STAFF REPORT
Fire Rescue Services

Title:	Fire Master Plan
Report Number:	COM2023-024
Author:	Richard Hepditch, Fire Chief
Council Date:	November 27, 2023
File:	N/A
Attachments:	Appendix A - Fire Master Plan
Ward No.:	All

Recommendations:

1. That Council approve report COM2023-024.
2. That Council approve the Fire Master Plan, 2023-2032 and next step implementation actions as outlined in report COM2023-024.
3. That Council direct staff to bring forward recommendations with budget implications as outlined in COM2023-024 as part of the staff tabled 2024-2026 budget and 2027 budget as a service level increase, for Council's approval.

A. Executive Summary

This staff report presents Council with strategic outcomes and public safety priorities pertaining to the completion of a Fire Master Plan (FMP) that includes a Community Risk Assessment as mandated by the Office of the Fire Marshal. The intention of this project is to provide a strategic framework and recommendations that will assist the City of Waterloo Council in determining community safety levels for the next 10 years and beyond. Fire Rescue Services is returning to Council to provide a comprehensive update regarding final recommendations to advance public safety in our community. Key components of the FMP inform the Fire Marshal of Ontario's 3 lines of defence that includes:

1.) Public Education
2.) Fire Code Enforcement
3.) Emergency Response

The FMP was further informed by a Fire Underwriters Survey (FUS) review completed in 2019 and in response to extensive growth in our community over time and projected future growth. Today, forecasted growth is underpinned by the Region of Waterloo and City of Waterloo's response to the Ontario government's plan to increase new homes and

support home development across the City with 16,000 new residential units planned for the City by 2031 (IPPW2023-013).

FUS reports are therefore beneficial to strategic planning. Strategic investments made by the City will be a critical factor as part of that renewal and assist in informing fire insurance rates for residential and commercial properties through the City of Waterloo. Of interest, Fire Rescue Services is preparing for another five year Fire Underwriter Survey (FUS) review in 2024. Coupled with the consultant's recommendations, this staff report includes recommendations identified in the Fire Underwriter Survey assessment completed in 2019.

The FMP project was undertaken in collaboration with POMAX Consulting (the consultant) that included public engagement, community partners, City and Fire Rescue Services staff. Since the beginning of this project in 2022, two staff reports were presented to Council. The first staff report (COM2022-010) was brought to the previous Council on April 4, 2022 to present a preliminary update on the FMP where it was decided the new and incoming Council in the fall of 2022 should decide on the future of fire protection as part of forthcoming budget processes. On June 19, 2023 a second staff report (COM2023-016) was provided to the current Council with preliminary strategic recommendations identified by the FMP consultant.

At that time, Council approved the release of capital funding for the purchase of a new pumper fire truck. Furthermore, Council endorsed the plan to hire 27 staff that includes 24 firefighters in addition to essential support services positions for the purpose of enhancing all aspects of public and firefighter safety. Areas of essential support services positions focus on positions aimed at enhanced firefighter training, technical maintenance and mechanical, and fire administration that includes responsibilities such as City and corporate oversight of the legislated emergency management program. All positions are recommended to be phased-in as part of the staff tabled 2024-2026 budget and the 2027 budget.

Subject to Council's approval as part of the 2024-2026 budget in February this staffing increase follows strategic increases in 1987 when previous Council opened the Northfield fire station, and again in 2011 when the University Avenue station was built to primarily serve the East side of the City. This staffing and resource requests will primarily serve the West side of the City at the Columbia Street fire station and, more centrally to 50% of total call volume out of the Weber Street N. fire station. It is important to note that all staff, trucks and resources, regardless of where they are deployed from, will support the entire City when a 9-1-1 call for service is placed in our community.

City and Fire Rescue Services (FRS) staff have been working with key recommendations made by the consultant that identify renovating or relocating the Weber Street N. fire station. Due to the fact that this fire station is in flood plain an architectural consultant has been hired to review and recommend all possible options to enable expansion needs and requirements. Key areas being explored range from renovation and enhancement options at all existing stations through to building a new fifth fire station, or an independent multi-

purpose facility to serve essential support services programs such as a mechanical bay/hoist and the firefighter hygiene program. Upon receipt of the architectural consultants report, FRS will return to Council to broadly inform the capital budget process as it pertains to recommendations associated with expansion, the deployment of staff and equipment and therefore space requirements. Due to the complexity and proposed timelines to advance project recommendations, including risk based solutions and references to the FUS completed in 2019, this staff report should be read in conjunction with the Fire Master Plan.

The FMP further punctuates strategic requirements to inform all aspects of the fire service including fire service culture, community outreach and the use of relational data to continue to inform decision making. This staff report also provides additional information surrounding the Community Risk Assessment and expansion to ensure emergency response capacities are enhanced in addition to essential support services such as: a mechanical bay and hoist, the firefighter hygiene program and storage for large vehicle/specialized response equipment.

Although recommendations are based upon matters pertaining to fire risks and response capacities, the FMP recognizes a need to prepare for a potential shift in priorities subject to a projected reduction in call volume specific to emergency medical response. A strategic planning effort is therefore required over the next 2 years and beyond in response to the Ministry of Health's Medical Priority Dispatching System. By working with Region of Waterloo Paramedic Services, Fire Rescue Service (FRS) continue to respond to priority medical and trauma related emergencies. This projected shift in call volume will allow FRS to focus on core legislated services as they pertain to the City's Establishing and Regulating By-law.

Initial planning to balance core services coupled with the continuation of emergency medical response is highlighted by the use and application of relational data toward the enhancement of public fire safety education, improving FUS grading points (ie. tactical preplanning) with a significant focus on public and firefighter safety through to the expansion of training programs. This staff report therefore presents Council with comprehensive recommendations to inform the forthcoming budget process to phase-in staffing, equipment and resources within the upcoming staff tabled 2024-2026 budget and into the following 2027 budget as part of a recommended four (4) year phase-in plan.

B. Financial Implications

Funding for capital costs of a new building and/or expansion to an existing building or property, is currently included in the 2023 Capital Budget (Ref# 266) for a total amount of $12,090,000 (split over 2023-2024) and fully funded from development charges (DC). This includes capital funding for a new dedicated mechanical bay. Staff are currently forecasting that this $12M will be re-budgeted to 2024 as part of the staff tabled 2024-2026 capital budget. Although not currently planned, should the final location and design plans include rehabilitation of existing space or service level increases, there may be an additional funding requirement of capital dollars from the Capital Infrastructure Reinvestment

Reserve Fund (CIRRF) or Capital Reserve Fund (CRF) respectively to accommodate the non-growth related portion. These needs have not yet been quantified or budgeted, and will require additional review and will be managed within existing funding envelopes.

Also included in the capital forecast (Ref#256) for $394,000 of funding in 2024 is personal protective equipment (PPE), and other capital equipment required for new Fire Rescue Services personnel (also fully funded from DC). This project will be included in the staff tabled 2024-2026 capital budget (2024). One new expansion fire truck was included in the 2023 Capital Budget funded by DC for $1,625,000 (ref#267) and was approved by Council with funding released in June 2023 via report COM2023-016. The other expansion apparatus recommended as a result of the findings of the FMP is for a fire rescue squad/light-rescue expansion vehicle that has been added to the staff tabled 2024-2026 capital budget and is estimated to cost $425,000.

The staff tabled 2024-2026 capital budget will be released by staff on December 11, 2023.

As assets are rehabilitated (e.g. space planning for a fire station) or added to the City's asset inventory (e.g. new PPE, fire response vehicles), the asset data will be used to inform the City's asset management processes and reporting. The City has invested a significant amount of time, effort, and funding to support community growth and provide emergency response capabilities. That same level of dedication is necessary in the coming years to maintain, rehabilitate, and replace these critical community assets.

Endorsed by Council (COM2023-016) and to be considered as part of the 2024-2026 and 2027 budget process, the operating costs include the addition of 27 Full Time Equivalents (FTE) staff. This includes the addition of 24 additional firefighters to cover 24 hours of service required as well as a Chief Mechanical Officer (day position), Chief Training Officer (day position), and an Assistant Deputy Chief. The operating costs also include fire apparatuses ongoing cost, software for staff training purposes, building operating costs and other incremental costs due to expansion.

The total operating cost is estimated to be $5,051,000 and is proposed to be phased-in over the 2024-2026 operating budget and 2027 operating budget. The operating cost of Fire expansion is a service level increase and would be over and above CPIX (currently at 4.28% on a 12-month average as of September 2023 data). Staff will look to phase this increase in over multiple years with the annual service level increase being in the range of 1.0%-1.5%, subject to Council approval as part of budget.

C. Technology Implications

The Fire Master Plan recommends various software enhancements associated with data analysis, fire prevention inspections, live geographic positioning systems (completed) and hands-free-user-gear equipment to assist with current emergency communications (dispatch) technologies. As a starting point, such technologies, other than required software for fire prevention and self-directed training, will be considered through existing

software within the divisions of Fire Rescue Services and Information Management Technology Services (IMTS) for the purpose of data analysis and decision making.

D. Link to Strategic Plan

(Strategic Priorities: Reconciliation, Equity, Accessibility, Diversity and Inclusion; Environmental Sustainability and Climate Action; Complete Community; Infrastructure and Transportation Systems; Innovation and Future-Ready)

(Guiding Principles: Equity and Inclusion; Sustainability; Integrity; Workplace Wellbeing; Community-centred; Operational Excellence)

- Reconciliation, Equity, Accessibility, Diversity and Inclusion: Workforce diversification and enhanced public education strategies such as English as a second language and the annual Regional Emergency Services Career Camp.
- Environmental Sustainability and Climate Action: Active planning underway as part of the forthcoming Corporate Climate Action Plan including smaller vehicles ie. New squad vehicle.
- Complete Community: Enhance community vibrancy through fire and life safety education, fire and emergency medical response thereby protecting life, property and the environment including parks, cultural and public spaces.
- Infrastructure and Transportation Systems: Operational excellence through enhanced service capacity to protect infrastructure and specialized response to Light Rail Transit emergencies.
- Innovation and Future Ready: Strategic fire prevention/safety education such as aging adults, enhanced response capacities highlighted by service level changes to enhance core services

E. Previous Reports on this Topic

COM2023-016 Fire Master Plan Update, June 19 2023

COM2022-010 Fire Master Plan Update, April 3, 2022

Fire Master Plan
COM2023-024

BACKGROUND: SUMMARY OF FIRE UNDERWRITER SURVEY REVIEW (2019), AND RECENT STAFF REPORTS (COM2022-010 and COM2023-016)

Summary of Fire Underwriter Survey Review, 2019

Prior to the current Fire Master Plan project, in 2019 the Fire Underwriters Survey (FUS) conducted an assessment of each area of the City of Waterloo's (the City) fire defenses primarily for fire insurance grading and classification purposes. Planned at 5 year intervals, the City is expected to undergo another review in early 2024. Among many priorities, recommendations outlined in the FMP are aimed at maintaining and/or enhancing various classifications that can impact commercial and residential insurance ratings.

The FUS is a national organization that represents approximately 90% of the private sector and casualty insurers across Canada. FUS utilizes two grading processes. The first grading process is the Public Fire Protection Classification (PFPC) that evaluates the ability of a community's fire protection programs to prevent and control major fires that may occur in a multi-family residential, commercial, industrial, institutional buildings and construction developments.

The second grading system is the Dwelling Protection Grade that assess the protection available for small buildings such as single family dwellings. For the purpose of fire insurance classification, and therefore cost to property owners, overall grading consists of four categories as outlined in the table below.

Table 1: Fire Underwriters Survey Grading Classification and Relative Data Points

	Grading Classification	Sections Evaluated (Data Points)	Value (100%)	Relative Classification (2018)
1.	Fire Department	19	40%	4 (25.76%/40%)
2.	Water Supply	15	30%	2 (25.72%/40%)
3.	Emergency Communications	4	10%	2 (8.61%/10%)
4.	Fire Safety Control (Fire Prevention and Public Education)	5	20%	5 (10.98%/20%)

Summary: City of Waterloo Relative Classification: 4 and Final Points: 66.86%/100

Similar to fire master planning (i.e. the mandatory Office of the Fire Marshal Community Risk Assessment), grading and recommendations completed by FUS are based upon fire risks as they pertain to public safety. FUS reports are therefore beneficial to establishing commercial and residential property insurance rates, but also beneficial to planning the future direction of fire protection services. Such inputs and outcomes are directly associated with enhancing the opportunity to enhance the Fire Marshal of Ontario's 3 lines of fire and life safety defence that includes:

1.) Public Education
2.) Fire Code Enforcement
3.) Emergency Response

For the City of Waterloo, the assessment completed by FUS in 2019 identified concerns that revolved around a lack of capacity for fire prevention inspection activities (due to staff capacity) and available fire suppression resources were noted to be of concern to overall grading through recommendations such as:

- Additional pumper company (recommended at total 6 pumpers, 2 ladders/towers);
- Distribution of companies (first response time grading benchmarks not met for 1st and 2nd on-scene pumpers); and,
- Staff capacity (recommended an increase staffing and/or additional staffing or add additional pumper with adequate staffing); and, Pre-fire planning (lack of staffing creates gap).

The 2019 FUS review has informed the fire master planning process and is aligned with the identification of fire safety risks, priorities and programs outlined in the legislated Community Risk Profile. With the exception of the 2019 FUS report identifying that a new fire station should be built to enhance first response to the West-side of the City, versus the FMP consultant advising on a second truck and crew at the Columbia Street station. Consultant Recommendations to increase staffing, additional front-line fire apparatus and overall enhanced fire response capacities are directly aligned with the FUS review completed 5 years ago. .

Such recommendations, at minimum, seek to maintain and/or improve all grading points for commercial/industrial and residential properties. FUS reports are therefore beneficial to strategic planning. Strategic investments made by the City will be a critical factor as part of that renewal and assist in informing fire insurance rates for residential and commercial properties through the City of Waterloo. Of interest, Fire Rescue Services is preparing for another five year Fire Underwriter Survey (FUS) review in 2024.

Summary of recent staff reports (COM2022-010 and COM2023-016)

In January, 2022 FRS completed a procurement process and the consultant was awarded a contract to complete a Community Risk Assessment and Fire Master Plan. The intention

of this project approved by Council was to provide a strategic framework and recommendations that will assist the City of Waterloo Council in determining community safety levels for the next 10 years and beyond.

A fire master plan update staff report (COM2022-010) was brought to the former Council in April, 2022 that outlined initial findings identified by the consultant that were, consequently, in alignment with the risks identified in the FUS report completed in 2019. At that time, Council decided to defer the FMP to the incoming Council of the present day. More recently, a second staff report (COM2023-016) was presented to Council in June, 2023. This staff report focussed on preliminary recommendations brought forward by the consultant and initial consultant/staff recommendations that were approved by Council, including:

1) *That Council approve report COM2023-016;*
2) *That Council approve the release of 2023 capital funding for the new Fire Rescue Pumper project in the amount of $1,625,000 funded by Development Charges, as approved in the 2023 Capital Budget (Ref #267); and,*
3) *That Council endorse a phased staffing model as outlined in the financial section of this staff report, subject to approval as part of the 2024-2026 budget."*

Council was further advised that:

- Since 1989 (Northfield Drive Fire Station #3) Fire Rescue Services has only increased staffing once in 2011 (University Avenue Fire Station #4). It was therefore anticipated that recommendations outlined in the FMP, following 34 years of significant growth by the end of this budget, would indicate a need to increase staffing, front-line fire apparatus/equipment and support services infrastructure such as a mechanical bay and hoist.
- Forecasted growth is underpinned by the Region of Waterloo and City of Waterloo's response to the Ontario government's plan to increase new homes and support home development across the City with 16,000 new residential units planned for the City by 2031 (IPPW2023-013).
- All reports, including preliminary recommendations outlined in the Fire Master Plan, recognized emergency response time challenges associated with ongoing trends of enhanced traffic calming/road space reductions (i.e. for bicycle lanes) throughout the City, the recent construction of light rail transit infrastructure, and significant high density redevelopment and intensification occurring in many parts of the community.
- The consultant is recommending, contrary to the 2019 FUS report, the City should not build a new fire station, but rather increase response capacities out of the Columbia Street Fire Station #2. If an additional fire truck and crew is deployed from Fire Station #2 space planning solutions are needed to accommodate expansion requirements such as the firefighter hygiene/decontamination program, a mechanical bay/hoist and large vehicle storage. Various options were (and continue) to be explored with an architectural consultant such as making improvements to an existing fire station, or constructing a new space for essential support services within the City

through to the prospect of building a new fire station to address all expansion needs in one location from emergency response through to essential support services.
- In addition to requesting a new front-line fire truck, a new squad/light-rescue response expansion vehicle is also recommended in order to address approximately 50% of the City's total call volume from the Weber Street Fire Station #1.
- Both response vehicles, deployed from Stations #1 and #2, would provide strategic support in their respective response areas, but throughout the entire community for first and secondary response to fire incidents, including low/high rise properties, and tiered response medical emergencies. FRS informed Council that staff would return to Council in the fall of 2023 to present a finalized Fire Master Plan that would include additional details surrounding the Community Risk Assessment, fire prevention and public education, and support services space planning needs and recommendations.

FIRE MASTER PLAN 2023: SUMMARY OF THE CONSULTANTS FINDINGS AND KEY RECOMMENDATIONS

Community Risk Assessment

The Fire Protection and Prevention Act, 1997, S.O. 1997, c.4 mandates that every municipality, and every fire department in a territory without municipal organization, must:

- Complete and review a community risk assessment as provided by this Regulation; and,
- Use its community risk assessment to inform decisions about the provision of fire protection services.

Mandatory profiles of the Community Risk Assessment process

Specific to the City of Waterloo, the following is a summary of mandatory profiles and key findings associated with high risk unless otherwise stated (Note: Each profile is to be interpreted as extending *only* to matters relevant to fire protection services):

1. Geographic profile: Highway 85, and response to light rail transit emergencies.

2. Building stock profile: Residential properties single detached through 7+ multi-unit properties i.e. Truss-light-weight construction, older building stock, including high rise properties where fires are difficult to suppress and evacuation is often ignored.

3. Critical infrastructure profile: Critical infrastructure is a key profile highlighting various infrastructure such as natural gas and hydro energy, Region of Waterloo and City properties.

4. Demographic profile: Higher risks were associated with retirement age citizens (65-79 yrs.) that are currently active in the workforce and our aging population overall. Considered difficult to reach due to schedules, working age adults are also a focus of expanded public education efforts in addition to a need to increase public education.

5. Hazard profile: Human health emergencies and cyber attack.

6. Public safety response profile (NOTE: Risks not ranked for this profile): Fire response delays due to light rail transit crossing from Station #3 (Northfield Drive) and aging infrastructure i.e. Fire Station #1 (Weber Street N.) constructed in 1966.

7. Community services profile (NOTE: Risks not ranked for this profile): Identified the types of services provided by other entities in the community, and those entities' service capabilities such as media partners, energy supply and emergency relief assistance.

8. Economic profile: 99% of economic sectors affecting the community that are critical to financial sustainability ranked as moderate risk versus 1% being high risk.

9. Past loss and event history profile: Past fire loss data reflects the main causes of fires in the City are similar to the main causes of fires in the Province. This includes unsafe cooking practices, careless use of smoking materials, heating equipment, appliance and electrical distribution equipment fires.

FIRE MASTER PLAN: CONSULTANTS KEY RECOMMENDATIONS

Consultant Recommendation #1: "That Waterloo Fire Rescue continues to develop the role of all staff in prevention and education activity."

Next steps: Expand involvement and design involvement of fire suppression staff's role in on-shift fire prevention and public education programs to lower fire risk in the community. Continue to intersect programs with pre-incident planning and time allocation pending outcomes associated with the Ministry of Health's Medical Priority Dispatch System (potential reduction of tiered response calls by 50%), the expanded analysis of data and the need for enhanced training due to a new workforce.

- Relationship to Fire Underwriters Survey:

A. Fire Department Grading (i.e. Training and qualifications and pre-incident Planning)
B. Fire Safety Control – Fire Prevention and Public Education

Consultant Recommendation #2: "We recommend increasing staffing by one truck, 24 hours a day at station 2 and remodeling station 2 to accommodate the additional staff."

Next steps: Council released funding for an additional pumper in June 2023 via council report COM2023-016, procurement of this apparatus has already commenced. If Council approves the capital budget request for fire expansion as a part of the staff tabled 2024-2026 budget 1 new and robust squad/rescue response expansion vehicle will be procured. Continue space planning expansion needs and requirements with an architect consultant as they pertain to the double-occupancy of Station #2 and essential support services

requirements. As new emergency response vehicles are purchased, they will be added to the City's asset inventory and will inform the City's Fire asset management reporting.

- Relationship to Fire Underwriters Survey:

A. Fire Department Grading (i.e. Engine Service, Distribution of Companies, Engine and Ladder Pump Capacities, and Total Fire Force Available)
B. Fire Safety Control – Fire Prevention and Public Education (i.e. General Program)

Consultant Recommendation #3: "We recommend rebuilding station #1, preferably on the existing site, to serve as a fire station and vehicle maintenance and repair facility while avoiding expenditure on new property."

Next steps: Continue work with the architectural consultant to complete a feasibility study as it pertains to bringing forward options for Council consideration regarding the expansion of fire operations and essential support services. Essential support services include technical maintenance and mechanical (i.e. hoist, service bay), the firefighter hygiene program, large and specialized vehicle storage. The current study is probing all available options including the expansion of existing space through to a stand-alone support services building or new fire station to address all expansion needs.

There are potential limitations in regards to the City's ability to be able to expand at current locations. The asset improvements resulting from the expansion of a fire station will be incorporated into the Facilities asset management reporting through the Facilities asset class.

- Relationship to Fire Underwriters Survey:

A. Fire Department Grading (i.e. All components including Design, Maintenance and Conditions of Fire Apparatus)
B. Fire Safety Control – Fire Prevention and Public Education (i.e. General Program)

Consultant Recommendation #4: "We recommend that Waterloo Fire Services strengthen the measurement of performance and outcomes while continuing to evaluate the efficacy of traditional response practices in areas such as:

a) Medical Incidents
    - Undertake a prospective study of medical responses over the next 6 to 12 months – preferably with the assistance of its medical advisor – to record and review services provided at the scene, and to the patient, to determine the percentage of incidents where fire arrives at least two minutes before paramedic services and undertakes life-saving measures such as cardiac or other resuscitation.
    - Based on the study results, determine if response to medical incidents needs to continue at the current volume.
    - By the six-month mark evaluate whether lights and siren response to medical calls is necessary and under what circumstances.

- Determine whether response to medical incidents can efficiently take place using a smaller vehicle such as a mid-size SUV or whether four firefighters in a fire truck is necessary. After appropriate incident analysis, including that of outcome evaluation, if the city decides to continue medical response with the same frequency as current, implement medical response units at all stations.

b) Automatic fire and Carbon Monoxide Alarms
- Undertake a prospective study of automatic alarms over the next 6 to 12 months to determine:
- the number that turns out to be fires, or carbon monoxide where it is unknown if the building was evacuate or other life-threatening circumstance, and for which there was no other form of alert; for example, someone calling from the location within a very short period of time (60 – 120 seconds) reporting smoke or fire.
- Based on the outcome of this study, determine whether response to automatic alarms can be reconfigured to lower the risk of response to firefighters.
- And, based on the findings, assess the possible reconfiguration of response to smoke and carbon monoxide automatic alarms to decrease the number of trucks dispatched.

c) Traffic and Rescue Incidents
- Undertake a prospective study of response to rescue incidents – particularly traffic events – over the next 6 to 12 months to determine:
- the number that turns out to be actual entrapments,
- the number where life-saving intervention was provided, and
- the number where traffic blocking, debris clean up, or spill remediation was provided.
- Based on the outcome of this study, determine whether response to rescue incidents, specifically traffic accidents – can be reconfigured."

Next steps: Working with IMTS staff, Fire Services will continue to advance relational data base toward decision making and continuous improvement for all emergency and non-emergency response call type including, but not limited to medical incidents, automatic fire and carbon monoxide alarms and traffic and rescue incidents. This undertaking will also utilize existing software utilized by IMTS and existing emergency reporting software that was implemented by FRS in 2022.

- Relationship to Fire Underwriters Survey:

A. Fire Department Grading: All components.
B. Water Supply Grading: All components.
C. Emergency Communication Grading: All components.
D. Fire Safety Control – Prevention and Public Education: All components.

Consultant Recommendation #5: "Revise the administrative structure of the fire service to support a business approach to fire safety. This includes hiring a business manager to

free up the Chief and Deputies to champion continuous improvement and long term strategic objectives toward public protection."

Next steps: With the expanded use and application of data Fire Rescue Services will consider this recommendation over the 10 year span of the FMP. Subject to Council's future approval, principles of business management, as starting point, can be achieved by advancing the current contract position of the assistant deputy fire chief to a full-time position recommended as part of the staff tabled 2024-2026 budget. The integration of existing IMTS and records management software to develop relational data reporting into daily operations and planning will continue to be expanded upon.

- Relationship to Fire Underwriters Survey:

A. Fire Department Grading: All components (ie. Administration).
B. Water Supply Grading: All components.
C. Emergency Communication Grading: All components.
D. Fire Safety Control – Prevention and Public Education: All components.

Consultant Recommendation #6: "Implementing a relational incident activity outcome data base to complement the information currently available within the fire record management system as demonstrated in this report"

- Procuring and implementing fire inspection and incident planning software to increase efficiency and effectiveness.
- Procuring and implementing Geographic Positioning – Automatic Vehicle Locating software to more accurately capture apparatus activity and avoid missed data due to human factors (Staff Report note: Completed).
- Working with 9-1-1, fire dispatch, police services, paramedic services to achieve improved Dispatch – Fire Service coordination including fire dispatch support of fire response by capturing on-scene information."

Next steps: Working with IMTS staff, Fire Services will continue to advance relational data base toward decision making and continuous improvement for all operations. Existing fire specific software will be expanded to the Fire Prevention Division in addition to reviewing current records management practices. Geographical positioning software has been included with access to dispatching software while at the same time the Waterloo Regional Police are advancing a project to modernize the 9-1-1 Public Safety Answering Point (PSAP) communication center which will improve service-wide improvement opportunities.

- Relationship to Fire Underwriters Survey:

A. Fire Department Grading: All components (ie. Administration).
B. Water Supply Grading: All components.
C. Emergency Communication Grading: All components.
D. Fire Safety Control – Prevention and Public Education: All components.

Consultant Recommendation #7:

- An Analytics Professional (non-firefighter position)
- A Business Manager (non-firefighter position)
- A Chief Training Officer

- An Assistant Deputy Chief – one permanent position (currently on contract)
- A Fire Prevention Officer
- Firefighter enhancements to improve response and reduce risk in west Waterloo.
- Two full-time mechanic positions (or equivalent) at station 1, one of whom should be a Chief Mechanic.

▪ In the alternative, should the city decide to continue with the four mechanic/firefighters assigned to suppression platoons, we recommend establishment of a Chief Mechanic position on day shift."

Next steps**:** This recommendation includes various positions to support program expansion and the stability of programs and services currently offered and set to be expanded upon as recommended as part of the staff tabled 2024-2026 budget and 2027 budget processes, subject to Council's approval.

- Analytics Professional (non-firefighter position): With the expanded use and application of data Fire Rescue Services will monitor this recommendation over the 10 year span of the FMP. Subject to the full-time approval of the current assistant deputy fire chief's contract position FRS will leverage this position to build relational data bases for the purpose of analytics instead of adding the Analytics Professional at this time.
- Business Manager (non-firefighter position): With the expanded use and application of data Fire Rescue Services will monitor this recommendation over the 10 year span of the FMP. Subject to the full-time approval of the current assistant deputy fire chiefs contract position FRS will leverage this position to build relational data bases for the purpose of business management instead of adding the Business Manager at this time.
- Chief Training Officer: This position was endorsed by Council as recommended in the COM2023-016 staff report. The original chief training officer's position was eliminated in 1997 and due to recent and extensive retirement fire services currently has a new-work force. Coupled with forecasted growth and development in the City and a subject to Council's future approval to hire 24 additional firefighters, this position is considered essential to enhance training and therefore public and firefighter safety.
- Assistant Deputy Chief – one permanent position (currently on contract): This position was endorsed by Council as recommended in the COM2023-016 staff report. Alongside current operational and planning duties, the assistant deputy chief position is required to assist with growth and expansion of records management, business management and data analytics outlined in the Fire Master Plan. This position, subject to Council's future approval will also have operational and corporate training oversight of the legislated position of Community Emergency Management Coordinator.
- Fire Prevention Officer: Fire Rescue Services was successful in hiring one additional fire prevention officer in 2023 (position added as part of the 2020-2022

budget). This position, the capacity of the current division and pressures associated with legislated fire prevention duties/programs, and ie. outstanding files will continue to be monitored through to the 2027 budget and 2028-2030 budget processes to determine the timing of requesting an additional Fire Prevention Officer.

- Two full-time mechanic positions (or equivalent) at Station 1, one of whom should be a Chief Mechanic : As recommended in the COM2023-016 staff report, Council has endorsed one day-shift Chief Mechanical Officer position. Subject to Council's approval of the staff tabled 2024-2026 budget in February 2024, pending the advancement of a Chief Mechanical Officer, fire management will explore various staffing options with existing staff, as opposed to 2 new positions at this time, to support the repair and maintenance of Fire Rescue Services fleet and specialized equipment.
- Firefighter enhancements to improve response and reduce risk in West Waterloo: These positions were endorsed by Council as recommended in the COM2023-016 staff report. The consultant recommends hiring 24 new staff which will staff a front-line pumper to support the West side of the City in addition to enhancing response capacities across the entire City. These firefighters are to be phased-in over 2024 (4), 2025 (8), 2026 (8) and 2027 (4).
- Relationship to Fire Underwriters Survey:

A. Fire Department Grading: All components (ie. Administration).
B. Water Supply Grading: All components.
C. Fire Safety Control – Prevention and Public Education: All components.

FINANCIAL

Capital

Funding for capital costs of a new building and/or expansion to an existing building or property, is currently included in the 2023 Capital Budget (Ref# 266) for a total amount of $12,090,000 (split over 2023-2024) and fully funded from development charges (DC). Staff are currently forecasting that this $12M will be re-budgeted to 2024 as part of the staff tabled 2024-2026 capital budget. Fire stations are considered critical infrastructure and as a result the Building Code requires critical infrastructure to be built to a higher standard than other buildings to withstand emergencies (i.e. high wind and flooding).

Debentures have been identified to be issued for this DC project, with repayment occurring from the DC reserve over 10 years. When this project moves forward towards initiation, finance staff will work with the project manager to determine timing and funding requirements, and ensure debt is issued only when needed and for the amount required. Debentures issued for this project will help the DC-Fire reserve fund maintain a positive position over the forecast period. The full cost of any DC debenture issued (principal and interest) are recoverable from future collections under the DC Act.

The capital costs for this also includes the estimated costs required to build a new dedicated repair bay for fire apparatus. Currently repairs take place at the Weber Street Fire Station #1 that was not designed and built to accommodate large vehicle repairs; having a space in a fire station dedicated to repairs with a proper hoist will allow for safer working conditions. This funding is also to be used to build or expand fire station capacity to house the additional personnel. As outlined in this staff report recommendations made by the consultant require space planning toward the expansion of essential support services programs.

Renovating an existing building to accommodate growth of additional personnel can be funded by DC, however, rehabilitation work and enhancements to the existing service level will need to be taken into account as these costs are not eligible to use DC funding. Although not being planned, should the final location and design plans include rehabilitation of existing space or service level enhancements, there may be an additional funding requirement of capital dollars from the Capital Infrastructure Reinvestment Reserve Fund (CIRRF) or the Capital Reserve Fund (CRF) to accommodate non-growth related rehabilitation needs of existing assets or service level increases respectively. These needs have not yet been quantified or budgeted, and will be managed within existing funding envelopes.

Also included in the capital forecast (Ref#256) for $394,000 of funding in 2024 is personal protective equipment (PPE), and other capital equipment required for new Fire Rescue Services personnel (also fully funded from DC). This project will be included in the staff tabled 2024-2026 capital budget (2024). PPE and equipment have a relatively short estimated service life (i.e. PPE has an estimated service life of 7 years before replacement, then becomes reserve PPE for 3 years before expiring) and as a result, future PPE replacement will need to be considered as part of the 2027 capital budget process.

COM2023-016 was approved in June 2023 which released capital funds (ref#267, $1,625,000) to purchase an additional apparatus, this was required in 2023 since lead times are approximately 2 to 3 years for delivery of these specialized units. The amount required for this apparatus should be sufficient based on the apparatus to be purchased and will cover any costs not included by the dealer. The ongoing operating costs for this vehicle would include maintenance parts, fuel, insurance, etc. and will cost approximately $50,000 to operate annually when it comes into service, to be added as part of the staff tabled 2024-2026 operating budget. Emergency response vehicles have an estimated service life of 13 years and the replacement of the new vehicle is anticipated to be included as part of the 2027 capital budget process.

In addition, it was recommended that Fire Rescue Services acquire a squad/light-rescue expansion vehicle. The cost of this vehicle and equipment is estimated to cost approximately $425,000. Based on the experience of all the vehicles it is estimated to cost approximately $33,000 annually to operate as well. As a result of the consultant's recommendations as the FMP progressed since the last budget process, this vehicle was not budgeted in the 2023 Capital Budget but has been added to the staff tabled 2024-

2026 capital budget. Similar to the above vehicle, this vehicle is anticipated to be identified for future replacement as part of the 2027 capital budget process.

As assets are rehabilitated (e.g. space planning for a fire station) or added to the City's asset inventory (e.g. new PPE, fire response vehicle), the asset data will be used to inform the City's asset management processes and reporting. The City has invested a significant amount of time, effort, and funding to support community growth and provide emergency response capabilities. That same level of dedication is necessary in the coming years to maintain, rehabilitate, and replace these assets.

Operating

The consultant is recommending the addition of 27 additional FTEs over 2024-2027. These include:

- 24 additional 1st class Firefighters (includes 4 officers)
- 1 new Chief Mechanical Officer
- 1 new Chief Training Officer
- 1 Assistant Deputy Chief (currently a contract position)

It is also recommended that 8 existing First Class Fire Fighter positions be converted to Captain positions. In addition to these positions, there are support costs that need to be budgeted for; these costs include ongoing training, acting pay, as well as overtime. Fire Rescue Services is proposing a staffing phase-in similar to the opening of the University Avenue Fire Station (Station #4) in 2011. With these costs phased in over 4 years as part of the staff tabled 2024-2026 budget and 2027 operating budgets, the total cost is estimated to be $5,051,000 or an annual service level increase in the range of 1.0%-1.5%, subject to Council approval as part of budget.

The additional fire apparatuses will have ongoing operating pressures that need to be taken into account. These costs include repairs, maintenance, fuel, insurance, and fleet management. The budget required for these items is anticipated to be $83,000 for both vehicles when they become operational to be added as part of the staff tabled 2024-2026 budget.

The additional space (expanded or new building) will have pressures from both utility and maintenance on a new space as well as the consumable costs due to additional personnel. This cost is estimated to be $61,000. Finally, new software acquisition for the purpose of enhanced and self-directed staff training was recommended for Fire Services, the cost is estimated to be approximately $38,000 annually to be added as part of the staff tabled 2024-2026 budget.

The total cost of the Fire Expansion operating items are estimated to be $5,051,000. As stated in the previous report there are advantages in phasing in this increase over 4 years. In doing this, Fire Rescue Services will be able to recruit fire fighters before an expanded station or potential new station comes online allowing for time to train personnel without being impacted by having a minimal amount of staff ready and on duty, and so they can train without disruptions due to calls for service.

Table 2: Fire Rescue Services Operating Phase-in Plan

	Year 1	Year 2	Year 3	Year 4	
Staffing Addition	2024	2025	2026	2027	**Total**
Firefighter	4	8	8	4	**24**
Chief Mechanic Officer	1				**1**
Chief Training Officer				1	**1**
Assistant Deputy Fire Chief	1				**1**
FTE Total	6	8	8	5	**27**
Captain Conversion		4	4		
TOTAL COST ($)	**$1,065,000**	**$1,437,000**	**$1,519,000**	**$1,030,000**	**$5,051,000**
Estimated Annual Property Tax Increase (%)	**1.15%**	**1.45%**	**1.45%**	**1.00%**	**5.05%**

City of Waterloo
Community Risk Assessment and Fire Master Plan

November 9th, 2023

Contents

After following a link, choosing ALT+ left arrow navigates back to the previous location in the document.

Summary

Recommendations

Recommendation 1
Waterloo Fire Rescue has a history of firefighter involvement in public education and fire prevention[1] activities such as smoke alarm education and visiting low-rise multifamily dwellings, but there are opportunities to increase and expand prevention endeavours. There is ample evidence reported in peer reviewed journals that the involvement of suppression staff in prevention activity lowers community risk of fire and the need for emergency response activity.

The public gains the greatest life-safety benefit from public education and prevention activity. There is considerable opportunity to increase the involvement of Waterloo Fire Rescue suppression staff (firefighters) within public education and risk reduction.

We recommend that Waterloo Fire Rescue continues to develop the role of all staff in prevention and education activity.

Recommendation 2
The concept for required fire protection – and that which has been included in several prior year's submissions to council – is to build another station in west Waterloo. We have found that the best location to provide optimum response in all parts of west Waterloo is from station 2; therefore, we recommend that instead of building another station, additional staff and a fire truck should be located at station 2.

The station is ideally located to provide a 5-minute driving time response to most areas of the west side of the city.

We recommend increasing staffing by one truck, 24 hours a day at station 2 and remodeling station 2 to accommodate the additional staff.

Recommendation 3
Station 1 is the oldest and busiest fire station in Waterloo and houses the mechanical division as well as two staffed fire apparatus 24 hours a day. Although it could be refurbished to allow additional years of useful life, rebuilding to include adequate and updated space, as well as a hoist for the mechanical division, should be considered. Should the addition of a mechanical facility, including a hoist, not be possible at this

[1] For the purpose of this document, 'prevention' is defined as *the act or practice of keeping something from happening* (*"Prevention." Merriam-Webster.com Thesaurus, Merriam-Webster, https://www.merriam-webster.com/thesaurus/prevention. Accessed 30 Apr. 2023.).* That includes public education, home and business safety checks, standards and code enforcement, and any other efforts to forestall the occurrence of fires.

location, consider relocating station 1 or establishing the mechanical division at another existing fire station.

Our recommendation to reconstruct station 1 at the present location assumes that the current site is acceptable for building. However, there are potential challenges including that the current location is the site of a flood plain. If construction is not possible, the city should seek another location within reasonable proximity since station 1 is well located to respond to the distribution of calls in that area of Waterloo.

We recommend rebuilding station 1, preferably on the existing site, to serve as a fire station and vehicle maintenance and repair facility while avoiding expenditure on new property.

Recommendation 4

Research in the past five to ten years into measuring the benefit of traditional emergency services practices indicates that there is an opportunity to reduce or adjust fire department response to certain call types. This possibility is captured in a variety of peer reviewed journal articles published in reputable scientific and medical publications. These call types include

- medical incidents,
- automatic fire and carbon monoxide alarms,
- rescue incidents, and
- traffic collisions.

With respect to medical events, peer reviewed journal articles indicate that there are few medical incidents that require the attendance of firefighters for lifesaving intervention other than cardiac/respiratory arrest, and asphyxia. The implementation of a more refined medical prioritization algorithm at Ontario Ministry of Health dispatch centres in the next two years may decrease the number of medical incidents to which Waterloo Fire Rescue is dispatched.

There is an opportunity to reduce the number of medical incidents to which fire is dispatched but, if fire rescue continues to attend medical incidents at the same frequency as is currently experienced, consideration should be given to the implementation of medical response units such as a small sports utility vehicle or similar conveyance. Vehicles do not have to be large because the equipment needed would be limited, such as an automated defibrillator and medical responder first aid equipment. The majority of incidents to which Waterloo Fire Rescue responds do not

require four firefighters and a large truck. One, or two at maximum, firefighters could respond to medical, and possibly other, events in a response vehicle.

We recommend that Waterloo Fire Services strengthen the measurement of performance and outcomes while continuing to evaluate the efficacy of traditional response practices in areas such as:.

a) **Medical Incidents**
   - **Undertake a prospective study of medical responses over the next 6 to 12 months – preferably with the assistance of its medical advisor – to record and review services provided at the scene, and to the patient, to determine the percentage of incidents where fire arrives at least two minutes before paramedic services and undertakes life-saving measures such as cardiac or other resuscitation.**
   - **Based on the study results, determine if response to medical incidents needs to continue at the current volume.**
   - **By the six-month mark evaluate whether lights and siren response to medical calls is necessary and under what circumstances.**
   - **Determine whether response to medical incidents can efficiently take place using a smaller vehicle such as a mid-size SUV or whether four firefighters in a fire truck is necessary. After appropriate incident analysis, including that of outcome evaluation, if the city decides to continue medical response with the same frequency as current, implement medical response units at all stations.**

b) **Automatic fire and Carbon Monoxide Alarms**
   - **Undertake a prospective study of automatic alarms over the next 6 to 12 months to determine**
     - the number that turns out to be fires,
     - or carbon monoxide where it is unknown if the building was evacuated,
     - or other life-threatening circumstance,
     - and for which there was no other form of alert; for example, someone calling from the location within a very short period of time (60 – 120 seconds) reporting smoke or fire,
   - **Based on the outcome of this study, determine whether response to automatic alarms can be reconfigured to lower the risk of response to firefighters.**
   - **And, based on the findings, assess the possible reconfiguration of response to smoke and carbon monoxide automatic alarms to decrease the number of trucks dispatched.**

c) **Traffic and Rescue Incidents**
   - **Undertake a prospective study of response to rescue incidents – particularly traffic events – over the next 6 to 12 months to determine**
     - the number that turns out to be actual entrapments,
     - the number where life-saving intervention was provided, and
     - the number where traffic blocking, debris clean up, or spill remediation was provided.
   - **Based on the outcome of this study, determine whether response to rescue incidents, specifically traffic accidents – can be reconfigured.**

Recommendation 5

The provision of services by fire departments is complex. Data, analysis, technology, and interconnection with municipal and other partners will become more prevalent in future. It is expected that, in addition to emergency response, the fire service becoming more widely involved with other municipal departments in an effort to prevent emergencies will take on greater importance.

Revise the administrative structure of the fire service to support a business approach to fire safety. **This includes hiring a business manager to free up the Chief and Deputies to champion continuous improvement and long term strategic objectives toward public protection**.

Recommendation 6

Technology provides opportunities to measure the important metrics of public safety delivery, reduce time consuming manual activity, increase efficiency and activity, and possibly reduce or mitigate inflationary operational costs.

We recommend

- **Implementing a relational incident activity outcome data base to complement the information currently available within the fire record management system as demonstrated in this report**
- **Procuring and implementing fire inspection and incident planning software to increase efficiency and effectiveness.**
- **Procuring and implementing Geographic Positioning – Automatic Vehicle Locating software to more accurately capture apparatus activity and avoid missed data due to human factors.**
- **Working with 9-1-1, fire dispatch, police services, paramedic services to achieve improved Dispatch – Fire Service coordination including fire dispatch centre support of fire response by capturing on-scene information.**

Recommendation 7

We found that Waterloo Fire Rescue can benefit from increasing staff complement in several areas. Our expectation is that the recommended complement will improve public safety, increase efficiency and effectiveness and, in concert with other recommendations, assist to mitigate future operational cost increases.

We recommend the following complement enhancements:

- an Analytics Professional (non-firefighter position)'
- a Business Manager (non-firefighter position) as indicated in Recommendation 5,
- a Chief Training Officer,
- an Assistant Deputy Chief – one permanent position (currently on contract),
- a Fire Prevention Officer,
- firefighter enhancements to improve response and reduce risk in west Waterloo as indicated in Recommendation 2,
- two full-time mechanic positions (or equivalent) at station 1, one of whom should be a Chief Mechanic.
    - In the alternative, should the city decide to continue with the four mechanic/firefighters assigned to suppression platoons, we recommend establishment of a Chief Mechanic position on day shift.

Project Summary

Pomax Consulting was retained by the City of Waterloo to achieve the project goal which, as stated in the request for proposals, is to

> *provide a strategic framework and recommendations that will assist City Council in determining community safety levels, public education, fire prevention and fire operations/specialized services.*

The deliverables included a community risk assessment[2] as required by Ontario Regulation 378/18, and an assessment of all facets of the fire service for the efficient utilization and optimization of City resources. Waterloo Fire and Rescue Services has decided to pursue a service strategy at a time after the delivery of this fire master plan.

This report offers recommendations and alternatives regarding fire service administration, operations, staffing levels, efficiencies, and methods of operation.

Fire departments tend to deploy resources utilizing traditional approaches, which are rarely reviewed[3]. The contents and recommendations contained herein offer suggestions for future assessment of services provided by Waterloo Fire Rescue and will demonstrate that the provision of fire protection to a community is complex and multifaceted and, by implementing analytics and examination of incident metrics, can accomplish – and increase – public safety with greater efficiency.

