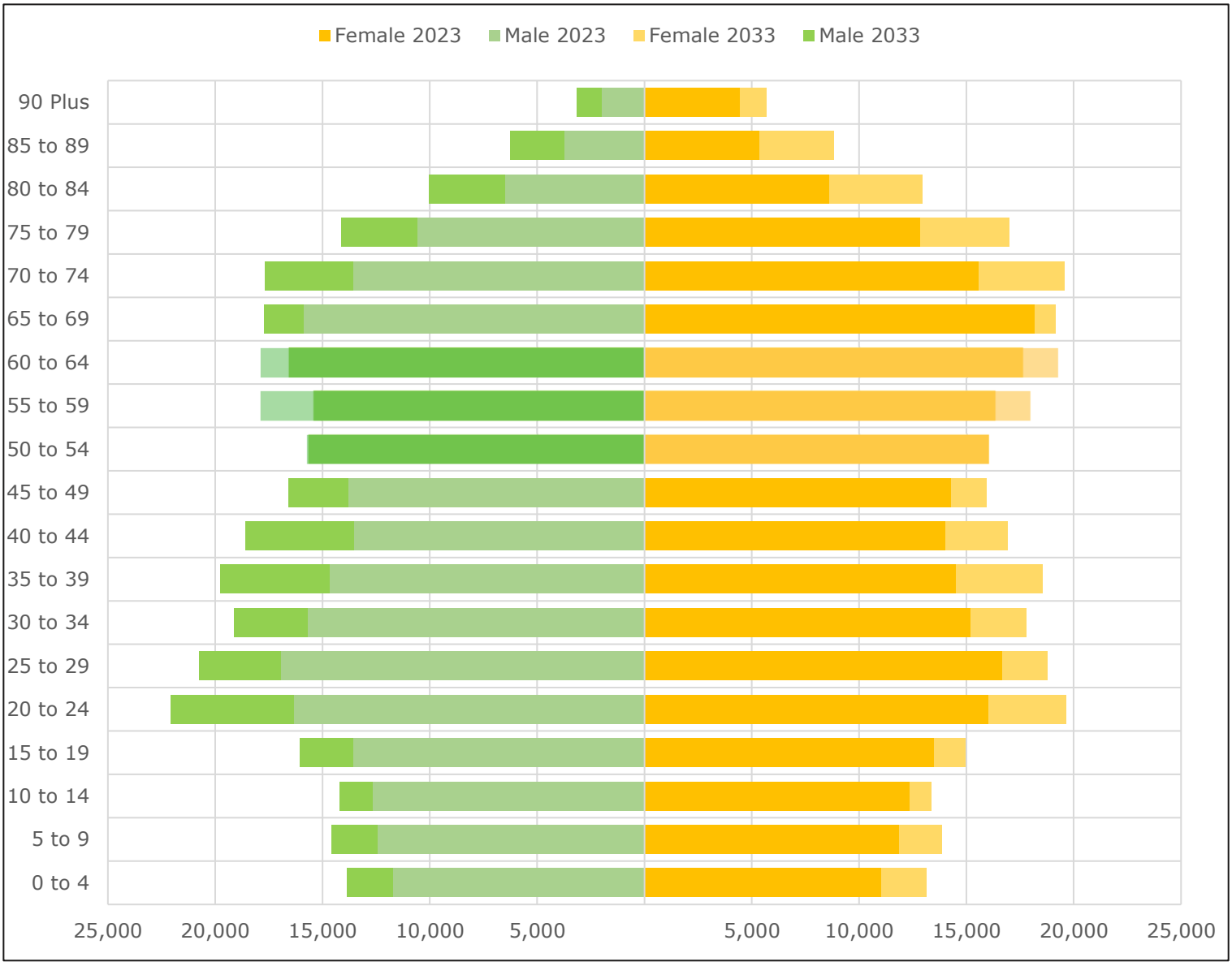
4.7 Traffic zone population projections were also supplied directly by Niagara Region for 2021 and 2031. The traffic zones sub-divide the municipalities, and this data gave further insight into which areas within each municipality were likely to grow the most over the next ten years (see Appendix **C2**).

Demand

4.8 Historical demand figures by year, age, and municipality for each year from 2013 to 2022 were also required to feed into the demand projection calculation. However, this could only be collected as far back as 2018.

4.9 There is a clear correlation between age and demand, with the older age groups generating the most incidents. As a result, when comparing historical population and historical demand, demand rates per 1,000 population are substantially higher for the '80+' age group than for other age groups (see Appendix **C3**). Demand rates in each age group have generally followed an upward trend and are therefore predicted to increase again between 2023 and 2033.

Figure 4-2: Population Pyramid, 2023 vs 2033



Year	Male	Female	Overall
2023	244,991	257,729	502,720
2033	292,263	296,255	588,518

4.10 The predicted increasing and ageing in population, coupled with increasing demand rates, suggests that demand on NEMS will continue to increase significantly to 2033. Although there was a slight dip in the number of incidents NEMS responded to in 2020 due to COVID-19, this is not expected to impact the onward projections.

4.11 P1 to P5 demand in Niagara Region is expected to increase by 40% between 2023 and 2033, from 179 incidents per day to 242 incidents per day (see Appendix **C4**). This equates to a 3% increase year-on-year Region-wide, with some variation by municipality.

4.12 The projected increases were first applied to each municipality as a whole, and then redistributed to align with the additional traffic zone projection profiles (see Figure **4-3**).

Response Performance Impacts

4.13 To provide meaningful context for future resource recommendations, it was important to model a 'do nothing' scenario through to 2033. This helps to highlight the impact on performance if no investment is made to NEMS frontline operations. The demand projections were therefore applied to the Base Position in AmbSim, and no other operational changes were made.

4.14 In this 'do nothing' scenario, P1 8-minute response performance for Niagara Region falls significantly from 79% in 2023 to 71% in 2033, well below the target of 80% (see Figure **4-4** and Appendix **C5**). Similarly, P2 15-minute response performance falls from 90% in 2023 to 79% in 2033. The lower priority categories fall even further.

4.15 Clearly there will be frontline resource investments required by 2033 to offset the demand increases and, at a minimum, maintain current response performance levels.

Figure 4-3: Demand Projection Distribution

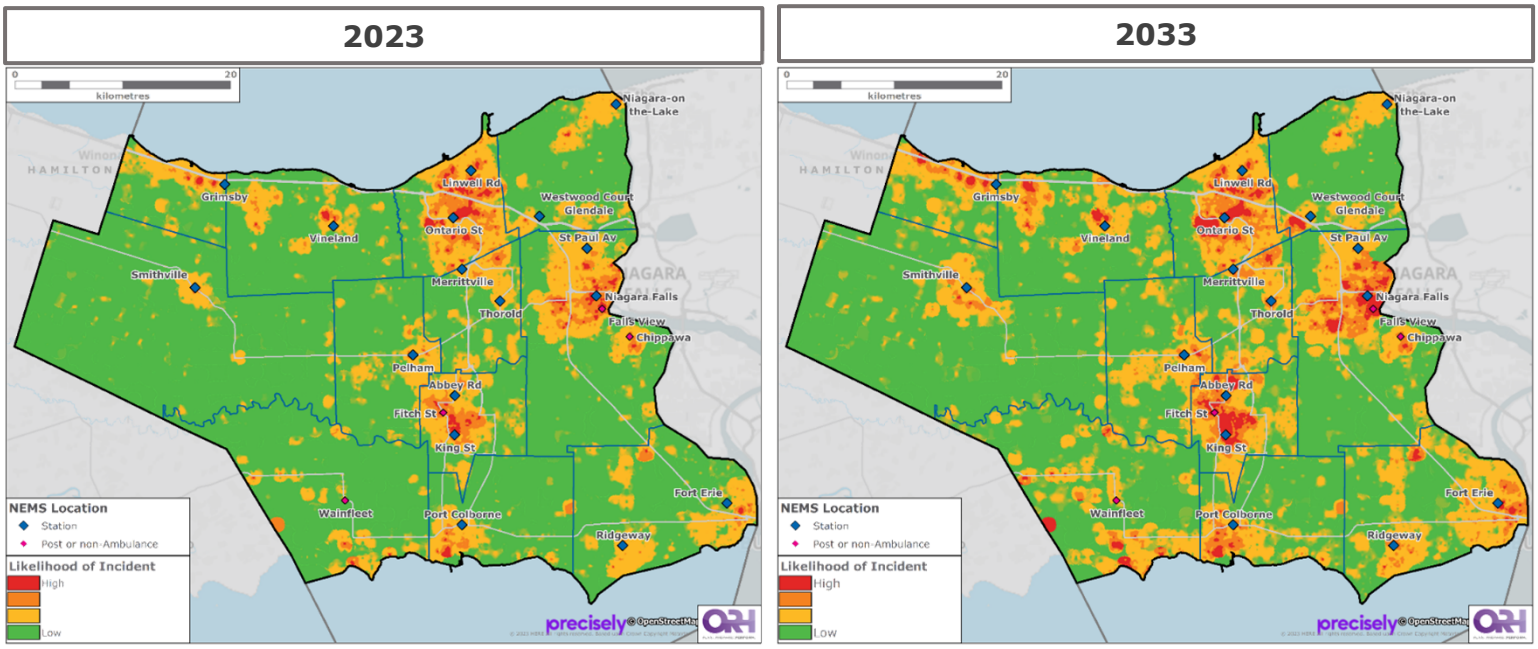
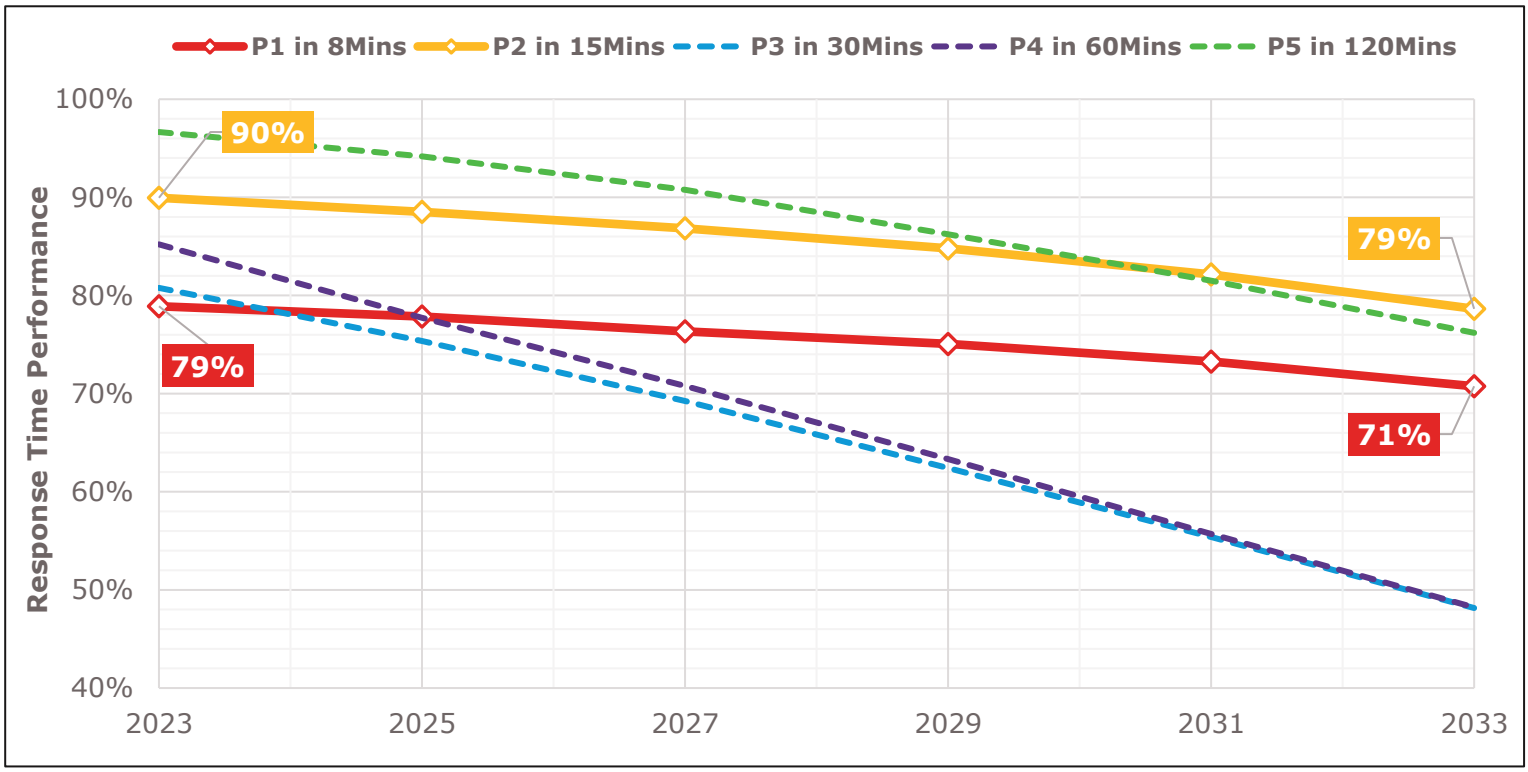


Figure 4-4: Performance under 'Do Nothing' Scenario



Measure	2023	2025	2027	2029	2031	2033
P1 in 8Mins	78.9%	77.9%	76.3%	75.1%	73.3%	70.8%
P2 in 15Mins	90.0%	88.5%	86.8%	84.8%	82.1%	78.6%
P3 in 30Mins	80.8%	75.4%	69.2%	62.4%	55.4%	48.2%
P4 in 60Mins	85.2%	77.7%	70.8%	63.3%	55.7%	48.2%
P5 in 120Mins	96.6%	94.2%	90.8%	86.2%	81.5%	76.2%

Note: Priority 1 to 2 response time performance measured from time first vehicle assigned, Priority 3 to 5 measured from time of call

5 IDENTIFYING OPTIMAL FACILITY LOCATIONS

The main aims of the facility optimization were to identify facility locations that would best improve equity of coverage across Niagara Region and/or resolve existing facility issues (for example, lack of spare capacity for the future, condition risks, or lease risks).

It is important to note that, whether facilities are to be utilized as traditional stations or as posts under a hub, spoke and post model, this does not meaningfully impact the location optimization process.

Following a highly iterative process, supported with input from the Steering Committee, the location optimization outcomes were as follows (see map in Figure **5-2**):

- Ten facilities were identified as being already optimally located, or not worth moving to a slightly more optimal location
- Two facilities were recommended to be moved to a new optimal location: Abbey Rd and Port Colborne
- Glendale and Niagara-on-the-Lake resources are recommended to be consolidated to a single facility near Virgil
- Grimsby resources are recommended to be divided between two new facilities, one in Beamsville and one more centrally located within Grimsby
- Niagara Falls/St Paul Av resources are recommended to be divided between three new facilities in the municipality

Approach

5.1 ORH's location optimization model was used to assess the configuration of existing station locations and identify how this could be improved currently and in the future. The main aims of the facility optimization were to identify facility locations that would best improve equity of coverage across Niagara Region and/or resolve existing facility issues (for example, lack of spare capacity for the future, condition risks, or lease risks).

5.2 Exploratory runs were undertaking using a 'blank canvas' optimization methodology, which involves identifying ideal locations taking no account of where current stations are located or other constraints. These runs were undertaken against a range of criteria, for example:

- Demand = P1, P2, or both P1 and P2
- Time Criteria = minimizing average travel time, or maximizing the percentage of incidents within X minutes travel time
- Number of Stations = initially keeping the same number of facilities, then testing areas that are identified with more or fewer facilities

5.3 The results of the exploratory scenarios were reviewed with the Steering Committee and used to identify targeted iterations of scenarios to test; initially, in the Base Position in AmbSim to understand the full response performance impacts (see examples of options considered in Figure **5-1**).

5.4 It is important to note that, whether facilities are to be utilized as traditional stations or as posts under a hub, spoke and post model, this does not meaningfully impact the location optimization process. The optimization process identifies suitable locations for crews to respond from, regardless of the type of location. The vehicle and capacity requirements, and response performance outcomes, of the differing facility models will be explored further in Sections 6 and 7.

