City of Winnipeg

Fire Underwriters Survey

2014/updated 2018

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Opta Information Intelligence, an SCM Company
3999 Henning Drive
Burnaby, BC V5C 6P9
1-800-665-5661

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1. SCOPE OF OUR ENGAGEMENT

Winnipeg Fire Paramedic Service (WFPS) contracted the services of SCM Opta Information Intelligence Inc. (formerly IAO) to evaluate the community's fire protection programs. The purpose of the assessment is to determine whether the community's current fire insurance grading classifications are representative of the fire protection programs and fire protection resources that are currently in place within the community. A fire insurance grading review is a key part of the assessment process.

The significant findings of the Fire Underwriters Survey fire protection review were requested to be outlined within a report format. The report will provide an update on the City of Winnipeg's fire insurance grading assignments and make recommendations aimed at improving the level of public fire protection and improving fire insurance grading classifications for the City of Winnipeg.

At the request of WFPS, specific items concerning optimizing levels of service and providing various cost benefit analyses are considered in this report.

1.1. Acknowledgement

Opta Information Intelligence Inc. wishes to thank Winnipeg Fire Paramedic Service and the City of Winnipeg for their valuable assistance in conducting this survey and preparation of this report.

1.2. Distribution of Use

This report, along with the findings and conclusions, contained herein, is intended for the sole use of Winnipeg Fire Paramedic Service to assist in the public fire protection planning needs of the community.

Judgements about the conclusions drawn, and opinions presented in this report should be made only after considering the report in its entirety. This report is Private and Confidential and is intended for the exclusive use of Winnipeg Fire Paramedic Service.

1.3. Reliance and Limitation

We have relied on the general accuracy of information provided by stakeholders without independent verification. However we have reviewed this information for consistency and reasonableness. The accuracy of our conclusions is dependent upon the accuracy and completeness of this underlying data. Therefore, any discrepancies discovered in this data by the reader should be reported to us and this report amended accordingly, as warranted.

2. EXECUTIVE SUMMARY

This report covers a Fire Insurance Grading review update for the City of Winnipeg. The review covers the 4 areas of the Fire Insurance Grading assessment, i.e. Fire Department, Water Supplies, Fire Safety Control, and Emergency Communications. Additional analysis has been completed related to impacts of traffic pre-emption systems and fire hall location analysis as it relates to Fire Insurance Grading. Recommendations concerning the items reviewed have been provided in order to improve or maintain credit. Each of the 4 areas have been assigned a relative classification which is based on a 1 to 10 scale (1 being the highest). A summary of the relative classifications is provided in the following table:

Area of Grading	Relative Classifications 2014
Fire Department	3
Water Supply	2
Fire Safety Control	4
Fire Service Communications	1

The final Public Fire Protection Classification (PFPC) is based on the relative classifications and is also on a 1 to 10 scale (1 being the highest). The final overall PFPC calculated for the City of Winnipeg is PFPC 3. Additionally, a Dwelling Protection Grade (DPG) 1 has been maintained for the City.

All items assessed during the Fire Insurance Grading review are discussed throughout the report with recommendations provided considering improving or maintaining credit within the Grading. The currently published PFPC Grade for the City of Winnipeg (PFPC 2) will be maintained provisionally to allow the City time to respond to the recommendations. Should the City wish to maintain the currently published PFPC 2 a formal letter should be provided to the Fire Underwriters Survey within 12 months committing to implementing some of the recommendations (notably those concerned with Fire Safety Control and pre-incident planning). If the City prefers to not implement recommendations the Fire Underwriters Survey should be advised and the updated PFPC 3 will be published to the Fire Insurance Grading Index for the City of Winnipeg.

3. TERMS OF REFERENCE

Term	Definition
Aerial Fire Apparatus.	A vehicle equipped with an Aerial ladder, elevating platform, Aerial ladder platform, or water Tower that is designed and equipped to support firefighting and rescue operations by positioning personnel, handling materials, providing continuous egress, or discharging water at positions elevated from the ground.
Aid - Automatic Aid	A plan developed between two or more fire departments for immediate joint response on first alarms. This process is accomplished through simultaneous dispatch, documented in writing, and included as part of a communication center's dispatch protocols.
Aid - Mutual Aid	Reciprocal assistance by emergency services under a prearranged plan. This is part of the written deployment criteria for response to alarms, as dispatched by the communications center.
Basic Fire Flow	The value which represents the fire potential of most large properties in the municipality, but may exclude several of the largest properties not considered as usual to the municipality. Normally, the value used as the Basic Fire Flow will not be the peak required fire flow in the municipality. The Basic Fire Flow is the benchmark against which all protective facilities are measured.
Building	Any structure used or intended for supporting or sheltering any use or occupancy.
Building area	The greatest horizontal area of a building above grade within the outside surface of exterior walls or within the outside surface of exterior walls and the centre line of firewalls.
Building height	The number of storeys contained between the roof and the floor of the first storey.
Built Environment	Buildings and structures: human-made buildings and structures, as opposed to natural features.
Classification Standard for Public Fire Protection	Fire risk rating schedule applied by the FUS to public fire protection in Canada. The Schedule applies various processes of modelling and scoring to produce a value representing public fire protection services relative to fire risk.
Combustible	A material fails to meet the acceptance criteria of CAN4-S114, “Determination of Non-Combustibility in Building Materials.”
Commercial Lines Insurance	A distinction marking property and liability coverage written for business or entrepreneurial interests (includes institutional, industrial, multi-family residential and all buildings other than detached dwellings that are designated single family residential or duplex) as opposed to Personal Lines.
Community - Major or Large	An incorporated or unincorporated community that has: • a populated area (or multiple areas) with a density of at least 400 people per square kilometer; AND • a total population of 100,000 or greater.
Community - Medium	An incorporated or unincorporated community that has: • a populated area (or multiple areas) with a density of at least 200 people per square kilometer; AND/OR • a total population of 1,000 or greater.
Community - Small	An incorporated or unincorporated community that has: • no populated areas with densities that exceed 200 people per square kilometer; AND • does not have a total population in excess of 1,000.
Company	A group of members that is (1) under the direct supervision of an officer or leader;

	(2) trained and equipped to perform assigned tasks; (3) usually organized and identified as engine companies, ladder companies, rescue companies, or squad companies; (4) usually operates with one piece of fire apparatus (Pumper, ladder truck, elevating platform, rescue, squad, ambulance); and (5) arrives at the incident scene on fire apparatus or assembles at the scene prior to assignment. The term company is synonymous with company unit, response team, and response group.
Demand Zone Levels	An area used to define or limit the management of a risk situation. A demand zone can be a single building or a group of buildings. It is usually defined in terms of geographical boundaries, called fire management areas or fire management zones.
Detached Dwelling	Buildings containing not more than two dwelling units in which each dwelling unit is occupied by members of a single family with not more than three outsiders, if any, accommodated in rented rooms. Aka. One- and Two-Family Dwelling
Dwelling Protection Grade (DPG)	The fire insurance grade or grades utilized by Personal Lines Insurers in Canada. The DPG is a number between 1 and 5 that is calculated by comparing the fire risk in terms of require fire flows to available resources. Unlike the PFPC system, within the DPG system, the benchmark required fire flow is a constant, and is typical for a Detached Dwelling. The DPG for communities across Canada is determined from a basic survey of the available resources related to fire risk reduction and fire protection capacity.
Dwelling, Typical	Refers to One- and Two-Family Detached Dwellings: - with no structural exposures (buildings with an area exceeding 9.3 sq.m) within 3 m; - with no unusual fire risks (such as wood shake roofs); AND - with an effective area (all storeys excluding basements) not exceeding 334 sq.m (3,600 sq.ft).
Emergency Dispatch Protocol	A standard sequence of questions used by telecommunicators that provides post-dispatch or pre-arrival instructions to callers.
Emergency Incident	Any situation to which the emergency services organization responds to deliver emergency services, including rescue, fire suppression, emergency medical care, special operations, law enforcement, and other forms of hazard control and mitigation.
Emergency Response Facility (ERF)	A structure or a portion of a structure that houses emergency response agency equipment or personnel for response to alarms. Examples of ERFs include a fire Hall, a police Hall, an ambulance Hall, a rescue Hall, a ranger Hall, and similar facilities.
Emergency	A condition that is endangering or is believed to be endangering life or property; an event that requires the urgent response of an emergency response agency.
Engine	A fire department Pumper having a rated capacity of 2840 L/min (625 Igpm) or more.
Exposing building face	That part of the exterior wall of a building which faces one direction and is located between ground level and the ceiling of its top storey or, where a building is divided into fire compartments, the exterior wall of a fire compartment which faces one direction.
Exposure	The heat effect from an external fire that might cause ignition of, or damage to, an exposed building or its contents.
Fire Apparatus	A fire department emergency vehicle used for rescue, fire suppression, or other specialized functions.
Fire Department Vehicle	Any vehicle, including fire apparatus, operated by a fire department.

Fire Department	A fire department is a group of persons formally organized as an authorized service of a municipal or other local government having a sustainable source of funding, which could include taxation, fees for services provided, contracts, permit fees or other reliable sources of revenue which will support the cost of services provided. A minimum number of trained persons able and equipped to respond with motorized firefighting apparatus to extinguish fires or to respond to other classes of circumstances which may occur within a designated geographical area.
Fire Department. - Public Fire Department	A legally formed organization providing rescue, fire suppression, emergency medical services, and related activities to the public.
Fire Force, Available	A measure of the human resources that are available to participate in firefighting operations on the fire ground or an equivalent measure.
Fire Force, Required	A measure of the human resources that are needed to participate in firefighting operations on the fire ground (or an equivalent measure) for an ideal response based on the required fire flow, number of companies and average response time as specified in the Table of Effective Response.
Fire Flow	The flow rate of a water supply, measured at 20 psi (137.9 kPa) residual pressure that is available for firefighting.
Fire Growth Potential	The potential size or intensity of a fire over a period of time based on the available fuel and the fire's configuration.
Fire Hall	An "emergency response facility" where fire department apparatus and equipment are housed, protected against harm, and made readily accessible for use in emergencies. The Fire Hall is normally the location where Firefighters respond from. Other primary purposes include training and administration of the fire department.
Fire Hydrant	A reliable connection to a water main for the purpose of supplying water efficiently and reliably to fire hose or other fire protection apparatus. To be recognized for Fire Insurance Grading purposes, the device shall be designed and installed in accordance with CAN/ULC S520, UL 246 and/or AWWA C502/C503 and listed for use as a fire hydrant by UL and/or ULC.
Fire Hydrant – Public	A fire hydrant situated and maintained for public use on a public right-of-way (or easement) to provide water for use by the fire department in controlling and extinguishing fires. The location of a public fire hydrant is such that it is accessible for immediate and unrestricted use by the fire department at all times. Public fire hydrants are owned and maintained by the government entity (ex. city, village, etc.) which is responsible for maintaining the hydrants and water supply distribution system in operating condition at all times and is authorised to levy taxes to fund the operation and maintenance programs.
Fire Hydrant – Private	A fire hydrant located on privately owned property, or on streets not dedicated to public use. Although a private fire hydrant may be connected to a public water supply system, maintenance of the hydrant and access to the hydrant are the responsibility of the property owner. Private hydrants are normally required where buildings are so located on the property or are of such size and configuration that a normal hose lay from a public hydrant would not reach all points on the outside of the building.
Fire load	(as applying to an occupancy) The combustible contents of a room or floor area expressed in terms of the average weight of combustible materials per unit area, from which the potential heat liberation may be calculated based on the calorific value of the materials, and includes the furnishings, finished floor, wall and ceiling finishes, trim and temporary and movable partitions.
Fire Protection	Methods of providing fire detection, control, and extinguishment.
Fire Suppression	The activities involved in controlling and extinguishing fires. Fire suppression includes all activities performed at the scene of a fire or training

	exercise that expose fire department members to the dangers of heat, flame, smoke, and other products of combustion, explosion, or structural collapse.
First Responder (EMS)	Functional provision of initial assessment (airway, breathing, and circulatory systems) and basic first aid intervention, including CPR and automatic external defibrillator (AED) capability. A first responder assists higher level EMS providers.
First Storey	The uppermost storey having its floor level not more than 2 m above grade
Grade	(as applying to the determination of building height) The lowest of the average levels of finished ground adjoining each exterior wall of a building, except that localized depressions such as for vehicle or pedestrian entrances need not be considered in the determination of average levels of finished ground.
Hazard	The potential for harm or damage to people, property, or the environment. Hazards include the characteristics of facilities, equipment systems, property, hardware, or other objects, and the actions and inactions of people that create such hazards.
Hazardous Material	A substance (solid, liquid, or gas) that when released is capable of creating harm to people, the environment, and property.
Incident Commander.	The person who is responsible for all decisions relating to the management of the incident and is in charge of the incident site.
Incident Management System (IMS)	An organized system of roles, responsibilities, and standard operating procedures used to manage emergency operations. Such systems are also referred to as incident command systems (ICS).
Initial Attack	An aggressive suppression action consistent with fire fighter and public safety and values to be protected.
Initial Attack Apparatus	Fire apparatus with a permanently mounted fire pump of at least 250 USgpm (950 L/min) capacity, water tank, and hose body whose primary purpose is to initiate a fire suppression attack on structural, vehicular, or vegetation fires, and to support associated fire department operations.
Ladder Company	A fire department company that is provided with an Aerial fire apparatus and is trained and equipped to support firefighting and rescue operations by positioning personnel, handling materials, providing continuous egress, or discharging water at positions elevated from the ground.
Ladder Truck	An alternate name for Aerial Fire Apparatus.
Master Stream	A portable or fixed firefighting appliance supplied by either hose lines or fixed piping and that has the capability of flowing in excess of 300 USgpm (1140 L/min) of water or water based extinguishing agent.
Member	A person involved in performing the duties and responsibilities of a fire department, under the auspices of the organization. A fire department member can be a full-time or part-time employee or a paid or unpaid volunteer, can occupy any position or rank within the fire department, and can engage in emergency operations.
Mobile Water Supply (Tanker)	A vehicle designed primarily for transporting (pickup, transporting, and delivery) water to fire emergency scenes to be applied by other vehicles or pumping equipment.
Non-combustible	A material that meets the acceptance criteria of CAN4-S114, “Determination of Non-Combustibility in Building Materials.”
Non-combustible construction	The type of construction in which a degree of fire safety is attained by the use of non-combustible materials for structural members and other building assemblies.

Non-combustible Material	A material, as defined in NFPA 220, Standard on Types of Building Construction, that, in the form in which it is used and under the conditions anticipated, will not ignite, burn, support combustion, or release flammable vapours when subjected to fire or heat. Materials reported as non-combustible, when tested in accordance with ASTM E 136, Standard Test Method for Behaviour of Materials in a Vertical Tube Furnace at 750°C, are considered non-combustible materials.
Officer	
Officer - Company Officer	A supervisor of a crew/company of personnel. This person could be someone appointed in an acting capacity. The rank structure could be either sergeant, lieutenant, or captain.
Officer - Incident Safety Officer	An individual appointed to respond or assigned at an incident scene by the incident commander to perform the duties and responsibilities of that position as part of the command staff.
Officer - Supervisory Chief Officer	A member whose responsibility is above that of a company officer, who responds automatically and/or is dispatched to an alarm beyond the initial alarm capabilities, or other special calls. In some jurisdictions, this is the rank of battalion chief, district chief, deputy chief, assistant chief, or senior divisional officer (UK fire service). The purpose of their response is to assume command, through a formalized transfer-of-command process, and to allow company officers to directly supervise personnel assigned to them.
One- and Two-Family Dwelling	Buildings containing not more than two dwelling units in which each dwelling unit is occupied by members of a single family with not more than three outsiders, if any, accommodated in rented rooms.
Optimum Level of Fire Protection	The combination of firefighting staff and apparatus that delivers a suppression effort commensurate with the fire demand faced, yet representing the most efficient use of resources in a safe and effective manner.
Peak Fire Flow	All buildings and building groups within a District or Municipality, the highest calculated required fire flow.
Personal Lines Insurance	Insurance covering the liability and property damage exposures of private individuals and their households as opposed to Commercial Lines. Typically includes all detached dwellings that are designated single family residential or duplex.
Personal Protective Clothing	The full complement of garments Firefighters are normally required to wear while on emergency scene, including turnout coat, protective trousers, fire-fighting boots, fire-fighting gloves, a protective hood, and a helmet with eye protection.
Personal Protective Equipment	Consists of full personal protective clothing, plus a self-contained breathing apparatus (SCBA) and a personal alert safety system (PASS) device.
Public Fire Department	An organization providing rescue, fire suppression, emergency medical services, and related activities to the public.
Public Fire Protection Classification	The fire insurance grade or grades utilized by Commercial Lines Insurers in Canada. The PFPC is a number between 1 and 10 that is calculated by comparing the fire risk in terms of require fire flows to available resources. The PFPC for communities across Canada is determined from an extensive survey and analysis of the fire risk in the built environment and the available resources related to fire risk reduction and fire protection capacity.
Public Fire Service Communications Center	The building or portion of the building used to house the central operating part of the fire alarm system; usually the place where the necessary testing, switching, receiving, transmitting, and power supply devices are located.
Public Safety Answering Point	A facility in which 9-1-1 calls are answered.

Pumper	Fire apparatus with a permanently mounted fire pump of at least 750 USgpm (2850 L/min or 625 Igpm) capacity, water tank, and hose body whose primary purpose is to combat structural and associated fires.
Quint	Fire apparatus with a permanently mounted fire pump, a water tank, a hose storage area, an Aerial ladder or elevating platform with a permanently mounted waterway, and a complement of ground ladders. The primary purpose of this type of apparatus is to combat structural and associated fires and to support fire-fighting and rescue operations by positioning personnel-handling materials, providing continuous egress, or discharging water at positions elevated from the ground.
Required Fire Flow	The rate of water flow, at a residual pressure of 20 psi (138 kPa) and for a specified duration, that is necessary to confine and control a major fire in a specific building or group of buildings which comprise essentially the same fire area by virtue of immediate exposure. This may include as much as a city block.
Storey	That portion of a building which is situated between the top of any floor and the top of the floor next above it, and if there is no floor above it, that portion between the top of such floor and the ceiling above it.
Wildland/Urban Interface	The line, area, or zone where structures and other human development meet or intermingle with undeveloped wildland or vegetative fuels.

4. FIRE UNDERWRITERS SURVEY

FUS is a national organization that represents more than 85 percent of the private sector property and casualty insurers in Canada. FUS provides data to program subscribers regarding public fire protection for fire insurance statistical and underwriting evaluation. It also advises municipalities if they desire to review the current levels of fire protection in the community and provide direction with recommendations where improvements will enable them to better deal with fire protection problems.

FUS offices maintain data from surveys on fire protection programs for all incorporated and unincorporated areas across Canada. The results of these surveys are used to establish the Public Fire Protection Classification (PFPC) and Dwelling Protection Grade (DPG) for each community. The PFPC and DPG is also used by underwriters to determine the amount of risk they are willing to assume in a given community or section of a community.

The overall intent of the grading systems is to provide a measure of the ability of the protective facilities within a community to prevent and control major fires that may be expected to occur by evaluating in detail the adequacy, reliability, strength and efficiency of these protective facilities.

4.1. Fire Insurance Grading Classifications

Public Fire Protection Classification (PFPC):

> The PFPC is a numerical grading system scaled from 1 to 10. Class 1 is the highest grading possible and Class 10 indicates that little or no fire protection is in place. The PFPC grading system evaluates the ability of a community's fire protection programs to prevent and control major fires that may occur in multifamily residential, commercial, industrial, and institutional buildings and course of construction developments.

FUS also assigns a second grade for community fire protection, referred to as the Dwelling Protection Grade, which assesses the protection available for buildings such as single-family dwellings.

Dwelling Protection Grade (DPG):

> The DPG is a numerical grading system scaled from 1 to 5. One (1) is the highest grading possible and five (5) indicates little or no fire protection is provided. This grading reflects the ability of a community to handle fires in buildings such as single family residences.

The method used to calculate the PFPC and DPG is called the Classification Standard for Public Fire Protection.

4.2. Public Fire Protection Classification System

The Public Fire Protection Classification grading system is a measure of a community's overall programs of fire protection. The ability of a community's fire defences are measured against recognized standards of fire protection relative to fire hazard and the fire/life safety risk present within the community. The following areas of fire protection are reviewed in the survey and have the following weights within the PFPC grading system:

- Fire Department 40%
- Water Supply 30%

- Fire Safety Control 20%
- Fire Service Communications 10%

The above classifications are conveyed to subscribing companies of FUS. FUS subscribers represent approximately 85-90% of the fire insurance underwriters in Canada. Subscribers use this information as a basis in their fire insurance underwriting programs to set limits in the amount of risk they are willing to assume within a given portion of a community, and to set fire insurance rates for commercial properties. Improved fire protection grades may result in increased competition for insurance underwriting companies to place their business within a community. Our analysis indicates that an improved fire protection grade has a positive effect on fire insurance rates.

In addition, PFPC classifications are a measure of the level of fire protection within a community. Many progressive communities use the classification system to assess the performance of their fire protection programs, and to plan the direction of fire protective services for the future of the community.

PFPC Grades do not apply beyond 5km road response distance from a recognized Fire Hall.

4.3. Dwelling Protection Grading System

Dwelling Protection Grades are based on a 1 to 5 grading system; DPG 5 indicates little or no fire protection being available. Most small and midsize communities that have a gradable emergency water supply are assigned a DPG 3A rating, which the insurance industry has termed fully protected. DPG 3B refers to communities, or portions of communities, that have a recognized fire department but are not protected with a recognized water supply. The insurance industry has termed this 'semi-protected'. Within the FUS grading, a grade of 3B indicates that the fire department is equipped, trained, prepared and adequately staffed to provide "Standard Shuttle Service" to a fire event within a reasonable response time (i.e. utilize a Pumper, tender and various related equipment to deliver water to a fire site and provide structural firefighting at the fire event).

The protected assignment refers to DPG 1 to DPG 3A. An unprotected designation refers to DPG 5. DPG 3B and 4 are given the semi-protected designation. The lower the DPG assignment is, the larger the discount given in fire insurance rates. The discounts given for an identical property considered fully-protected over those considered unprotected can be approximately 60%. Where there is sufficient population and sufficient taxation base, the savings generated can more than offset the operating and capital costs of an effective fire service.

A summary of the requirements for the Dwelling Protection Grade system is provided in Appendix G.

Many insurers have simplified the Dwelling Protection Grading system to a simple three tier system. This is typical for setting insurance premium rates for detached single family residences only. Some insurers also inquire as to whether a department is career, composite, or volunteer.

Different insurers utilize the Dwelling Protection Grades differently to set their own rates based on the marketplace and their own loss experiences. The three tier system that is typically used by many insurers is shown in Table 1.

Table 1 FUS Grades Correlation to Commonly used Insurance Terminology and Simplified Grades

Fire Underwriters Survey Dwelling Protection Grades	System Used by Many Insurance Companies "3 tier" system	Insurance Companies typically refer to this grade as
1	Table I	Fully Protected, Career
2	Table I	Fully Protected, Composite
3A	Table I	Fully Protected, Volunteer
3B[1]	Table II	Semi–Protected, Volunteer (Shuttle)
4	Table II or III	Limited–Protection, Volunteer
5	Table III	Unprotected

The fire insurance industry has minimum requirements that communities must meet in order for their fire protection program to receive recognition.

It should be noted that DPG Grades do not apply beyond 8km road response distance from a recognized Fire Hall.

4.4. Measuring Fire Risk in This Review

The strength of fire defence within a community depends largely on the will and financial ability of the community to support this emergency service. FUS and the National Fire Protection Association statistics indicate that the larger the population of a community, the higher the level of fire protection, when measured against the risk of fires within the community. The best scenario for the level of fire protection occurs when expectations of fire suppression and prevention match the community's willingness to pay for this expectation.

Community growth resulting from capital developments increases the level of fire risk; however, the development of fire protective services often falls behind the developments, particularly in communities where growth happens quickly. If the community expectation levels are constant and the fire protective service level is also constant, then as the fire risk level increases the fire protection level relative to the fire risk level decreases and community expectation may no longer be met.

Optimum Level of Fire Protection

The combination of firefighting staff and apparatus that delivers a suppression effort commensurate with the fire demand faced, yet representing the most efficient use of resources in a safe and effective manner.

4.5. Overview of the Assessment Process

There is no one universal model of fire defence that can be applied to all situations or to a community requiring this emergency service. Ideally, the strength of a fire protection program is balanced between the risk of serious fire and the community's fire loss experience. Fire defences should be tailored with these issues in mind. To gauge the needs of the fire service based on experience alone would be to ignore perils that have not yet occurred. Ignoring experience and focusing on risk alone may tend to build-up a fire department force beyond the financial acceptability of the community paying for the service.

FUS measures the ability of a fire department against the risk of fire likely to occur within a community. This measurement is usually not determined by the most significant risk, nor is it based on the average fire risk. Our

1 Note that communities qualifying for Dwelling Protection Grade of 3B may also be able to achieve an equivalency to 3A through Superior Tanker Shuttle Service Accreditation.

measurement tends to focus on those structures where there is a considerable risk to fire and life safety, and where total or temporary loss of a particular structure would have a significant impact on a community's tax base and economy. A fire department should be structured and supported to effectively deal with everyday emergencies while at the same time capable of controlling and extinguishing most fires that may occur.

FUS examines the entire program of the community's fire defence in order to assess and grade the overall program. There are some areas within a FUS grading that carry substantial weight, such as:

- Type and number of apparatus
- The condition and age of fire apparatus and fire suppression equipment
- The type of apparatus and ancillary equipment for the hazards present
- Pumping capacity
- The type of staffing (i.e. career Firefighters vs. volunteers)
- The distribution of companies relative to fire risk
- Response to alarm protocols
- Response times to critical risks
- Management of emergency services
- The quality of training programs for the fire fighter including specialized training
- The availability, adequacy and reliability of emergency water supplies.
- Fire prevention inspections
- Public education programs
- Building controls (application of Building Codes and related standards; plan review process; effective construction inspection and permit process; local building bylaws)
- Automatic fire protection systems
- Emergency communication systems

5. PROJECT SCOPE AND METHODOLOGY

5.1. Project Objectives

The scope of this project was to conduct an assessment of Winnipeg Fire Paramedic Service's fire protection programs for Fire Insurance Grading, specifically looking at the following:

- Citywide risk assessment
- Fire Department operations
- Programs of Fire Safety Control including those of fire prevention and public education
- Dispatch and communications
- Water Supply
- Review Fire Hall locations and distribution of resources
    - Use historical response data and FUS methodology to establish current response capacity.
    - Complete a community wide optimization analysis considering no current Fire Halls and provide comparison analytics
    - Review the effects of removing/merging certain Fire Halls and resultant expected effects on FUS methodology and distribution of resources.
    - Analysis of future proposed development and station locations.
- Traffic pre-emption analysis and effects
    - Review current traffic pre-emption options
    - From current established distribution of resources review the effect of traffic pre-emption on resource needs related to the FUS methodology and response analysis.
- How Fire Insurance Rates Affect Insurance Rates
- Establish strategies for the current situation and future predicted growth of the study area throughout recommendations throughout the report.

The following key contacts were made and provided information throughout the survey and development of the report:

- John A. Lane, Chief, Winnipeg Fire & Paramedic Service
- Michelle Weimer, Executive Assistant to the Fire & Paramedic Chief
- Janet Bier, Director of Fire Prevention
- Russ Drohomereski, Academy Director, Winnipeg Fire Department
- Margot Bergstrom, Manager of Communications
- Rick Shumila, EMSB Director, Winnipeg Fire Department
- Tom Howards, Supervisor of Light Fleet, Winnipeg Fire Paramedic Service
- Nina Grebely, Quality Improvement Analyst, Winnipeg Fire Paramedic Service
- Jon Goodbrandson, Water Distribution Planning Engineer
- Ryan Lucky, Water Distribution Planning Engineer
- Duncan French, Process Improvement Coordinator
- Randy Hull, Emergency Preparedness Coordinator
- Kelly Shields, Deputy City Assessor
- Patrick Closen, Acting Supervisor, Grafting and Graphic Services
- Kristine Corbett, Superintendent of Building Maintenance Services
- Luis Escobar, Manager of Transportation
- David Tang, Transportation Planning Engineer

6. COMMUNITY RISK AND HAZARD ASSESSMENT

6.1. Background

A risk assessment was conducted throughout the City of Winnipeg to aid in determining the community's fire protection needs and to assist in assessing the adequacy of the current Fire Hall locations and distribution of apparatus. A risk and hazard assessment, along with a response distance review, lays the groundwork for determining fire protection needs within a community. This assessment is important in ascertaining organizational structure, personnel requirements, training requirements, fire apparatus and fire equipment needs, response time requirements and adequacy of fire Hall locations.

The "Risk and Hazard Assessment" is an evaluation of the fire loading and risk present in a given area.

6.2. Measuring Fire Risk

Adequate response to a fire emergency is generally measured by the speed with which a responding firefighting crew(s) can arrive at the fire emergency with sufficient resources, to have a reasonable degree of opportunity to control or extinguish a fire. Simply put, the response provided by a firefighting crew should equal the potential severity of the fire or fire emergency.

The potential severity of a fire event is generally associated with the fuel load present and exposures to the fire. Factors such as building construction materials; quality of construction; building renovation history; building size, height and age; occupancy and hazards associated with the occupancy, will all contribute to the potential severity of a fire. In addition, other buildings sufficiently exposed to a burning building can contribute to the magnitude of a fire and the resources necessary to be in place to control or extinguish a given fire. Alternatively, building controls and automatic fire protection systems (both active and passive) that limit fire spread will reduce the potential severity of a fire. For building controls to be considered effective, their design, installation and maintenance must also be reviewed as any weak link may result in the system being ineffectual.

Much of the research into fire protection requirements for individual buildings and communities and the corresponding number of Pumper companies and response times has been conducted by FUS and the National Fire Protection Association (NFPA). FUS evaluates adequacy of response by comparing the potential severity of fires that may occur with a rating of the ability of fire crews and their resources responding within a specified time period relative to the fire and life safety risk potential that may be needed.

The base point, within the Classification Standard for Public Fire Protection, for measuring fire risk and the resultant available and adequate response is the determination of Required Fire Flows (RFF).

6.3. Required Fire Flows

Required Fire Flows (RFF) may be described as the amount and rate of water application, and company response, required in firefighting to confine and control the fires possible in a building or group of buildings which comprise essentially the same fire area by virtue of immediate exposures.

RFFs were derived for buildings throughout the City of Winnipeg using the methodology described in the FUS 1999 Guideline "Water Supply for Public Fire Protection" (refer to APPENDIX B Fire Underwriters Survey – 1999 – Water Supply for Public Fire Protection). The calculation takes into account the construction type, occupancy, exposures, total effective area, and the fire protection systems in place for each risk. The RFF calculation is based on the following formula:

$$F = 220C\sqrt{A}$$ .....see additional notes[2]

Where:

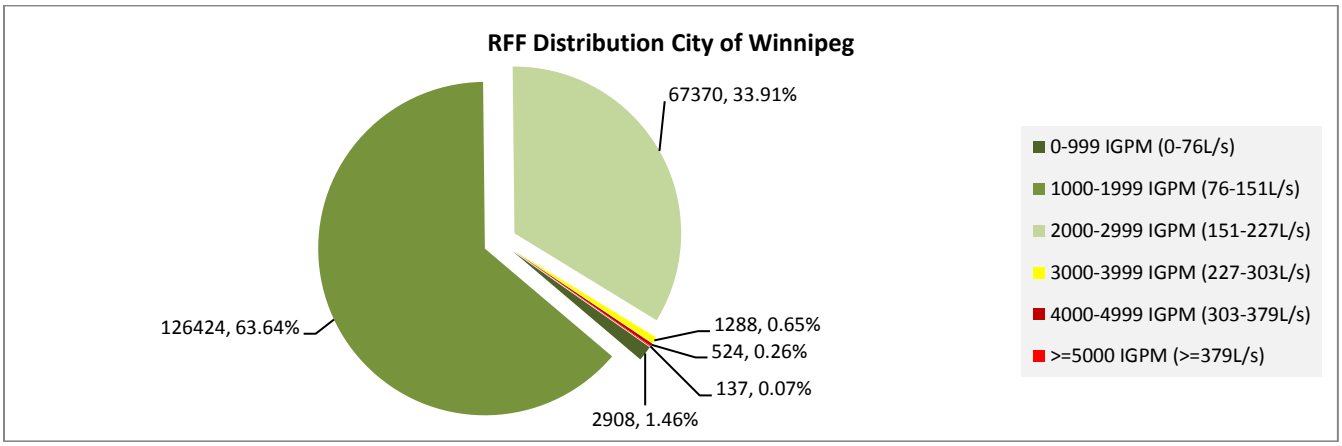
- C=coefficient related to the type of construction
- A=total effective building area

A risk assessment tour was conducted with the Emergency Preparedness Coordinator during the site visit of the City. Ten manually calculated RFFs were then completed for each Fire District (Fire District boundaries provided by WFPS) which can be seen in Figure 2 with values referenced in APPENDIX A Manual Required Fire Flow Calculations.