Response capacity is important and measured in detail in this report. But the document emphasizes the need for the fire service to develop a greater capacity for prevention and public education, thereby reducing the frequency and effect of fires by advising the public how to prevent fires that could impact themselves, their family, and the community. The core purpose of all members of the fire service should be to provide information to the public on common causes of fires, activity that can be taken to prevent occurrences, and action to take should a fire occur. Effective public education requires frequent repetition and consistent, appropriate messaging.

The review identified response gaps[4] in the current capacity of Waterloo Fire Rescue and disclosed a number of opportunities to increase community safety levels, some which should be taken immediately to reduce public risk, while others can be phased,

[2] The Community Risk Assessment detail and working papers are included in Appendix F.

[3] Operational and Administrative Analysis Tulsa Fire Department, Tulsa, Oklahoma; Center for Public Safety Management, 2016

[4] Some of which have been outlined by fire administration in historical Fire Rescue Services documents.

and the scope and nature of the phased opportunities may be dependent on the success of those recommendations that are more imperative.

The Request for Proposals, in the Statement of Work, declares that the "overall goal of the project is to provide a strategic framework and recommendations that will assist the City of Waterloo Council in determining community safety levels". Our recommendations support that goal by presenting means by which Waterloo Fire Rescue Services can accomplish increased public safety while avoiding costs within fire services, on a per capita basis, relative to growth of the city. The forecasted population and building growth in Waterloo could result in significant future costs related to fire protection if response methods and incident types are not carefully analyzed to attain greater efficiency and effectiveness. The approach recommended in this report is intended to avoid additional costs to the taxpayer as much as possible while increasing public safety. We recommend an analytics-based, business-like approach to fire service that recognizes the success of other jurisdictions in implementing additional fire prevention and education programs which support the first two lines of fire defense recommended by the Ontario Fire Marshal[5]

Several recommendations may not be seen by some as traditional within a fire organizational structure or applicable to "what fire departments do" therefore, a low priority. But the business function of a fire department is important to future endeavours to redirect programs and in managing costs while increasing public safety. Many fire master plans overlook the essential requirement of ensuring that organizational structure and business processes are adequate and designed to ensure the expected outcomes of the plan are successfully achieved. We hold the position that the success of a fire master plan is contingent upon provision of adequate and appropriate human resources which we have identified in this report.

The majority of public education, prevention, and fire safety standards are left to a handful of fire department staff even though there is overwhelming evidence that education and prevention efforts by on-duty firefighters is a primary contributor to a reduction of fires, injuries, and deaths. Existing programs – such as the firefighter smoke alarm program – are being reintroduced after a COVID related hiatus but can be expanded and new initiatives can be created to enhance public education programs to their fullest capacity using *all* staff, not just fire prevention.

Our recommendations aim to assist Waterloo Fire Rescue to bring existing resources and activities into line with practices that have been shown to provide the greatest

[5] The Ontario Office of the Fire Marshal recognizes the three lines of fire defence as 1) public education and prevention, 2) fire safety standards and code enforcement, 3) emergency response.

level of safety for the public and reduce costs. At the same time, our recommendations recognize that emergency response capabilities have to be adequate to assist public safety in case of a fire, and there are some shortfalls in response protection primarily on the west side of the city.

Our recommendations strongly support the expansion of fire department analytics to

- inform the department, council, and the public of the validity of activity, or degree of value, fire department endeavors provide to the public, and
- the financial and risk implications of those activities.

One of the challenges of developing comprehensive and useful analytics is that there is not a commercial fire record management system which analyzes outcome of activity relative to public value, but we are encouraged by the leadership of Waterloo Fire Rescue's recognition of this critical problem and the inquiries it is making to enhance data collection to inform decision making. In 2022, fire management implemented a new records management system to align with Kitchener Fire Department communications. The new records management software, in combination with linking existing City of Waterloo GIS software, may enhance the fire service's ability to analyze data.

Nevertheless, implementation of an analytics program, the metrics of on-scene activity, and supporting research is a considerable undertaking which is why we recommend creating a new position capable of accomplishing analysis to the depth required. While an additional complement looks like an expense, it isn't. The intent of our recommendations, including this pivotal one, is to organize the structure of Waterloo Fire Rescue to achieve a net reduction of costs while increasing public safety by employing outcome-based metrics to help determine the operational and capital requirements of the fire service.

Our recommendations include expanding the existing role of firefighters in the areas of public education and safety checks to be an as important and equal job function to response to emergencies. Even though Waterloo Fire Rescue implemented a low-rise residential program in 2016 which deployed suppression staff to check fire alarms and smoke alarms in low-rise buildings, and a separate firefighter public education – residential smoke alarm check program, both were sidelined by the COVID pandemic. Both the residential smoke alarm and the low-rise residential programs have resumed in 2023.
Pivoting firefighters to accept that an expanded public education and safety role is as important as response to emergencies is expected to be a significant change for some – the proverbial paradigm shift – which, along with other initiatives, will absorb

the time of the Chief and Deputies for the next four to five years. Therefore, we have recommended a senior role of a business manager to run the non-operational side of the fire service pending the shift becoming the paradigm. This is a senior position within the fire service at the same level as a Deputy Chief only in a civilian role. It is one more often seen in fire services in western Canada where incumbents historically have been Chartered Professional Accountants. The position can assist the Chief and Deputies with program focus and strategic support needed to drive change and improve performance and stability for the organization. Additionally it will complement the analytics function and reinforce a business approach to operating a fire service.

There is an elevated fire response risk in west Waterloo that should be resolved; therefore, our recommendation is to increase suppression staff at station 2 in west Waterloo. There has been discussion over the past several years about an additional station, staff, and truck in west Waterloo, but our analysis indicates that the best response is from the existing station.

If the recommendation to add staff at station 2 is accepted, we also recommend that, as a preference to be hired, all future candidates should have achieved training, if not certification, to Fire Prevention/Inspection level II (conducting fire and life safety inspections including in facilities that store, handle, or use flammable/combustible liquids), and Fire and Life Safety Educator (providing fire and life safety education) (Ontario Regulation 343/22). Candidates can access training courses through community colleges which provide them as three- or four-day seminars, or over the course of a semester, and even online, and they are inexpensive (less than $400 per program). This requirement promotes the shift to a prevention-centric organization. It also eliminates the possible discussion point that firefighters can't perform prevention activities or home and business safety checks because they aren't "qualified".

In concert with improved response staffing at station 2, we recommend that station 1, which is now 57 years old, be rebuilt, preferably on the existing site. Included in the rebuilding should be a purpose-built mechanical bay, including a heavy truck hoist, so that the firefighter-mechanic on each platoon can more effectively and safely repair fire trucks. We have been made aware that fire station 1 is sited in the Laurel/Clair Special Policy Area (SPA) flood fringe and therefore, there are restrictions on use of that area. We recommend that the city works with the necessary authorities to permit rebuilding a new station on the current site as it is ideally situated for effective emergency response. Should these approvals not be forthcoming, we recommend acquisition of suitable property in the vicinity and building a new station.

Further, we find that the firefighter-mechanic positions are less effective than they should be. The nature of the position means that the mechanics, in their firefighter role, are pulled away from repairing trucks to respond to incidents. Records kept by the mechanics and Chief Mechanic indicate that, at best, about five hours a day are spent on mechanical repairs and repairs that should be accomplished on the same day sometimes extend into two or more days.

We recommend that two full-time mechanics (or equivalent) should be hired, one of which would be a Chief Mechanic. The mechanics should work Monday to Friday or Monday to Sunday business hours, which can be defined in a manner that the Fire Chief determines to be most useful to the department. Should the City decide its preference is to maintain the structure that provides a mechanic /firefighter on each platoon, then we recommend a full-time Chief Mechanic position be provided in addition to the four firefighter/ mechanics.

Most fire departments, including Waterloo's, employ a standard response model of sending at least one fire truck, staffed by four firefighters, to all incident types even though almost 50% of them are medical responses and another 25% to 30% are traffic collisions or alarms. Journal articles and scientific studies indicate that incidents of these types are mostly over resourced. There is a belief by some that a response of this magnitude is required, if not for the specific nature of the incident, in case a fire call is received then four firefighters can respond together.
An integrated risk assessment [6] approach to fire services deployment, rather than a prescriptive approach, doesn't support that position.

We recommend a change to the response model, based on sound analytics and outcome evidence, including reevaluating the number of trucks dispatched, type of conveyance, number of staff, and equipment required for each call type. The critical information necessary to determine changes in the response model is best captured in a searchable database format and then rigorous analysis. This requires implementation of a robust data collection system. Currently, information is collected in officers' notes, but the content is not easily retrieved and not available in a searchable format.

[6] The Ontario Fire Marshal's Community Risk Assessment document is a good start to a risk assessment approach that can be applied to all sizes of fire services throughout the province. However, Integrated Risk Management Planning is significantly more comprehensive, befits a fire service like Waterloo's, is highly dependent on detailed statistical gathering, and targets resources to prevent incidents from occurring while making sure resources are in the right location to best protect the community.

Other options, pending the availability of searchable data, is for Waterloo Fire Rescue to undertake a prospective review of officers notes for each incident and capturing that information in a tabular format, such as Excel, associated with the event's incident number. While labour intensive it would, after several months, create awareness of the services being provided to the community, and enable measurement of associated benefits.

Other possibilities, based on good analytics, include reducing the size of fire trucks, as Ottawa and other communities have done, or considering whether all equipment has to be carried on all trucks. Analysis of the time each truck arrives at incidents, sequencing of incident types, and outcome assessment (all part of the analytics process) will reveal opportunities for reducing cost while remaining within an acceptable risk profile. Waterloo Fire Rescue has already moved to a limited implementation of a smaller vehicle – called a squad unit – based on an existing pickup truck, that can support fire trucks by delivering equipment to incidents as required. The squad unit will support the opportunity to implement smaller front-line fire trucks because not every truck would require all rescue equipment.

Our interviews with fire service leadership and staff revealed that firefighter training is a challenge with respect to consistency, quality assurance, program implementation, and record keeping. A new records management system (Emergency Reporting System) was implemented in 2022 and will assist with issues regarding training records and other record keeping. The existing training organizational design utilizes a training captain on each platoon who is responsible for ensuring training takes place. The current joint promotional policy for Captain Training Officers results in frequent turnover of staff in the Training Division which contributes to the challenges identified above.

We were informed during staff interviews that limited time available to the on-shift training captains does not provide for a consistent, coordinated department wide training program. The Deputies and Assistant Deputy have assisted with training coordination and oversight but their heavy workloads on other matters limit positive impact. Training challenges can be a safety issue if due diligence with respect to quality control and assurance can't be easily demonstrated.

Interviewees suggested that the resolution to training challenges is the implementation of a Chief Training Officer with which we agree and recommend, particularly in light of a recommended staffing increase in west Waterloo. A Chief Training Officer position will provide necessary oversight and consistency to training and contribute to public and firefighter safety.

The current fire leadership complement consists of a Chief, a Deputy of Operations responsible for response, mechanical, and operational training; a Deputy of Support Services responsible for fire prevention, public education, and professional development; and an Assistant Deputy Chief, reporting to Support Services and responsible for emergency management, training, and operational support. The Assistant Deputy Chief is a contract position which we recommend making permanent.

Fire services in general, but also somewhat applicable to Waterloo, are modeled on the pressures of a time when there were many fires. That is no longer the case, yet there are opportunities to reduce the incidence of fires even further. But it will take a shift in sentiment and public acceptance of a different fire safety paradigm, and a recognition of the important value of Waterloo Fire Rescue firefighters to the community as public educators, to accomplish greater safety at the right cost.

The current Fire Prevention Division consists of a Chief Fire Prevention Officer, a Fire Prevention Captain, four prevention officers and a public education officer who is assigned half time to prevention (inspections, code enforcement) and half time to public education activities. The four fire prevention officers also assist with public education that is roughly equivalent to half of a full-time equivalent employee. In reality, there are a maximum of seven prevention staff to take care of the tasks of investigations, enforcement, and home and business safety. The Division is several thousand inspections and follow-up inspections behind where they should be. This is simply due to a historic lack of resources which increases public risk, and which is why we have recommended enhancing existing programs and expanding the deployment of operational staff to take on the tasks of home and business safety checks and simple location assessments.

Though one new Fire Prevention Officer was added in 2023, we recommend an increase of another Fire Prevention Officer to assist with the ongoing backlog of inspections and follow-up compliance, thereby allowing the public education officer to return to public education and coordinating all public education campaigns, programs, and activities, including those assigned to the fire suppression division. The role of public education compared to inspections and compliance, and home and business safety checks are significantly different, requiring different aptitudes and skills. Related to this subject, we recommend that all firefighters should eventually have the competencies to fulfill the requirements of public education and prevention within Ontario regulation 343/22.

Changes to the fire service that may result from the implementation of these recommendations could have an impact on the Fire Department Establishing and Regulating By-law. We recommend that frequent review of the by-law should occur

to ensure services provided are supported by the by-law. Further, clear service levels set out in the by-law will assist in training priorities and on-scene decision-making.

The intent of the project is to review, report on, and recommend all aspects of fire services delivery and resources, accompanied by objective supporting material, to protect the city over the next ten years. This report supports the goal and objectives of the project.

A description of the terms of reference, objectives, and deliverables can be found in Appendix A.

The consulting team reviewed all aspects of the fire department such as training, assets, budgets, risk, response, call handling, prevention, education, performance, and other facets that contribute to an efficient and effective emergency service, through both strategic and operational lenses.

Report Structure

This report is made up of three parts

- Part 1: The current state of the Fire and Rescue Services;
- Part 2: A discussion based on the current state;
- Part 3: The future.

Part 1: Current State

1 Data Collection and Information Management

1.1 Understanding Emergency Response

Exhibit 1 demonstrates the stages of an incident response. An emergency process includes

1. detection or recognition of a fire or other emergency;
2. reporting the emergency by calling 9-1-1;
3. call handling, dispatching firefighters, and turnout (the duration required for the communications centre to obtain information from a caller, alert the fire department, and firefighters departing the station);
4. driving time (wheels start turning to wheels stop turning);
5. setup (the 'action' time); for example,
   a) the time it takes to travel from a fire truck [upon 'wheels stop turning'] to an incident such as an apartment or other location requiring vertical travel; or ground travel if firefighters have to move from the fire truck to the incident; for example, down railway tracks or to the back of a building; or
   b) the time it takes to access a victim, recognize the issue, and start definitive activity in a scenario other than fire; or
   c) the time it takes to prepare to investigate other incident types such as a smoke or carbon monoxide alarm; or
   d) the time it takes to connect to a hydrant, or water source, or foam.
6. harm limiting
   a) apply water or foam;
   b) care for victims.

Exhibit 1: Response Graphic

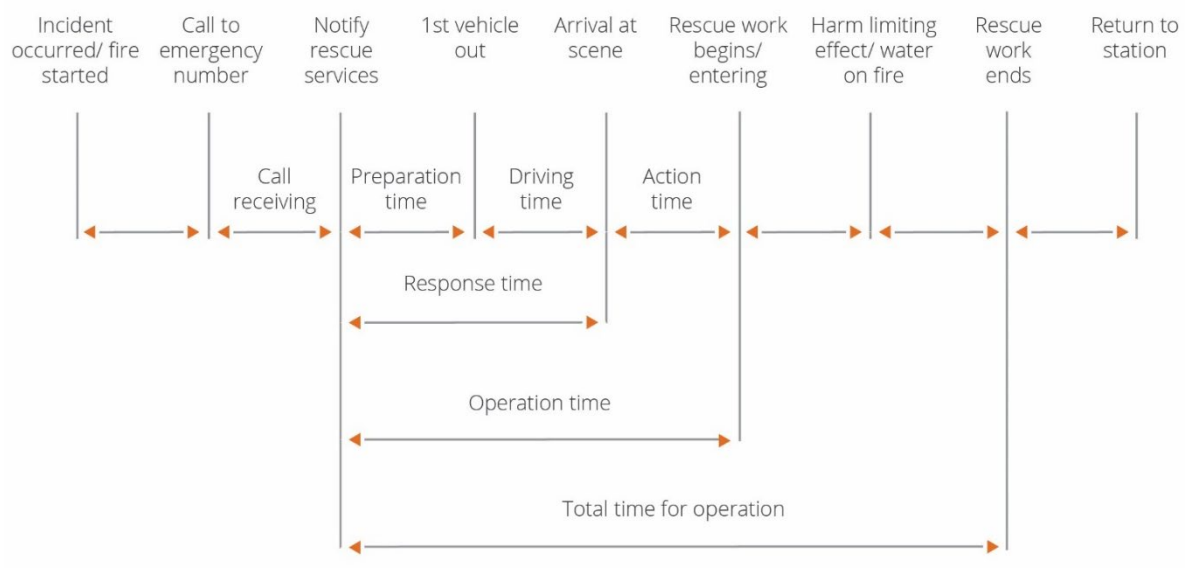


Exhibit 1 demonstrates response to all types of events (incidents), Exhibit 2: Fire Response Graphic is more specific to a fire response situation.

Exhibit 2: Fire Response Graphic

The 'setup' time between the 10 and 15-minute marks shown in Exhibit 2 is usually about 5 minutes. Information from the Ontario Office of the Fire Marshal and Emergency Management, provided in a 2016 inquest, indicates that, in

In Waterloo, the city-wide driving time to all call types has increased by 90 seconds over the last five years to 6 minutes and 30 seconds at the

Ontario, it takes an average of five to seven minutes[7] to get agent (water or foam) on a fire after arriving at a scene.

As Exhibit 2 shows, the elapsed time from the time of fire detection to applying water or foam can be 15 minutes. This assumes a driving time of about four minutes. In Waterloo, the driving time has increased by 90 seconds over the last five years to 6 minutes and 30 seconds at the 90th percentile. A change in driving time will affect the duration of a fire before an agent is applied. Additionally, overall response can be negatively affected by impediments to gaining access to an incident; for example, fire in a multi-storey building.

1.2 What do the statistics indicate?

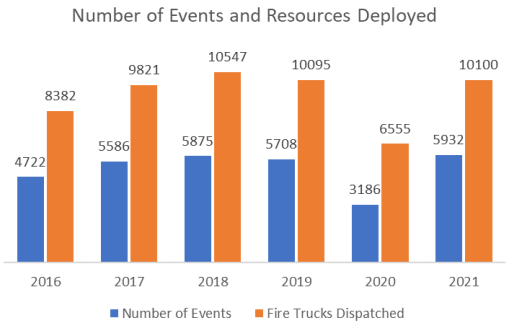
This section summarizes data from 2016 to 2021. A change in the fire services' record management system in early 2022 resulted in some challenges in obtaining 2022 information due to the transition from the previous to current record management system.

Each of the charts, tables, or exhibit thumbnails shown in this section, and more, can be found in larger format with additional explanation in *Appendix B, Detailed Incident Information*.

Choose the Chart Number links in parentheses to see larger charts and additional information then use Alt + left arrow to return to the original location.

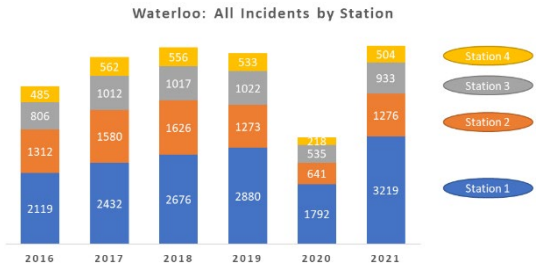
1.3 Overall Number of Events

- Waterloo Fire Rescue's maximum number of events (also known as incidents, which includes all calls of all types) peaked at 5,932 in 2021. The maximum number of vehicles dispatched to these incidents peaked at 10,547 in 2018. (Chart 19)



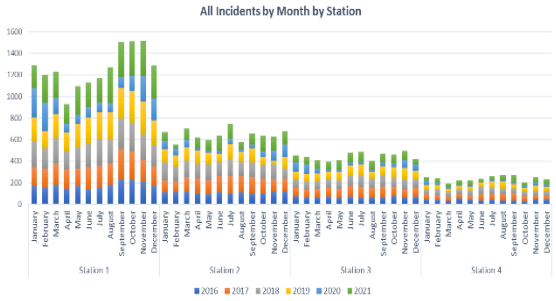
[7] We have seen setup times as low as 2 minutes during demonstrations, but those times were in a training site parking lot with a hydrant immediately available.

- Over 50% of all incidents occur in station 1's primary response area. The majority are medical events which increased in 2021 and are attributable to drug and alcohol occurrences. (Chart 20)

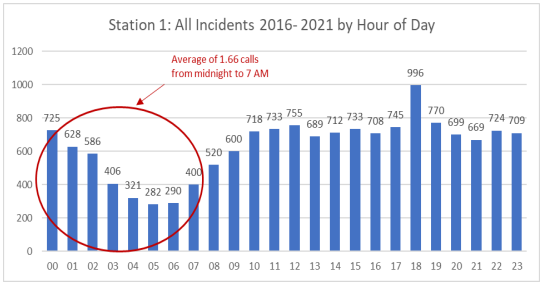


- Individual station event volume and year over year changes can be found in Chart 21, Chart 22, Chart 23, and Chart 24.
  - Stations 2, 3, and 4 experienced flat call volume in 2018 and 2019, negative volume change in 2020 due to COVID, and some recovery in 2021.
  - Volume changes in stations 2, 3, and 4, from 2018 to 2021, have netted out to zero.
  - The volume growth in Waterloo is directly associated with station 1 primarily due to drug and alcohol related medical incidents.

- The number and pattern of incidents was evaluated by time of year and station.
  - Station 1 has a distinct pattern that could be influenced by student population and summer activity. Station 2's pattern isn't as distinct, and stations 3 and 4 don't have patterns that seem to be greatly affected by seasonal student population. (Chart 25).



- The number and pattern of incidents was evaluated by time of day and station for the period 2016 - 2021. The thumbnail to the right shows the results for station 1 but the same detail for other stations can be found in Appendix B.
  - The greatest occurrence of incidents takes place in late afternoon – early evening with the fewest after midnight to 7 AM.



- Please note that the charts represent six years of data. The volume shown is for six years, not annually.

Chart 26: Incidents by Day 2016 - 2021,

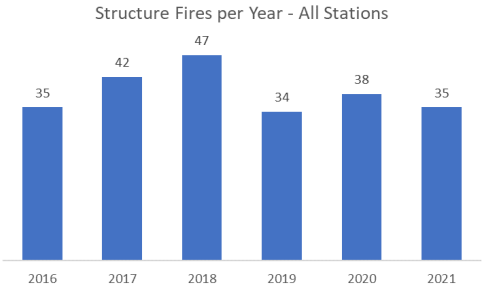
Chart 27: Station 1: Incidents by Hour by Station 2016 – 2021,

Chart 28: Station 2: Incidents by Hour by Station 2016 - 2021,

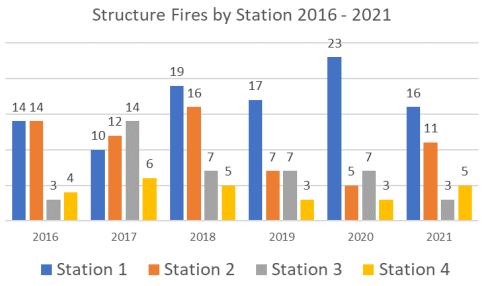
Chart 29: Station 3: Incidents by Hour by Station 2016 – 2021,

Chart 30: Station 4: Incidents by Hour by Station 2016 – 2021.

1.4 Structure Fires

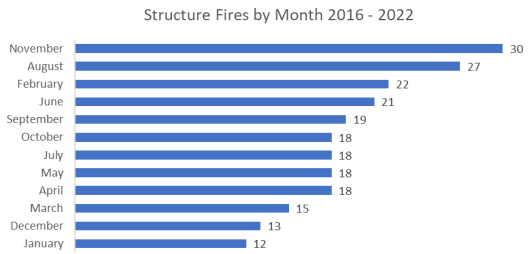


- Structure fires peaked at 47 in 2018 but have declined to fewer than 40 in subsequent years. (Chart 31)
- In 2016, stations 1 and 2 had the same number of fires in their areas, with stations 3 and 4 experiencing only 30% of the volume of stations 1 and 2. (Chart 32)



- In 2017, station 3 experienced 14 fires whereas there were only 3 the year before.
- Also in 2017, station 1's area had 10 fires but, since then, has experienced the most fires, sometimes by a significant percentage.
- Reasons for these variances are not apparent.

- The number and pattern of structure fire occurrences were evaluated by month, day, and station for the period 2016 – 2021, to determine if patterns were prevalent. (Chart 33)

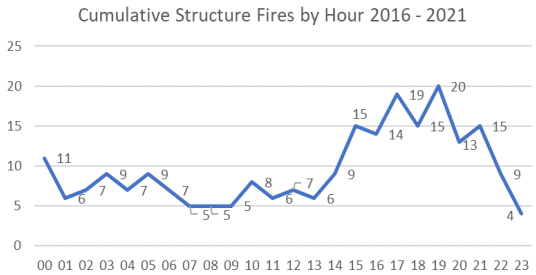


  - We found:
    - From 2016 to 2021, 60% more structure fires have taken place in November than December and January.
    - This could coincide with the arrival of student population, but students arrive in late August – which has the second highest number of fires – but September's structure fire count is 36% lower than November's. Determining the reasons for this variance may assist with prevention and education initiatives.
    - The distribution of structure fires in station 1's area appears random.
    - Neither is there a discernible structure fire pattern in stations 2's primary response area.
    - There are several months, sometime in consecutive years, when no fires have taken place in station 2's primary response area.
    - In the six-year period examined, there is no record of a structure fire occurring in station 3's primary response area in December.
    - There are several months, in consecutive years, when no fires have occurred in station 4's primary response area and no record of structure fires in April or June in the six-year period, 2016 to 2021.

Individual station statistics can be found in:

Table 9: Station 1: Distribution of Structure Fire Occurrence by Month,
Table 10: Station 2: Distribution of Structure Fire Occurrence by Month,
Table 12: Station 3: Distribution of Structure Fire Occurrence by Month,
Table 13: Station 4: Distribution of Structure Fire Occurrence by Month,
Chart 34: Structure Fire Distribution by Day Station 1,
Chart 35: Structure Fire Distribution by Day Station 2,
Chart 36: Structure Fire Distribution by Day Station 3,
Chart 37: Structure Fire Distribution by Day Station 4.

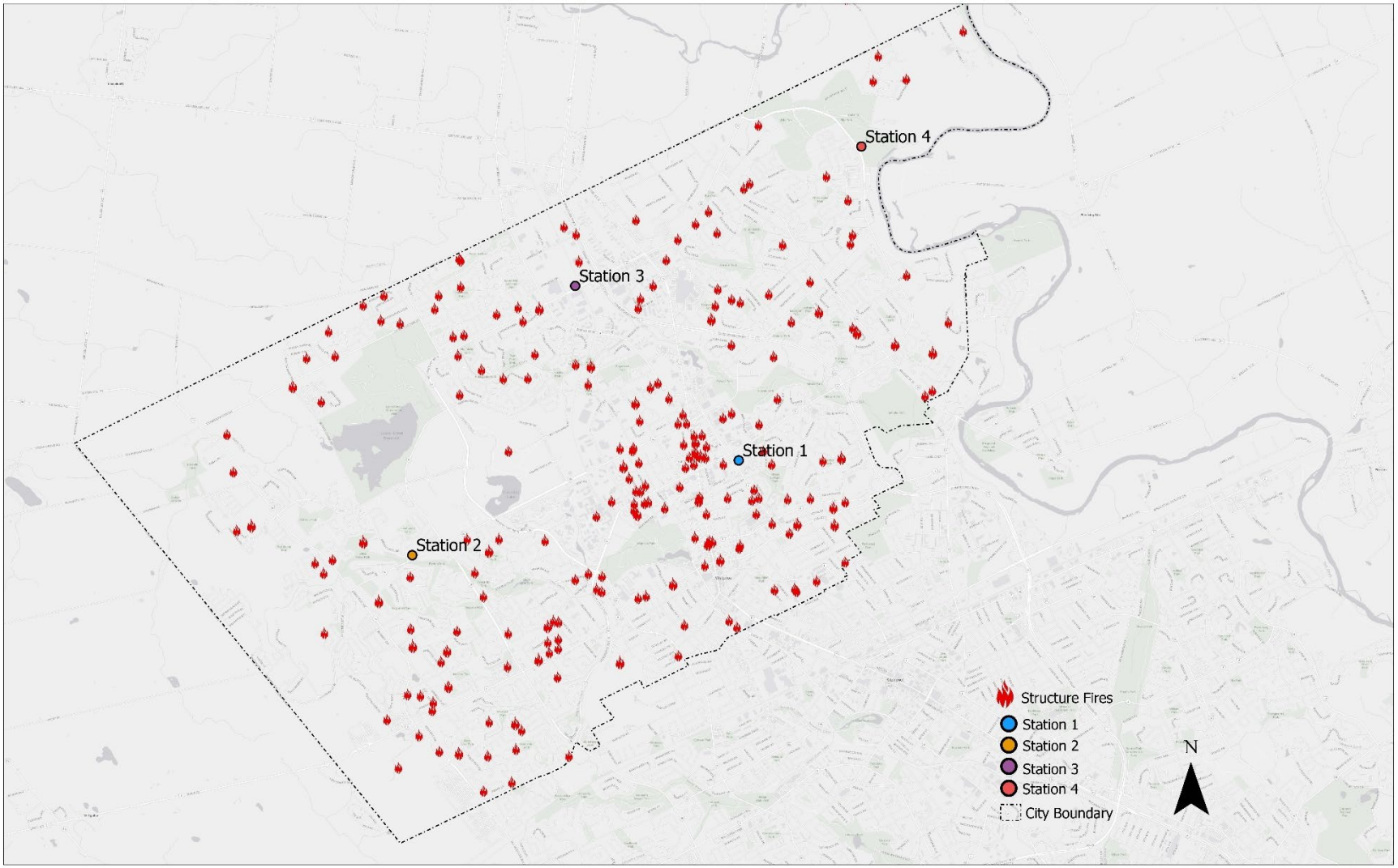
- No discernable differences in structure fires by day were found.
- Most structure fires take place in mid to late afternoon and early evening. (Chart 38)



1.4.1 Geographic Distribution of Fires 2016 -2021

Exhibit 3 shows the location of structure fires for the period 2016 – 2021. The west side of Waterloo requires additional fire response which we discuss further in Section 6.

Exhibit 3: Location of Structure Fires 2016 - 2021

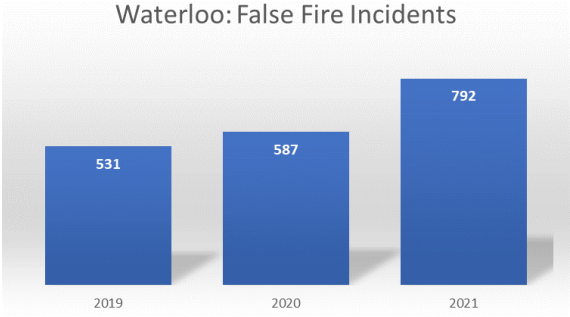


1.5 False Fire Calls

The Office of the Ontario Fire Marshal classifies false fire calls as

- Alarm System Equipment - Malfunction
- Alarm System Equipment – Accidental activation
- Human - Malicious intent, prank
- Human - Perceived Emergency
- Human - Accidental (alarm accidentally activated by person)
- Other False Fire Call

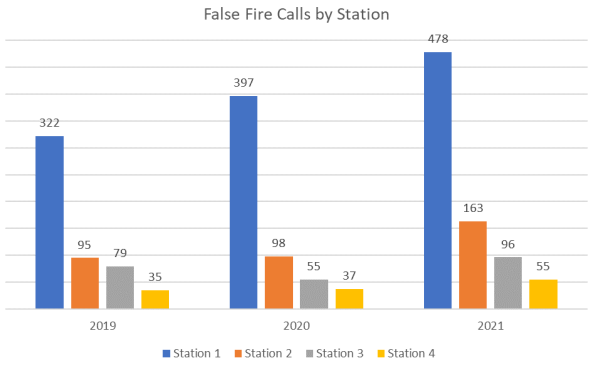
False fire call data were not available for 2016 – 2018.
(Chart 39: False Fire Calls; False Alarms)



- The majority of false fire incidents occur in station 1's area.

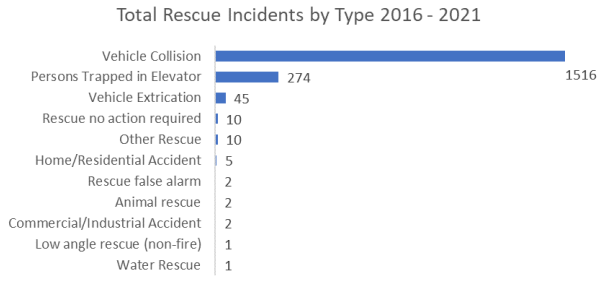
- In 2021 there were an average of over 2 false alarms daily. Of course, alarms are false only after they have been determined to be.

(Chart 40: False Calls by Fire Station)

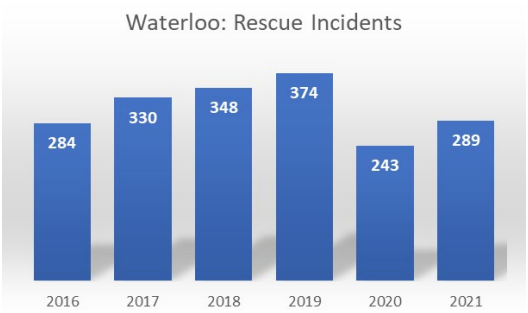


1.6 Rescue Incidents

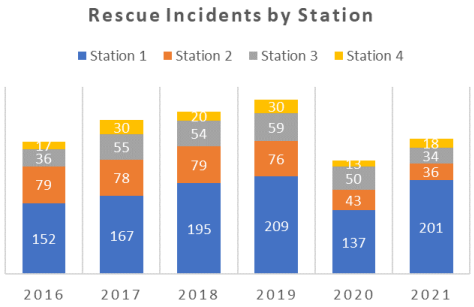
- Rescue incidents, mostly attendance at vehicle collisions, increased from 2016 to 2019, declined in 2020, probably due to COVID influence, and increased again in 2021. (Chart 41)



- The number of rescue incidents by year is shown in the thumbnail to the right and in Chart 41.
- Over the six-year period, 2016 to 2021, 81% of these incidents have been attendance at vehicle collisions. Almost 15% were rescues from elevators, while 2.5% were extrications from vehicles. (Chart 42)

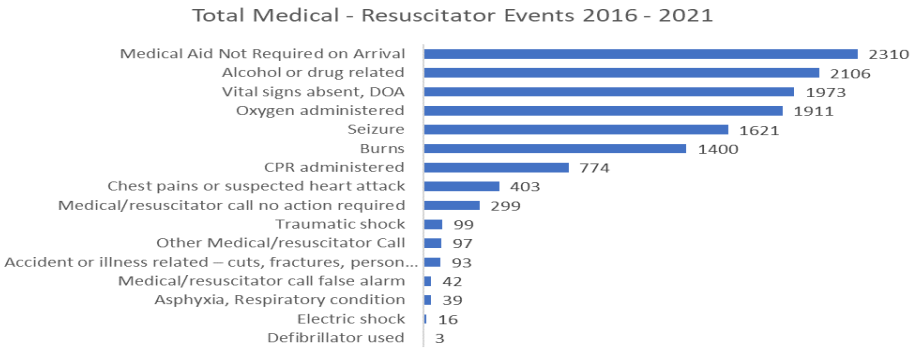


- On a percentage basis almost 57% of rescue events were responded to by station 1 (which might be due to higher traffic volume in this area and primary response to highway 85), 21% by station 2, 15.5% by station 3, and 7% by station 4. (Chart 43)



1.7 Medical – Resuscitator Events

Events classified by the Ontario Fire Marshal as medical – resuscitator include



Oxygen administration
CPR administration
Defibrillator used
Asphyxia, Respiratory condition
Seizure
Electric shock
Traumatic shock
Chest pains or suspected heart attack

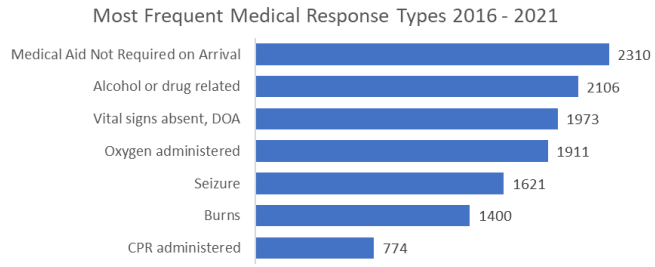
Burns
Medical Aid Not Required on Arrival
Vital signs absent, DOA
Alcohol or drug related
Accident or illness related – cuts, fractures, person fainted, etc.

Other Medical/resuscitator Call
Medical/resuscitator call no action required
Medical/resuscitator call false alarm

(Chart 44: All Medical - Resuscitator Events 2016-2021)

- The greatest number of medical incidents during the six-year period measured was *Medical Aid Not Required on Arrival* which represented 17.5% of total responses.
- Second to Not Required were alcohol or drug related incidents – which is also the response type with the greatest growth (please see Chart 47: Medical – Resuscitator Notable Changes).

Medical Aid Not Required on Arrival	17.52%
Alcohol or drug related	15.97%
Vital signs absent, DOA	14.96%
Oxygen administered	14.49%
Seizure	12.29%
Burns	10.62%
CPR administered	5.87%

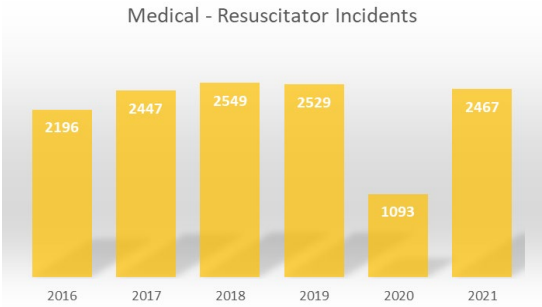


(Chart 45: Most Frequent Medical Response Types 2016 – 2021)

1.7.1 Medical – Resuscitator Event Distribution

Of the 13,281 medical – resuscitator incidents to which Waterloo fire responded between 2016 -2021,

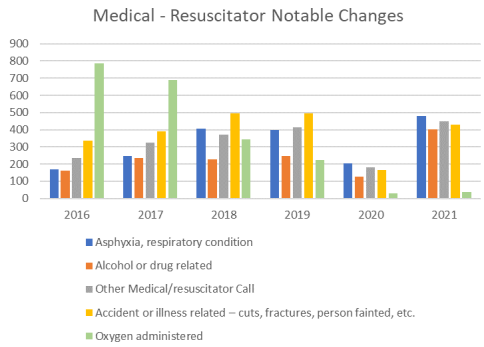
- 43.5% were responded to by station 1,
- 23% by station 2,
- 21% by station 3, and
- 11.7% by station 4.



(Chart 46: Medical – Resuscitator Incidents by Year)

As with other event types, most of the call load occurred in station 1's primary response area.

1.7.2 Medical – Resuscitator Notable Changes



- Five medical response categories showed notable changes over the six years examined. Three categories increased, two decreased.
- *Asphyxia - respiratory*, *alcohol or drug related*, and *other medical/resuscitator* events have trended upwards which may reflect social issues related to drug use.
- *Cuts, fractures, person fainted* – a category to which fire response is able to provide only minimal benefit – did not rebound in 2021 to the volumes experienced in 2019 and earlier.
- The *oxygen administered* incident type has declined from almost 800 responses in 2016 to less than 40 in 2021 which may reflect medical guidance that oxygen administration is not as beneficial as once thought, and sometime dangerous.

(Chart 47: Medical – Resuscitator Notable Changes)

1.8 Public Hazards

The Office of the Fire Marshal classifies the following incident types as Public Hazards:

CO incident, CO present (NOT false alarm)
Gas Leak – Natural Gas
Gas Leak – Propane
Gas Leak – Refrigeration
Gas Leak – Miscellaneous
Spill – Gasoline or Fuel
Spill – Toxic Chemical
Spill – Miscellaneous
Radio-active Material Problem
Ruptured Water, Steam Pipe
Power Lines Down, Arcing
Bomb, Explosive Removal, Standby
Suspicious substance
Public Hazard no action required
Public Hazard call false alarm
Other public hazard

We have added to the Public Hazard category,

- CO false alarm – perceived emergency (no CO present)
- CO false alarm – equipment malfunction (no CO present)

These carbon monoxide incidents could have been included in either the false alarm category or public hazards grouping.

- Overall, public hazard incidents have been trending lower since 2016 but the majority of public hazard incidents are in station 1's area and they have been increasing.

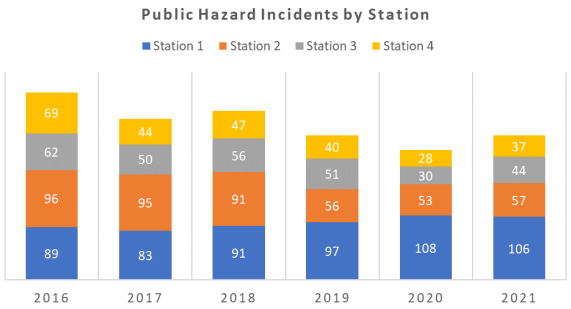
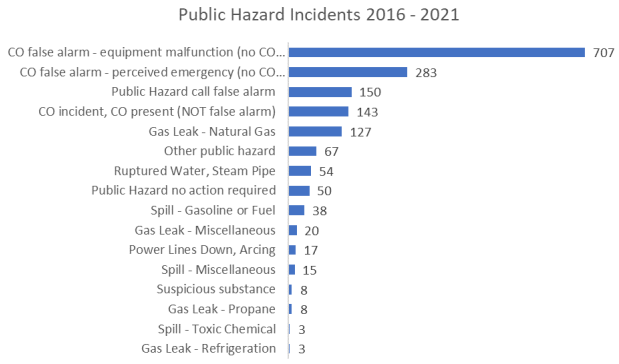


Chart 48: Public Hazard Incidents

Chart 49: Public Hazard Incident Distribution by Station

- In the six years 2016 – 2021 the three leading public hazard categories, by call volume, have been 707 false carbon monoxide alarms (again, alarms aren't false until confirmed false), 143 carbon monoxide incidents, and 127 gas leaks.



(Chart 50: Public Hazard Incidents)

2 Incident Response

As shown in Section 1, fire departments respond to many different event types. Some of these incidents are time sensitive. For example, structure fires, carbon monoxide alarms where there is not a confirmation that the premise has been vacated, medical incidents such as cardiac/respiratory arrest and asphyxia, and some traffic collisions. The number of incidents where time is critical are small compared to the sum of responses, but time sensitive events are a vital consideration in determining the placement and type of resources.

2.1 Incident Response in Waterloo 2016 – 2021

2.1.1 Call Receiving

The first part of overall call response is call receiving. That's the activity of the fire services staff members (communicators) who receive the call for assistance and dispatch fire responders.

Chart 1 demonstrates the time it takes the fire communication center in Kitchener to take information and dispatch Waterloo's fire trucks to all call types at the 90th percentile.

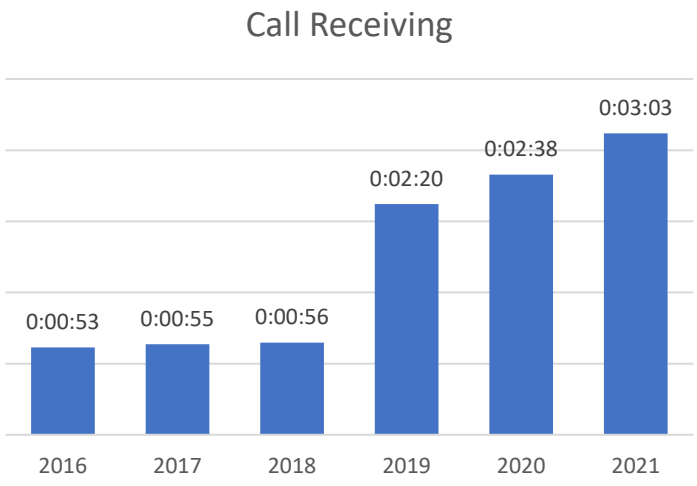


Chart 1: Call Receiving at the 90th Percentile

It's noticeable that call receiving (and dispatching) time was less than a minute in 2016 to 2018 and then increased by more than a minute, up to two minutes, from 2019 to 2021. Kitchener Fire Dispatch explained to us, during an earlier region-wide project in 2021, that some or all of this variance is due to a change in the computer aided dispatch system in Waterloo Region and the way it tracks telephone time.

In 2019 fire services started using the same dispatch platform as the regional police 9-1-1 centre which, in the case of an event that might require fire response, allows the

9-1-1 operator to populate the information to the fire dispatch screens even though the caller would not be put through to fire dispatch until the 9-1-1 operator ascertained fire is required. This wasn't possible prior to the change to a uniform computer aided dispatch platform.