Outcomes

5.5 Following this iterative process, the location optimization outcomes were as follows (see map in Figure **5-2**):

- Ten facilities were identified as being already optimally located, or not worth moving to a slightly more optimal location: Fort Erie, King St, Linwell Rd, Merrittville, Ontario St, Pelham, Ridgeway, Smithville, Thorold and Vineland
- Two facilities are recommended to be moved to a new optimal location: Abbey Rd and Port Colborne
- Glendale and Niagara-on-the-Lake resources are recommended to be consolidated to a single facility near Virgil (with MIH teams remaining at Westwood Court)
- Grimsby resources are recommended to be divided between two new facilities, one in Beamsville and one more centrally located within Grimsby
- Niagara Falls/St Paul Av resources are recommended to be divided between three new facilities in the municipality

5.6 Each of these outcomes are discussed in more detail below.

Figure 5-1: Examples of Exploratory Optimization Results

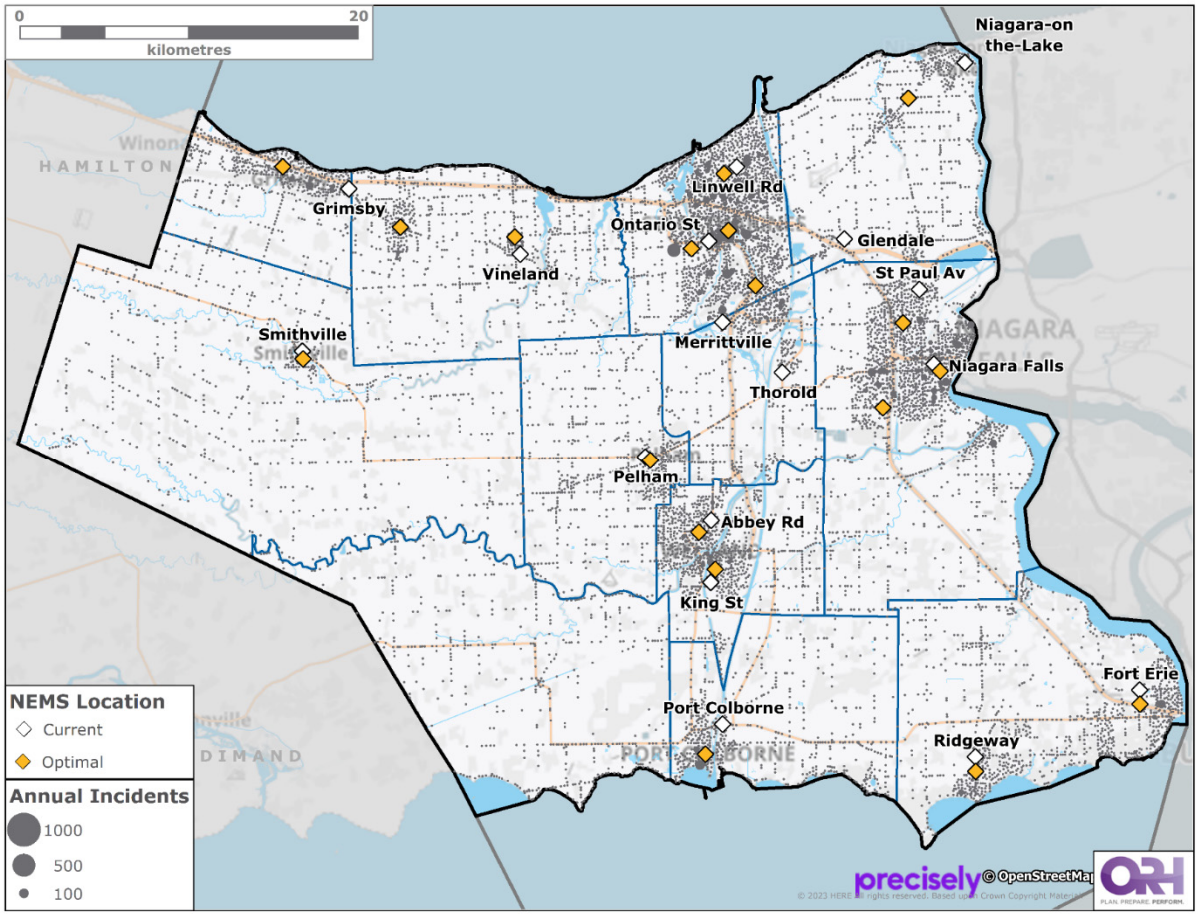
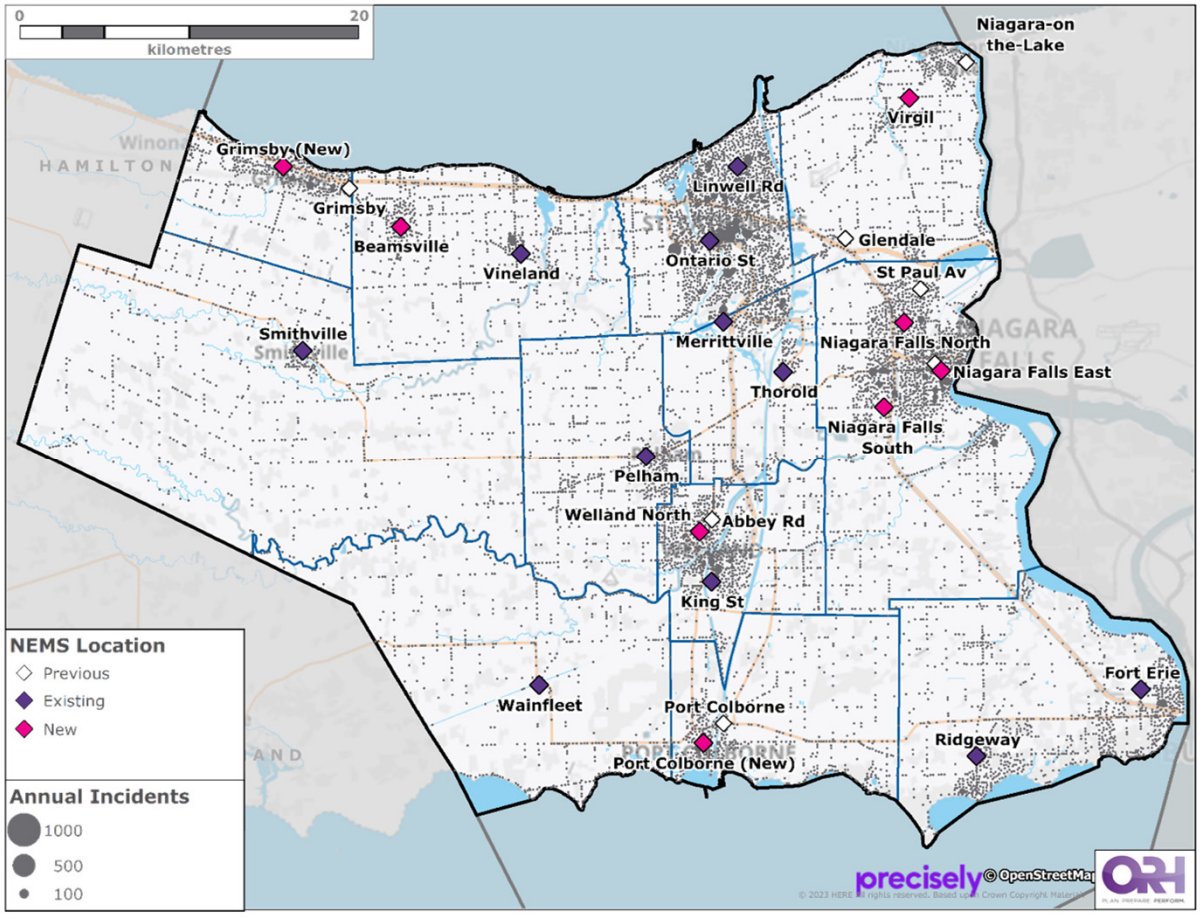


Figure 5-2: Recommended Facility Configuration



Niagara-on-the-Lake

5.7 A single optimal site was consistently found for Niagara-on-the-Lake, at approximately East & West Ln and Niagara Stone Rd. Modelling in AmbSim showed that there would be benefits to consolidating resources from both Niagara-on-the-Lake and Glendale at this site. The optimal location gives better coverage to Virgil while still providing good access to the old town.

5.8 In addition, the existing Niagara-on-the-Lake facility is leased and in poor condition, and the municipality would ideally like NEMS to vacate this site. If the Glendale resource was also consolidated at the optimal site, this would free up some additional space (possibly to be utilized by supervisors) at Westwood Court.

5.9 There may be land available to Niagara Region at Anderson Ln (approximately 3km northeast of the optimal site) that could be utilized for a new facility; this site has been tested as part of the sensitivity modelling scenarios covered in Section 9.

5.10 Some other potential sites, for example south of Virgil, were tested as an alternative to the optimal site, but were rejected as they led to poor performance outcomes.

Grimsby, Lincoln and West Lincoln

5.11 Optimal sites were found close to the existing Smithville and Vineland facilities, and testing within AmbSim found that the response performance improvements were not significant enough to warrant relocating either facility. While there are potential condition and capacity concerns at both sites, these are not as pressing as for some other facilities. The Vineland location is shared with Lincoln Fire Rescue, who may vacate the facility, giving EMS the potential opportunity to alleviate capacity issue here in the future.

5.12 The optimization results consistently proposed dividing the existing Grimsby into two facilities, one in Grimsby (at approximately Clarke St and Christie St) and another in Beamsville (at approximately King St and Ontario St). AmbSim modelling confirmed that there would be significant response performance improvements if a two-site configuration was utilized. There is already no spare bay capacity and the predictive modelling confirmed that it would be difficult to meaningfully improve response performance in Grimsby from the existing site alone, even if capacity issues were negated.

5.13 There may be land available to Niagara Region on Clarke St (approximately 1km east of the optimal site) that could be utilized for a new facility; the difference between this site and the optimal site has been tested as part of the sensitivity modelling scenarios covered in Section 9.

Niagara Falls

5.14 There is currently no spare bay capacity at either of the existing facilities in Niagara Falls. The Niagara Falls facility is leased and will need to be vacated when the hospital closes and moves to a new South Niagara Site. St Paul Av is leased and in poor condition with only a single bay and janitorial inventory space. It is therefore recommended that both these sites be closed by 2033.

5.15 Testing of alternative optimal two-, three-, and four-site configurations in this municipality indicated that the three-site configuration would be most favourable (the four-site configuration gave limited additional benefits). The three optimal sites were identified at approximately Thorold Stone Rd and Dorchester Rd ('Niagara Falls North'), Stanley Av and Ferry St ('Niagara Falls East'), and McLeod Rd and Montrose Rd ('Niagara Falls North').

5.16 There may be land available to Niagara Region at Kitchener St (approximately 1km northwest of the optimal Niagara Falls East site) that could be utilized for a new facility; this site has been tested as part of the sensitivity modelling scenarios covered in Section 9.

Pelham and Welland

5.17 Optimal sites were found close to the existing Pelham and King St facilities, and testing within AmbSim found that the response performance improvements were not significant enough to warrant relocating either facility. Pelham is in good condition and has medium potential for expansion if necessary, and King St currently has some potential spare capacity if the Superintendents could be deployed elsewhere (for example, at Fitch St or Wainfleet).

5.18 An optimal site (at approximately Thorold Rd and First Av) was also found close to Abbey Rd indicating that this facility is well located. However, there are other significant risks associated with this facility. For example, it is in poor condition, there are issues with the width of bay doors, and there is limited inventory space. It is therefore recommended that Abbey Rd facility be closed and relocated to this new site ('Welland North').

5.19 There may be land available to Niagara Region at Prince Charles Dr (approximately 1km west of the optimal site) that could be utilized for a new facility; this site has been tested as part of the sensitivity modelling scenarios covered in Section 9.

5.20 A further alternative one-site scenario was investigated for Welland, where King St and Abbey Rd resources could be consolidated a single central location. While this gave similar performance results as a two-site configuration, it was deemed infeasible due to the lack of available land near to the optimal single site.

Fort Erie and Port Colborne

5.21 Optimal sites were found fairly close to each of the existing Fort Erie, Port Colborne and Ridgeway facilities, and each were tested in AmbSim to understand the response performance improvements.

5.22 The most significant response performance improvement was found for the move to the Port Colborne optimal facility (at approximately Killaly St W and Fielden Av), which also provided some performance benefits for southeast Wainfleet. The existing facility has no spare bay capacity and no option for expansion and, although the site is owned, there are potential issues with other tenants. It is therefore recommended that this facility be relocated to the optimal site.

5.23 There were smaller response performance improvements for the Fort Erie and Ridgeway optimal locations. Given that both existing facilities are in good condition, it is not recommended that these are relocated. Additionally, Fort Erie has high potential for expansion if required. Ridgeway has limited potential for expansion, so could pose a capacity issue under a traditional facilities model in the future.

St Catharines and Thorold

5.24 The blank canvas configuration for St Catherines and Thorold initially indicated that a four-site configuration could be optimal, with a north, south, east and west facility all within St Catharines. However, there is understandably unlikely to be the appetite for a future facilities configuration that does not include a station in the Thorold municipality.

5.25 The existing Ontario St, Linwell Rd and Merrittville facilities are all owned and in good or fair condition. Additionally, Merrittville has high potential for expansion and Ontario St has medium potential for expansion. Linwell Rd has limited scope for expansion and Thorold has no spare bay capacity, so each could pose a capacity issue under a traditional facilities model in the future.

5.26 AmbSim was used to understand the response time impact of moving to the optimal sites identified versus retaining the existing facilities. There were only slight improvements in overall response performance from utilising the optimal sites (coupled with a reduction in Thorold); it was agreed that this didn't warrant relocating each of the facilities.

Wainfleet

5.27 There is currently no permanent NEMS facility in Wainfleet, and the optimization process did not identify a significant need to develop an ambulance facility here. However, Wainfleet Fire and Emergency Services are planning to vacate their Station 2 and pass responsibility for this facility to NEMS. The Wainfleet CP vehicle will therefore be able to permanently deploy from this location in future, rather than booking on at Fitch St.

6 IDENTIFYING AMBULANCE REQUIREMENTS

To identify future vehicle requirements, resources were added at the most appropriate facilities and times to improve performance in every municipality as much as possible against targets. This was initially carried out under a traditional facilities model, utilizing the recommended facilities identified in Section 5.

An increase of 1,764 weekly ambulance hours, from 4,704 in the 2023 Base Position to 6,468 in 2033, is recommended to improve performance in every municipality in 2033. This is equivalent to a 38% increase in resource hours, compared to the 40% increase projected in demand.

Crucially, these resources and facilities would allow the P1 8-minute response performance target of 80% to be to be exceeded in overall Niagara Region terms and in six municipalities. Furthermore, the remaining municipalities would either have maintained the same performance as recorded in the Base Position or have substantially improved.

The majority of the recommended resource investment would be required to offset the demand increases, even if the only criteria for response performance was to ensure no degradation from the Base Position.

If the 80% P1 performance target must be met in every municipality, then this is not possible without a further five new facilities and a particularly significant 70% increase in resource hours. In this scenario there would be cost inefficiencies in rural municipalities due to the low utilization of certain facilities and resources.

Improving Coverage in Every Municipality (Recommended)

6.1 The predictive model was used to determine the frontline shifts and ambulances that would be required by 2033 to offset the negative response performance impacts outlined under the 'do nothing' scenario.

6.2 This was initially carried out under a traditional facilities model, utilizing the recommended facilities identified in Section 5. This modelling exercise found that it would not be possible to achieve performance targets in 2033 utilizing only existing facilities as part of a traditional facilities model, due to the various capacity, condition and lease issues also outlined in the previous section.

6.3 To identify future vehicle requirements, resources were therefore added at the most appropriate facilities and times to improve performance in every municipality as much as possible against targets. However, it was recognized that in order for every municipality to achieve target performance levels a significant investment would be required, and certain resources would run inefficiently (that is, with very low utilization). Therefore, the requirement to meet targets in every municipality was relaxed for some municipalities where appropriate (this is explored more in the Meeting Targets in Every Municipality sub-section).

6.4 An increase of 1,764 weekly ambulance hours, from 4,704 in the 2023 Base Position to 6,468 in 2033, is recommended to improve performance in every municipality in 2033 (see Figure **6-1**). This is equivalent to a 38% increase in resource hours, compared to the 40% increase projected in demand.

6.5 An increase of 15 peak ambulances would be required, increasing from 34 peak ambulances in the Base Position to 49 peak ambulances (plus spares) by 2033.

6.6 Peak ambulances are a measure of the absolute minimum number of physical ambulances required to deploy the recommended shifts. For example, a day shift of 07:00 to 19:00 followed by a night shift of 19:00 to 07:00 technically only requires one physical ambulance under the optimistic assumption that neither shift overruns. Alternatively, a day shift of 07:00 to 19:00 along with a day shift of 08:00 to 20:00 would require a minimum of two physical ambulances for at least the 08:00 to 19:00 period.

6.7 Crucially, these resources and facilities would allow the P1 8-minute response performance target of 80%[3] to be exceeded in overall Niagara Region terms and in six municipalities (see Figure **6-2** and Appendix **D1**). Furthermore, the remaining municipalities would either have maintained the same performance as recorded in the Base Position or have substantially improved. Only two municipalities achieve lower than 70% P1 response performance, and both are higher than in the Base Position.