GIS, zoning, parcel, and assessment data was used to generate RFFs for the remainder of the City. Derived higher values were further reviewed. These RFFs were typically found to fall within the RISK RATING limits of Table 11 Fire Underwriters Survey - Table of Effective Response. These generated and manual RFF calculations were joined to form the final risk assessment layer for the City of Winnipeg for Fire Insurance Grading purposes as shown in Figure 3.

Overall 198651 RFFs were derived for the City of Winnipeg. The distribution of RFFs is shown in Figure 1.

Figure 1 RFF Distribution City of Winnipeg



[2] Adjustments for occupancy, automatic fire protection systems, exposures are detailed in Fire Underwriters Survey 1999 Guideline "Water Supply for Public Fire Protection".

Due to the large number of RFF points it can be difficult to see the distribution of RFF points throughout the Fire Protection Area. To better graphically represent the distribution of RFF points 2 “Heat maps” have been created. In both cases a grid is overlaid on the Fire Protection Area and a summing value is calculated for each individual grid based on a function of RFF value and distance from the grid centre. The following have been created:

- Figure 4 - Concentration Weighted Risk Assessment

This map shows the distribution of RFF points considering the concentration as the weighting factor (note that RFF value is still considered). Due to the close concentration (and exposures) of residential properties, these areas show as a darker blue/purple.

- Figure 5 - Value Weighted Risk Assessment

This map shows the distribution of RFF points considering the value as the weighting factor (note that RFF concentration is still considered). Due to the higher RFF values of non-residential properties; yellow, orange, and red areas reflect higher RFF value areas. The higher value areas are seen in the industrial areas and downtown core. The “pixelated” look of the map is due to the need to use a larger grid to display useful information on risk distribution.

The following items were noted during the survey that are beyond the scope of a risk assessment for Fire Insurance Grading:

- At the time of the tour it appears that there is limited knowledge of goods being carried at both the CN and CP Rail yards. The risk assessment in this study did not look at the levels of risk at these facilities.
- There is an industrial area located outside the City of Winnipeg in the Transcona area of the Rural Municipality of Springfield. This area directly borders the City of Winnipeg and as such a fire incident in the area may have an effect on the City (the Emergency Preparedness Coordinator noted that this has previously occurred). At this time there is no automatic aid agreement in place for response to the area. Any incident in the industrial area will receive response from the Transcona Fire Hall in the Rural Municipality of Springfield which is expected to be delayed as this is an auxiliary staffed Fire Hall. Consideration should be given to an automatic aid agreement response to the Transcona Industrial Area in the Rural Municipality of Springfield. A second industrial area was also noted in the North West of Winnipeg outside the City boundary in the Rural Municipality of Rosser. Again, Automatic Aid should also be considered for this area as an incident in this area may also affect the City. Automatic Aid being provided to any building should not be limited to suppression but should also include prevention and pre-incident planning.
- Flooding was noted to be an issue in the area of Kingston Crescent. There may be no Fire Department access during certain flooding levels.
- The land area around Fort Gibraltar was noted to have 2 access roads that are crossed by an above grade rail crossing. A train has de-railed in this area in the past which closed one access road. This appears to have been due to rail speed. If a derailment closed both access roads the area would only be accessible from the water. Even though there are access issues to the area, development was noted to be ongoing during the site visit.
- There is a high occupancy casino beside the CP Rail yard at McPhilip’s Street. From discussions with the Emergency Preparedness Coordinator it appears that recently a Shelter in Place plan has been implemented at the casino. This was not further reviewed. This should be considered when developing an ERAP.

Recommendation 1 Complete Site/Industry Specific Risk Assessment of Rail Yards and Transportation of Goods

The Transportation Safety Board of Canada released Rail Recommendations R14-01, R14-02, R14-03 in January 2014. As noted in R14-02:

"The Department of Transport set stringent criteria for the operation of trains carrying dangerous goods, and require railway companies to conduct route planning and analysis as well as perform periodic risk assessments to ensure that risk control measures work."

WFPS should work with the railway companies to complete a risk assessment and ensure that resources are in place to address these risks through the implementation of an ERAP (Emergency Response Assistance Plan) as detailed in R14-03:

"The Department of Transport require emergency response assistance plans for the transportation of large volumes of liquid hydrocarbons."

Regular drills of the ERAP should be conducted and the plan adjusted accordingly.

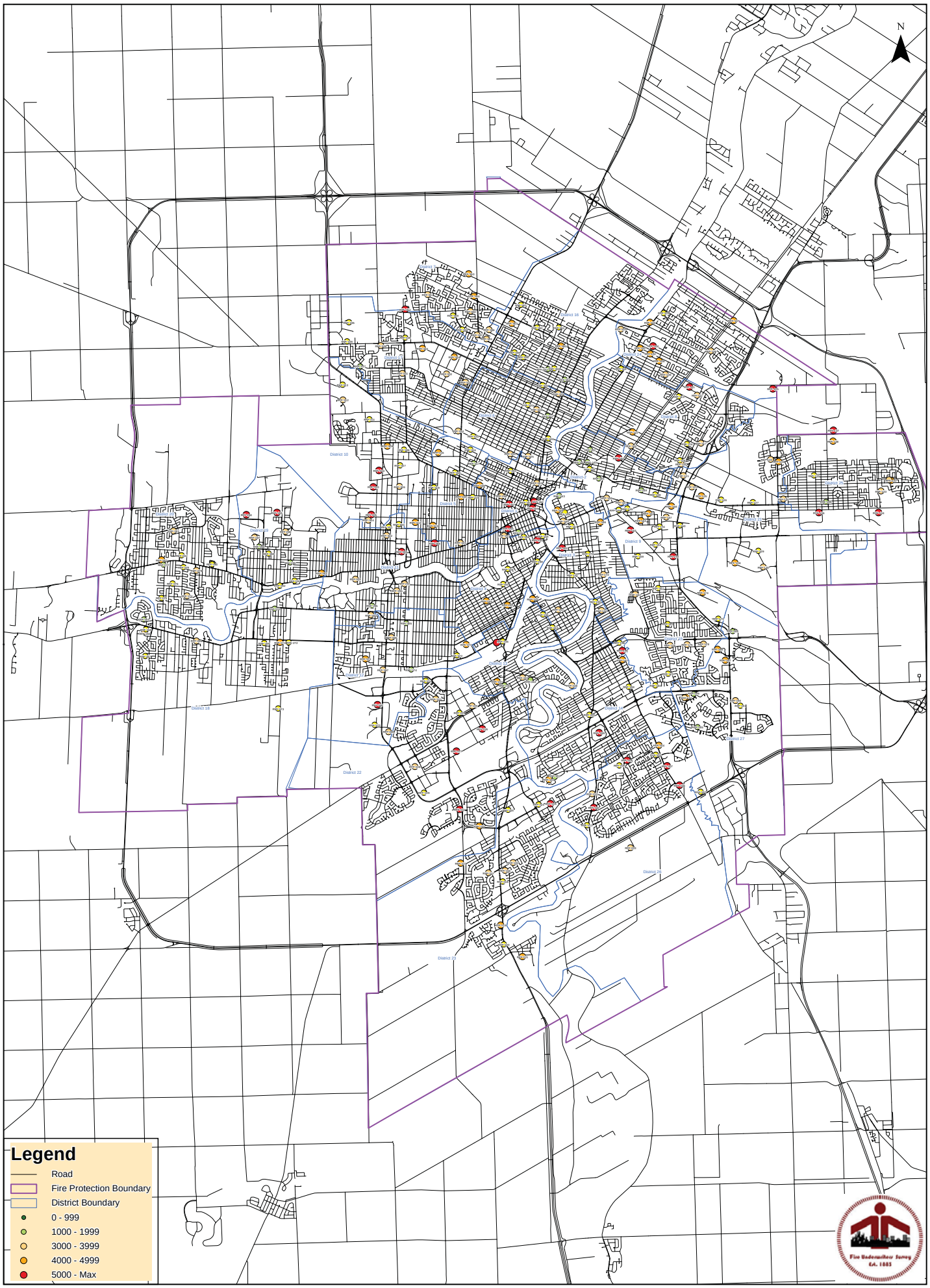
A large number of at-grade rail crossings were noted within the City and these should be considered as part of the ERAP when considering access to areas of the City. Additionally above-grade that could cause access issues should also be considered.

6.4. Setting Basic Fire Flows for the City of Winnipeg

The Basic Fire Flow is determined from the analysis of the RFFs. The value which represents the fire potential of most large properties in the municipality, but may exclude several of the largest properties not considered as usual to the municipality. Normally, the value used as the Basic Fire Flow will not be the peak RFF in the municipality.

Required Fire Flows were subdivided by Fire Districts. The 5th highest RFF in each District was then used to select the final Basic Fire Flow for the City which is 5700 IGPM (432 L/s).

RFFs calculated that were higher than the Basic Fire Flow are not excluded Public Fire Protection Classification Standard calculation. They are still utilized under specific items of the Rating Schedule. Additional resources and planning may be required to adequately provide protection to peak RFF risks.

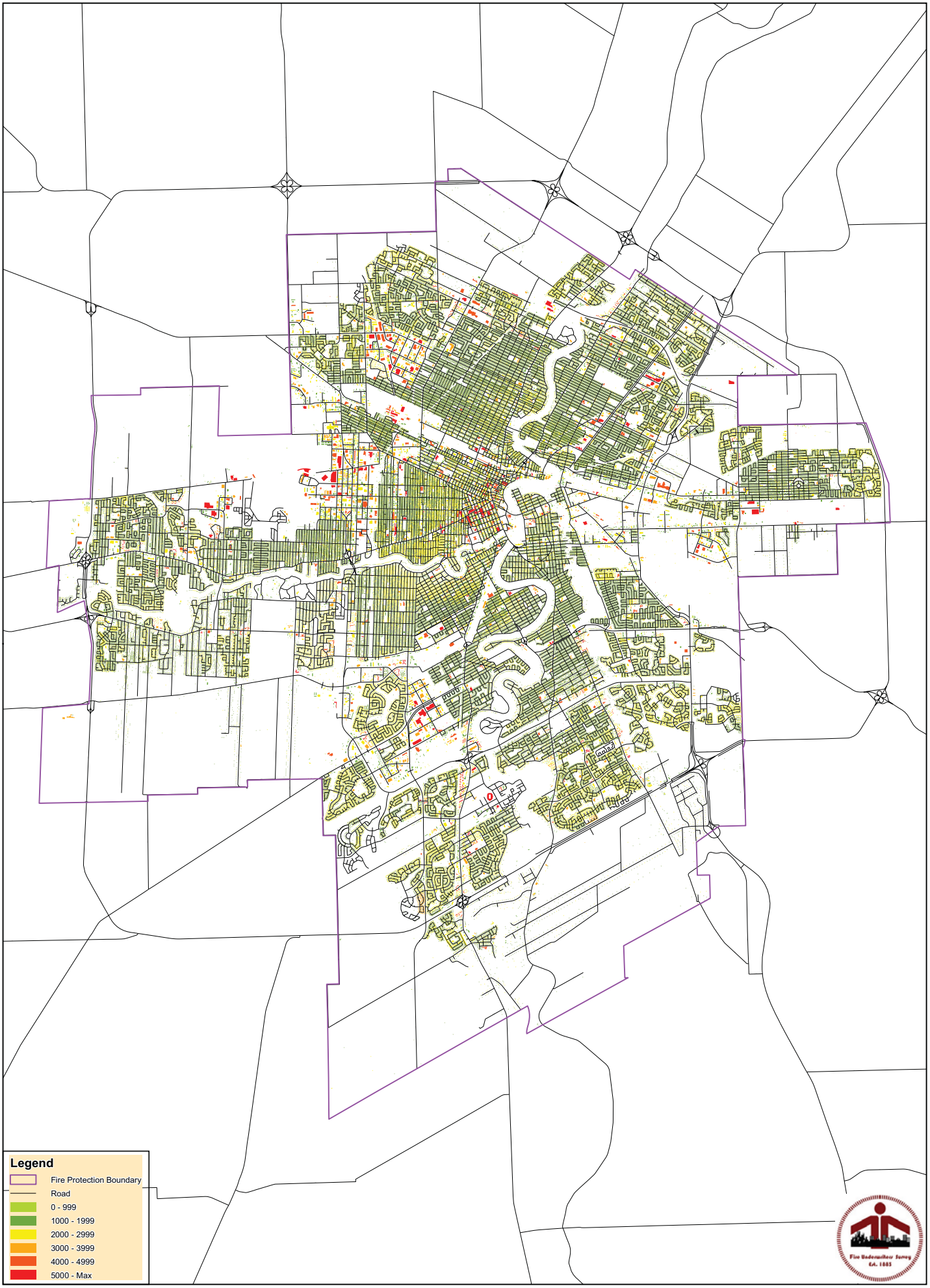


City of Winnipeg

Figure 2 - Manual Required Fire Flows by District

Scale = 1:38,000 0 500 1,000 2,000 3,000 Meters

Fire Underwriters Survey

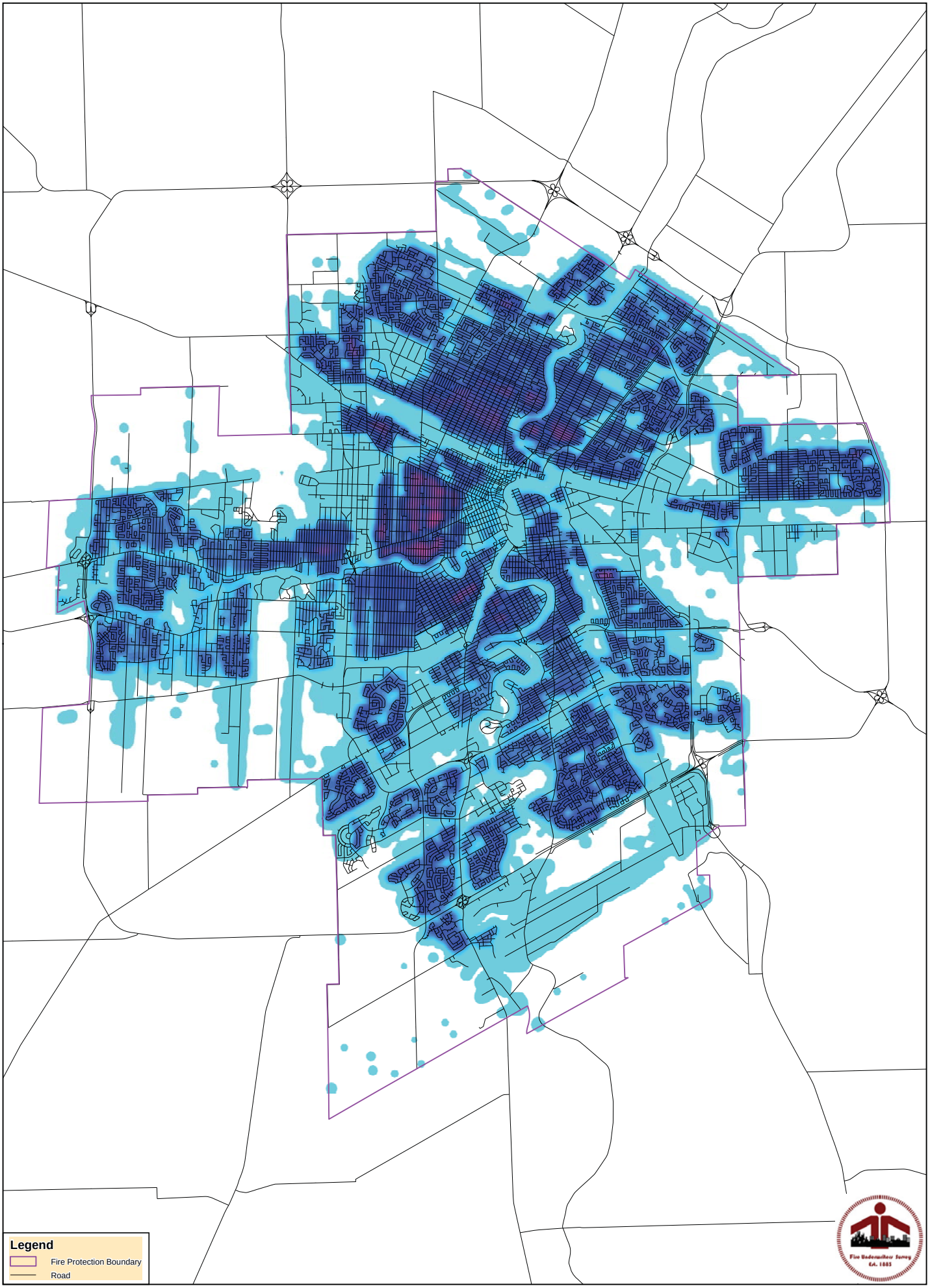


City of Winnipeg

Figure 3 Building Footprints with RFF Points

Scale = 1:38,000 0 500 1,000 2,000 3,000 Meters

Fire Underwriters Survey

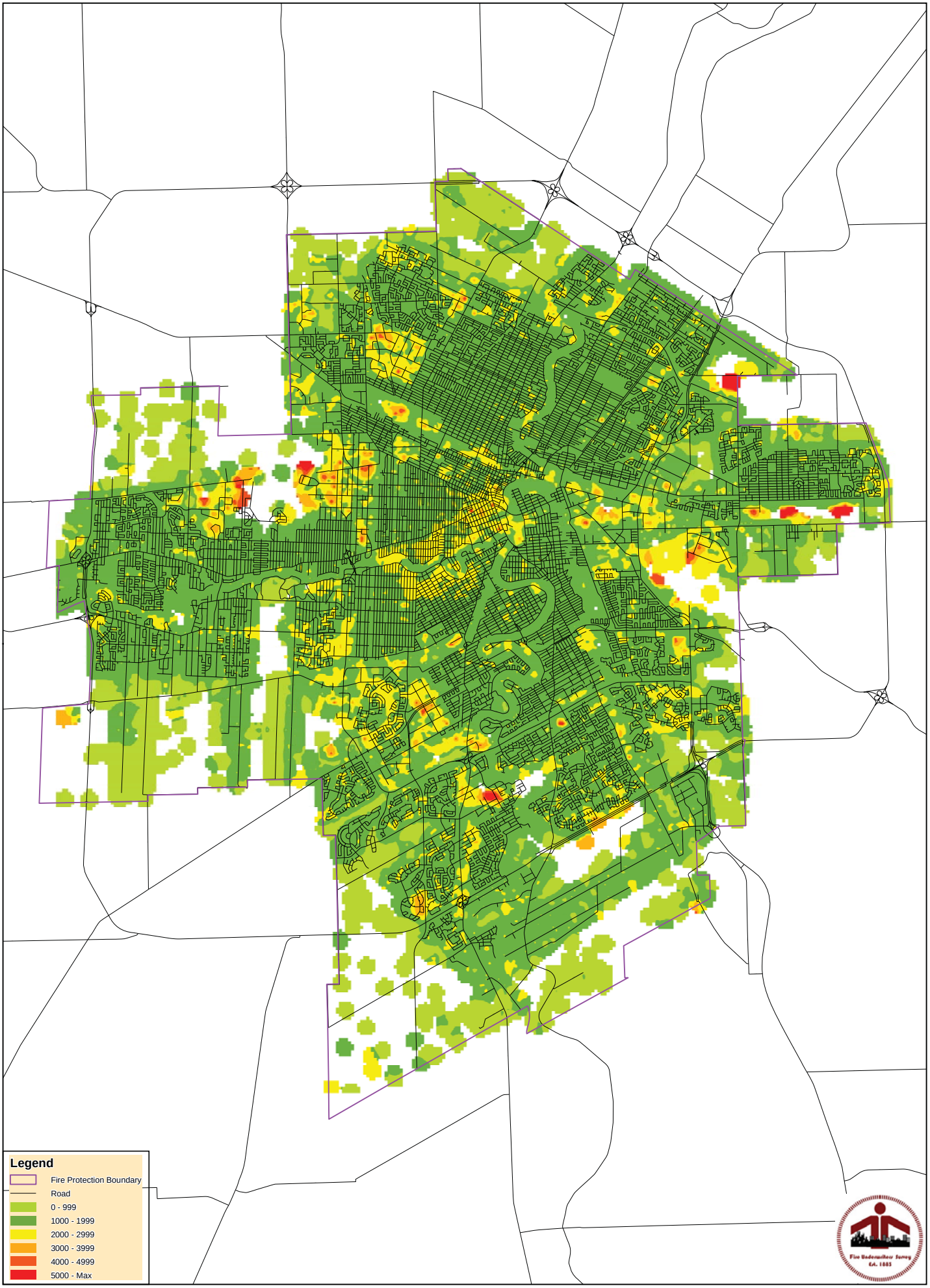


City of Winnipeg

Figure 4 - Concentration Weighted Risk Assessment

Scale = 1:38,000 0 500 1,000 2,000 3,000 Meters

Fire Underwriters Survey



City of Winnipeg

Figure 5 - Value Weighted Risk Assessment

Scale = 1:38,000 0 500 1,000 2,000 3,000 Meters

Fire Underwriters Survey

7. PFPC - FIRE DEPARTMENT ASSESSMENT

7.1. Fire Department Grading Items

The following items are assessed as part of this study and as part of the Fire Insurance Grading process. Some of the areas have been further analyzed as requested by WFPS in order to provide additional feedback on distribution and levels of response.

Areas analyzed in the assessment of the Fire Department are as follows:

- FD – 1: Engine Service
- FD – 2: Ladder Service
- FD – 3: Distribution of Companies
- FD – 4: Engine and Ladder Pump Capacity
- FD – 5: Design, Maintenance and Condition of Apparatus
- FD – 6: Number of Line Officer – Fire Suppression
- FD – 7: Total Fire Force Available
- FD – 8: Engine and Ladder Company Unit Manning
- FD – 9: Master and Special Stream Devices
- FD – 10: Equipment for Engines and Ladder Apparatus
- FD – 11: Fire Hose
- FD – 12: Condition of Fire Hose
- FD – 13: Training and Qualifications
- FD – 14: Response to Alarms
- FD – 15: Fire Ground Operations
- FD – 16: Special Protection Required
- FD – 17: Miscellaneous Factors and Conditions
- FD – 18: Pre-Incident Planning
- FD – 19: Administration

7.2. Engine Service

Fire departments are evaluated for the number of engine companies in service relative to the overall fire potential and the area being protected. Engine apparatus are required to be adequately housed and staffed in order to receive full credit.

The engine service grading item refers to the amount of credit received for each of the department's engines. Recognition and credit for engines may be reduced or withheld based upon the measured reliability of the pumps and the apparatus upon which they are installed (ex. factors such as age, listing, testing, etc.).

Fire apparatus that serve dual purposes are evaluated based on the primary duty it serves on the fire ground. For example, a ladder apparatus with a fire pump may be credited in one of two ways.

- 100 percent credit as a ladder apparatus and 50 percent credit as an engine, or
- 100 percent credit as an engine apparatus and 50 percent credit as a ladder apparatus.

This depends upon the number of apparatus a department has available and where credit should be distributed properly in the grading depending on the primary use of the fire apparatus.

The maximum acceptable age of apparatus for the City of Winnipeg, as specified in the Fire Suppression Rating Schedule, is 15 years as a First Line Duty apparatus and up to 20 years as a reserve. Refer to APPENDIX C Insurance Grading of Used or Rebuilt Apparatus.

The benchmark number of Engine Companies that WFPS can receive credit for is based on the Basic Fire Flow of 5700 IGPM. Initial apparatus needs are cross referenced with Table 11 Fire Underwriters Survey - Table of Effective Response. For a Basic Fire Flow of 5700 IGPM 7 pumper apparatus are needed.

Further apparatus needs are determined based on distribution of resources to provide reasonable coverage within the City. Ideally between 90%-100% of properties should have a pumper apparatus response within first due response time which is derived from the RFF calculated for the property and resource needs read from Table 11. Typically response times are converted to response distances using an established Time-Distance formula as road speeds; network maps; etc. are generally not readily available. As one of the objectives of this study is to look at certain road network impedances, and as road network and historical call data was readily available, the accuracy of the study has been improved by looking at travel time. GIS tools were used to measure first due response time needs to each RFF. Regression analysis in conjunction with road network data (provided by the Public Works Department Transportation Division) and historical response data (provided by WFPS) was used to establish impedance times associated with certain road features. This established the Fire Department response model which was used for this assessment (a more complete discussion on this is provided in section 7.4.3). Using a location-allocation GIS tool the optimal location and number of facilities to provide 90% coverage to RFF points under first due response time was found to be an additional 19. Currently 86.8% of RFF points are covered under their individual first due response times. With Fire Halls place as shown in Figure 10, 90.2% of RFF points are covered under first due response times.

Additionally, further apparatus needs are considered based on number of calls from historical data. In order to review additional apparatus needs historical fire department response data was used.

The data goes through the following quality improvement process by WFPS prior to analysis:

- Call Time (T0 to T2) between 1 and 300 seconds
- Turnout Time (T2 to T3) between 1 and 300 seconds
- Travel Time (T3 to T4) 30 seconds or greater
- Response Time (T0 to T4) 30 seconds or greater
- Commit Time (T2 to Tmax) 60 seconds or greater

The data was then separated by call type, i.e. DeterminantType=WFD or DeterminantType=WAD where WFD is fire type and WAD is medical type. Fire type calls will be used later in this report to analyze distribution of resources and hence further data cleaning was completed which is discussed in section 7.4.

Records were chosen for the year 2013 in order to reflect the most recent response protocols and facilities. An overview of the dataset showed that some calls had very unlikely response times. This issue was further discussed with WFPS and it was noted that when an apparatus is cancelled off a call the user entering the time stamps needs to cycle through status heads (timestamps) in order to become available again within the dispatch system. In order to remove these record types it was suggested that the following quality improvement condition should be applied:

- AtSceneTime to DepartSceneTime (T4 to T6) must be greater than 30 seconds.

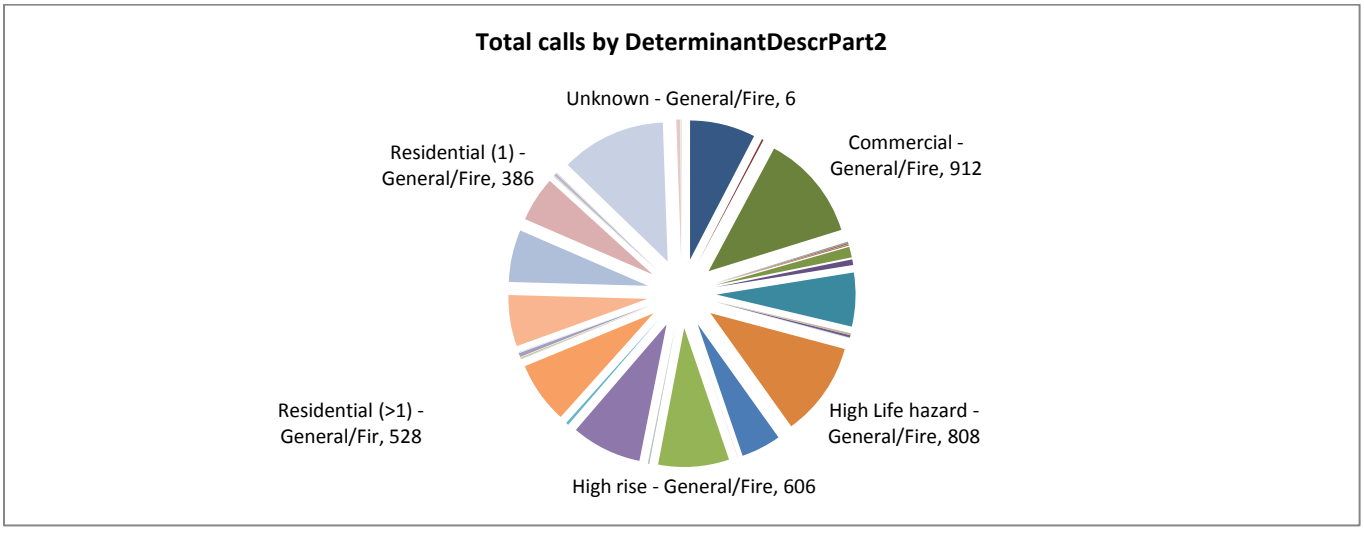
After cleaning there were 63914 records (all apparatus) and 48632 records (unique calls) analyzed for 2013. Unique calls are summarized in Table 2, i.e. only the call and not the number of apparatus responding to the call. It can be seen that "Alarms" make up the majority accounting for 15.14% of all calls for the period. Second to "Alarms" are calls of the type "Unknown Problem (Man Down)" accounting for 15.08%. There were 1229 calls for "Structure Fire" in 2013 which accounts for 2.53% of all call types. Alarm calls were further broken down based on the Determinant – Part 2 which determines the type of call when arriving on scene. The breakdown of alarm calls is shown in Figure 6 and shows that an additional 3246 calls were determined to be fire type calls. In total this resulted in 4475 calls or 9.2%.