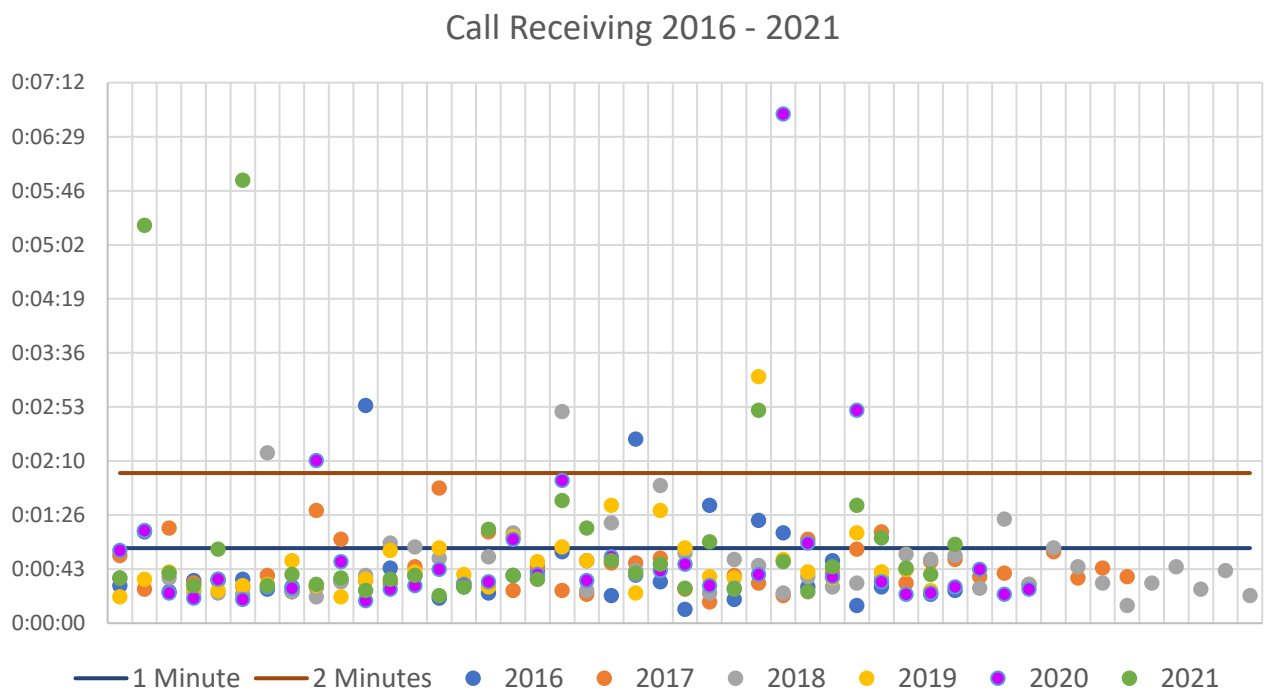
This means that, as of 2019, the call receiving and dispatching time reflects the full 9-1-1 and fire department call taking and dispatch time, rather than just the fire portion, for all call types. We show in Chart 2 that when the 9-1-1 and fire department call taking and dispatch time for structure fires only is measured, the duration falls predominantly within the National Fire Protection Association 64 second target time. There is no evidence to suggest the communication centre is taking longer to process a call than prior to 2019.

The 90th percentile time from 2016 to 2018 might be a good indicator of how long the fire dispatch takes to receive information and dispatch fire, and the 2019 to 2021 period might be a more accurate picture of the additional time that should be included as part of calculating fire service requirements to all call types.

Chart 2 offers an idea of the duration between the time fire dispatch receives a call for assistance for a structure fire and the time to dispatch a fire truck. This is the Call Receiving phase shown in Exhibit 1. The majority of structure fire incidents are dispatched in a minute or less although a few take up to two minutes, and a very few are outliers.

Waterloo's fire department, and the Kitchener dispatch centre, should track outliers, determine the reasons, and provide Waterloo Fire rescue with a weekly report of variances and reasons.

Chart 2: Call Receiving Distribution of Times for Structure Fires



2.1.2 Preparation Time

Preparation time is the time it takes firefighters to don the appropriate protective clothing required for the type of incident to which they are responding and leave the station.

Chart 3 shows that preparation time at the 90th percentile, for all incident types, is about one minute 50 seconds to slightly over two minutes. NFPA 1710 suggests 80 seconds at the 90th percentile for structure fires.

Chart 3: Preparation Time - 90th Percentile

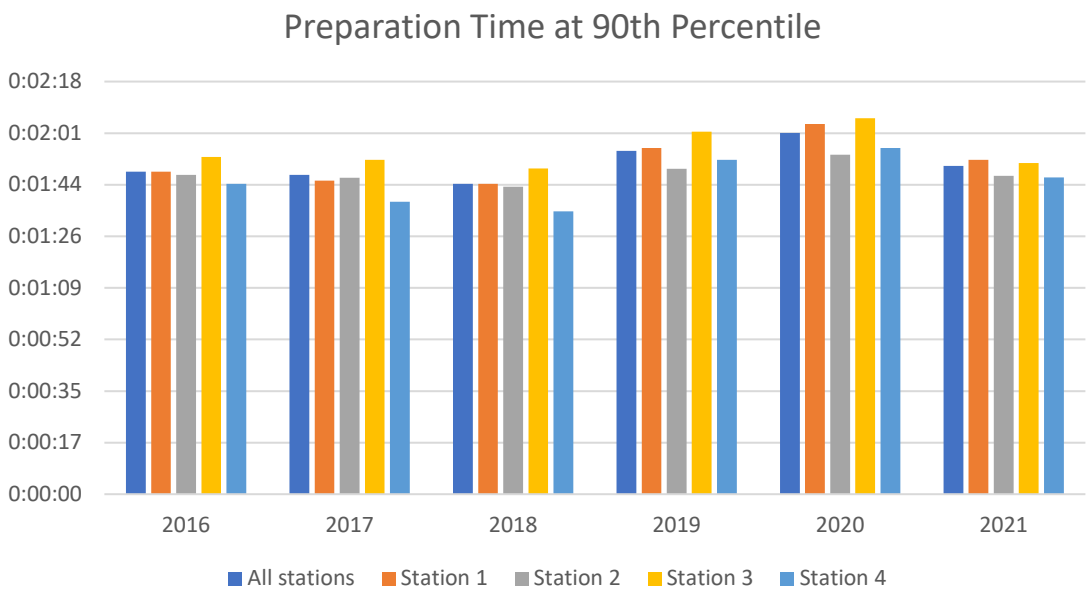
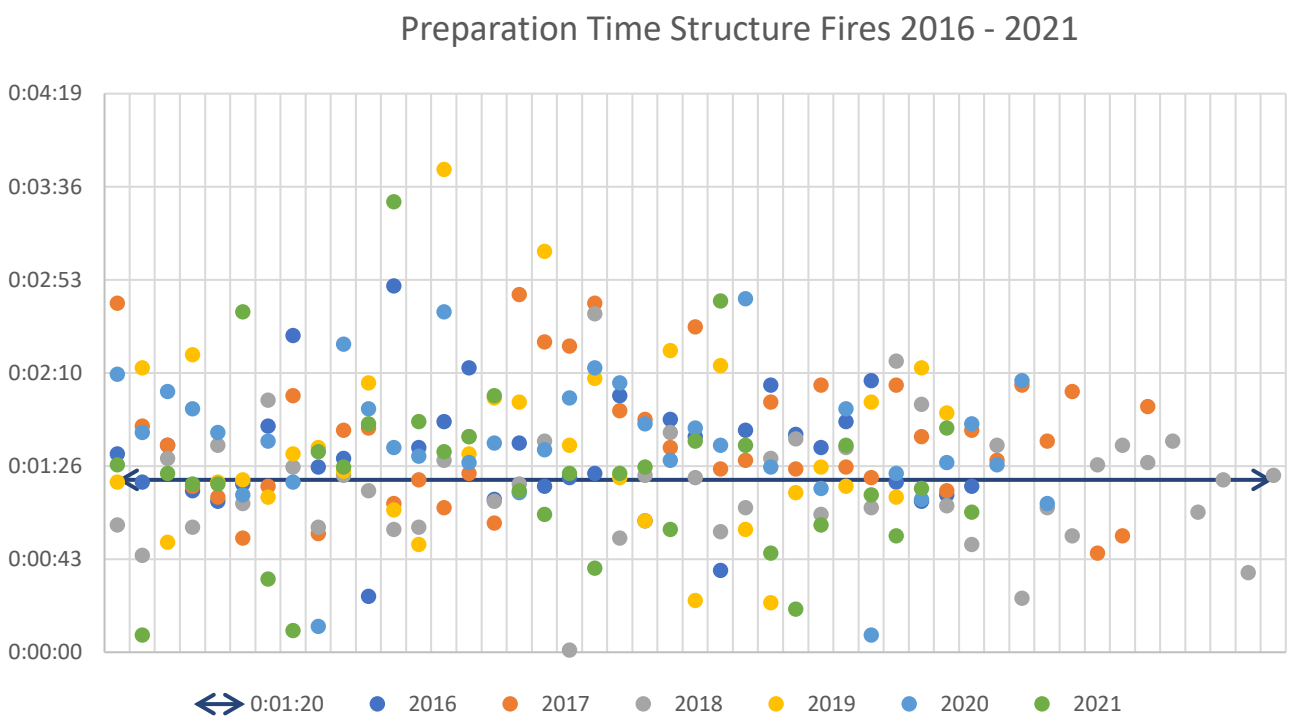


Chart 4 indicates the historical preparation time (known as 'turnout' to firefighters) for structure fires only. About 60% of preparation time took longer than that suggested by the National Fire Protection Association; however, the NFPA target is very difficult to meet. Some of Waterloo Fire Rescue Service's preparation times are quite high while others are very low, which may represent timekeeping errors, or a truck may have been mobile when assigned to a fire incident.

We note that Waterloo Fire Rescue is monitoring turnout times on a daily basis as an effort towards continuous improvement. Waterloo Fire Rescue should continue to track all time components and check outliers as to the cause on daily basis.

Chart 4: Preparation Time – Structure Fires



2.1.3 Driving Time

In North America the conventional method of measuring fire response is as a percentile score against targets published by the National Fire Protection Association. The intent is to achieve response targets as laid out in NFPA publications 90% of the time.

A challenge with using percentile measurement is that it doesn't indicate exactly how many incidents achieved whatever target a municipality has decided upon – NFPA or other – or the extent to which incidents ranged from the target.

The National Fire Protection Association suggests the following driving times to assemble an initial full alarm assignment[8]

- *Travel time* (driving time in Exhibit 1: Response Graphic) of 240 seconds (4 minutes) or less for the arrival of the first engine company,
- *Travel time* of 360 seconds (6 minutes) or less travel time for the arrival of the second company with a minimum staffing of 4 personnel,

[8] An *Initial Full Alarm Assignment* is defined in section 3.3.40 of NFPA 1710 as "Those personnel, equipment, and resources ordinarily dispatched upon notification of a structure fire".

- *Travel time* of 480 seconds (8 minutes) or less for the deployment of an initial full alarm assignment.

Sections 2.1.3.1 to 2.1.3.4 show a series of charts indicating historic driving time to structure fire incidents for a six-year period by

- service-wide response, and
- by station, and
- for first, second, third, and fourth arriving apparatus, separately.

Fire suppression requires substantial resources. A good description of firefighters required, and duties, can be found in Section 5.2.4 of National Fire Protection Association 1710 – 20 (see Appendix C).

The time of arrival of resources is also critical. For example, even if the first fire truck arrives in a few minutes, the four initial firefighters are restricted in what can be accomplished until subsequent trucks arrive. Achieving a drive time of four minutes for the first truck is admirable but if the second truck arrives 8 minutes later (8 total staff), and the third truck arrives 4 minutes after the second truck, that represents a higher risk than all the trucks arriving with 8 or 12 minutes after the first is dispatched.

2.1.3.1 First Arriving Apparatus Drive Time

Chart 5 shows the service-wide driving time measurement for the first arriving apparatus to all incident types. There is a notable upward trend.

Chart 5: Service-wide 90th Percentile Driving Time – First Vehicle Arrival

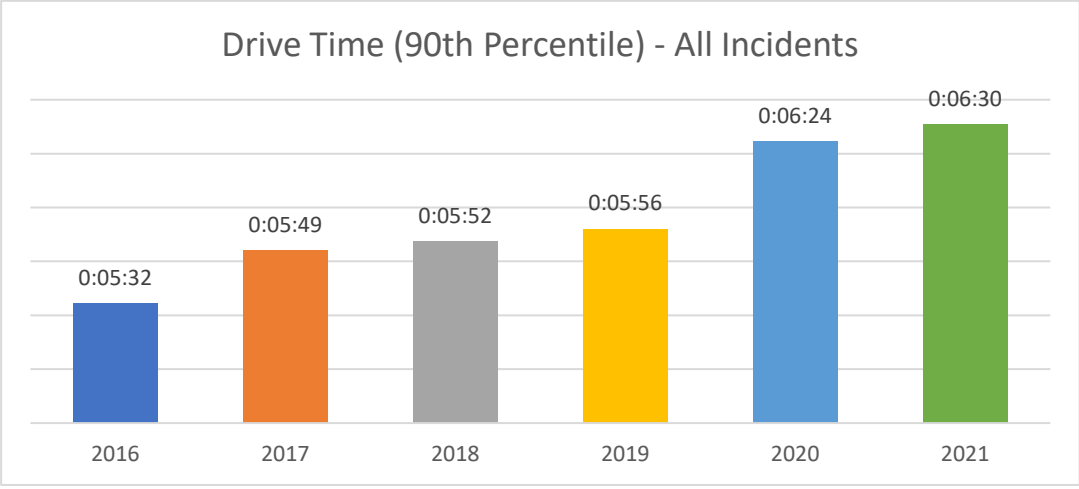


Chart 6 shows the 90th percentile driving time for the first arriving apparatus at structure fires by year. Again, the upward trend since 2016 is noticeable.

Chart 6: 90th Percentile Drive Time Service Wide – First Arriving Apparatus Structure Fires

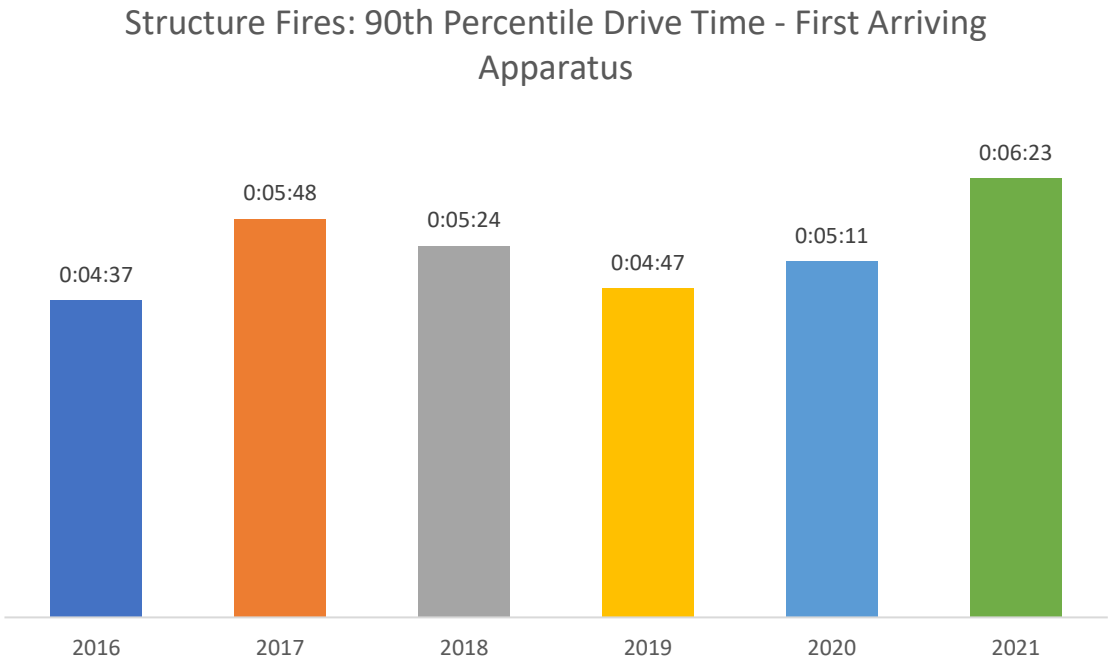


Chart 7 indicates the distribution of drive times for the first arriving apparatus at structure fires for 2016 – 2021. Similar charts by station can be found in Appendix D. The elevated drive time for 2021 seen in Chart 5 and Chart 6 could be indicative of fires occurring further from the fire stations than in previous years, or the effect of improved livability efforts in the city including bicycle lanes, traffic calming, public transit, reduced speed limits, and reduction of driving lanes on some roadways.

37 of 231 structure fire incidents (16%) shown in Chart 7 exceeded the city's 5-minute drive time target. 84% achieved the drive time target.

Chart 7: Fire Drive Time Distribution - Service Wide – First Arriving Apparatus

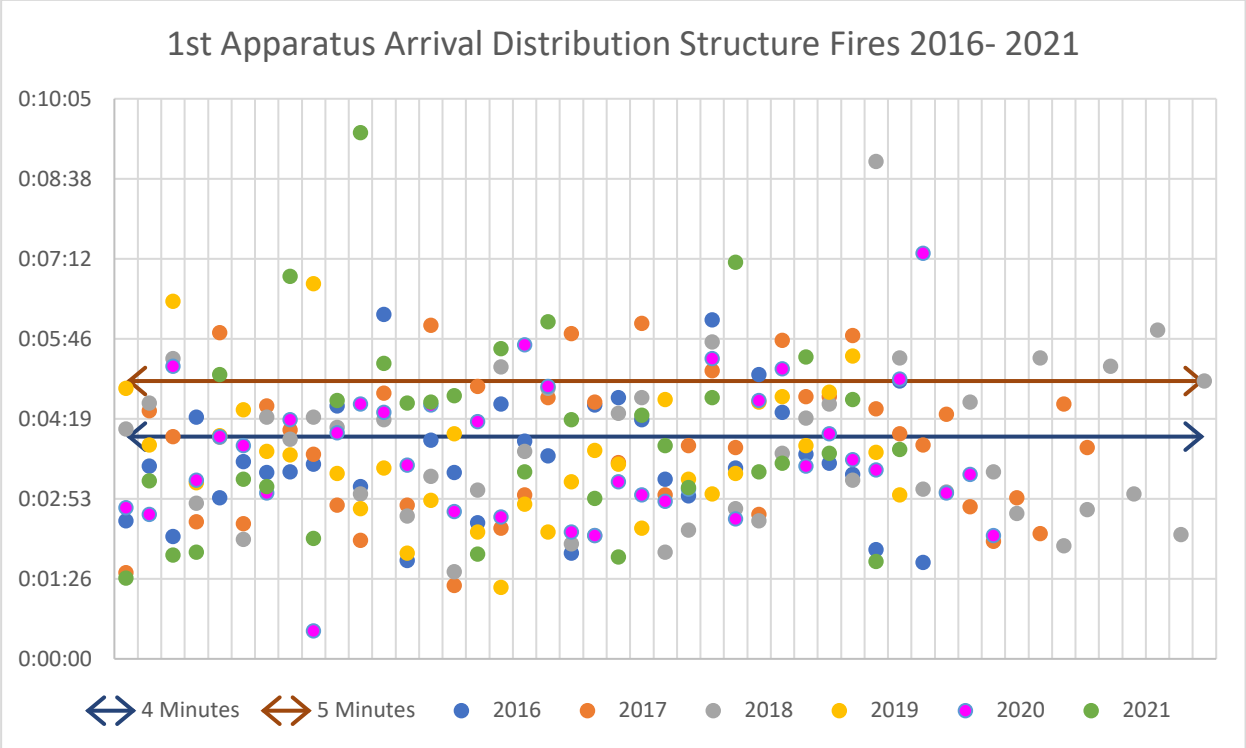


Table 1 shows the range of driving times for the first arriving truck, by year, to structure fires. In 2021 the percentage of structure fires where driving time was beyond the five-minute city target had risen to 23.5% (Table 2).

Table 1: Drive Time for First Arriving Apparatus to a Structure Fire

	2016	2017	2018	2019	2020	2021
Number of Fires	35	42	47	34	38	34
<=4	24	22	26	23	22	18
4> <5	7	13	13	8	10	8
5> <6	2	6	7	1	5	4
6> <7	2	1	0	2	0	2
>7	0	0	1	0	1	2
<= 4	68.6%	52.4%	55.3%	67.6%	57.9%	52.9%
4> <5	20.0%	31.0%	27.7%	23.5%	26.3%	23.5%
5> <6	5.7%	14.3%	14.9%	2.9%	13.2%	11.8%
6> <7	5.7%	2.4%	0.0%	5.9%	0.0%	5.9%
>7	0.0%	0.0%	2.1%	0.0%	2.6%	5.9%
Total Percentage	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%

Table 2: Driving Time exceeding Five Minutes

Percentage of Driving Time Exceeding 5-minutes	2016	2017	2018	2019	2020	2021
	11.4%	16.7%	17.0%	8.8%	15.8%	23.5%

2.1.3.2 Second Arriving Apparatus Drive Time

In a structure fire, the target is to have a second fire truck reach the scene within six to eight minutes to aid the first four firefighters.

Chart 8 shows the 90th percentile performance of second fire truck drive time on a city-wide basis. Historically, the second truck drive time has been seven and a half to eight and a half minutes. The lowest drive time was in 2020 possibly due to less traffic during COVID. Other than that year, driving times have been closer to eight minutes.

A significant jump in the 90th percentile driving time for second vehicle arrival was experienced in 2021 likely due to five lengthy calls (driving time, not time on scene). We weren't able to delve sufficiently into the data to find the reasons for the extended responses.

Chart 8: 90th Percentile Drive Time Service Wide – Second Arriving Apparatus

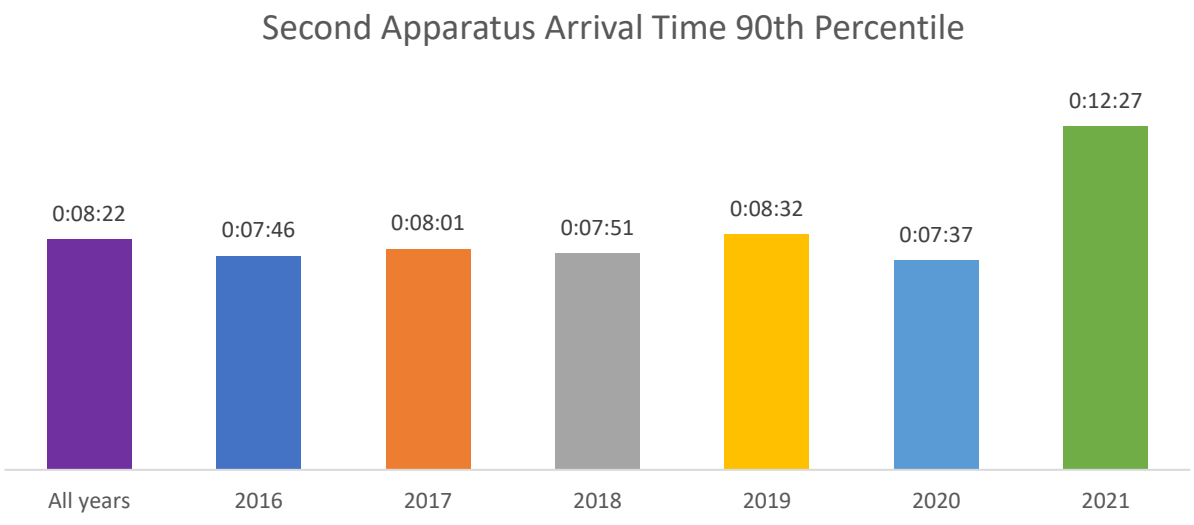


Chart 9 shows the driving time performance distribution of the second arriving apparatus to structure fires. The blue line indicates a drive time target of 6 minutes, which is the National Fire Protection Association recommendation for a second

vehicle, and the deep orange line shows an eight-minute target for comparison. We are cautious about some of the times depicted where it appears that second arriving vehicles have a driving time as low as a minute and thirty-six seconds, but this could be in station 1's area where two fire trucks are staffed.

Chart 9: Fire Drive Time Distribution - Service Wide – Second Arriving Apparatus

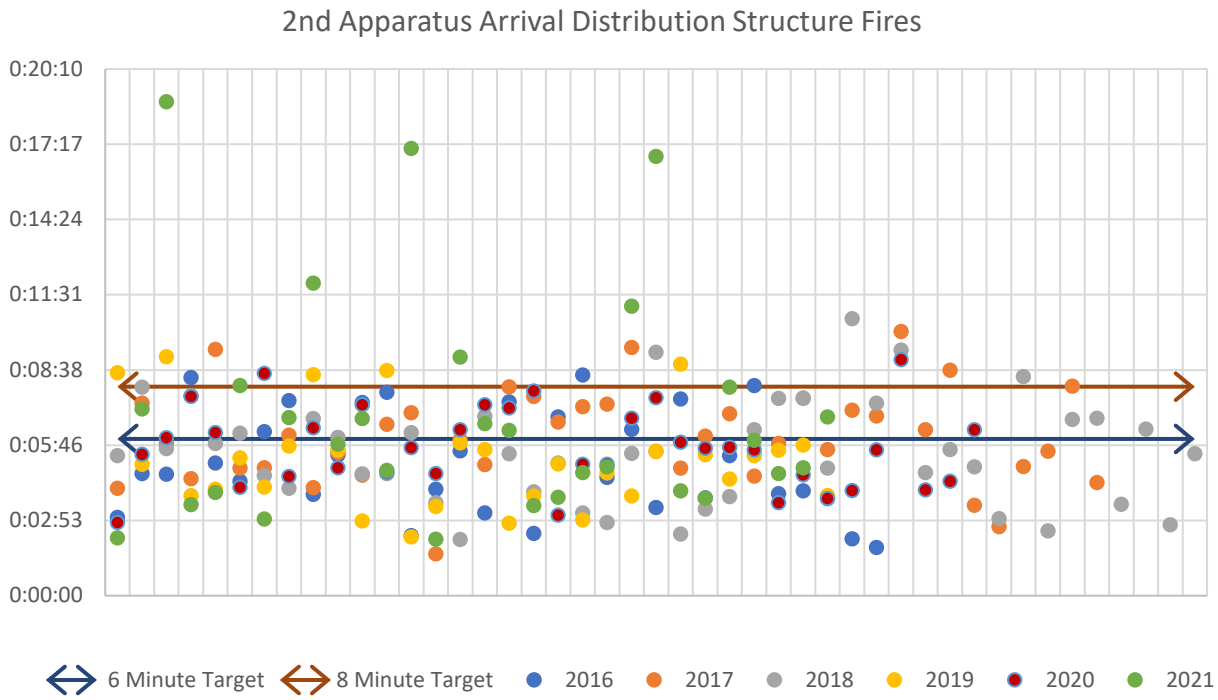


Table 3 indicates the number of times, and percentage of time, a second truck drive time exceeded six and seven minutes. In 2021 the second truck drive time exceeded six minutes in 37% of structure fire incidents.

Table 3: Drive Time for Second Arriving Apparatus to a Structure Fire

	2016	2017	2018	2019	2020	2021
Number of Fires	32	41	45	30	36	30
<=4	11	3	12	9	4	8
4> <5	6	10	7	4	9	6
5> <6	4	8	8	12	9	2
6> <7	3	7	9	0	6	5
>7	8	13	9	5	8	9
<= 4	34.4%	7.3%	26.7%	30.0%	11.1%	26.7%
4> <5	18.8%	24.4%	15.6%	13.3%	25.0%	20.0%
5> <6	12.5%	19.5%	17.8%	40.0%	25.0%	6.7%
6> <7	9.4%	17.1%	20.0%	0.0%	16.7%	16.7%

	2016	2017	2018	2019	2020	2021
>7	25.0%	31.7%	20.0%	16.7%	22.2%	30.0%
Total Percentage	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%

2.1.3.3 Third Responding Apparatus Drive Time

Chart 10 shows the traditional method of measuring drive time performance, in this case at the third apparatus response level. Third apparatus drive time has ranged from a low of 8:46 at the 90th percentile in 2019, to a high of 13 minutes and 29 seconds in 2021.

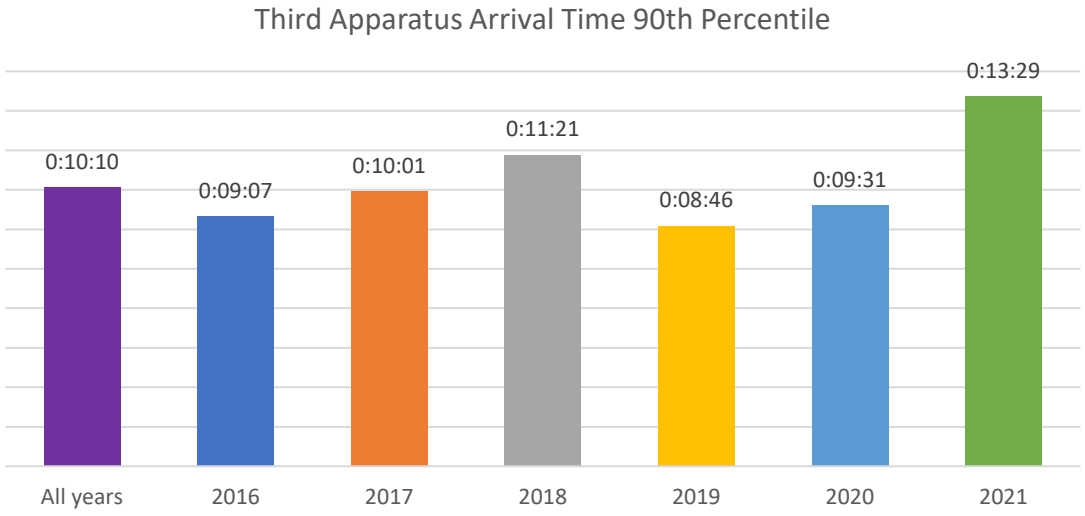


Chart 10: 90th Percentile Drive Time Service Wide – Third Arriving Apparatus

Chart 11 shows the drive time distribution for the third arriving apparatus at structure fires. The quickest third vehicle drive time was three minutes and fifty-one seconds in 2019 which may have been possible if the fire was located approximately mid-way of stations 1 and 3. The quickest third vehicle drive time in 2021 was four minutes and twenty-seven seconds.

Chart 11: Fire Drive Time Distribution - Service Wide – Third Arriving Apparatus

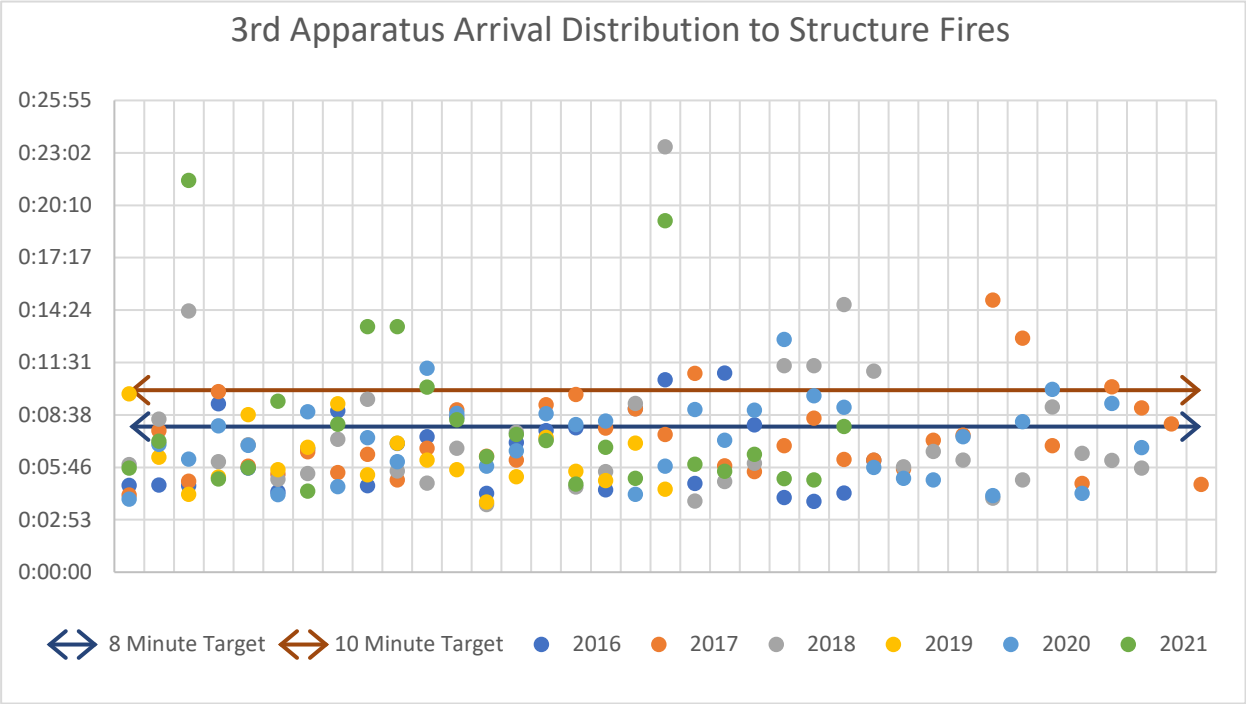


Table 4 indicates the number of times, and percentage of time, a third truck drive time exceeded eight or more minutes. The National Fire Protection Association guideline for third arriving truck drive time is eight minutes. We chose nine and 10 minutes as other reference targets. In 2021 third truck drive time exceeded eight minutes in 36% of incidents.

Table 4: Drive Time for Third Arriving Apparatus to a Structure Fire

	2016	2017	2018	2019	2020	2021
Fires	26	37	35	19	35	25
<=4 minutes	1	0	2	1	0	0
4> <5 minutes	10	4	4	2	6	2
5> <6 minutes	1	7	9	7	5	8
6> <7 minutes	2	9	6	3	5	3
7> <8 minutes	5	5	4	3	4	3
8> <9 minutes	4	4	1	1	9	3
9> <10 minutes	1	4	3	2	3	1
>10	2	4	6	0	3	5
<= 4 minutes	3.8%	0.0%	5.7%	5.3%	0.0%	0.0%
4> <5 minutes	38.5%	10.8%	11.4%	10.5%	17.1%	8.0%
5> <6 minutes	3.8%	18.9%	25.7%	36.8%	14.3%	32.0%
6> <7 minutes	7.7%	24.3%	17.1%	15.8%	14.3%	12.0%

	2016	2017	2018	2019	2020	2021
7> <8 minutes	19.2%	13.5%	11.4%	15.8%	11.4%	12.0%
8> <9 minutes	15.4%	10.8%	2.9%	5.3%	25.7%	12.0%
9> <10 minutes	3.8%	10.8%	8.6%	10.5%	8.6%	4.0%
>10 minutes	7.7%	10.8%	17.1%	0.0%	8.6%	20.0%
Total Percentage	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%

2.1.3.4 Fourth Responding Apparatus Drive Time

Chart 12 indicates the 90th percentile drive time for a fourth apparatus to a structure fire. A fourth vehicle raises the total number of firefighters at a structure fire to 16. The National Fire Protection Association guidelines indicate 16 to 17 firefighters are required at a two-story single-family dwelling with no basement and no structures nearby that could be threatened by the initial fire.

The 90th percentile times shown in Chart 12 range from a low of 14:29 in 2016 to a high of 26:47 in 2019. The 2021 time was 21:50.

Chart 12: 90th Percentile Drive Time Service Wide – Fourth Arriving Apparatus

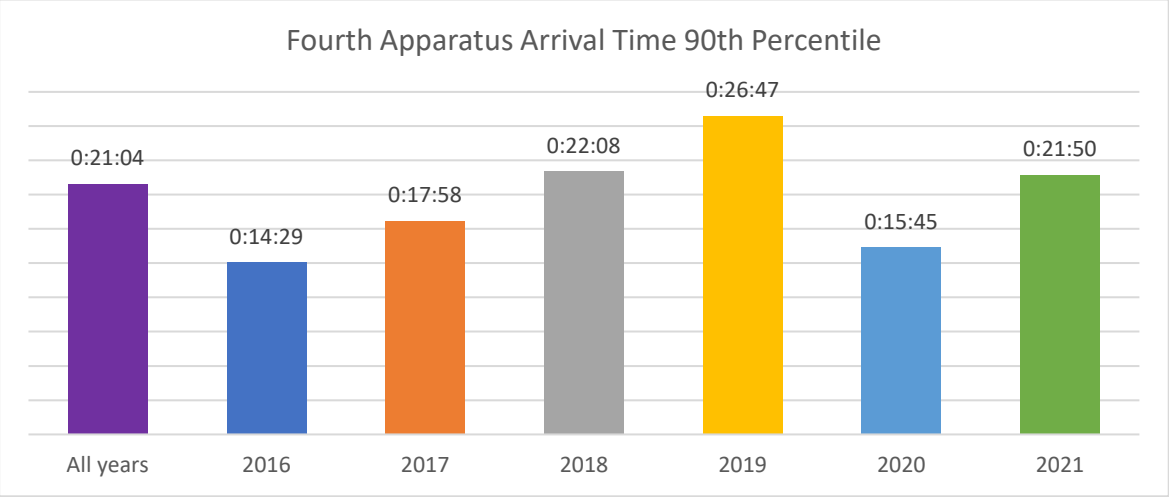


Chart 13 shows the distribution of the fourth apparatus drive times to structure fires. Fewer points are shown in Chart 13 because there are fewer instances of fires requiring 16 firefighters as determined by the senior fire officer on scene. However, when a fourth truck is required, driving times range from a low of about seven minutes (2021) to a high of almost 26 minutes (also 2021), with the majority around 14 minutes.

Chart 13: Fire Drive Time Distribution - Service Wide – Fourth Arriving Apparatus

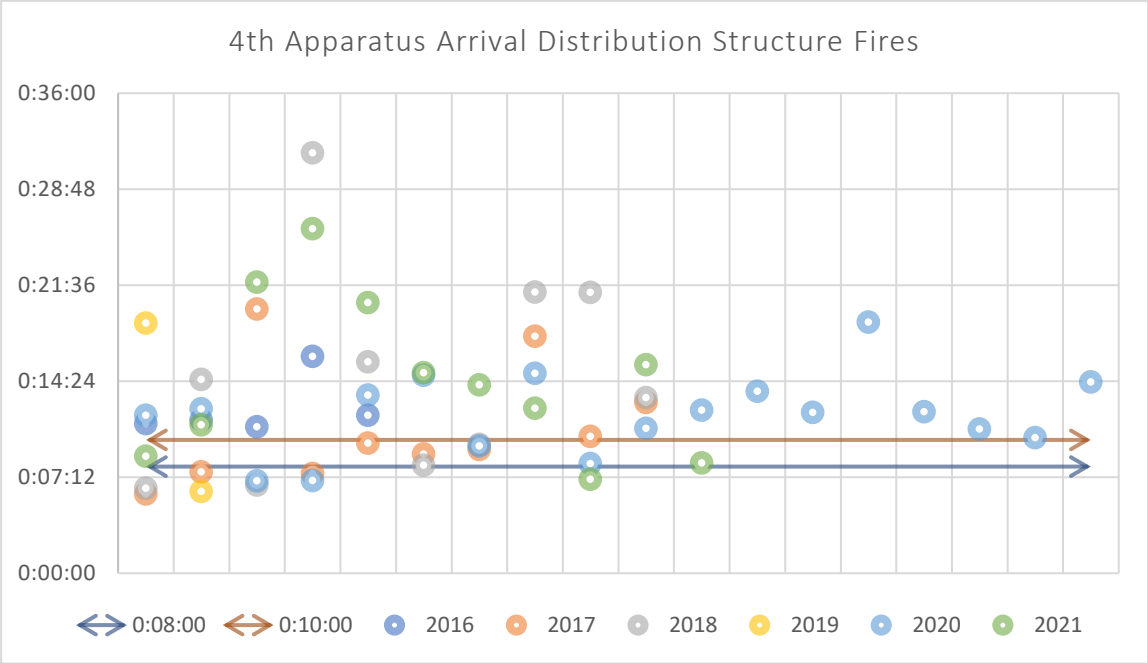


Table 5 indicates the number of fires at which a fourth fire truck was required. We chose 10 and 12 minutes as response targets. Table 5 also shows the percentage that fourth apparatus response exceeded 8, 10, and 12 minutes.

Table 5: Drive Time for Fourth Arriving Apparatus to a Structure Fire

	2016	2017	2018	2019	2020	2021
Fires	6	11	11	3	19	12
<=4 minutes	0	0	0	0	0	0
>4> <5 minutes	0	0	0	0	0	0
>5> <6 minutes	1	0	0	0	0	0
>6> <7 minutes	0	1	0	0	1	0
>7> <8 minutes	0	0	2	1	2	0
>8> <9 minutes	0	2	0	0	0	1
>9> <10 minutes	0	1	1	0	1	2
>10 minutes	5	7	8	2	15	9
<= 4 minutes	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
>4> <5 minutes	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
>5> <6 minutes	16.7%	0.0%	0.0%	0.0%	0.0%	0.0%
>6> <7 minutes	0.0%	9.1%	0.0%	0.0%	5.3%	0.0%

	2016	2017	2018	2019	2020	2021
>7> <8 minutes	0.0%	0.0%	18.2%	33.3%	10.5%	0.0%
>8> <9 minutes	0.0%	18.2%	0.0%	0.0%	0.0%	8.3%
>9> <10 minutes	0.0%	9.1%	9.1%	0.0%	5.3%	16.7%
>10 minutes	83.3%	63.6%	72.7%	66.7%	78.9%	75.0%
Total Percentage	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%

3 Non-Fire Incident Response

3.1 Medical Response

Chart 44: All Medical - Resuscitator Events 2016-2021 shows that of all medically related responses in the time period measured, the most frequent category was *medical aid not required upon arrival* (2,310 instances), then *drug and alcohol related*.

3.1.1 Medical Incidents: Time on Scene, Time with Patients

We found 55,500 fire truck incident activity records for the six years, 2016 to 2021 and filtered those records for medical and emergency medical services events to which Waterloo Fire was dispatched. There were 21,070 of those, or 38% of all activity records. The 21,070 records were further filtered to remove any that the response was cancelled before the fire apparatus left the station, or the codes Waterloo Fire reported to the Office of the Fire Marshal were something other than medical; 13,764 remained. Then, any incident records that had no time stamp for arriving at the scene were removed. And any events where there was no record of firefighters contacting a patient were removed leaving 8,691.

Error! Reference source not found. shows medical dispatches compared to the number of patient contacts for each year since 2016, and the percentage of patient contacts relative to the number of dispatches each year. Column 5 shows the number of records we found indicating firefighters were sent to cardiac arrests.

There were some interesting variations in the percentage of patients with whom firefighters came into contact.

- 2016 was the highest year for patient contact relative to medical dispatches at just over 56%.
- 2017 was a very low year for patient contact percentage.
- 2020 has the second lowest patient contact percentage of the six years.

- 2021 has the highest number of medical dispatches at 4,362 yet actual patient contact records are relatively low.
  - Column 5, Cardiac Arrest, indicates that cardiac arrest is an infrequent call type, historically ranging between 7 and 32 a year.

Table 6: Medical Dispatches Compared to Patient Contacts 2016 - 2021

1	2	3	4	5
	Medical Dispatches	**Record of patient Contact**	**Percentage of patient contact**	**Record of Cardiac Arrest**
2016	3063	1717	56.1%	23
2017	3499	950	27.2%	7
2018	3546	1878	53.0%	14
2019	3686	1756	47.6%	27
2020	1788	751	42.0%	32
2021	4362	1639	37.6%	27
Totals	19944	8691		130

Pomax also measured the fire department's time on scene and patient contact time (Table 7). Time on scene is calculated from the time the firefighters report to a dispatcher that they have reached the roadway from which they gain access to a patient, until the time firefighters depart the location (wheels stop turning to wheels start turning). Time with patient is calculated from the time firefighters report they have reached the patient to the time the vehicle departs the incident.