6.8 The majority of the recommended resource investment would be required to offset the demand increases, even if the only criteria for response performance was to ensure no degradation from the Base Position (this is explored more in the Minimum Requirements to Offset Demand sub-section).

6.9 Under a traditional model there will likely still be some capacity issues at the existing facilities that are recommended to be retained. Rather than expand or relocate these facilities, the capacity issues could be resolved by a hub, spoke and post model, and this will be explored in the next section.

[3] For succinctness, only the P1 response performance outcomes are discussed within the body of this report. However, all category targets were reported during the modelling process and reviewed by ORH consultants.

Figure 6-1: Resourcing Summary, Improving Coverage in Every Municipality

Weekly Ambulance Hours

Municipality	Base Position (2023)	Improving Coverage in Every Municipality (2033)	Difference to Base	Peak Ambulances
Fort Erie	588	756	168	7
Grimsby	252	504	252	4
Lincoln	168	420	252	3
Niagara Falls	756	924	168	6
Niagara-on-the-Lake	336	420	84	3
Pelham	336	420	84	3
Port Colborne	336	504	168	4
St Catharines	672	924	252	7
Thorold	672	756	84	6
Wainfleet	0	0	0	0
Welland	420	588	168	4
West Lincoln	168	252	84	2
Overall	**4,704**	**6,468**	**1,764**	**49**

See definition of peak ambulances given in paragraph 6.6.

Figure 6-2: Performance Summary, Improving Coverage in Every Municipality

P1 within 8 minutes

Municipality	Base Position (2023)	Do Nothing (2033)	Improving Coverage in Every Municipality (2033)	Difference to Base
Fort Erie	73.4%	58.6%	79.3%	5.9%
Grimsby	58.4%	44.8%	83.1%	24.8%
Lincoln	46.0%	44.5%	70.1%	24.1%
Niagara Falls	81.5%	74.5%	86.4%	4.9%
Niagara-on-the-Lake	51.8%	49.5%	80.5%	28.7%
Pelham	72.1%	56.6%	77.4%	5.3%
Port Colborne	82.1%	63.5%	86.7%	4.5%
St Catharines	86.6%	81.7%	90.1%	3.6%
Thorold	68.6%	55.7%	71.1%	2.5%
Wainfleet	28.7%	23.5%	37.4%	8.6%
Welland	93.7%	88.8%	94.0%	0.2%
West Lincoln	49.1%	39.0%	67.0%	17.9%
Overall	**78.9%**	**70.8%**	**84.7%**	**5.8%**

Below 80% | Below 70% | Below 70% **and** Degradation from Base Position

Alternative Scenarios

Minimum Requirements to Offset Demand

6.10 The predictive model was also used to understand the minimum level of frontline shifts and ambulances that would be required by 2033 to simply offset the demand increases and ensure that no municipality sees a degradation in response performance from current levels.

6.11 This was tested under a traditional facilities model, utilizing only existing facility locations to highlight the absolute minimum investment for comparison to the recommended resource position described above.

6.12 An increase of 1,092 weekly ambulance hours, from 4,704 in the 2023 Base Position to 5,796 in 2033, would be required to maintain Base Position performance in every municipality in 2033 (see Figure **6-3**). This is equivalent to a 23% increase in resource hours.

6.13 An increase of 8 peak ambulances would be required, increasing from 34 peak ambulances in the Base Position to 42 peak ambulances (plus spares) by 2033.

6.14 Using only existing facilities, it is not possible to maintain Base Position performance in Grimsby and Wainfleet due to the location of (or lack of) facilities in these municipalities. While Base Position performance can be maintained in every municipality, there is substantial disparity in performance across Niagara Region (see Appendix **D2**). For example, only four municipalities achieve the 80% P1 target while six achieve lower than 70% P1 response performance, including five achieving 60% or under.

6.15 Additionally, none of the existing facility condition or lease risks have been addressed. There would also be capacity issues at almost all stations, as there are very few spare bays to accommodate the additional ambulances.

Meeting Targets in Every Municipality

6.16 At the opposite end of the scale, the predictive model was used to understand the frontline shifts and vehicle requirements by 2033 to ensure that every single municipality could achieve the 80% P1 response performance target.

6.17 If the 80% P1 performance target must be met in every municipality, then this is not possible without a further five new facilities in addition to those recommended in Section 5 (13 new facilities in total). Of the five, one would be required in each of West Lincoln (at approximately Sixteen Rd and Caistor Centre Rd), Lincoln (at approximately Dustan St and Victoria Av N), and Thorold (at Maitland St and Queen St S), along with two in Wainfleet (at approximately Forks Rd and Victoria Av, and Lakeshore Rd and Bellview Rd).

Figure 6-3: Resourcing Summary, Minimum Requirement to Offset Demand

Weekly Ambulance Hours

Municipality	Base Position (2023)	Minimum Req. to Offset Demand (2033)	Difference to Base	Peak Ambulances
Fort Erie	588	588	0	5
Grimsby	252	504	252	4
Lincoln	168	168	0	1
Niagara Falls	756	924	168	6
Niagara-on-the-Lake	336	336	0	2
Pelham	336	420	84	3
Port Colborne	336	504	168	4
St Catharines	672	840	168	6
Thorold	672	756	84	6
Wainfleet	0	0	0	0
Welland	420	588	168	4
West Lincoln	168	168	0	1
Overall	**4,704**	**5,796**	**1,092**	**42**

See definition of peak ambulances given in paragraph 6.6.

Figure 6-4: Resourcing Summary, Meeting Targets in Every Municipality

Weekly Ambulance Hours

Municipality	Base Position (2023)	Meeting Targets in Every Municipality (2033)	Difference to Base	Peak Ambulances
Fort Erie	588	840	252	7
Grimsby	252	504	252	4
Lincoln	168	588	420	4
Niagara Falls	756	924	168	6
Niagara-on-the-Lake	336	420	84	3
Pelham	336	504	168	4
Port Colborne	336	504	168	4
St Catharines	672	924	252	7
Thorold	672	1176	504	9
Wainfleet	0	420	420	3
Welland	420	588	168	4
West Lincoln	168	588	420	4
Overall	**4,704**	**7,980**	**3,276**	**59**

See definition of peak ambulances given in paragraph 6.6.

6.18 Alongside these additional sites, a particularly significant increase of 3,276 weekly ambulance hours, from 4,704 in the 2023 Base Position to 7,980 in 2033, would be required in 2033 (see Figure **6-4**). This is equivalent to an 70% increase in resource hours and would also lead to cost inefficiencies in rural municipalities due to the low utilization of certain facilities and resources.

6.19 An increase of 25 peak ambulances would be required, increasing from 34 peak ambulances in the Base Position to 59 peak ambulances (plus spares) by 2033.

6.20 With the P1 8-minute response performance target of 80% met in every municipality, the overall Niagara Region P1 response performance would reach 89% in 8 minutes (see Appendix **D3**).

6.21 Furthermore, under a traditional model, there will still be capacity issues at some existing facilities unless they could be expanded.

7 HUB, SPOKE AND POST FACILITIES MODEL

Under a hub, spoke and post model, the recommended facilities within the configuration identified in Section 5 would operate as posts, reducing the footprint of future builds and alleviating the remaining capacity pressures at facilities to be retained. Ambulances associated with these facilities would book on and off at a primary location or locations.

A three-hub solution (one primary hub plus two spokes) was found to best meet the geographical coverage needs of Niagara Region (see Figure **7-1**). Potentially suitable land near to each of the optimal sites has already been identified. Based on the recommended vehicle requirements outlined in Section 6, this means that hub facilities would need to accommodate 22 peak ambulances plus spares at the Primary Hub, 9 peak ambulances plus spares at the North West Spoke, and 18 peak ambulances plus spares at South Spoke.

There is a small response performance improvement of moving to the hub, spoke and post facilities model when compared with the traditional facilities model. There are also many other potential benefits of a hub, spoke and post model that are not captured within response time metrics, for example:

- Minimized footprint for the post facilities, which are often in high-population areas where land prices are expensive; this also reduces energy requirements
- Centralized supplies, cleaning, and maintenance, reducing the logistics mileage impact, supplies wastage and vehicle downtime
- Focus for frontline staff on patient care rather than stocking and cleaning
- Increased equity in workload by shift, with opportunities for improved skills retention and reduced WSIB incidents
- Opportunity to consolidate administration, dispatch, dispatch training, and quality assurance functions alongside the primary hub

Identifying Hub Requirements

7.1 Although the modelling discussed in the report so far has focused on the requirements under a traditional facilities model, a key part of this review was to understand the facility requirements under an alternative hub, spoke and post model.

7.2 Under a hub, spoke and post model, the recommended facilities within the configuration identified in Section 5 would operate as posts, reducing the footprint of future builds and alleviating the remaining capacity pressures at facilities to be retained. Ambulances associated with these facilities would book on and off at a primary location or locations.

7.3 The process for identifying optimal hub locations to service the post facilities is very similar to the optimization process described in Section 5. However, this time the recommended vehicle requirements at each facility are used as 'demand'. Scenarios were tested to identify the best locations for minimizing the average travel time from potential hubs to post facilities, or maximizing the number that could be reached within 20 minutes; both criteria yielded similar results.

7.4 A three-hub solution (one primary hub plus two spokes) was found to best meet the geographical coverage needs of Niagara Region. For example, with only one or two hubs, many facilities would still need to operate as traditional facilities or accept a drive of over 20 minutes from hub to post. With four hubs, the fourth hub would only need to be a booking on location for one or two posts in the more isolated areas of the Region (for example, one hub to service the Fort Erie and Ridgeway facilities).

7.5 Several three-hub configurations were tested, with the optimal configuration comprising of one Primary Hub (at Westwood Court), one North West Spoke (at the optimal new Grimsby facility), and one South Spoke (at approximately Morris Rd and Netherby Rd). Each of the recommended facilities described in Section 5 can be associated with one of these three hubs (see Figure **7-1**).

7.6 Potentially suitable land has been identified near to each of the optimal sites:

- There is unused land adjacent to the existing Westwood Court facility that could be pursued to accommodate the Primary Hub
- The Region owns land at Clarke St (approximately 1km east of the optimal North West Spoke site) next to Niagara Regional Police
- The Region owns land at Montrose Rd and Netherby Rd (approximately 2.5km east of the optimal South Spoke site)

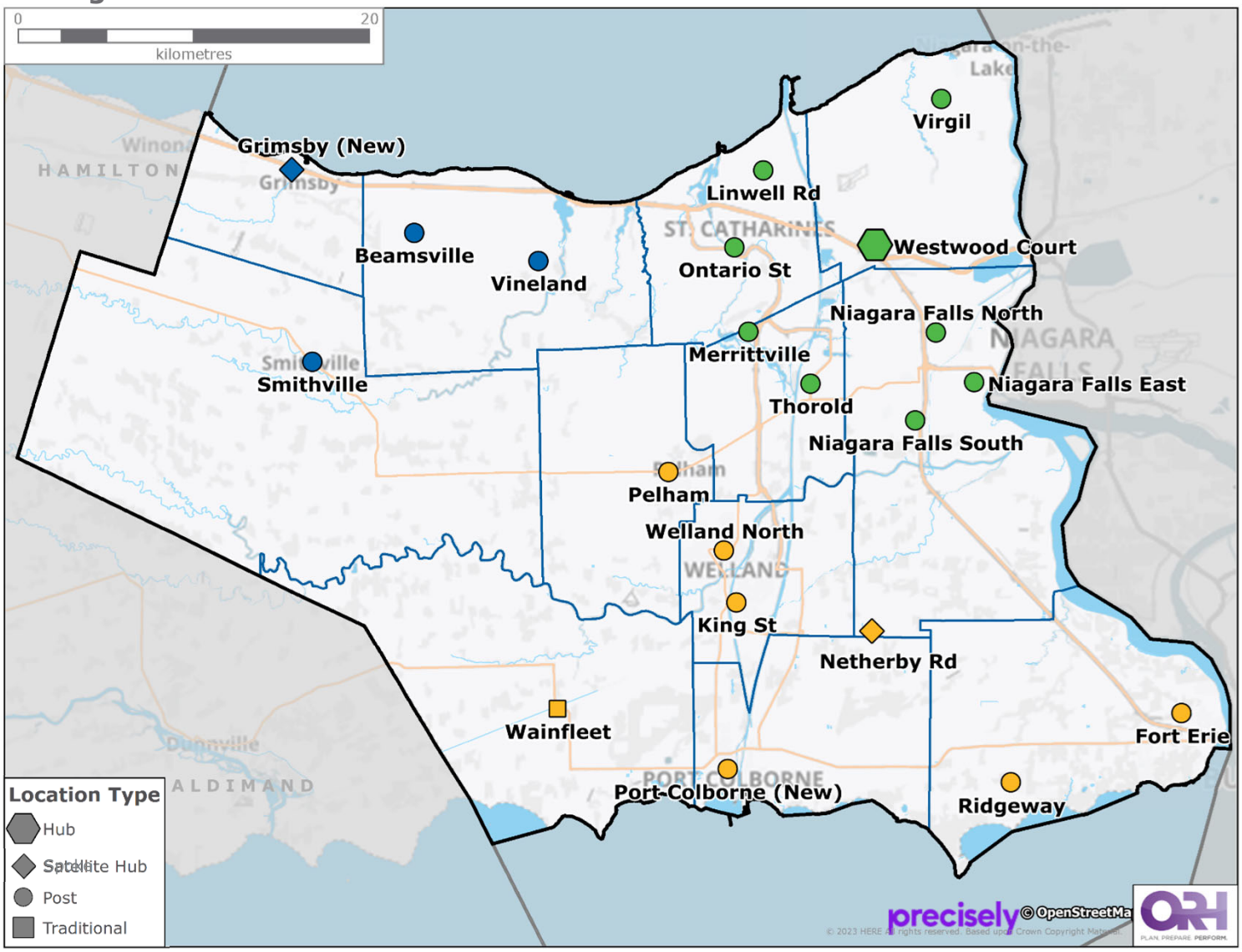
7.7 Based on the recommended vehicle requirements outlined in Section 6, this means that hub facilities would need to accommodate:

- Primary Hub = 22 peak ambulance[4]s plus spares
- North West Spoke = 9 peak ambulances plus spares
- South Spoke = 18 peak ambulances plus spares

[4] See definition of peak ambulances in paragraph 6.6.

Figure 7-1: Hub Requirements

Configuration



Drive Times

North East Hub	
Post	Drive Time
Linwell Rd	13
Merrittville	15
Niagara Falls East	15
Niagara Falls North	10
Niagara Falls South	15
Ontario St	14
Thorold	14
Virgil	13

South Spoke	
Post	Drive Time
Pelham	21
King St	14
Welland North	11
Fort Erie	18
Ridgeway	15
Port Colborne (New)	13

North West Spoke	
Post	Drive Time
Beamsville	11
Grimsby (New)	0
Smithville	14
Vineland	13

Impacts of Hub Model

7.8 The recommended facilities and ambulances from Sections 5 and 6, together with the hub and spoke reporting facilities from the previous sub-section, were then tested within the predictive model. The following assumptions were made when setting up the hub, spoke and post system:

- A dynamic system is implemented whereby ambulances will move to cover the highest priority vacancies at a post, within the vehicle's hub or spoke grouping, whenever a vehicle becomes unavailable
- Crews are usually unavailable for 15 minutes at the start of their shift for vehicle checks; it is assumed that this can be conservatively reduced to 10 minutes due to centralized cleaning and stocking
- Crews can take meal breaks at any hub, spoke or post
- MIH teams continue to operate as usual from Westwood Court or Fitch St

7.9 There is a small response performance improvement of moving to the hub, spoke and post facilities model when compared with the traditional facilities model (see Figure **7-2**). However, it should be cautioned that, in reality, performance benefits are often only seen when a hub is operating extremely efficiently.

7.10 There are also many other potential benefits of a hub, spoke and post model that are not captured within response time metrics. A comparison of the vehicle and facility requirements for a traditional or a hub, spoke and post model is in Figure **7-3**. Only seven new posts are required, compared with eight new traditional facilities, as one of the original post facilities is co-located with the North West Spoke.

7.11 Under a traditional facilities model, even with the recommended facilities configuration, there would be capacity issues at the remaining retained facilities given the need to accommodate frontline ambulances and spare ambulances.

7.12 Under a hub, spoke and post model, the footprint of posts is anticipated to be much smaller than a traditional station, even if the intention is to deploy a similar number of vehicles to each area. This is because they will not necessarily need space for supplies and staff facilities, except for a small lounge and washroom. The reduced footprint also reduces energy requirements.