Table 2 Total Unique Calls by Call Type 2013 (WAD and WFD)

Determinant - Part1	Total calls by Determinant 2013	AVG time on calls (min)	Standard Deviation (min)	95th percentile (min)
Alarms	7361	12.0	12.3	27.5
Unknown Problem (Man Down)	7333	24.5	19.7	61.6
Breathing Problems	4880	23.3	12.8	45.5
Falls	4446	28.2	17.3	59.6
Chest Pain (Non-Traumatic)	3955	24.8	12.9	47.8
Traffic/Transportation Incidents	2377	34.6	23.2	74.3
Unconscious/Fainting (Near)	2241	25.9	15.2	53.3
Sick Person (Specific Diagnosis)	2201	24.6	13.5	49.7
Convulsions/Seizures	1443	25.1	13.6	50.6
Structure Fire	1229	33.0	43.9	115.3
Hemorrhage/Lacerations	1128	20.7	10.1	35.6
From Police	1025	23.7	19.3	61.7
Outside Fire	994	19.7	28.7	56.4
Stroke (CVA)	960	24.8	10.9	44.6
Cardiac or Respiratory Arrest/Death	841	41.7	21.3	80.7
Overdose/Poisoning (Ingestion)	691	24.0	14.9	51.4
Heart Problems/A.I.C.D	626	23.6	12.0	47.0
Abdominal Pain/Problems	514	21.9	11.8	40.8
Diabetic Problems	498	25.7	12.6	48.6
Traumatic Injuries (Specific)	399	23.6	16.3	53.3
Allergies (reactions)/Envenomations (stings, bites)	365	21.8	13.4	45.0
Pregnancy/Childbirth/Miscarriage	326	24.5	15.9	57.5
Assault/Sexual Assault	288	20.5	13.0	45.4
Citizen Assist/Service Call	285	15.8	11.8	38.3
Electrical Hazard	269	28.9	28.5	89.6
Assist Police	258	22.6	21.3	61.1
Vehicle Fire	239	37.7	31.4	97.1
Choking	222	21.4	13.7	43.2
Gas Leak/Gas Odour (Natural and LP Gases)	209	22.7	24.6	78.2
Psychiatric/Abnormal Behaviour/Suicide Attempt	131	23.9	13.2	48.5
Headache	129	20.9	9.7	38.5
Stab/Gunshot/Penetrating Trauma	107	24.2	16.0	50.9
Smoke Investigation (Outside)	100	14.3	12.3	29.5
Odour (Strange/Unknown)	83	24.0	16.5	66.1
Elevator/Escalator Rescue	77	32.1	26.8	77.5

Water Rescue	59	27.6	23.2	71.7
Back Pain (Non-Traumatic or Non-Recent Trauma)	53	24.3	10.5	39.0
Fuel Spill	46	29.2	33.9	98.8
Heat/Cold Exposure	37	21.9	11.4	38.7
Psychiatric/Abnormal Behavior/Suicide Attempt	34	25.6	14.0	49.2
HAZMAT	25	119.5	94.8	308.8
High Angle Rescue	18	21.7	23.9	77.9
Burns (Scalds)/Explosion	16	24.0	16.5	50.3
Mutual Aid/Assist Outside Agency	16	24.2	28.1	65.8
Inaccessible Incident/Other Entrapments (Non-Vehicle)	14	22.1	11.1	38.0
Animal Bites/Attacks	12	16.7	8.3	30.1
Burns (Scalds)/Explosion (Blast)	11	15.8	8.4	26.3
Drowning (Near)/Diving/Scuba Accident	8	22.9	12.9	41.4
Explosion	7	15.2	8.1	25.6
Confined Space/Structure Collapse	6	22.7	11.7	41.6
Eye Problems/Injuries	6	18.4	7.6	26.4
Aircraft Emergency	5	49.9	53.9	126.0
Carbon Monoxide/Inhalation/Hazmat/CBRN	5	27.9	14.4	46.9
Midwife	5	20.1	19.3	46.4
Electrocution/Lightning	4	19.3	12.6	34.6
Train/Rail Incident	4	50.6	62.5	126.7
Extrication/Entrapped (Machinery, Vehicle)	3	24.0	18.8	42.5
Used for immediate dispatch	2	16.4	3.4	18.6
Carbon Monoxide/Inhalation/HAZMAT	1	13.7	0.0	13.7
Hazmat Level I	1	58.7	19.4	76.4
Hazmat Level II	1	177.8	16.3	187.4
Interfacility	1	44.6	0.0	44.6
Lightning Strike (Investigation)	1	7.5	4.8	12.2
Watercraft in Distress	1	9.8	0.0	9.8

Figure 6 Alarm Calls by Determinant - Part 2



The total number of calls by Fire Hall was also analyzed and is shown in Figure 7 and Figure 8. It can be seen that Fire Hall 1 has the most calls at 11565 or 18.06% of all calls for 2013. Fire Hall 4 is second to this with 6062 calls or 9.45%. Furthermore the total time spent on calls expressed as a percentage of the total time available in a year for Fire Hall 1 is 44.32%. Even though there are 2 pumper crews and 1 ladder crew (Engine 101, Engine 103, and Ladder 1) this is still considered comparatively large considering other Fire Halls.

Figure 7 Total Calls by Fire Hall

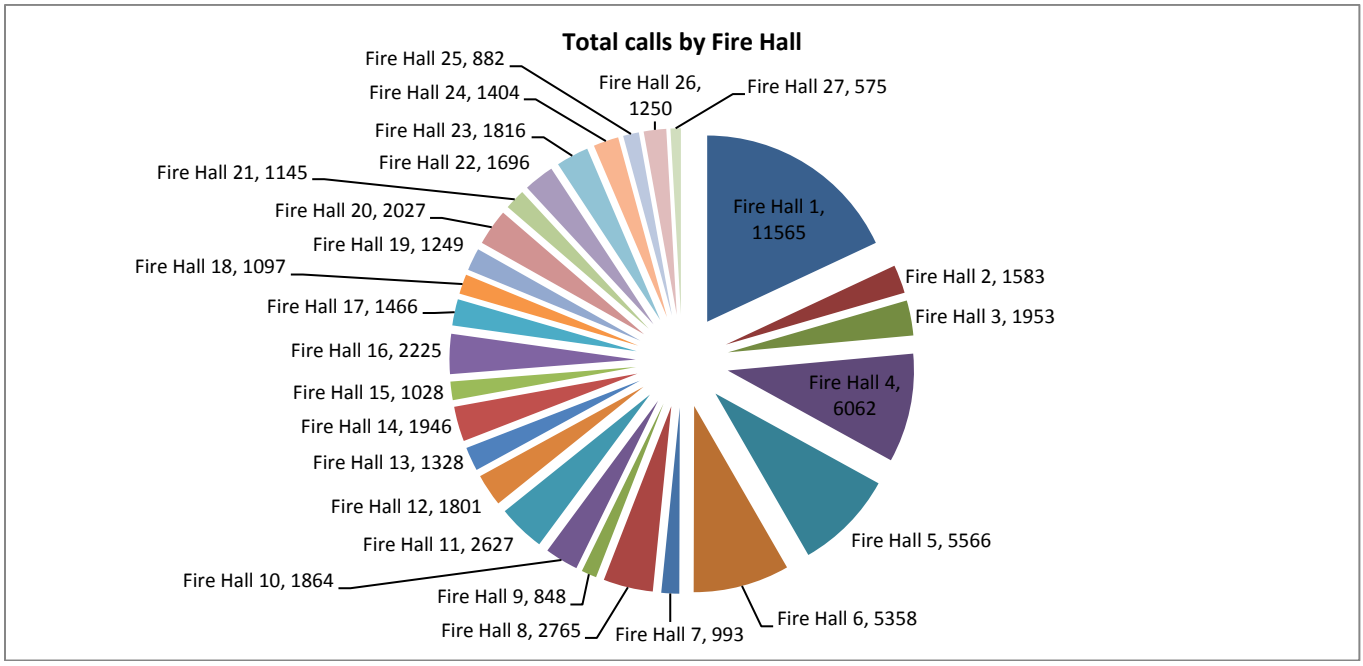
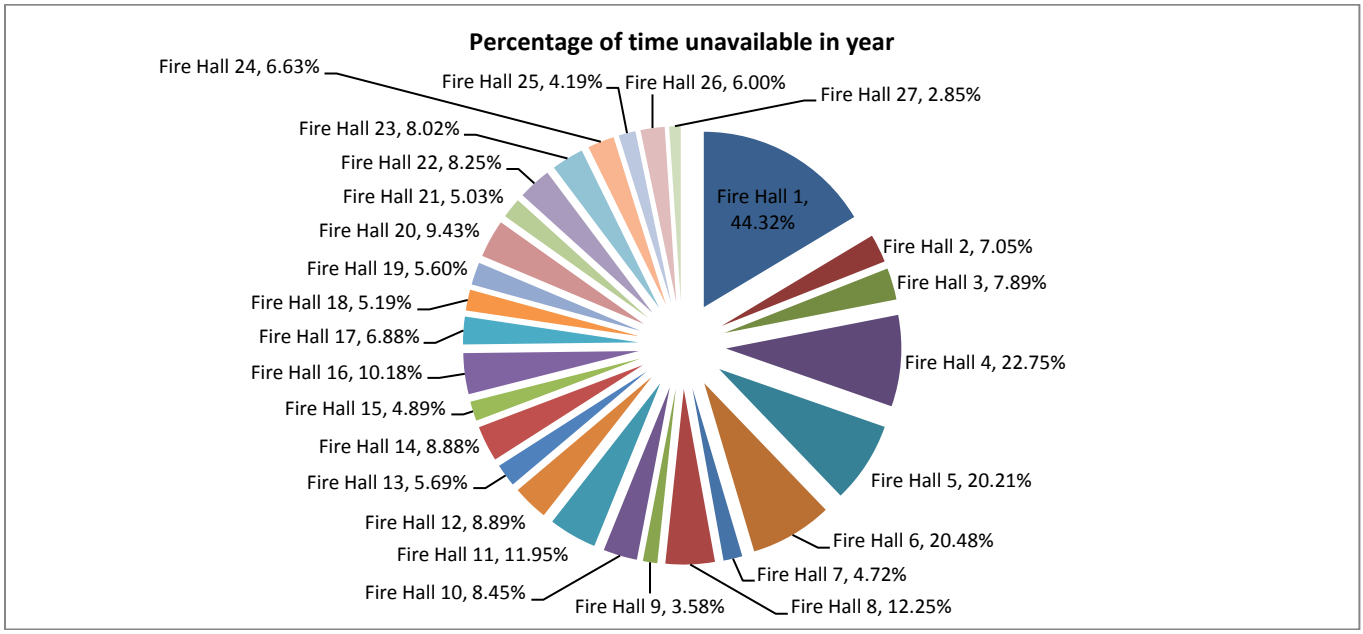


Figure 8 Percentage of Time Unavailable in Year



From historical response data further apparatus needs are determined based on the number of fire type calls. When there are over 4000 fire type calls within a municipality, further apparatus needs are based on having the total number of companies determined from the Basic Fire Flow, which for the City of Winnipeg is 5700 IGPM (432 L/s) or 7 pumper companies. A summary of apparatus needs is as follows:

- Pumper company needs from Basic Fire Flow = 7
- Pumper company needs from distribution analysis = 19
- Pumper company needs from fire calls >4000 = 7

Therefore the total needed companies for benchmarking within the Fire Suppression Rating Schedule is 33. For fire insurance grading, a fire department should have one reserve engine for each eight engines in service. A fire department even with a single engine company should have a reserve engine.

A summary of pumper apparatus credit is provided in Table 3.

Table 3 Credited In-Service Engine Summary

Identifier	Apparatus Credit	Engine Credit	Reserve Engine Credit	Pump Capacity (IGPM)
Engine 101	Pumper	1.0	0	1500
Engine 103	Pumper	1.0	0	1500
Ladder 1	Quint	0.5	0	1750
Squad 101	LAV	0.5	0	200
Squad 102	LAV	0.5	0	200
Engine 2	Pumper	1.0	0	1500
Engine 3	Pumper	1.0	0	1250
Engine 4	Pumper	1.0	0	1500
Rescue 4	Pumper/Rescue	0.5	0	1250
Engine 5	Pumper	1.0	0	1500
Rescue 5	Pumper/Rescue	0.5	0	1250
Engine 6	Pumper	1.0	0	1500
Rescue 6	Pumper/Rescue	0.5	0	1250
Engine 7	Pumper	1.0	0	1750
Engine 8	Pumper	1.0	0	1500
Engine 9	Pumper	1.0	0	1500
Engine 10	Pumper	1.0	0	1500
Engine 11	Pumper	1.0	0	1500
Ladder 11	Quint	0.5	0	1800
Engine 12	Pumper	1.0	0	1500
Engine 13	Pumper	1.0	0	1250
Ladder 13	Quint	0.5	0	1750
Engine 14	Pumper	1.0	0	1500
Engine 15	Pumper	1.0	0	1250
Engine 16	Pumper	1.0	0	1500
Ladder 16	Quint	0.5	0	1750
Engine 17	Pumper	1.0	0	1250
Engine 18	Pumper	1.0	0	1500
Engine 19	Pumper	1.0	0	1100
Engine 20	Pumper	1.0	0	1500
Engine 21	Pumper	1.0	0	1500
Ladder 21	Quint	0.5	0	1750
Engine 22	Pumper	1.0	0	1250
Engine 23	Pumper	0	1.0	1300

Engine 231	Pumper	1.0	0	1500
Engine 24	Pumper	1.0	0	1250
Engine 25	Pumper	1.0	0	1250
Engine 26	Pumper	1.0	0	1500
Engine 27	Pumper	1.0	0	1500
822-9928	Quint	0	0	1750
822-9930	Quint	0	0	1750
822-9931	Quint	0	0.5	1750
822-9958	Pumper	0	1.0	1500
822-9960	Pumper	0	1.0	1500
822-9961	Pumper	0	1.0	1500
822-9962	Pumper	0	1.0	1500
823-9964	Pumper	0	1.0	1100
823-9965	Pumper	0	1.0	1100
827-9876	Pumper	0	1.0	1500
833-9997	LAV	0	0.5	200
Total Engine/Reserve Credit		33	9	
Credit Receivable		33	4.125	

The City of Winnipeg received **100%** credit for this grading item.

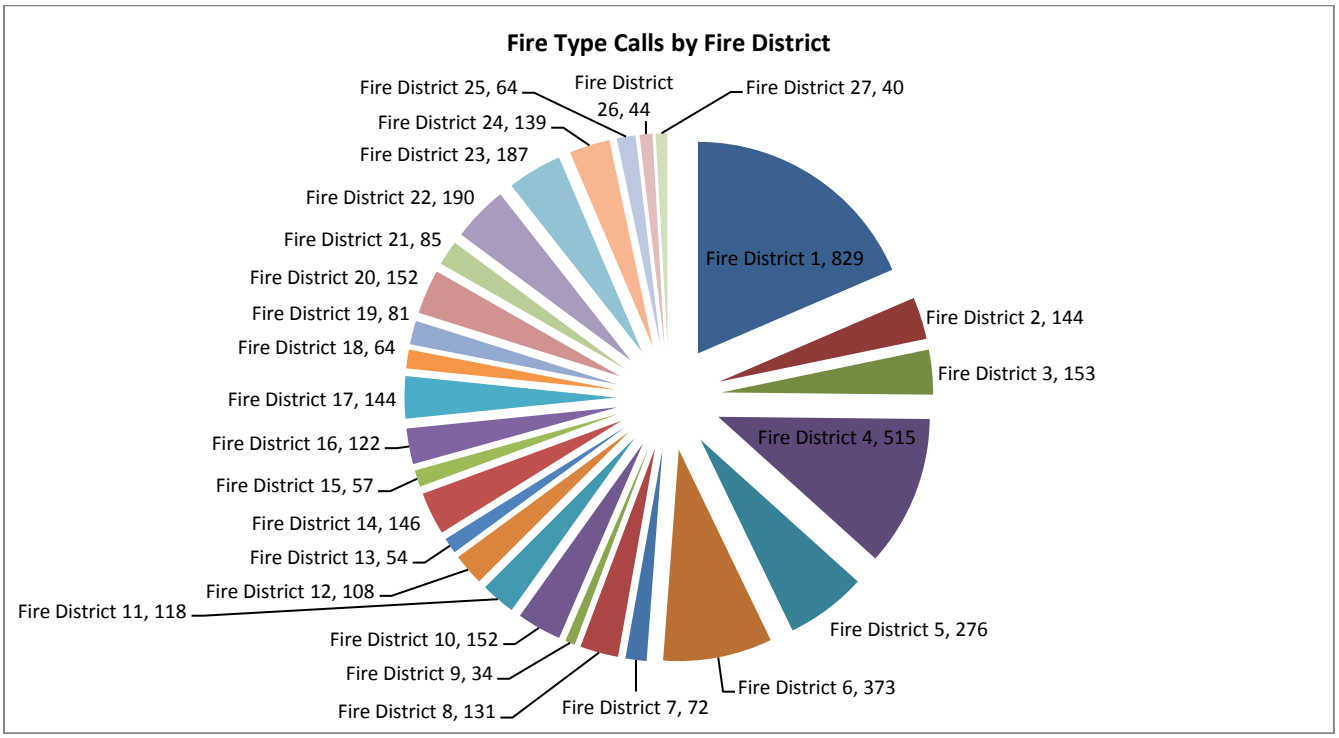
Recommendation 2 Implement a complete targeted prevention and education program

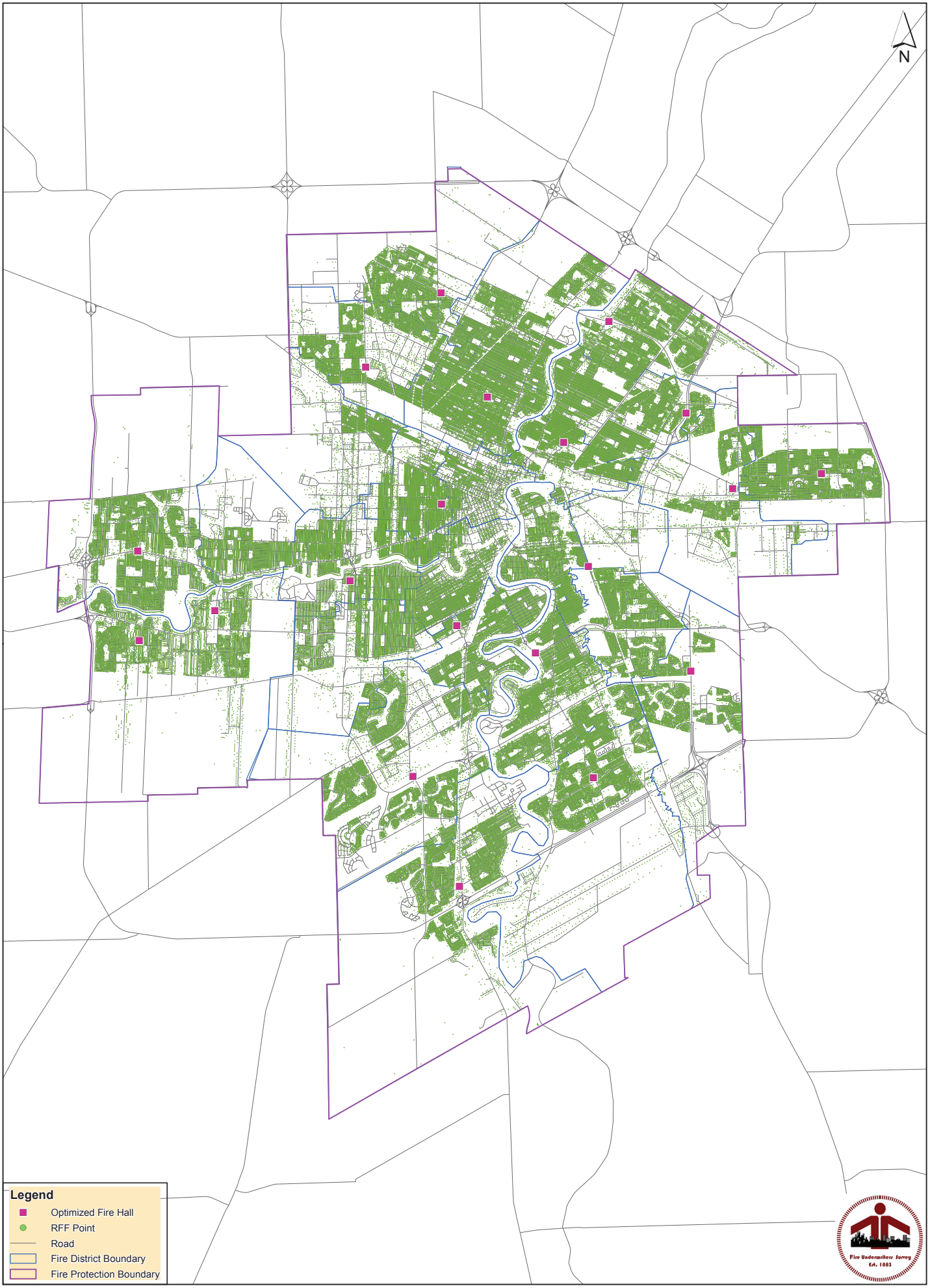
The prevention programs in place in the City of Winnipeg should be expanded. A complete discussion of prevention is provided in section 8. A targeted program should be implemented to reduce the number of fire type calls within the City in order to reduce apparatus needs within the Fire Suppression Rating Schedule. Currently additional needs of all companies for a fire at the full Basic Fire Flow was added within this grading item as there are over 4000 fire type calls within the City. Reducing the number of calls below 4000 will reduce the apparatus needs. A targeted prevention program should be implemented for those Districts with the largest call volume (see Figure 9). The program should be monitored on an on-going basis for effectiveness and adjusted accordingly in order to reduce the fire type calls. Further investigation should be completed on fire type calls in high volume Districts and causes established. Prevention and education programs should be tailored to the causes.

Recommendation 3 Apparatus replacement schedule

The current apparatus replacement schedule in place generally meets the replacement schedule for a large City. WFPS should continue to ensure that the maximum acceptable age of apparatus for the City of Winnipeg, as specified in the Classification Standard for Public Fire Protection, is 15 years as a First Line Duty apparatus and up to 20 years as a reserve in order to continue to receive credit as shown in Table 3.

Figure 9 Fire Type Calls by Fire District





City of Winnipeg

Figure 10 - Optimal Location of Facilities for 90% Coverage under First Due Pumper

Scale = 1:38,000 0 500 1,000 2,000 3,000 Meters

Fire Underwriters Survey
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7.2.1. Light Fleet Service

While some equipment such as wildland fire equipment are reviewed under the Fire Suppression Rating Schedule, see section 7.17, ambulance and paramedic vehicles and equipment are not reviewed. It was requested that a brief review be conducted of the Light Fleet and interview with the Light Fleet Supervisor.

Any apparatus not considered major fire apparatus (heavy fleet) are managed under a separate division of Winnipeg Fire Paramedic Service, i.e. Light Fleet (generally 1 ton and under), which is under the direction of the Supervisor of Light Fleet. As WFPS is a joint Fire and Paramedic service the Light Fleet division manages both ambulance and minor fire vehicles. Ambulance vehicles are either owned by the Provincial Vehicle Equipment Management Agency (VEMA) or the Winnipeg Fleet Management Agency (WFMA). WFPS leases all vehicles from either VEMA or WFMA. All purchases of other vehicles and equipment, i.e. the "Non-Transport" fleet are completed through a lease from Winnipeg Fleet Management Agency (WFMA) with approximately 95% of vehicles and equipment owned by WFMA at the time of this report.

A summary of ambulances is provided in Table 4. Unit number 682-3315 is a Provincial spare unit and may go to an outside Regional Health Authority, i.e. it is not committed to the City of Winnipeg. Additional medical vehicles are listed in Table 5. The remainder of the Light Fleet vehicles which are mainly owned by WFMA are listed in Table 6.

Light fleet maintenance is discussed in section 7.6.1.

Table 4 Provincial (VEMA) Ambulances

Vehicle #	Assignment	Year	Make	Stn.	Owner
682-3342	17	2013	Chev. Exp. 3500	33	VEMA
682-3341	12	2013	Chev. Exp. 3500	12	VEMA
682-3340	18	2013	Chev. Exp. 3500	18	VEMA
682-3339	11	2013	Chev. Exp. 3500	11	VEMA
682-2332	13	2012	Chev. Exp. 3500	13	VEMA
682-2333	92	2012	Chev. Exp. 3500	1	VEMA
682-2334	06	2012	Chev. Exp. 3500	6	VEMA
682-2335	16	2012	Chev. Exp. 3500	16	VEMA
682-2336	27	2012	Chev. Exp. 3500	27	VEMA
682-2337	91	2012	Chev. Exp. 3500	1	VEMA
682-2338	05	2012	Chev. Exp. 3500	5	VEMA
681-1348	01	2011	Chev. Exp. 3500	31	VEMA
681-1349	48	2011	Chev. Exp. 3500	17	VEMA
681-0344	41	2010	Chev. Exp. 3500	31	VEMA
681-0345	45	2010	Chev. Exp. 3500	5	VEMA
681-0346	31	2010	Chev. Exp. 3500	1	VEMA
681-0347	40	2010	Chev. Exp. 3500	10	VEMA
682-9309	Spare	2009	Chev. Exp. 3500	40	VEMA
682-9314	49	2009	Chev. Exp. 3500	21	VEMA
682-9316	Spare	2009	Chev. Exp. 3500	40	VEMA
682-9317	43	2009	Chev. Exp. 3500	33	VEMA
682-9319	Spare	2009	Chev. Exp. 3500	40	VEMA
682-9322	Spare	2009	Chev. Exp. 3500	6	VEMA
682-9325	25	2009	Chev. Exp. 3500	25	VEMA

682-9326	24	2009	Chev. Exp. 3500	24	VEMA
682-9327	20	2009	Chev. Exp. 3500	20	VEMA
682-6310	Spare	2006	Ford E350	40	VEMA
682-6314	Spare	2006	Ford E350	40	VEMA
682-6316	Spare	2006	Ford E350	40	VEMA
682-6318	95	2006	Ford E350	10	VEMA
682-6319	Spare	2006	Ford E350	40	VEMA
682-6320	Spare	2006	Chev. Exp. 3500	40	VEMA
682-3315	Spare(PROV)	2004	Ford E350	1	VEMA
681-0637	14	2010	Ford E450	14	WFMA
681-0638	02	2010	Ford E450	02	WFMA
681-1639	22	2011	Ford E450	22	WFMA
803-0772	Bariatric	2010	G4500 Express	40	WFMA
803-8770	36	2008	Chev. Exp. 3500	16	WFMA
803-8771	26	2008	Chev. Exp. 3500	32	WFMA
681-5624	MCI UNIT	2000	Ford Crestline	20	WFMA

Table 5 Additional Medical Fleet

Vehicle #	Assignment	Year	Make	Stn.	Owner
128-0901	Superintendant 55	2010	Ford 150 XLT	1	
152-3204	Spare MS	2013	Ford Interceptor	40	
152-4805	Med.Sup.75	2014	Ford Interceptor	11	
152-4806	Med.Sup.73	2014	Ford Interceptor	17	
152-4807	Med.Sup.74	2014	Ford Interceptor	31	
152-4808	Med.Sup.72	2014	Ford Interceptor	21	
152-4809	Spare MS	2014	Ford Interceptor		
154-3805	P-1 Platoon Chief	2013	Ford Expedition	1	

Table 6 Additional Fire Fleet

Vehicle #	Assignment	Year	Make	Stn.	Owner
101-4901	Director FP Janet Bier	2014	Ford Focus	FP	WFMA
101-4902	FP/PE (Senior's car)	2014	Ford Focus	FP	WFMA
101-4903	Comm Center	2014	Ford Focus	COMM	WFMA
101-7421	FP/PE **Spare**	2007	Ford Focus	FP	WFMA
101-7422	FP/PE Greg Wahl	2007	Ford Focus	FP	WFMA
101-7423	FP/PE Tammy Dreger	2007	Ford Focus	FP	WFMA
101-7424	FP/PE John Dela Cruz	2007	Ford Focus	FP	WFMA
101-7425	FP/PE Dwayne Huot	2007	Ford Focus	FP	WFMA
101-7426	FP/PE Marc Reshaur	2007	Ford Focus	FP	WFMA
101-7427	PubEd Coordinator	2007	Ford Focus	Academy	WFMA
101-7428	FP/PE Janice Thomson	2007	Ford Focus	FP	WFMA
101-8770	Fire Training	2008	Chevy Cobalt	Academy	WFMA
111-9570	Pool	2009	Chev Malibu	HQ	WFMA
127-5201	Arson/G30	2005	Chev Silverado	30	WFMA
130-1951	Fire House/Pub.Ed.	2011	Ford 250 XLT	Academy	WFMA
140-1825	Spare DC	2011	Ford F350 XLT	40	WFMA
140-1826	Spare DC	2011	Ford F350 XLT	24	WFMA
140-3401	Utility/Shop 1	2014	Dodge Ram 2500	Academy	WFMA

140-4405	D10	2014	Chev Silverado	10	WFMA
140-4406	D3	2014	Chev Silverado	3	WFMA
140-4407	D4	2014	Chev Silverado	4	WFMA
140-4408	D24	2014	Chev Silverado	24	WFMA
140-8916	Pool unit	2008	Chev Silverado	40	WFMA
140-8917	Pool unit	2008	Chev Silverado	40	WFMA
142-1329	EMS Training	2003	Trailblazer	Academy	WFMA
148-5201	Medical D1	2005	Chevy Cargo	Stores	WFMA
149-0390	Light Fleet	2010	Ford Escape	40	WFMA
150-7602	EPIC	2007	Ford Escape	40	WFMA
150-8910	Admin.Platoon Chief	2008	Ford Escape	H.Q.	WFMA
150-8911	EMS/WRHA Liaison	2008	Ford Escape	HQ	WFMA
150-8912	F.P. acmdtn. vehicle	2008	Ford Escape	HQ	WFMA
150-8913	Safety	2008	Ford Escape	HQ	WFMA
150-8914	Spare MS unit	2008	Ford Escape	40	WFMA
150-9921	Acting Ass. Chief	2009	Escape Hybrid	HQ	WFMA
150-9922	Acting Ass. Chief	2009	Escape Hybrid	HQ	WFMA
150-9923	Pool	2009	Escape Hybrid	40	WFMA
150-9924	HQ Pool	2009	Escape Hybrid	HQ	WFMA
150-9925	Pool	2009	Escape Hybrid	40	WFMA
152-3801	WFPS Chief	2013	Ford Explorer	HQ	WFMA
154-3805	Platoon Chief	2013	Ford Expedit SSV	1	WFMA
161-0901	Training	2010	Ford Transit XLT	Academy	WFMA
163-4801	Training	2014	Dodge Gr.Caravan	EMSB	WFMA
163-8911	IT	2008	Dodge Gr.Caravan	HQ	WFMA
164-3220	DC Operations	2013	Dodge Journey	HQ	WFMA
164-3221	Ass.Chief Fire Ops	2013	Dodge Journey	HQ	WFMA
164-3222	Acting Ass.Chief Fire Ops	2013	Dodge Journey	HQ	WFMA
164-3223	DC Prof. Develop.	2013	Dodge Journey	HQ	WFMA
164-3224	Ass.Chief EMS Ops	2013	Dodge Journey	HQ	WFMA
164-3955	Light Fleet Supervisor	2013	Dodge Journey	40	WFMA
164-3956	POOL	2013	Dodge Journey	HQ	WFMA
164-3957	EPCR	2013	Dodge Journey	HQ	WFMA
166-7701	Backboards	2007	Chev Express	Stores	WFMA
167-8770	Light Fleet Maint.	2008	Dodge Gr.Caravan	40	WFMA
169-1911	Supplies D2	2011	Ford E150 Econoline	Stores	WFMA
169-7902	Command / Air	2007	Dodge Sprint	3	WFMA
169-7903	WFPS	2007	Dodge Sprint		WFMA
171-7901	Field Safety Officer	2007	Dodge Sprint	30	WFMA
173-7904	Mech. Services	2007	Dodge Sprint	Academy	WFMA
173-9901	Building Maint.	2008	Dodge Sprint	Academy	WFMA
175-9808	16 Pass./Academy	1996	Dodge Van	Academy	WFMA
530-3902		2013	Bobcat 3600 UTV	24	WFMA
531-6911	Medical Gator	2006	John Deere	40	WFMA
531-3901	Wildland Fire Gator	2013	John Deere	26	WFMA
746-0946	Trailer	2004	Avenger	Academy	WFMA
746-3840	Trailer	2013	US Cargo Trailer	26	WFMA
746-3841	Trailer	2013	Lightning Trailer	20	WFMA

746-4915	Bobcat UTV Trailer	2014	Gatormade Trlr	24	WFMA
746-6911	EMS Gator Trailer	2006	Canada Trailer	40	WFMA
801-9784	Arson	2002	Explorer	30	WFMA
801-9790	Light Fleet	1996	Suburban	40	WFMA
801-9797	Light Fleet	1997	Suburban	40	WFMA
801-9802	Air/Sewing Rms	1999	Chevy	Academy	WFMA
801-9805	Spare	2003	Ford F-350	Academy	WFMA
801-9825	Pool	2003	Ford F-350	40	WFMA
801-9829	Pool	2003	Ford F-350	40	WFMA

7.3. Ladder Service

Fire departments are evaluated for the number of ladder companies in service relative to the overall fire potential and the area being protected. Ladder apparatus are required to be adequately housed and staffed in order to receive full credit.

The ladder service grading item refers to the amount of credit received for each of the department's ladder apparatus. Recognition and credit for ladders may be reduced or withheld based upon the measured reliability of the apparatus upon which they are installed (ex. factors such as age, listing, testing, etc.).