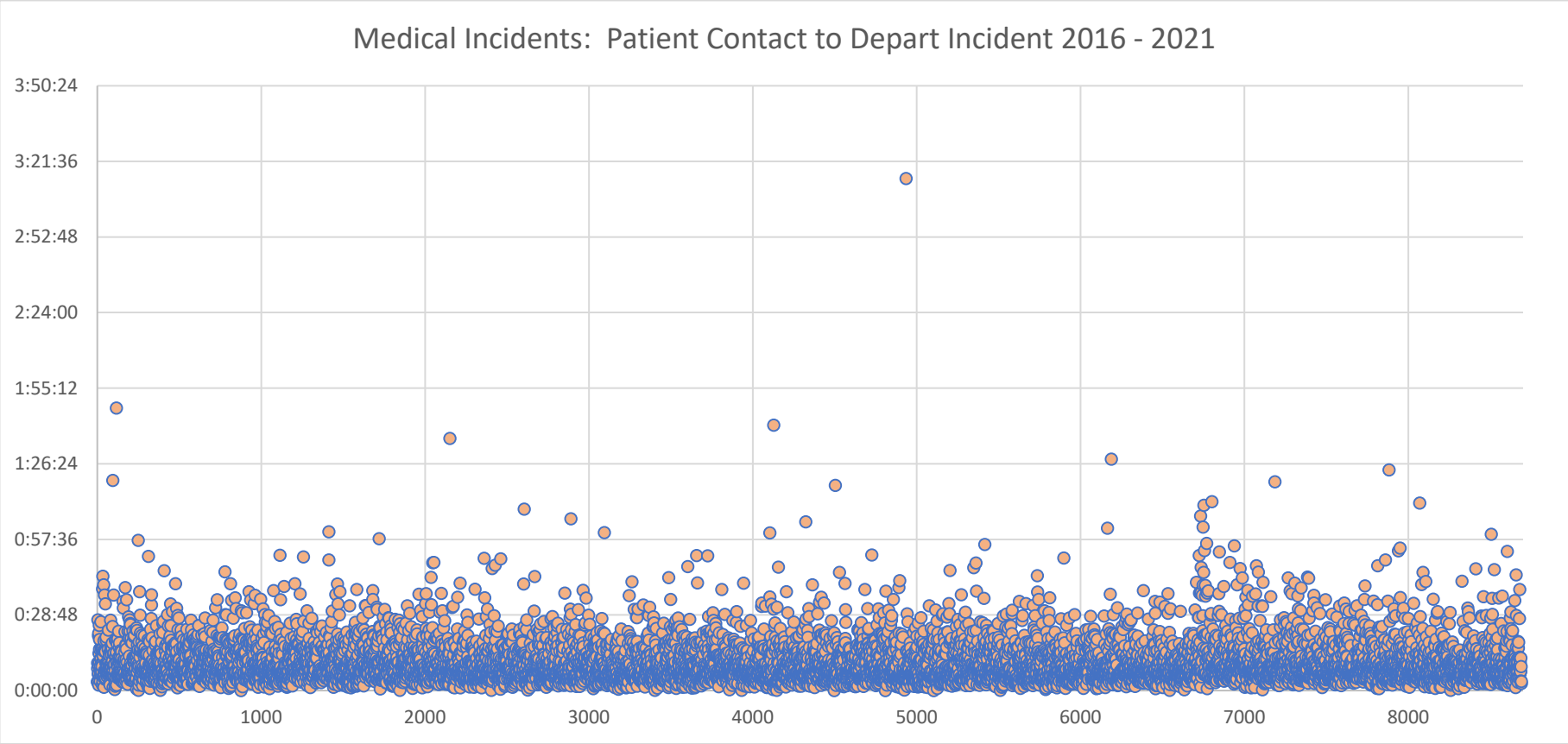
Table 7: Average and Median Time on Scene and With Patient

	2016 - 2021	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**
Average Time on Scene	0:12:44	0:13:13	0:12:31	0:12:05	0:12:08	0:13:46	0:13:17
Average Time with Patient	0:10:51	0:11:30	0:10:48	0:10:20	0:10:24	0:11:38	0:10:55
Median Time on Scene	0:10:30	0:11:04	0:10:19	0:09:57	0:09:55	0:10:53	0:10:52
Median Time with Patient	0:08:29	0:09:23	0:08:29	0:08:08	0:07:56	0:08:35	0:08:33

Averages have limitations in determining performance but the averages and medians for each year 2016 – 2021 are usually within one minute of each other. The pattern makes us inquisitive as to why the averages and medians are so low. If fire is needed to provide medical relief to patients, we would expect that time on scene and time with patients would average higher as they do with cardiac arrests. Unfortunately, information that would inform the reason for low averages is available in free form text in officers' notes but not in a relational database.

Chart 14Chart 14: *Medical Incidents – Time Distribution Patient Contact to Depart Incident* shows the time firefighters spent with patients for each medical incident that occurred from 2016 -2021. Most data are clustered below the 15 minute mark and up to 29 minutes.

Chart 14: Medical Incidents – Time Distribution Patient Contact to Depart Incident



3.2 Vehicle Incidents

There were, in the Waterloo Fire record management system, 1885 incidents noted as motor vehicle collisions of some form, 2016 – 2021, including:

- MVC: Extrication
- MVC: Major
- MVC: No extrication
- Rescue: MVC: Extrication Required
- Rescue: MVC: No Extrication Required

200 of the 1885 incidents were coded, for Ontario Fire Marshal reporting, as something other than vehicle collisions. We removed anything from this analysis that seemed unrelated to vehicle collisions.

3,595 apparatus (fire trucks) were dispatched to these incidents over the six-year period. Two fire trucks are often sent to vehicle collisions. The first truck is sent to attend the collision; a second truck is sent to protect the scene and workers by blocking the roadway. Out of those, 76 trucks (2%) were recorded as being on scene where someone was trapped and required extrication.

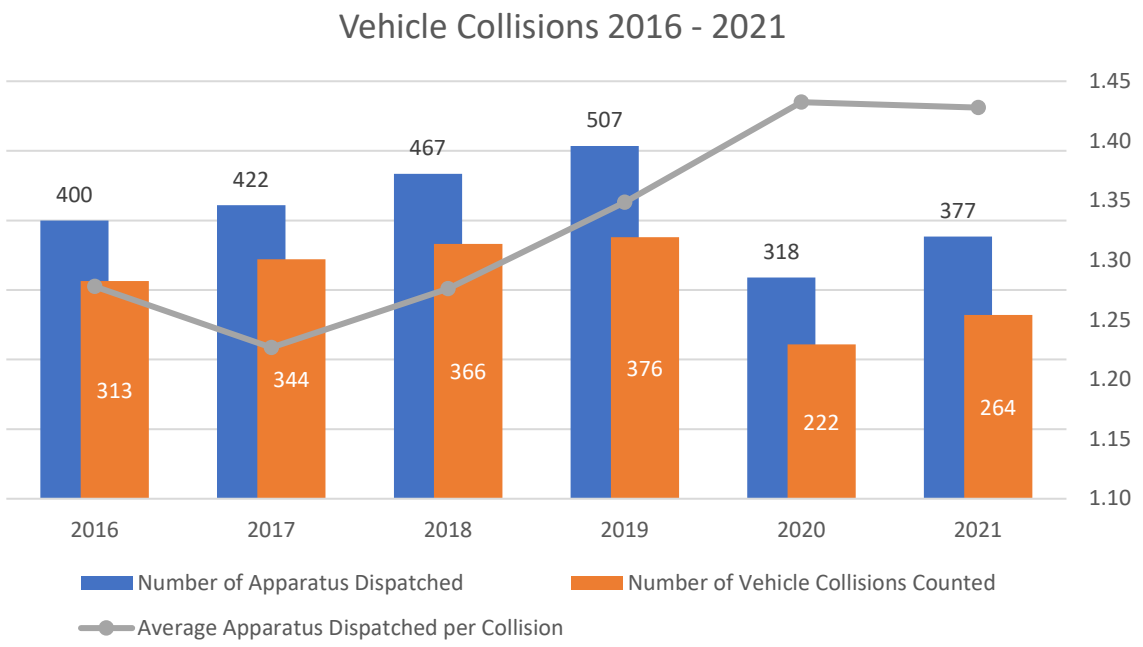
Of the 3,595 trucks dispatched to vehicle collisions, we filtered out

- 1,078 that had no record of the time departing station (985 of the 1,078 had a record of the fire truck leaving the incident).
- any incidents that were missing time points such as when a truck arrived or left an incident.

Subsequently, we were left with 2,491 fire apparatus records for this assessment.

Chart 15 shows, for each year, the number of vehicle collisions attended (orange bar), the number of apparatus sent to the collisions (blue bar), and the average number of trucks sent to each incident (grey line). The number of collisions to which Waterloo fire was dispatched and the average trucks sent per incident have trended upward since 2016. This increase in vehicle response may be indicative of the broader fire service practice to send additional apparatus to motor vehicle collisions to act as blockers creating a safe work zone for firefighters on busy roadways and highways. Waterloo Fire Rescue sends two vehicles when there is uncertainty regarding the possibility of victim entrapment.

Chart 15: Vehicle Collisions 2016 - 2021



3.2.1 Summary of Vehicle Collision Data

Overall, for the six-year period, average on scene time for traffic accidents was just over 22 ½ minutes while median time on scene was 16 minutes and 20 seconds. Waterloo Fire Rescue Service's data shows that there were from 4 to 11 extrication (people trapped) incidents per year out of almost 3,600 fire truck responses.

4 Vehicle Replacement Plan

Pomax received Waterloo's 2021 asset replacement plan for the fire service. The charts that follow have been adjusted to reflect the date of writing this report date. We also acknowledge that vehicle costing is changing so quickly that the figures offered below are likely to be inaccurate.

Apparatus and asset replacement are primary considerations for fire services. Fire trucks and other vehicles are part of the work environment for a firefighter, and they cost a lot of money. They might also last 15 to 20 years. So, a $900,000 truck that lasts 15 years costs $60,000 a year plus maintenance and fuel. If it lasts 20 years, the cost is $45,000, although expected increases in maintenance will add to that annual amount in the last few years of use. A 1.4-million-dollar ladder truck is about $56,000 a year. We acknowledge that these are expensive work environments.

One of the guidelines recognized by fire services is National Fire Protection Association 1901, which offers 10-to-20-year replacement considerations and recognizes other factors that must be considered for the serviceable time of a truck. In Canada, Underwriters Laboratory of Canada (ULC) standard ULC-S515 is similar to the NFPA standard, and its development process is almost identical to that of the NFPA.

From Annex D of NFPA 1901-16

> *It is generally accepted that fire apparatus, like all types of mechanical devices, have a finite life. The length of that life depends on many factors including vehicle mileage and engine hours, quality of the preventative maintenance program, quality of the driver training program, whether the fire apparatus was used within the design parameters, whether the apparatus was manufactured on a custom or commercial chassis, quality of workmanship by the original manufacturer, quality of the components used, and availability of replacement parts, to name a few.*
>
> *In the fire service, there are fire apparatus with 8 to 10 years of service that are simply worn out. There are also fire apparatus that were manufactured with quality components, that have excellent maintenance, and that have responded to a minimum number of incidents that are still in serviceable condition after 20 years. Most would agree that the care of fire apparatus while being used and the*

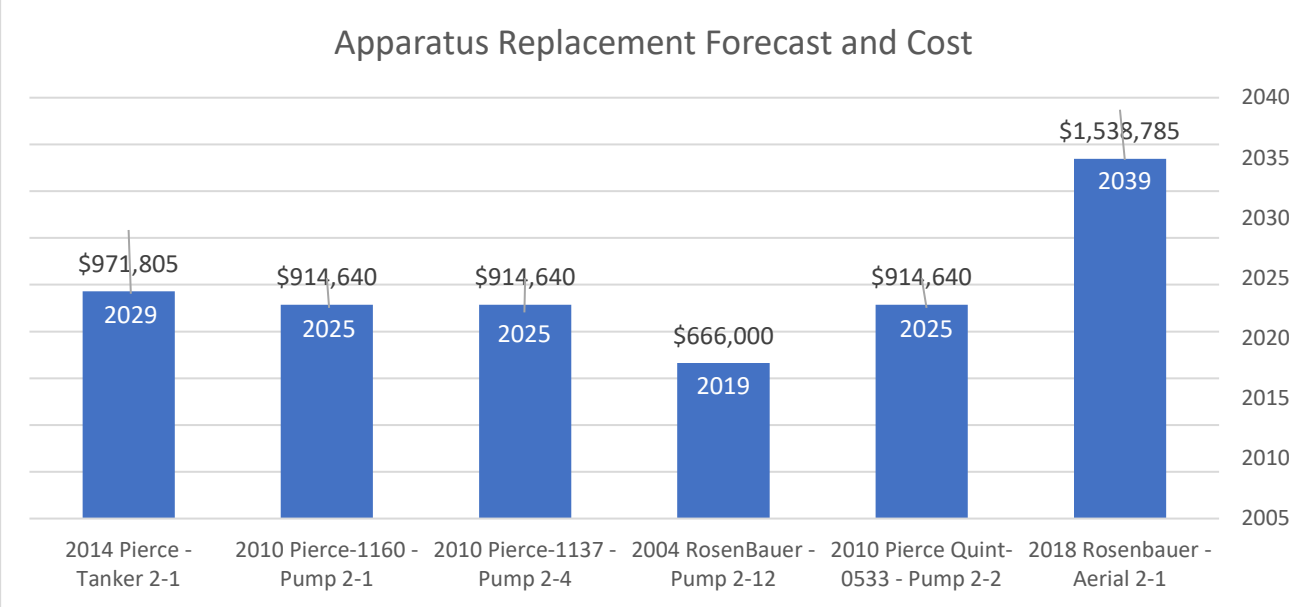
quality and timeliness of maintenance are perhaps the most significant factors in determining how well a fire apparatus ages.

Possibly more, or as, important than the mechanical age of the truck are safety considerations that have been implemented during a 10-to-20-year period. Critical enhancements in design, safety, and technology should play a key role in the evaluation of an apparatus' life cycle (NFPA 1901 Annex D).

A slow-moving supply chain and skilled worker shortage is a problem that is affecting fire truck replacement, as it does many other industries. Waterloo Fire Rescue has adopted a 12-year replacement request cycle because, by the time approvals are received, orders placed, and apparatus manufactured, it is estimated that it will be close to a further two years before a truck is received.

Chart 16, based on a 15-year delivery cycle, shows the expected replacement year, and cost, updated to 2023. Not included is an additional apparatus and associated equipment related to our recommendation for added staff at station 2. Three trucks show a replacement cycle within two years (2025). A 2004 Rosenbauer pump is four years past it's expected replacement date, however, it is being kept in-service due to aging trucks awaiting replacement, and production delays due to the pandemic. Manufacturers now have varying production estimates of 2 to 3 years whereas pre-pandemic delivery times were generally nine months to year.

Chart 16: Apparatus Expected Replacement Year and Cost[9]



[9] These estimates may be out of date. The latest City of Waterloo apparatus replacement forecast and cost should be used.

In addition to the aforementioned supply chain problems, Waterloo Fire rescue reports difficulty finding replacement parts for some trucks as well as significant frame compromise on three vehicles due to corrosion. Since the first truck frame failed, fire management has procured trucks with extensive frame warranty and/or stainless steel frames.

Apparatus has to be assessed on a truck-by-truck basis to determine the best time for replacement. As part of an extensive corporate program, the fire service and asset management staff track all equipment and resources on an annual, and by purchase, basis that includes regular review and grading. A timeline of 10 to 20 years as mentioned in NFPA 1901 should be considered a guideline rather than prescriptive.

5 Stations

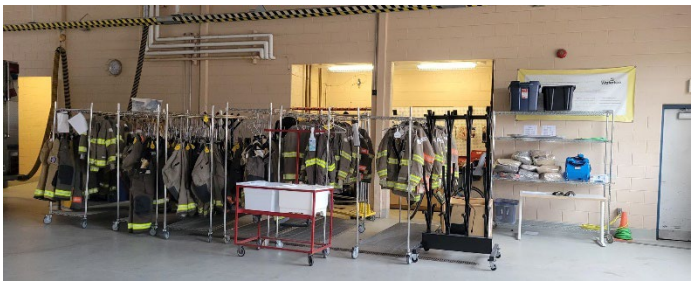
Waterloo has four fire stations:

- Station 1, built in 1966 with an addition in 1989; 12,670 square feet; houses the vehicle maintenance and repair division.
- Station 2, constructed in 2003; 20,800 square feet. This was a relocation of the station at 90 Westmount Road North, not an additional station. There was no increase in staffing.
- Station 3, constructed in 1989; 4,932 square feet.
- Station 4, constructed in 2010; 6,141 square feet.

We offer comments about stations 1 and 2. We have no comments with respect to station 3 and 4.

5.1 Station 2

The current concept for required fire protection, and which has been included in several prior year's submissions to council, is to build another station in west Waterloo. We have found that the best location to provide optimum response in all parts of west Waterloo is from station 2 therefore we recommend that instead of building another station, additional staff and a fire truck should be located at station 2.



The station is ideally located to provide 5-minute response to most areas of the west end. However, it was explained to us that station 2 also accommodates the service-wide cleaners (washers) and drying racks which decontaminate firefighter turnout gear and occupies 21 square metres of space in the vehicle bays, plus it houses administration, and prevention and public education personnel. If the option to increase staff at station 2 is selected, a space planning assessment is required to ensure space for lockers, the storage of personal protective equipment, and training. The personal protective equipment laundering and storage program will have to be relocated (see photo above) because a second truck will occupy that space.

5.2 Station 1

Station 1 is 57 years old and tired. We suggest that replacing station 1, on the same site if possible, including sufficient room for administration and the vehicle maintenance division, would be a judicious use of funds, provide a better – and safer

– workplace for the vehicle technicians, and bring administration into a closer working relationship if it relocates from station 2 to station 1. Ideally, administration, training, prevention, public education, and vehicle maintenance should be located together to assist planning and communication.

Vehicle technicians are currently working on, and under, heavy vehicles using floor jacks, albeit ones rated for heavy trucks. The area for tools, equipment, and parts is space-restricted, and parts supply is decentralized from the work area. Rebuilding station 1 should include adequate space for vehicle technicians and their tools and supplies, and a hoist so that vehicles can be raised to a reasonable work height which would reduce the fatigue encountered by technicians from working on their knees or back.

Station 1 is ideally located from a response perspective but, if our recommendation to rebuild Station 1 on the current site is not possible, or another close-by site is not available, an addition at another fire station to accommodate the mechanical division should be considered inclusive of additional storage space for spare trucks, equipment, storage, and laundering facilities for clean personal protective equipment. The City should explore options towards a satisfactory resolution.

Vehicle technicians also function as part of the firefighter complement at station 1 and sometimes have to leave the maintenance work being performed to respond to an incident. This not only delays, or interrupts mechanical work, it might delay second apparatus' departure. We were not able to measure if the latter is true, but we recommend tracking to determine effectiveness and efficiency both for response and vehicle repair.

Part 2: Discussion

6 Fire Incident Response

Fire incident response to large portions of the city is satisfactory from a risk perspective although not in west Waterloo. The central area is well covered although it may take up to eight minutes for a second truck response to a structure fire in the northeast corner of the city; however, the frequency of structure fires in the northeast is low (Exhibit 3, page 8).

Exhibit 3 shows the distribution of structure fires in Waterloo for the six years 2016 to 2021. Exhibit 4 (page 41) to Exhibit 6 show the areas of the city where first responding apparatus drive time is challenging at 5, 6, and 8 minutes. That also means second, third, and fourth truck response is an even greater challenge than first apparatus timely arrival.

Exhibit 4: Drive Time by Station

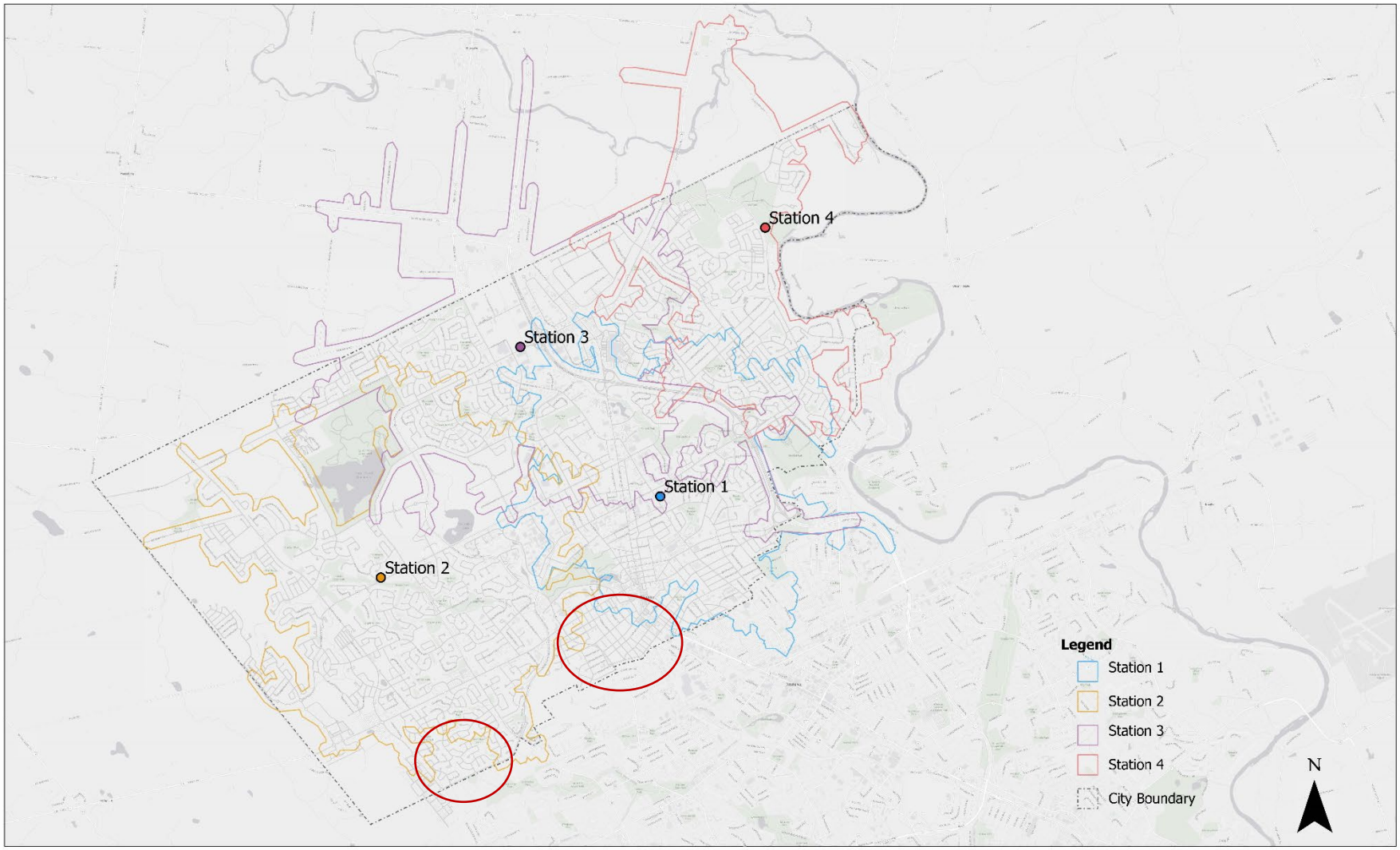
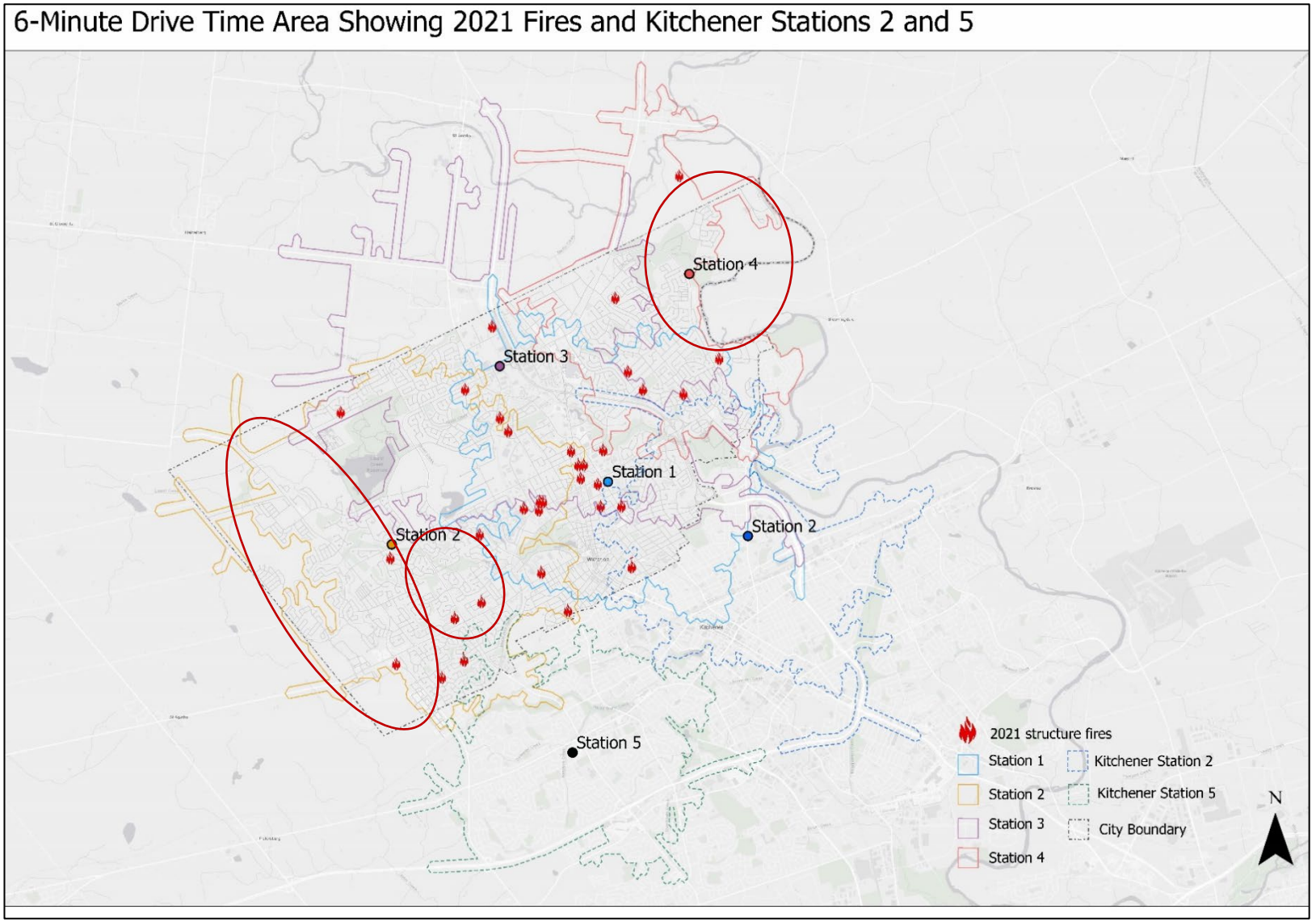


Exhibit 4 outlines the council approved drive time target of five minutes, for each station area, for the first responding fire truck. There are two areas of the city, indicated by the red outline, that are difficult to reach in five minutes. These areas can be reached in six to six and a half minutes. We evaluated drive time into these locations from Kitchener fire

Exhibit 5: Six Minute Drive Time



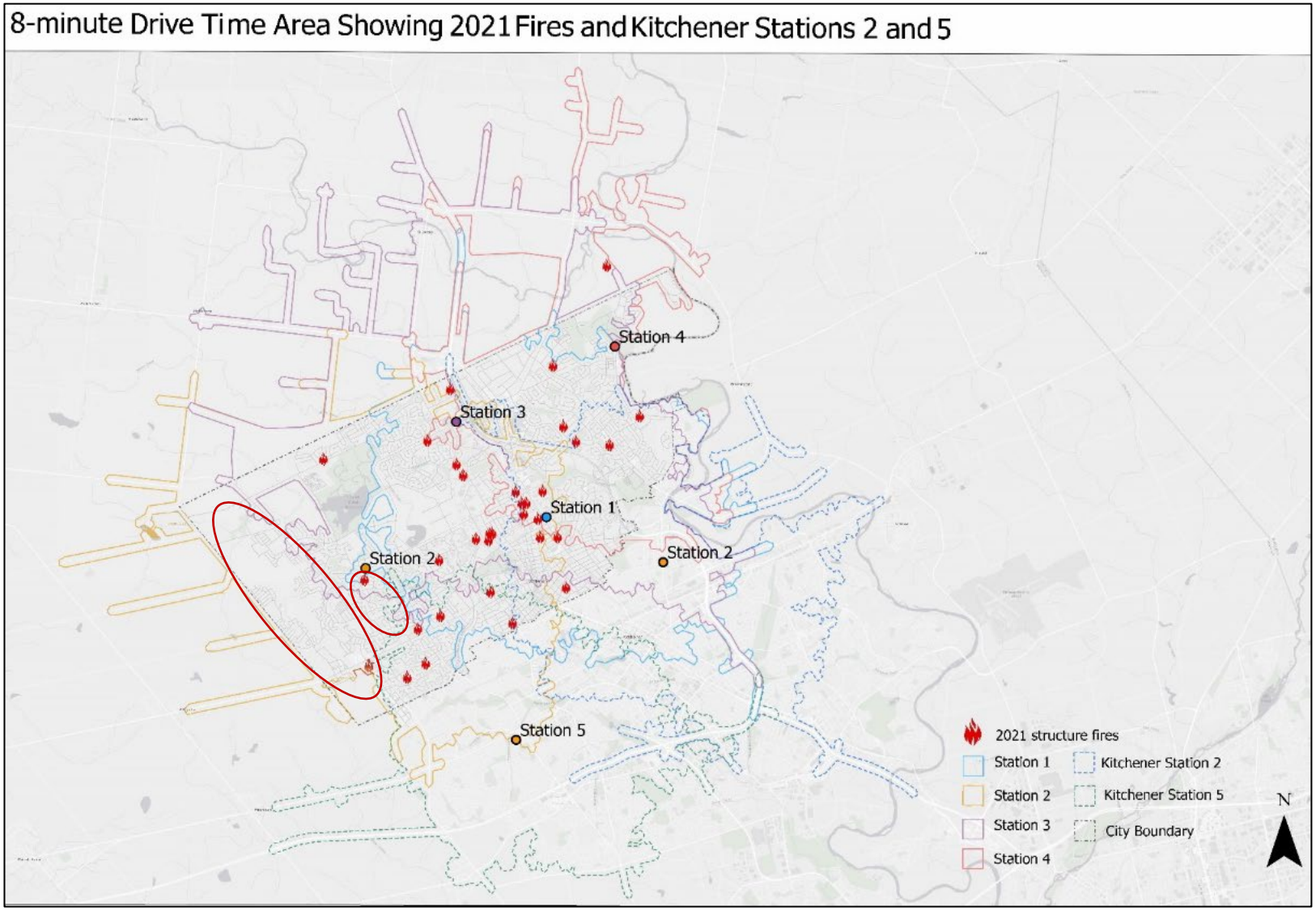
Six-minute drive time is important because it represents a reasonable travel time target for a second fire truck to arrive at a structure fire.

Kitchener stations 2 and 5 are included in Exhibit 5 because they can also provide service to Waterloo.

The central portion of Waterloo, served primarily by stations 1 and 3, have reasonably good 2nd and 3rd apparatus

However, there are areas of Waterloo, depicted by the red outline, where a second arriving truck for a structure fire will exceed six-minutes and possibly eight minutes.

Exhibit 6: 8-Minute Drive Time



Eight-minute drive time represents a travel time target for a third fire truck to arrive at a structure fire. Kitchener stations 2 and 5 are included in Exhibit 6 because they can also provide service to Waterloo.

The central portion of Waterloo, served primarily by stations 1 and 3, have reasonably

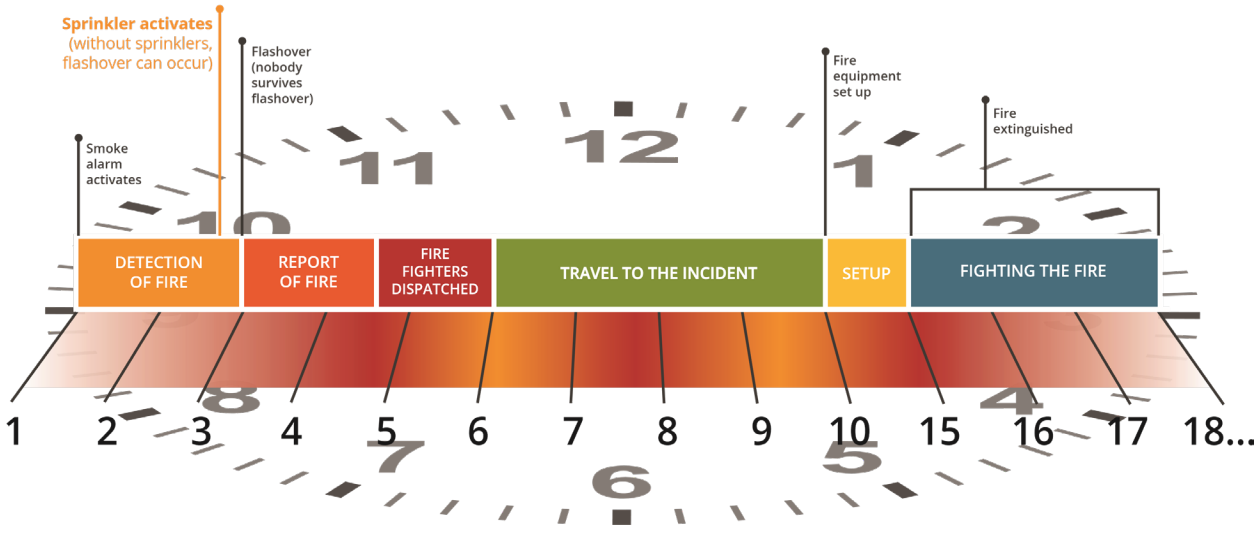
The area depicted by the red outline, shows where a second, third, and fourth arriving truck for a structure fire may exceed eight-minutes or more.

6.1.1 Real Response Time to a Structure Fire

Section 2.1.3 provides evidence that drive time to a structure fire in Waterloo can vary from as low as 30 seconds for a first apparatus response, to over seven minutes; and second, third, and fourth arriving apparatus can be as low as approximately five minutes (second vehicle) to almost 20 minutes for a fourth vehicle. This is driving time only.

Exhibit 7 is the same exhibit we introduced in *Section 1.1 Understanding Emergency Response*. The exhibit assumes that a fire is going to expand at a rate that allows only three minutes from the time a smoke alarms sounds – assuming there is a working smoke alarm – to the time flashover occurs. Flashover is a rapid event involving a significant increase in fire growth due to superheated temperatures where combustibles in an environment almost simultaneously ignite. Flashovers aren't survivable. Practically, though, no one can know whether a fire has smoldered for hours before igniting or whether it is a rapidly progressing event. In either case, response is required based on effective information gathering by fire communications, and incident type assessment based on full data analysis.

Exhibit 7: Fire Response Graphic



For the purpose of estimating real response time and risk in Waterloo we are going to calculate response from the time ignition occurs and detection. Whether the fire has smoldered for hours or had sudden eruption makes no difference; a rapid response is necessary.

Table 8: Fire Response, lays out the time before action can be taken to suppress a fire. The times we allocate to each activity are what we feel comfortable with putting forward considering the depth of statistical information gathered for the period 2016 to 2021.

Table 8: Fire Response

Activity	Duration	Fire has been burning for	Reference
Fire detection	180 seconds	3 minutes	
Contact 9-1-1	15 seconds	3 minutes 15 seconds	
Fire dispatch call taking	60 seconds	4 minutes 15 seconds	Chart 2
Preparation time (turnout)	90 seconds	5 minutes 45 seconds	Chart 4
Driving time – first apparatus	240 seconds	9 minutes 45 seconds	Chart 7
Setup[10] and apply water or foam	180 seconds	12 minutes 45 seconds	
Second apparatus arrives (6-minute drive)		11 minutes 45 seconds	
Setup time – 2nd apparatus – rescue can begin[11]	90 seconds	14 minutes 25 seconds	

It's unknown whether a fire will occur rapidly or smolder, thereby the importance of pushing out the fire safety message of working smoke alarms.

6.1.2 Vertical Response: Response to high and low-rise properties

The scenario in Table 8 assumes that the fire is occurring in an easily accessed structure at street level. Additional time is needed in case of a multi-storey building. We have no scientific references we can offer as to the additional time firefighters require to access a fire in a multi-storey building, but an article in an online media report[12] indicated that in 2011 Mississauga Fire and Emergency Services conducted a study for the average vertical response time of crews climbing stairs and using elevators. It took firefighters approximately four and a half minutes to reach the 5th floor of a building via the stairs, and three minutes, 23 seconds by elevator. The

[10] Inquest testimony from a representative of the Ontario Office of the Fire Marshal and Emergency Management indicates that, in Ontario, it takes an average of five to seven minutes to get agent (water or foam) on a fire after arriving at a scene. Waterloo fire demonstrated a setup time of as low as two minutes but that was in station 1's parking lot area with an immediately available hydrant on a sunny summer afternoon.

[11] If life threat is imminent, and the Incident Commander determines a rescue can be attempted, the first arriving crew will endeavor to rescue, but suppressing the fire will not be started until a second apparatus arrives.

[12] As Mississauga grows up (literally) towering buildings are forcing a rethink of how fires & other emergencies are dealt with | The Pointer

higher the floor the more fatigued a person gets carrying equipment, ultimately making the response time slower.

A study conducted at the John Jay College of Criminal Justice of the City University of New York presented a Discrete Event Simulation to estimate the time for firefighters to access a fire floor using stairs[i]. This study provides a method for estimating time rather than presenting a time, but it includes the complexities of reaching a fire in a multi-storey building.

A study published in PubMed in September 2007[ii], relating to the additional time it takes paramedics to arrive at a patient's side in multi-storey buildings, indicated that the extra time required from arrival at the curb to a patient's side, at the median, was 2.8 minutes for multi-floor residential buildings, 2.7 minutes for office complexes, 1.3 minutes for private homes (less than four stories), and 0.5 minutes for outdoor calls. Therefore, in the case of multi floor buildings it would not be unreasonable to add three or more minutes before fire suppression can begin.

From a risk decision point of view, we believe that expecting around 12 or 14 minutes to elapse from the time fire is detected to the first firefighters being able to get water on a fire is fully defensible.

Add at least 3 minutes in a multi-floor building for a total of approximately 15 to 17 minutes

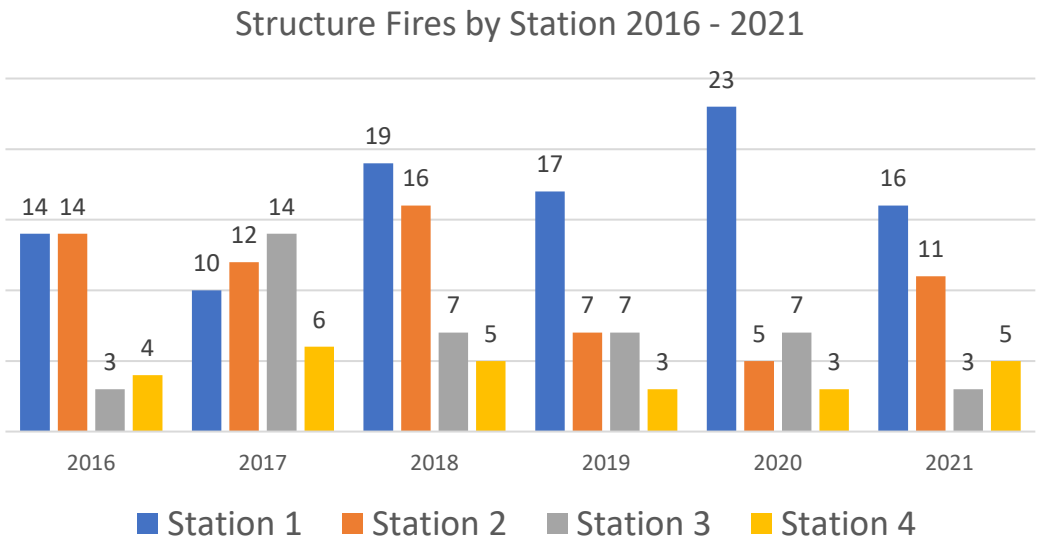
Vertical response to low and high-rise properties will take more time dependent on equipment requirements and the ability for firefighters to access an elevator. Using an elevator is not an option in certain circumstances such as smoke and fire conditions. Equipment staging and set up typically takes place 2 levels below the fire floor adding additional time during fire incidents.

The timeline shown in Table 8 may be accomplished sooner because of quicker recognition of a fire, shorter preparation time, or shorter driving time – or it may be longer. From a risk assessment point of view, we believe that expecting around 12 or 14 minutes to elapse from the time fire is detected to the first firefighters being able to get water on a fire is fully defensible. Add at least 3 minutes in a multi-floor building for a total of approximately 15 to 17 minutes. There is no doubt, though, that proximity of a structure fire event to a fire station may result in a shorter drive time and quicker 'agent on fire' time.

Chart 17 shows the number of structure fires, by year, in each station's primary response area. Station 1 is the busiest station, not only in fires, but all categories.

Station 2 has experienced fire frequency in the six-year study period at about 66% that of station 1, station 3 at 41%, and station 4 at 26%. But, as can be seen in Chart 17, the primary area and frequency of structure fires can change in any year.

Chart 17: Structure Fires by Station

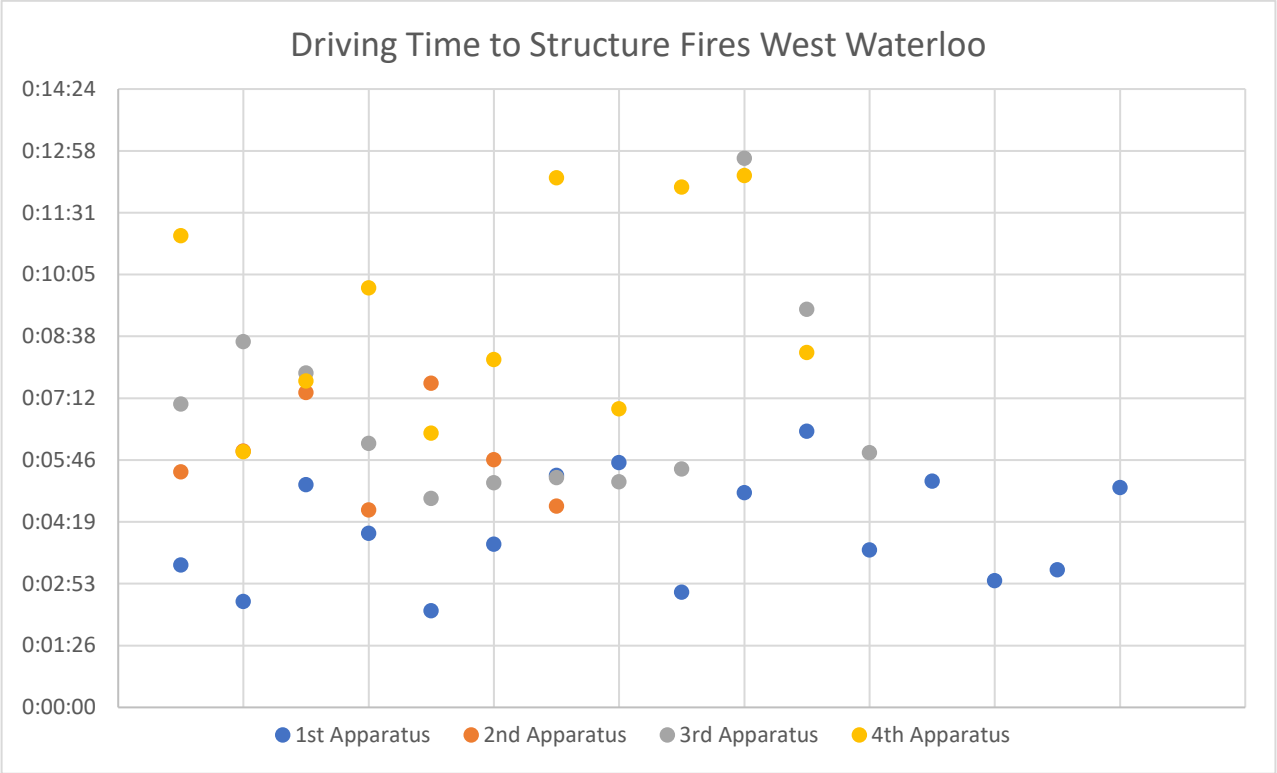


6.2 Fire Incident response Challenges: Waterloo's West Side

The primary area where response resulting in increased risk may be a problem is the west side of Waterloo. Chart 18 demonstrates the distribution of actual drive times to structure fire incidents, for 1st to 4th responding apparatus, over a six-year period to west Waterloo, station 2's area.

First vehicle drive time ranged from 2:15 (2 minutes, 15 seconds), to 6:26; second vehicle from 4:36 to 7:33; third vehicle from 4:52 to 9:16; and fourth vehicle from 5:57 to 12:33.

Chart 18: Driving Time Distribution Structure



6.2.1 Risk Associated with Response Time to a Structure Fire

Based on the data presented in this report, we have concluded that there is a higher degree of risk on the west side of the city that can be resolved to an acceptable level by the addition of another staffed fire truck, 24 hours a day – which we recommend. This is consistent with the fire service's earlier reports to council.

We examined several locations for another fire station in west Waterloo, but the possible sites do not provide the same degree of coverage as having two staffed vehicles at station 2. Two apparatus at station 2 means that two fire trucks can arrive at a structure fire within station 2's primary coverage area at approximately the same time as one truck, may reduce the need for taking multiple apparatus from station 1's or station 3's area for additional vehicle response, and could reduce the frequency of dispatching trucks from station 1's or station 3's area.

In arriving at this recommendation, we took into account Waterloo's plans for height and density on the west side and throughout the city (Exhibit 8), and greenspace

plans (Exhibit 9). Height and density will influence the time required to reach a fire, such as in a multi-floor building, but greenspace may reduce the potential for the number of buildings and therefore, fires in a catchment area, although it might affect drive time to areas beyond the greenspace.

Depending on the height and density of development in west Waterloo, a future fifth station might be required, but this possibility can be directly mitigated by integrated risk fire prevention activities as demonstrated in the United Kingdom, accurate record keeping of incident response outcome and value, and measuring incident metrics.