7.13 Many of the existing and recommended facilities are in high-demand, high-population areas where land prices are expensive; minimizing the footprint of sites in these areas is an important consideration for the overall cost envelope comparison. Putting posts in these locations as opposed to traditional stations should create reductions in capital and operating expenditure, as well as having shorter construction timescales.

Figure 7-2: Hub, Spoke and Post P1 Response Performance

P1 within 8 minutes

Municipality	Base Position (2023)	Traditional Facilities Model (2033)	Hub, Spoke & Post Facilities Model (2033)	Difference to Traditional
Fort Erie	73.4%	79.3%	75.5%	-3.8%
Grimsby	58.4%	83.1%	78.3%	-4.9%
Lincoln	46.0%	70.1%	75.9%	5.8%
Niagara Falls	81.5%	86.4%	91.9%	5.4%
Niagara-on-the-Lake	51.8%	80.5%	80.9%	0.5%
Pelham	72.1%	77.4%	80.8%	3.5%
Port Colborne	82.1%	86.7%	88.9%	2.2%
St Catharines	86.6%	90.1%	93.8%	3.6%
Thorold	68.6%	71.1%	77.3%	6.2%
Wainfleet	28.7%	37.4%	39.0%	1.7%
Welland	93.7%	94.0%	96.9%	2.9%
West Lincoln	49.1%	67.0%	68.7%	1.7%
Overall	**78.9%**	**84.7%**	**88.1%**	**3.3%**

Below 80%

Below 70%

Below 70% **and** Degradation from Base Position

Figure 7-3: Comparison of Facility Models

Traditional Facilities Model

- Additional 5 x 24/7 shifts and 11 x 12/7 ambulance shifts required (38% increase)
- Additional 21 ambulances required (including 30% spares required at municipality level)
- Retain 10 existing facilities, but at least 4 would require expansion including 2 that have low potential for expansion
- No spare capacity at existing facilities
- Develop 8 new traditional facilities: at minimum 1 x 1-bay, 3 x 2-bay, 2 x 3-bay and 2 x 4-bay (need to be larger than this to accommodate spares)
- No hub requirements
- No resilience for beyond 10 years without new traditional facilities or further expansions

Hub, Spoke & Post Facilities Model

- Same shift requirements as Traditional Facilities Model
- Additional 18 ambulances required (including 30% spares required at hub level)
- Retain 10 existing facilities and use as posts, all requiring same or smaller footprint than existing facility
- Spare capacity only needs addressing at hubs rather than post facilities
- Develop 7 new posts facilities: 2 x 1-bay, 5 x 2-bay (noting that 2-bay post will have smaller footprint than 2-bay traditional facility)
- Develop 3 new hub facilities: Primary Hub, North West Spoke and South Spoke
- Easier to build new posts if required beyond the 10-year horizon

7.14 It is anticipated that spokes would operate like large traditional facilities. They should have adequate bays for vehicles and spares to be housed indoors, along with storage for supplies, and crew rest and work areas.

7.15 As well as providing adequate vehicle housing to supply its associated posts, the primary hub would act as a central logistics and supplies department for the Region. It is anticipated that vehicle maintenance and deep cleaning will take place at the primary hub.

7.16 With the complementary spokes, logistics travel relating to delivery of supplies would be significantly reduced; deliveries will only be required to the two spokes and the hospitals, instead of to each of the 18 distinct facilities recommended by 2033. This increases the life cycle of logistics vehicles, saves logistics staff time which can be redeployed to other appropriate tasks, and will lead to environmental impact efficiencies.

7.17 The current administration, dispatch, dispatch training, and quality assurance facility at Lampman Court is already fully utilized and is currently leased, posing a risk to the Region should alternative accommodation or expansion in the future be required at short notice. It would therefore be advantageous to consolidate these functions, and alongside the primary hub, enabling NEMS to deliver a highly cohesive service across frontline, support, logistics, QA, and dispatch staff.

7.18 Ownership of land and infrastructure has clear benefits over leasing as this will provide more flexibility in terms of construction and expansion options and, in total cost terms, should be cheaper long term without a landlord requiring profit. However, there are potential disadvantages that need considering, such as the possible difficulty in procuring sites, and economic climates affecting the life-cycle cost of land and buildings.

7.19 It is anticipated that larger hub locations will have greater operating costs but, given the centralization of services, this could be offset by lower costs at posts compared to traditional stations. Post configurations and layouts can be standardized more easily than for traditional stations, given the lack of ancillary function requirements, potentially allowing for greater economies of scale in procurement and construction.

7.20 An inherent advantage of a hub, spoke and post model is that logistics operations, maintenance, restocking and storage can be centralized within larger hub locations, ensuring greater efficiency given a larger quantum of resourcing. The benefits of scale can also be particularly realized with a central pool of spares. Inventory and supply chain management should be improved in a hub, spoke and post model, leading to decreased wastage.

7.21 Within a traditional model, minor and major vehicle cleans will need to be undertaken within a vehicle's daily cycle, often impacting productivity at shift start and end times. It is possible within hub, spoke and post models to introduce 'ambulance vehicle preparation', meaning that dedicated staff prepare ambulances at hub locations and thus crews have ready-prepared ambulances at their shift start. Frontline staff can therefore focus on patient care rather than on stocking and cleaning.

7.22 The advantages of dynamically deploying ambulances to posts includes an increased balance of coverage which should result in improvements to response performance. With ambulances flowing between sites as necessary, there should also be increased equity in workload by shift in the system, in contrast to wider variation within the traditional model. This could potentially provide a better balance of staff working time, leading to better opportunities for skill retention and reduced WSIB incidents, and improve wellbeing and morale.

7.23 Assuming supervisors are based at each hub and spoke, frontline staff will have much greater visibility of, and access to, their support staff. There will also be better and more equal access to crew quarters amenities, the quality of which currently vary wildly across the existing facilities.

7.24 A potential downside of a hub, spoke and post system is that staff may feel that an increased amount of their time is spent travelling, either to start their shift or within the shift itself. However, it should be noted that this is also reported in a traditional model where standby moves between stations occur. Travel between hubs and posts within the shift would be reduced if there are facilities to take rest breaks at every post.

8 RECOMMENDED TRAJECTORY

8.1 The recommended facility and ambulance requirements are suggested to be introduced over the next ten years according to the trajectory outlined in Figure **8-1**. This includes:

- Seven new posts
- A Primary Hub and two complementary Spokes
- A 38% increase in weekly ambulance hours
- An additional 18 physical ambulances (including 3 spares)

8.2 The process for determining an appropriate trajectory aimed to address high risk facilities as quickly as possible. However, the trajectory also needed to reflect budget cycles, follow a sensible construction schedule, stagger ambulance increases so that the financial impacts are as evenly spread across the ten years as possible, and balance this with the need to improve performance.

8.3 Until the Primary Hub and complementary Spokes are fully operational, there are some restrictions on where ambulances can be added. This is because, in the interim, there is limited spare capacity at retained facilities and any new facilities will be built as posts (that is, with a smaller footprint than a traditional facility and without the full capabilities of book-on location).

8.4 There will therefore need to be some temporary arrangements made to accommodate new shifts. For example, in 2027, both the shifts associated with the new Niagara Falls and Niagara-on-the-Lake posts, and the additional shifts recommended in Niagara Falls and St Catharines will need to temporarily forward deploy from Westwood Court.

8.5 In particular, this means that, until the South Spoke is fully operational in 2032, there is very limited capacity for adding ambulances to Pelham, Welland, Port Colborne and Fort Erie.

8.6 A summary of weekly ambulance hours added in each year, for each hub or spoke area, is given in Appendix **E1**. The P1 8-minute response performance in each year, along with the alternative Do Nothing performance, is given in Appendix **E2**.

Figure 8-1: Recommended Trajectory Implementation

Year	Facilities Opened			Facilities Closed	Ambulance Requirements			Notes
	1-bay Post	2-bay Post	Hub		Shifts		Peak Ambulances	
2025	*None*	*None*	*None*	*None*	Ontario St Smithville Fort Erie	24/7 12/7 12/7	1 1 1	No space for any spare vehicles at Smithville, Fort Erie or Ontario St
2026	*None*	*None*	*None*	*None*	Abbey Rd Niagara-on-the-Lake	12/7 12/7	1 1	No space for any spare vehicles at Abbey Rd or NOTL
2027	Niagara Falls North*	Niagara Falls East* Virgil*	*None*	Niagara Falls St Paul Av Niagara-on–the-Lake	Niagara Falls East* Linwell Rd*	12/7 12/7	1 1	*Shifts associated with the opened posts and the additional Linwell Rd shift will now forward deploy from Westwood Court as a temporary hub. Glendale technically won't close, but shifts will forward deploy to Virgil
2028	*None*	Welland North*	North West Spoke	Abbey Rd	North West Spoke Welland North*	12/7 + 12/7 (Night) 12/7 (Night)	1 0	North West Spoke will open as a fully operational spoke, with Grimsby, Smithville and Vineland used as posts. *Shifts associated with the Welland North post will forward deploy from King St temporarily, supervisors will need to be temporarily relocated (Fitch St?)
2029	Niagara Falls South*	*None*	*None*	*None*	Merrittville* North West Spoke	12/7 24/7	1 1	*Shifts associated with the Niagara Falls South post and the additional Merrittville shift will forward deploy from Westwood Court as a temporary hub
2030	*None*	*None*	Primary Hub	Glendale	Primary Hub	12/7 (Night)	0	Primary Hub will open as a fully operational hub, with Niagara Falls, NOTL, St Catharines and Thorold facilities all used as posts
2031	*None*	Beamsville	*None*	Grimsby	South Spoke	12/7	1	
2032	*None*	Port Colborne (New)	South Spoke	Port Colborne	South Spoke	24/7	1	South Spoke will open as a fully operational spoke, with Fort Erie, Pelham, Port Colborne and Welland facilities all used as posts
2033	*None*	*None*	*None*	*None*	North West Spoke South Spoke	12/7 2 x 12/7	1 2	

9 SENSITIVITY MODELLING

Sensitivity modelling was also undertaken to test assumptions about parameters incorporated into the core modelling scenarios, including:

- Building optimal sites at potential alternative locations
- Opening the new South Niagara Site hospital
- Variations to time at hospital
- Variations to demand projections

These scenarios were tested in the 2033 position with the recommended facilities and ambulances, under a hub, spoke and post model. The response performance impacts, and resulting resourcing changes to offset any of these impacts, are given in Figure **9-1**.

The response performance impacts were generally negligible when moving each of the optimal sites to potential alternative locations, meaning that the alternative locations would be appropriate options for the future.

Testing Locations at Available Land

9.1 In order to determine facility requirements for the future, ORH's models were used to identify the mathematically optimal facility locations. However, it is accepted that land may not be available at the exact optimal site in each case.

9.2 Through the Steering Committee (including Real Estate representatives), alternative options for some of the recommended facilities were put forward for testing, including:

- Anderson Ln instead of the optimal Virgil site (approximately 3km northeast of the optimal site)
- Prince Charles Dr instead of the optimal Welland North site (approximately 1km west of the optimal site)
- Kitchener St instead of the optimal Niagara Falls East site (approximately 1km northwest of the optimal site)
- Clarke St next to the Niagara Regional Police building instead of the optimal Grimsby (New) site / North West Spoke (approximately 1km east of the optimal site)
- Montrose Rd and Netherby Rd instead of the optimal South Spoke (approximately 2.5km east of the optimal site)

Figure 9-1: Sensitivity Modelling Summary

Response Performance Impacts under Changes

P1 within 8 minutes **Differences compared to Core Scenario**

Municipality	2033 Recommended Hub, Spoke and Post Scenario	New South Niagara Site opens and Niagara General closes		Changes to Time at Hospital		Differing Demand Projection	
		Welland Site stays open	Welland Site Closes	2018-19 Average	2022 Average	Subtract 10% from Uplift	Add to 10% Uplift
Fort Erie	75.5%	-0.7%	-4.9%	3.6%	-3.4%	2.6%	-3.4%
Grimsby	78.3%	0.0%	0.0%	0.2%	0.0%	0.1%	0.0%
Lincoln	75.9%	-0.4%	-0.4%	1.3%	-0.9%	0.5%	-0.6%
Niagara Falls	91.9%	-1.7%	-1.8%	2.0%	-1.5%	1.2%	-1.4%
Niagara-on-the-Lake	80.9%	-3.2%	-4.2%	4.7%	-3.6%	3.4%	-4.0%
Pelham	80.8%	-0.3%	-5.4%	3.1%	-2.8%	1.6%	-2.6%
Port Colborne	88.9%	-0.3%	-5.0%	2.3%	-1.9%	1.6%	-1.8%
St Catharines	93.8%	-0.7%	-0.9%	1.1%	-0.7%	0.5%	-0.5%
Thorold	77.3%	-1.3%	-1.5%	3.5%	-2.6%	2.0%	-2.0%
Wainfleet	39.0%	-0.1%	-1.6%	0.8%	-1.1%	0.8%	-1.1%
Welland	96.9%	0.0%	-1.4%	0.6%	-0.5%	0.4%	-0.4%
West Lincoln	68.7%	-0.2%	0.1%	1.0%	-0.7%	0.6%	-1.1%
Overall	**88.1%**	**-0.9%**	**-1.7%**	**1.6%**	**-1.3%**	**0.9%**	**-1.1%**

Resourcing Changes to Offset Impact

Weekly Ambulance Hours **Differences compared to Core Scenario**

Base	2033 Recommended Hub, Spoke and Post Scenario	New South Niagara Site opens and Niagara General closes		Changes to Time at Hospital		Differing Demand Projection	
		Welland Site stays open	Welland Site Closes	2018-19 Average	2022 Average	Subtract 10% from Uplift	Add to 10% Uplift
Primary Hub	3,024	168	168	-252	168	-168	168
South Spoke	2,268	0	336	-168	168	-84	84
North West Spoke	1,176	0	0	-84	0	0	0
Total	**6,468**	**168**	**504**	**-504**	**336**	**-252**	**252**

9.3 Sensitivity modelling scenarios were undertaken which involved moving each optimal site to its corresponding alternative location and reviewing the response performance impacts (see Appendix **F**). However, as the final two alternative locations were already built into the 2033 recommended hub, spoke and post scenario, the sensitivity modelling instead tested moving the alternative locations back to their optimal sites.

9.4 In each case, the response performance impacts were generally negligible, meaning that the alternative locations would be appropriate options for the future.

9.5 The largest impact was seen in moving the alternative Grimsby (New) / North West Spoke back to the optimal location at approximately Clarke St and Christie St, where the optimal site gives a 6.7 percentage point increase in P1 8-minute response performance over the alternative. However, even with the alternative site, P1 8-mintue response performance is still close to the 80% target and significantly improved over the Base Position.

South Niagara Site

9.6 It is anticipated that a new South Niagara Site hospital facility will open towards the end of the ten-year horizon of this review. At this point the Niagara Falls Site hospital facility will close. It is not yet known if the Welland Site hospital facility will close, or, if it remains open, what functions it will retain.

9.7 Sensitivity modelling was therefore completed to understand the potential response performance impacts of this hospital reconfiguration. Several assumptions were agreed with the Steering Committee:

- The new South Niagara Site would have similar offload delays to the St Catharines Site (the most pessimistic option)
- There would be no significant changes to hospital destination policies, except where these are based on the patient's proximity to destination hospital
- South Niagara Site will send and receive the same number of inter-facility transfers to and from each other facility as the Niagara Falls Site

9.8 Given the uncertainty regarding the Welland Site, two scenarios were tested either with Welland Site remaining open or with it closing entirely. In the scenarios where the Welland Site is closed, it is assumed that inter-facility transfers between it and other hospitals would instead go to and from the South Niagara Site.

9.9 In both scenarios, P1 8-minute response performance gets slightly worse across Niagara Region; 0.9 percentage points worse when the Welland Site remains open or 1.7 percentage points worse when the Welland Site closes. When Welland Site remains open, the most affected municipalities are Niagara Falls, Niagara-on-the-Lake, and Thorold as the ambulances transporting patients in some parts of these areas will typically now have to travel further to their destination hospital and spend longer at hospital with the patient. When Welland Site closes, Fort Erie, Pelham and Port Colborne municipalities are also impacted more severely.

9.10 To offset the worsened response performance, it is recommended that an additional 168 weekly ambulance hours be added to the Primary Hub by 2033. If Welland Site closes, then a further 336 weekly ambulance hours should be added to the South Spoke by 2033.

Variations to Time at Hospital

9.11 The core modelling scenarios for 2033 assumed there would be no changes to the call components incorporated into the Base Position. The call component inputs in the Base Position were based on 2021 and 2022 data.