Fire apparatus that may serve dual purposes are evaluated based on the primary duty it serves on the fire scene. As previously stated, a ladder apparatus with a fire pump may be credited in one of two ways.

- 100 percent ladder credit as a ladder apparatus and 50 percent credit as an engine, or
- 100 percent credit as an engine apparatus and 50 percent credit as a ladder apparatus.

This all depends upon the number of apparatus a department has available and where credit should be distributed properly in the grading depending on the primary use of the fire apparatus.

Response to buildings that are 3 storeys or 10 m (35 ft) or more in height, or districts that have a Required Fire Flow greater than 3,300 IGPM (250 L/s), or any combination of these criteria, should have a ladder company. The height of all buildings in the community, including those protected by automatic sprinklers, is considered when determining the number of needed ladder companies for fire insurance grading to receive maximum credit. Refer to Appendix E for Requirements for Aerial Apparatus.

The benchmark number of ladder companies that WFPS can receive credit for based on the Basic Fire Flow of 5,700 IGPM (432 L/s) is 2. Values are cross referenced with the Table of Effective Response. Using a location-allocation GIS tool the optimal location and number of facilities to provide 90% coverage to RFF points under first due response time was found to be an additional 11. Currently 53.6% of RFF points are covered under their individual first due response times. With Fire Halls placed as shown in Figure 12, 89.6% of RFF points are covered under first due response times. When there are over 4000 fire type calls within a municipality, further apparatus needs are based on having the total number of ladder companies determined from the Basic Fire Flow, which for the City of Winnipeg is 5700 IGPM (432 L/s) or 2 ladder companies. A summary of apparatus needs is as follows:

- Ladder company needs from Basic Fire Flow = 2
- Ladder company needs from distribution analysis = 11
- Ladder company needs from fire calls >4000 = 2

Therefore the total needed companies for benchmarking within the Classification Standard for Public Fire Protection is 15. For fire insurance grading, a fire department should have one reserve ladder for each eight ladders in service. A fire department even with a single engine company should have a reserve engine.

A summary of ladder apparatus credit is provided in Table 7.

Table 7 Credited In-Service Ladder Summary

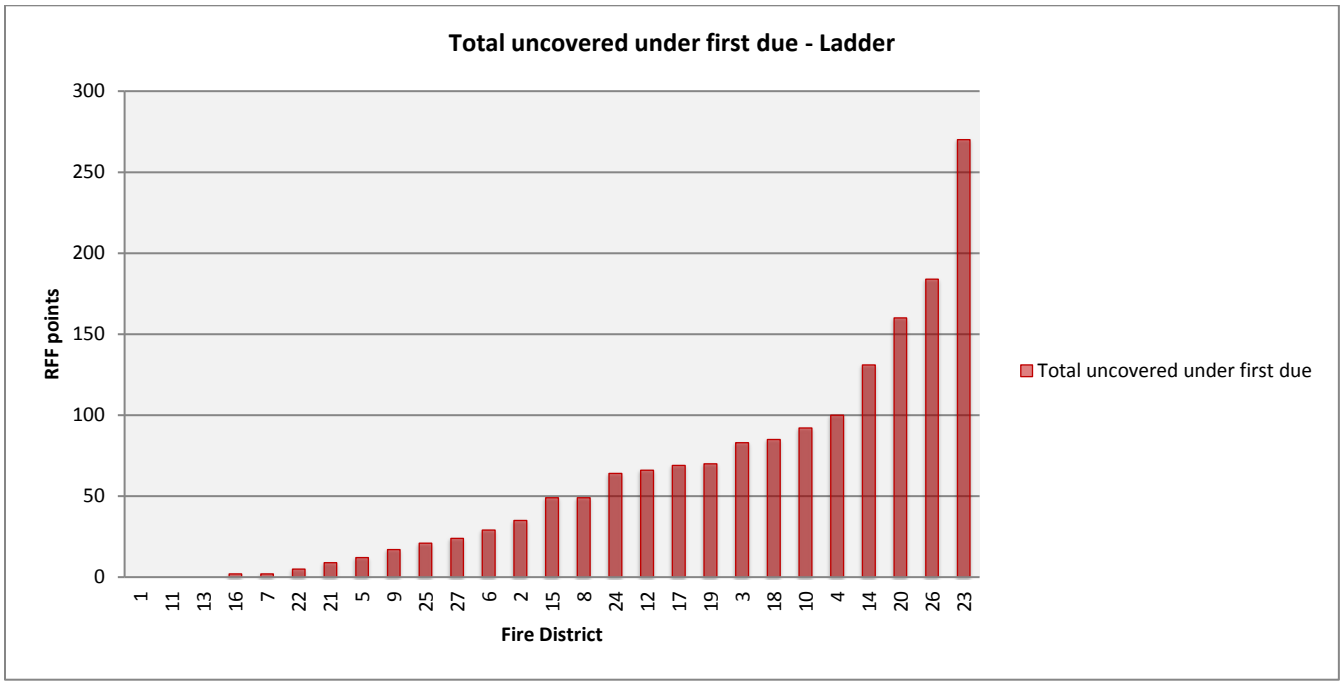
Identifier	Apparatus Credit	Ladder Credit	Reserve Ladder Credit
Ladder 1	Quint	1.0	0
Ladder 7	Quint	0	1.0
Ladder 11	Quint	1.0	0
Ladder 13	Quint	1.0	0
Ladder 16	Quint	1.0	0
Ladder 21	Quint	1.0	0
Ladder 22	Quint	0	1.0
822-9931	Quint	0	1.0
Total Ladder/Reserve Ladder Credit		5.0	3.0
Credit Receivable		15	2.0

The City of Winnipeg received **55.29%** credit for this grading item.

The RFF points chosen for ladder response are indicated in Figure 12. In the majority of cases details on number of stories was provided in the City Assessment data and was considered to be reasonably accurate. In cases where assessment parcels existed but the land was listed as Vacant Residential in the Parcel Use the number of stories/height may have been used as that allowable within the Zoning Bylaw. In addition the building area will have been taken as the average of buildings within the same Zoning Bylaw. An example of this can be seen in Figure 12 where there are building groupings in Fire District 23 and 26. This area is newer development or land zoned for development and the Zoning Bylaw for the R1-M allowing buildings 35ft in height. As buildings are constructed in this area of the community, structure stories and heights should be monitored in order to confirm ladder requirements.

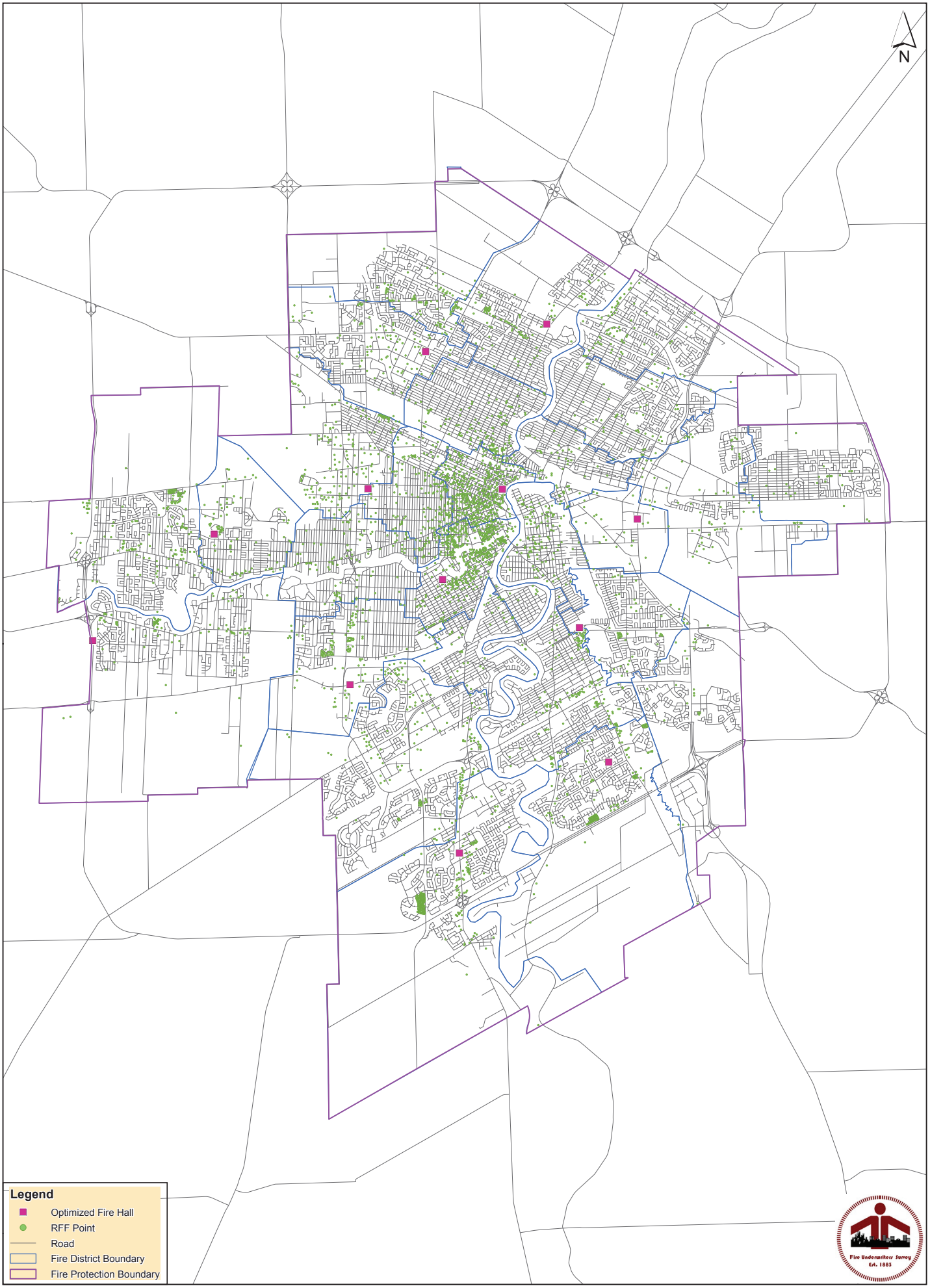
Figure 11 shows the number of RFF points, by Fire District, not covered under respective first due response distances. Fire District 26 and 23 are not further considered until further community build-out is reached. Fire District 20 has the next largest number of RFF points not meeting the benchmark response distance for ladder response. Fire District 18 and 19 also have a large number of points not meeting the benchmark response distances. Currently within the City of Winnipeg the closest ladder response to Fire District 18 and 19 comes from Fire Hall 11. This area of the community should be considered for additional ladder response. Further ladder apparatus placement should be considered based on Figure 11.

Figure 11 RFF points uncovered under first due – Ladder



Recommendation 4 Improve Ladder Coverage within the City of Winnipeg

Ladder Coverage should be improved within the City of Winnipeg. The area of Fire District 18, 19 and 20 was noted to have a lack of coverage. Careful consideration should be given to adding additional ladder apparatus which should include a review of call demand. Additional apparatus should be designed in accordance with the most recent edition of NFPA 1901.



City of Winnipeg

Figure 12 - Optimal Location of Facilities for 90% Coverage under First Due Ladder

Scale = 1:38,000 0 500 1,000 2,000 3,000 Meters

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7.4. Distribution of Companies

7.4.1. Background

While various standards and guidelines exist for measuring the number of apparatus needed and the placement of Fire Halls, each share the same basic theory. The process is typically as follows:

Most response standards identify 2 levels of responses:

- Initial Response – usually a time to scene for the first apparatus
- Total Concentration Response – usually the total number of apparatus needed on scene within a specified time

Within the Fire Underwriters Survey methodology the following are identified for each Required Fire Flow (RFF) (building):

- First due response – Initial number of companies within a specified time/distance depending on RFF value
- Second due response – Secondary number of companies within a specified time/distance depending on RFF value
- Total concentration response – Total number of companies within a specified time/distance depending on RFF value

NFPA identifies needed response in a similar manner (from 1710):

- "240 seconds or less travel time for the arrival of the first arriving engine company at a fire suppression incident and 480 seconds or less travel time for the deployment of an initial full alarm assignment at a fire suppression incident"…4.1.2.1(3)
- "The fire department shall have the capability to deploy an initial full alarm assignment within a 480-second travel time to 90 percent of the incidents"…..5.2.4.2.2

The NFPA Fire Protection Handbook further identifies typical response capabilities based on elevated risk levels identified as:

- High-hazard occupancies
- Medium-hazard occupancies
- Low-hazard occupancies
- Rural operations

Overall a municipality should identify the level of response that it will strive to provide and establish a standard of response policy statement. The following is an excerpt from the Commission on Fire Accreditation

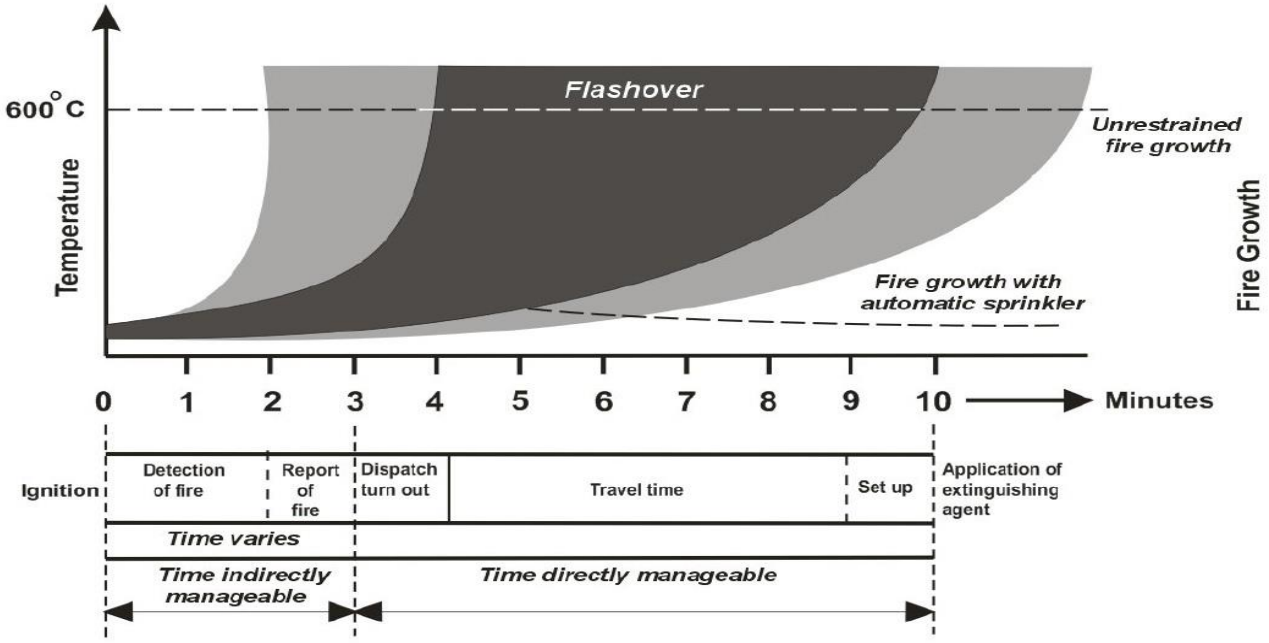
International manual “Creating and Evaluating Standards of Response Coverage for Fire Departments”, Chapter One – Service Level Expectations:

“After understanding the risks present in the community, what control measures do the citizens and elected officials expect? For example, does the agency confine the fire to the compartment of origin, area of origin, floor of origin, or building of origin? Some agencies in sparsely populated areas with response times of 30 minutes or more might have to accept (not like) an exposure level of service where the building fire does not spread to the adjoining forest and start a conflagration……Each risk category found in a community should have an outcome expectation developed for it.”

7.4.2. Response Assessment Overview

The intent of fire department response is to arrive at a fire scene with the necessary resources before the point of flashover, see Figure 13. Beyond the point of flashover, it can become very difficult to combat a fire as fire growth increases exponentially as can be seen.

Figure 13 Fire Propagation Curve (source NFPA)



It can be seen from Figure 13 that in order for a fire department to arrive with the necessary resources at a specific point of fire growth would require knowledge/control of all aspects of two systems: the fire and the response. In both cases neither system is completely controllable and as such most response standards are based on empirical data and research from mutual agencies. Response standards form the basis of fire station location/staffing/apparatus.

Within Canada two sets of response benchmarks are generally measured which are as follows:

- Fire Underwriters Survey – benchmark response distances
- NFPA response times

Both attempt to quantify the needed response at a certain point of fire growth. These two systems have the same origin and are essentially the same. NFPA sets out response time targets in NFPA 1710:

"240 seconds or less travel time for the arrival of the first arriving engine company at a fire suppression incident and 480 seconds or less travel time for the deployment of an initial full alarm assignment at a fire suppression incident"

Just as Required Fire Flows quantify the level of risk and hence the required response, the initial full alarm assignment is defined in NFPA 1710 only for:
"structure fire in a typical 2000ft^2 (186 m^2), two-story single-family dwelling without basement and with no exposures"

The resources needed for full alarm assignment within 480 seconds are not further defined.

For response assessment within the Fire Suppression Rating Schedule, the Table of Effective Response is used as the benchmark, see Table 11 Fire Underwriters Survey - Table of Effective Response. The single family dwelling structure described in NFPA 1710 would have a RFF value of 1100 IGPM. The benchmark response for 1100 IGPM is read from the Table of Effective Response (see Table 11) as follows:

- Initial response to alarms for Pumper companies is 2, i.e. 1 Pumper company in a first due response time of 4 minutes (same as NFPA 1710) and 1 Pumper company in a second due response time of 6 minutes.
- The total number of Pumper companies required is 2 in 6 minutes.
- In the case of 1100 IGPM (84 L/s) a Ladder company is required only if the building is 3 stories or greater.

Within the Fire Suppression Rating Schedule individual property response is measured against these benchmarks with 100% credit being applied where the requirements are met.

7.4.3. Response Assessment Model

WFPS records were chosen for the year 2013 in order to reflect the most recent response protocols and facilities; only fire type calls were selected (DeterminantType=WFD) resulting in 45,847 records. The data was further cleaned to remove the issue of cycling through status heads as discussed in section 7.2.

This further condition reduced the number of records to 32,262.

In order to further increase the number of good quality records, road network data provided by Winnipeg Public Works Transportation Division was imported into GIS and the best route distance (road speeds used as impedance to determine best routes) to the 32,262 records was determined. Average response speed for the route was then determined and records were removed based on the following conditions:

- WFPS GOG #2.10 – allows for a maximum travel speed (Code 4) of 15kmph over the posted speed limit. The maximum posted speed limit in the City is 100kmph; therefore, all records above 115kmph were removed.
- Records below 20kmph were also removed as the minimum posted speeds in the City are 30kmph (allowing estimate for traffic).

Travel times in excess of 20 minutes were also removed. This resulted in 28,889 records.

The GIS road network was used to determine the total response time for each of these records. Linear regression was then used to further calibrate the model. Traffic was not considered as from discussions with Public Works this was not considered to be a major issue over a 24 hour period. Additionally, fire apparatus

would use the on-coming lane on a road if traffic impeded response. The following was used as the response time function:

$$R_T = R_1 v + R_2 x + R_3 y + R_4 z$$

Where:
v = Road speed
x = Traffic signals
y = At grade rail crossings
z = All way stops

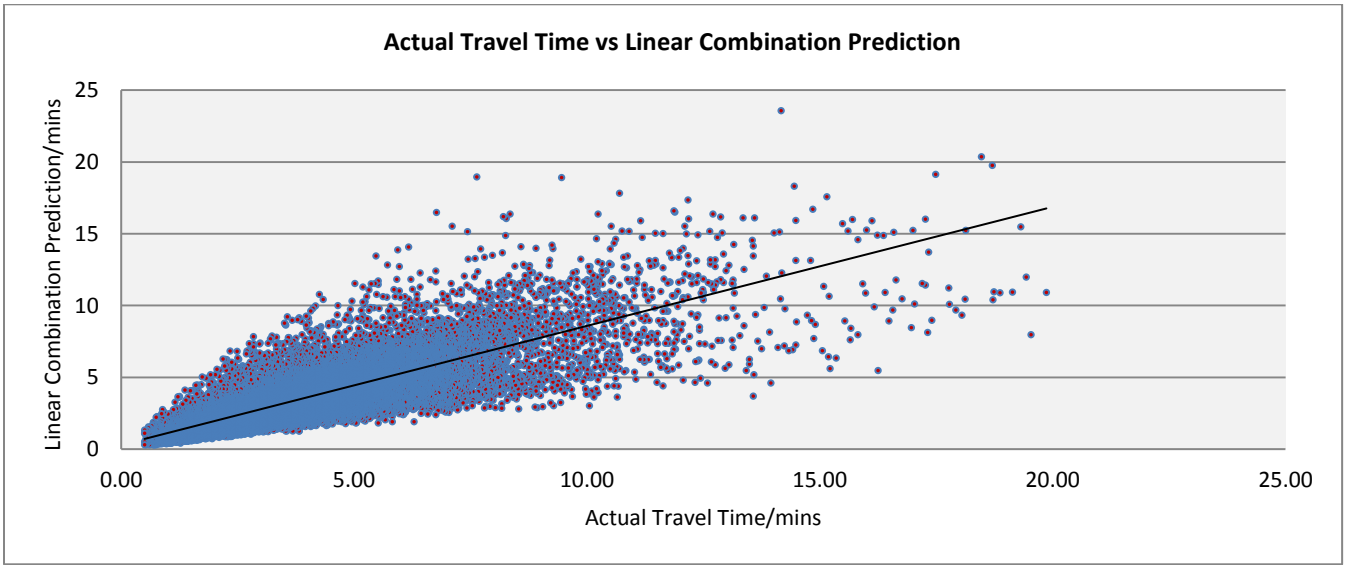
Again GIS was used with provincial rail network data and municipal road network data to establish values for x, y, and z for the 28,889 records. A summary of the regression analysis is provided in Table 8.

Table 8 Linear Regression Summary

	R Square	Prediction Standard Error	F Statistic	F Test P Value
	0.613	1.28	15234	0
Regression Coefficients				
	Coefficient	Coefficient Standard Error	t Statistic	T Test P Value
R1 (Road speed)	1	0.006	181.249	0
R2 (traffic signals)	0.076	0.002	32.159	0
R3 (Grade rail crossings)	0.148	0.007	22.586	0
R4 (All way stops)	0.22	0.007	29.505	0

The four predictors of road speed, traffic signals, at-grade rail crossings, and all-way stops accounted for 61% of the variance in response time. All variables are shown to be significant with response time derived from GIS road network showing direct correlations as expected. Traffic signals show an impedance of 4.56 seconds, at-grade rail crossings show an impedance of 8.88 seconds and all-way stops show an impedance of 13.2 seconds. A comparison of actual time to prediction is shown in Figure 14.

Figure 14 Actual Travel Time vs Linear Combination Prediction



The response variables were used to derive the current pumper and ladder coverage within the City of Winnipeg when response is measured against the benchmarks listed in Table 11. The results are summarized in Table 9, Table 10, Figure 15 and Figure 16. Percentage credit received for each RFF point is shown in Figure 18 and Figure 19. Figure 18 shows how well each RFF point met the benchmark pumper response for all apparatus needed. 100% credit (red) shows that all pumper apparatus are expected to be on-scene within the times specified in Table 11. As would be expected RFF points closer to the boundary of the City receive less credit; however, there are also pockets within the centre of the City that receive lesser credit. A notable area of lesser credit is in the area of Fire District 18 and 20. The area in the south of the community is also notable. Figure 19 shows percentage credit received for ladder response. Again, it can be seen that RFF points in the area of Fire District 18 and 20 receive 0%-20% (blue) credit.

A summary of the first apparatus on-scene can also be seen in Figure 17 where it shows that 93% of calls would expect a response within 4 minutes travel time from this analysis.

Table 9 Current Distribution of Response Credit - Pumper

	Required	Met Benchmark	Coverage
First Due Pumper	198651	172375	86.77%
Second Due Pumper	196993	166885	84.72%
Total Concentration Pumper (remaining apparatus needed)	66813	50986	76.31%

Figure 15 Current Distribution of Pumper Response Credit

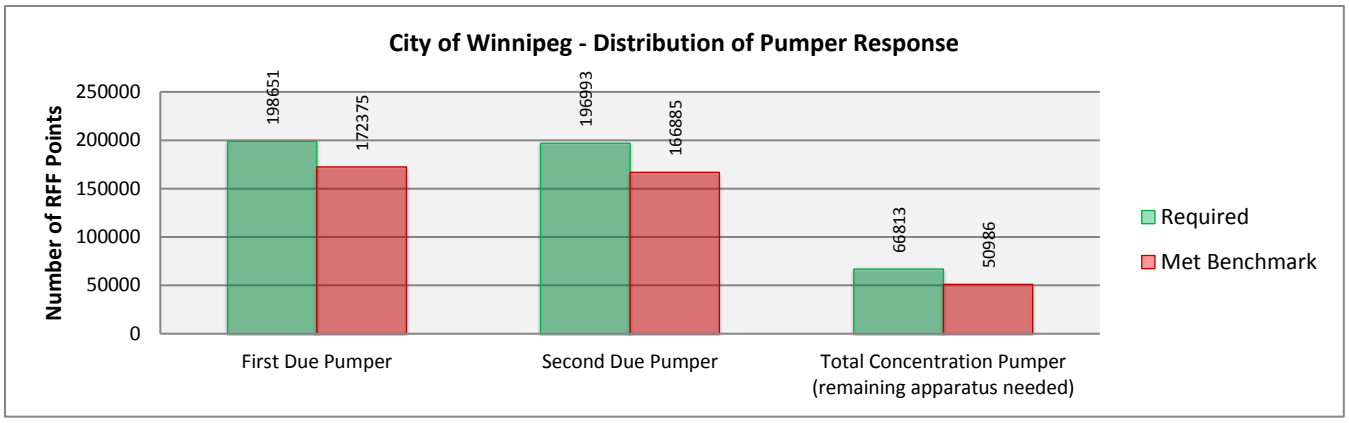


Table 10 Current Distribution of Response Credit – Ladder

	Required	Met Benchmark	Coverage
First Due Ladder	3507	1879	53.58%
Second Due Ladder	661	143	21.63%
Total Concentration Ladder (remaining apparatus needed)	34	10	29.41%

Figure 16 Current Distribution of Ladder Response Credit

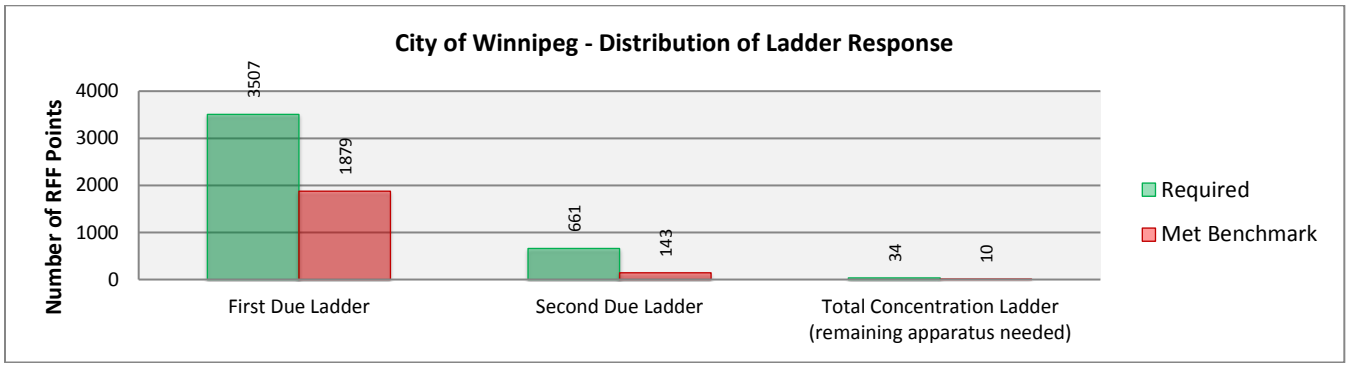
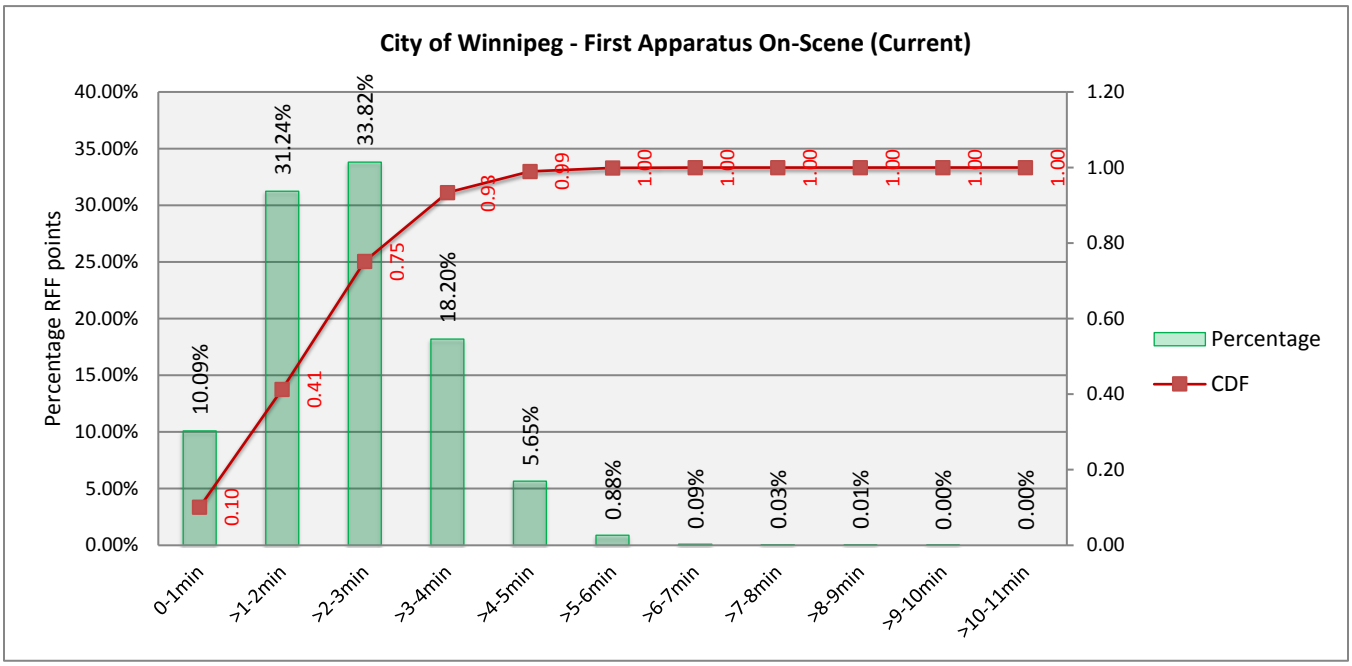


Figure 17 First Apparatus On-Scene (Current)



The City of Winnipeg received **69.5%** credit for this grading item.

Table 11 Fire Underwriters Survey - Table of Effective Response

The following Table aids in the determination of Pumper and Ladder Company distribution and total members needed. It is based on availability within specified response travel times in accordance with the fire potential as determined by calculation of required fire flows, but requiring increases in availability for severe life hazard.