Exhibit 8: Waterloo Height and Density Plans

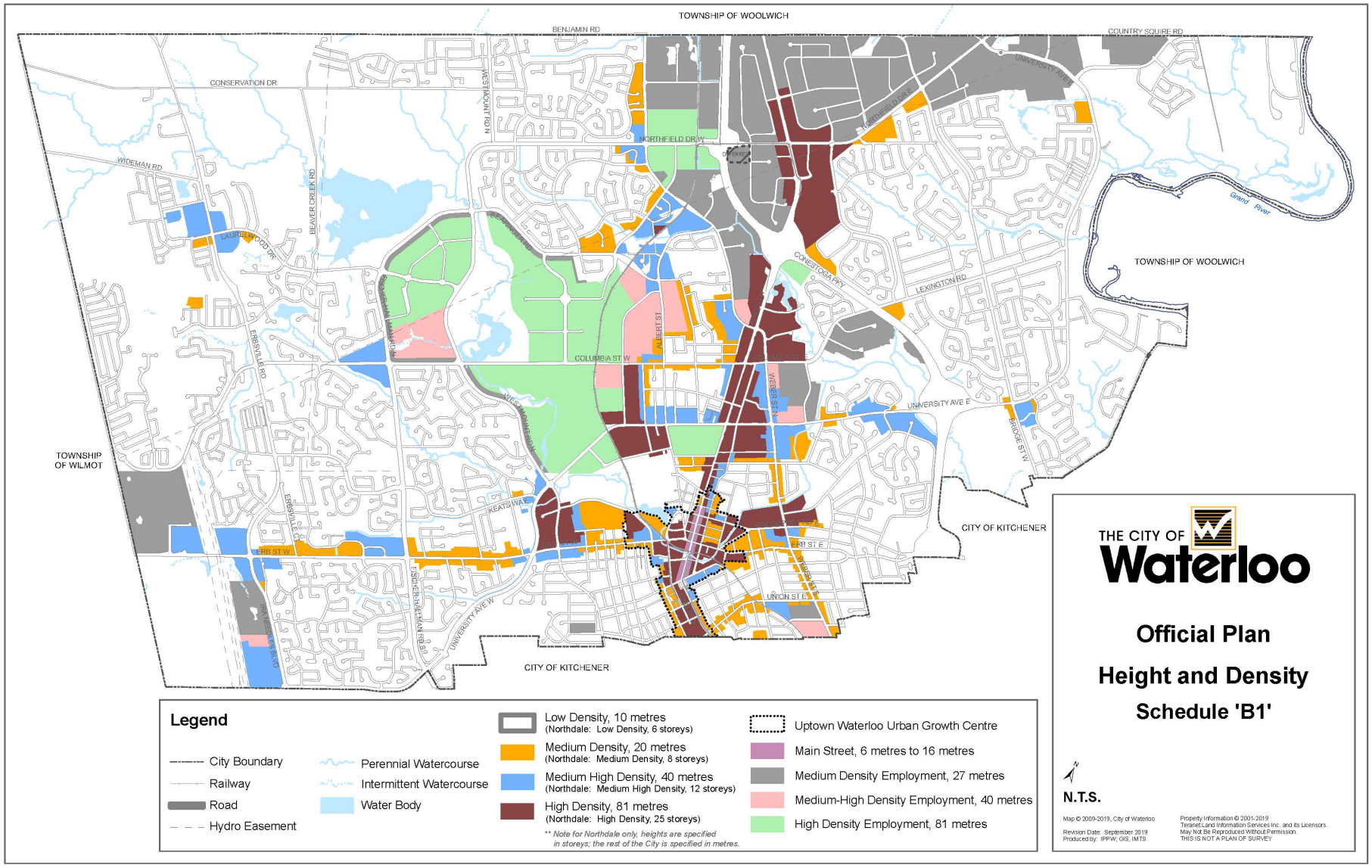
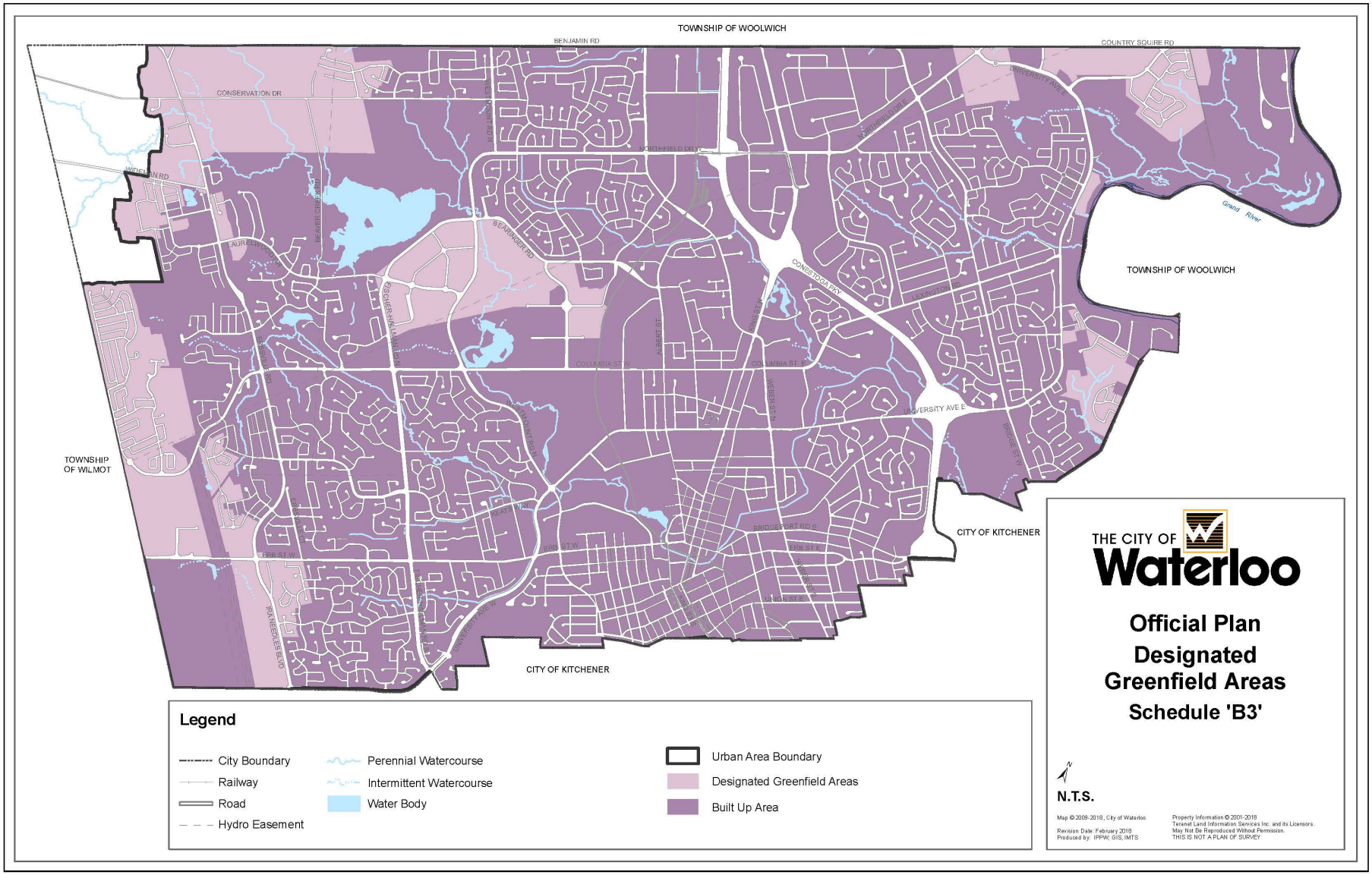


Exhibit 9: Waterloo Greenspace Plan



7 Fire Underwriters Survey

The Request for Proposals for this project included references to the Fire Underwriters Survey and the need to associate risk assessment and outcomes with that program.

Like Waterloo, many municipalities are interested in how the Fire Underwriters' Survey and ratings might translate to lower or higher insurance premiums for homeowners and businesses. The proximity to a station and the type of equipment, fire prevention and education activity, and dispatch centre capabilities are all part of Fire Underwriters Survey grading.

The report accompanying the 2019 City of Waterloo Fire Underwriters review included the following comments and recommendations:

- Staffing - Increase staffing and/or add an additional pumper with adequate staffing
- Fire Prevention General Program
  - limited resources in prevention/public education,
  - no routine inspection program,
  - open files.
- Fire Prevention Fire Safety Laws and Enforcement
  - no routine inspection program for most commercial occupancies (request and complaint mostly),
  - open files/lack of enforcement.

The Fire Underwriters Grade Update Letter (April 4, 2019) included the following statements:

- The categories where significant number of points are available was determined to revolve around fire prevention activities and available fire suppression resources.
- Any improvement to firefighting resources, apparatus, and fire prevention inspectors – educators should be communicated to Fire Underwriters Survey (FUS) for the purpose of determining whether these investments in community fire protection have further impacts towards improving fire insurance classifications in the community.

We further note that the 2019 Fire Underwriters Survey shows several areas in west Waterloo with lower grading for both Commercial and Personal Insurance Lines.

Pomax conducted an independent and objective review of the fire protection system in the City of Waterloo and the recommendations in our report provide effective solutions to the issues presented in the 2019 FUS survey.

Part 3: The Future

8 Non-Fire Incident Response

In Waterloo, medical response accounts for between 42% to 47% of fire service activity (Chart 44 to Chart 47) except for 35.4% in 2020 (COVID). The next large category is alarms (Chart 39 and Chart 40 and Chart 50), and another category is response to vehicle collisions (Chart 41). Fires of all types and near fires are usually less than 20% of the fire service's activity,

8.1 Medical Response

Medical incident response makes up a considerable component of Waterloo Fire Rescue's activity. We suggest that, when responding to medical incidents, fire services are actually part of the pre-hospital emergency services system. Therefore, the responding department should be considered and evaluated as part of the pre-hospital system rather than the fire services system. Re-identification of fire services was identified as Critical Issue A within the Center for Public Safety Excellence[13] white paper on 21st Century Fire and Emergency Services:

> *Initiative 1: Celebrate the heritage of the fire and emergency services while recognizing that services provided have evolved and will continue to experience significant changes over the next 30 years.*

A recent paper[14] published in the journal *Pre-Hospital Emergency Care* examined several million medical responses, mostly in the United States, to determine how often potential life-saving interventions are performed.

The background of this study is described as

---

[13] **About the Center for Public Safety Excellence**
The Center for Public Safety Excellence (CPSE) is a not-for-profit corporation that progressively focusses on fire and emergency services organizations globally through processes of accreditation, credentialing, and education. This is accomplished through the use of quality improvement models and education. The Center for Public Safety Excellence's intent is to instill long-lasting processes and resources to benefit communities and personnel.

The concept for fire service accreditation began in 1986 when the International Association of Fire Chiefs and the International City/County Management Association met to develop the concepts and design for continuous improvement within the fire service industry. In 1996 the Commission on Fire Accreditation International was established to award accreditation to fire and emergency services agencies and to pursue scientific research and education in the public interest. In 2006, the Center for Public Safety Excellence was created to conduct the corporate role to enhance the Commission on Fire Accreditation International and the commission on Professional Credentialing.

[14] Jeffrey L. Jarvis, Vaughn Hamilton, Mike Taigman & Lawrence H. Brown (2021) Using Red Lights and Sirens for Emergency Ambulance Response: How Often Are Potentially Life-Saving Interventions Performed?, Prehospital Emergency Care, 25:4, 549-555, DOI: 10.1080/10903127.2020.1797963

Emergency Medical Services (EMS) often respond to 911 calls using red lights and sirens (RLS). RLS is associated with increased collisions and increased injuries to EMS personnel. While some patients might benefit from time savings, there is little evidence to guide targeted RLS response strategies. Objective: To describe the frequency and nature of 911 calls that result in potentially life-saving interventions (PLSI) during the call.

In other words, part of the objective was to determine if speed made a difference to outcome.

The stated result of the study was
Results:

There were 5,977,612 calls from 1,187 agencies included in the analysis. The majority (85.8%) of calls utilized red lights and sirens, yet few (6.9%) resulted in PLSI (potential life-saving interventions). When stratified by call nature, cardiac arrest calls had the highest frequency PLSI (45.0%); followed by diabetic problems (37.0%). Glucose was the most frequently given PLSI, n=69,036. When including multiple administrations to the same patient, epinephrine was given most commonly PLSI, n=157,282 administrations.

The conclusion of the study was
Conclusion: *In this large national dataset, RLS responses were very common (86%) yet potentially life-saving interventions were infrequent (6.9%). These data suggest a methodology to help EMS leaders craft targeted RLS response strategies.*

Another research article published in Prehospital and Disaster Medicine[15] titled *Utilization of Warning Lights and Siren Based on Hospital Time-Critical Interventions*[16] examined a small group of incidents (112 incidents) to determine if time saved travelling to and from medical incidents using lights and sirens was critical. It found that the average difference in time with versus without lights and siren was - 2.62 minutes and "*Of the 112 charts evaluated, five patients (4.5%) received time-critical hospital interventions. No patients received time-critical interventions within the time saved by utilizing lights and siren. Longer distances did not result in time saved with lights and siren".*

[15] Prehospital and disaster medicine: the official journal of the National Association of EMS Physicians and the World Association for Emergency and Disaster Medicine in association with the Acute Care Foundation
[16] Utilization of Warning Lights and Siren Based on Hospital Time-Critical Interventions, Andreia Marques-Baptista, MD; Pamela Ohman-Strickland, PhD; Kimberly T. Baldino, BS, EMT-B; Michael Prasto, MS; Mark A. Merlin, DO, EMT-P, FACEP.

A publication by the U.S. Department of Transportation, National Highway Traffic Safety Administration, Office of Emergency Medical Services titled Lights and Siren Use by Emergency Medical Services: Above All Do no Harm states:

> *Several studies have consistently shown that the use of L&S, on average, shortens response and transport intervals by 1.7 minutes to 3.6 minutes and transport times by 0.7 minutes to 3.8 minutes. These time savings have been realized in urban, suburban, and rural settings. Most authors have suggested that the time saved only impacts patient outcome in rare situations.*
>
> *EMS agency administrators, managers and medical directors should understand the likely time saved by L&S response and transport in their area and apply this to decisions related to L&S response and transport policies for the system.*

It further states:

The Association between L&S Driving and Crash Risk

> *There is clearly an increased risk of EMS vehicle crashes or collisions when operating with L&S. L&S attract attention to the EMS vehicle and are used to request the right-of-way. With due regard, the EMS vehicle operator may then take privileges permitted by law for the purpose of arriving at the scene or hospital in less time due to L&S use. But no matter how effective L&S are in drawing attention to the EMS vehicle, any collision with a vehicle that is proceeding through an intersection against a signal increases the risk over normal driving.*
>
> *Clawson[17] described the "maximal response disease" of sending multiple vehicles, all with L&S, to medical calls that do not justify this response. He estimated that as many as 12,000 EMS vehicle crashes occurred every year in the U.S. in the 1980s and that there are approximately four "wake effect" collisions involving other vehicles for every crash involving an emergency vehicle. (Clawson 1987, Clawson 1997).*

A report[18] in Pediatric Quality and Safety Journal describes that thousands of vehicle accidents occur each year because of lights and siren usage which is associated with increased risk of crashes resulting in more severe injuries and fatalities. The intent of the study experiment was to determine the reduction in use of lights and sirens by a

[17] Jeff Clawson, MD, inventor of Medical Priority Dispatch, a tool to determine and triage the urgency of needed responses and sending only those resources required based on the nature of illness or injury, thus preventing 'maximal response disease' (the response of multiple emergency vehicles unnecessarily).

[18] Decreasing Usage of Lights and Sirens in an Urban Environment: A Quality Improvement Project Laura Westley, BSN, MSM, C-NPT; Janice Nokes, RN, BSN, C-NPT; Ranna A. Rozenfeld, MD, FAAP, FCCM

critical transport team by virtue of having to record and justify every use. The study notes that

> *The risk of lights and sirens usage has been well documented with increased risk of ambulance crashes and fatalities. Several studies in the EMS literature have evaluated the time saved due to the use of lights and sirens with a range between 43.5 seconds and 3.63 minutes. Many studies have shown that the time saved is not clinically significant for the patient.*

At the outset of this study (Decreasing Usage of Lights and Sirens in an Urban Environment), light and siren use was recorded at 75.8% but in the three to five years following the implementation of a lights and siren accountability process, lights and siren usage was maintained at or below 20% with no negative clinical impact on patients.

In a Joint Statement on Lights & Siren Vehicle Operations on Emergency Medical Services Responses[19] in the publication Prehospital Emergency Care, the sponsoring organizations state:

> *For EMS, the purpose of using L&S* [lights and siren] *is to improve patient outcomes by decreasing the time to care at the scene or to arrival at a hospital for additional care, but only a small percentage of medical emergencies have better outcomes from L&S use. Over a dozen studies show that the average time saved with L&S response or transport ranges from 42 seconds to 3.8 minutes. Alternatively, L&S response increases the chance of an EMS vehicle crash by 50% and almost triples the chance of crash during patient transport (10). Emergency vehicle crashes cause delays to care and injuries to patients, EMS practitioners, and the public.*

> *In most settings, L&S response or transport saves less than a few minutes during an emergency medical response, and there are few time-sensitive medical emergencies where an immediate intervention or treatment in those minutes is lifesaving. These time-sensitive emergencies can usually be identified through utilization of high-quality dispatcher call prioritization using approved EMD* [emergency medical dispatch] *protocols. For many medical calls, a prompt response by EMS practitioners without L&S provides high-quality patient care without the risk of L&S-related crashes. EMS care is part of the much broader*

[19] Douglas F. Kupas, Matt Zavadsky, Brooke Burton, Shawn Baird, Jeff J. Clawson, Chip Decker, Peter I. Dworsky, Bruce Evans, David Finger, Jeffrey M. Goodloe, Brian LaCroix, Gary G. Ludwig, Michael McEvoy, David K. Tan, Kyle L. Thornton, Kevin Smith & Bryan R. Wilson (2022) Joint Statement on Lights & Siren Vehicle Operations on Emergency Medical Services Responses, Prehospital Emergency Care, 26:3, 459-461, DOI: 10.1080/10903127.2022.2044417, https://doi.org/10.1080/10903127.2022.2044417

spectrum of acute health care, and efficiencies in the emergency department, operative, and hospital phases of care can compensate for any minutes lost with non-L&S response or transport.

Sponsors of this Position Statement are

Academy of International Mobile Healthcare Integration
American Ambulance Association
American College of Emergency Physicians Center for Patient Safety
International Academies of Emergency Dispatch
International Association of EMS Chiefs
International Association of Fire Chiefs
National Association of EMS Physicians
National Association of Emergency Medical Technicians
National Association of State EMS Officials
National EMS Management Association
National EMS Quality Alliance
National Volunteer Fire Council
Paramedic Chiefs of Canada

As we noted above, when responding to medical incidents, fire services become part of the pre-hospital emergency services system. So, while the studies quoted above refer to EMS lights and siren response rather than fire response, when responding to medical incidents, fire becomes a proxy for EMS and part of the prehospital emergency medical services system. The discoveries and statements within these and many other reports are applicable to fire when acting as part of the prehospital emergency medical services system.

The studies shown above indicate

1. Lights and siren response saves minimal time especially in a compact municipality such as Waterloo.
2. A relatively small percentage of medical responses result in life saving actions being taken.
3. No studies have found that the time saved from lights and siren response resulted in hospital-based life saving intervention during that time frame.
4. The risk of lights and sirens usage has been well documented with increased risk of crashes and fatalities.

One of the Actions included in the Center for Public Safety Excellence white paper on 21st Century Fire and Emergency Services Critical Issue A is to "*Set agency goals and strategies to reduce the number of 911 emergency calls, which reduces risk to the community and the first responder".*

Response to medical calls by fire services is a result of four things

1. The influence of American models of fire services where fire departments operate ambulance services, often as a revenue source because of different billing and funding models in the USA.
2. Heritage beliefs of fire and medical services, dating back to the 1970s and before, that seconds count in medical calls, and fire can respond faster. In fact, there are few medical instances where seconds count other than in cardiac/respiratory arrest and asphyxia, and in those cases response by emergency services is the least effective way of service delivery[20]. [iii] [iv]
3. The need by many firefighters to want to help and, due to the history and culture of fire services, they see response as a form of help even though the utility of that response isn't measured.
4. The belief that activity, and being busy, is value. Response is a noticeable activity and therefore considered valuable[v].

Medical response is not a core part of fire and rescue services, but the literature referenced above indicates unnecessary lights and siren response to medical incidents contributes to risk by increasing the possibility of accidents, both directly and through wake effect. Risk increases because

- fire resources are occupied on medical and vehicle collision incidents which may delay response to core fire incidents,
- large trucks are driven in emergency mode unnecessarily,
- firefighters who could be involved in prevention activities are occupied responding to incidents that rarely require their assistance.

Whereas response to medical incidents makes up over 40% of Waterloo Fire Rescue's call volume, the City of Ottawa Fire Services' response to medical incidents makes up only about 17% of activity. This was first identified by KPMG in a report named "Review of Edmonton Fire and Rescue Services". Pomax confirmed this estimate with

[20] Except for cardiac arrest, there is little or no scientific evidence suggesting a causal relationship between response interval and improved patient outcomes. There is little evidence linking improved response intervals to improved survival in critical trauma, and there is no literature suggesting that rapid response intervals improve outcome for noncritical patients.

Ottawa's Chief of Emergency Medical Services in the last week of July 2023. Ottawa Fire Services responds only to incidents where a patient is unconscious, unresponsive, or apneic, or EMS asks for assistance due to a delay in ambulance availability.

8.1.1 If we save one life …

In discussions respecting fire service response to medical incidents and traffic accidents, reasoning such as "if we save only one life, it will be worth it" is offered as a rationale for continuing the practice. The literature shows that it is highly unlikely that a high number of responses to medical incidents will result in improvements in clinical outcome. In those incident types where response time may make a difference (unconscious, unresponsive, or apneic) Waterloo fire should continue to be dispatched as determined with adequate medical guidance.

There is substantial literature, as identified in this report, which indicates that prevention activity through home visits is likely to have a positive impact on reduction in fires and the severity of fires which means resources should be applied to prevention activity. Lives are more likely to be saved through fire prevention.

8.1.2 Comfort for the patient

Other reasoning we hear for attending medical incidents is that the arrival of firefighters is a source of comfort for patients, family, and bystanders even if a life isn't saved. This is true in some cases, particularly when someone is alone, or family and bystanders are substantially concerned. There are several considerations if Council determines that the fire service should respond to medical incidents to provide comfort or relieve anxiety. These considerations include

- How does the dispatch service determine when those circumstances occur, and should it be the 9-1-1 centre, the fire service, or Waterloo Region Paramedic Services that determines when that is appropriate?
- If time is not a factor, as shown in the literature referenced above, should fire respond to incidents that are not life threatening using lights and sirens considering that studies show that use of lights and siren saves only from less than a minute to three or four minutes in an area the size of Waterloo, but increases crash risk and possibly 'wake crashes'?
- Is it necessary to dispatch four firefighters in a heavy truck to a non-life threatening incident or would one or two firefighters in an SUV, not using lights or sirens, be sufficient?

- In a study of the Tulsa fire department done by the Center for Public Safety Management on behalf of the International City/County Management Association the consultants indicated that the City of Shreveport, Louisiana had determined that the cost of maintenance of an SUV was 15% of the cost of maintenance of a heavy truck and the capital cost was between 7% and 10% of a fire truck.
- The former Fire Chief of the City of Shreveport is now the Chief in the City of Plano, Texas. He estimates that the implementation of SUVs for medical first response in Plano, an initiative that has been underway for several years, will double the useful life of fire trucks – currently only five years – to 10 years.

Published literature indicates that, in aggregate, fire response to medical incidents has little influence on outcome other than in specific cases such as cardiac arrest etc., whereas participation by firefighters in fire prevention, smoke alarm, and public education programs has been proven to reduce fire events and negative impacts. We support the gathering and analysis of data to compare Waterloo's response models against the published literature and perhaps inform an evolution of the current service levels.

There is ample evidence in peer reviews and studies that the fire service could reduce frequency of response to medical and traffic incidents. Staff could be redeployed to assist with residential smoke alarm programs, low rise residential assessments, and other education and prevention endeavors, all of which have been shown to provide benefit in the form of increased public safety, lower property loss, and reduced immediate and long-term health jeopardy for firefighters by way of lower exposure to carcinogenic fire byproducts.

8.1.3 Medical Priority Dispatch

The Ontario Ministry of Health is introducing a call taking program at its dispatch centres referred to as the Medical Priority Dispatch System (MPDS). MPDS is one of the highest ranked medical call taking systems in the world and has a greater sensitivity and specificity in determining the severity of out-of-hospital medical issues than the current algorithm.

There is a possibility that, when introduced in Waterloo Region in approximately two years, there may be a reduction in the number of medical incidents to which fire is dispatched. This is assuming that fire is not automatically dispatched by arrangement between the 9-1-1 centre and fire communications. In other words, if fire responds

only when the ambulance communications centre determines a need for fire, the implementation of Medical Priority Dispatch System may reduce the frequency of responses to non-fire events.

As an example, the Niagara Paramedic Services has been using MPDS for more than a decade and, in January of 2021, reported that lights and siren response occurs in only about 10% of patient incidents, and fire deployment has declined by approximately 50% from pre-MPDS levels.

We recommend that Waterloo Fire Services

- Undertake a prospective study of medical responses over the next 6 to 12 months – preferably with the assistance of its medical advisor – to record and review services provided at the scene, and to the patient, to determine the percentage of incidents where fire arrives at least two minutes before paramedic services and undertakes life-saving measures such as cardiac or other resuscitation.
- Based on the study results, determine if response to medical incidents needs to continue at the current volume.
- By the six-month mark evaluate whether lights and siren response to medical calls is necessary and under what circumstances.
- Determine whether response to medical incidents can efficiently take place using a smaller vehicle such as a mid-size SUV or whether four firefighters in a fire truck is necessary.

8.2 Automatic Alarms

Automatic alarms, or false fire calls as categorized by the Office of the Fire Marshal, represent an average of over one response a day in Waterloo (Chart 39, Chart 40). Response to carbon monoxide alarms due to perceived emergencies (no CO present) or carbon monoxide equipment malfunction represent almost another incident response per day on average (Chart 50).

Response to false calls presents the same risk to firefighters and the public as response to medical incidents. Similar to our recommendations related to medical incidents we recommend that Waterloo Fire Services

- Undertake a prospective study of automatic alarms over the next 6 to 12 months to determine
  - the number that turn out to be fires,

- or carbon monoxide where it is unknown if the building was evacuated,
- or other life-threatening circumstance,
- and for which there was no other form of alert; for example, someone calling from the location within a very short period of time (60 – 120 seconds.
- Based on the outcome of this study, determine whether response to automatic alarms can be reconfigured to lower the risk of response.

The London, U.K Fire Brigade, in the latest annual report, indicates that 0.39% of alarms turned out to be fires but the report doesn't indicate the number that were positive alarms absent of secondary calls. Nevertheless, based on information gathered over several years, the Brigade adjusted its response configuration to automatic alarms unless there is a confirmation of fire. Some fire departments, being aware that automatic alarms are usually false unless accompanied by calls to 911 indicating smoke or fire, have adopted a policy of restrained response. For example, one fire truck, without using warning systems, will investigate the alarm. We are aware of one fire department that no longer responds to some types of automatic alarms.

8.3 Rescue Incidents

Rescue incidents, mostly attendance at vehicle collisions, increased from 2016 to 2019, declined in 2020, possibly due to COVID influence, and increased again in 2021 (Chart 41, Chart 42, Chart 43).

8.3.1 Fire Department Attendance at Traffic Incidents

Similar influences that have led to a high number of fire responses to medical calls have resulted in increased responses to vehicle collisions. Several decades ago, fire services responded to vehicle collisions usually only when entrapment was reported, such as those 45 over six years as shown in Chart 41. In the United States, as municipalities, through their fire departments, assumed responsibility for ambulance services in the late 1970s and 80s fire departments started to send a fire truck with every ambulance response, in part because fire departments sometimes employed paramedics, and ambulance services often had less skilled emergency medical technicians. When ambulances were dispatched to vehicle collisions that might include injuries, a fire truck accompanied. That still happens in many cities in the United States and some places in Canada. But in the United States, response to traffic accidents can be a revenue driver because fire departments charge insurance companies for the service. That happens in some parts of Canada also where

Ministries of Transportation or insurance companies are invoiced for fire service attendance.

Many reasons have been brought forward as to the benefits of fire service at collisions. These include

- an early response in case of possible entrapment,
- possibility of a fire resulting from the collision,
- the need to isolate a battery (cut the cables or disconnect a battery) to prevent supplemental restraint systems (airbags) from deploying, if they didn't as a result of the initial collision, and injuring someone who might still be in the vehicle,
- cleaning up spilled fluids and hazards (coolant, gasoline, other fuel),
- assisting paramedics,
- blocking the roadway to protect workers.

Most municipalities and the public favour the practice of dispatching fire to vehicle collisions, particularly on highways. Studies have shown that in many cases, the perceived benefits of fire response to motor vehicle collisions are not objectively supported. [vi] [vii] [viii].

Entrapment and the need for extrication is rare as can be seen by the few times Waterloo fire reports it has had to provide that service in the six-year study period. As well, research has shown that the public over-reports entrapment and it is unusual for extrication, if required, not to be called for by bystanders in the immediate aftermath of a collision.

Vehicle fires have also declined by 60% in 2018 from 1980, and the rates of fires per billion miles driven and fire deaths per 100 billion miles driven, were 81 percent and 65 percent lower, respectively according to a National Fire Protection Association study in the USA. Firefighters sometimes point to the risk of battery fires from electric vehicles, but manufacturers have been installing, for several years, isolation switches in cars which activate upon collision and cut off an automobile's electrical system. Roll Over Sensors provide similar protection in the case of a vehicle upset.

Unexpected deployment of airbags was a concern in the 1980s and 1990s but are rare now. A study into late and failure of airbag deployment in rear end collisions measured 'late' airbag deployment in milliseconds, not minutes or tens of minutes

which would be the time span in which fire trucks would arrive after an incident[ix],[x],[xi] [21].

Waterloo Fire and Rescue provides many of the activities required at motor vehicle collisions such as debris cleanup, containment of spills of oil, fuel, and fluid as well as scene safety and initial medical attention for victims. The fire service has assumed these roles over time. During our interviews for this project the question was asked, "If fire doesn't respond to provide these services, who will?" The answer to this question requires in depth discussions with the other emergency services in the Region regarding roles and responsibilities at motor vehicle collisions and a determination of what services each emergency service is able to provide in a timely manner. Final determination of the roles and responsibilities of each service should be formally stated and adhered to.
Similar to our recommendations related to medical incidents and automatic alarms, we recommend that Waterloo Fire Services

- Undertake a prospective study of response to rescue incidents – particularly traffic events – over the next 6 to 12 months to determine
- the number that turn out to be actual entrapments,
- the number where life-saving intervention was provided,
- the number where traffic blocking, debris clean up, or spill remediation was provided
- Based on the outcome of this study, determine whether response to rescue incidents, specifically traffic accidents – can be reconfigured.

The key message of our study – and the principal recommendations centered on the use of data and information, particularly outcome data – is to answer questions such as

Does co-responding to medical incidents

a) improve response times and, if so, are these improvements both statistically significant and clinically relevant?
b) lead to improvements in patient care in terms of outcomes (reduction in mortality and effect of injury)?

Are responses to incidents statistically assessed in areas such as

a) response time (from the time the telephone rings),
b) activities of each responder that arrived on scene,

[21] Hazard Information Bulletins provide relevant information regarding unrecognized or misunderstood safety and health hazards, and/or inadequacies of materials, devices, techniques, and engineering controls.

c) cost of each incident relative to services delivered, and
d) the service delivered such as extrication, blocking, road service, and debris clearing?

Does responding to other than confirmed fires or life-threatening rescues

a) result in value-added service to the public aside from emotional support to affected parties;
b) lead to unintended consequences such as delays to primary responsibilities such as fires, or water and entrapment rescues;
c) detract from the advantages of firefighter participation in prevention and education efforts?

Further local assessment and, if possible, development of a relational outcome database will enable these questions to be answered.

We recommend that in conjunction with the recommendations in this Section, Waterloo Fire Rescue should hire a data analyst (this can be a civilian position) to review available data and assist with the development of additional information gathering for the purpose of accomplishing best efficiency and effectiveness.

9 Prevention and Public Education

As part of conducting the fire master plan and community risk assessment process, Pomax completed a paper review of the activity of Waterloo Fire Rescue's Prevention and Public Education Division including:

- the fire investigations process,
- public education initiatives,
- inspections and enforcement,
- fire safety plans, and
- process mapping all activities.

Process mapping of each service provided by the prevention and education team can be found in Appendix E. The differences between the before and after process maps are minimal because the division is working to its capacity with the staffing and technical resources they have. We do recommend, though, that the division should concentrate on core activities that research has shown to be of benefit to public protection, such as coordinating residential smoke alarm checks and second exit checks.

The prevention and education division could benefit from staffing and technology assistance with respect to data gathering. Waterloo Fire Rescue has purchased, in the last year, a new record management system which can track permits and inspections, but it doesn't include software or hardware to support the inspection process, on site, and in real time. This means that although Waterloo Fire Rescue keeps detailed records, someone has to manually enter the record of activity – essentially requiring that manual notes be kept during the inspection and entered a second time into the records.

This is a poor use of staff time, and the cost should be assessed in comparison to having hardware and software to do the inspection/investigating recording on site. For example, if 10% of five prevention officers' time can be shifted from records administration to being 'on the street' or coordinating other fire department staff's building safety check responsibilities, that's similar to adding .5 of a complement. If 20% of time can be recovered, that's one full time equivalent.

9.1 The Division has Inadequate Complement

The prevention and education division is heavily tasked with the duties they are supposed to fulfill, particularly that of follow up inspections to make sure that fire code rectifications that had been ordered, are completed.

The division has inadequate staff complement. Approved staffing includes

- a Chief Fire Prevention Officer,
- a Fire Prevention Captain,
- four Fire Prevention Officers,
- a Fire Prevention Officer/Public Education Officer

Fire Rescue Services introduced 1 additional Fire Prevention Officer in 2023, this position was requested and confirmed to assist with a backlog of open files in an attempt to move the division forward from a reactive to a pro-active state to address risk in the community.

Fire is mostly preventable and social in nature. Fire is not inevitable. If the frequency of fires is driven down through aggressive inspection and awareness activity, the useful life of some suppression equipment can be extended, and long-term costs will be lower. Some will disagree with the last statement but the lower the incidence of fire, the lower the risk, and the lower the risk the more leeway and options there are for meeting that risk.

Our recommendation is to increase the fire prevention complement by one full-time position, and associated hardware and software to allow that division to do their jobs effectively.

9.2 On-Duty Firefighters Assisting Public Education and Prevention Activities

Prior to the COVID pandemic, Waterloo Fire Rescue started a program where on-duty firefighters assisted the fire prevention division by visiting and assessing occupancies, albeit not to the same level of detail as qualified inspectors. This program began in 2015 and was conducted alongside a long-standing Smoke Alarm Program that includes firefighters going door-to-door in the community to talk to residents about fire safety and offering to check smoke detectors in addition to reporting real or potential Fire Code violations to Fire Prevention staff who would then follow up with a

visit to the homeowner and/or the responsible party. Unfortunately, neither program could be offered during the pandemic.

Firefighters are capable of assessing accessory apartments and high rise buildings for fire safety including doors being open, compliance dates on fire extinguishers, standpipes and hoses, exit and safety requirements in small multi-family or converted student housing, door to door visits to offer to check and replace smoke alarms (noting that local legal advice may need to be considered) distribute fire safety awareness material, follow up orders, and create what is known in fire services as 'pre incident planning[22], which is a process of recording building details such as where to park a fire truck in an emergency, floor plans, hydrant locations, hazardous materials on site, and so on. These plans can be completed for every occupancy in the city even though that is a multi-year process.

Similar programs in other jurisdictions have been found to contribute to the reduction of structure fire frequency and should be expanded to the extent possible.

The City of Waterloo Planning Department has indicated that the fire prevention division could assist the city's development approvals process in the following core areas[23]:

- ***Site Plan Control****: dedicated staff resources to participate in the site plan review process, to proactively influence the design of new developments from the perspective of emergency response. Development in the City of Waterloo is shifting from outward suburban growth in greenfield areas, to inward and upward built forms being primarily mixed-use intensification within designated nodes and corridors. Intensification planning is complex, and the development approval process would benefit from dedicated Fire resources to proactively influence designs early in the planning process, as retrofits after the fact are too expensive. Kitchener currently has representatives from Fire on its Site Plan Committee.*
- ***Emergency Response Policies/Standards for Development****: dedicated staff resources to prepare and maintain emergency response policies and standards for development, including but not limited to: (i) Fire Route By-law; (ii) Emergency Flood Plans; (iii) Road Design Standards, including maximum road length for a single point of access; (iv) Fire Truck turning radii; etc.*

[22] https://www.eso.com/blog/building-a-fire-preplans-program/

[23] Quoted from an email from the Waterloo Director of Planning to the Fire Chief.

- ***Building Permit Review****: dedicated staff resources to assist in Building Permit Review, as required.*

9.3 All Firefighters Should Contribute to Risk Reduction

A cooperative study between the University of Saskatchewan and Regina Fire and Protective Services study titled *Incidence, Circumstances and Risk Factors of Residential Careless Cooking Fires in The City of Regina* determined

> *the need of a firefighting paradigm shift from a narrow "reactive" model for fire safety to an 'interactive" model that acknowledges the important role of human involvement in fire causation, escalation and spread, and addresses the high vulnerability of particular groups to fire hazards.*

The paradigm shift requires a change of perspective by fire services and firefighters as to their core responsibilities, which should include prevention and public fire safety education along with the need for suppression and rescue.

The role of the prevention and education division should include coordination of prevention activities by firefighters while also addressing the more major fire risk issues in Waterloo that require the intervention of a qualified investigator. Firefighters are 'risk aware' professionals by virtue of the role they play in suppression and that knowledge can be extended, in a coordinated manner, to the public and property owners.

The Deputy Chief of Operations and the Deputy Chief of Support Services should continue their efforts to ensure that training and preparation for suppression and rescue events continues while deploying operations staff to reduce the need for response.

Benjamin Twiddy, 19, Marilee Towie, 17, and Holly Harrison, 18, died in a

The witness, fire investigator Rick Derstroff of the Office of the Fire Marshal (OFM) for Ontario, replied: "We'd all like to imagine we'd be rescued…. We live in a world where we think (rescue's) going to occur. But that's not reality."

As he put it a little later, under questioning by OFM lawyer Claudia Brabazon, "No matter how quickly a fire department gets there, it may not be in time."

"Does this case also emphasize the importance of investigations and enforcement?" Brabazon asked.

"Huge," said Derstroff.

He urged the jurors to recommend "more fire prevention, inspections and enforcement," … then added quietly, "This incident was preventable, and shouldn't have resulted in loss of life."

Jurors have heard that the three young people – Ben Twiddy, 19, who was the tenant of the tiny second-floor flat in an illegal three-unit house, and friends Marilee Towie, 17, and Holly Harrison, 18 – died through a miserable combination of a landlord who brazenly ignored the provincial Fire Code and a fire department that devoted minimal resources to the unglamorous work of prevention and enforcement.

At the time of the April 29, 2012, fire, xxxxxx had 104 firefighters involved in "suppression," which means actually fighting fires, and six in fire prevention.

Landlord Andrew Strzelec was convicted in 2009 of Fire Code breaches and fined and told he could have only two rental flats in the house, but by the time of the fire, had turned it back into three.

The division of labour at the fire department is probably typical.

The trucks actually got to the scene of the Dundas Street West fire in four minutes, 49 seconds, even faster than the 2015 average for full-time professional Ontario fire services – five minutes, 38 seconds.

Mind you, they were dispatched from a fire hall just 260 metres away.

Christie Blatchford
National Post
Published Apr 12, 2016

10 Technology and Analytics

Technology should be invested in to define risk, improve safety and effectiveness, and support the core purpose of public protection. The cost of technology should be measured against complement offsets and effectiveness that will achieve efficiency and lower costs. As in any business, financial break-even, and cost reduction points should be included in any supporting business case.

Traditionally, fire departments' service provision has been evaluated on response time and resource arrival and it served the public well for many years. But a shift in focus to the use of technology for information gathering and analytics is necessary in order to determine the most valuable use of existing resources, assets required in the future, mitigation activities, and education concentration.

Technology will enable officers and firefighters to gather information about incidents including the cause, injuries, loss, resources required, on scene activity, and other aspects of emergency response in almost real time rather than making notes on paper that may or may not be later included in a records management system.

Technology will also allow gathering of risk-related information such as floor plans, hydrants, sprinkler systems, hazardous material, and other characteristics of commercial or industrial establishments, multi-residential dwellings, schools, hospitals, assisted living locations, and other occupancies which can be reviewed enroute to an emergency.

And it will enable staff and firefighters conducting prevention endeavors to record information found at the time of activity without waiting to get back to the fire station. It will also assist firefighters conducting neighbourhood safety and fire awareness programs to record risk activities or unique neighbourhood characteristics as they are encountered.

Analytics is the use of data gathered to discover meaningful patterns and applying those relationships to increase effectiveness or efficiency, whether it is response related, education, prevention, or other circumstances. Analytics is not limited to emergency incidents but can assist with determining education programs, patterns to assist prevention program scheduling, and associate causal relations with outcomes. It will assist Waterloo Fire Rescue to anticipate when emergencies may occur based on historical patterns and will help determine the most effective and efficient method of response and use of responding resources.

Data gathered will result in information dissemination to inform the initiatives that will be of primary importance from time to time.

10.1 Analytics and Risk

Risk determination is the process of gathering reliable data, looking for meaningful patterns, analyzing information and using it effectively to determine the right response and resource allocation depending on incident type.

Careful collection and interpretation of data improves decisions about tactical, operational, educational, prevention, and strategic priorities. Trend analysis will enable Waterloo Fire Rescue and the city to predict future needs, deploy resources, and improve services. For example, answering questions as to when, if, and the number of fire responders that should be sent to medical emergencies, the nature of the vehicle that should be used, or the number of firefighters and equipment that should undertake initial response to different emergency types. It may mean moving away from a 'one size fits most' response, or the risk analysis may confirm that a standards based, or prescriptive response is indeed the right one.

Analytics will enable Waterloo Fire and Rescue to identify all event types and their potential for occurrence based on historical patterns, the equipment used most frequently, when incidents are most likely to occur (season, day, and time) the resources required to effectively and efficiently resolve the incident type, initiatives that might moderate risks, and increased protection to the public by virtue of reducing incidents. The data captured in this Fire Master Plan serves as a starting point to the data that needs to continue to be recorded and analyzed toward effective decision making and continuous improvement.

10.2 Recommended Technology

10.2.1 For 'as soon as possible' implementation:

A relational incident activity outcome data base so that Waterloo Fire Rescue and the city can measure the benefit of response activity. Although we have not found a market ready product of this nature, there are companies which are reported to have configurable databases and are interested in working with fire services that want to improve their information gathering and output.

Inspection and incident planning software including the supporting hardware so that prevention and public education records can be captured, on site, and uploaded in real time thus avoiding note taking and transferring information to a static record management system. Such software and hardware should augment efficiency and effectively increase staff time and value. Licenses and hardware sufficient to serve all prevention and education staff and firefighter teams assigned to day-to-day prevention activity should be purchased.

Geographic Positioning System – Automatic Vehicle Locating and vehicle movement reporting: This technology reports vehicle movement such as departing station, arriving incident, departing incident, and back at station automatically, thereby avoiding missed activity time stamps or erroneous vehicle movement times; for example, reporting in service while waiting for the full firefighting team to board the apparatus. Several hundred, or more, time stamps are missed each year in Waterloo. A GPS – AVL reporting system will improve data collection.

Improved Dispatch – Fire Service Integration
Some on-scene activities could be tracked by the fire dispatch service including critical time records and other activities. These activities could be reported to dispatch from the incident commander or firefighters using helmet-incorporated hands-free communication. The information recorded by a dispatcher should be directly entered into Waterloo Fire Rescue's record system so that it will be part of the overall incident without handling the material more than once.

10.2.2 Future consideration technology

Technology may eventually assist firefighters at incidents or safely allow more than one assignment on scene; for example:

A digital fire pump control system not unlike portable controls used on concrete truck pump systems, although more critical. It manages fire truck pumps, tanks, intakes, and discharges and appears to get agent on a fire 20 to 30 seconds faster than manually operated pump systems. Even though a firefighter is still required to monitor the digital fire pump, manufacturers of such technology claim that the equipment allows the pump operator, using wireless remote controls, to also be able to help with fire size up and scene monitoring. We're not sure this is true but simplified digital pump operation will likely be standard on future fire trucks. In 10 to 15 years voice activated or artificial intelligence pump operation may be possible thereby eliminating the need for a pump monitor/operator.

11 Resources (Staff)

This is the part of a fire services plan that no one wants to read: "How much is the plan, if approved, going to cost?" We suggest that the net cost of the resources will be much lower than they initially appear, which we detail in Section 12 Recommendations Summary.