9.12 As discussed in Section 2, the time at hospital call component varied significantly over the full five-year sample period. For example, the average time at hospital was:

- 64 minutes for 2018 and 2019
- 78 minutes for 2021 and 2022 (used in the Base Position)
- 86 minutes for 2022 only

9.13 Sensitivity modelling was therefore undertaken to understand the response performance impacts of a more optimistic position (reducing the average to 64 minutes) and a more pessimistic position (increasing the average to 86 minutes).

9.14 In the optimistic scenario, P1 8-minute response performance increases by 1.6 percentage points. Comparatively, in the pessimistic scenario, P1 8-minute response performance reduces by 1.3 percentage points.

9.15 This therefore means that a saving of 504 weekly ambulance hours by 2033 could be made under the optimistic scenario, with the remaining hours equivalent to a 27% total increase above the Base Position. Under the pessimistic scenario, a further increase of 336 weekly ambulance hours by 2033 would be required, equivalent to a 45% total increase above the Base Position.

Variations to Demand Projections

9.16 ORH has a tried and tested approach to projecting ambulance demand. However the change in demand over a ten-year horizon is difficult to predict with absolute certainty, as this can vary depending on a wide range of factors.

9.17 Sensitivity modelling was therefore undertaken to understand the impact of a 10% increase and a 10% decrease in the projected demand figures for 2033. A 10% decrease in demand results in an increase of 0.9 percentage points to P1 8-minute response performance. Conversely, a 10% increase in demand results in a decrease of 1.1 percentage points to P1 8-minute response performance.

9.18 Either a saving, or an increase, of 252 weekly ambulance hours would be required to address the demand variation impacts.

Appendices

A	Current Service Profile
B	Predictive Model Setup
C	The 'Do Nothing' Scenario
D	Identifying Vehicle Requirements
E	Recommended Trajectory

Niagara EMS

Ten Year Facilities Master Plan

Final Report

PLAN. PREPARE. **PERFORM.**

ORH/NEMS/2

A Current Service Profile

A1 Demand by Hour

A2 Transported Patients by Hospital

A3 Conveyance Rates by Category

A4 Performance by Month

A5 Station Catchment Performance

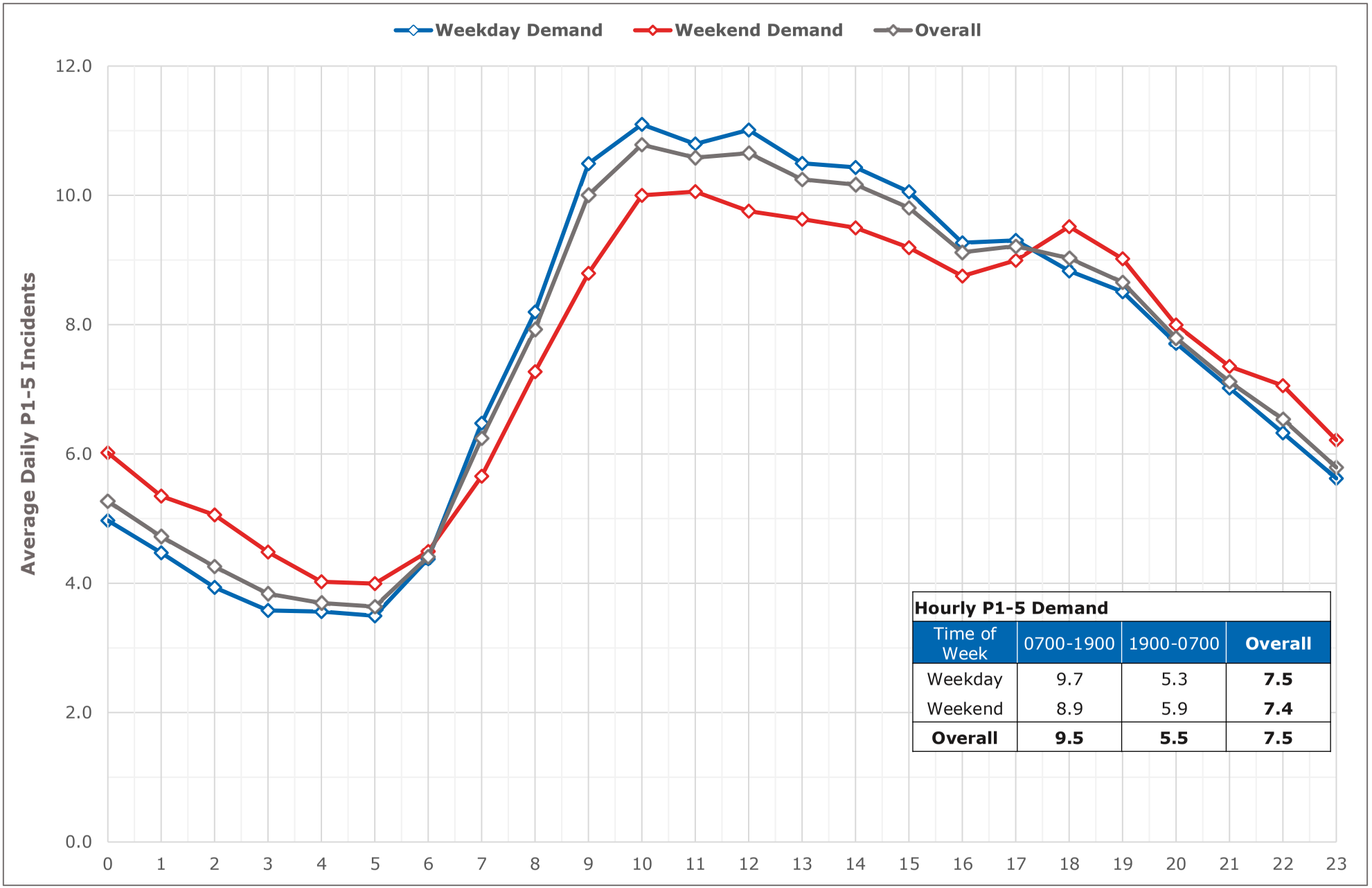
A6 Responses by Category and Vehicle Type

A7 Ambulance Utilization by Hour

A8 Vehicle Unavailability

A1

Demand by Hour (2021 & 2022)



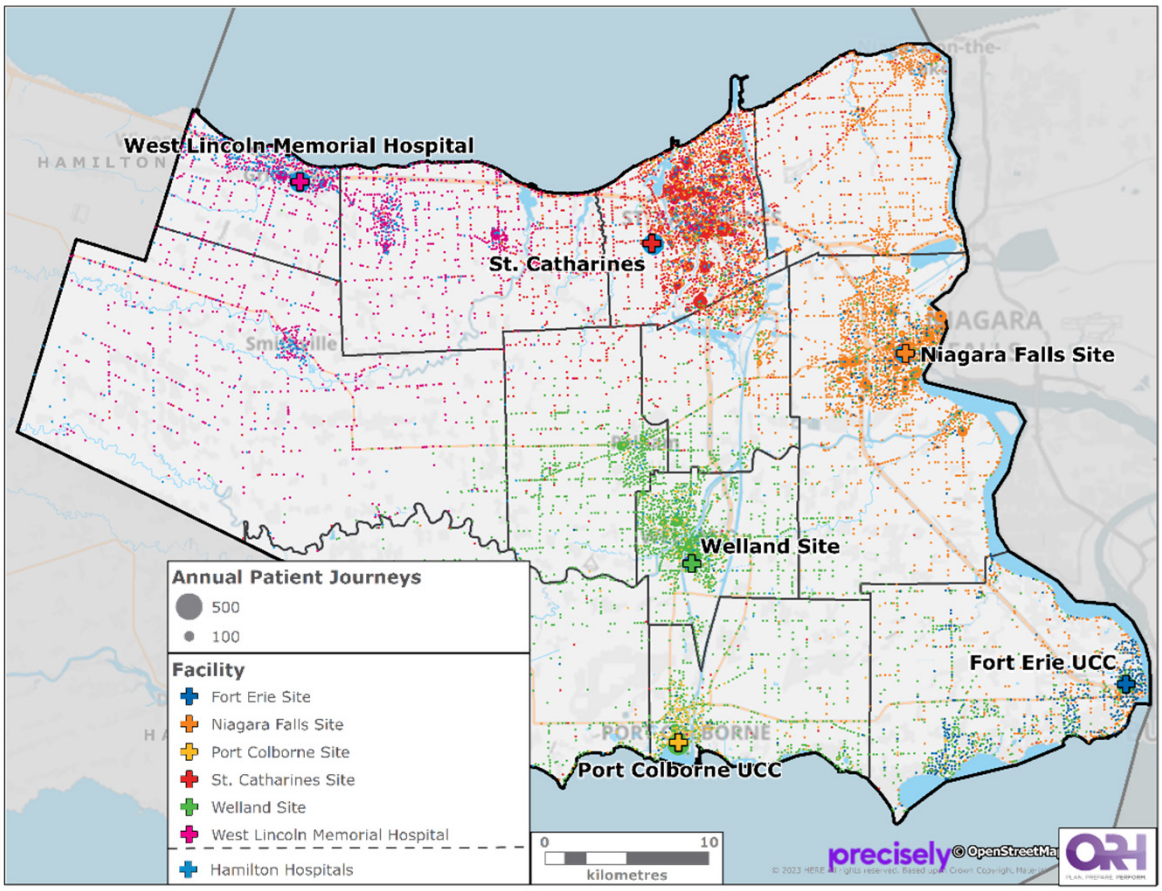
Hourly P1-5 Demand

Time of Week	0700-1900	1900-0700	Overall
Weekday	9.7	5.3	**7.5**
Weekend	8.9	5.9	**7.4**
Overall	**9.5**	**5.5**	**7.5**

Note: Uses typical Monday to Friday definition of weekday and Saturday to Sunday for weekend.

Transported Patients by Hospital

Patient Journeys by Destination Facility



Patient Journeys per day by Priority

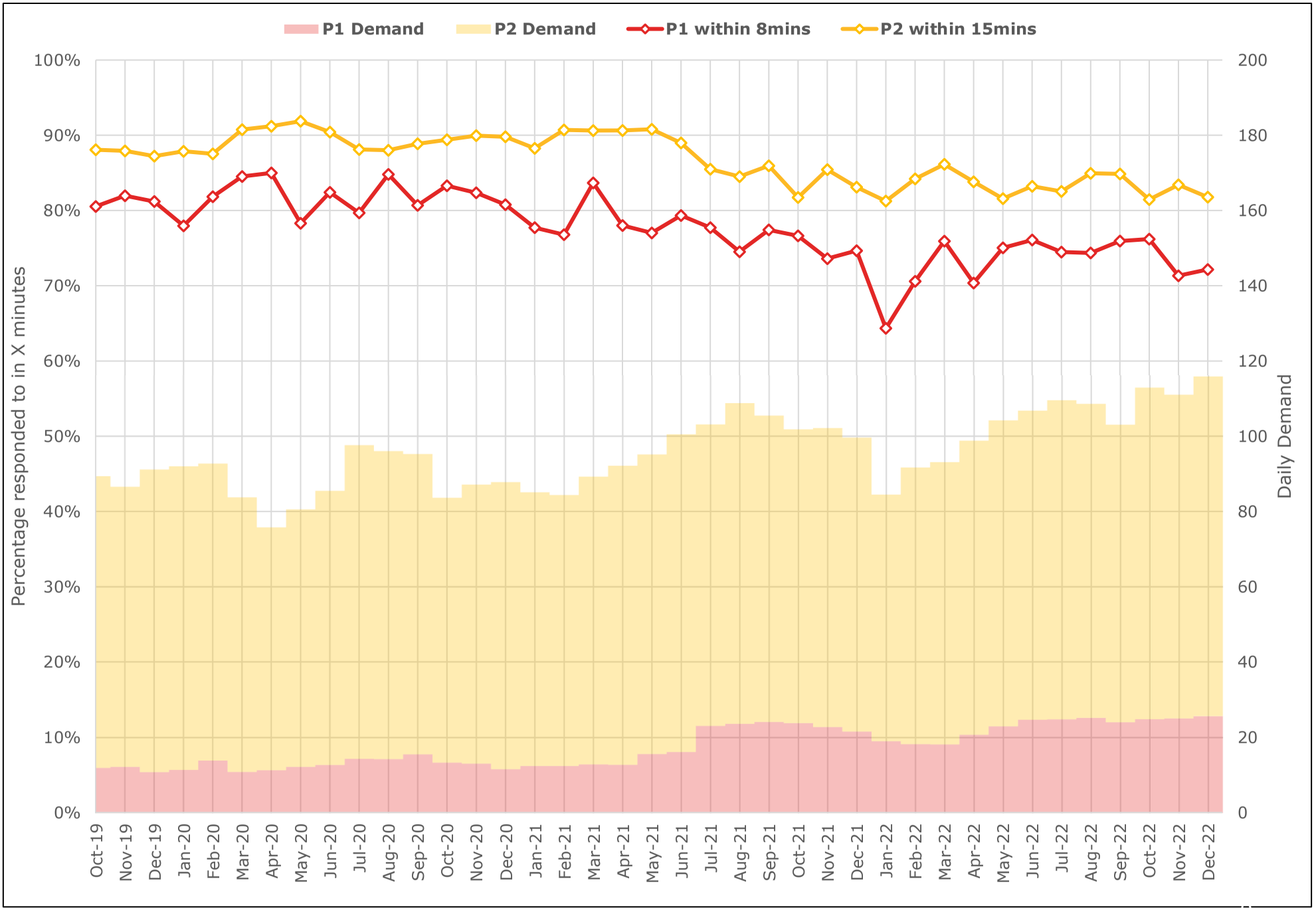
Hospital	Priority					Total
	P1	P2	P3	P4	P5	
St. Catharines Site	3.7	23.3	13.3	3.3	5.1	**48.7**
Niagara Falls Site	2.8	16.6	8.3	1.4	2.9	**31.9**
Welland Site	1.8	10.7	5.7	1.9	2.1	**22.2**
West Lincoln Memorial Hospital	0.6	4.1	1.9	0.3	0.9	**7.9**
Hamilton General Hospital	0.1	1.2	1.0	0.2	0.0	**2.5**
McMaster University Medical Centre	0.0	0.1	0.5	0.2	0.0	**0.8**
FE Urgent Care Centre	0.0	0.2	0.2	0.1	0.2	**0.8**
PC Urgent Care Centre	0.0	0.1	0.1	0.1	0.1	**0.4**
Haldimand War Memorial Hospital	0.0	0.2	0.1	0.0	0.0	**0.3**
Juravinski Hospital	0.0	0.0	0.2	0.1	0.0	**0.3**
St. Joseph's Healthcare Hamilton	0.0	0.0	0.1	0.1	0.0	**0.2**
Niagara Falls Site Helepad	0.0	0.0	0.0	0.1	0.0	**0.1**
Other	*0.0*	*0.1*	*0.1*	*0.1*	*0.1*	***0.4***
Total	**9.1**	**56.5**	**31.5**	**8.0**	**11.5**	**116.6**
Conveyance Rates	63.7%	76.2%	62.0%	75.6%	65.8%	69.5%

Conveyance Rates by Category

Category	Year					Overall
	2018	2019	2020	2021	2022	
P1	70.9%	65.4%	58.7%	62.4%	65.9%	**63.7%**
P2	79.6%	80.4%	74.5%	73.4%	74.7%	**76.2%**
P3	67.7%	64.2%	57.2%	60.6%	58.8%	**62.0%**
P4	80.5%	71.3%	74.4%	78.3%	75.4%	**75.6%**
P5	71.5%	67.1%	66.8%	60.1%	51.8%	**65.8%**
Other	*0.4%*	*2.0%*	*1.3%*	*0.6%*	*1.1%*	***1.0%***
Overall	**72.2%**	**70.1%**	**65.6%**	**64.6%**	**65.5%**	**67.4%**

A4

Priority 1 and 2 Performance by Month



Station Catchment Performance

Station Catchment	Percentage within X minutes	
	P1 in 8	P2 in 15
Abbey Rd	82%	91%
Glendale	74%	85%
King St	84%	87%
Niagara Falls	78%	88%
Niagara-on-the-Lake	30%	60%
St Paul Av	74%	89%
Thorold	54%	75%
Vineland	36%	62%
Fort Erie	73%	86%
Grimsby	56%	87%
Linwell Rd	78%	83%
Merrittville	70%	85%
Ontario St	88%	90%
Pelham	60%	79%
Port Colborne	75%	87%
Ridgeway	53%	74%
Smithville	34%	67%