RISK RATING	BUILDING DISTRICT EXAMPLES	FIRE FLOW L/min X1000	FIRE FLOW Approx. Igpm Range	INITIAL RESPONSE TO ALARMS Pumper Companies	INITIAL RESPONSE TO ALARMS Ladder Companies	1st DUE Engine Company, Minutes	2nd DUE Pumper Company, Minutes	1st DUE Ladder Company, Minutes	TOTAL Pumper Companies. No.	TOTAL Pumper Companies. Min.	TOTAL Ladder Companies No.	TOTAL Ladder Companies Min.
1 (a)	Very small buildings, widely detached buildings.	2	400	1	0	7.5	-	*9	1	7.5	*1	9
(b)	Scattered development (except where wood roof coverings).	3	600	1	0	6	-	*7.5	1	6	*1	7.5
2	Typical modern, 1 - 2 storey residential subdivision 3 - 6 m 10 - 20 ft. detached).	4-5	800-1,000	2	0	4	6	*6	2	6	*1	6
3 (a)	Close 3 - 4 storey residential and row housing, small mercantile and industrial.	6-9 10-13	1,200-2,000 2,200-2,800	2 2	1(if required by Hazards)	3.5 3.5	5 5	*4 *4	2 3	5 6	*1 *1	4 4
3 (b)	Seriously exposed tenements. Institutional. Shopping Centres Fairly large areas, fire loads, and exposures.	14-16 17-19	3,000-3,600 3,800-4,200	2 2	1 1	3.5 3.5	5 5	4 4	4 5	7 7	1 **1	4 4
4 (a)	Large combustible institutions, commercial buildings, multi-storey and with exposures.	20-23 24-27	4,400-5,000 5,200-6,000	2	1	2.5 2.5	4 4	3.5 3.5	6 7	7.5 7.5	2 2	5 5
4 (b)	High fire load warehouses and buildings like 4(a).	28-31 32-35	6,200-6,800 7,000-7,600	3	1	2.5 2.5	3.5 3.5	3.5 3.5	8 9	8 8	3 3	7 7
5	Severe hazards in large area buildings usually with major exposures. Large congested frame districts.	36-38 39-42 43-46	7,800-8,400 8,600-9,200 9,400-10,000	3	3	2 2 2	3.5 3.5 3.5	2.5 2.5 2.5	10 12 14	8 9 9	4 5 6	7.5 8 9

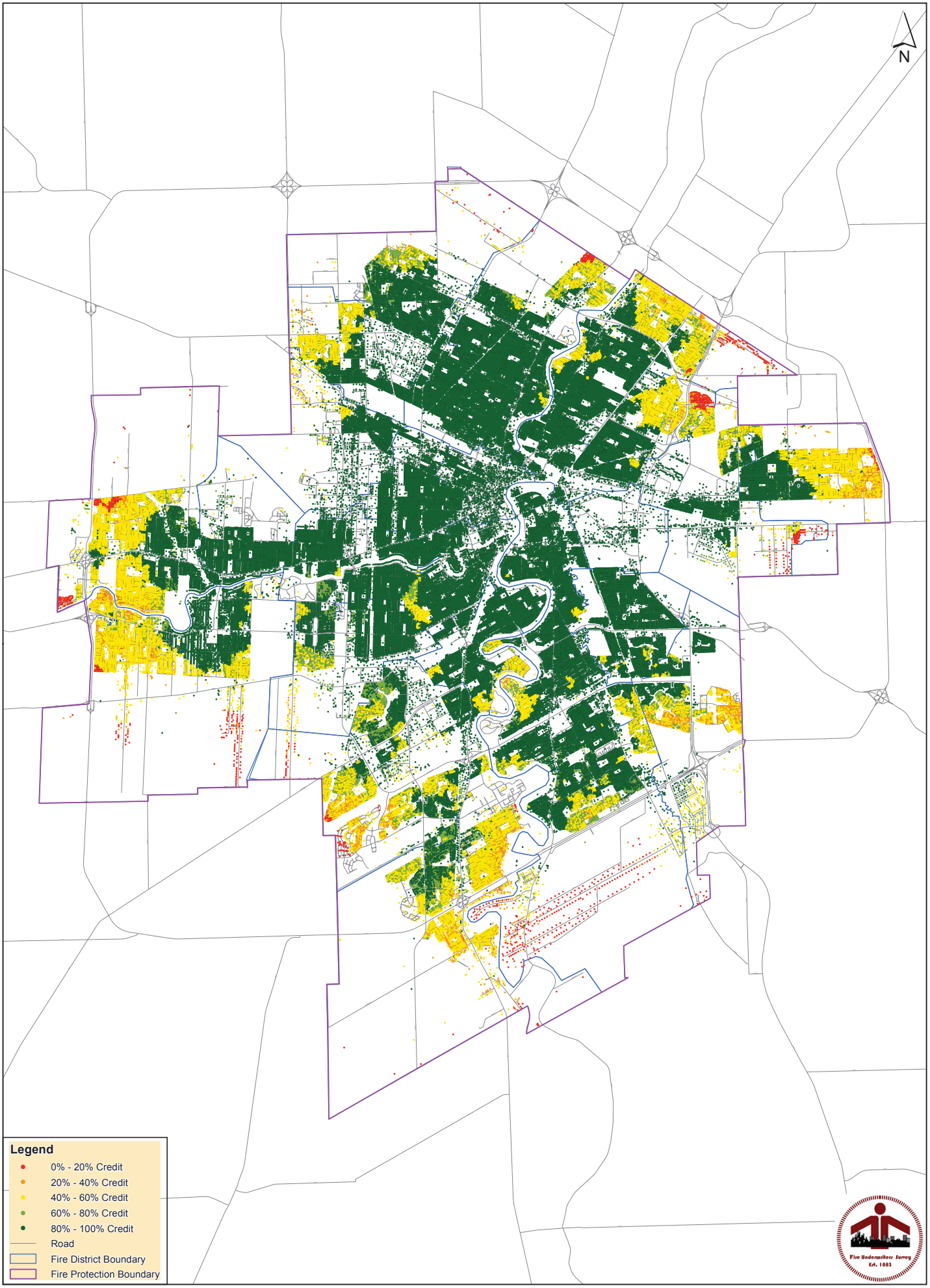
Notes to Table of Effective Response

* A ladder company is required here only when exceptional conditions apply, such as 3 storey heights, significant life hazards.

** For numerous or large single buildings over three stories use two ladder companies in 5 minutes.

When unsprinklered buildings over six stories have fire flow requirements less than Group 4, the number of Pumper and Ladder Companies under “Total Availability Needed” should be increased at least to the next group to provide the additional manpower required except where this additional manpower regularly responds in the time allotted, as occurs in some volunteer or composite fire departments.

The table gives travel times for apparatus AFTER dispatch and turn-out. Under very exceptional conditions affecting total response time, these nominal figures should be modified.

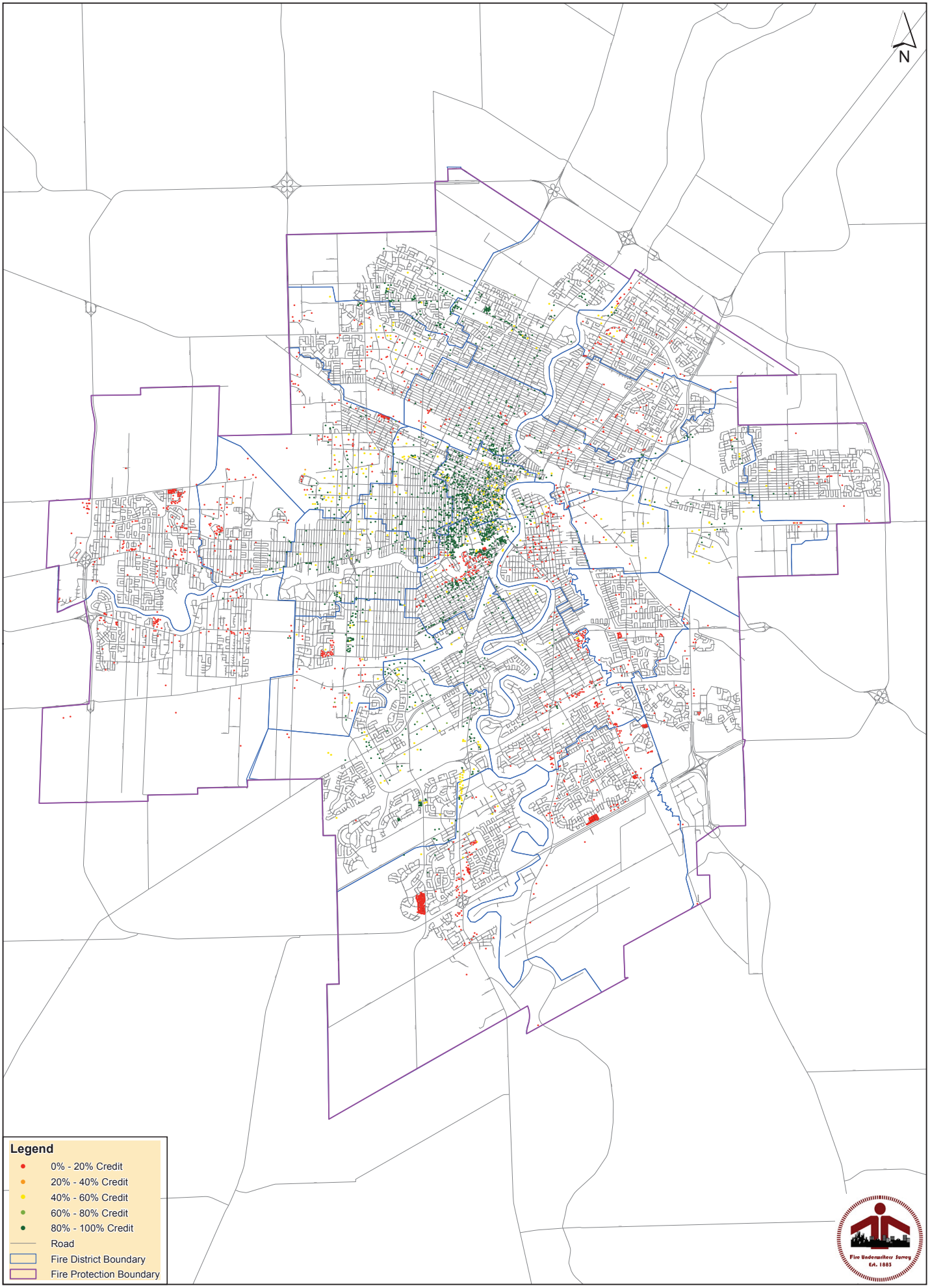


City of Winnipeg

Pumper Benchmark Credit

Scale = 1:38,000 0 500 1,000 2,000 3,000 Meters

Fire Underwriters Survey
A Service to Insurers and Municipalities



City of Winnipeg

Figure 19 – Ladder Benchmark Credit

Scale = 1:38,000 0 500 1,000 2,000 3,000 Meters

Fire Underwriters Survey
A Service to Insurers and Municipalities

7.5. Engine and Ladder Pump Capacity

The Engine and Ladder Pump Capacity grading item refers to the capacity of credited, recognized pumps located on fire apparatus. Recognition and credit for pumps on fire apparatus may be reduced or withheld based upon the measured reliability of the pumps and the apparatus upon which they are installed (ex. factors such as age, listing, testing, etc.).

Fire apparatus that may serve dual purposes are evaluated based on the primary duty the apparatus serves on the fire scene (ladder or pump). As previously stated, a ladder apparatus with a fire pump may be credited in one of two ways.

- 100 percent credit as a ladder apparatus and 50 percent credit of the pump on the apparatus, or
- 100 percent for the pump on the ladder and 50 percent credit as a ladder apparatus.

This all depends upon the number of apparatus a department has available and where credit should be distributed properly in the grading depending on the primary use of the fire apparatus.

The benchmark pumping capacity that the City of Winnipeg can receive credit for is based on the Basic Fire Flow of 5,700 IGPM (432 L/s).

Total credited pumper capacity is summarized in Table 3.

The City of Winnipeg received **100%** credit for this grading item.

7.6. Design, Maintenance and Condition of Fire Apparatus

Maintaining a reliable fire apparatus fleet could well be the most important capital asset for any municipal fire department. Firefighters are heavily dependent on the performance of their fire apparatus to deliver emergency services to protect lives, property and the environment. The apparatus must be maintained in superior operating condition and perform at the highest levels of safety, availability, functionality and reliability to ensure that emergency services are provided in a timely and efficient manner. When adequate performance levels can no longer be assured, apparatus should be replaced without delay, where possible.

The public fire service is rather unique when compared to other emergency services due to the fact that fire department apparatus are not continuously in use. However, when in use, fire apparatus are subject to considerable mechanical stress due to the nature of their function. The types of mechanical stresses that present immeasurable wear and tear on apparatus include, but are not limited to the following:

- The nature of emergency responses,
- Repeated acceleration and braking,
- Frequent defensive driving manoeuvres,
- High engine speeds prior to sufficient engine warm-up,
- Excessive loads adding additional stresses (water weight and equipment), and
- Long term cumulative effects of emergency responses and extreme operating conditions resulting in reduced performance levels and fatigued mechanical components and assemblies.

Visual indications of the effects of mechanical stress do not always manifest themselves on the exterior of the apparatus; they are often effectively masked in most fire departments by a higher standard of aesthetic care and maintenance.

Fire Department apparatus should be of suitable design and well maintained for the emergency service that is to be performed. A breakdown en-route to, or on the fire ground could result in loss of life and greater damage to property. Maintenance facilities, quality of maintenance programs, qualifications of maintenance personnel, apparatus suitability and apparatus age are considered in this item.

Maintenance Facilities
Maintenance (major or minor) on fire apparatus is conducted at the Fleet Maintenance yard by Master Emergency Vehicle Technician's (MEVT) and certified mechanics. From discussions with the Heavy Fleet maintenance manager all maintenance programs are under WFPS (note that this is unlike the Light Fleet case where maintenance programs are defined by WFMA and VEMA).

The pumps undergo regular scheduled maintenance in-house, as well as by a third party contractor, when necessary due to a back log of work orders. Each apparatus undergoes annual servicing and commercial vehicle inspection certification. The fire department maintains maintenance records typically in hard copy format, but has begun to move to digital storage in recent years. In addition, annual safety inspections are done in-house. Fire fighters perform daily and weekly checks on each apparatus. Check sheets for each of apparatus are kept in the fire stations, and sent to Fleet management. Work orders moved to an electronic system in 2006.

Maintenance Personnel
The qualifications of maintenance personnel that conduct regular maintenance on fire apparatus is reviewed under this portion of the grading item. To receive maximum credit in this portion of the grading item for fire insurance grading, individuals conducting preventive maintenance on fire apparatus should be certified Emergency Vehicle Technicians. Currently, the City of Winnipeg maintains a thorough fleet management program that maintains all Fire Paramedic Service vehicles. Three (3) of the mechanics permitted to work on fire apparatus are certified as Master Emergency Vehicle Technician's (MEVT), while the other three (3) are certified heavy mechanics and are working towards their EVT designation.

Discussions with the Heavy Fleet maintenance manager indicated that the current position is an acting manager. The length of time in this acting position was not clarified.

Engine and Ladder Testing
Engine and ladder service tests including but not limited to pump testing are valuable in assessing the effectiveness of the preventive maintenance program. Service tests of pumps and ladders on apparatus are generally conducted to show whether the equipment is working correctly.

Annual pump tests were provided for pumper and ladder apparatus for the past 3 years. In addition provincial Motor Vehicle Inspections were also provided. Non-destructive tests of aerial apparatus were provided. These tests are completed by a third party called Certified Inspection Services Ltd.

Two preventive maintenance schedules are reported to be completed on apparatus: PM A and PM B. PM A is completed after 150 hours of service and PM B is completed annually. PM A and B are outlined in APPENDIX F. A sample check sheet was provided; however, no records of completed tests were provided. The PM in place as listed in APPENDIX F is comprehensive and appears to generally meet the intent of *NFPA 1911 – Standard for the Inspection, Maintenance, Testing, and Retirement of In-Service Automotive Fire Apparatus 2012 edition*; however, an in-depth comparison was not completed. Although the PM program lists a brake performance travelling test,

discussions with the Heavy Fleet maintenance manager indicated that road brake tests have not been completed in a few years and would only be done upon complaint. The Heavy Fleet maintenance manager indicated that during his time with the division (13 years) the PM program has not been updated. NFPA 1911 has been updated various times over that period (2012, 2007, 2002) with a major update being completed in 2007 which included the addition of road and weight tests for apparatus. The PM program in place should be reviewed against the latest edition of NFPA 1911 and updated as required/needed. This should be a formal review listing documented considerations and decisions on updates to the current PM program. Additionally, the PM program should go through a periodic review that would best align with updates to NFPA 1911 or when there are noted issues with the PM program.

Recommendation 5 Complete periodic formal review of PM program.

The PM program in place should be reviewed against the latest edition of NFPA 1911 and updated as required/needed. This should be a formal review listing documented considerations and decisions on updates to the current PM program. Additionally, the PM program should go through a periodic review that would best align with updates to NFPA 1911 or when there are noted issues with the PM program.

Recommendation 6 Fully develop maintenance database

All in-house testing should be entered into a fully developed maintenance database listing all fields, e.g. all items listed in PM in APPENDIX F. In this way gap analysis and reporting can be completed easily especially at the Fire Department management level. These should also require a sign-off from the EVT completing the testing. Ideally this data should be entered at the time of testing, i.e. as each item is completed. The municipal IT department should be consulted on this implementation and feasible solutions such as database-connected tablets explored.

Firefighters conducting daily and weekly checks should also be connected to this maintenance database and entering all required fields accordingly.

Apparatus are removed from service for inspections and/or repairs if there appears to be any issues or concerns reported by fire fighters related to pumps, braking systems, steering and suspension components.

Age, Obsolescence and Condition of Apparatus

As fire department apparatus age, numerous studies have confirmed that they tend to require maintenance and/or repair on a more frequent basis, thus increasing costs and decreasing their level of reliability. Increased frequencies of maintenance/repair result in more “out of service” time often leading to an increased reliance on reserve apparatus, which typically have been demoted to reserve status as a result of exceeding its front line response expectancy. Increased probability of apparatus and equipment breakdowns or failures can also negatively impact the fire department’s level of personnel safety and operational efficiency.

A lack of readily available replacement parts can also make long term use of the apparatus less economically feasible. Vehicle, pump and equipment manufacturers typically maintain a parts inventory for each model year for a finite period of time. After that period has passed the necessary replacement parts may be difficult to locate and/or obtain which can lead to increased “out of service” time or result in the apparatus being operated with deficiencies. Availability of replacement parts can be particularly problematic with fire department apparatus, largely due to the limited market and specialized nature of the individual components which in many cases must

be re-built or custom fabricated. As previously mentioned, increased "out of service" time often results in an increased dependency on reserve apparatus which can further drive up maintenance/operating costs.

Obsolescence is another key factor related to aged fire department apparatus. Modern fire apparatus continually increase levels of safety, performance, functionality and reliability through the use of new technology, improved engineering practices and compliance with updated, recognized industry standards. Fire department apparatus equipped with the latest operating capabilities and safety features will ensure that fire fighter operational efficiency is maximized and their risk to possible injuries is kept to a minimum.

Service life is considered to be the period of time in which a fire department apparatus can be maintained in superior operating condition and is capable of adequately, reliably and efficiently performing all of its originally designed functions and duties. There are a number of indicators that will enable fire service management and fleet managers to understand that a piece of apparatus may in fact be reaching the end of its serviceable life span. The majority of these indicators will likely be identified during regular maintenance or annual testing of apparatus such as:

- Decline in pump capacity,
- Degradation of braking systems (longer braking distances experienced),
- Decreased engine performance, reliability and acceleration,
- Structurally weakened chassis due to constant load bearing,
- Slower engine warm up times, and
- Engines operating at higher revolutions per minute (RPM).

The National Fire Protection Association (NFPA) standards do not specify a mandatory retirement age for fire apparatus mainly due to the number of individual factors that can affect the lifespan of any fire department apparatus. The NFPA does however recommend that fire apparatus older than fifteen (15) years, that have been properly maintained and that are still in serviceable condition, be shifted from first-line service and placed in reserve status. The NFPA further recommends that any apparatus over twenty-five (25) years of age or those not conforming to applicable NFPA fire apparatus standards should be replaced.

Fire Underwriters Survey (FUS) considers the age of fire department apparatus to be one of many important factors when conducting fire insurance classification grading evaluations in large part as a result of the factors previously noted. The specified service tests are outlined in Appendix C "Recommended Service Tests for Used or Modified Fire Apparatus". Testing and apparatus maintenance should only be completed by a certified technician in accordance with NFPA 1071, "Standard for Emergency Vehicle Technician Professional Qualifications (Most Recent Edition.").

The age of fire apparatus is reviewed within the fire insurance grading system relative to age benchmarks of 15 years. The WFPS apparatus age vary from 1 to 20 years in age, this includes second line or reserve engines and/or aerials. Front line response apparatus (engines) are of reasonable age and kept in good working order.

One further item noted through discussions with both Fire Department management and Heavy Fleet maintenance was the issue of cracked chassis in apparatus. Through the regular PM program a cracked chassis was noted on one of the ladder apparatus. Since this initial issue, 2 further ladder apparatus and one pumper apparatus were also noted to have chassis cracking issues. While this was not further explored it was reported by the Heavy Fleet maintenance manager that the issue is apparently happening where 2 chassis metal components are mounted together. The Heavy Fleet maintenance manager also noted that newer apparatus have been galvanized and suggested that galvanic corrosion (considering road salting) may have caused previous chassis issues. NFPA 1901 – Standard for Automotive Fire Apparatus 2003 edition introduced section 15.9.1:

"Where dissimilar metals that pose a galvanic corrosion or reactive threat are to be mounted together, the mounting base material shall have an isolation barrier prior to assembly to prevent dissimilar metal reaction"

This issue should be further investigated.

Recommendation 7 Further investigate chassis issues

Further investigation of the chassis issue should be completed as this may be a concern in all apparatus manufactured prior to 2003.

The City of Winnipeg received **97%** credit for this grading item.

7.6.1. Light Fleet Maintenance

Light Fleet maintenance programs and preventive maintenance are defined by VEMA and WFMA.

VEMA has a defined Preventive Maintenance Program in place for ambulances. 4 levels of preventive maintenance are conducted as shown in APPENDIX F.

In addition to the Preventive Maintenance Program the following yearly maintenance and safety inspections are also completed:

- Complete Manitoba Public Insurance (MPI) Commercial Truck Inspection (Note: replace brake lining if worn 50% or greater)
- Automatic transmission service (if required) per Manufacturer's recommendation
- Check and adjust front-end alignment (if required) per Manufacturer's recommendation
- Replace rear differential fluid (if required)
- Check cooling system, coolant strength and block heater operation
- Check for tune-up and replace fuel filter – gas engines only (if required)

WFMA also has a defined Preventive Maintenance Program in place for ambulances. 7 levels of preventive maintenance are conducted as shown in APPENDIX F.

Maintenance is conducted at both the VEMA facility and the WFMA facility. It was noted that minor maintenance is not completed due to a lack of spare vehicles being available.

The Light Fleet Supervisor indicated that the replacement schedule has improved since 2010. VEMA tailors replacement to regions, with ambulances in the City of Winnipeg being replaced approximately every 4-5 years. Prior to 2010 replacement was on an 8 year schedule. VEMA replaces ambulances approximately every 5 years.

Regular equipment checks are reported to be conducted by Paramedic crews; however, this program is not reviewed for conformance and discussions with the Light Fleet Supervisor indicated that there may be compliance issues. This should be further reviewed for compliance and a digital database system of tracking put in place so that is easier to track and manage.

7.7. Number of Line Officers – Fire Suppression

The number of Chief Officers and Company Officer positions is reviewed and graded under this item. The number of Chief Officers and Company Officers required to receive maximum credit for this grading item is determined from the Basic Fire Flow and the resulting number of engine and ladder companies associated with the benchmark.

Chief Officers
For fire insurance grading the maximum credit WFPS can receive for Chief Officers is seven. Full credit is received for each career Chief or career Deputy Chief on the department. An Auxiliary Chief or Auxiliary Deputy Chief is credited at 50 percent.

Additional credit can be received up to the maximum if there were more individuals assigned and trained to provide duties of the Fire Chief and or Deputy Chief. Credit can be received through a combination of career and auxiliary Chief Officer positions.

Company Officers
The number of Company Officers that WFPS can receive maximum credit for fire insurance grading is determined by the total number of engine and ladder companies based on the Basic Fire Flow benchmark and an on duty shift factor. Credit can be received through a combination of career and auxiliary officers on the fire department. Full credit is received for each career officer on the department. Auxiliary officers are credited at 50 percent.

The City of Winnipeg received **100%** credit for this grading item.

7.8. Total Fire Force Available

Under this grading item, a fire department is measured in its ability to meet the staffing requirements as determined by the Basic Fire Flow benchmark from the Table of Effective Response. For the grading of this item there should be at least six competent career fire fighters available and assigned to respond to fire for duty with each required engine and ladder company. The number of these fire fighters that should be on-duty with the apparatus of these companies at all times should be appropriate to the fire risk and fire incidence load.

For the purposes of fire insurance grading, the maximum creditable number of career fire fighters per company is six (including officers). Therefore, the maximum credit that that City of Winnipeg can receive for in this grading item is 288 career fire fighters based on 33 engine companies and 15 ladder companies (48 apparatus x 6 per apparatus = 288).

The total maximum creditable number of firefighters is based on the number of companies (total concentration) and the maximum creditable number of career fire fighters per company (six) per shift (including officers), available continuously year round (day and night) for fire insurance grading.

Credit for available fire force may be received according to the:

- minimum career fire fighters on duty,
- minimum regular vol. and off shift response of career fire fighters on 1st alarms,

- police officer/fire fighter and ambulance attendant/fire fighter,
- minimum automatic aid response,
- minimum mutual aid response, and
- minimum response of off-shift career fire fighters on multiple alarms.

Note that probationary fire fighters (incomplete training) and junior fire fighters (under age) are not credited due to lack of active fire ground duties.

Minimum Career Fire Fighters on Duty
The minimum number of career fire fighters on duty is determined by reviewing the fire departments records. Records are reviewed to determine the number of fire fighters on duty as during normal vacation periods less average details and sick leaves, but not the absolute minimum that may occur only one or two days a year. This includes career company officers and fire fighters. For fire insurance grading, career fire fighters on duty are equal to one Fire Fighter Equivalent Unit (FFEU).

Minimum regular vol. and off shift response of career fire fighters on first alarms
Fire departments having off duty career members or auxiliary members responding on first alarms may receive credit. Typically three off duty or auxiliary members responding on first alarm are considered as one FFEU for grading purposes. Consideration for credit is based on records being available indicating response statistics. If no records are kept of response, credit for FFEU is limited to one FFEU for each six off duty or auxiliary members claimed to respond.

Police and Ambulance Personnel
Fire Departments may receive credit within the grading of this item for police and ambulance personnel responding and performing fire ground duties. The amount of credit depends upon the extent to which they are available and are used for response to fire alarms. Records of response and training are reviewed to determine that amount of credit that can be received. Each ambulance attendant/fire fighter or police officer/fire fighter on duty in a radio equipped vehicle and responding on first alarm equals 0.5 FFEU.

Automatic Aid
Fire departments that have formal contracts for automatic aid response may receive credit for the personnel responding for this grading item. For personnel to be credited for automatic aid the responding fire department should be within 8 km in road travel distance to built-up areas of the community or municipality. Each career fire fighter from the responding fire department may be credited as one FFEU and each volunteer fire fighter from the responding fire department may be credited as 0.33 FFEU.

Mutual Aid
Fire departments that have formal contracts for mutual aid response may receive some credit for the personnel responding for this grading item. For personnel to be credited for mutual aid the responding fire department should be within 25 km of travel distance to built-up areas of the community or municipality. Each career fire fighter from the responding fire department may be credited as one FFEU and each volunteer fire fighter from the responding fire department may be credited as 0.33 FFEU.

Off shift Response on Multiple Alarms
Fire departments that have formal agreements for career members to respond off shift on multiple alarms may receive credit for members responding within this grading item. Career members responding on multiple alarms are credited on the basis of four off duty career members being equal to one FFEU. Auxiliary members are credited the same as on first alarm as 1/3 if statistical records of response are available or 1/6 if no records of response are available.

The City of Winnipeg received **77.5%** credit for this grading item.

7.9. Engine and Ladder Company Unit Manning

This grading item measures the company unit strength of on-duty paid personnel responding on in-service apparatus. A maximum manning of six can be credited for each in service engine and ladder company.

The number of members credited on-duty and on first alarm response determined from section 7.8 is used in the analysis of this grading item. The number of in-service engines and ladder apparatus is determined from sections 7.2 and 7.3.

The amount of credit received in this grading item is as follow:

Average Company Staffing	Credit
6 members	240
5 members	230
4 members	225
3 members	210
2 members	180
1 member	120
0 members	0

The City of Winnipeg received **97.92%** credit for this grading item.

7.10. Master and Special Stream Devices

This grading item considers the equipment fire fighters would use to be effective in combating large fires and fires in upper storeys or hard to reach locations. Equipment considered under this grading item are fixed and portable turrets, large spray nozzles, distributing nozzles, foam equipment, and elevated master stream devices.

The City of Winnipeg received **100%** credit for this grading item.

7.11. Equipment for Engines and Ladder Apparatus, General

This grading item considers the general equipment for engine and ladder apparatus. Equipment includes, but is not limited to, rope, cutters, fire extinguishers, nozzles, first aid equipment, wrenches, generators, salvage tarps, etc.

Inventories have been developed by the fire department to keep track of equipment stored on its fire apparatus.

General Equipment for Engines and Ladder Apparatus
The inventories for each fire apparatus were briefly reviewed for fire insurance grading purposes and found to be generally adequate.

The City of Winnipeg received **100%** credit for this grading item.

7.12. Fire Hose

Fire hose used by the fire department should be distributed so that each engine company carries a minimum of at least 360 m (1,200 ft) of 65 mm (2 ½ in) (or larger), 180 m (600 ft) of 38 mm (1 ½ in), and 60 m (200 ft) of 25 mm (1 in) booster hose (or equivalent hose). A fire department should maintain a complete reload or spare hose at the Fire Hall. Maximum credit for this grading item is given if the fire department meets or exceeds the minimum hose totals. Larger hose may be credited in the place of smaller hose.

The City of Winnipeg received **100%** credit for this grading item.

7.13. Condition of Fire Hose

This grading item reviews the condition and maintenance of the fire department's fire hose. Fire hose should be properly cared for. Fire hose failure on the fire ground can lead to injury or death of building occupants or to fire fighters, and result in unnecessary property damage. Suitable facilities should be provided for washing, drying, and storing of fire hose. Fire hose should be maintained in good condition and tested annually to at least 1,700 kPa (250 psi) pressure.

Testing Program and Age of Fire Hose
A portion of this grading item reviews the testing procedures and frequency of testing of the fire department fire hose. Fire hose should be maintained in accordance with NFPA 1962, *Standard for the Inspection, Care, and Use of Fire Hose, Couplings, and Nozzles and the Service Testing of Fire Hose,* recent edition.

WFPS has an annual hose maintenance program. Records of hose testing were provided.

Drying Facilities
Facilities and equipment for cleaning and drying of fire hose are reviewed in this portion of the grading item. All except 5 Fire Halls have hose drying towers.

The City of Winnipeg received **98%** credit for this grading item.

7.14. Training and Qualifications

Fire Department training is commensurate with fire potential in the community or municipality which facilitates the effective handling of fires through provision of a competent force of personnel. The objective of this grading item is to measure qualifications of the members of the department through the results of the training programs, not simply the programs and facilities themselves. The training and qualifications grading item is separated into five areas for review and grading.

Facilities should be provided, sufficient in size and number and suitably equipped, for the proper instruction of all members. There should be a complete, uniform training program under the close supervision of a competent officer; the program should include the study and development of modern practices, including standard operational procedures. There should be a comprehensive schedule of regular classes and drills at the training facility and at fire stations. Special classes for new members, officers, operators, and drivers should be held.

The Training Division within Winnipeg Fire Paramedic Service consists of an Academy Director of Training and five (5) Training Officers. The Training Officers are responsible for the delivery of recruit class training; specialized training for on duty crews; incident command training; and training that may include various tools and props at the training academy.

Quality of Basic Recruit Training
This portion of the grading item reviews the basic recruit training program used by the fire department including the probation period. Ideally a fire fighter should serve a probation period of up to one year in training status in which thorough training is provided in safe and efficient fire fighting and the probationer is assessed in actual fire service performance.