1. Additional fire suppression staff for station 2, west Waterloo – 24 full time equivalent fire personnel which includes firefighters, captains, and replacement for paid time off.
2. Analytics professional (non-firefighter position). This position would be responsible for developing, with vendors, or with other city departments a way of gathering data which is currently not available, analyzing the data, developing principles, metrics, and standards for service and program quality and delivery, submitting reports, liaising with fire, paramedic services, and police dispatch to improve information gathering at the initial call stage, refining deployment need, and assisting the Chief to increase efficiency and effectiveness in the fire service.
3. A business manager (non-firefighter position). This is a position that is more frequently found in western Canada fire services, sometimes filled by someone with a CPA designation, but is a position which takes care of running the non-operational aspect of the fire service freeing up the Chief to ensure the vision and strategy of the fire service is successful. Responsibilities can include budgeting and forecasting for operating and capital, resource planning, payroll oversight, process analysis and improvement, purchasing, contract management, and liaising with the city finance department. This fire master plan proposes major organizational, operational, and culture changes at Waterloo Fire Rescue which is going to require the direct attention of the Chief for several years.
4. Assistant Deputy Chief. The Assistant Deputy Chief's position is on contract. We recommend making it permanent to oversee training which, in addition to traditional training activity, will be responsible for a change in focus to make firefighter delivered prevention and education as important as traditional training.

   Further, we envision the position as being tasked with continued liaison and coordination with the fire prevention division which will have to learn to share its traditional role with firefighters and coordinate firefighter public education and prevention activity.
5. Emergency Vehicle Technicians (2) or equivalent. The vehicle technicians are part of a fire crew which means they frequently are pulled from a mechanical repair to

respond to an emergency. This is an ineffective way to have repairs completed. We recommend two full-time mechanics, one of whom should be a Chief Mechanic.

6. An additional fire prevention officer. An additional fire prevention officer would assist with the backlog of re-inspections and assist the fire service moving to a proactive risk management state, including supporting the enhancement of existing and new firefighter programs.

7. Chief Training Officer. The Chief Training Officer would be responsible for coordinating training content and delivery to ensure consistency across the fire service. The need for a Chief Training Officer was frequently suggested during staff interviews.

12 Recommendations Summary

Recommendation 1

Waterloo Fire Rescue has a history of firefighter involvement in public education and fire prevention[24] activities such as smoke alarm education and visiting low-rise multifamily dwellings, but there are opportunities to increase and expand prevention endeavours. There is ample evidence reported in peer reviewed journals that the involvement of suppression staff in prevention activity lowers community risk of fire and the need for emergency response activity.

The public gains the greatest life-safety benefit from public education and prevention activity. There is considerable opportunity to increase the involvement of Waterloo Fire Rescue suppression staff (firefighters) within public education and risk reduction.

We recommend that Waterloo Fire Rescue continues to develop the role of all staff in prevention and education activity.

Recommendation 2

The concept for required fire protection – and that which has been included in several prior year's submissions to council – is to build another station in west Waterloo. We have found that the best location to provide optimum response in all parts of west Waterloo is from station 2; therefore, we recommend that instead of building another station, additional staff and a fire truck should be located at station 2.

The station is ideally located to provide a 5-minute driving time response to most areas of the west side of the city.

We recommend increasing staffing by one truck, 24 hours a day at station 2 and remodeling station 2 to accommodate the additional staff.

Recommendation 3

Station 1 is the oldest and busiest fire station in Waterloo and houses the mechanical division as well as two staffed fire apparatus 24 hours a day. Although it could be refurbished to allow additional years of useful life, rebuilding to include adequate and

[24] For the purpose of this document, 'prevention' is defined as *the act or practice of keeping something from happening* (*"Prevention." Merriam-Webster.com Thesaurus, Merriam-Webster, https://www.merriam-webster.com/thesaurus/prevention. Accessed 30 Apr. 2023.).* That includes public education, home and business safety checks, standards and code enforcement, and any other efforts to forestall the occurrence of fires.

updated space, as well as a hoist for the mechanical division, should be considered. Should the addition of a mechanical facility, including a hoist, not be possible at this location, consider relocating station 1 or establishing the mechanical division at another existing fire station.

Our recommendation to reconstruct station 1 at the present location assumes that the current site is acceptable for building. However, there are potential challenges including that the current location is the site of a flood plain. If construction is not possible, the city should seek another location within reasonable proximity since station 1 is well located to respond to the distribution of calls in that area of Waterloo.

We recommend rebuilding station 1, preferably on the existing site, to serve as a fire station and vehicle maintenance and repair facility while avoiding expenditure on new property.

Recommendation 4

Research in the past five to ten years into measuring the benefit of traditional emergency services practices indicates that there is an opportunity to reduce or adjust fire department response to certain call types. This possibility is captured in a variety of peer reviewed journal articles published in reputable scientific and medical publications. These call types include

- medical incidents,
- automatic fire and carbon monoxide alarms,
- rescue incidents, and
- traffic collisions.

With respect to medical events, peer reviewed journal articles indicate that there are few medical incidents that require the attendance of firefighters for lifesaving intervention other than cardiac/respiratory arrest, and asphyxia. The implementation of a more refined medical prioritization algorithm at Ontario Ministry of Health dispatch centres in the next two years may decrease the number of medical incidents to which Waterloo Fire Rescue is dispatched.

There is an opportunity to reduce the number of medical incidents to which fire is dispatched but, if fire rescue continues to attend medical incidents at the same frequency as is currently experienced, consideration should be given to the implementation of medical response units such as a small sports utility vehicle or similar conveyance. Vehicles do not have to be large because the equipment needed would be limited, such as an automated defibrillator and medical responder first aid

equipment. The majority of incidents to which Waterloo Fire Rescue responds do not require four firefighters and a large truck. One, or two at maximum, firefighters could respond to medical, and possibly other, events in a response vehicle.

We recommend that Waterloo Fire Services strengthen the measurement of performance and outcomes while continuing to evaluate the efficacy of traditional response practices in areas such as:.

d) Medical Incidents

- **Undertake a prospective study of medical responses over the next 6 to 12 months – preferably with the assistance of its medical advisor – to record and review services provided at the scene, and to the patient, to determine the percentage of incidents where fire arrives at least two minutes before paramedic services and undertakes life-saving measures such as cardiac or other resuscitation.**
- **Based on the study results, determine if response to medical incidents needs to continue at the current volume.**
- **By the six-month mark evaluate whether lights and siren response to medical calls is necessary and under what circumstances.**
- **Determine whether response to medical incidents can efficiently take place using a smaller vehicle such as a mid-size SUV or whether four firefighters in a fire truck is necessary. After appropriate incident analysis, including that of outcome evaluation, if the city decides to continue medical response with the same frequency as current, implement medical response units at all stations.**

e) Automatic fire and Carbon Monoxide Alarms

- **Undertake a prospective study of automatic alarms over the next 6 to 12 months to determine**
  - the number that turns out to be fires,
  - or carbon monoxide where it is unknown if the building was evacuated,
  - or other life-threatening circumstance,
  - and for which there was no other form of alert; for example, someone calling from the location within a very short period of time (60 – 120 seconds) reporting smoke or fire,
- **Based on the outcome of this study, determine whether response to automatic alarms can be reconfigured to lower the risk of response to firefighters.**

- **And, based on the findings, assess the possible reconfiguration of response to smoke and carbon monoxide automatic alarms to decrease the number of trucks dispatched.**

f) Traffic and Rescue Incidents

- **Undertake a prospective study of response to rescue incidents – particularly traffic events – over the next 6 to 12 months to determine**
  - the number that turns out to be actual entrapments,
  - the number where life-saving intervention was provided, and
  - the number where traffic blocking, debris clean up, or spill remediation was provided.
- **Based on the outcome of this study, determine whether response to rescue incidents, specifically traffic accidents – can be reconfigured.**

Recommendation 5

The provision of services by fire departments is complex. Data, analysis, technology, and interconnection with municipal and other partners will become more prevalent in future. It is expected that, in addition to emergency response, the fire service becoming more widely involved with other municipal departments in an effort to prevent emergencies will take on greater importance.

Revise the administrative structure of the fire service to support a business approach to fire safety. **This includes hiring a business manager to free up the Chief and Deputies to champion continuous improvement and long term strategic objectives toward public protection**.

Recommendation 6

Technology provides opportunities to measure the important metrics of public safety delivery, reduce time consuming manual activity, increase efficiency and activity, and possibly reduce or mitigate inflationary operational costs.

We recommend

- **Implementing a relational incident activity outcome data base to complement the information currently available within the fire record management system as demonstrated in this report**
- **Procuring and implementing fire inspection and incident planning software to increase efficiency and effectiveness.**

- **Procuring and implementing Geographic Positioning – Automatic Vehicle Locating software to more accurately capture apparatus activity and avoid missed data due to human factors.**
- **Working with 9-1-1, fire dispatch, police services, paramedic services to achieve improved Dispatch – Fire Service coordination including fire dispatch centre support of fire response by capturing on-scene information.**

Recommendation 7

We found that Waterloo Fire Rescue can benefit from increasing staff complement in several areas. Our expectation is that the recommended complement will improve public safety, increase efficiency and effectiveness and, in concert with other recommendations, assist to mitigate future operational cost increases.

We recommend the following complement enhancements:

- an Analytics Professional (non-firefighter position),
- a Business Manager (non-firefighter position) as indicated in Recommendation 5,
- a Chief Training Officer,
- an Assistant Deputy Chief – one permanent position (currently on contract),
- a Fire Prevention Officer,
- firefighter enhancements to improve response and reduce risk in west Waterloo as indicated in Recommendation 2,
- two full-time mechanic positions (or equivalent) at station 1, one of whom should be a Chief Mechanic.
    - In the alternative, should the city decide to continue with the four mechanic/firefighters assigned to suppression platoons, we recommend establishment of a Chief Mechanic position on day shift.

13 The Steps Supporting the Fire Master Plan

The steps in this section are critical to Waterloo Fire Rescue adopting a prevention centric strategy. After the fire service and city have decided on a strategy, communicating that position to all levels within the city, partner agencies, and the public, setting the plans into motion is the next step.

Based on a three-month target:

- Decide on and communicate the fire service's Vision, Purpose, Strategy, and implementation plans.
- Fill the position of a program analyst (analytics professional), and business manager.
- Start the process to increase suppression staff as recommended and start procurement of associated capital initiatives.

Based on a six-month target:

- Start developing an outcome-based data capture program that would be relational to data already available in the fire record management system, and which will inform value, effectiveness, and efficiency of fire service activity.
- Increase the Prevention Division complement by one position.
- Draft a plan for firefighters to participate in expanded home and business safety checks
- Continue and strengthen firefighter home and business safety checks.

Based on a nine-month target

- Educate all staff on the requirements of data capture.
- Start data capture.
- Make the Assistant Deputy Chief's position permanent.
- Hire a Chief Training Officer.

Based on a one-year target

- Work with 9-1-1, fire dispatch, police services, paramedic services to achieve improved Dispatch – Fire Service coordination including fire dispatch support of fire response by capturing on-scene information.
- Implement the recommended two mechanic (equivalent) apparatus service model.
- Investigate renovation of station 2.

Based on an 18-month target

- Start analyzing and using outcome metrics to determine response profiles, particularly to medical, traffic, and alarm incidents.
- Renovate station 2.

Based on a two-year to 30-month target

- Procure and implement fire inspection and incident planning software.
- Procure and implement Geographic Positioning – Automatic Vehicle Locating software.
- Decide whether revised response protocols will affect vehicle purchasing decisions.

Based on a 30-month to five-year target

- Rebuild station 1.
- Reinforce the prevention centric safety model.
- Train all firefighters to Fire Prevention/Inspection Level II and Fire and Life Safety Educator in accordance with Ontario Regulation 343/22. This is a knowledge based recommendation. Certification is not suggested for those who don't require certification as part of their job function.

Based on a five-to-ten-year model

- Continue to reinforce a prevention culture within the fire services, with partners, the city, and the public.
- Ensure all newly hired firefighters have taken courses equivalent to Fire Prevention/Inspection Level II and Fire and Life Safety Educator (certification not required).

Appendix A Terms of Reference, Objectives, and Deliverables

From The City of Waterloo Request for Proposal (RFP #21-23)

SCHEDULE 1 – STATEMENT OF WORK

Terms of Reference

1.0 Introduction

The City of Waterloo is seeking the professional services of an experienced and qualified consulting firm to develop a comprehensive evidence-based Fire Master Plan that utilizes quantitative and qualitative data.

Fiscally responsible and comprehensive, the principal study objective of the Fire Master Plan will identify growth, in contrast to service requirement, in terms of high, moderate and low risk scenarios. This analysis, including but not limited to, the Community Risk Assessment and outcomes associated with Fire Underwriter Survey data, will assist in the development of a sustainable, effective and efficient Fire Master Plan to inform the delivery of fire protection services, and establish strategic priorities.

The overall goal of the project is to provide a strategic framework and recommendations that will assist City of Waterloo Council in determining Community Safety levels, Public Education, Fire Prevention and Fire Operations/Specialized services.

2.0 Scope of Services

The consulting firm will work in conjunction with the project directors and a working group including:

- The Fire Services Senior Management team;
- Commissioner of Community Services;
- A working group consisting of staff including representation on behalf of Waterloo Professional Firefighters Association, committee leadership, fire services and corporate staff; and,
- Engagement with the general public, user groups, community partners, including various City Departments, is required.

Key Project Assessment and Analysis

The 10-year Fire Master Plan & Community Risk Assessment will include an assessment and analysis of current and forecasted fire protection, prevention and public education service delivery needs and develop clear and concise recommendations supported by a 10-year implementation strategy for City Council and staff.

- The strategy shall be expressed in terms of clear and concise goals, objectives, action steps, resources (human and financial) and the time lines required to successfully complete the priorities detailed in an implementation plan. All strategies, where applicable, require the acknowledgement and linkages toward the enhancement of Fire Underwriter Survey assessments and grading.
- The plan will identify and consider strategies aimed at planning for and responding to future growth within the City of Waterloo. These plans will identify key areas and corridors where residential/commercial intensification is planned for and projected.
- Assessing staffing needs by evaluating the impacts of existing and future growth patterns and the projected community needs; circumstances as they relate to all areas of fire protection services; review capabilities of existing staffing and identify current and future needs to all, but not limited to, the following areas;
- Administration;
- Public education;
- Fire prevention and Fire Code Enforcement;
- Fire suppression and emergency response for the efficient utilization and optimization of City resources, work force, including mutual aid and automatic aid;
- Training and Professional/Leadership Development;
- Technical Maintenance and Mechanical;
- Community Risk Profiles.
- Asset Management, including technology; and,
- Environmental sustainability

3.0 Deliverables

Proponents are to address each requirement listed in a Terms of Reference in addition to identifying key deliverables required of this project. Proponents should indicate understanding of the terms/requirements identified and their ability to comply or detail the deviance from the term in clear, concise language.

- The project is to be conducted with current legislation, informed practices and industry standards as the foundation for all work undertaken;

- The project will review the Establishing & Regulating By-law and make recommendations for amendments;
- The project will assess the station, staffing and apparatus implications of National Fire Protection Association (NFPA) standards; and,
- The project will consider the application of the Office of the Fire Marshal's Comprehensive Fire Safety Effectiveness Model.

Administration Division:
Evaluate all aspects of Waterloo Fire Services (WFR) and determine optimal service levels for fire protection service delivery to meet the current and future needs and circumstances of the community including:

a) Fire protection delivery for legislative compliance;
b) Fire Protection and Prevention Act, Ontario Regulation 378/18 Community Risk Assessments;
c) Section 21 Guidance notes;
d) Occupational Health and Safety Act and City By-laws;,
e) National Fire Protection Association (NFPA) related standards;
f) Ontario Fire Marshal's Public Fire Safety Guidelines inclusive of the Ontario Fire Marshal's Review current administrative processes, workflow & management practices;
g) Department communications strategies;
h) Identify enhanced processes for technology;
i) Assess mutual aid and determine the need/opportunity for automatic aid agreements with neighboring municipalities;
j) Develop a comprehensive community risk assessment in accordance with current and proposed FPPA legislative changes including:

Geographic profile: The physical features of the community, including the nature and location of features such as highways, waterways, railways, canyons, bridges, landforms and wildland-urban interfaces;
Building stock profile: The types of buildings in the community, the uses of the buildings in the community, the quantity of each type of building, the quantity of buildings of each use and any building-related risks known to Fire Services;

Critical infrastructure profile: The capabilities and limitations of critical infrastructure, including electricity distribution, water distribution, telecommunications, hospitals and airports;
Demographic profile: The composition of the community's population, respecting matters relevant to the community, such as population size and dispersion, age, gender, cultural background, level of education, socioeconomic make-up, and transient population;
Hazard profile: The hazards in the community, including natural hazards, hazards caused by humans, and technological hazards;
Public safety response profile: The types of incidents responded to by other entities in the community, and those entities' response capabilities;
Community services profile: The types of services provided by other entities in the community, and those entities' service capabilities;
Economic profile: The economic sectors affecting the community that are critical to its financial sustainability;
Past loss and event history profile: The community's past emergency response experience, including the following analysis:

- The number and types of emergency responses, injuries, deaths and dollar losses;
- Comparison of the community's fire loss statistics with provincial fire loss statistics.

Conduct a detailed trend analysis including issues and best practices regarding fire and emergency services in an effort to identify opportunities for continuous improvement, service optimization and innovation;

Fire Prevention and Public Education Division:

Assess and evaluate Public Fire Safety Education and Fire Safety Standards and Enforcement focusing on strategic deployment of resources, technological changes, efficiencies and effectiveness with respect to inspection services, data gathering. and current service delivery against applicable standard(s) / legislation analysis of data analytics for decision support for Public Education.

Fire Suppression Division (Operations):

Detailed review of service delivery levels against accepted applicable standards, legislation and industry specific informed practices. Assessment of all specialized service delivery and identification of opportunities for efficiencies and enhancements.

Evaluation of all fire station locations – including a comprehensive study for a potential new fire station, the re-occupancy of a former fire station and the

expanded use of existing fire station(s). Considering factors not limited to; GIS Locations of current stations relating to response capabilities, vertical

response/fire ground operations, roadways including attributes such as traffic calming, one-way streets and turn restrictions, light rail transit infrastructure, building and population densities. Identifying, analysing, evaluating and prioritizing risks to public safety including the age and infrastructure of all facilities.

Comprehensive examination of response times for each fire station against standards, legislation and best practices. Identify projected long range needs and implementation strategies and timelines.

Review of current and emerging technologies that may be employed to effectively and efficiently improve current, future services and environmental sustainability. Alternative response options toward efficient and effective operations must be identified to enhance community safety.

Training and Professional Development:

Evaluate professional qualifications and standards to determine current and future training needs for all positions within the Fire Services.

Consideration of National Fire Protection Act (N.F.P.A.) professional qualifications and standards, documentation requirements, succession planning.

Review present-day service delivery against applicable standard(s) and legislation.

Identify opportunities for enhancement and effectiveness of training practices to improve leadership capacity training delivery methods, infrastructure, props, tools, facilities, staffing, divisional organization and deployment, and enhancement of the training environment through partnerships.

Apparatus and Equipment:

Using existing asset management planning, analyze long range strategy for vehicle acquisition and replacement including critical equipment and critical resources.

Assess and evaluate apparatus, vehicle and equipment condition, maintenance programs, replacement schedules and plans relative to existing and expected service demands, budget process, budget reserves, and preventative maintenance requirements;

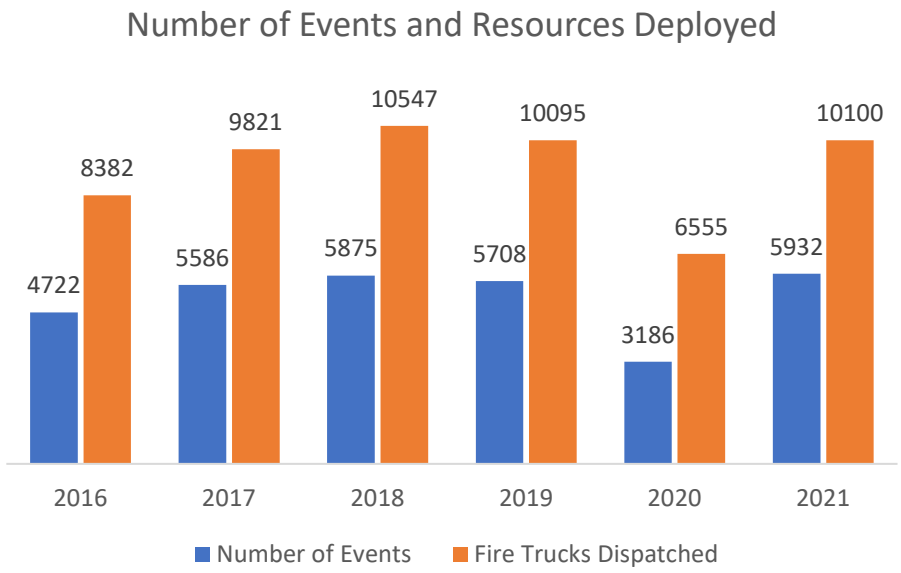
Review applicable fire apparatus maintenance and repair standards, legislation and best practices to identify opportunities to increase efficiencies.

Appendix B Detailed Incident Information

The information that follows indicates Waterloo Fire Rescue activity by incident category over the 2016 to 2021 period, as well as individual fire station activity for the same categories where applicable.

The incident types reported on here are self-explanatory, but some notes have been included for clarification. Data is based on first arriving vehicle and the assumption is that the first arriving vehicle's number defines the station area within which an incident occurred, although recognizing that, occasionally, this isn't true.

Chart 19: All Incidents



The number of events by year in The information that follows indicates Waterloo Fire Rescue activity

Chart 20: All Incidents by Station

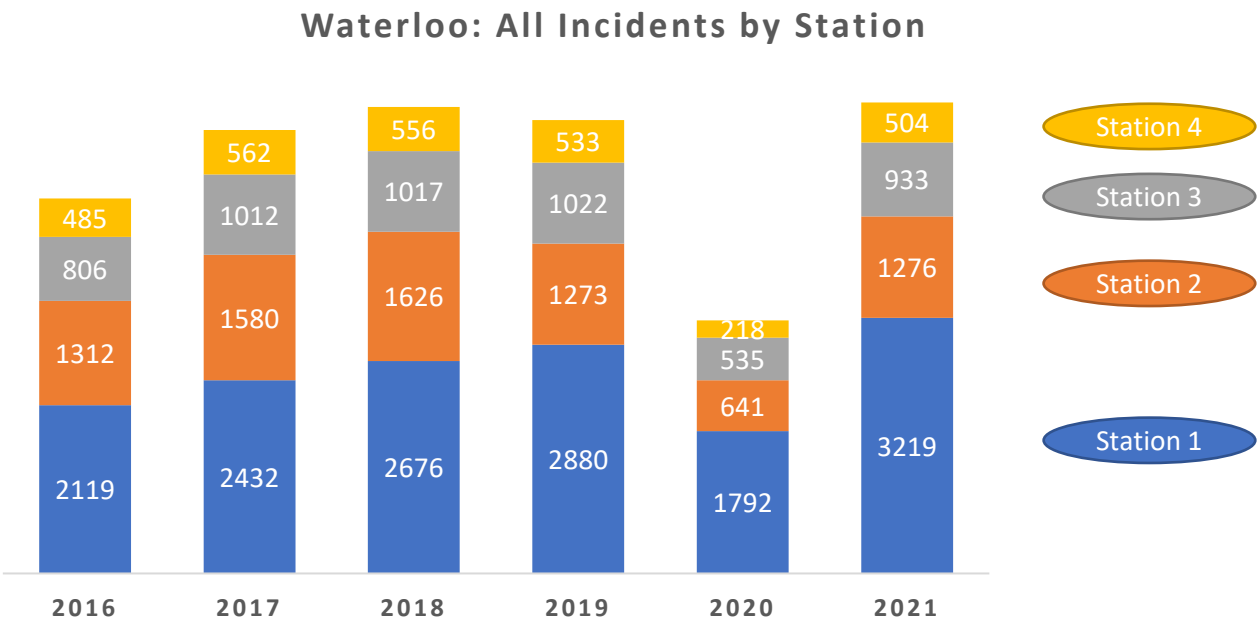
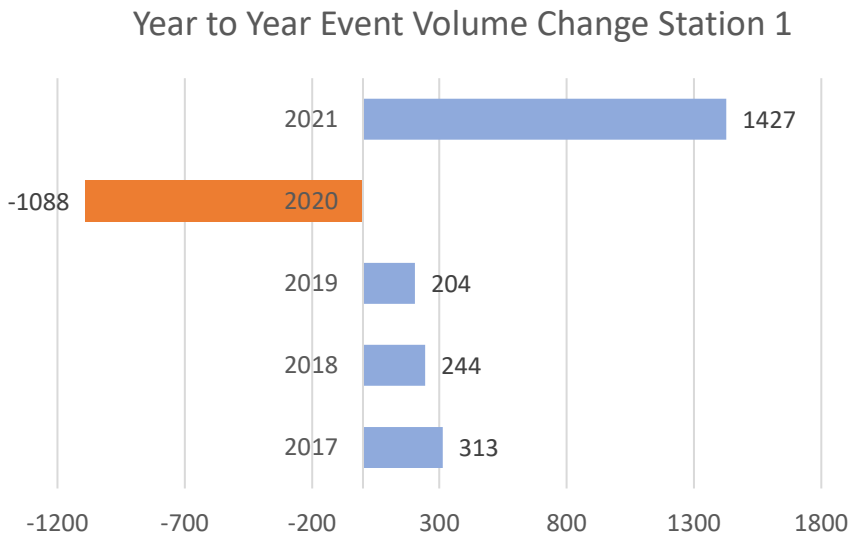


Chart 21 to Chart 24 demonstrate the change in number of events, year to year, starting from 2016 as the base year. 2016 isn't shown on the charts.

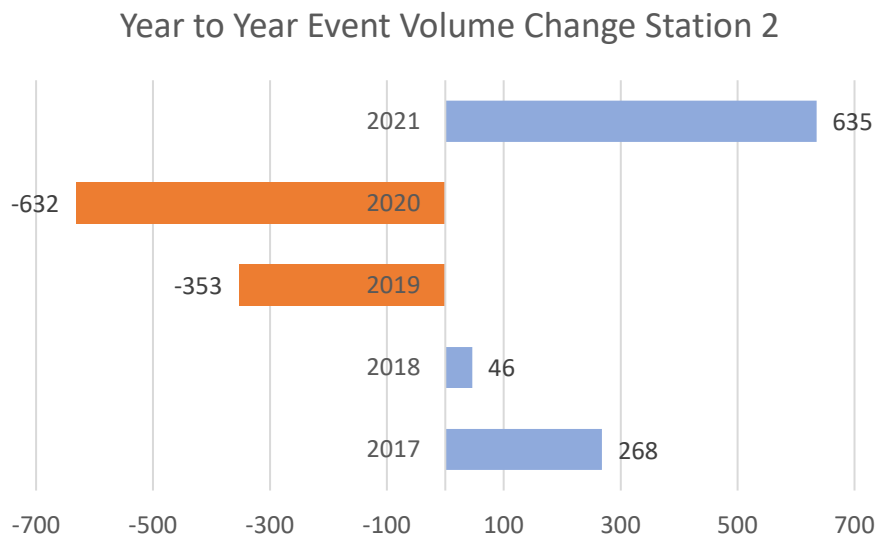
Chart 21: Year to Year Event Volume Change Station 1



The majority of incidents occur in station 1's area; in some years more than 50% of incidents in Waterloo are serviced by station 1.

Using 2016 as the base year, Station 1's call volume increased until the COVID-related decline of 2020. But the rate of increase in 2017, 2018, and 2019 slowed each year. However, in 2021 station 1 not only recaptured the volume that may have been expected in a non-COVID 2020 but, unlike the other stations, achieved the growth that might be expected if COVID had not occurred.

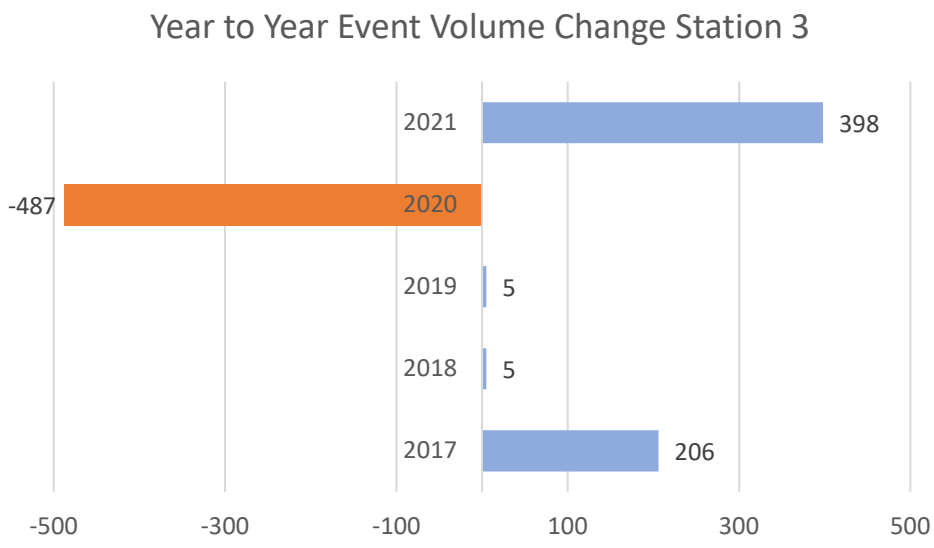
Chart 22: Year to Year Event Volume Change Station 2



In 2017 station 2 had a 268-incident increase over 2016 but that moderated to only a 46-incident increase in 2018 from 2017. 2019 saw a 353-incident decrease, and a further COVID-related 632 incident decrease in 2020.

An increase of 635 events from 2020 to 2021 brought station 2 back to the call level of 2019.

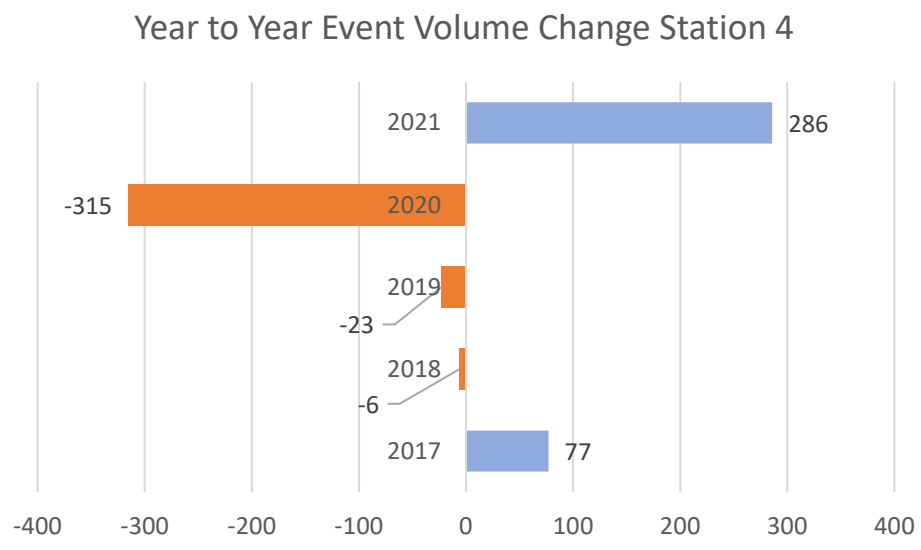
Chart 23: Year to Year Event Volume Change Station 3



After an increase of 206 incidents in 2017 from 2016, call volume remained steady at station 3 in 2018 and 2019 before a COVID influenced decline of 487 in 2020.

An increase of 398 events in 2021brough the call volume at station 3 within 89 calls of 2019 levels.

Chart 24: Year to Year event Volume Change Station 4



Station 4's call volume increased by 77 incidents in 2017 over 2016 but then remained stable or dropped slightly in 2018 and 2019.

Calls reduced by a further 315, influenced by COVID, in 2020 and increased by 286 in 2021 over 2020. The result is that 2021's call volume is slightly less than in 2019.

Chart 25 indicates the pattern of call volume by month based on 2016 to 2021. Station 1 has a distinct pattern that could be influenced by student population and summer. Station 2's pattern isn't as distinct and stations 3 and 4 don't have patterns that seem to be greatly affected by seasonal student population.

Chart 25: Incidents by Month and Station

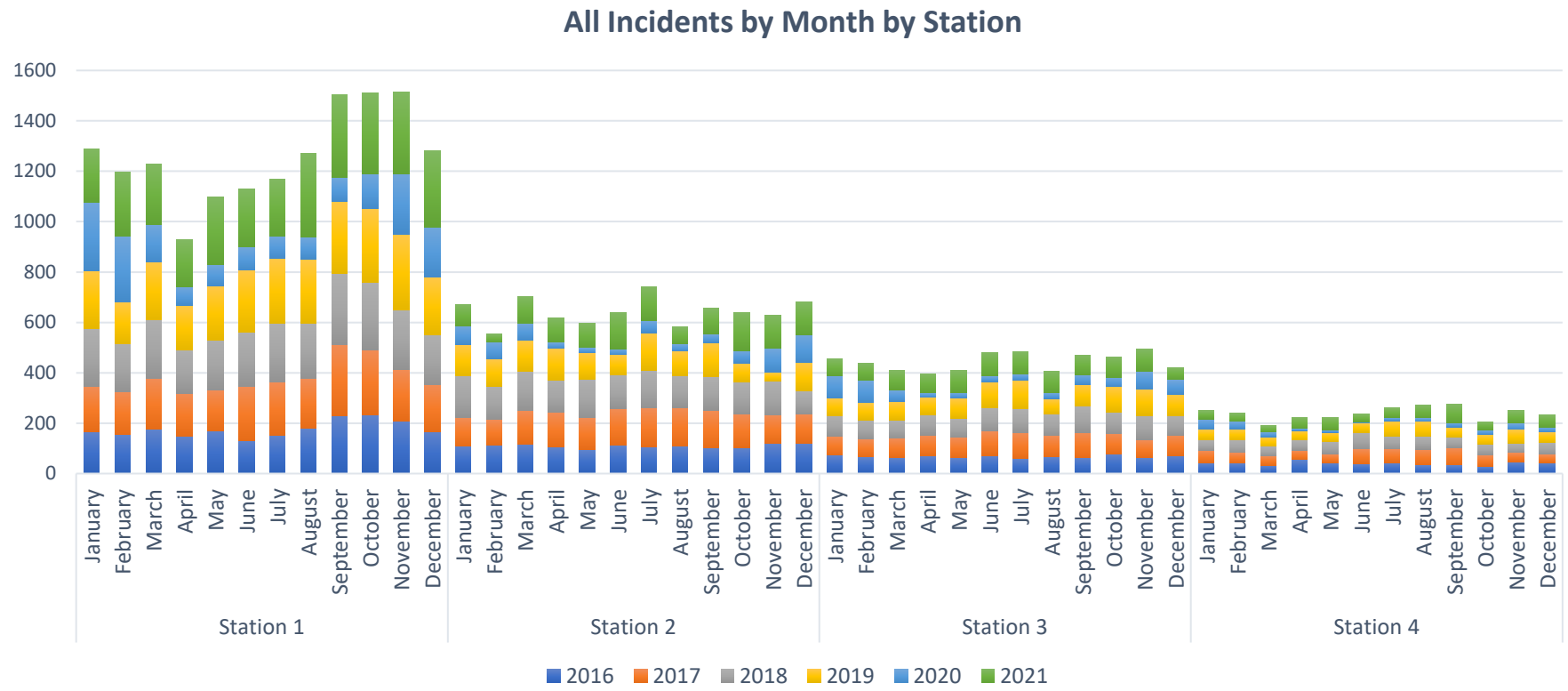
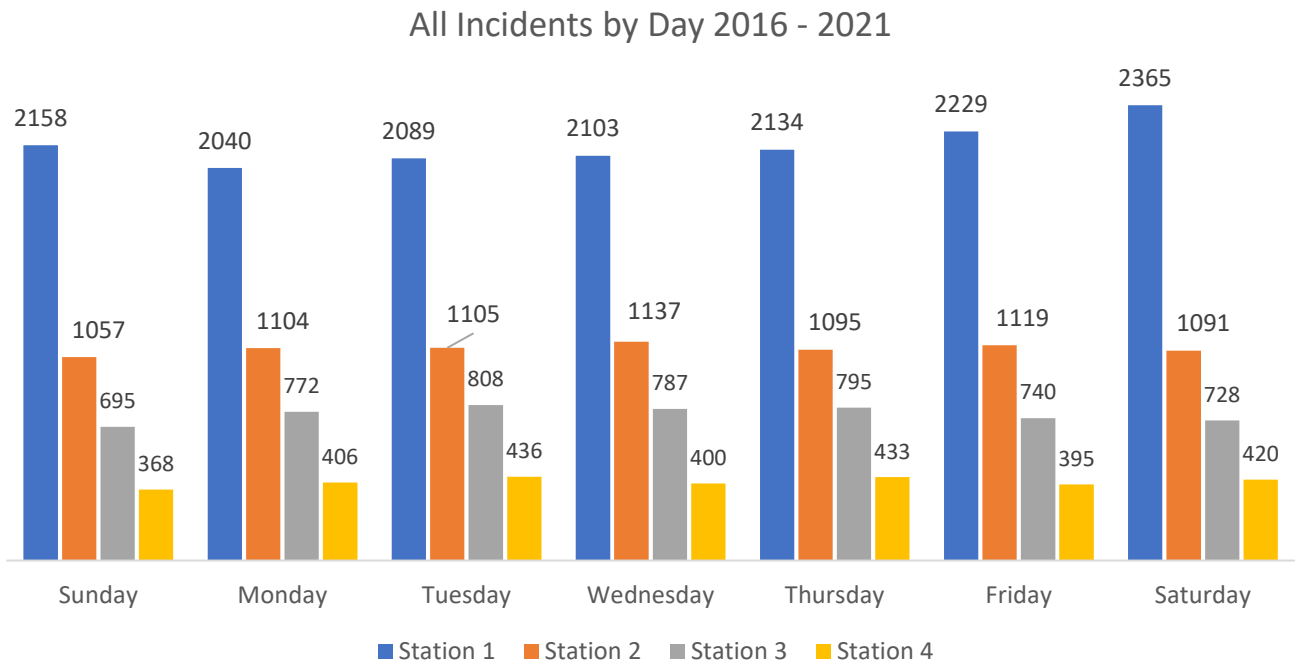


Chart 26 indicates the number of incidents by day over six years in an effort to determine if any days of the week have a greater concentration of incidents. For example, in station 1, there were 2,365 more incidents on Saturdays in six years than there were on Mondays. However, since Mondays or Saturdays occur once a week, or 52 times a year, the values shown in Chart 8 have to be divided by (52 days x 6 years) 312 to find the average number of incidents per day. In that case, station 1 has experienced an average of 7.6 events of all types on Saturdays, while Mondays have resulted in an average of 6.6 events; a practical difference of 1 call a day which doesn't suggest that resources need to be realigned to meet call load variation of any significance. Beyond the numbers, the type and duration of incidents have to be examined as part of resource analysis (please see Section 2.1).

Similarly, there is no significant variance in call occurrence at other stations to suggest that resources need to be re-scheduled.

Chart 26: Incidents by Day 2016 - 2021



Incidents by Hour by Station 2016 – 2021

Chart 27 to Chart 30 demonstrate call demand on a cumulative hourly basis for the period 2016 to 2021 inclusive.

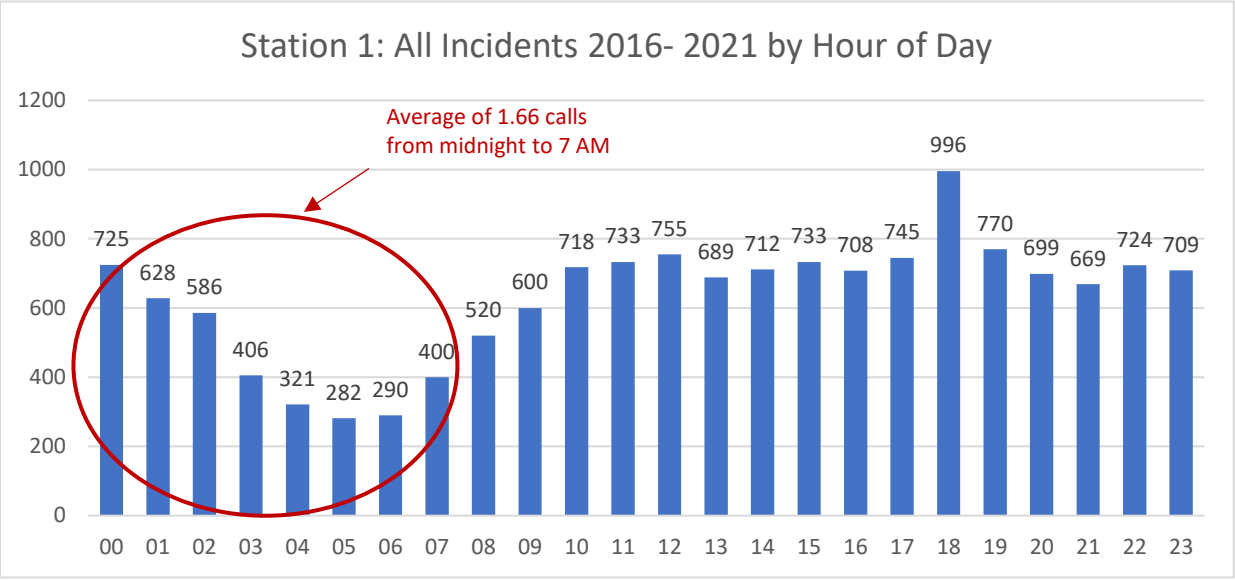
- Each chart shows 24 bars representing hours of the day.
- Each hour occurs once a day or 365 times a year.
- The values shown with each bar represent six years of incidents in that hour.

- To find the average incidents per hour over six years, the value per hour would be divided by (365 x 6 =) 2,190 hours.
- As an example, Chart 27 indicates that station 1 was primary response to 996 incidents at 1800 hours (6:00 PM) over six years.
  - 996 incidents divided by 2,190 = an average of 0.45 calls during the 6:00 PM hour over six years.

There must be caution with averaging in that it does not inform us of the trend and type of incidents or call load in a four- or eight-hour period. For example, a medical call at 1800 hours every two days that commits one truck for 18 minutes is a lot different than a fire incident every two days that commits three or four trucks for 60 to 90 minutes. Fortunately, fires aren't occurring with that frequency.

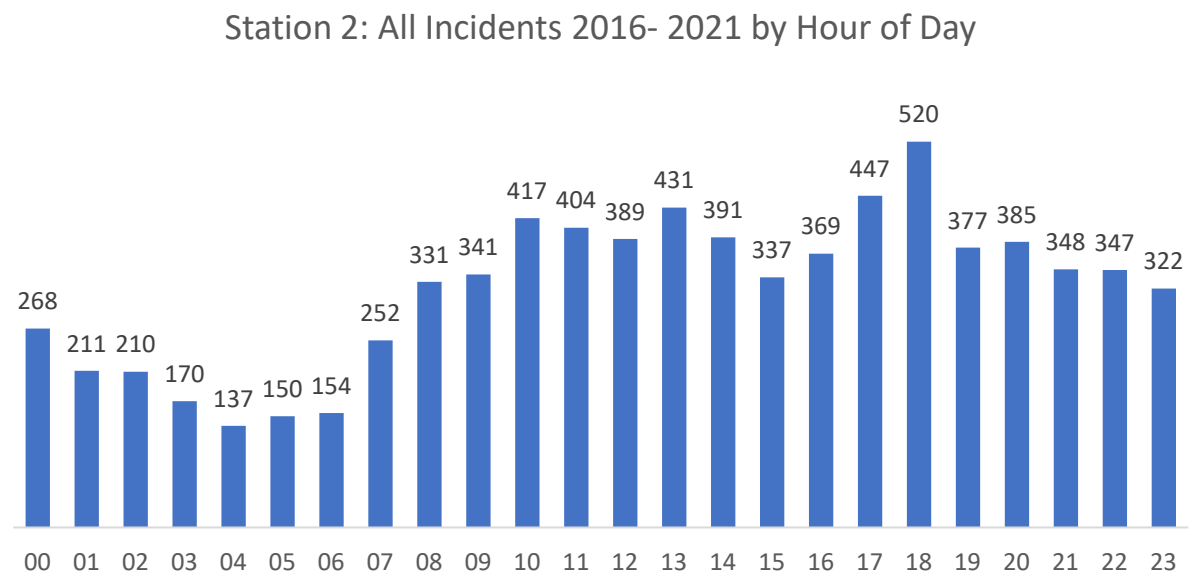
Station 1 (Chart 27) is the most active fire station in the city. Demand for services (call volume) reflects activity in the city; more incidents occur in the day and evening when people are moving about, and businesses are open. Peak activity occurs at 1800 hours (6:00 PM), mostly due to medical calls and traffic accidents.