Responses by Category and Vehicle Type

% of Responses by Vehicle Type

Vehicle Type	Category						Overall	Average Daily Responses
	P1	P2	P3	P4	P5	Other		
TU (PCP)	13%	43%	29%	9%	6%	0%	100%	85.7
TU (ACP)	15%	54%	25%	4%	2%	0%	100%	80.2
MIH (CARE)	10%	4%	27%	5%	24%	30%	100%	9.6
Supervisor	70%	20%	7%	1%	2%	0%	100%	4.5
MIH (Not Specified)	2%	2%	3%	0%	4%	89%	100%	3.5
Other	16%	40%	20%	5%	3%	16%	100%	2.9
MIH (FIT)	4%	2%	45%	3%	6%	40%	100%	2.5
MIH (MHART)	9%	14%	38%	8%	23%	9%	100%	2.2
MIH (CP)	8%	15%	9%	1%	3%	64%	100%	2.0
MIH (STREET)	9%	8%	45%	1%	5%	32%	100%	1.2
Overall	15%	43%	26%	6%	6%	5%	100%	194.2

% of Responses by Category

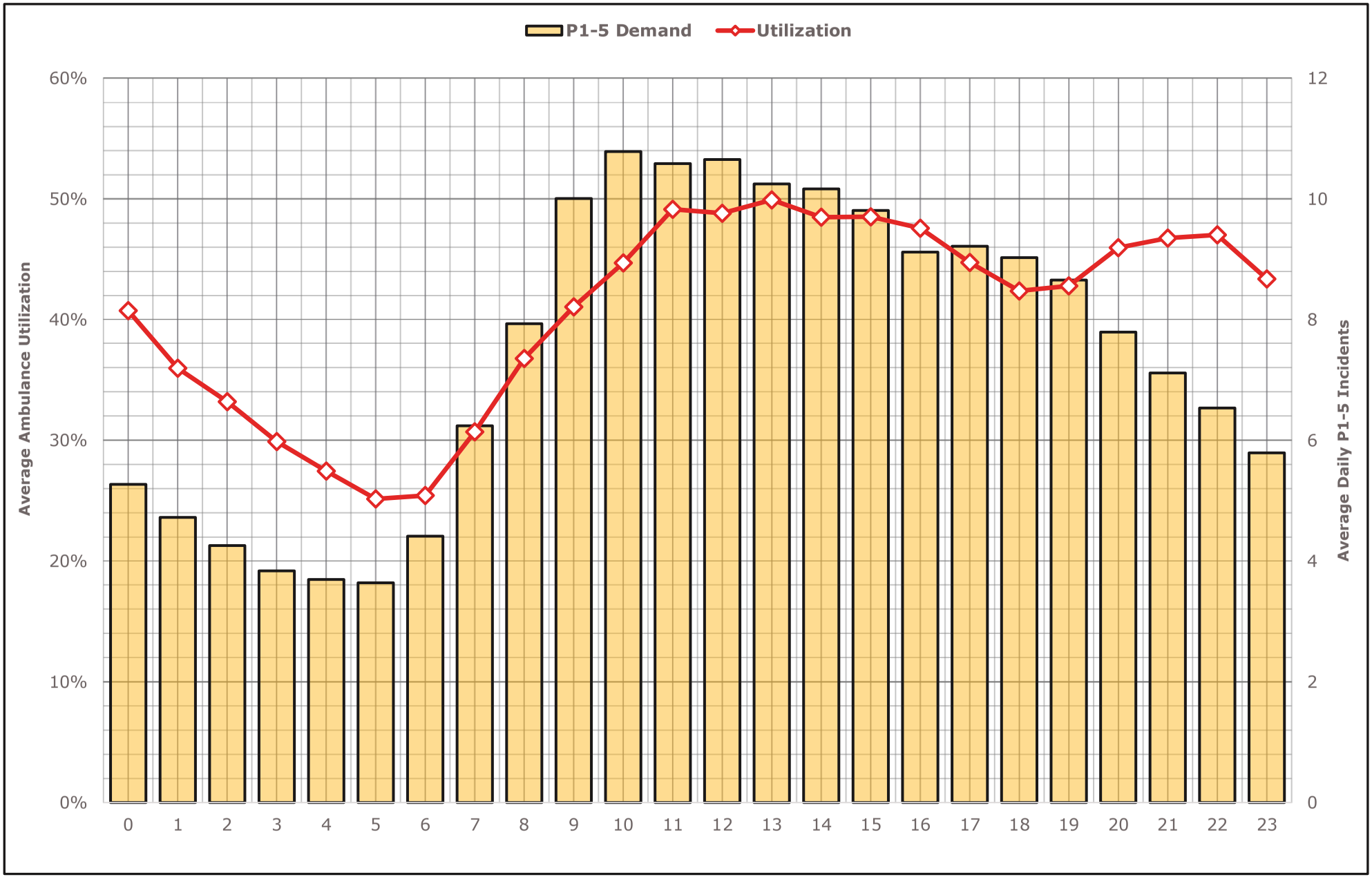
Vehicle Type	Category						Overall	Average Daily Responses
	P1	P2	P3	P4	P5	Other		
TU (PCP)	39%	44%	49%	64%	51%	2%	44%	85.7
TU (ACP)	42%	52%	39%	27%	18%	2%	41%	80.2
MIH (CARE)	3%	0%	5%	4%	22%	30%	5%	9.6
Supervisor	11%	1%	1%	0%	1%	0%	2%	4.5
MIH (Not Specified)	0%	0%	0%	0%	1%	32%	2%	3.5
Other	2%	1%	1%	1%	1%	5%	1%	2.9
MIH (FIT)	0%	0%	2%	1%	1%	11%	1%	2.5
MIH (MHART)	1%	0%	2%	2%	5%	2%	1%	2.2
MIH (CP)	1%	0%	0%	0%	1%	13%	1%	2.0
MIH (STREET)	0%	0%	1%	0%	1%	4%	1%	1.2
Overall	100%	100%	100%	100%	100%	100%	100%	194.2

TU (PCP) = PCP-led Transport Unit

TU (PCP) = ACP-led Transport Unit

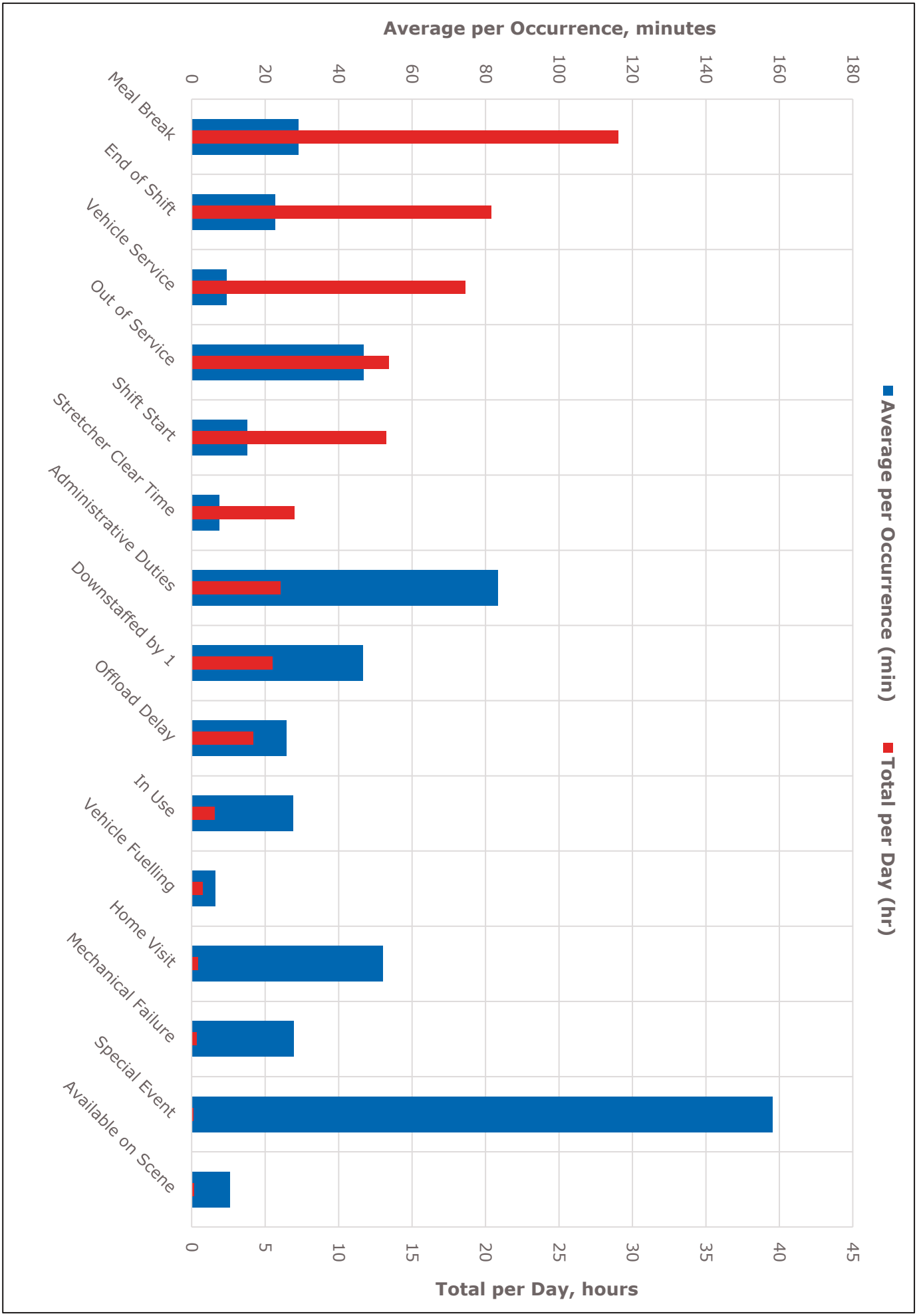
A7

Ambulance Utilization by Hour



Utilization is defined as the sum of occupied time (from vehicle mobilization to clear) divided by actual rostered vehicle time; time spent on meal breaks and returning to base are thus excluded from the calculation. Standby moves are also excluded. CAV descriptions 'VS' and 'STR' are included.

Ambulance Unavailability



B Predictive Model Setup

B1 Model Validation Example, Hospital Flows

B2 Model Validation Example, Responses by Category and Vehicle Type

Model Validation Examples, Hospital Flows

Model Validation Examples, Responses by Category and Vehicle Type

Analysed				Validated			Examples		
Category	ACP Transport Units	PCP Transport Units	MIH	ACP Transport Units	PCP Transport Units	MIH	ACP Transport Units	PCP Transport Units	MIH
P1	12.0	11.2	1.6	12.5	10.3	1.8	0.5	-0.9	0.2
P2	43.1	36.5	1.2	45.0	33.6	0.9	2.0	-3.0	-0.3
P3	19.8	24.7	5.4	17.4	25.9	6.1	-2.3	1.2	0.8
P4	3.3	7.7	0.8	3.7	7.3	1.1	0.4	-0.4	0.3
P5	1.9	5.4	3.2	1.9	5.4	3.8	0.0	0.0	0.5
Other	0.2	0.2	8.7	0.4	0.5	7.9	0.2	0.3	-0.9
Overall	**80.1**	**85.7**	**20.9**	**81.0**	**83.0**	**21.5**	**0.9**	**-2.7**	**0.5**

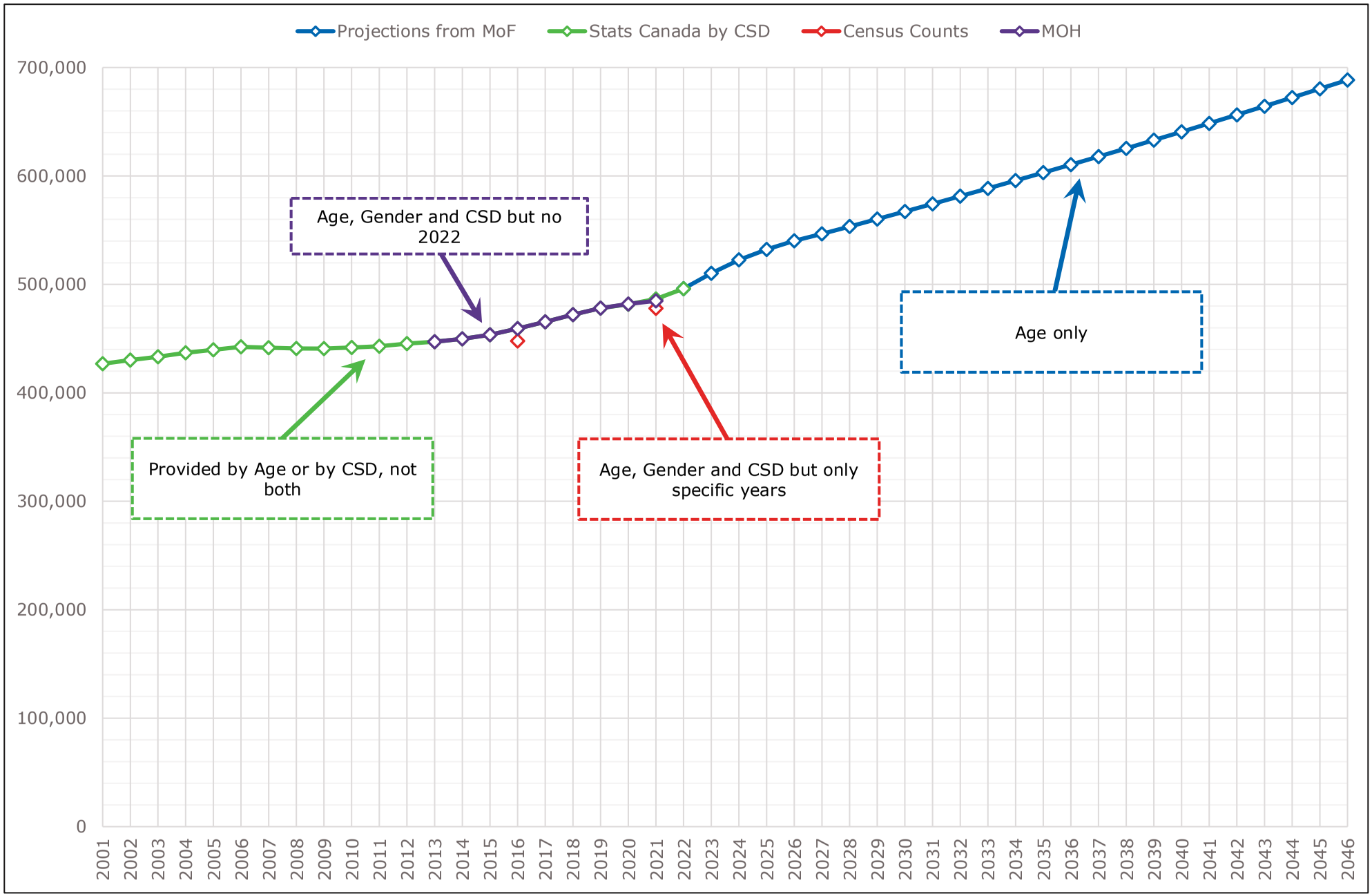
PCP Transport Unit = PCP-led Transport Unit