Training should produce, for most of the force, an all-around fire fighter/fire prevention inspector. This allows the fire fighting force to complement the fire prevention staff in the total fire department objective. Recruit training should be separate from the routine drill program.

The Fire Department requires that new applicants have their NFPA 1001 Level 2 certification and Class 4 licence. The majority (if not all) of fire fighters within Winnipeg have received training through the Manitoba Emergency Services College (MESC). Selected candidates must pass a physical test and an interview. Candidates are then put on a waiting/eligibility list for a period of twelve (12) months. A job offer is made to the candidate(s) and recruit class begins.

Fire fighters are on probation for a period of eighteen (18) months. During the first six (6) months, the fire fighters do not drive the apparatus. During probation, junior/probationary fire fighters are assigned various roles and tasks and receive regular mentoring from Senior Fire Fighters and Captains. Upon completion of the probation period of eighteen (18) months, a promotion test is required which includes SOGs, common practices and techniques.

Quality of On-going Drills and Training
This portion of the grading reviews a fire departments on-going drill and training program. A fire department training program should include practise evolutions, classroom work, fire fighting, prevention and other areas, all to be contained in a department manual; as well as inter-company and building familiarization exercises. This program should be under the supervision of an officer in charge with developing, coordinating and evaluating the results.

Within the Winnipeg Fire Paramedic Service there is no mandatory fire fighter skills maintenance training program, no annual or quarterly training matrix/schedule. Fire fighters are not required to complete a specified number of hours of training nor are fire fighters required to complete training for core competencies required for NFPA 1001 Level 2 or Winnipeg Company Officer. In shift training is completed at the discretion of the on duty Captain and may include reviewing the online database of videos and lesson plans and practical training (ropes, knots, ladders, SCBA, tactics, etc.). As in-shift training is at the discretion of the Captain, skills maintenance and aptitude of fire fighters and officers is considered to be inconsistent throughout the City of Winnipeg. Though fire fighters and captains are NFPA 1001 Level 2 and Winnipeg Company Officer, the skills needed to achieve those certifications should also be maintained consistently throughout the Fire Department.

Completed training is indicated by a station Captain logging onto the online records management system and accessing the fire fighter(s) record and indicating that they have completed a specified topic. There is no digital signature/sign off completed by either the Captain or the Fire Fighter; however, the Captain does indicate in the records management system that the fire fighter has completed a topic with a “completed yes/no”. The current records management system in place can show the Training Officers and Academy Director of Training what training has been completed (by topic or by staff). The system does not currently allow the user to perform a gap analysis to indicate any outstanding training that must be completed or training that has not yet been completed. To do this, the user would have to search individual staff and cross reference completed training with required or outstanding training.

The majority of training is through the online video database. Practical training scheduled by the Training Officers includes:

- Forcible entry,
- Saws course,
- Flame simulator (incident command management),
- Auto extrication training (also completed at the request of firefighting crews),
- Pump operator,
- Specialty training (water/ice rescue, hazmat, technical rescue, trench rescue, ICS 100)

Recommendation 8 Develop Annual and Quarterly Training Matrix

It is recommended that the Fire Department develop an annual and quarterly training matrix that includes mandatory training required for NFPA 1001 Level 2 and NFPA 1021 Level 2 certification in addition to maintaining the skills and techniques needed for speciality services. An annual and quarterly training matrix/schedule is a critical tool that will assist with the Fire Department operations management, planning and budgeting. Implementing an annual and quarterly training matrix will also help ensure quality and consistency of training for each Fire Fighter and Captain.

A log and notification tracking system should also be in place to ensure that all staff are up to date with their mandatory training. See Recommendation 9.

Recommendation 9 Improve Record Keeping Practices for Staff Training

It is recommended that the record keeping practices for staff training include mandatory digital sign offs for Fire Fighters and Captains. The program should notify Captains, District Chiefs and Platoon Chiefs of any outstanding training that has not been completed as required by the annual training matrix described in Recommendation 8. The program should include summary reports that can be produced for District and

Platoon Chiefs, Training Officers and senior staff to determine trends, possible setbacks, bottle necks and challenges faced with scheduling and completing mandatory training.

Qualifications of Officers

A portion of the grading item reviews the fire departments qualifications of line officers and promotion of its members. Within the fire insurance grading, promotions should be carried out under a documented system providing job related criteria for each rank for internal and lateral entry. Written and oral examinations, in-service training, programs directed toward particular job positions, and evaluation by superiors as well as training ground tests should be used for the selection of candidates for fire suppression officer positions. Career, on-call and auxiliary members of the same fire department should be trained to identical qualification levels. (NFPA Standards for Professional Qualifications, 1001, 1002, 1021, 1031 and 1041 are indicative of good practice.)

Eligibility of Fire Fighters for promotion to rank of Lieutenant is based on seniority. Fire Fighters with a minimum fifteen (15) years' experience as a Winnipeg Fire Fighter are eligible for promotion. Selection of staff is strictly based on seniority and does not consider previous experience, knowledge, qualifications or aptitude. Staff selected to become a Lieutenant enter the Lieutenant Training Program or Senior Fire Fighter Program. The selected candidate(s) must complete 80 shifts as a driver for a District Chief. While serving as the District Chief driver, the candidate is mentored in Incident Command Management (ICM). After completing 80 shifts, the candidate begins the Company Officer Development Program (CODP).

Previously WFPS had the CODP program in place which was not accredited or recognized as equivalent to NFPA 1021 by Manitoba Emergency Services College. Upon review, the Company Officer Program is not considered equivalent to NFPA 1021 from the perspective of the fire insurance grading. NFPA 1021 considers several key components with requisite skills and knowledge associated for each. The components considered for Fire Officer Level 1 and Level 2 are:

- General
- Human Resource Management
- Community and Government Relations
- Administration
- Inspection and Investigation
- Emergency Service Delivery
- Health and Safety

Through the 80 shifts as a driver for a District Chief, the candidate is exposed to and develops an understanding of the roles, responsibilities and expectations placed upon them as an Officer. Some of knowledge and experiences gained through the mentoring program provides the candidate with the requisite skills and knowledge associated with NFPA 1021. The Company Officer Course is a ten (10) day course outlined in Table 12:

Table 12 Winnipeg Company Officer Development Outline

Day 1	-Classroom address by Department Chief and Academy Director outlining expectations of Company Officers. -Lectures related to ICS (Brief Initial Reports, Size-up benchmarks, Command Board)
Day 2	-Lecture and discussion relating to role of Company Officer (leadership, strategy, Tactics for incident stabilization) -Review and introduction to 8 functions of IC, building construction, reading smoke
Day 3	-Lecture - equity and diversity program -Presentation and discussion with WFPS medical doctor

Day 4	-Workplace conflict workshop (provided by outside agency)
Day 5	-Workplace conflict workshop (provided by outside agency)
Day 6	-Flame simulator introduction -Arson and fire prevention presentations -Principles of forced ventilation (PPV, PPA, PPP)
Day 7	-Flame simulator scenario (IC focus and accountability and command board)
Day 8	-Flame simulator scenario -Hazmat scenario
Day 9	-Command test -Flame simulator practical evaluations -Classroom presentations regarding MSA air telemetry system
Day 10	-Flame simulator practical continued

The CODP has focus on incident command, which is a critical element of a Company Officer when responding to emergency events. The primary components within the CODP that are not included or may need to be expanded upon to meet NFPA 1021 are: Inspection and Investigation skills and requisite knowledge; Administration skills and requisite knowledge; Human Resources Management skills and requisite knowledge; and Community and Government Relations skills and requisite knowledge.

Since 2016, WFPS has exclusively used IFSAC and/or ProBoard accredited, NFPA 1021-compliant company officer level 1 training for new Lieutenants. WFPS is commencing level 2 training for new District Chiefs in fall 2017.

Recommendation 10 Improve succession planning for all line Officer positions

To help improve fire ground operations, it is recommended the WFPS provide progressive and current leadership training earlier in the career for front-line Lieutenants, Captains, District Chiefs, and Platoon Chiefs. Candidate considerations should include existing credentials, previous experience, training, education, and personal characteristics needed to succeed in the position.

Qualification of Specialists

A portion of the grading item reviews the specialized training and qualifications of members of the fire department. Training and education of members of the department on the job or by outside resources should provide personnel with the abilities to perform their manual rescue firefighting, firefighting or specialist functions effectively in a manner commensurate with the size of the fire department and the fire potential of the community or municipality, including pump and ladder operators, mechanics, communications and any other fire suppression specialized personnel.

WFPS previously did not have NFPA certifications for the specializations they perform. In lieu of this, in house training programs were developed and referred to as “Winnipeg Certified”. Since 2014, WFPS has moved to IFSAC or ProBoard NFPA-compliant training wherever possible for all technical specialist training.

Furthermore, once a risk assessment has been completed of rail facilities within the community (see Recommendation 1) a training gap analysis can be completed for this specific site and cost sharing explored for the specific risks presented by these facilities. Additionally regular drills of the ERAP with all agencies involved should be completed.

Facilities for Training

Facilities for drill and training should be readily available for these purposes and include necessary buildings or structures for ladder work, smoke and breathing apparatus training, use of pumpers and hose lines, lecture space, are all in keeping with the size of the fire department. Larger fire departments should have full training facilities capable of duplicating or simulating a variety of fire types and situations using real fires. Smaller departments may use provincial, regional or cooperative training facilities according to need, but in any case should provide for a broad range of realistic training exercises. Training facilities should always work towards meeting the needs of the potential fires. When a ladder company is required, the tower should be at least 4 stories.

The Winnipeg Fire Training Academy consists of a three (3) storey burn building which is used to practice: confined space, self rescue, low or no visibility, roof operations, high angle operations, standpipe, aerial operations, fire attack, rapid intervention team (RIT) training, water supply and hose training. Class A combustibles are not used in the facility as there is no heat shielding in place. Propane and smoke machines are used in lieu of Class A combustibles.

The training academy also contains: adequate classroom space for recruit training; command trailer which contains desks and computers for the command simulator; open field is provided where trench rescue operations are practiced; self rescue and more.

During the survey, it was reported that the main power line supplying the burn tower experiences power interruptions and power outages when heavy apparatus drive on portions of the tarmac where underground power lines are located. When this occurs, the system and electronic panel in the burn tower must be reset and the practice evolution may have to be restarted. Sensors throughout the burn tower are reportedly faulty or malfunction.

Recommendation 11 Conduct a Building Assessment of Burn Tower to Identify Faults and Malfunctions

It is recommended that the burn tower undergo a building assessment to determine the extent that faults and malfunctions occur or may occur when the facility is in use. Items and concerns brought forth by Training Officers should be reviewed and corrective actions taken as required. Props for rail facility response should be added at this site and considered in a building needs assessment.

Winnipeg Fire Paramedic Service received **82.25%** for this grading item.

7.15. Response to Alarms

An adequate initial response of apparatus and personnel upon receipt of an alarm of fire is essential to provide for prompt control of what is generally an escalating emergency. This is required to be pre-arranged in nature as far as possible to ensure reliability. Efficient advance plans should be made for developing a maximum concentration of forces including reserve apparatus and outside assistance for the largest fires. Response should be commensurate with the hazard of the location responded to, with due consideration for the likelihood of other simultaneous fires. Minimum responses to fires in buildings considered reasonable are set out in Table 13, which is based off the Table of Effective Response.

First Alarm Response to Commercial Districts
The Basic Fire Flow Benchmark of 5,700 Igpm (432 L/s) is used to determine the response on first alarm to commercial districts.

First Alarms Response to Residential Districts
An average required fire flow for residential districts was determined and used for the first alarm response for residential districts. An average required fire flow of 1,600 Igpm (121 L/s) was determined.

Suitable Pre-arranged responses (Running Cards)
When a fire department requires the response of more than three engine companies determined by the Basic Fire Flow Benchmark, pre-arranged responses (running cards) are reviewed.

Running cards should set fourth assignments of specific companies to respond to locations throughout the community or municipality on first and succeeding alarms, even though specific assistance is frequently specified by the officer requesting it. Running cards should call for relocation of companies on second alarms and succeeding alarms may be necessary for the purpose of equalizing depleted coverage of the community or municipality during large fires.

WFPS has pre-determined response built into the dispatching system currently in place. The response is based on pre-defined determinants.

Table 13 Initial Response to Alarms of Fire

Group	General Description Examples	Fire Flow		Response to First Alarm		Add for Severe Life Hazard: Engine, Ladder or Rescue Company, at Least
		L/min x 1000	Approx. Igpm range	Engine Companies	Ladder Companies	
1 (a)	Minor fires not in buildings, very small buildings, widely detached	1	200	1		
		2	400			
1 (b)	Scattered development (except wood covered roofs)	3	600	1		
2	Typical modern, 1-2 storey residential subdivision, 3-6 m (10-20 ft.) detached.	4-5	800 - 1,000	2		
3 (a)	Close 3-4 storey residential & row housing, small mercantile and industrial	6-13	1,200 - 2,800	2	1 (if required by hazards)	
3 (b)	Seriously exposed tenements. Institutional. Shopping Centres. Fairly large areas & fire loads, exposures.	14-19	3,000 - 4,200	2	1	1
4 (a)	Large combustible institutions, commercial	20-27	4,400 - 6,000	2	1	1

	buildings, multi-storey and with exposures.					
4 (b)	High fire load warehouses and buildings like 4 (a).	28-35	6,200 - 7,600	3	1	1
5	Severe hazards in large area buildings usually with major exposures. Large congested frame districts.	36-46	7,800 - 10,000	3	2	1

Suitable Covering-in and 2nd Alarm Responses
When a fire department requires the response of more than three engine companies determined by the Basic Fire Flow Benchmark, the means of which a fire department has capacity to provide cover-in and 2nd alarm response is reviewed.

The City of Winnipeg received **100%** credit for this grading item.

7.16. Fire Ground Operations

Good results at the fire scene depend on the use of effective and efficient fire suppression methods and standard operating procedures, involving the laying of 65 mm (2 ½ inch) or larger hose lines, connecting pumpers to hydrants, connecting to and supplying sprinkler and standpipe systems in buildings so equipped and the efficient use of breathing equipment and tools and other devices as may be called for by the conditions encountered.

Fire ground operations will also be influenced (favourably or unfavourably) by the adequacy of department manpower, sufficiency of pumper and ladder companies, quality of training and other factors.

Initial Available Fire Force Response to Commercial Districts
This portion of the grading item reviews fast response call members that includes individuals who are specifically designated to be available for first alarms for a given period and are able to respond immediately by motor vehicle, receiving the alarm call by vehicle radio, personal radio, or pager. These may include off shift career fire fighters, volunteers, ambulance attendants and police officers. The City of Winnipeg is staffed with career firefighters at 27 Fire Halls and as such off-shift response would not be used.

The City of Winnipeg received **98%** credit for this grading item.

7.17. Special Protection Required

Some municipalities have particular fire hazards within areas they protect requiring specialized apparatus or equipment which should be provided either by the fire department, individual property owners, or both together. These hazards, including waterfront port and marina facilities, large petrochemical installations or brush and grass fire potentials should be provided for.

The City of Winnipeg has the following specialist equipment in place:

- 2 power boats are available at Fire Station 13 for water rescue. These boats are equipped with water fire pumps; however, there appeared to be questions concerning pump operation. No records were provided for pump testing for these boats.
- WFPS is equipped with a wildland fire trailer at Fire Station 26.

The City of Winnipeg has many industrial occupancies within the community in addition to a contract response to a Chemical facility. An inspection program began in 2014 for Major Occupancy Classification Group F1 type buildings which is providing more details on the hazards present within these occupancies. Furthermore a priority pre-incident plan program also began in 2014 for F1 occupancies. WFPS has now determined the number of F1 occupancies in the community and will continue to work on identification of F2 and F3 type occupanices.

As previously discussed in section 0 there are two large rail yards located in the community as well as a large rail network. At this time there is limited understanding of the levels of risk presented by these facilities. As recommended in Recommendation 1 a site specific/industry risk assessment should be completed and resource and training gap analysis completed and addressed.

The City of Winnipeg received **91.13%** credit for this grading item.

Recommendation 12 Complete testing on fireboat pumps

Testing should be completed on fireboat pumps to ensure that these are in good operating condition.

Recommendation 13 Work with Industrial/Rail Sites to Develop Clear Understanding of the Risk Levels for these Sites

WFPS should work with the industrial/rail sites to develop a clear understanding of the risk levels present and to create pre-incident plans for these sites as well as resource/training gap analysis. This is further discussed in Recommendation 1 and Recommendation 22.

7.18. Miscellaneous Factors and Conditions

Records (For Effective Operations, Planning)
Suitable records of fires, fire operations, personnel, training, fire hose and other essential matters should be kept. Records should be maintained as they are essential to effective and responsible management of a fire department. Daily, monthly, and annual reports are useful management tools for the Fire Chief.

Records of fires, training, tests, attendance and activities in the department should be developed to aid in planning future activity and policy as well as the assessment of performance. Good records of performance evaluations, work record and training should be maintained for each member.

Personnel records are reasonably complete and up to date. Pumper test records were provided. Ladder test records were also provided for review. Apparatus maintenance records are typically kept in hard copy but are moving to digital. Training records have been discussed in section 7.14. Comprehensive equipment inventories

are also kept in paper format and were available for review. Hose testing records are kept and were provided and reviewed during this survey.

Recommendation 14 Records Management System

All fire department records should be moved to one central database system which is backed-up at a separate location. This database should be fully developed for all record fields and all departments and should consider integration with other municipal departments to avoid duplication.

Fire Stations (Suitability)

All stations should be of substantial construction, suitable for the service, and located and arranged for ease and quickness of response. Proper safeguards against internal hazards should be provided. Construction of fire stations should be substantial, non-combustible, preferably fire resistive and protected from exposures, with internal and external hazards minimized. Stations should be equipped with adequate heating and lighting with consideration of the need to dry or thaw wet or frozen equipment and perform maintenance on apparatus.

A summary of each Fire Hall is provided in APPENDIX D WFPS Fire Station Summaries. Credit was given for each hall based on a fixed 25%, 50%, 75%, 100% scale and then averaged over the City. A summary of credit assigned is shown in Figure 20.

Recommendation 15 Emergency response facilities should be designed in accordance with NFPA 1500

Emergency response facilities are listed as post disaster facilities within the National Building Code (Division B Table 4.1.2.1) unless exempted by the authority having jurisdiction. As such they can be considered of high importance and essential to the provision of services in the event of a disaster.

It is recommended that the City adopt NFPA 1500 as a design reference in order to address issues noted in APPENDIX D WFPS Fire Station Summaries especially those concerning smoke alarms and CO detectors. Additionally the current Fire Hall inspection program in place should be reviewed against NFPA 1500 – Chapter 9.

While the need to sprinkler an emergency response facility was only introduced in NFPA 1500 2013 edition, critical (or all) Fire Halls (such as Fire Hall 1) such be considered for sprinklering.

Recommendation 16 Review critical Fire Halls for backup power supplies and SCBA filling stations

Backup power supplies for Fire Halls were noted to be limited within the City with all Fire Halls being on an Uninterruptible Power Supply (UPS). There is a portable generator available at Fire Hall 1 and a secondary generator reported to be available but this was not reviewed. UPS systems typically only run for a short time in order for a standby power source to start. While a complete review of needs is beyond the scope of this study it is recommended that availability of backup power supplies (portable or stationary) should be further reviewed.

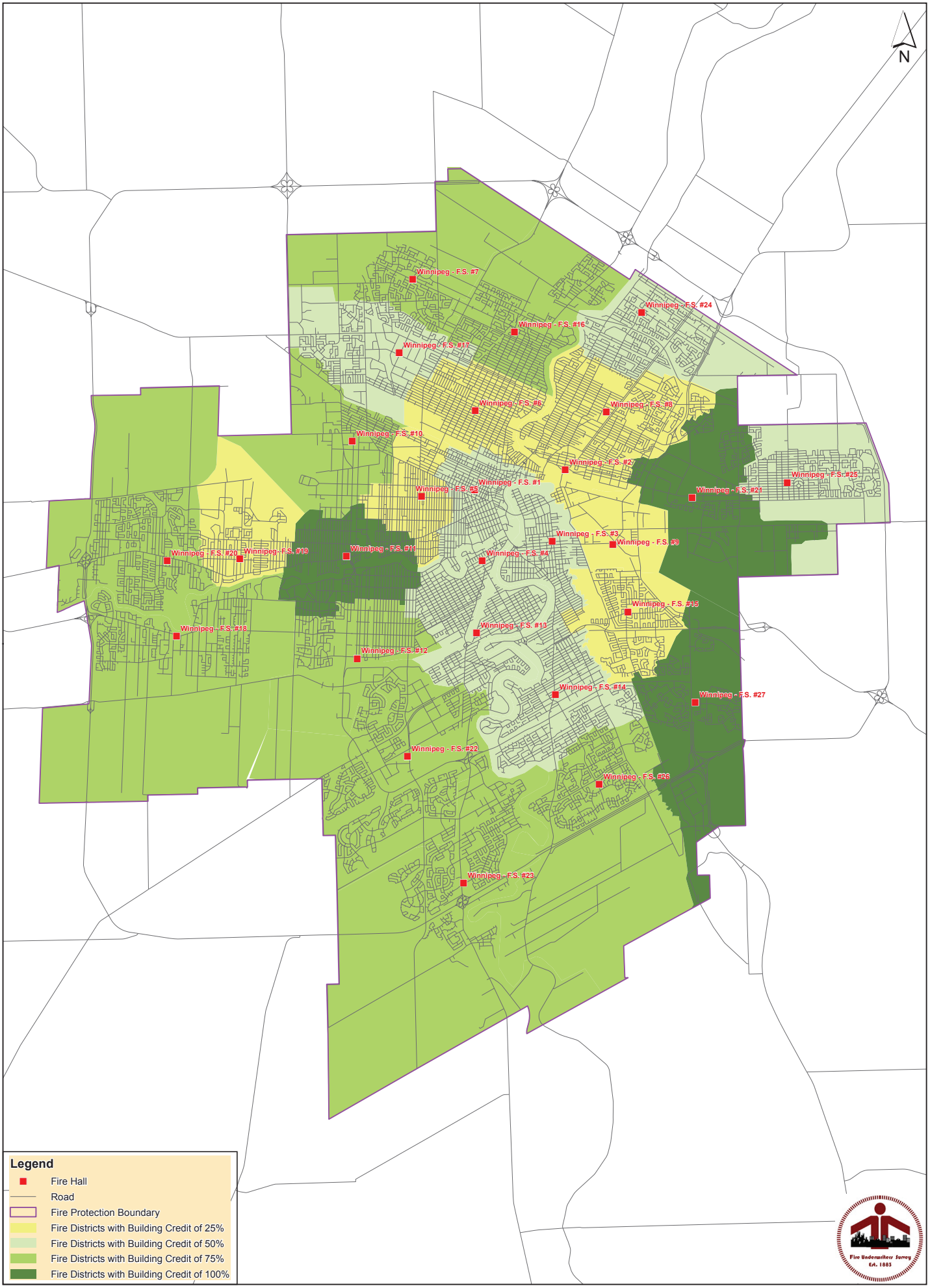
Furthermore it was also noted that SCBA filling stations may be limited within the City. There is a filling station at Fire Hall 1 and a portable filling station also reported as being available; however, this was not reviewed. Again it is recommended that availability of SCBA filling stations should be reviewed.

Apparatus Refuelling
Fuel should be available in sufficient quantities at convenient points within the community or municipality. Suitable arrangements should be made for delivery of fuel to apparatus at fires of long duration.

Response Delays (Exceptional)
Every fire department may have delays in response for personnel or when on route to an emergency. The possibility of delays due to poor condition of roads, including inadequate snow removal and sanding, steep grades, vehicle parking, traffic, railroad crossing, and other similar features should be considered.

There are a considerable number of at-grade rail crossings in the City of Winnipeg which introduce notable delays in response as shown in section 7.4.3.

The City of Winnipeg received **83.5%** credit for this grading item.



City of Winnipeg

Figure 20 - Fire Hall Building Credit

Scale = 1:38,000 0 500 1,000 2,000 3,000 Meters

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7.19. Pre-Incident Planning

Pre-incident planning is one of the most effective tools a fire department has in controlling or reducing the damage caused by fire, and identifying potential hazards or unsafe conditions at an emergency. Planning for fires in industrial and commercial occupancies increases the confidence and ability of the fire department in handling the fires and reduces the risk to the life safety of the fire fighters involved.

This grading item reviews the fire departments pre-incident planning program. Review of this grading item looks at the pre-incident plan inspection program, preparation of plans, quality of data, and the use of pre-incident plans in training.

A pre-incident planning program began in early 2014. WFPS has assigned modified duty personnel to the pre-incident planning program. WFPS has procured a pre-incident planning software tool and currently has 2,865 addresses in the system. This pre-plan information is available to all crews via their in-apparatus mobile data terminal.

While a pre-incident plan may include portions of an Emergency Response Plan for industrial facilities such as rail facilities, separate Emergency Response Plans should be implemented for these facilities as noted in Recommendation 1.

Duplication of collection of building data can be common in municipal departments. WFPS should explore options with other municipal departments to remove this duplication. A central collection system should be considered.

The City of Winnipeg received **28.5%** credit in this grading item.

Recommendation 17 Continue to Develop Pre-Incident Planning Program

The Winnipeg Fire Paramedic Service pre-incident planning program is in development, however to receive additional credit within the fire insurance grading and to help improve fire fighter effectiveness during emergency events, the number of completed pre-incident plans should be increased. As the Fire Department continues to develop its pre-incident planning program, additional credit up to the maximum can be received. It is strongly recommended that the Pre-Incident Plan program should be expanded. Pre-incident plans should ideally be developed in accordance with NFPA 1620, Recommended Practice for Pre-Incident Planning recent edition or a similar standard/guideline; however, an approach that would allow the creation of plans for the majority of buildings would be preferable to only a few resource intensive plans. Plans for higher hazard occupancies should be further expanded. Plans should be created for properties/sites within the City and in the contract areas of the community including the airport, CFB Winnipeg Base, rail yards and facilities, contract response properties.

Officers or fire fighters may be trained to develop pre-incidents plans and manage the overall program to ensure pre-incident plans are kept up to date. Personnel charged with the management of the pre-incident planning program may also be utilized to aid in the fire prevention inspections; however, training should be provided to ensure inspections are properly completed.

7.20. Administration

Fire departments should be administrated and managed by qualified and progressive leadership with adequate authority to carry out its mandate. Adequate procedures should be established to govern the administration and operation of the organization. The fire department should be organized with appropriate staff for routine management and operational fire fighting and emergency command.

The WFPS is administrated by the City of Winnipeg. The department is organized with career administration and staffing to manage the operations of fire suppression, training, and fire prevention.

Contracts for response were not provided for the CFB or Winnipeg International Airport and it appears that the services provided to these properties may not be defined.

The City of Winnipeg Fire Paramedic Service received **96%** credit in this grading item.

Recommendation 18 Review Contracts for Response

Contracts for response to all facilities not within the City of Winnipeg administration area should be reviewed and clarified. The contracts should also discuss prevention and pre-incident plan activities to be completed and responsibilities.

7.21. Summary of Recommendations

Recommendation #
Recommendation 1 Complete Site/Industry Specific Risk Assessment of Rail Yards and Transportation of Goods
Recommendation 2 Implement a complete targeted prevention and education program
Recommendation 3 Apparatus replacement schedule
Recommendation 4 Improve Ladder Coverage within the City of Winnipeg
Recommendation 5 Complete periodic formal review of PM program.
Recommendation 6 Fully develop maintenance database
Recommendation 7 Further investigate chassis issues
Recommendation 8 Develop Annual and Quarterly Training Matrix
Recommendation 9 Improve Record Keeping Practices for Staff Training
Recommendation 10 Improve succession planning for all line Officer positions
Recommendation 11 Conduct a Building Assessment of Burn Tower to Identify Faults and Malfunctions
Recommendation 12 Complete testing on fireboat pumps
Recommendation 13 Work with Industrial/Rail Sites to Develop Clear Understanding of the Risk Levels for these Sites
Recommendation 14 Records Management System
Recommendation 15 Emergency response facilities should be designed in accordance with NFPA 1500
Recommendation 16 Review critical Fire Halls for backup power supplies and SCBA filling stations
Recommendation 17 Continue to Develop Pre-Incident Planning Program
Recommendation 18 Review Contracts for Response

8. PFPC - FIRE SAFETY CONTROL ASSESSMENT

8.1. Fire Safety Control Grading Items

The sections below cover the four grading items that pertain to Fire Safety Control. Twenty percent of the Public Fire Protection Classification for the City of Winnipeg comes from the grading of Fire Safety Control. Fire Safety Control has become an increasingly heavily weighted portion of the fire insurance grading system.

A substantial degree of safety to life and protection of property from fire should be provided by provincial and municipal control of hazards. Control can be best accomplished by the adoption and enforcement of appropriate codes and standards for manufacture, storage, and use of hazardous materials and for building construction, as well as through training, advisory and education programs for the public.

This grading item reviews the general fire prevention, inspection and investigation activities of the fire department. The official in charge of fire prevention activities, in cooperation with the chief of the fire department, should establish an inspection procedure for correction of: obstructions to exits which interfere with emergency egress or with fire department operations; and inadequate or defective automatic or other fire alarm equipment or fire extinguishing equipment or conditions in buildings or other structures which create a severe life hazard potential. Provisions should be made for the investigation of fires.

The fire prevention program should include visiting and inspection of dwellings on an occupant voluntary basis and the continuous education of the public. The fire department should maintain a highly visible profile in enforcement, education, training, and advisory services.

Overview and Mandate
The Winnipeg Fire Paramedic Service has a Fire Prevention branch consisting of 1 Director, 3 Senior Officers, 1 Plans Examiner, 13 Fire Prevention Officers, 2 Clerks and 1 Acting Safety Officer. The Acting Safety Officer does not currently report to the Director of Fire Prevention; however, they currently occupy a full time position within the Fire Prevention branch.

The following provides a brief overview of the roles and responsibility of the Fire Prevention Division in Winnipeg and is an excerpt from “Briefing Notes” that were provided to Fire Underwriters Survey during the field survey in July 2014:

“The Fire Prevention Branch provides a number of services which reduce the incidences of injury, death and property loss as a result of fire. The Office of the Fire Commissioner mandates a scheduled inspection process for various occupancies. Fire Prevention Officers annually inspect elderly person’s housing and hostels, child care centers, personal care homes, residential care facilities and hospitals. Anticipating that the F-Occupancy scheduled inspection program recommendations are accepted by Council, we will be conducting (scheduled inspections of) F1 occupancies annually as well.

Fire Prevention Officers also inspect all licensed premises, public and private schools, recreation centers, hotels and motels, and any restaurants located in a building that contains one or more dwelling units every 3 years as part of the OFC's mandated inspection process.

In addition to the OFC mandated inspection, we conduct license inspections for rooming houses and converted residential dwellings, second hand dealers, scrap yards and large public venues.

Our branch administers components of the Fire Prevention By-Law 150/2004 by issuing permits for open air fires, fireworks distribution and display and pyrotechnics. We issue licenses to service personnel and fire extinguisher trainers.

We also conduct plan review to ensure new buildings comply with the Manitoba Building Code and Manitoba Fire Code requirements involving fire safety. The Fire Prevention/Plans Review Officer works directly with Planning and Property Development at 65 Garry Street to assist with the City's Fast Track Permit Process."

Selection of staff is by internal posting and made available only to fire fighters. Those with most seniority are selected for the position. Within the existing collective bargaining agreement, Fire Prevention Officers are considered Lieutenants. Staff who remain within the Fire Prevention Division for more than three (3) years no longer retain their seniority level within fire suppression. As such, Fire Prevention experiences a high turnover rate of staff who transition back to suppression.