Chart 27: Station 1: Incidents by Hour by Station 2016 – 2021



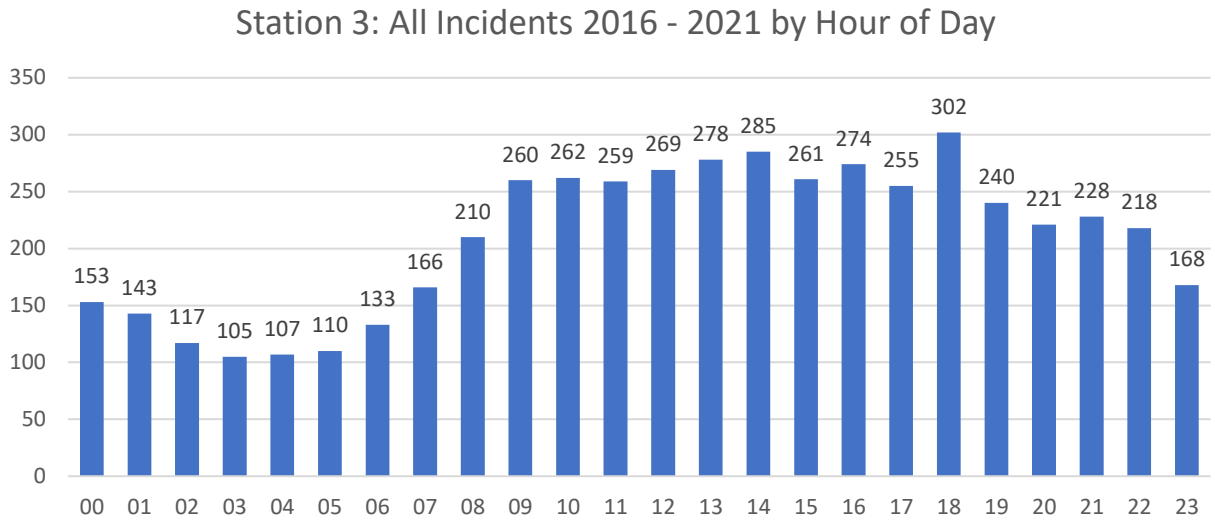
Station 2 (Chart 28) has a similar call pattern as station 1 but, in 2021, approximately 40% of the volume of station 1. Again, peak activity is late afternoon.

Chart 28: Station 2: Incidents by Hour by Station 2016 - 2021



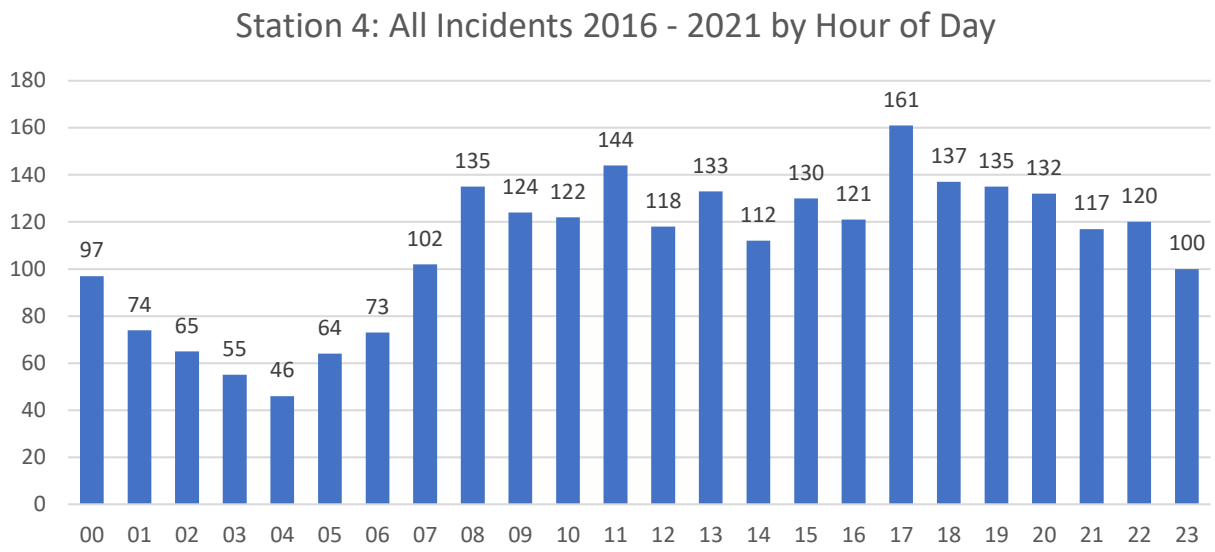
Station 3 shares a similar call volume pattern, with peak activity at 1800 hours, but call volume was 29% of station1's in 2021.

Chart 29: Station 3: Incidents by Hour by Station 2016 – 2021



Although Station 4 reflects a similar call pattern to the other stations and peak activity at 1800 hours, it performed less than 16% of the number of calls as station 1 in 2021. However, station 4 – in fact all the stations – serves in a backup role to cover other station areas when the primary crew responds to incidents within their respective areas.

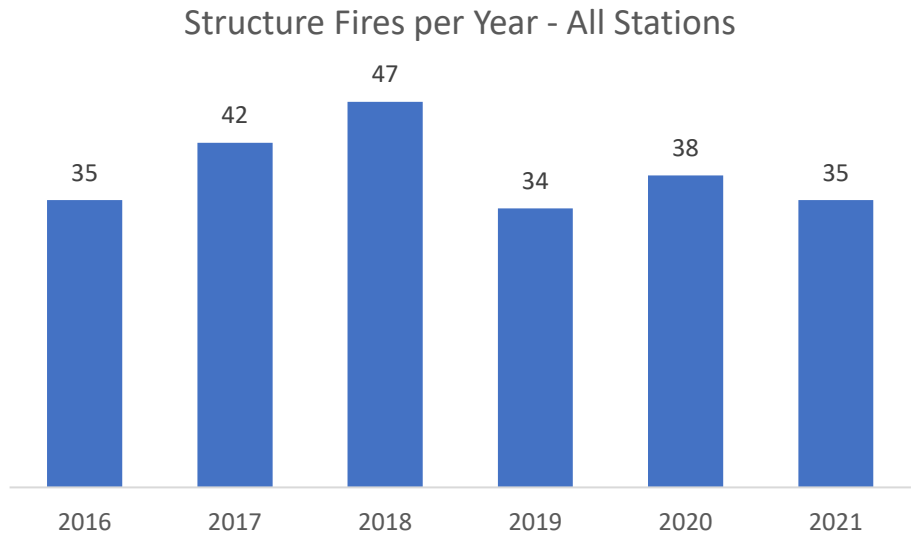
Chart 30: Station 4: Incidents by Hour by Station 2016 – 2021



Structure Fires 2016 - 2022

The Ontario Office of the Fire Marshal establishes codes for reporting incident types. Chart 13 shows the number of events such as fires or explosions in structures based on the OFM incident codes.

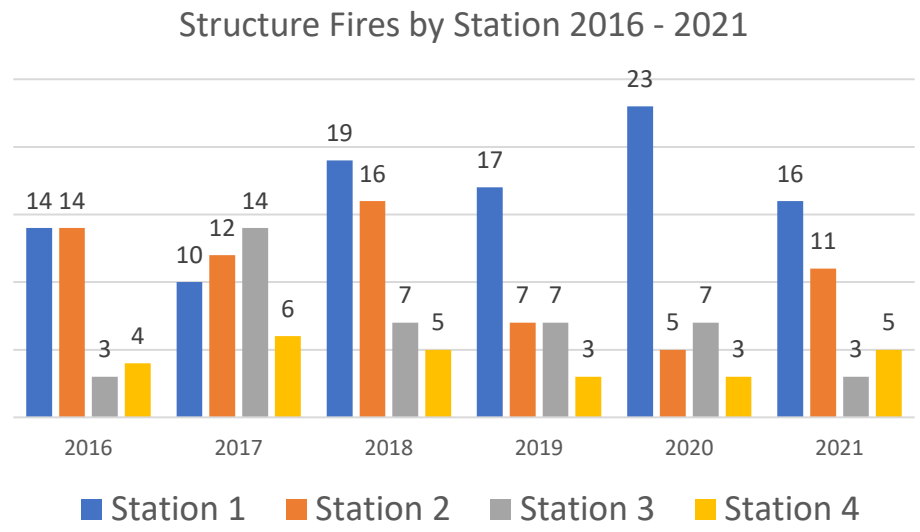
Chart 31: Structure Fires 2016 - 2021



Structure fires peaked at 47 in 2018 but have reduced by between 9 and 13 compared to that

Chart 32 demonstrates the distribution of structure fires, by year, based on the station of the first arriving vehicle. We have assumed that the fire was likely in the primary catchment area of the first arriving fire truck.

Chart 32: Structure Fires by Station



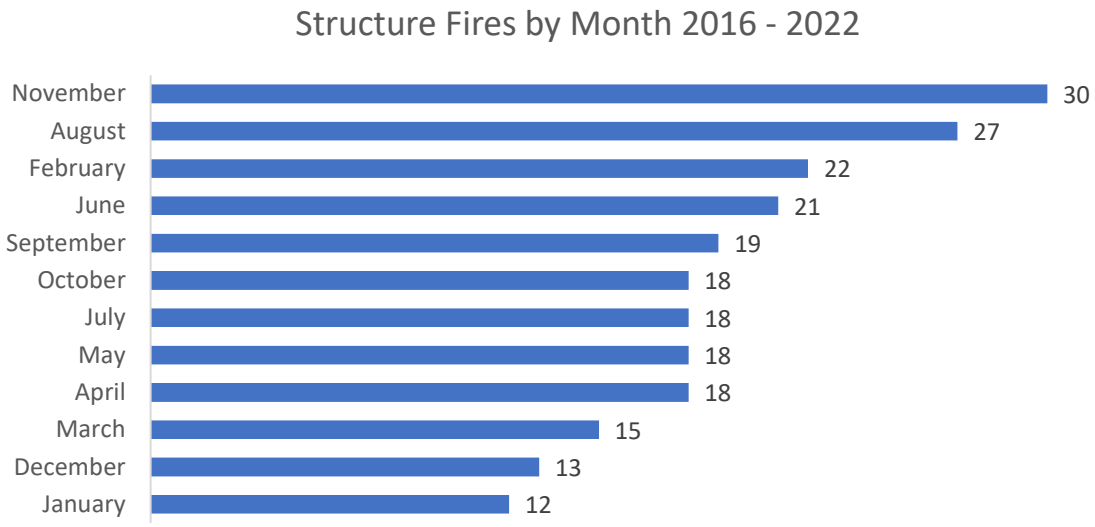
In 2016, stations 1 and 2 had the same number of fires in their areas, with station 3 and 4 experiencing only 30% of the volume of stations 1 and 2.

In 2017, station 3 experienced 14 fires whereas there were 3 the year before.

Also in 2017 station 1's area had 10 fires but, since then, has experienced the most fires, sometimes by a significant percentage. Reasons for this change are not apparent.

When do Structure Fires Occur?

Chart 33: Structure Fire Totals by Month 2016 - 2021



From 2016 to 2021, 60% more structure fires have taken place in November than December and January. This could coincide with the arrival of student population,

but students arrive in late August – which has the second highest number of fires – but September's structure fire count is 36% lower Than November's. Determining the reasons for this variance may assist with prevention and education initiatives.

Table 9: Station 1: Distribution of Structure Fire Occurrence by Month

The distribution of structure fires in station 1's area appears random.

	2016	2017	2018	2019	2020	2021	Total
January	1		1		1		3
February	1		3	2	1	2	9
March			1	2	1	3	7
April	2			3	1	1	7
May	2	1	1	1	5		10
June	1	3	2	2	2	1	11
July			3		1	1	5
August	1		1	1	2	4	9
September	2	1	2	2	1		8
October	1	2	1	1	4	1	10
November	2	2	3	2	2	3	14
December	1	1	1	1	2		6
Total	**14**	**10**	**19**	**17**	**23**	**16**	**99**

Table 10: Station 2: Distribution of Structure Fire Occurrence by Month

Table 11: Station 2: Distribution of Structure Fire Occurrence by Month

	2016	2017	2018	2019	2020	2021	Total
January	1			1			2
February	1		2	1	1		5
March			1	2		1	4
April	2	2	1	1	2	1	9
May	1		1				2
June		1	1	1		2	5
July	3	2	2				7
August	3	2	2		1	1	9
September			2			3	5
October		1	2	1	1		5
November	2	3	1			2	8
December	1	1	1			1	4
Total	**14**	**12**	**16**	**7**	**5**	**11**	**65**

Neither is there a discernible structure fire pattern in stations 2's primary response area.

There are several months, sometime in consecutive years,

Table 12: Station 3: Distribution of Structure Fire Occurrence by Month

	2016	2017	2018	2019	2020	2021	Total
January	2	1	1	1			5
February		2	2		1	1	6
March			1				1
April		1		1			2
May	1	2	1				4
June		3			1	1	5
July		2		1		1	4
August		2		1	1		4
September			1		2		3
October				1	1		2
November		1	1	2	1		5
Total	**3**	**14**	**7**	**7**	**7**	**3**	**41**

There is no record of a structure fire occurring in station 3's primary response area, in December, in the six-year period examined

Table 13: Station 4: Distribution of Structure Fire Occurrence by Month

	2016	2017	2018	2019	2020	2021	Total
January			1	1			2
February					1	1	2
March		1		1		1	3
May	1					1	2
July		1				1	2
August		2	1	1	1		5
September	1				1	1	3
October			1				1
November	2		1				3
December		2	1				3
Total	**4**	**6**	**5**	**3**	**3**	**5**	**26**

There are several months in consecutive years when no fires have occurred in Station 4's primary response area and no record of structure fires in April or June in the six-year period, 2016 to 2021.

This is good news; prevention and public education efforts might lower the frequency further.

Fire Distribution by Day

The following four charts (Chart 34 to Chart 37) indicate the distribution of fires by day from 2016 to 2021. Except for 2016 and 2017, most fires occur in station 1's primary response area. Fortunately, the number of structure fires is low which means that it isn't possible to suggest, as an example, that Wednesdays and Thursdays are a higher risk day than others considering that the frequency of fires is a maximum of six on any day, and there are 52 of each day in a year. Therefore, six fires over 52 Thursdays mean there is an 11.5% chance of a fire happening on a Thursday. In a different year, 2019 for example, only one fire took place on a Thursday in station 1's primary response area.

So far, we have not noted any patterns in structure fire occurrence.

Chart 34: Structure Fire Distribution by Day Station 1

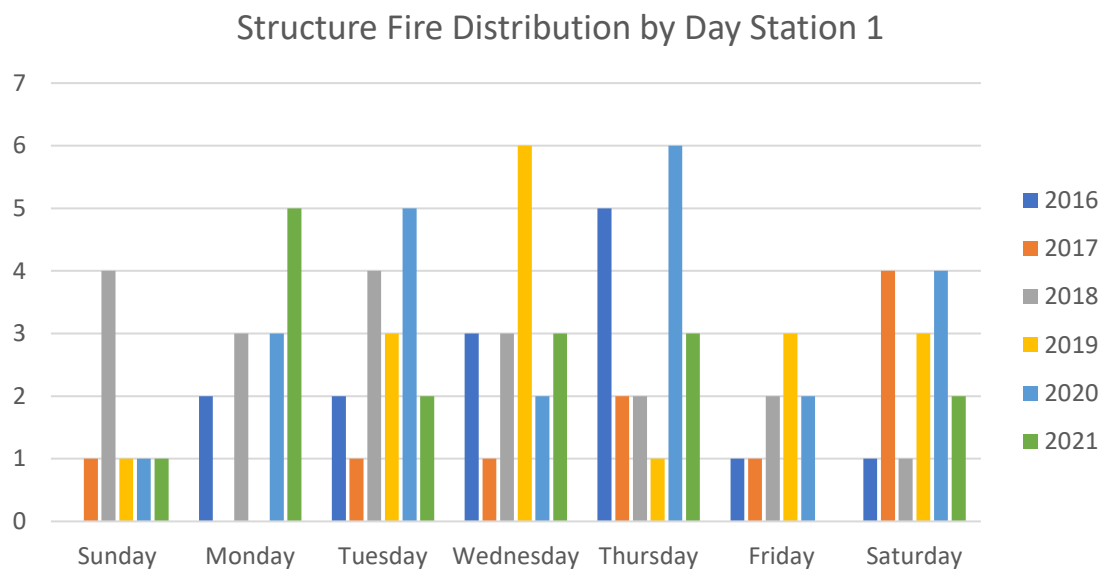
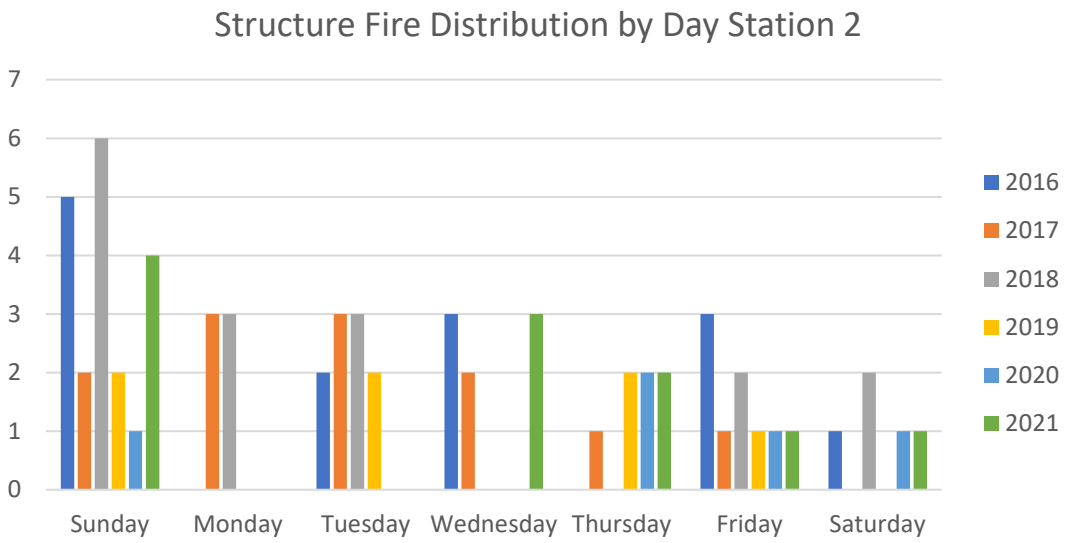


Chart 35: Structure Fire Distribution by Day Station 2



Neither station 2 nor 3 demonstrate a significant variance in structure fire pattern by day of week to suggest that redistribution of resources, for example, from station 1 on specific days should take place. The frequency of structure fires is fortunately low and offers an opportunity to use prevention and education as a primary means of protecting the public and reducing fires.

Chart 36: Structure Fire Distribution by Day Station 3

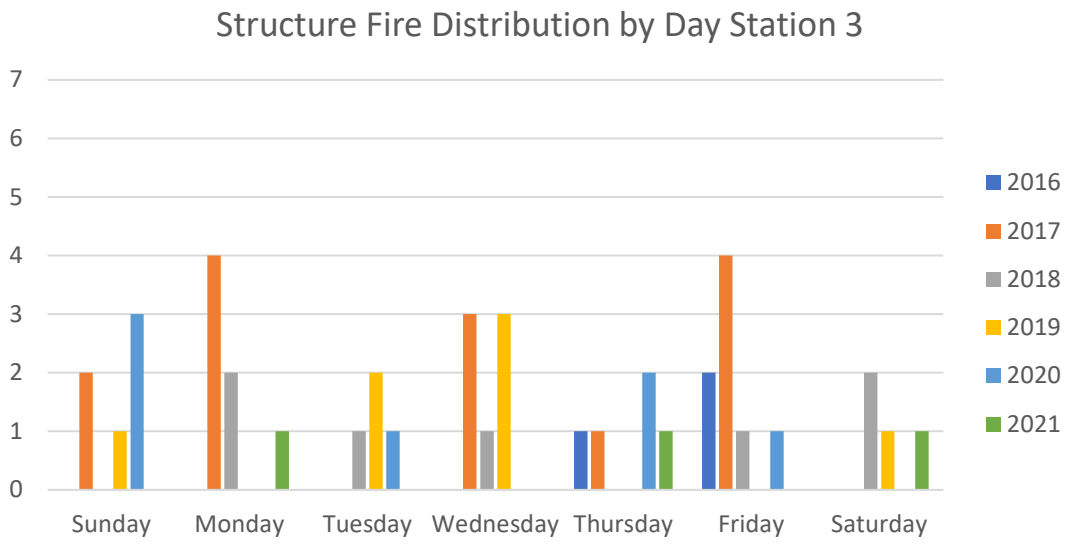
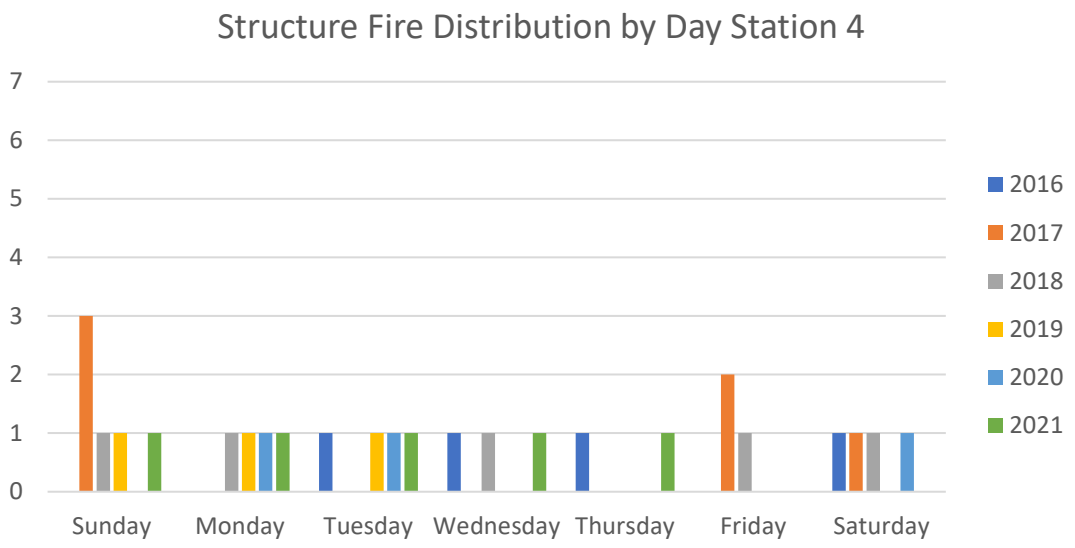


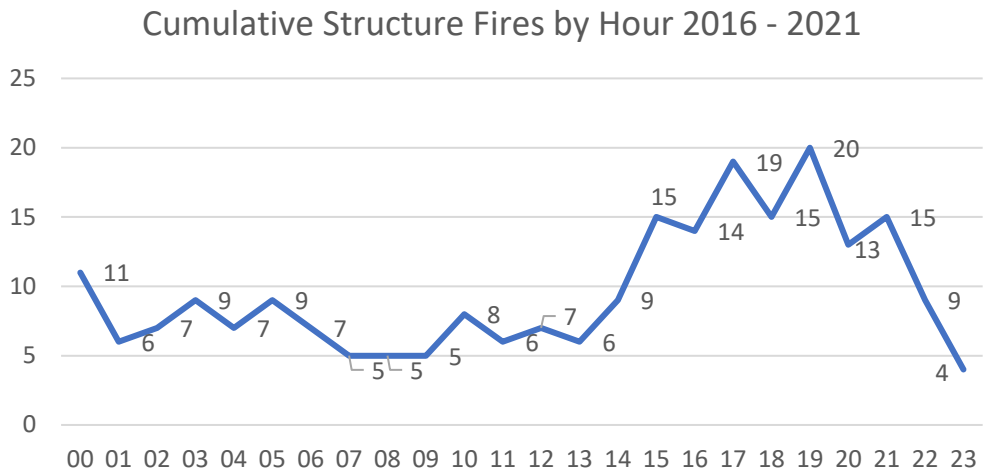
Chart 37: Structure Fire Distribution by Day Station 4



Station 4, fortunately, experiences few structure fires in its primary response area.

We performed an assessment of fires by hour, within each year, for each station, but because of the fortunately low number of fires, the results didn't reveal anything. Therefore, charts and commentary related to that assessment are not included in this report.

Chart 38: Cumulative Structure Fires by hour 2016 - 2021



Most structure fires take place in the mid to late afternoon and early

Table 14 demonstrates the history of structure fires based on the experience of 2016 – 2021. The results are presented in percentage by hour, 8-hour shift, and daily (to reflect a 24-hour shift).

Historical experience of a structure fire incident by hour indicates the occurrence for each one-hour slot over the six-year period. As an example, if we measure the probability between midnight and 1:00 AM for six years, the calculation is 365 (each hour happens once a day or 365 times a year) times six years which equals 2,190 hours. The total number of structure fires in that hour over six years was 11. Eleven divided by 2,190 = 0.005 or .50%.

Table 14: Structure Fire Occurrence Experience by hour 2016 - 2021

Hour Beginning at	00	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20	21	22	23
Number of Structure Fire Incidents Over 6 Years	11	6	7	9	7	9	7	5	5	5	8	6	7	6	9	15	14	19	15	20	13	15	9	4
Historical Experience in %	0.50%	0.27%	0.32%	0.41%	0.32%	0.41%	0.32%	0.23%	0.23%	0.23%	0.37%	0.27%	0.32%	0.27%	0.41%	0.68%	0.64%	0.87%	0.68%	0.91%	0.59%	0.68%	0.41%	0.18%

We measured the frequency of structure fires based on sections of the day (Table 6). We chose 8-hour time periods of 7:00 AM to 3:00 PM, 3:00 PM to 11:00 PM and 11:00 PM to 7:00 AM (0700 – 1500; 1500 – 2300; 2300 – 0700).

Table 15: History of Structure Fire Frequency During Selected 8-hour Periods 2016 - 2021

Time Periods	Number of Fires in the Time Period Over Six Years	Historical Frequency of Fires in the Time Period	Historical Frequency of a Structure Fire not Occurring in the time Period
0700 - 1500	51	2.33%	97.67%
1500 - 2300	120	2.30%	97.70%
2300 - 0700	60	5.50%	94.50%

On a daily basis, there has been a 10.5% frequency of structure fire occurrence in any 24-hour period from 2016 to 2021 inclusive.

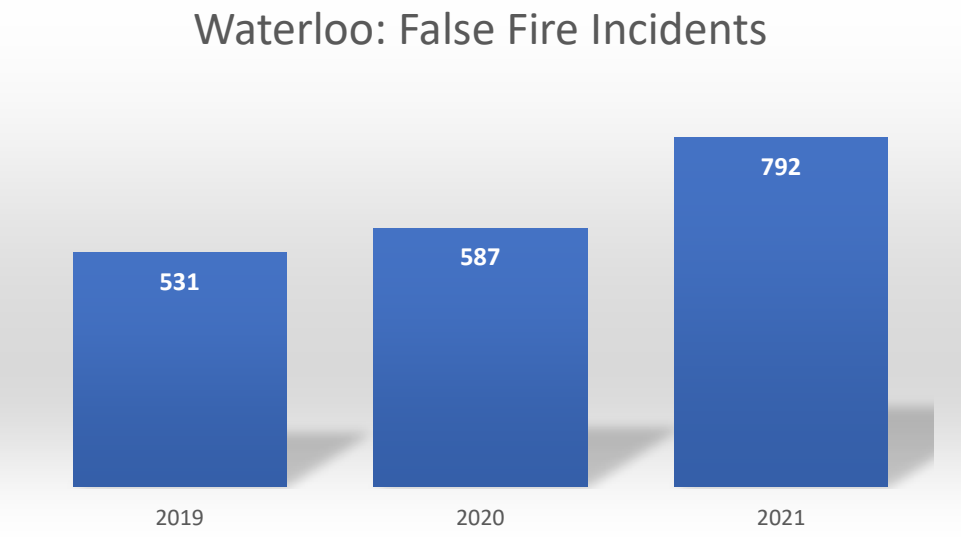
False Fire Calls

The Office of the Ontario Fire Marshal classifies false fire calls as

- Alarm System Equipment - Malfunction
  - Alarm System Equipment – Accidental activation
  - Human - Malicious intent, prank
  - Human - Perceived Emergency
  - Human - Accidental (alarm accidentally activated by person)
  - Other False Fire Call

False fire call data were not available for 2016 – 2018.

Chart 39: False Fire Calls; False Alarms

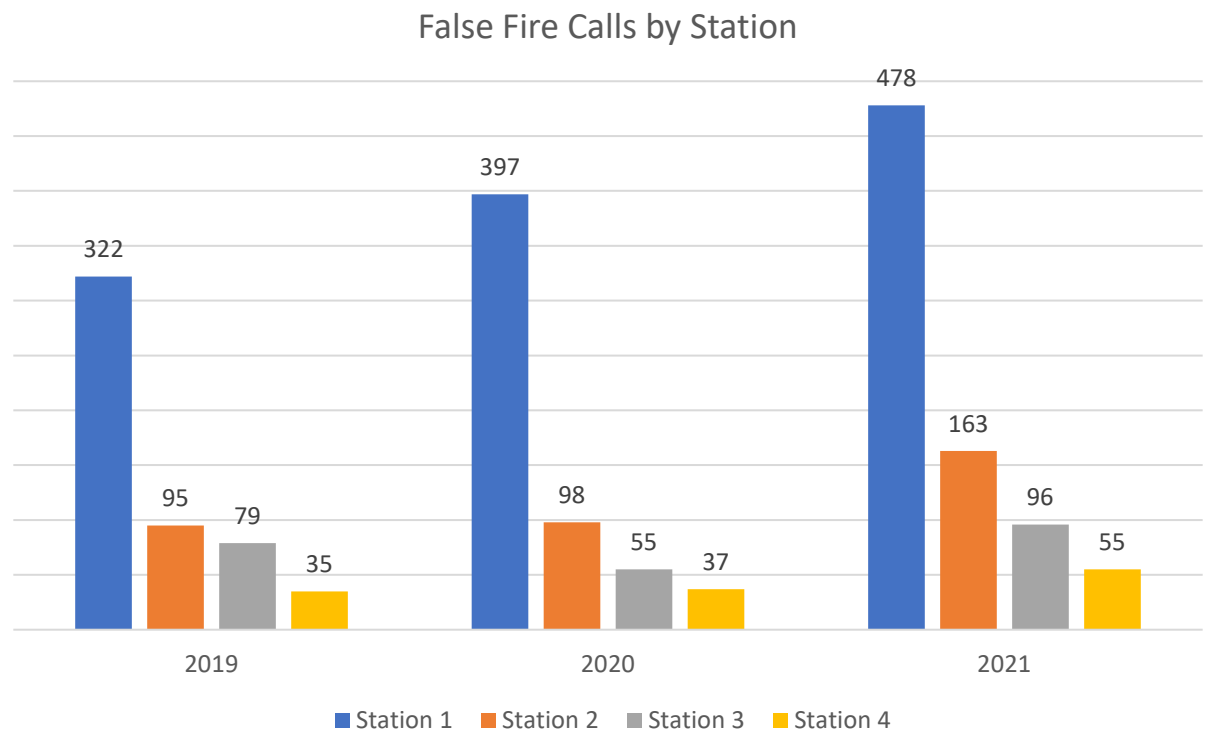


In 2021 there were an average of over 2 false alarms daily.

Of course, alarms are false only after they have been

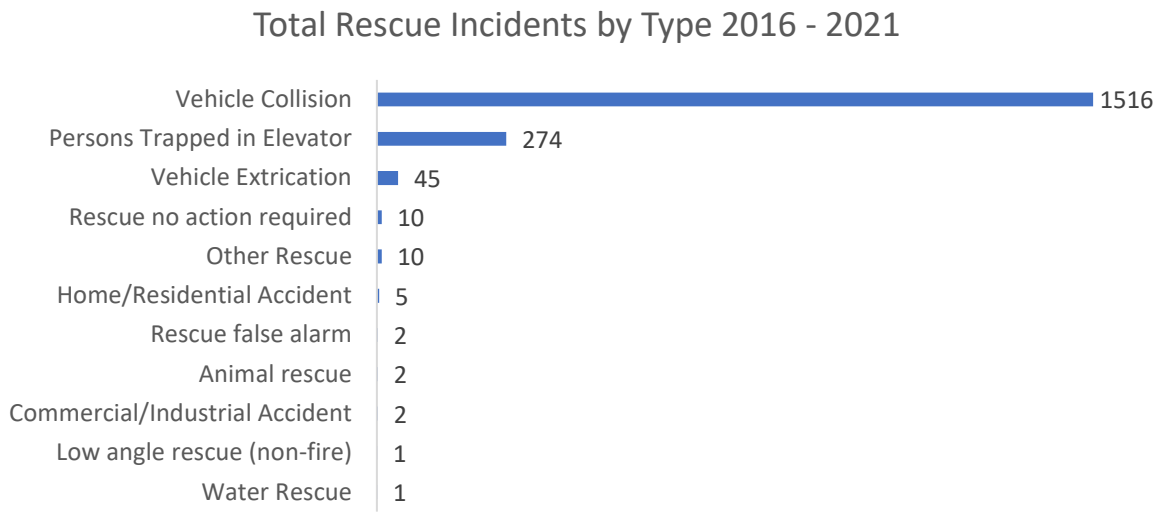
The majority of false fire incidents occur in station 1's area (Chart 40)

Chart 40: False Calls by Fire Station



Rescue Incidents

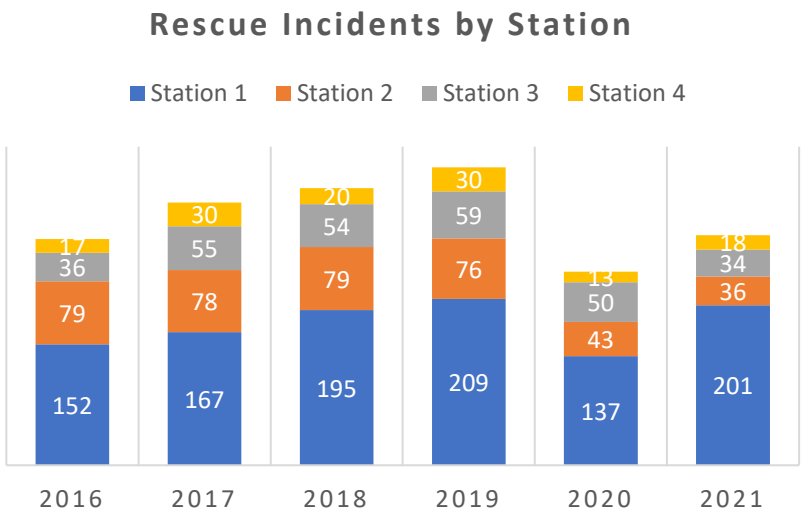
Chart 41: Rescue and Extrication



Rescue incidents, mostly attendance at vehicle collisions, increased from 2016 to 2019, declined in 2020, probably due to COVID influence, and increased again in 2021.

Chart 42: Rescue Incidents by Year

Chart 43: Rescue Incidents by Station



Incidents classified by the Ontario Fire Marshal as rescue and extrication are shown in Chart 42.

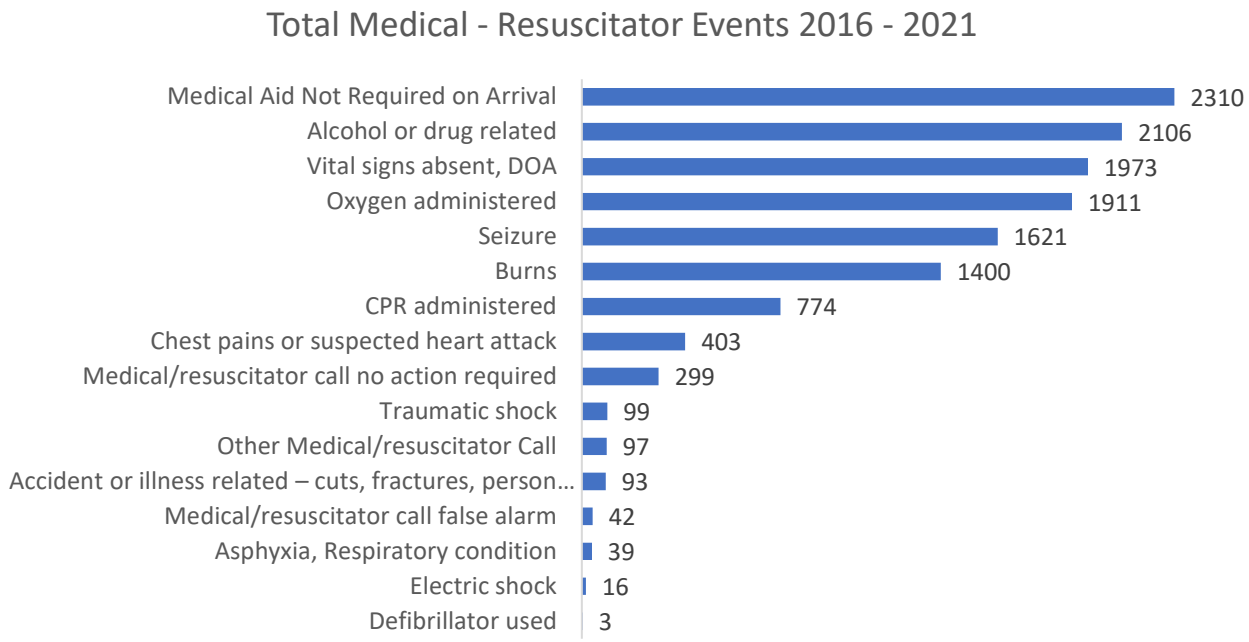
Over the six-year period, 2016 to 2021, 81% of these incidents have been attendance at vehicle collisions. Almost 15% were rescues from elevators, while 2.5% were extrications from vehicles.

Medical - Resuscitator Events

Events classified by the Ontario Fire marshal as medical – resuscitator include

Oxygen administration
CPR administration
Defibrillator used
Asphyxia, Respiratory condition
Seizure
Electric shock
Traumatic shock
Chest pains or suspected heart attack
Burns
Medical Aid Not Required on Arrival
Vital signs absent, DOA
Alcohol or drug related
Accident or illness related – cuts, fractures, person fainted, etc.
Other Medical/resuscitator Call
Medical/resuscitator call no action required
Medical/resuscitator call false alarm

Chart 44: All Medical - Resuscitator Events 2016-2021

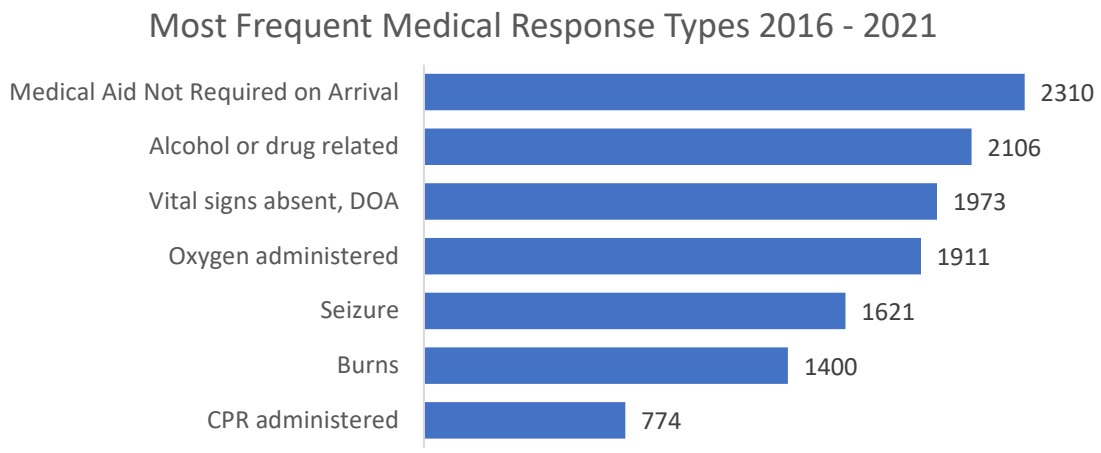


- The greatest number of medical incidents during the six-year period measured was *Medical Aid Not Required on Arrival* which represented 17.5% of total responses.
  - Senior fire department operations staff commented about the high number of 'wave-offs', meaning that Waterloo Fire Rescue was dispatched to a medical incident, but were waved off by paramedics upon fire's arrival to indicate they were not required.
  - Interviews with firefighters revealed that they were experiencing burnout because of call load at station 1.

- Revised response requirements and protocol decisions between Waterloo Fire rescue, the fire dispatch centre, and the Ministry of Health EMS dispatch centre could resolve the 'wave-off' frequency and alleviate overuse of firefighters especially at station 1.

Second to *Not Required* were alcohol or drug related incidents – which is also the response type with the greatest growth (please see Chart 45).

Chart 45: Most Frequent Medical Response Types 2016 – 2021



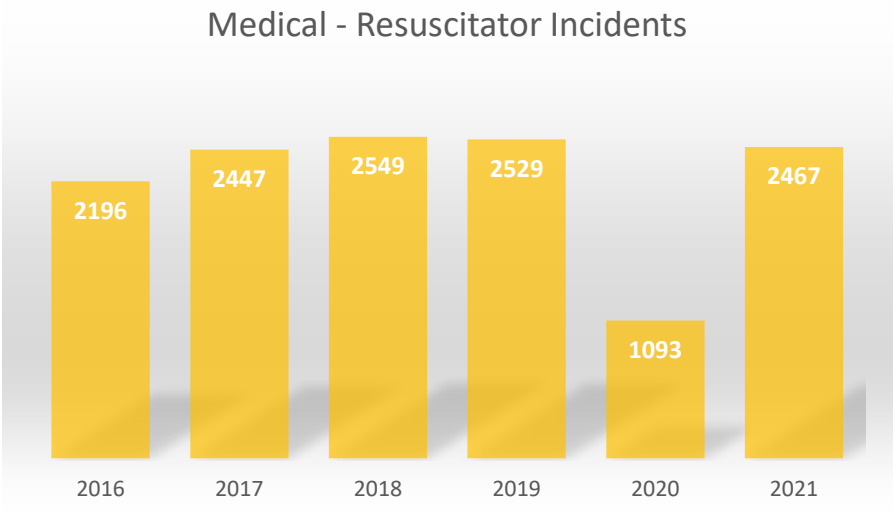
Medical Aid Not Required on Arrival	17.52%
Alcohol or drug related	15.97%
Vital signs absent, DOA	14.96%
Oxygen administered	14.49%
Seizure	12.29%
Burns	10.62%
CPR administered	5.87%

Medical - Resuscitator Event Distribution

Chart 46: Medical – Resuscitator Incidents by Year

Of the 13,281 medical – resuscitator incidents to which Waterloo fire responded between 2016 -2021 43.5% were responded to by station 1,

- 23% by station 2,
- 21% by station 3,



As with other event types, most of the call load occurred in station 1's primary response area.

Chart 47: Medical – Resuscitator Notable Changes

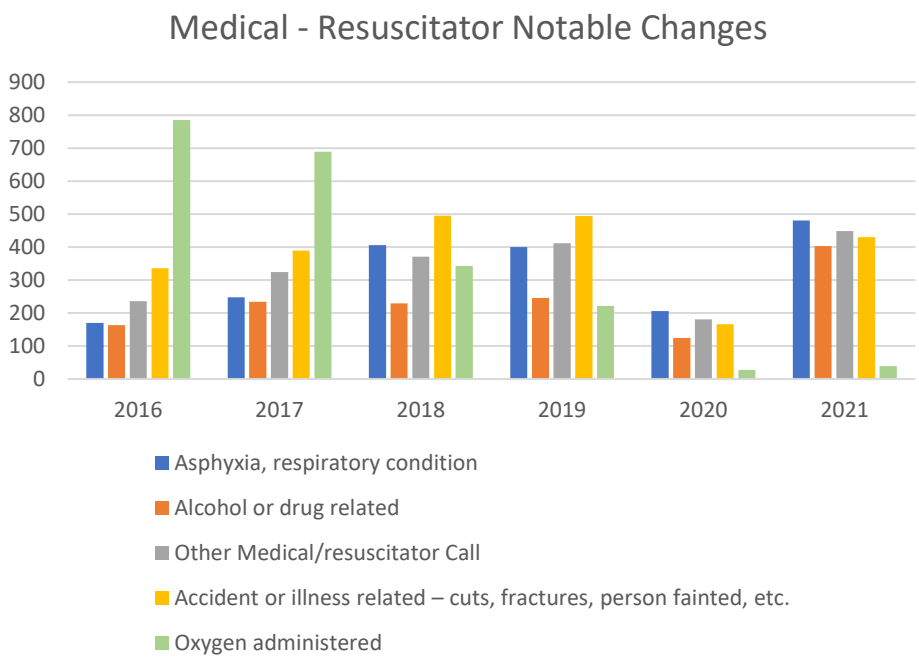


Chart 47 indicates five categories of medical response by Waterloo fire that showed notable changes over the six years examined. Three categories increased, two decreased.

Asphyxia - respiratory, alcohol or drug related, and other medical resuscitator have trended upwards

Cuts, fractures, person fainted – a category to which fire response is able to provide only minimal benefit – did not rebound in 2021 to the volumes experienced in 2019 and earlier.