ACP Transport Unit = ACP-led Transport Unit

C The 'Do Nothing' Scenario

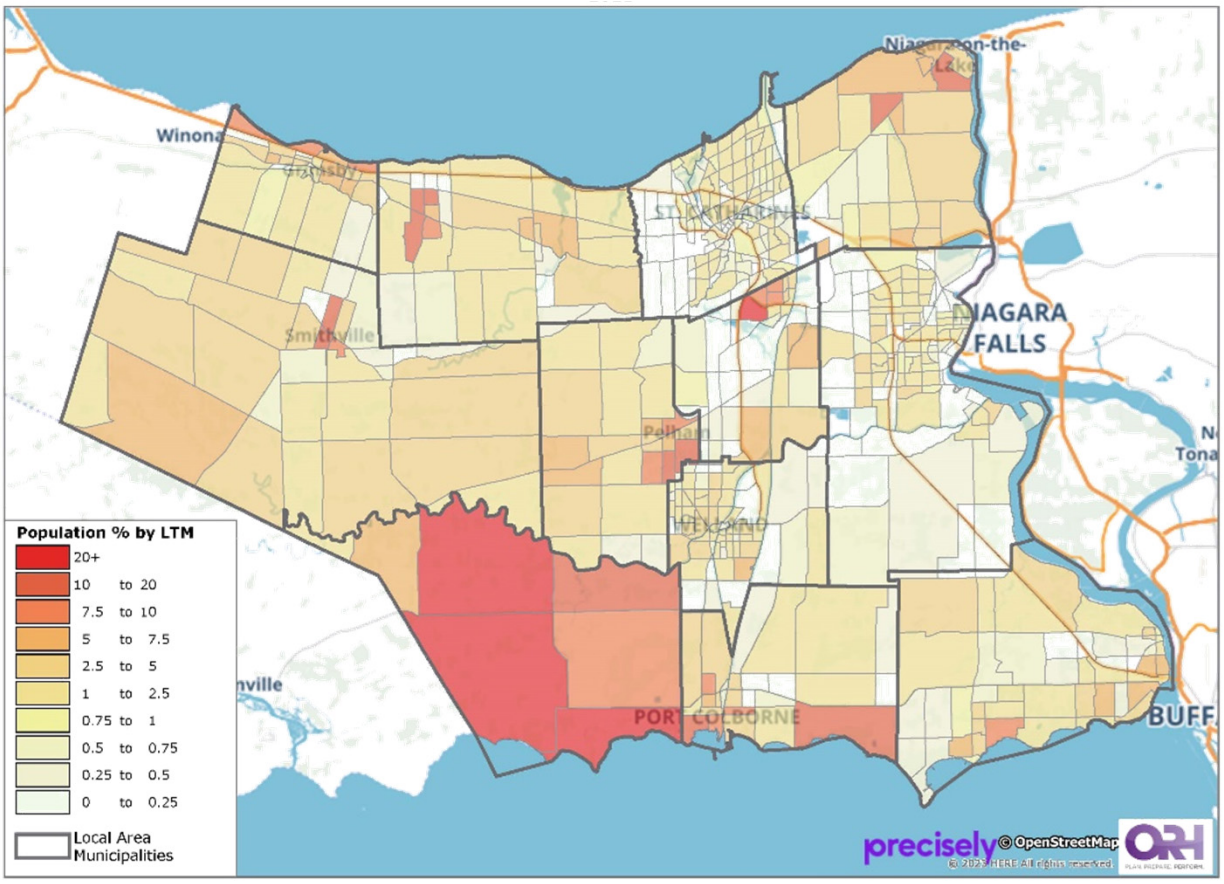
C1

Population Data Summary

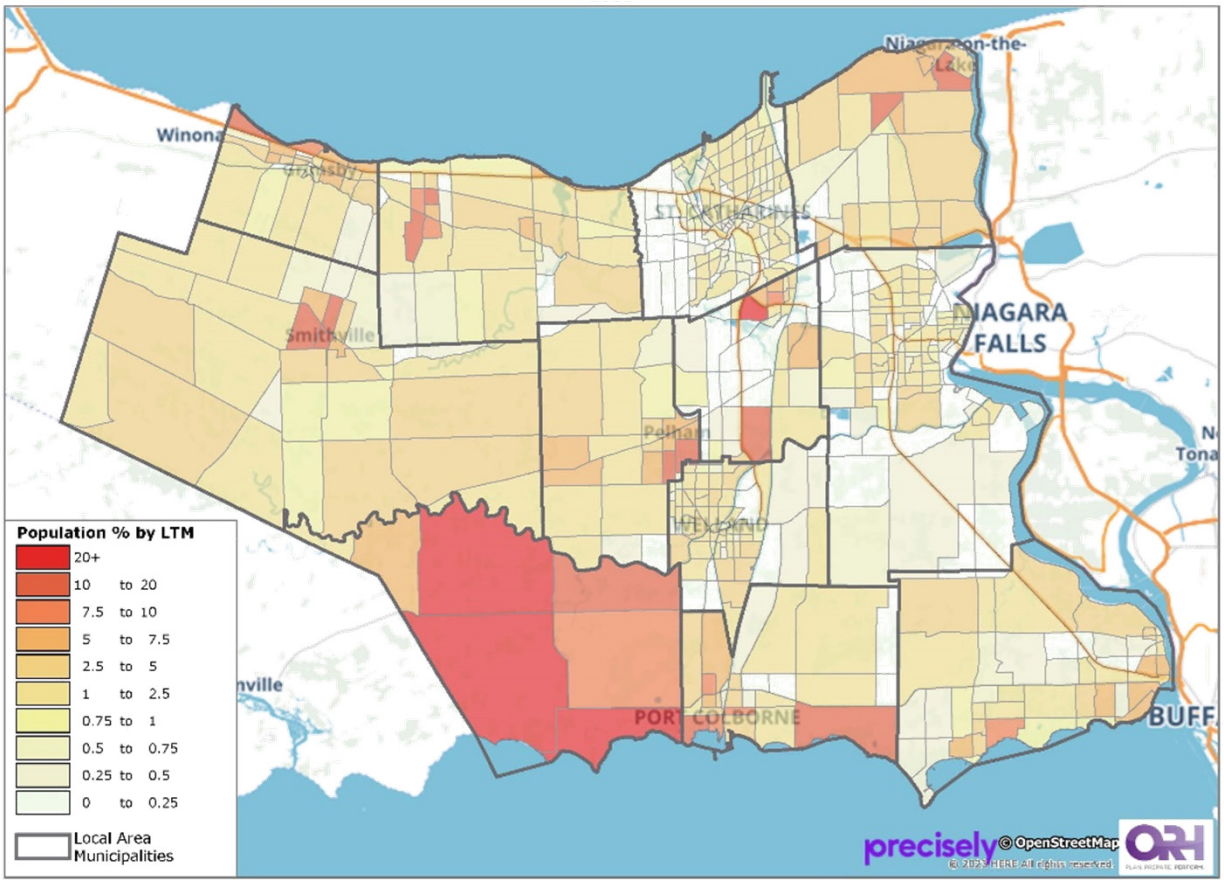


Traffic Zone Population Changes– Percentage by Municipality

2021

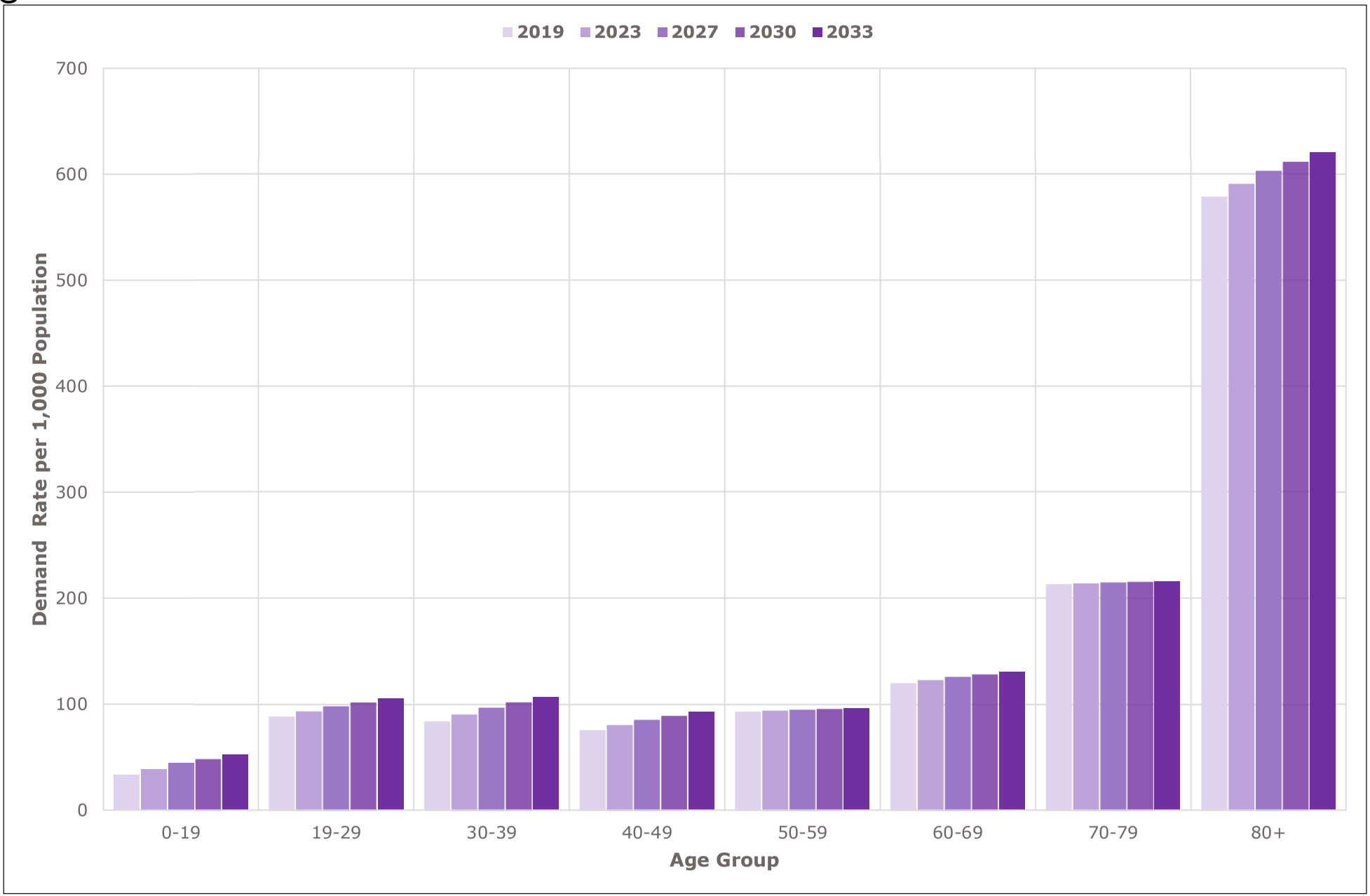


2033



C3

Demand Rates



Note:

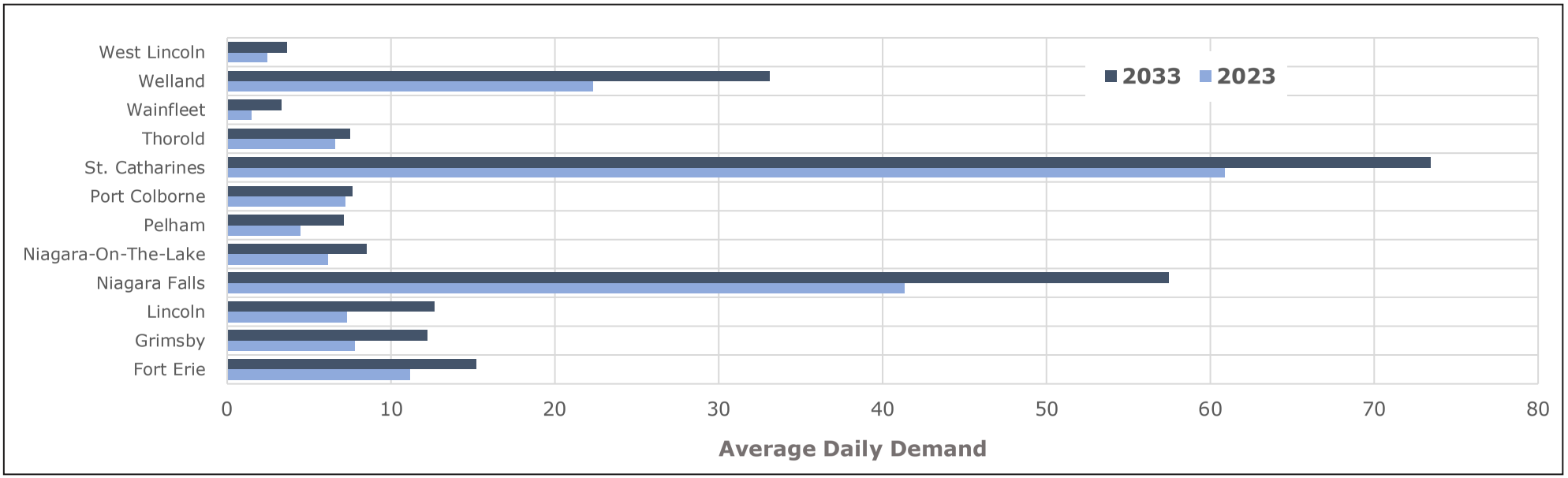
- Excludes 2020 when projecting demand rates

C4

Demand Projections by Municipality

Average Daily Demand

Municipality	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	d
Fort Erie	10.8	11.1	11.5	11.9	12.2	12.6	13.0	13.4	13.8	14.3	14.7	15.2	141%
Grimsby	7.4	7.8	8.1	8.4	8.8	9.3	9.7	10.2	10.6	11.1	11.6	12.2	164%
Lincoln	6.8	7.3	7.7	8.2	8.7	9.2	9.8	10.3	10.9	11.4	12.0	12.6	185%
Niagara Falls	39.5	41.3	43.1	44.7	46.2	47.8	49.4	51.0	52.6	54.1	55.8	57.4	145%
Niagara-On-The-Lake	5.9	6.1	6.3	6.5	6.8	7.0	7.2	7.5	7.7	8.0	8.2	8.5	144%
Pelham	4.2	4.5	4.7	5.0	5.2	5.5	5.8	6.0	6.3	6.6	6.8	7.1	169%
Port Colborne	7.1	7.2	7.3	7.4	7.5	7.6	7.6	7.7	7.7	7.7	7.7	7.6	108%
St. Catharines	59.2	60.9	62.5	63.8	64.9	66.3	67.6	68.7	69.9	71.1	72.2	73.4	124%
Thorold	6.4	6.6	6.7	6.9	7.0	7.1	7.2	7.2	7.3	7.4	7.4	7.5	118%
Wainfleet	1.3	1.5	1.6	1.8	1.9	2.1	2.3	2.5	2.7	2.9	3.1	3.3	251%
Welland	21.2	22.3	23.4	24.4	25.3	26.4	27.5	28.5	29.6	30.7	31.9	33.1	156%
West Lincoln	2.3	2.5	2.6	2.7	2.8	2.9	3.0	3.1	3.2	3.4	3.5	3.6	154%
Overall	**172.2**	**179.0**	**185.6**	**191.6**	**197.3**	**203.7**	**210.1**	**216.2**	**222.4**	**228.6**	**235.0**	**241.6**	**140%**



'Do Nothing' Response Performance by Municipality

'Do Nothing' 2033

Municipality	P1 Mean	P2 Mean	P1 8-minute	P2 15-minute	P3 30-minute	P4 60-minute	P5 120-minute
Fort Erie	09:11	12:54	58.6%	71.3%	40.7%	38.7%	62.5%
Grimsby	09:26	10:48	44.8%	81.2%	43.6%	41.8%	69.1%
Lincoln	09:42	13:01	44.5%	66.4%	42.0%	52.2%	70.7%
Niagara Falls	06:37	10:46	74.5%	82.1%	47.5%	50.0%	77.5%
Niagara-on-the-Lake	08:45	13:13	49.5%	67.1%	48.0%	48.4%	74.8%
Pelham	07:57	12:19	56.6%	70.7%	51.6%	57.3%	82.3%
Port Colborne	08:02	12:00	63.5%	75.3%	48.5%	37.0%	79.1%
St Catharines	06:06	10:44	81.7%	81.4%	49.2%	50.4%	76.3%
Thorold	08:10	12:08	55.7%	75.4%	48.8%	56.0%	78.3%
Wainfleet	12:12	14:50	23.5%	58.0%	49.7%	68.1%	80.8%
Welland	05:27	09:50	88.8%	84.7%	53.4%	49.5%	80.5%
West Lincoln	10:18	12:29	39.0%	64.6%	45.7%	52.8%	76.4%
Overall	**07:09**	**11:13**	**70.8%**	**78.6%**	**48.2%**	**48.2%**	**76.2%**

Difference from 2023 Base Position

Municipality	P1 Mean	P2 Mean	P1 8-minute	P2 15-minute	P3 30-minute	P4 60-minute	P5 120-minute
Fort Erie	02:06	03:05	-14.8%	-15.5%	-39.4%	-42.4%	-33.6%
Grimsby	01:45	01:42	-13.6%	-10.0%	-36.4%	-40.6%	-25.1%
Lincoln	00:47	01:36	-1.5%	-10.3%	-34.1%	-36.5%	-25.0%
Niagara Falls	00:39	01:39	-7.0%	-9.9%	-32.6%	-36.7%	-19.6%
Niagara-on-the-Lake	00:28	01:16	-2.3%	-6.5%	-28.5%	-34.0%	-20.8%
Pelham	01:27	02:52	-15.5%	-17.2%	-32.0%	-33.3%	-16.2%
Port Colborne	01:56	02:56	-18.7%	-14.7%	-33.2%	-41.5%	-18.3%
St Catharines	00:29	01:41	-4.9%	-10.9%	-31.4%	-35.3%	-20.1%
Thorold	01:09	02:03	-12.9%	-13.0%	-29.9%	-33.7%	-19.1%
Wainfleet	01:29	02:19	-5.2%	-12.9%	-28.4%	-30.4%	-17.0%
Welland	00:27	01:48	-4.9%	-9.3%	-32.8%	-36.9%	-16.7%
West Lincoln	01:48	02:40	-10.1%	-15.3%	-36.2%	-38.1%	-23.1%
Overall	**00:54**	**01:55**	**-8.1%**	**-11.3%**	**-32.6%**	**-37.0%**	**-20.5%**

Note: Priority 1 & 2 measured from time first vehicle assigned. Priority 3-5 measured from time of call.