Fire fighters who transfer to Fire Prevention Officers receive online training through the Manitoba Emergency Service College's (MESC) NFPA 1031 Level 1 and Level 2 certificate program. Manitoba Emergency Service College is accredited with the International Fire Service Accreditation Congress (IFSAC) and the National Board on Fire Service Professional Qualifications (ProBoard). The certificate program is approximately 80 hours which is completed by the inspector over four months of training. Once complete, the Fire Prevention Officer then completes a four to six week in house training program which includes:

- inspection procedures guidelines
- fire inspection reporting system training
- Residential Upgrading By-Law 4304/86 training
- Fire Prevention By-Law 150/2004
- high building training
- occupancy inspection procedures
- enforcement procedures
- work alone policy and procedures
- general operating guidelines training
- file maintenance

Within the fire insurance grading, fire prevention inspectors are measured against NFPA 1031 Level 1 and Level 2.

Recommendation 19 Consider Revisions to the Selection and Hiring Practices for Fire Prevention Officers

The WFPS should explore methods of ensuring longevity in the Fire Prevention Branch. In addition, the WFPS should consider offering accredited Fire Inspector training to personnel while they are in suppression positions to enable full productivity more quickly when suppression personnel migrate to Prevention positions.

As previously mentioned, the Winnipeg Fire and Paramedic Service have an established fire prevention bylaw, referred to as Fire Prevention By-law No. 150/2004. This By-law includes issuing of permits applicable to fire

safety in the City, outdoor fires, installation of smoke alarms in residential rental units, fire protection/life safety installations, fireworks, fire extinguisher training license and, miscellaneous (occupant load sign, no parking in fire lanes, flammable and combustible liquid storage tanks). This By-Law is currently under review to include annual inspections of F1 occupancies, F2 occupancies inspected every three (3) years and F3 occupancies inspected every five (5) years.

Currently, the Office of the Fire Commissioner (OFC) mandates scheduled inspections for various occupancies on an annual basis and every three years as shown in Table 14.

Table 14 Fire Prevention Inspection Frequency Described by the Office of Fire Commissioner (http://www.firecomm.gov.mb.ca/support_inspections.html)

Annual	Buildings where persons are under the care of others
Every three (3) years	Assembly occupancies where persons often gather

Winnipeg Fire Prevention Target Hazard Program Inspections Performance

Fire Underwriters Survey was provided with various data sets to review the number and type of inspections that are completed in addition to the approximate number of buildings/occupancies throughout the City. Table 15 indicates the number of properties in Winnipeg by occupancy classification, as defined by the National Building Code of Canada. The values shown in the table below have been provided by the Fire Prevention Division. The data has been compiled by fire prevention staff completing inspections and identifying occupancy classification by address. The totals provided are assumed to be incomplete. As shown, there are approximately 40,000 addresses in occupancy classes in the City, approximately 30,000 of which have been identified by fire prevention staff. The remaining 10,000 have not yet been identified by fire prevention staff.

Table 15 Number of Properties by Occupancy Classification

Occupancy Classification	# of Properties
A1 – Assembly occupancies intended for the production and viewing of the performing arts	39
A2 – Assembly occupancies not elsewhere classified in Group A	4572
A3 – Assembly occupancies of the arena type	91
A4 – Assembly occupancies in which occupants are gathered in open air	43
B1 – Detention occupancies	26
B2 – Care and treatment occupancies	107
B3 – Care occupancies	89
B4 – Residential care occupancies with 10 or less residents[3]	170
C – Residential occupancies	12,691
D – Business and personal service occupancies	4206
E – Mercantile occupancies	3172
F1 – High hazard industrial occupancies	40
F2 – Medium hazard industrial occupancies	5334
Total Identified	31,374
Total	42,157

[3] B4 Occupancy classification was established in an amendment to the Manitoba Fire Code in Manitoba Regulation 221/2015 and 222/2015.

Total not Identified	10,783

The data set identifies inspections by year of inspection, occupancy classification, type of inspection and number of inspections completed by occupancy type. The classification of each type of inspection is shown in Table 16.

Table 16 Inspection Type by Classification

Inspection Type
Complaint
Post Fire Inspection
Request
Licensed Establishment
Office of the Fire Commissioner
Scheduled
Occupancy Classification
Special Event
Order/Common Offense Notice (follow up inspection)
Fire Safety Plan Meeting
Training (for new inspectors)
Occupancy Inspection - Vacant Building
Occupancy Inspection – Scheduled Inspection
Occupancy Inspection – New Building Inspection
Occupancy Inspection – Approval of fuel tank (above or below ground)
Plans Examination

From the above classification of inspections, an analysis was completed to compare the total number of inspectable properties (i.e. all buildings/occupancies that are not single family residences or duplex) to the total number of inspections that were completed for occupancy classification. For this assessment the following inspection classifications were used:

- Licensed establishment
- Office of the Fire Commissioner
- Scheduled
- Occupancy Classification
- Occupancy Inspection – Vacant Building
- Occupancy Inspection – Scheduled Inspection
- Occupancy Inspection – New Building Inspection

From the perspective of the fire insurance grading, completing fire prevention inspections on complaint and request basis is considered a reactive and inconsistent approach to mitigating fire hazards throughout the City. As such, complaint and request inspections have been excluded to determine the effectiveness of the fire prevention inspection program.

Table 17 summarizes the number of inspections that have been completed by occupancy type and types of inspection as shown above. Up until 2014, fire suppression crews had been assigned approximately 50 fire prevention inspections each (some crews had been assigned 30). These assigned inspections are Group D and E occupancies in strip malls or are smaller buildings. Large buildings under these occupancies are inspected by fire prevention staff. Where fire suppression crews complete inspections, basic fire and life safety hazards are

assessed. The crew will complete a follow up inspection if needed and if further remedial action is required fire prevention officers are then assigned and take appropriate action.

Table 17 Winnipeg Summary of Fire Prevention Inspections

Occupancy Classification	Number of Buildings	2014 Completed Inspections	2013 Completed Inspections	2012 Completed Inspections	2011 Completed Inspections
A1	37	2	5	6	1
A2	4,218	631	823	939	627
A3	65	2	3	8	9
A4	33	1	1	0	0
B1	30	0	5	0	1
B2	142	50	44	39	35
B3	8	11	7	3	1
C	12,031	603	537	322	378
D	4,372	61	1365	1387	1478
E	3,314	57	863	903	936
F1	246	3	3	3	4
F2	4,159	72	77	77	108
F3	903	12	27	20	34
Unidentified	10,216	37	143	20	116
Total	39,774	1,542	3,903	3,859	3,728

Within the fire insurance grading, Fire Underwriters Survey evaluates the number of inspectable properties to the frequency of initial inspections that are completed on a routine and scheduled basis. To receive maximum credit or near maximum credit for the City of Winnipeg, properties should receive an initial fire prevention inspection every six (6) months with high hazard occupancies (Group F1) receiving a scheduled inspection every three (3) months. Group D and E occupancies are measured against annual inspections. Table 18 indicates the type inspections mandated by the Office of the Fire Commissioner, the adopted frequency followed by Winnipeg Fire Prevention (including anticipated revisions to By-Law 150/2004), the ideal benchmark considered within the fire insurance grading and the frequency of inspections as recommended by Fire Underwriters Survey.

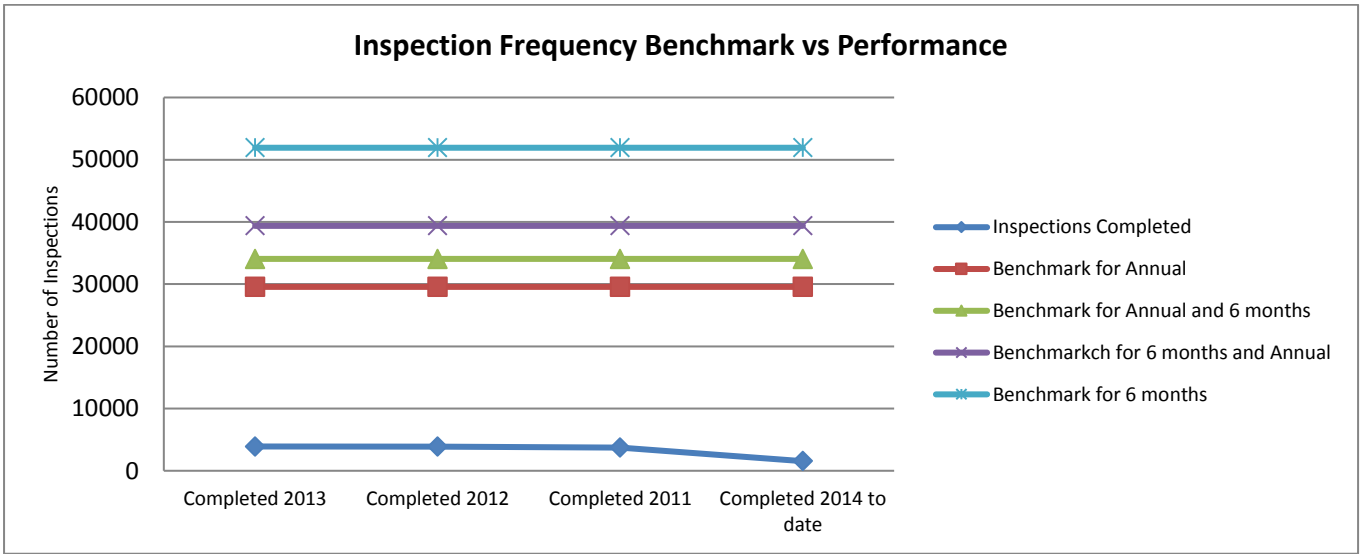
Table 18 Winnipeg Inspection Performance and FUS Benchmarks

Occupancy Classification	OFC Frequency	Winnipeg Adopted Frequency	FUS Ideal Frequency	FUS Recommended Frequency
A – Assembly	- all licensed premises - any restaurant located in bldg w/ one or more dwelling units - public and private schools - recreation centres - large public venues	Same as OFC	6 months	Annual
B – Institutional	- elderly person's housing - child care centres, personal care homes and residential care facilities - hospitals	Same as OFC	6 months	Annual
C – Residential	- hotels and motels - rooming houses and converted residential dwellings	Same as OFC	6 months	Annual

D – Business and Personal Service		Same as OFC[4]	Annual	Annual
E – Mercantile	- second hand dealers	Same as OFC[5]	Annual	Annual
F – Industrial	- scrap yards	F1 = Annual F2 = 3 years F3 – 5 years	F1 = 3 months F2/F3 = 6 months	Annual

It is important to note that both the OFC and Winnipeg Fire Prevention have identified specific property types that fall within a specified occupancy classification. There are many other property types that may fall within the same occupancy classification; however, those properties have not been targeted or specified by the OFC or Winnipeg Fire Prevention. Figure 21 illustrates the various benchmarks within the fire insurance grading that are considered for fire prevention performance with regards to the number of initial inspections completed and the total number of inspectable properties within the City. Though a large number of inspections have been completed, the number of inspections completed is not enough to meet the benchmark for annual inspections.

Figure 21 Winnipeg Performance and FUS Benchmarks

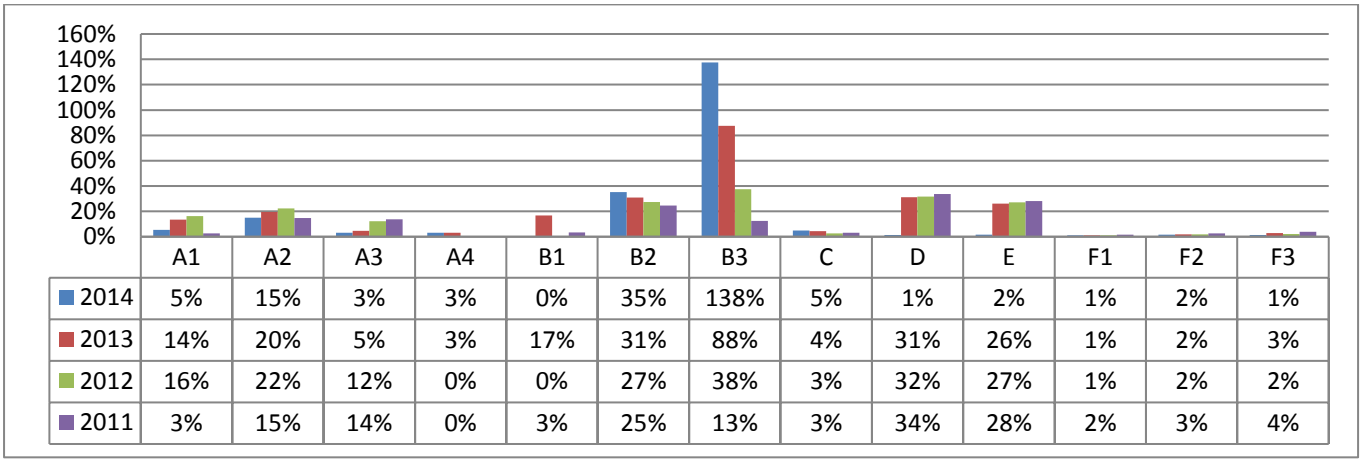


It is important to note that this level of performance is not unusual for large cities in Canada. Due to demographics and how most communities tend to build and grow, new buildings are built and occupied (increasing the risk profile) but resources for fire fighting and fire prevention activities typically do not grow at the same pace. From the perspective of the fire insurance grading, communities with lower risk profiles and higher ratios of funding in fire prevention are in a better position to score well in this area of the fire insurance grading. This is due to a lower number of inspectable properties and available dedicated fire prevention staff available for routine scheduled inspections.

Figure 22 illustrates the percentage of properties, for each occupancy classification, that have received an inspection. The percentages shown consider the number of properties for each occupancy classification and the percentage of properties within that classification that have received an inspection. In other words, in 2013, 20% of all Group A2 occupancies in Winnipeg received an initial inspection.

[4] Up until 2014, each suppression crew was assigned 50 fire prevention inspections in their response area. Some areas were assigned 30. This practice has not been continued with the anticipation of mandated fire prevention inspections for industrial occupancies.

Figure 22 Winnipeg Summary of Fire Prevention Inspections by Percentage



	A1	A2	A3	A4	B1	B2	B3	C	D	E	F1	F2	F3
2014	5%	15%	3%	3%	0%	35%	138%	5%	1%	2%	1%	2%	1%
2013	14%	20%	5%	3%	17%	31%	88%	4%	31%	26%	1%	2%	3%
2012	16%	22%	12%	0%	0%	27%	38%	3%	32%	27%	1%	2%	2%
2011	3%	15%	14%	0%	3%	25%	13%	3%	34%	28%	2%	3%	4%

2014 data shown in Figure 21 and Figure 22 considers initial inspections in addition to reinspections/follow up inspections. A reinspection/follow up inspection is one where the inspector or assigned fire crew has completed an inspection and has returned to confirm that the owner or occupant of the property has made corrective actions to any Fire Code violations that have been noted.

Recommendation 20 Increase Staffing to Meet Recommended Frequency of Inspections

To improve the effectiveness of the Fire Prevention Division and to help reduce fire and life safety risk for both the public and firefighters throughout the City, it is recommended that additional resources are assigned to completing fire prevention inspections. Consideration should be given to reassigning fire prevention inspections of simple and non-complex Group D and E and possibly Group C occupancies to fire crews. Additionally, consideration should be given to increasing the number of Fire Prevention Officers currently on staff. A needs analysis should be completed to determine the resources that may be reasonably needed to meet Fire Underwriters Survey recommended frequency of inspections, as shown in Table 18. A prevention program effectiveness measurement should be put in place and staffing progressively considered in addition to adjustments to prevention inspection programs in order to achieve desired results of reducing calls and incidents, see Recommendation 21.

Recommendation 21 Review Inspection Frequency and Amend By-Law 150/2004 as Needed

By-Law No. 150/2004 should be reviewed and frequency of inspections increased. Industrial facilities (Group F1 and F2) should be regularly inspected in addition to multi-family residential occupancies and other occupancies that present high risk of property damage and loss of life.

The fire prevention inspection program should work towards completing regular scheduled inspections for the occupancies identified above on an annual basis. A plan should be developed to identify these buildings in the City and begin a phased approach where some of these buildings receive inspections every 36 and 24 months and then phase into 24 and 12 months and eventually 12 months.

Recommendation 22 Implement Site Specific Prevention Programs for Noted Sites not under Prevention By-Law No. 150/2204

The following properties were noted during a risk assessment tour of the City of Winnipeg with the Emergency Preparedness Coordinator. Prevention programs for the following appeared to be unspecified/unclear:

CFB Winnipeg has their own Fire Department; WFPS responds to assist if requested. There is no formal agreement in place for fire protection services. Responsibility for prevention inspections lies with the Federal Government for all federal buildings.

WFPS should be completing fire prevention inspections for all properties outside of the municipality that are under fire protection service agreements with WFPS.

Large rail storage yards were noted at 2 sites within the City in addition to rail lines crossing the City. Discussions with the Emergency Preparedness Coordinator and WFPS indicated that while some discussion is in place with one of the rail companies there is limited understanding at this time of the fire risk presented by these facilities. WFPS should work closely with the facility owners to identify the fire (and other) risk presented by the facilities and rail lines through a fire risk assessment or other method. If an assessment of this nature has been completed in the past it should be updated to assess the impact of the increase in rail shipments of dangerous/hazardous goods in Canada since 2009. A resource needs and gap analysis should be completed by WFPS in conjunction with the facility operators and resource sharing plan developed to acquire additional resources/training/etc. Current Emergency Response Assistance Plans (ERAP) in place should be updated and the needs for further ERAPs identified based on the Transport Safety Board of Canada Rail Recommendations (23rd January 2014) should be established. All Transportation Safety Board of Canada Rail Recommendations should be implemented (http://www.tsb.gc.ca/eng/recommandations-recommendations/rail/2014/rec-r1401-r1403.asp).

A petroleum storage facility was noted during the risk assessment tour. The capacity of WFPS to respond to such a facility appears unclear and should be identified through a fire risk assessment and gap analysis. If this has already been completed it should be reviewed and updated as required. A resource sharing plan should be developed to acquire additional resources/training/etc. if identified in the gap analysis.

Records Management and Inspection Reporting Software

The existing records management system is a web based solution referred to as Fire Inspection Reporting System (FIRS). Fire Prevention Officers are provided with a laptop and may complete the majority (if not all) of their inspection order/report write up in their vehicle or at their desk. This system has been in use for ten (10) years now. The software does not have the Manitoba Fire Code built into it; however, the most common parts, sections and articles are included and contain a standardized statement which indicates the violation and corrective actions to be taken. From the perspective of the fire insurance grading, this helps ensure consistency, accuracy and efficiency for the development of any inspection order or write up. As the entire Manitoba Fire Code is not built into the software, Fire Prevention Officers maintain a hard copy of the Fire Code in their vehicles at all times.

As mentioned, reports, write ups and orders developed by Fire Prevention Officers can be completed in the vehicle or at fire prevention offices. Inspection orders can be remotely printed in fire prevention offices or emailed to the owner or occupant using the laptops. Portable printers were in use in each fire prevention vehicle but considered unreliable due to cold weather temperatures in the winter.

The records management system contains a database of addresses, buildings and building characteristics such as: the number of floors, installation of sprinkler and/or fire alarm systems and, construction of the building. This

information is not tied to the Building or Planning Departments and has been input by the inspectors on an ongoing basis; data entry was found to be inconsistent for buildings throughout the City. Some Fire Prevention Officers have been diligent and completed this information to a high degree of accuracy and reliability for each one of their inspections and have made corrections and updates to existing files when needed. Other Fire Prevention Officers have either not completed this information or have input incorrect data.

As the Fire Prevention Division has been utilizing the existing records management system for ten (10) years, the majority of records that are kept on file are digital/soft copies. Some hard copy information is kept on file but general practice is to create digital copies and attach files in the records management system. The information and data contained within the record management system is stored on the City server which is remotely backed up daily.

In addition to building and property data that is kept in the records management system, there is a section for Fire Prevention Officers to transpose any of their hand/legal notes or correspondence the Fire Prevention Officer may have had with the building owner/occupant (phone calls, emails, letters, etc.). Practice of using this function is inconsistent amongst previous and existing Fire Prevention Officers. Use of this function is encouraged by senior staff within Fire Prevention.

Recommendation 23 Improve Records Management System and Practices

It is recommended that the records management system be expanded or developed to include attachments or automatic export of email correspondence to each fire prevention inspection file. Fire Prevention Officers should also regularly transpose all relevant hand/legal notes to each inspection file including general notes summarizing any verbal communication that may have occurred between the building owner/occupant and the Fire Prevention Officer. These practices are considered good practice as it shows clear lines of documentation and allows the other inspectors to clearly follow the evolution of any work that has been or will transpire for any given file.

Recommendation 24 Develop Central Database Collection for GIS, Building, Planning, Water and Fire

Winnipeg Fire Paramedic Service should work with the municipal GIS, Building, Planning and Water Service departments to develop a centrally hosted data collection system for building data collected through planning, land development, building construction, inspections and pre-incident plans. Creating this system would allow the Fire Department to have relevant GIS layers and building data. A system of this type would reduce duplicate data collection and provide for better management and visualization of the inspection and pre-incident planning program. This system will also enable the Fire Department to have access to maintenance of public and private hydrants as well as better notification when hydrants are out of service.

Plans Examination

Plans review and examination is completed by the Plans Examiner. Applications for permits include new house construction, decks, garages, recreation room development, multifamily residential, office, arenas, stadiums and, shopping malls. The plan examiners review the plans for all these types of buildings. Compliance to the applicable building, electrical, plumbing/mechanical codes, standards and by-laws must be met before a permit is issued to commence construction. All this is for the protection and safety of the general public. It is important to note that the Plans Examiner within Fire Prevention reviews items related to fire safety as applicable within the Building Code. Structural, electrical, plumbing and mechanical elements are reviewed by other City Plans Examiners.

Public Education

Public Education within the City of Winnipeg is performed by a separate division within the Fire Department. Within the Fire Department there is one (1) Public Education Coordinator and three (3) Public Educators. Selection of Public Educators is identical to selection of Fire Prevention Officers. An internal posting is made and a list of interested fire fighters is generated. Fire fighters with most seniority are then selected for the position. The selection of the Public Education Coordinator is identical to the selection of the Director of Fire Prevention. Existing Public Educators express their interest and the individual with the most seniority is then selected for the position. Selected Public Educators receive training through Manitoba Emergency Service College's and are NFPA 1035 Level 1. As part of training for Public Educators a practical component is included. The staff member selects a topic for discussion, designs a lesson plan and provides a thirty (30) minute presentation. Training also covers topics concerning time management and scheduling.

As with Fire Prevention, Public Education experiences a high turnover rate of Public Educators. Staff who remain within Public Education for more than three (3) years no longer retain their seniority level within fire suppression. As such, Public Education experiences a high turnover rate of staff who transition back to suppression.

Recommendation 25 Consider Revisions to the Selection and Hiring Practices for Public Education Officers

The WFPS should explore methods of ensuring longevity in the Public Education Branch. In addition, the WFPS should consider offering accredited Public Educator training to personnel while they are in suppression positions to enable full productivity more quickly when suppression personnel migrate to Public Education positions.

In total, approximately 4,000 working hours are spent on public education initiatives. The Public Education within the City of Winnipeg includes several different programs and initiatives such as:

- Arson Awareness
- Adopt a School
- Senior Safety
- Safety Trailer
- Social Media
- Fire Prevention Week
- TV, radio and newsprint
- Cadet program
- Fire station tours

These programs are provided on a scheduled and request basis.

Recommendation 26 Develop and Implement Public Education Programs

The Public Education Program should include promotion and development of various elements such as:

- Smoke Alarm Installation Program
- Hold Regular Fire Department Open Houses
- Host Regular Community-Wide Fire Drills

The Program should also include promotion of Educational Programs/Materials such as, but not limited to:

- Fire Smart
- Fire Prevention Canada

- Fire Safety Information
- Home Fire Escape Plan Worksheet
- Learn Not to Burn® (LNTB®)
- Older & Wiser
- Kitchen Care Fire Safety Program
- "Use Candles with Care"
- Risk Watch™

Recommendation 27 Expand and Update Lesson Plans Including Acquiring Additional Props.

It is recommended that additional resources be provided for Public Education tools and initiatives. The effectiveness of the program can improve significantly by:

- maintaining up to date informational and instructional videos for all age groups,
- providing each fire station with public education kits which contain simple and basic lesson plans which are consistent throughout the community and contains props and visuals appropriate for each age group and the lesson plan.

In addition to providing each fire station with a public education kit, each fire fighting crew should receive training from the Public Educators in the delivery of each lesson plan. Training should include desired outcomes for each lesson plan and effective use of props and tools.

Recommendation 28 Development of Safety Village

In collaboration with City departments (police, fire, ambulance, building and planning) and groups (schools, elected officials, assistance and mentoring groups, rail, businesses and more), a safety village should be developed within the City of Winnipeg. This facility can include a scaled down version of a community with various types of buildings with simple/basic props including those typically found in homes. These should also highlight home safety and escape plans, common safety hazards found throughout the City (street lights, no walk signs, school crossings, rail safety and rail crossings, bike lanes, sidewalks, and props throughout such as broken glass, needles, flammable and combustible liquids).

Additionally, an interactive classroom should be provided which will highlight everything that the students and visitors will encounter in addition to providing targeted public education lesson plans.

City of Winnipeg received **59.8%** for this grading item.

8.2. Fire Safety Laws and Enforcement

This grading item reviews the fire safety laws in use and the enforcement of those laws within a community or municipality. Adequate laws or ordinances should be enacted to properly regulate the manufacture, storage, transportation and use of hazardous liquids, gases, and other combustible materials, including the handling of combustible waste, and to properly control building construction and electrical, heating, and ventilating

installations. The National Fire and Building Codes of Canada and the Canadian Electrical Codes are accepted as the minimum standard regulation.

For enforcement purposes, inspections shall be made by personnel having specialized knowledge of special hazards by fire company members. Inspections should be made as frequently as may be necessary for the proper enforcement of fire prevention regulations.

Proper records of permits (licenses if required by local regulation), inspections, violations and their correction, and of all other important matters should be kept and analyzed.

The Manitoba Fire Code is used in the City of Winnipeg and is mainly enforced through Winnipeg Fire Paramedic Service. As previously mentioned, the Office of the Fire Commissioner has mandated annual and five year inspections for specified property or business types. The properties identified are specific and do not include other businesses that fall within the same major occupancy classification as defined by Building Codes. The City of Winnipeg has adopted a revision to By-Law 150/2004 which will includes:

- Annual inspection for:
    - Group F1 occupancies
    - Converted residential dwellings with shared facilities
    - Food trucks/trailers
- Every 30 months: converted residential dwellings
- Every 3 years: F2 medium hazard industrial occupancies
- Every 5 years: F3 low hazard industrial occupancies

This item looks further at the inspection program in place which has been discussed in the previous section. Recommendations made in the previous section equally apply. Again the main issue is frequency and meeting the frequency.

City of Winnipeg received **64%** for this grading item.

8.3. Building Construction Laws and Enforcement

This grading item reviews the building construction laws in use and the enforcement of those laws within a community or municipality. An adequate building construction code and enforcement program should be provided in the municipality, using a code equal to or better than the National Building Code of Canada.

Automatic fire protection sprinklers are installed in some buildings throughout the City of Winnipeg; however, automatic sprinkler protection systems are typically only installed where required by the MB Building Code. The MB Building Code is a minimum standard and does not require sprinkler systems to be installed in many occupancies that contain high occupant densities and increased life safety risks. Additionally, the MB Building Code does not require pre-existing buildings to be brought up to meet current code requirements.

Sprinkler protection (when designed and installed in accordance with NFPA 13 and maintained in accordance with NFPA 25) is widely accepted as one of the most effective methods of reducing fire risk in buildings and communities. Statistically properly designed, installed and maintained sprinkler systems have been shown to reduce fire losses significantly and reduce the number of lives lost to fire.

City of Winnipeg received **96.00%** for this grading item.

Recommendation 29 Implement Sprinkler Bylaw

Credit can be received in the area of fire safety control through implementing a sprinkler bylaw that requires all buildings other than detached dwellings to be sprinkler protected. Furthermore, additional credit could also be received if the City extended this bylaw to include detached dwellings and/or developed a retrofit requirement for the existing building stock.

Implementing a sprinkler bylaw, positively affects Required Fire Flow calculations by reducing the Required Fire Flow if the sprinkler system is properly designed, maintained and tested according to NFPA 13. This also results in lowering the benchmark Basic Fire Flow of the community if implemented in buildings with high Required Fire Flows. Furthermore sprinkered buildings within the Fire Insurance Grading allow for longer response times thereby reducing resource needs under certain items of the Grading.

8.4. Electrical Code and Inspections

This grading item reviews the extent of electrical code inspections and enforcement. An electrical code should be applicable and equivalent to the Canadian Electrical Code and be enforced by an inspection and permits program.

Electrical code inspection and enforcement is administered by the City of Winnipeg.

City of Winnipeg received **100.00%** for this grading item.

8.5. Summary of Recommendations

Recommendation #
Recommendation 19 Consider Revisions to the Selection and Hiring Practices for Fire Prevention Officers
Recommendation 20 Increase Staffing to Meet Recommended Frequency of Inspections
Recommendation 21 Review Inspection Frequency and Amend By-Law 150/2004 as Needed
Recommendation 22 Implement Site Specific Prevention Programs for Noted Sites not under Prevention By-Law No. 150/2204
Recommendation 23 Improve Records Management System and Practices
Recommendation 24 Develop Central Database Collection for GIS, Building, Planning, Water and Fire
Recommendation 25 Consider Revisions to the Selection and Hiring Practices for Public Education Officers
Recommendation 26 Develop and Implement Public Education Programs
Recommendation 27 Expand and Update Lesson Plans Including Acquiring Additional Props.
Recommendation 28 Development of Safety Village
Recommendation 29 Implement Sprinkler Bylaw

9. PFPC - FIRE SERVICE COMMUNICATIONS ASSESSMENT

9.1. Fire Service Communications Grading Items

The sections below cover the seven grading items that pertain to Fire Service Communications. Ten percent of the Public Fire Protection Classification of the City of Winnipeg Fire Protection Area comes from the grading of Fire Service Communications.

9.2. Communication Center

This grading item reviews the facility used for emergency communications. Equipment for the receipt and transmission of alarms should be housed securely and be protected against fire or damage from other sources, including flooding, vandalism, and earthquakes. Emergency communication centres should be of non-combustible construction with one to three hour protection from exposures depending on complexity of the installation. Most importantly, there should be protection from ignition sources and rapid initial fire spread through control of such sources as flammable furnishings and building finish materials.

The City of Winnipeg Fire Paramedic Dispatch centre is located on the ground floor of 700 Assiniboine Park Drive. The dispatch centre is in an isolated location and is considered inconspicuous from the perspective of identifying the operations performed within the occupancy. The building is provided with security fencing and a gated parking lot. All doors providing entrance to the building are kept locked and entry is provided with the use of pass cards, for permissible staff only. Access within the facility is also controlled by pass card entry based on security clearances and appropriate work area requirements. Additional security features include ballistic windows, surveillance security cameras with clear viewing of all exits and entrances from the exterior of the building, with non-uniform security personnel located at the front entrance. Entry by civilian persons or contractors is permitted only after a Winnipeg Police Service Security Clearance Check is performed.

The three storey structure is considered to be of non-combustible construction and has a monitored fire alarm and automatic sprinkler system. Portable fire extinguishers are provided throughout the building including server rooms and electrical rooms containing critical communications equipment. The dispatch room is provided with self-closing devices on all doors, as well as manual pull stations located in paths of egress. An emergency HVAC system (independent of the buildings HVAC system) is provided for the PSAP Dispatch Room and Fire Paramedic Dispatch Room, with individual air diffusers that also operate independently from primary building systems. The PSAP and Fire Paramedic Dispatch Centre are enclosed and provided with two hour fire separations, and are able to operate at a normal level of functionality with a fire occurring anywhere within the remainder of the building.

Risk of ignition and rapid fire spread is reasonably controlled through limitation of combustibles and flammables including interior finishes and furnishings. Automatic sprinkler protection has been provided throughout the building to help minimize the spread of a potential fire. The automatic sprinkler system is inspected once a year with a record of the inspection kept within the Centre, and a duplicate log forwarded to the City of Winnipeg Property Planning and Development Department.