The *oxygen administered* incident type has declined from almost 800 responses in 2016 to less than 40 in 2021 which may reflect medical guidance that oxygen

Public Hazards

The Office of the Fire Marshal classifies the following incident types as Public Hazards:

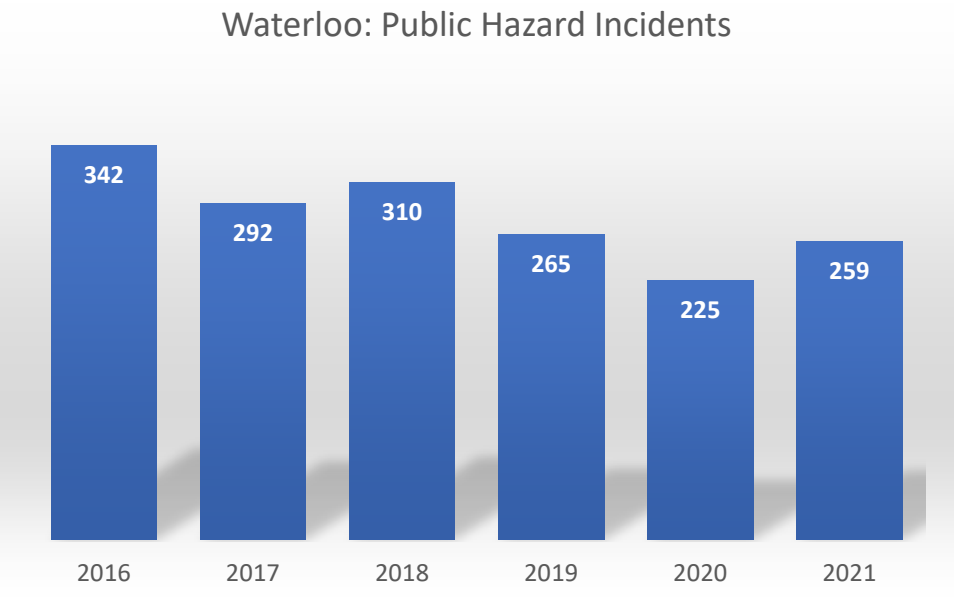
CO incident, CO present (NOT false alarm)
Gas Leak – Natural Gas
Gas Leak – Propane
Gas Leak – Refrigeration
Gas Leak – Miscellaneous
Spill – Gasoline or Fuel
Spill – Toxic Chemical
Spill – Miscellaneous
Radio-active Material Problem
Ruptured Water, Steam Pipe
Power Lines Down, Arcing
Bomb, Explosive Removal, Standby
Suspicious substance
Public Hazard no action required
Public Hazard call false alarm
Other public hazard

We have added to the Public Hazard category,

- CO false alarm – perceived emergency (no CO present)
- CO false alarm – equipment malfunction (no CO present)

These carbon monoxide incidents could have been included in the false alarm category rather than public hazards.

Chart 48: Public Hazard Incidents



Overall, public hazard incidents have been trending lower since 2016 but the majority of public hazard incidents are in station 1's area and they have been trending up (Chart 49).

Chart 49: Public Hazard Incident Distribution by Station

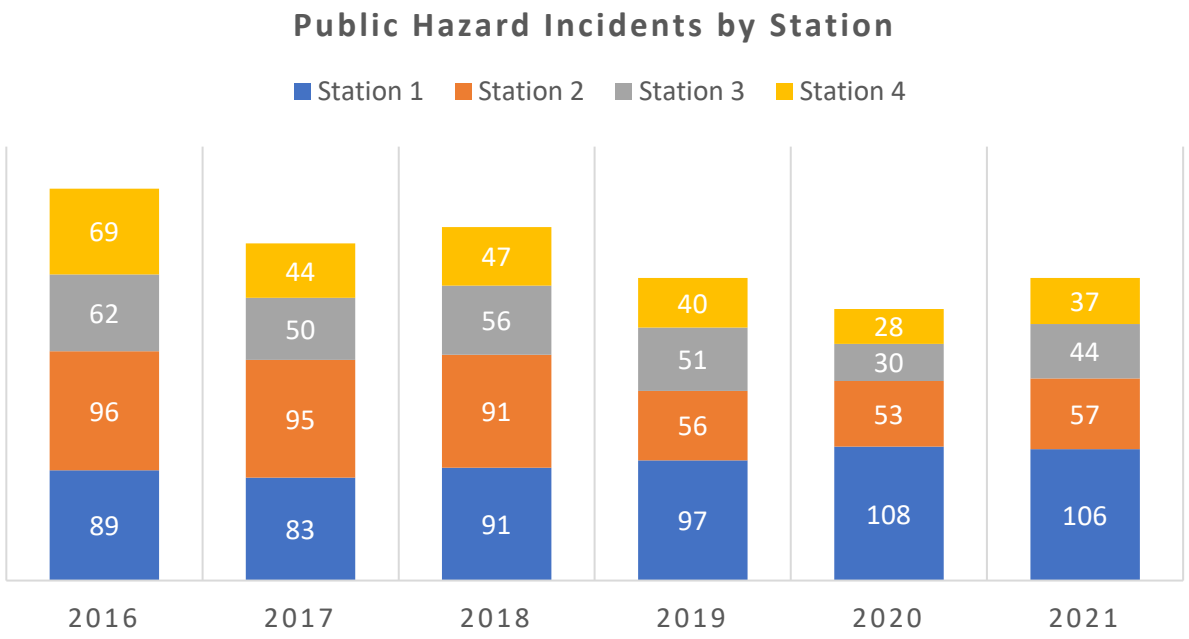


Chart 50: Public Hazard Incidents

The three leading public hazard categories, by call volume, have been false alarms (again, alarms aren't false until confirmed false). In the six years 2016 – 2021 there were also 143 carbon monoxide incidents and 127 gas leaks.

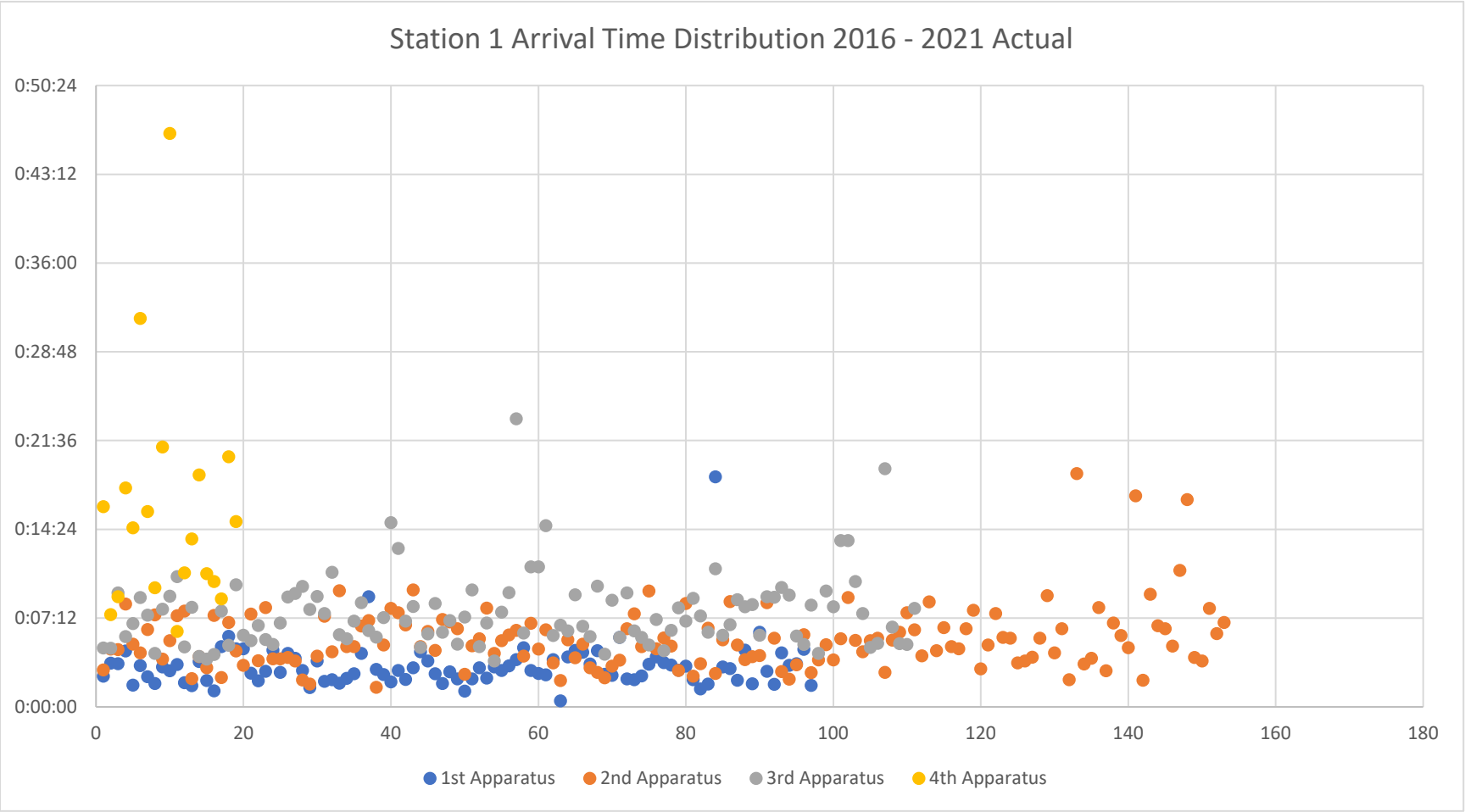
Appendix C Initial Full Alarm Assignment

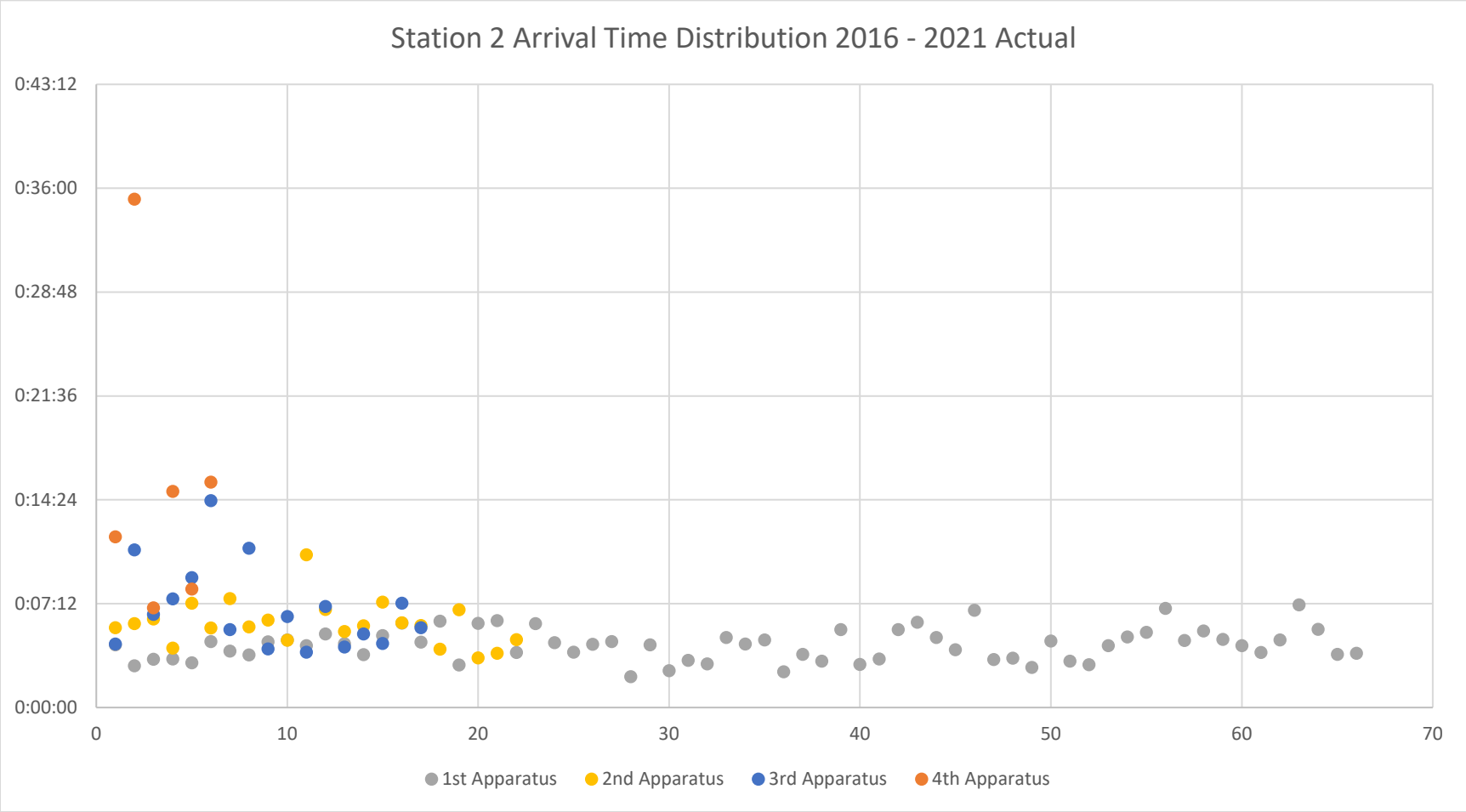
From National Fire Protection Association 1710 for Career Fire Services

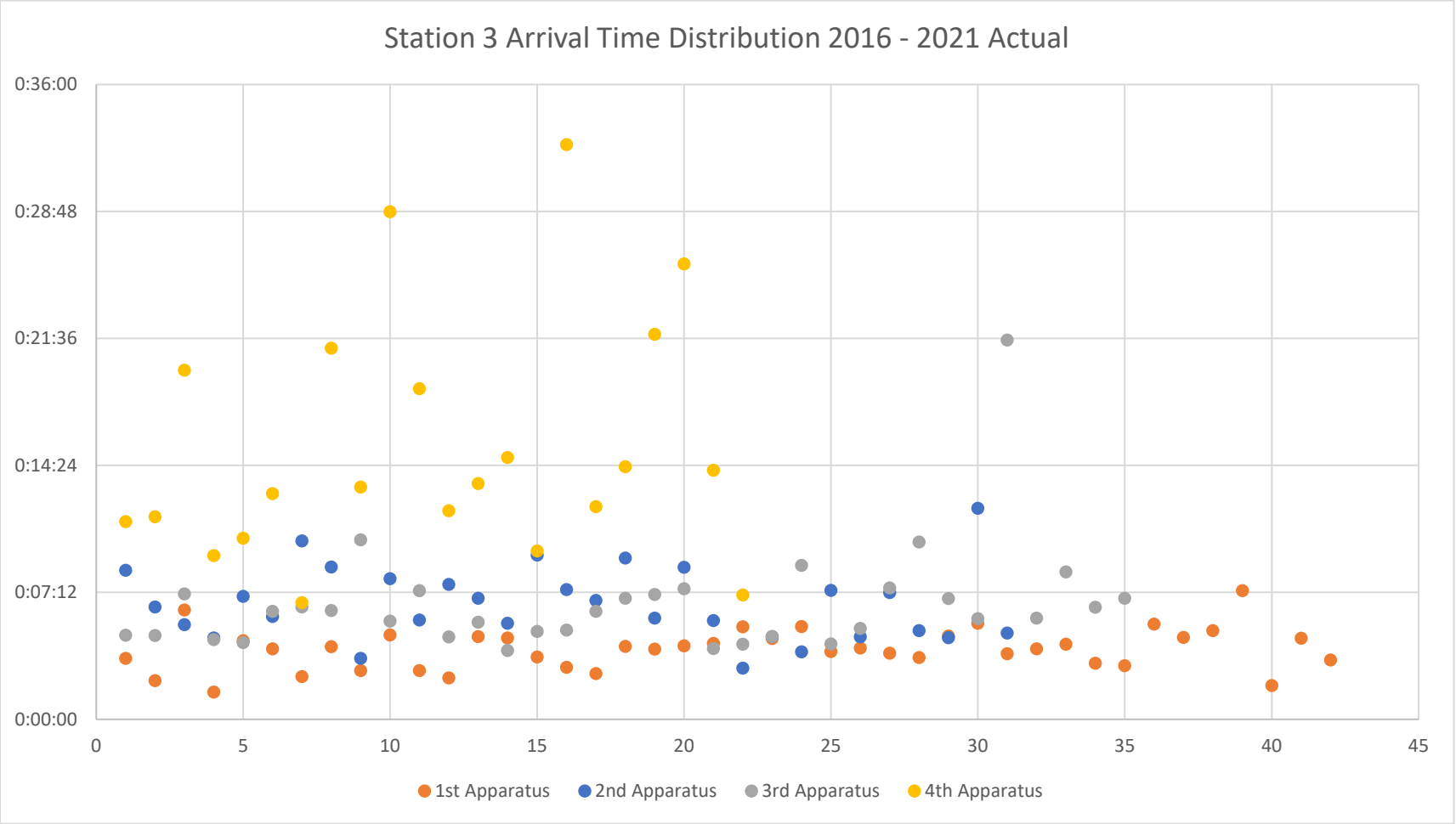
5.2.4 Deployment.
5.2.4.1 Single-Family Dwelling Initial Full Alarm Assignment Capability.
5.2.4.1.1* The initial full alarm assignment to a structure fire in a typical 2000 ft2 (186 m2), two-story single-family dwelling without basement and with no exposures shall provide for the
following:
(1) Establishment of incident command outside of the hazard area for the overall coordination and direction of the initial full alarm assignment with a minimum of one member dedicated to this task (1)
(2) Establishment of an uninterrupted water supply of a minimum of 400 gpm (1520 L/min) for 30 minutes with supply line(s) maintained by an operator (1) (3) Establishment of an effective water flow application rate of 300 gpm (1140 L/min) from two handlines, each of which has a minimum flow rate of 100 gpm (380 L/min) with each handline operated by a minimum of two members to effectively and safely maintain the line (4)
(4) Provision of one support member for each attack and backup line deployed to provide hydrant hookup and to assist in laying of hose lines, utility control, and forcible entry (2)
(5) Provision of at least one victim search and rescue team with each such team consisting of a minimum of two members (2)
(6) Provision of at least one team, consisting of a minimum of two members, to raise ground ladders and perform ventilation (2)
(7) If an aerial device is used in operations, one member to function as an aerial operator to maintain primary control of the aerial device at all times (1)
(8) At a minimum, an initial rapid intervention crew (IRIC) assembled from the initial attack crew and, as the initial alarm response arrives, a full and sustained rapid intervention crew (RIC) established (4)
(9) Total effective response force with a minimum of 16 (17 if an aerial device is used).

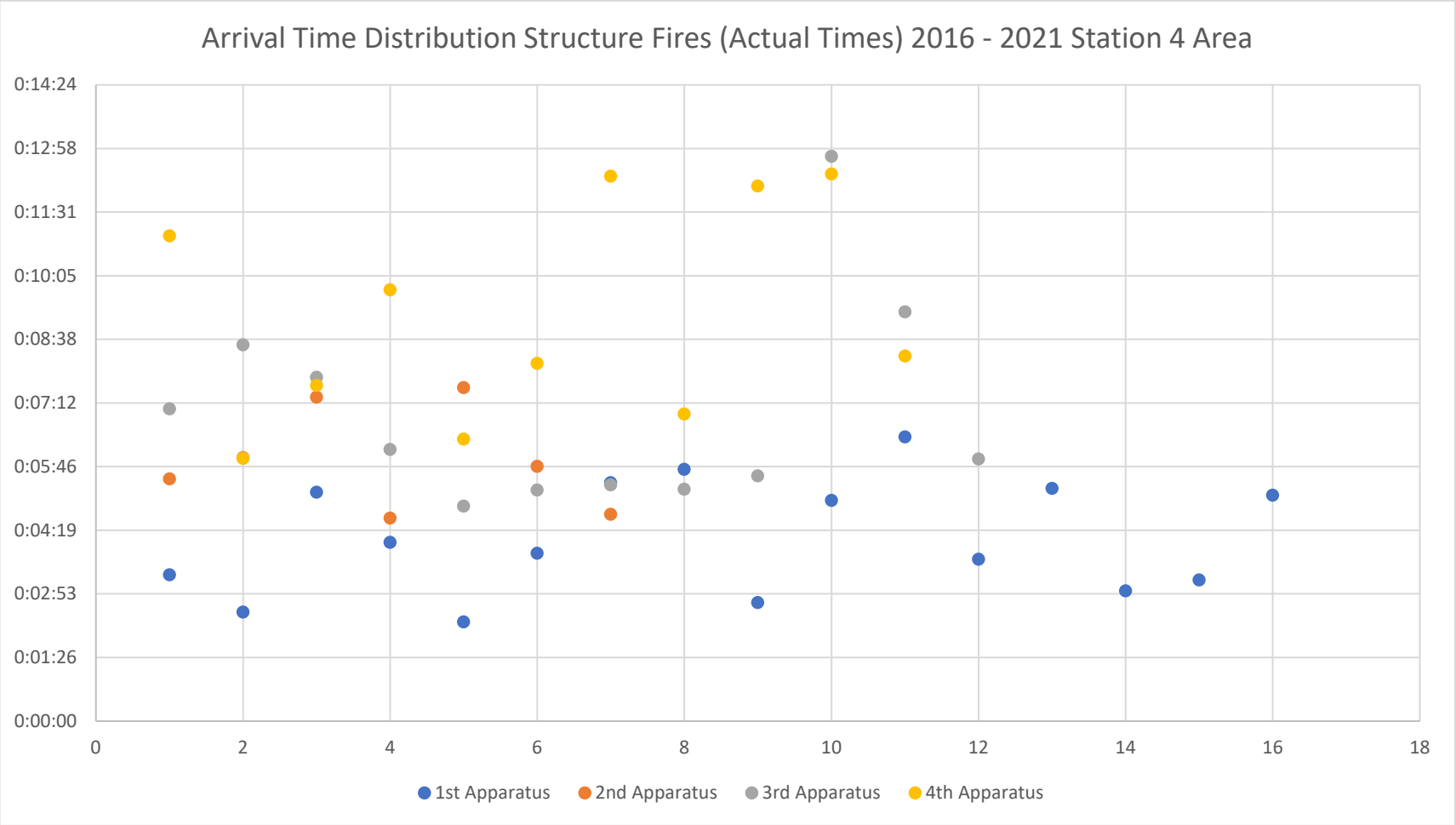
Appendix D Distribution of Driving Times by Station

The four charts in this appendix indicate the arrival times for first, second, third, and fourth apparatus to structure fires, within each station's primary response area, during the period 2016 – 2021. The actual times for each call are represented. The values shown on the horizontal axis represent the number of fire incidents that occurred in each station's area over the six years.

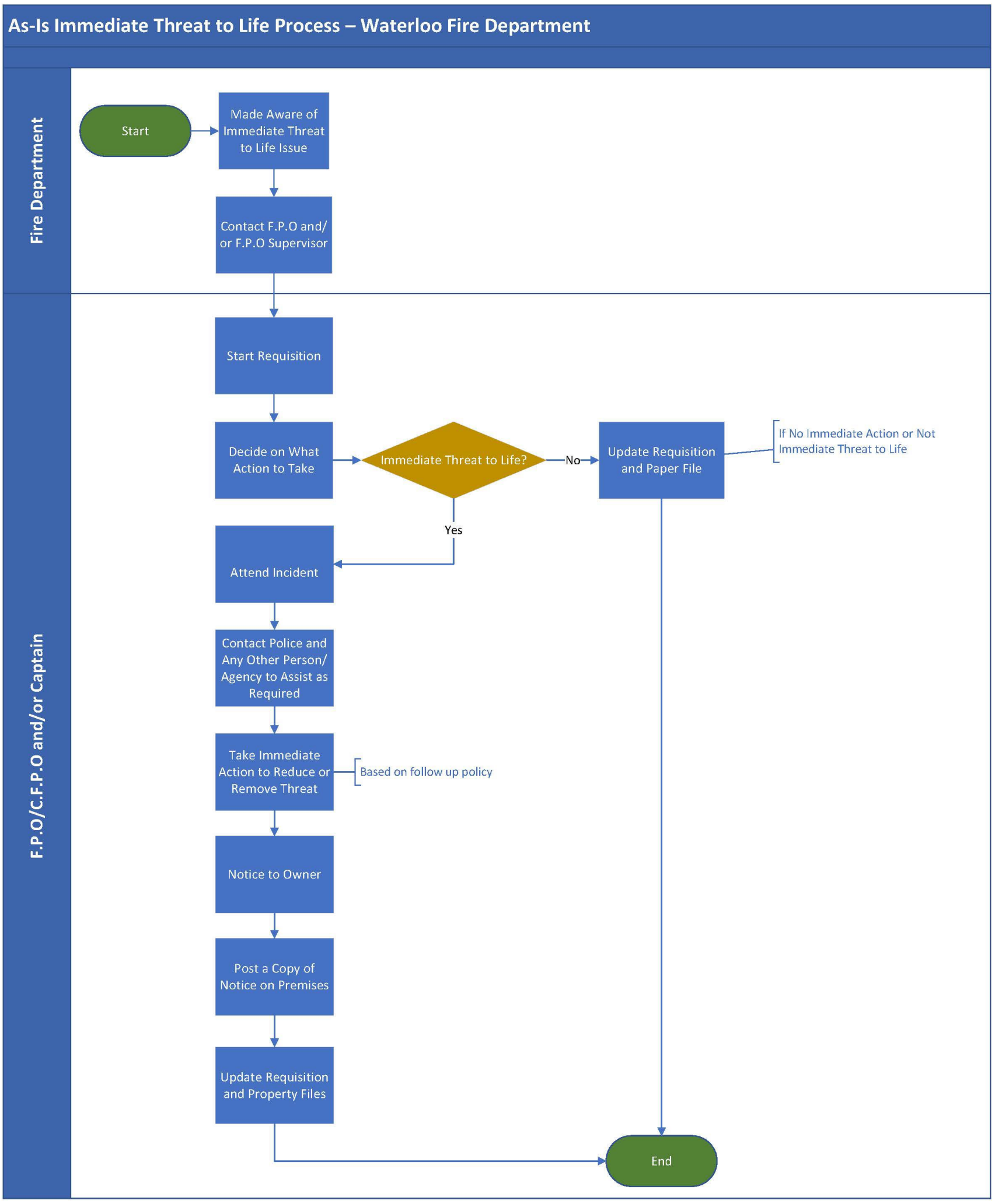

Station 1 Arrival Time Distribution 2016 - 2021 Actual
0:50:24
0:43:12
0:36:00
0:28:48
0:21:36
0:14:24
0:07:12
0:00:00
0
20
40
60
80
100
120
140
160
180
1st Apparatus
2nd Apparatus
3rd Apparatus
4th Apparatus


Station 2 Arrival Time Distribution 2016 - 2021 Actual
0:43:12
0:36:00
0:28:48
0:21:36
0:14:24
0:07:12
0:00:00
0
10
20
30
40
50
60
70
1st Apparatus
2nd Apparatus
3rd Apparatus
4th Apparatus


Station 3 Arrival Time Distribution 2016 - 2021 Actual
0:36:00
0:28:48
0:21:36
0:14:24
0:07:12
0:00:00
0
5
10
15
20
25
30
35
40
45
1st Apparatus
2nd Apparatus
3rd Apparatus
4th Apparatus

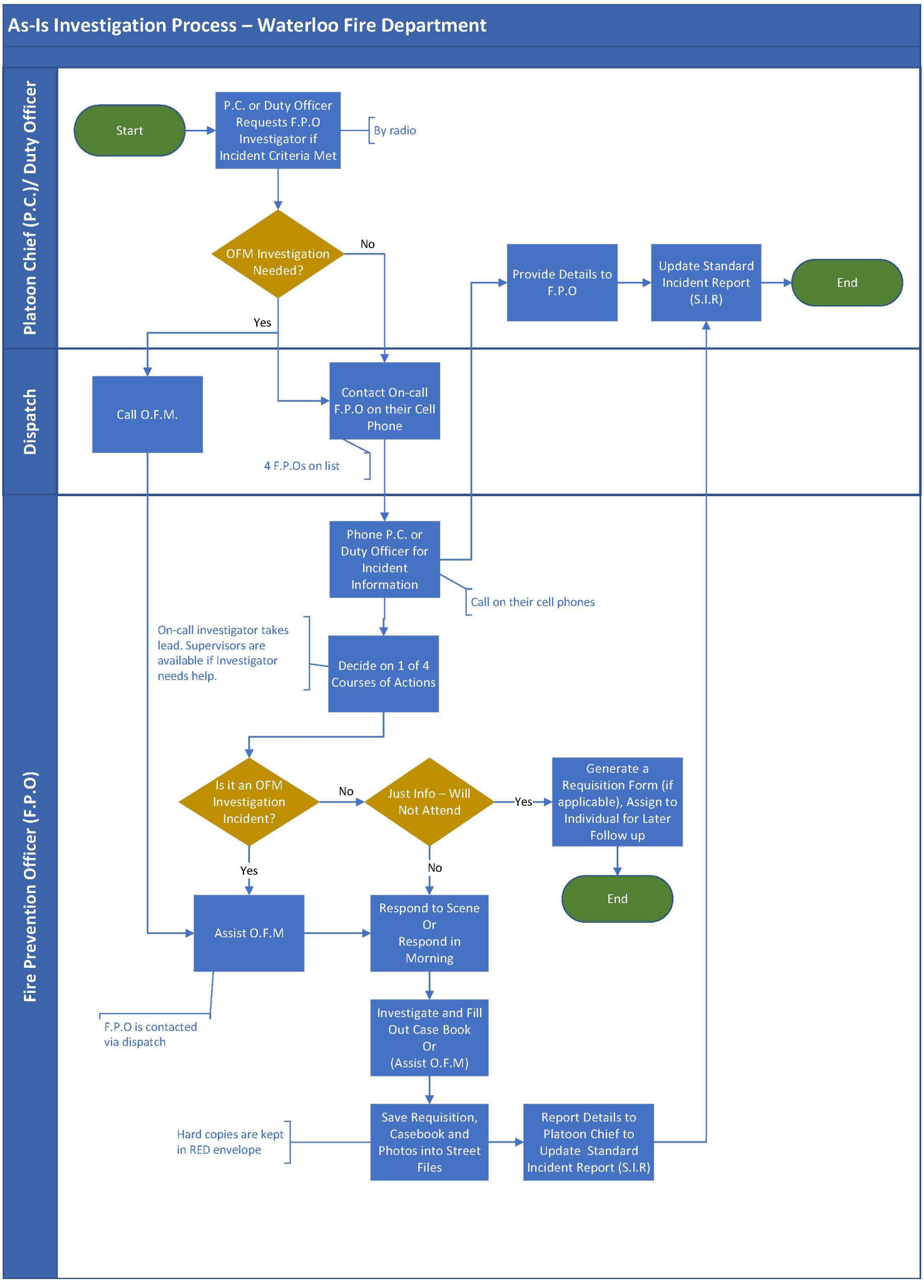

Arrival Time Distribution Structure Fires (Actual Times) 2016 - 2021 Station 4 Area
0:14:24
0:12:58
0:11:31
0:10:05
0:08:38
0:07:12
0:05:46
0:04:19
0:02:53
0:01:26
0:00:00
0
2
4
6
8
10
12
14
16
18
1st Apparatus
2nd Apparatus
3rd Apparatus
4th Apparatus

Appendix E Prevention & Public Education Process Maps



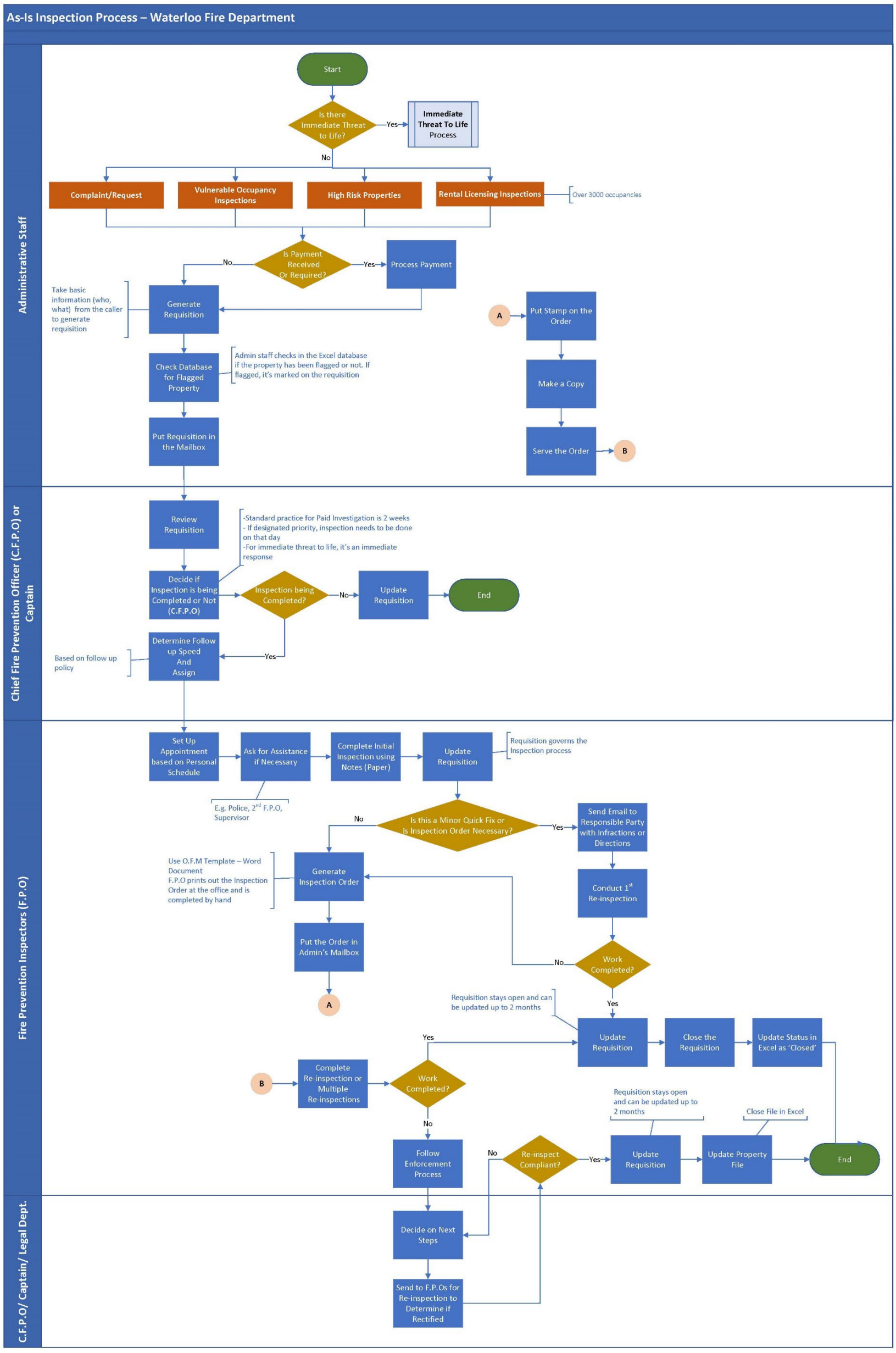
Version 0.2
Date: April 16, 2022

Pomax Inc.



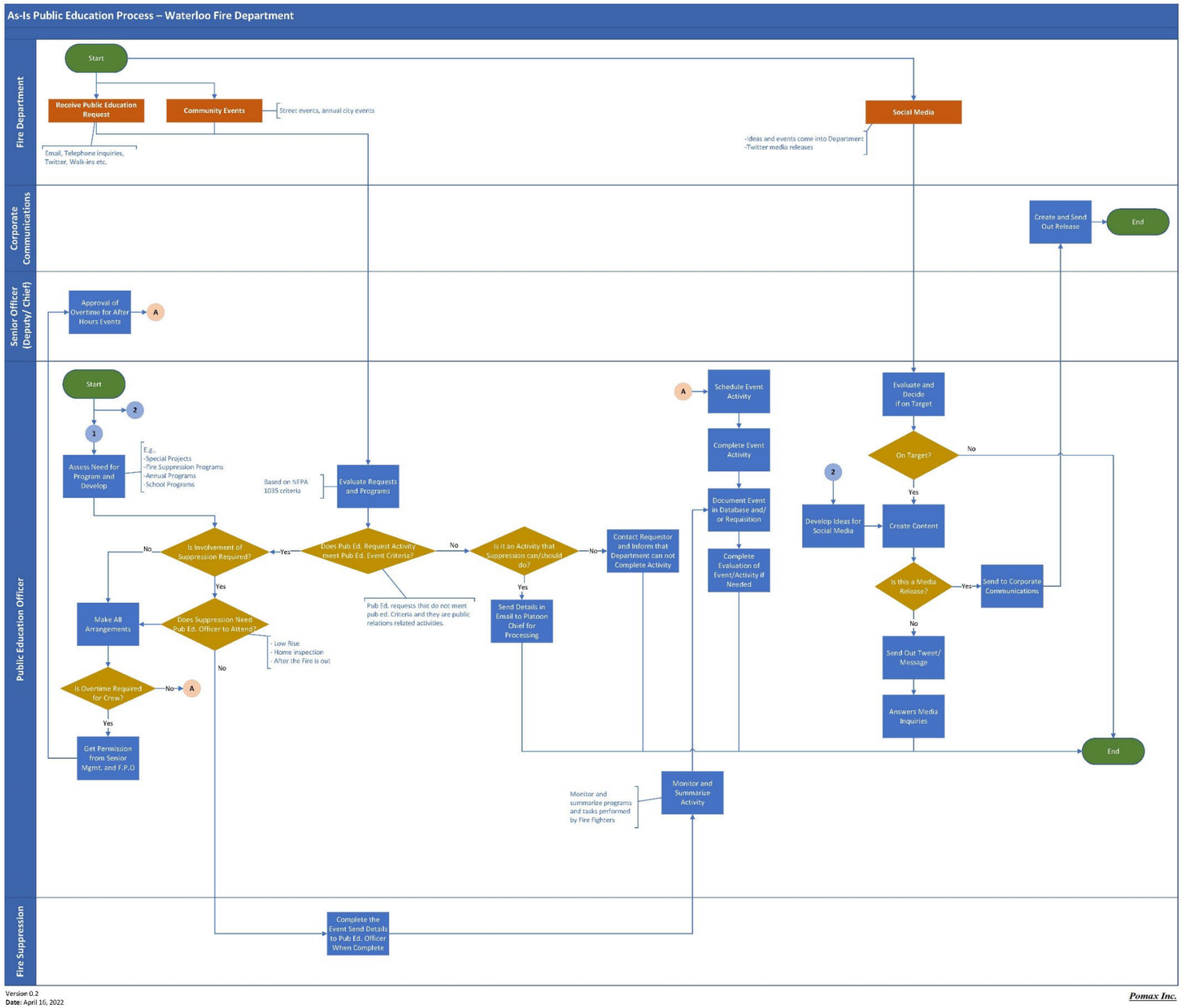
Version 0.2
Date: April 16, 2022

Pomax Inc.



Version 0.2
Date: April 16, 2022

Pomax Inc.


As-Is Public Education Process – Waterloo Fire Department
Fire Department
Corporate Communications
Senior Officer (Deputy/ Chief)
Public Education Officer
Fire Suppression
Start
Receive Public Education Request
Community Events
Street events, annual city events
Email, Telephone inquiries, Twitter, Walk-ins etc.
Social Media
-Ideas and events come into Department
-Twitter media releases
Create and Send Out Release
End
Approval of Overtime for After Hours Events
A
Start
2
1
Assess Need for Program and Develop
E.g.,
-Special Projects
-Fire Suppression Programs
-Annual Programs
-School Programs
Based on NFPA 1035 criteria
Evaluate Requests and Programs
Is Involvement of Suppression Required?
No
Yes
Does Pub Ed. Request Activity meet Pub Ed. Event Criteria?
No
Yes
Pub Ed. requests that do not meet pub ed. Criteria and they are public relations related activities.
Is it an Activity that Suppression can/should do?
No
Yes
Contact Requestor and Inform that Department can not Complete Activity
Send Details in Email to Platoon Chief for Processing
Make All Arrangements
Does Suppression Need Pub Ed. Officer to Attend?
- Low Rise
- Home inspection
- After the Fire is out
No
Yes
Is Overtime Required for Crew?
No
A
Yes
Get Permission from Senior Mgmt. and F.P.O
A
Schedule Event Activity
Complete Event Activity
Document Event in Database and/ or Requisition
Complete Evaluation of Event/Activity if Needed
Monitor and Summarize Activity
Monitor and summarize programs and tasks performed by Fire Fighters
Evaluate and Decide if on Target
On Target?
No
Yes
2
Develop Ideas for Social Media
Create Content
Is this a Media Release?
Yes
No
Send to Corporate Communications
Send Out Tweet/ Message
Answers Media Inquiries
End
Complete the Event Send Details to Pub Ed. Officer When Complete
Version 0.2
Date: April 16, 2022
Pomax Inc.

Appendix F Community Risk Assessment Detail

The City of Waterloo Fire Master Plan Request for Proposal required the consultant to complete a community risk assessment and a risk level matrix which consider the following profiles:

- Geographic,
- Building stock,
- Critical infrastructure,
- Demographics,
- Hazards,
- Public safety response,
- Community services,
- Economics,
- Past loss and event history.

Worksheets relating to this requirement follow below.

The detail and working papers meet the requirements of Ontario Regulation 387/18, Community Risk Assessments, and National Fire Protection Association 1300, *Standard on Community Risk Assessment and Community Risk Reduction Plan Development* which indicates in Annex A that

> *Risk assessment is the first and most critical step toward identifying and prioritizing a community's risks and targeting populations for action. The CRA is a fact-based study of local risks. The CRA is the first step in developing the CRR [*Community Risk Reduction] *Plan. A good assessment will accomplish the following:*
>
> *(1) Identify specific risks affecting a community*
>
> *(2) Locate hidden, hard-to-reach, or underserved populations*
>
> *(3) Identify high-risk occupancies, populations, behaviors, and neighborhoods*
>
> *(4) Build a foundation for the development of goals, objectives, and strategies*
>
> *In the absence of staff and sufficient resources to conduct an in-depth risk assessment, at a minimum an analysis should be conducted of the local data to identify more prevalent incidents.*

The worksheets that follow fulfill the requirement of being a fact-based study of local risks, and the full fire master plan report represents an integrated risk-based analysis which goes beyond what is required by a community risk assessment, and

can be used as quantifiable information to complete a community risk reduction plan and assist the Community Risk Reduction portion noted in National Fire Protection Association 1300.

[i] Modeling Initial Response: Firefighter High-Rise Access Time Simulation; Robert Till, PhD; Christian Regenhard Center for Emergency Response Studies (RaCERS), John Jay College of Criminal Justice of the City University of New York

[ii] The "vertical response time": barriers to ambulance response in an urban area. Acad Emerg Med . 2007 Sep; 14(9):772-8.

[iii] Influence of advanced life support response time on out-of-hospital cardiac arrest patient outcomes in Taipei; Hsuan-An ChenID, Shuo-Ting HsuID, Ming-Ju Hsieh, Shyh-Shyong Sim, Sheng-En Chu, Wen-Shuo Yang, Yu-Chun Chien, Yao-Cheng Wang, Bin-Chou Lee, Edward Pei-Chuan Huang, Hao-Yang Lin, Matthew Huei-Ming Ma, Wen-Chu Chiang, Jen-Tang Sun; PLOS One.

[iv] Improving Out-of-Hospital Cardiac Arrest Survival Rates—Optimization Given Constraints; Kevin G. Volpp, MD, PhD; Benjamin S. Abella, MD, MPhil; Journal of American Medical Association Cardiology online.

[v] Beware a Culture of Busyness; Organizations must stop conflating activity with achievement; Adam Waytz, March – April Issue, Harvard Business Review

[vi] Necessity of Fire Department Response to the Scene of Motor Vehicle Crashes; Deborah L. Funk, MD, NREMT-P, Jonathan F. Politis, BA, NREMT-P,Mara Earlean, MD, And Edward T. Dickinson, Md, NREMT-P

[vii] Can emergency medical dispatch systems safely reduce first-responder call volume? Prehosp Emergency Care, David C Cone, Nicholas Galante, Donald S MacMillan

[viii] Predicting the Need for Extrication in Traffic Accidents Reported to 911: Is Anyone Pinned/Trapped? *Chris Davis, EMD-I; Paige Dodson, MD, MPH, FAAFP; Chad Pore, MS, Paramedic; Sirilakshmi Sangaraju, MS; Meghan Broadbent, MS; Greg Scott, MBA, EMD-Q-I; Isabel Gardett, PhD; Christopher Olola, PhD.*

[ix] Defective Designs in Airbag Technology; From the Forum: University of Tennessee Legal Journal; 2015

[x] A late and failure of airbag deployment case study for drivers of passenger cars in rear-end collisions. George-Radu Toganel and Adrian Ovidiu Soica 2017 IOP Conf. Ser.: Mater. Sci. Eng. 252 012020

[xi] OSHA Hazard Information Bulletins Automobile Air Bag Safety; Safety Hazard Information Bulletin on Automobile Air Bag Safety; August 30, 1990