D Identifying Vehicle Requirements

D1 Improving Coverage in Every Municipality - Response Performance

D2 Minimum Requirements to Offset Demand - Response Performance

D3 Meeting Targets in Every Municipality - Response Performance

Improving Coverage in Every Municipality - Response Performance

Performance under Scenario

Municipality	P1 8-minute	P2 15-minute	P3 30-minute	P4 60-minute	P5 120-minute	P1 Mean	P2 Mean
Fort Erie	79.3%	90.7%	83.5%	83.2%	96.3%	06:32	09:05
Grimsby	83.1%	97.6%	86.4%	85.7%	94.8%	05:39	06:37
Lincoln	70.1%	89.6%	83.2%	91.5%	96.3%	07:07	09:14
Niagara Falls	86.4%	92.8%	79.9%	86.4%	97.0%	05:29	08:32
Niagara-on-the-Lake	80.5%	93.4%	84.1%	86.5%	96.4%	06:12	09:02
Pelham	77.4%	90.6%	85.1%	91.6%	98.6%	06:07	08:56
Port Colborne	86.7%	92.8%	84.6%	79.4%	97.5%	05:11	07:37
St Catharines	90.1%	93.2%	82.1%	86.9%	96.3%	05:10	08:31
Thorold	71.1%	90.9%	80.2%	90.1%	97.0%	06:42	09:38
Wainfleet	37.4%	77.3%	80.7%	98.7%	97.7%	09:44	11:33
Welland	94.0%	94.9%	87.4%	87.0%	97.2%	04:51	07:39
West Lincoln	67.0%	89.1%	88.9%	93.9%	99.6%	06:39	08:08
Overall	**84.7%**	**92.6%**	**83.0%**	**86.5%**	**96.7%**	**05:40**	**08:30**

Difference from 2023 Base Position

Fort Erie	5.9%	3.9%	3.3%	2.1%	0.2%	-00:32	-00:44
Grimsby	24.8%	6.4%	6.4%	3.3%	0.6%	-02:02	-02:29
Lincoln	24.1%	12.9%	7.2%	2.7%	0.6%	-01:48	-02:11
Niagara Falls	4.9%	0.9%	-0.2%	-0.2%	-0.1%	-00:30	-00:36
Niagara-on-the-Lake	28.7%	19.8%	7.6%	4.1%	0.8%	-02:06	-02:55
Pelham	5.3%	2.8%	1.5%	0.9%	0.1%	-00:24	-00:31
Port Colborne	4.5%	2.8%	2.9%	1.0%	0.1%	-00:55	-01:27
St Catharines	3.6%	0.9%	1.4%	1.1%	0.0%	-00:26	-00:31
Thorold	2.5%	2.5%	1.5%	0.4%	-0.3%	-00:19	-00:28
Wainfleet	8.6%	6.5%	2.6%	0.2%	-0.1%	-00:59	-00:57
Welland	0.2%	0.9%	1.2%	0.6%	-0.1%	-00:09	-00:22
West Lincoln	17.9%	9.2%	7.0%	3.1%	0.1%	-01:51	-01:41
Overall	**5.8%**	**2.6%**	**2.2%**	**1.2%**	**0.0%**	**-00:35**	**-00:48**

Response Performance Summary
Minimum Requirement to Offset Demand

P1 within 8 minutes

Municipality	Base Position (2023)	Do Nothing (2033)	Min. Req. to Offset Demand (2033)	Diff. to Base
Fort Erie	73.6%	58.6%	74.7%	1.3%
Grimsby	55.2%	44.8%	52.5%	-5.8%
Lincoln	49.3%	44.5%	56.4%	10.4%
Niagara Falls	81.6%	74.5%	84.0%	2.5%
Niagara-on-the-Lake	50.9%	49.5%	59.3%	7.5%
Pelham	72.5%	56.6%	76.2%	4.1%
Port Colborne	83.1%	63.5%	82.6%	0.4%
St Catharines	86.6%	81.7%	89.0%	2.5%
Thorold	68.4%	55.7%	69.5%	0.9%
Wainfleet	30.5%	23.5%	27.1%	-1.6%
Welland	93.8%	88.8%	93.7%	-0.1%
West Lincoln	39.7%	39.0%	59.7%	10.6%
Overall	**78.9%**	**70.8%**	**80.4%**	**1.5%**

Below 80% | Below 70% | Below 70% **and** Degradation from Base Position

Cannot raise Grimsby or Wainfleet performance without significant additional resource or new facilities

Response Performance Summary
Meeting Targets in Every Municipality

P1 within 8 minutes

Municipality	Base Position (2023)	Do Nothing (2033)	Meeting Targets in Every Municipality (2033)	Difference to Base
Fort Erie	73.4%	58.6%	82.7%	9.3%
Grimsby	58.4%	44.8%	85.8%	27.4%
Lincoln	46.0%	44.5%	84.3%	38.3%
Niagara Falls	81.5%	74.5%	88.1%	6.6%
Niagara-on-the-Lake	51.8%	49.5%	83.3%	31.6%
Pelham	72.1%	56.6%	85.6%	13.5%
Port Colborne	82.1%	63.5%	90.2%	8.0%
St Catharines	86.6%	81.7%	93.0%	6.4%
Thorold	68.6%	55.7%	80.3%	11.7%
Wainfleet	28.7%	23.5%	80.2%	51.4%
Welland	93.7%	88.8%	94.8%	1.1%
West Lincoln	49.1%	39.0%	82.0%	32.9%
Overall	**78.9%**	**70.8%**	**89.0%**	**10.1%**

Below 80%

Below 70%

Below 70% **and** Degradation from Base Position

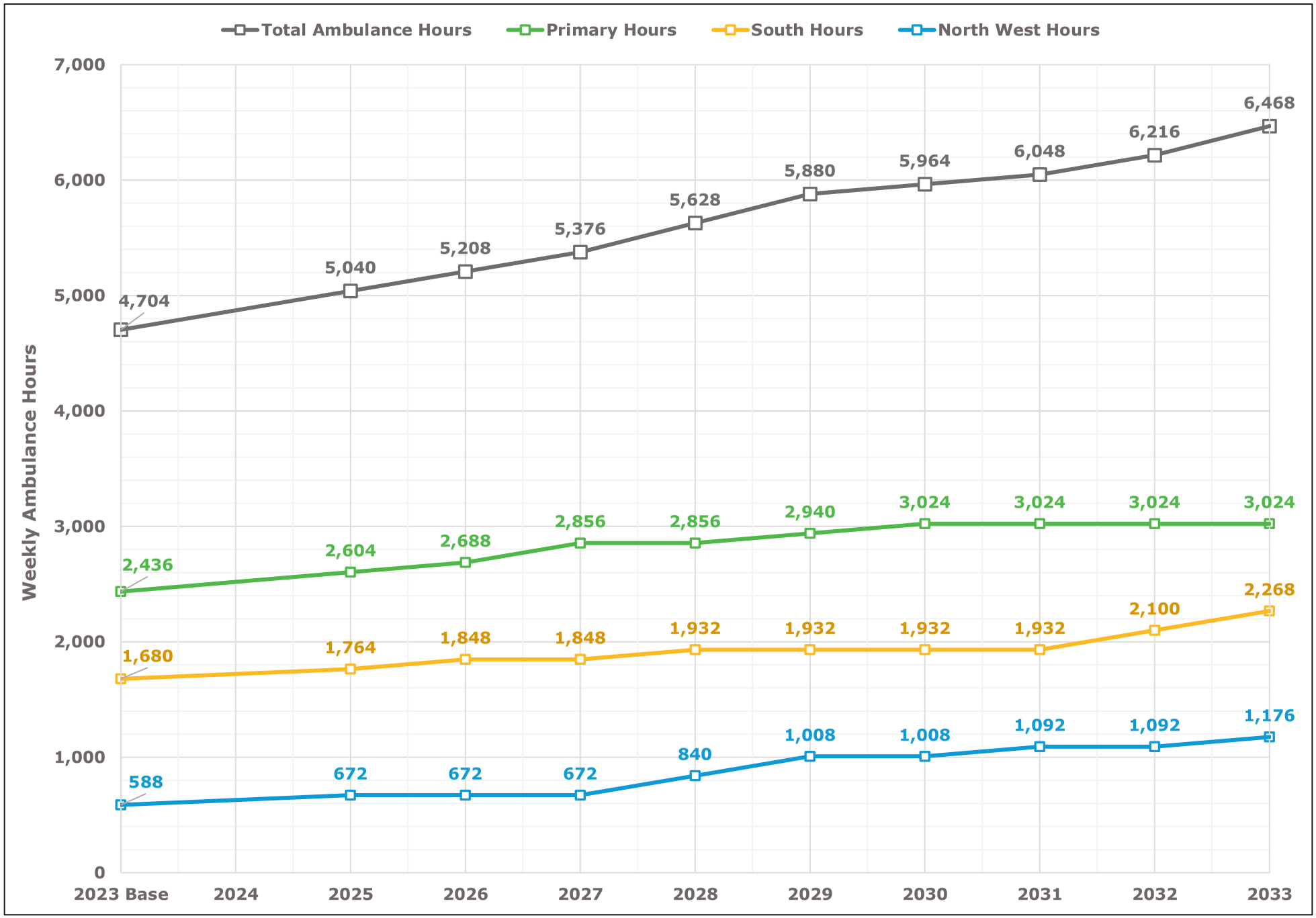
E Recommended Trajectory

E1 Trajectory Resource Summary

E2 Trajectory Response Performance Summary

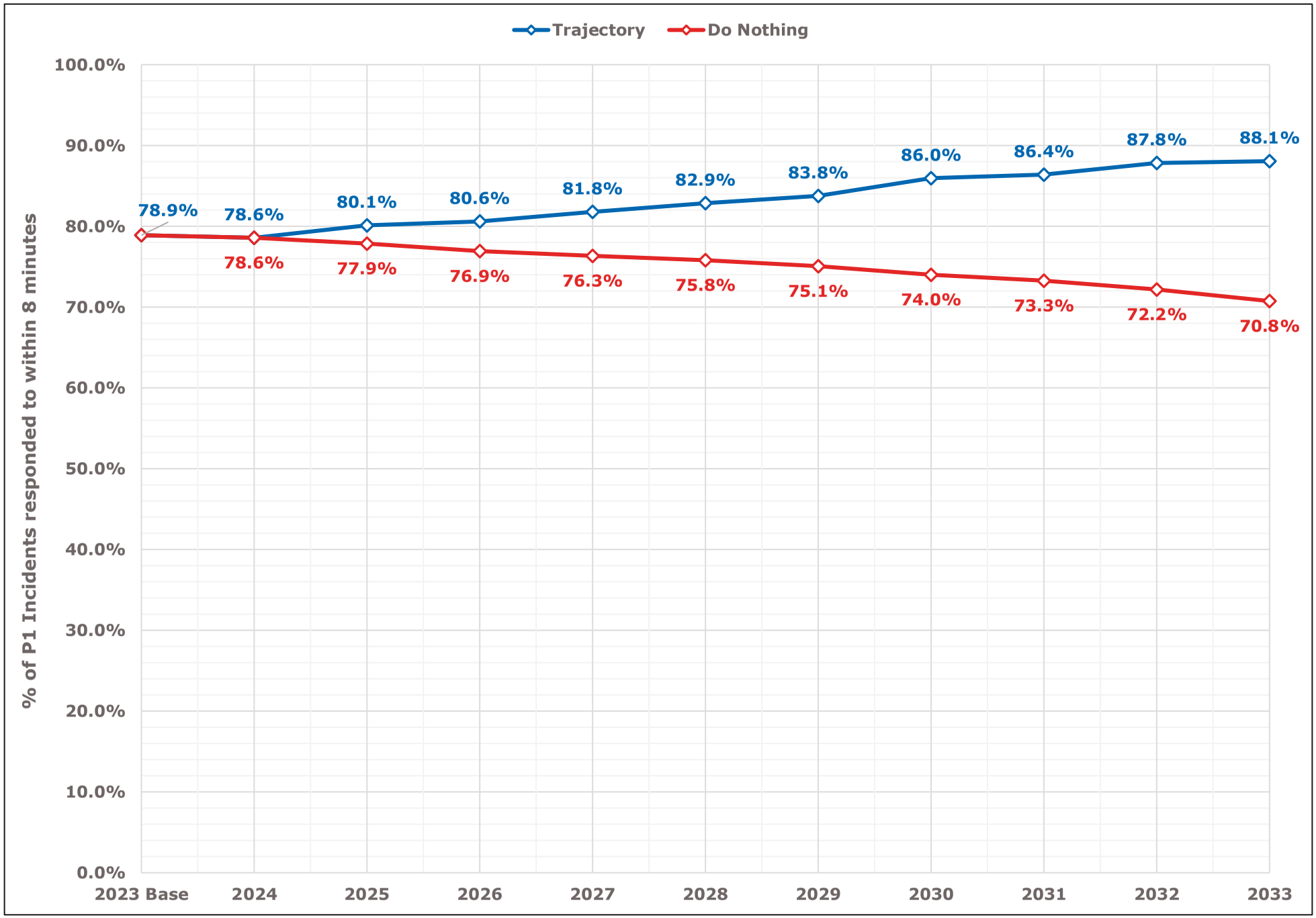
E1

Trajectory Resource Summary



E2

Trajectory Response Performance Summary



F Sensitivity Modelling

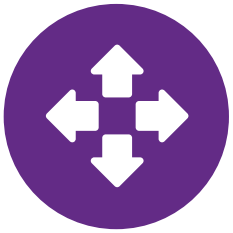
F1 Response Performance using Alternate Locations

F1

Response Performance Impacts of Alternative Sites

			Moving from Optimal to Alternative			Moving from Alternative to Optimal		Moving from Optimal to Alternative			Moving from Alternative to Optimal	
P1 within 8minutes			**Response Performance with Site Changes**					**Difference to Core Scenario**				
Municipality	Base Position (2023)	2033 Recommended Hub, Spoke and Post Scenario	Anderson Ln instead of **Virgil**	Thorold Stone Rd/Prince Charles Dr instead of **Welland North**	Kitchener St instead of **Niagara Falls East**	Grimsby (New) instead of **Clarke St**	Netherby Rd /Morris Rd instead of **Netherby Rd /Montrose Rd**	Anderson Ln instead of **Virgil**	Thorold Stone Rd/Prince Charles Dr instead of **Welland North**	Kitchener St instead of **Niagara Falls East**	Grimsby (New) instead of **Clarke St**	Netherby Rd /Morris Rd instead of **Netherby Rd /Montrose Rd**
Fort Erie	73.4%	75.5%	75.4%	75.3%	75.3%	75.3%	75.5%	-0.2%	-0.3%	-0.2%	-0.2%	-0.1%
Grimsby	58.4%	78.3%	78.3%	78.3%	78.3%	84.9%	78.3%	0.0%	0.0%	0.0%	6.7%	0.1%
Lincoln	46.0%	75.9%	76.1%	75.9%	75.9%	75.5%	75.8%	0.2%	0.0%	0.0%	-0.4%	-0.1%
Niagara Falls	81.5%	91.9%	91.9%	91.9%	92.2%	92.0%	91.9%	0.0%	0.0%	0.3%	0.1%	0.0%
Niagara-on-the-Lake	51.8%	80.9%	80.0%	81.0%	81.3%	80.8%	80.9%	-1.0%	0.0%	0.4%	-0.1%	0.0%
Pelham	72.1%	80.8%	80.8%	81.7%	80.9%	80.9%	81.2%	0.0%	0.9%	0.1%	0.1%	0.4%
Port Colborne	82.1%	88.9%	89.0%	89.2%	89.1%	89.2%	88.8%	0.1%	0.3%	0.2%	0.3%	0.0%
St Catharines	86.6%	93.8%	93.7%	93.8%	93.8%	93.8%	93.8%	0.0%	0.1%	0.1%	0.0%	0.1%
Thorold	68.6%	77.3%	77.5%	76.9%	77.3%	77.5%	77.3%	0.2%	-0.4%	0.0%	0.2%	0.1%
Wainfleet	28.7%	39.0%	38.6%	39.3%	39.0%	39.1%	38.4%	-0.5%	0.3%	-0.1%	0.1%	-0.6%
Welland	93.7%	96.9%	96.8%	96.5%	96.9%	96.9%	96.9%	-0.1%	-0.4%	0.0%	0.0%	0.0%
West Lincoln	49.1%	68.7%	68.9%	68.9%	69.0%	69.8%	68.8%	0.3%	0.2%	0.3%	1.2%	0.1%
Overall	**78.9%**	**88.1%**	**88.0%**	**88.0%**	**88.2%**	**88.4%**	**88.1%**	**0.0%**	**0.0%**	**0.1%**	**0.4%**	**0.0%**

Emergency Service Planning



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