Exposure Hazards
The communications center and equipment rooms have been reasonably designed to be protected from fires, floods, storms, crime and other possible perils. Hazards from external exposures are considered to be minimal due to zoning, building location and no existing neighbouring structures.

Power
Winnipeg Fire and Paramedic Dispatch Centre has three independent and reliable power sources. The primary power source is from the commercial utility distribution system. The secondary power source is a diesel powered back-up generator located at the rear of the building in the gated portion of the parking lot. In the event of a power failure, stand-alone UPS power maintains operations at each dispatcher console until the generator transfer occurs to maintain building operations under full load conditions. Appropriate uninterruptable power supplies (UPS) are provided for the communication equipment within the facility. In addition, UPS battery capacity is also provided for the building and server/LAN rooms.

Recommendation 30 Review Security Gate Needs

While beyond the level of review of the Classification Standard for Public Fire Protection, the needs of a security gate limiting road access to the communications centre should be further reviewed.

The City of Winnipeg Fire Paramedic Service received **95.00%** credit in this grading item.

9.3. Means for Transmitting Alarm by Public

This grading item reviews the means for transmitting alarm by the public. There should be reliable and convenient means for the public to communicate alarms of fire to the fire department, by public telephone or alternative means.

There are reliable and convenient means for the public to communicate alarms of fire to the fire department by public telephone provided by Manitoba Telephone System Allstream (MTSA) throughout the City of Winnipeg. Enhanced 911 Phase 1 and Phase 2 cellular services are available in all areas of the City of Winnipeg and fully integrated into emergency dispatch services.

In addition, WFPS Emergency Communications Dispatch Centre receives and handles all alarms from alarm monitoring companies. The receipt of alarms is provided by a dedicated ULC alarm reporting line.

The City of Winnipeg Fire Paramedic Service received **100.00%** credit in this grading item.

9.4. Fire Department Telephone Service (Incoming from Public)

This grading item considers the means for the public to contact the fire department. There should be reliable and convenient means for the public to communicate alarms of fire to the fire department, by public telephone or alternative means.

This grading item reviews how the public contacts the emergency response agency. This is usually done by a published fire emergency number or 911. The primary means for the public to contact Winnipeg Fire and Paramedic Services is through the use of 911, it should be noted that Enhanced 911 systems are also available. The Department also has a non-emergency number for general inquiries.

The number of fire lines available for alarm receiving at the communication centre has been reviewed. The WFPS Dispatch Centre has six dedicated 911 lines and four dedicated 911 lines located at the live back-up dispatch centre (Inter-Facility Transfer Centre). All calls are seamlessly transferrable between facilities.

Calls are transferred to the WFPS Dispatch from the Public Safety Answer Point (PSAP). The PSAP is also currently located at 700 Assiniboine Park Drive until building renovations are completed at Police headquarters. The back-up PSAP is a full duplication of the centre located at Headquarters. The Public Safety Answering Point (PSAP) is provided with similar redundancies as the Emergency Communications Centre.

Incoming lines are monitored for service interruption and alarmed to signal service provider. Error messages that occur (an internal alarm) are automatically received by Lynx Graphics and they can also monitor the system. Often when calling in the issue after hours they log in and fix remotely or diagnose remotely without having to physically attend the Communications Centre. Monitoring integrity and maintenance of the system is conducted weekly in person.

The City of Winnipeg Fire Paramedic Service received **100.00%** credit in this grading item.

9.5. Means of Alarm Dispatch

This grading item considers the point of receipt of fire alarms from the public. It is necessary to have reliable and prompt notification of fire fighters to respond. The use of both audible and visual means is considered essential in larger fire departments having more frequent fire calls.

Sufficiency of circuits or radio frequencies for the transmission of alarms to fire stations shall be provided as required by NFPA 1221, Standard for the Installation, Maintenance, and Use of Emergency Services Communications Systems. Alarm-receiving equipment in fire stations, and elsewhere as may be required, shall be provided and served as specified in NFPA 1221.

The emergency communications system used in the City of Winnipeg is a trunked system using multiple radio channels with three FleetNet radio repeater sites. Radio repeater sites are located in the North at 2232 Main Street, South at 1539 Waverley Drive, Downtown at 360 Main Street and the last repeater is located at Winnipeg International Airport. A propagation study was conducted in 1998, and found that radio signals throughout the City were acceptable. However, radio coverage was not measured inside of buildings.

The Public Safety Answering Point (PSAP) is managed and operated by Winnipeg Police. Through inter-computer aided dispatch notifications Winnipeg Police transfer call information and the caller to Winnipeg Fire Paramedic Service (WFPS) Emergency Communication Centre (ECC). The transfer of caller and information occurs when Fire or Paramedic assistance is required.

Calls are then triaged using National Academies of Emergency Dispatch (NAED) Fire Dispatch Protocols by dispatchers. Call takers retrieve information from the caller using a sequence of questions using NAED cardsets.

The dispatcher codes the event for Fire Dispatch and sends the call through inter-computer aided dispatch (CAD) seamlessly. All necessary information related to the emergency will arrive on the Fire Dispatchers console with a proposal provided by computer aided dispatch (CAD). Response proposals can be selected or declined by the dispatcher if the response is deemed acceptable given the information provided and location of available resources. Once the appropriate response is determined, the resources needed are dispatched and an electronic gong is sounded by CAD at the fire station(s) accompanied by a computer print out in the radio room of the fire station(s). Responding companies will collect the computer print out from the radio room and commence their response. Verbal confirmation over the radio is provided to dispatchers by responding crews to inform them that they have begun their response.

Call answering and processing times are regularly monitored by a Quality Improvement Analyst for general conformance with the NFPA 1221 standard.

The City of Winnipeg Fire Paramedic Service received **95%** credit in this grading item.

9.6. Dispatching Service

This grading item considers the dispatching services in use. Telephone alarms should be received at a point where a competent operator or firefighter assigned to duty is available to promptly receive and process emergency calls at all times.

Operators should be familiar with the facilities provided and adequate in number for handling all alarms as required by the NFPA 1221 and NFPA 1061, *Standard for Public Safety Telecommunications Personnel Professional Qualifications*. The handling of all calls, including those related to fire and other emergencies shall be considered in determining the number of operators to be on duty.

Each 911 service is measured against their evacuation plans and ability to maintain dispatch service for emergency response personnel during an evacuation and while operating from the back up facility.

Winnipeg Fire Paramedic Services (WFPS) Emergency Communications Centre (ECC) is obligated by legislation to meet the Manitoba Health, *Standards for Dispatch Centres in the Land Emergency Medical Response System.* The Land Emergency Medical Response System Regulation (2006) requires that a dispatch centre must operate in accordance with the standards approved by the Minister of Health (section 10). The standard requires that dispatch facilities in the Province meet Federal and Provincial statutes codes and regulations, such as building codes; applicable Manitoba Health policies and procedures, and maintain licensure with Emergency Medical Services of Manitoba Health.

Manitoba standards for dispatch include requirements pertaining to the following features which are perceived to impact the delivery of emergency response services:

Physical and Equipment Standards:

- Emergency Lighting
- Automatic Alarms Systems
- Alternate Power Supplies
- Facility Support for Continuous Operations
- Restricted Access Policy and Implementation

Telecommunication System

- Advanced Telephony System
- Radio System
- Voice Recording System

Staffing Standards

- Valid License
- Education Program
- Core Competency Requirements
- Minimum Staffing

Operational Standards

- Dispatch Protocols
- Inter-operability
- Time Stamping

Medical Direction

- Requirements for medical direction
- Quality Improvement (QI) Program
- Supervision and Management
- Written Policies and Procedures
- Maintenance of records and recordings
- Reporting
- Continuous Operations
- Contingency/Disaster Planning

The secondary dispatch centre is located at 185 King Street and is capable of providing redundant emergency dispatch services. The facility is maintained in a "live" state and facilitates Inter-Facility Transfer Service when not in use for Fire and Paramedic Dispatch services. Calls can be transferred and/or followed live from the back up location, as well as having the capacity to maintain service levels during emergencies should the primary facility become incapacitated. Regular business continuity transfer practice evolutions occur four times a year to ensure that in the event of an emergency or disruption of service, the transition to the back-up facility is seamless.

The City of Winnipeg Fire Paramedic Service received **95.00%** credit in this grading item.

9.7. Operations Radio

This grading item considers the means of the emergency communication centre to stay in contact with fire stations, apparatus, and personnel during emergency events. Telecommunicators should be able to maintain radio communications, using established procedures, with fire companies and essential personnel away from their quarters, in order to permit more effective and efficient operations, including the recall or re-assignment of companies, passing reports from and between units on the fire ground and contact with units on in-service inspection activity and training.

Hand portable radios should be provided for all operational Chief and Company Officers on duty. The housing of base station equipment should be reliable and facilities preferably duplicated as to transmitter, wire circuits or radio relays. A duplicate transmitter and auxiliary power supply should be provided in fire departments having frequent fire calls.

Winnipeg Fire Paramedic Services utilizes permanently mounted and portable radio equipment to receive emergency information and communicate between personnel on the fire ground during an emergency situation. The Department has a sufficient amount of portable radios. Portable radios are provided on each of the Department's fire apparatus, as well as being provided to Captains. Base radios are also provided in the fire stations. Each fire apparatus has a mobile radio installed and individual portable radios for each crew member. A mobile repeater is available for delivery to a scene."

The City of Winnipeg Fire Paramedic Service received **100.00%** credit in this grading item.

9.8. Miscellaneous Factors

This grading item considers any factors or conditions, not covered elsewhere, that may adversely affect the receipt and transmission of fire alarms or related emergency calls. These could include, but are not limited to: incompetent or insufficient supervisory and maintenance personnel; insufficient size or physical arrangement of the communication centre such that efficiency of fire alarm operators is decreased; unsuitable location of these operators; improper use of or inadequate testing of existing equipment; inadequate records; inadequate maintenance; possible delays to the handling of non-emergency calls; handling of alarms prior to receipt by the fire alarm operators and other undesirable operating procedures.

Recommendation 31 Enhance Computer Aided Dispatch Technology and Software

The communications systems and staff are well set up and have appropriate layers of redundancy. The facilities (buildings) in which emergency communications are operated from are well protected and are in good condition. Strong consideration should be given to upgrading the Computer Aided Dispatch software available to call takers and dispatchers to include NAED ProQA Medical Priority Dispatch System (MPDS) Software, along with cardsets formats. From the perspective of emergency communications, new versions of NAED ProQA Software increase effectiveness and efficiency of call processing and are currently able to handle more types of incidents than previous versions. Cardset formats should be considered a back-up redundancy with ProQA Fire and MPDS Software the primary means for response protocol determinants.

The City of Winnipeg Fire Paramedic Service received **83.33%** credit in this grading item.

The Emergency Communications system provided by Winnipeg Fire Paramedic Service Emergency Communication Center graded well under all items considered. Therefore, the focal point of our assessment was to update the grading attributed to the capabilities of emergency communications. The communications system, staffing, supervision and training/development generally meet the intent of NFPA 1221, *Standard for the Installation, Maintenance, and Use of Emergency Services Communications Systems* and closely resemble the NFPA 1061, *Standard for Public Safety Telecommunications Personnel Professional Qualifications.*

Technological advancements attributed to providing enhanced emergency communications are always encouraged by Fire Underwriters Survey. Such enhancements include Computer Aided Dispatch (CAD) services, including NAED ProQA MPDS and Fire Software, as well as the continued and enhanced utilization of Geographical

Information Systems (GIS), and should be considered for the future improvement of the existing communications systems.

9.9. Summary of Recommendations

Recommendation #
Recommendation 30 Review Security Gate Needs
Recommendation 31 Enhance Computer Aided Dispatch Technology and Software

10. WATER SUPPLY ASSESSMENT

The City of Winnipeg operates its own water distribution system complete with hydrants for firefighting purposes. The source of raw water comes from Shoal Lake located east of Winnipeg at the border between Manitoba and Ontario. Water is drawn from the lake by gravity through a 136 km long aqueduct to the Deacon Station water treatment facility. Treated water at the Deacon station is distributed by booster pumps to three separate storage reservoirs within the City.

Note that the private systems within the City are not considered as part of the fire insurance grading process. FUS will be available to review the systems upon request by the system owner/operator under a separate study (systems at some industrial sites).

10.1. Overview of Water Supply System

According to the information provided by the City's Water and Waste Department, the water system has pumping, storage and distribution facilities as summarized in the following:

Water Resource – Shoal Lake
- Size: 2.64×10^{12} L
- Permitted Withdrawal Limit: 455×10^{6} L/day

Reservoir (raw water) – Deacon Station
- Storage Capacity: 8.8×10^{9} L

Water Treatment Facility – Deacon Station
- Raw Water Intake Capacity:
  - 410×10^{6} L/day (firm)
  - 520×10^{6} L/day (maximum)
  - 4 pumps
- Clearwell: 22.6×10^{6} L
- Pumping Capacity (Treated Water)
  - 500×10^{6} L/day (firm)
  - 550×10^{6} L/day (maximum)
  - 5 pumps

Table 19 Water Distribution Facilities

	Availability	Size	Capacity
MacLean Station			
Reservoir	365 day/year	222×10^{6} L	-
Pumps	365 day/year	-	255×10^{6} L/day (firm); 318×10^{6} L/day (maximum); 5 pumps (3 electric, 2 gas)
McPhillips Station			
Reservoir	365 day/year	240×10^{6} L	-
Pumps	365 day/year	-	363×10^{6} L/day (firm); 436×10^{6} L/day (maximum); 6 pumps (3 electric, 3 gas)
Wilkes Reservoir/Hurst Pumping Station			
Reservoir	365 day/year	252×10^{6} L	-
Pumps	365 day/year	-	409×10^{6} L/day (firm); 500×10^{6} L/day (maximum);

	Availability	Size	Capacity
			6 pumps (2 electric, 4 gas)
Taché Station			
Booster Pumps	365 day/year	-	182 x 10^6 L/day (firm); 273 x 10^6 L/day (maximum); 3 pumps

10.2. Water Mains in the Distribution System

Water mains in the distribution system range as follows:

- Feeder Main Network: 400 – 1,050 mm (16 – 42 in) in diameter
- Water Main Network: 100 – 400 mm (4 – 16 in) in diameter

10.3. Plans, Records

Key components of the water system such as water mains, valves, reservoirs, and pump stations have been geocoded.

10.4. Hydrants

There are approximately 22,500 public fire hydrants. The City does not keep track of private hydrants. Hydrants are inspected twice annually, three times if possible.

10.5. Assessment Zones

Given limited changes in elevation in the City, the entire water system is considered one pressure zone for the purpose of fire insurance grading.

Approximately 200,000 RFF points were generated for a risk assessment resulting in a Basic Fire Flow of 5,700 IGPM (432 L/s). Details of risk assessment and RFF points are provided in section 6. Max Day Demand was taken as 52,556 IGPM (3,981 L/s), which is 1.6 times of Average Day Demand as provided, approximately 32,837 IGPM (2,488 L/s).

10.6. Water Supply Grading Items

The sections below cover the 15 grading items that pertain to the Water Supply. Thirty percent of the Public Fire Protection Classification of the City of Winnipeg comes from the grading of the Water Supply.

An adequate and reliable water supply is an essential part of the firefighting facilities of a community or municipality. A water supply is considered to be adequate if it can deliver the required fire flow for the appropriate duration while simultaneously providing domestic water supply at the max day demand; if this delivery is possible under certain emergency or unusual conditions, the water supply is also considered to be reliable.

In most municipalities, due to structural conditions in some areas, the possibility exists that a combination of unfavourable factors, such as the delayed receipt of an alarm of fire, high winds, or an explosion, will result in a fire becoming large enough to tax the ability of the fire service to confine the fire using the normally available water supply.

If, at the same time, the water supply is lacking or is considerably curtailed due to the failure of essential equipment (reliability), any fire, even if relatively small upon the arrival of the fire department, could rapidly expand and extend to adjoining buildings, becoming a conflagration.

In order to provide reliability, duplication of some or all parts of a water supply system is important, the need for duplication being dependent upon the extent to which the various parts may reasonably be expected to be out of service as a result of maintenance and repair work, emergencies, or some unusual condition. The introduction of storage, either as part of the supply works or on the distribution system, may partially or completely offset the need for duplicating various parts of the system; the value of the storage depends upon its amount, location and availability.

Gravity Systems and Pumping Systems
Gravity systems delivering supply from the source directly to the community or municipality without the use of pumps is advantageous from a fire protection standpoint because of its reliability, but the reliability of a pumping system can be developed to such a high degree through redundancies and back-up power supplies that no distinction is made between the two types.

Storage
In general, storage reduces the requirements of those parts of the system through which supply has already passed. Since storage usually fluctuates, the total normal daily minimum maintained or 80 percent of capacity is the amount that is considered as available. Because of the decrease in pressure when water is drawn down in standpipes, only the portion of this normal daily minimum storage that can be delivered at the required residual pressure at the point of use is considered as available.

Pump Capacities
As part of the grading analysis of pumps for fire insurance grading the capacities of pumps are de-rated by 25 percent to factor in age and reliability.

10.6.1. Normal Adequacy of Supply Works

The first grading item of the water system considers the ability of the supply works to deliver water at a rate equal to the maximum day demand plus the Basic Fire Flow rate for the time duration specified in Appendix B – Water Supply for Public Fire Protection under normal conditions. Credit may be given for the permissible overload rate of delivery from a filtration plant. If the supply works, alone or in conjunction with storage, can deliver the needed quantities to the distribution system, maximum credit will be received for this grading item.

This grading item reviews the supply works for possible limitations. Limitations may be in the intake main size(s), low-lift pumping capacity, raw water main size(s), settling capacity, settled water mains, filter capacity including allowable overload, filtered water main size, high-lift pumping capacity or the transmission main size to the community or municipality.

At a Basic Fire Flow of 6,000 IGPM (455 L/s), the fire flow duration is 6.375 hours. When considering the supply to the distribution by the three reservoirs, no issues were expected in this zone under normal conditions.

City of Winnipeg received **100.00%** credit for this grading item.

10.6.2. Reliability of Sources of Supply

This grading item considers the effect on adequacy of the source of supply. Factors considered for adequacy may include the frequency, severity, and duration of droughts; physical condition of dams and intakes; danger from earthquakes, floods, forest fires, and ice dams or other ice formations; silting-up or shifting of channels; possibility of accidental contamination on the watershed; absence of watchmen where needed; and injury by physical means.

This item considers the miscellaneous factors in the source of supply, especially those due to natural causes that could result in partial or complete interruption of the delivery.

No major issues are expected with the sources of supply for the City of Winnipeg Water System.

City of Winnipeg received **94.00%** credit for this grading item.

10.6.3. Reliability of Pumping Capacity

The ability of the water supply system to maintain the maximum day demand concurrently with the Basic Fire Flow with one and two pumps out of service is considered under this grading item. The pumps considered out of service are those which would cause a maximum reduction in service delivery to the system. To receive maximum credit, the remaining system capacity in conjunction with available storage, should be able to provide the Basic Fire Flow for the specified duration of the design fire at any time during a period of five days concurrently with consumption at the maximum day demand.

For this grading item a single failure and dual point failure analysis is conducted for the pumps considered as having the greatest impact being out of service.

City of Winnipeg received **100.00%** credit for this grading item.

One of the 6 pumps at the Hurst pumping station was considered as being out of service and the capacity of the system to provide to this zone was considered adequate. Again, with 2 pumps at the Hurst pumping station out of service the provision of flows is considered adequate within the system.

10.6.4. Reliability of Power Supply

The ability of the system to maintain the maximum day demand concurrently with the Basic Fire Flow for the specified duration at any time when considering power interruption that may affect internal or external lines or devices is considered under this grading item.

Electric power supply should be so arranged that a failure in any power line or the repair or replacement of a transformer, switch, control unit, or other device will not prevent the delivery, in conjunction with available storage, of the Basic Fire Flow for the specified duration of the design fire.

Two situations are considered for the reliability of power supply, one with an internal line or device affected, and the second a full grid outage.

Reliability of Fuel Supply (for Normal Operations)
The reliability of fuel supply was also considered because some of the distribution pumps are fueled by natural gas. The impact of fuel shortage on overall pumping capacity was evaluated in a scenario where fuel supply is not available for these pumps.

In case of unavailability of natural gas, considerable pumping capacity would still be in place for distribution.

City of Winnipeg received **94.51%** credit for this grading item.

Considering a power failure to the Hurst pumping station, the remaining capacity of the system is adequate as there is a dual electric feed. Considering a grid failure there is gas powered pumps available except for the Hurst pumping station.

10.6.5. Reliability, Condition, Arrangement, Operation, and Maintenance of System Components

This grading item considers the condition of all necessary equipment that is not evaluated in other items which can also include pumps. This evaluation includes equipment such as pressure regulating valves or altitude valves that may be in the distribution system. The capability of personnel to operate the equipment credited under both normal operation and emergency conditions is also considered.

Monitoring of Water System Components
Key components of the City of Winnipeg Water System are monitored by a SCADA system which is supervised by Water Services staff at all time.

City of Winnipeg received **95.00%** credit for this grading item.

10.6.6. Fire Flow Delivery by Mains

This item is concerned with the actual rate of delivery of water from hydrants for use in combating fires. Typically, credit is calculated by comparing the Required Fire Flows to Available Fire Flows as determined through actual flow tests conducted in accordance with the procedure specified in NFPA 291, *Recommended Practice for Fire Flow Testing and Marking of Hydrants, recent Edition*. Available fire flows are calculated through interpolation of data to determine the capacity of the water system when flows bring the residual pressure in the system to 20 psi, which is the minimum pressure that is required within the system for firefighting. It should be noted that FUS makes an assumption that the theoretical value calculated at 20 psi is the available flow, i.e. the system can be drawn down to 20 psi. In areas of the system it may not be possible to draw the pressure down to 20 psi. Additionally, more accurate results on theoretical flows are achieved with a 25 percent drop in pressure at the static (gauge) hydrant during flow testing.

Flow test results may be influenced by various factors that may positively or negatively influence the result such as seasonal fluctuations in demand and time of day demand. For this reason, it is important to regularly test and monitor water supplies to ensure adequate fire flows can be provided when compared to the Required Fire Flows.

It is important to note that although in some cases Available Fire Flows may be adequate; if hydrant distribution is inadequate it may not be possible to deliver the water at the fire flow rate that is available. Adequate distribution of hydrants is important, particularly when dealing with larger flows. Hydrant distribution is analyzed in section 10.6.11.

For the City of Winnipeg, the available flows delivered by hydrants were determined by hydraulic simulation conducted by the City's water engineering department as site conditions would make physical flow testing difficult. The results from these simulations were measured against the Required Fire Flows calculated for the building near the hydrants. Fifty-seven simulations were taken into consideration for this grading item. Based on the simulations, the majority of these Required Fire Flow points, commercial and residential, associated with the hydrants modelled are provided with adequate water supply.

Modeled Available Flow/Required Fire Flow is shown in Figure 23 where 1.00 would indicate 100% availability. Additionally green points indicate >100% available and orange points indicate <100% available.

City of Winnipeg received **97.86%** credit for this grading item.

City of Winnipeg

Figure 23 – Modeled Available Flow/Required Fire Flow

Scale = 1:38,000 0 500 1,000 2,000 3,000 Meters

Fire Underwriters Survey

10.6.7. Reliability of Principal Mains

This grading item reviews any and all pipe lines, aqueducts, tunnels, or conduits upon which service is dependent. This includes intakes, suction or gravity lines to pumping stations, flow lines from reservoirs, treatment plant piping, force mains, supply and arterial mains, etc.

In this grading item the ability of the supply works or main arteries in the distribution system to deliver the maximum day demand plus the Basic Fire Flow with the most critical length of main shut off due to a break in the pipe, was analysed. The time duration used in this item is three (3) days which should normally be sufficient to locate the break, isolate it, excavate to the main, make the necessary repairs, sterilize the main, verify the sanitary condition of the main and return the main to service.

Depending on the complexity of the supply works and distribution, the reliability of principal mains may be analyzed for a single main break or several main breaks across the water system. The mains that are analyzed are typically chosen on the basis of causing the most reduction in service.

City of Winnipeg received **100%** credit for this grading item.

The following mains were considered and the ability of the system was analysed:

- Main from Hurst Pumping Station to distribution
- Main from McPhilips Pumping Station to distribution
- Main from MacLean Pumping Station to distribution

Dual mains are in place at all pump stations.

10.6.8. Installation of Pipes

The Installation of Pipes grading item reviews the installation of mains throughout the water distribution system. The type of water main used, the provision of proper main appurtenances and the manner of installation is evaluated.

Mains should be in good condition and properly installed. Water mains should be suitable for the service intended. Asbestos-cement, Poly-vinyl chloride (PVC), cast and ductile iron, reinforced concrete and steel pipe manufactured in accordance with appropriate Canadian Standards Association or ANSI/AWWA standards, or any pipes listed by Underwriters' Laboratories of Canada for fire service are considered satisfactory. Normally, water mains rated for a maximum working pressure of 1,000 kPa is required. Service records, including the frequency and nature of leaks, breaks, joint separations, other failures and repairs, and general conditions should be considered as indicators of reliability.

The age of water mains in the distribution varies with age and construction. As the water system continues to age water mains should be continually reviewed for reliability and replacement. From GIS data, 13.8 percent of water mains (in length) were installed before 1950, of which 57 percent are over 100 years old.

A sufficient number of valves should be installed so that a break or other failure will not affect more than 400 m of arterial mains, 150 m of mains in commercial districts, or 250 m of mains in residential districts. Valves should

be maintained in good operating condition. The recommended inspection frequency is once a year, and more frequently for larger valves and valves for critical applications. There is no standard valve inspection frequency program in place; however, is was noted through meetings with the Water and Waste Department that through the unidirectional flushing program 50% of valves in a flushing area are operated and typically all mains with diameter <350mm are cleaned on roughly a 6-year cycle.

There are over 28,000 valves installed on water mains serving about a maximum of 20 customers per section.

City of Winnipeg received **90.5%** credit for this grading item.

10.6.9. Arrangement of Distribution System

The reliability of the arrangement of the mains in the distribution system is reviewed under this grading item. The supply mains, arteries, and secondary feeders should extend throughout the system, should be properly spaced, and looped for mutual support and reliability of service; dependence of relatively large areas upon single mains may constitute a reduction in credit.

This grading item is intended to review the amount of the community that is not serviced by arterial mains and arterial main looping. Also the overall distribution grid is reviewed for dead end mains and the amount of mains that are smaller than 150 mm (6 in).

Approximately 200,000 Required Fire Flow points were calculated for the study with approximately 0.011 percent not covered by the water system. On the other hand, about 0.9 percent of the total length of mains is less than 150 mm (6 in).

City of Winnipeg received **99%** credit for this grading item.

10.6.10. Additional Factors and Conditions Relating to Supply and Distribution

Water Supply grading items 1, 3, 4, 5, and 7 consider the adequacy and the reliability of the supply facility to deliver the maximum day demand concurrently with the Basic Fire Flow. This grading item evaluates, for the same items, the ability of the supply facilities to deliver the maximum day demand concurrently with the peak Required Fire Flow value obtained from the risk assessment. It also covers any factors or conditions that will occasionally reduce the fire protection credited in the other items. Additional factors that are considered when analyzing the distribution system include built on areas that are not served, localized weakness, and service levels that are not considered.

City of Winnipeg received **95%** credit for this grading item.

10.6.11. Distribution of Hydrants

The ability of the distribution system to deliver adequate rates of flow for fire protection to various locations of a community or a municipality does not alone provide good fire protection. There should be sufficient hydrants to allow the required rate of flow to be delivered to fire department engines and these hydrants should be well spaced in order to keep the length of fire department hose lines short. This grading item compares the existing hydrant spacing with the hydrant spacing needed for the various districts within a community or municipality. Hydrant distribution was determined using the Standard Hydrant Distribution table listed in Appendix B, FUS – 1999 Water Supply for Public Fire Protection.

To determine the average area served by each hydrant, representative districts are selected based on being primarily commercial or primarily residential. As part of the analysis for hydrant distribution three items are used in determining the distribution of hydrants:

- Representative areas are determined by the total area in square metres. Green space, unused land, or undeveloped land (no infrastructure developed ex. water mains or road ways) is subtracted from the total area being considered.
- Fire hydrants within the representative area are counted.
- The 10 highest Required Fire Flows are averaged for the area.
- The average area per hydrant is compared against that listed in Fire Underwriters Survey – 1999 Water Supply for Public Fire Protection.

City of Winnipeg received **75%** credit for this grading item.

10.6.12. Fire Hydrants – Size, Type, and Installation

Fire hydrants should conform to American Water Works Standard for Dry Barrel Fire Hydrants or Underwriters' Laboratories of Canada listing. Hydrants should have at least two 65 mm outlets. Where Required Fire Flows exceed 1,100 IGPM (5,000 LPM) or pressures are low there should also be a large pumper outlet. The lateral street connection should not be less than 150 mm (6 in) in diameter. Hose threads, operating and cap nuts on outlets should conform to Provincial Standard dimensions. A valve should be provided on lateral connections between hydrants and street mains.

Fire hydrants that open in a direction opposite to that of the majority are considered unsatisfactory. Flush hydrants are considered undesirable because of delay in getting into operation; this delay is more serious in areas subject to heavy snow storms. Cisterns are considered unsatisfactory as an alternative to pressure hydrants.

There are over 22,500 public hydrants of which approximately 2 percent are installed on 100 mm (4 in) mains. Hose threads on hydrants within the City were reported to be equivalent; however, hydrants are not standardized.

Hydrants do not have Storz connections. Hydrants installed operate in a uniform direction.

The City of Winnipeg does not maintain private hydrants and does not track private hydrant maintenance. Furthermore Winnipeg Water and Waste Department does not maintain fire hydrants located at the Fire Halls as these are considered “private” within the Water and Waste Department definition.

City of Winnipeg received **95%** credit for this grading item.

Recommendation 32 Private Hydrant Tracking

Private hydrant maintenance should be tracked by the City of Winnipeg to ensure that annual maintenance is being conducted.

Recommendation 33 Private Hydrant Maintenance at Fire Halls

Private hydrant maintenance should be conducted on hydrants located at the Fire Halls.

10.6.13. Fire Hydrants – Condition and Inspection

For fire hydrants to be useful in combating fires, hydrants must be in good operating condition. This grading item considers the condition and inspection of hydrants.

Hydrants should be inspected at least semi-annually and after use. The inspection should include operation at least once a year. Where freezing temperatures occur, the semi-annual inspections should be made in the spring and fall of each year. Hydrants should be kept in good condition and suitable records of inspections and repairs be maintained. Fire hydrants should be painted in highly visible colours so that they are conspicuous and be situated with outlets at least twelve inches above the grade. There should be no obstruction that could interfere with their operation. Snow should be cleared promptly after storms and ice and snow accumulations are removed as necessary.

Inspections are necessary to ensure that all hydrants in a community or municipality are in good condition. Full operation of the hydrant is necessary during inspections in order to check all features of the hydrant.

Frequency of Inspection
Hydrants are inspected twice annually, three times if time permits. The estimated frequency for hydrant flushing is about 10-20 percent every five years. Fire flow testing is only conducted after request. The City maintains a hydraulic model that is used for predictive flow testing. Full tear-down of hydrants only occurs on failure.

Condition
Hydrants are colour-coded based on the water main size to which they are connected in lieu of per colour-coding system of NFPA 291. Approximately 2 percent of which are installed on 100 mm (4 in) mains.

There is no integrated database type hydrant record for complete hydrant information.

Within the fire service, colour-coding of hydrants is generally understood to be related to the available flow as outlined in NFPA 291 – Recommended Practice for Fire Flow Testing and Marking of Hydrants. This is also typically consistent with fire service training resources. Within the City of Winnipeg hydrant colour-coding is indicative of the main size feeding the hydrant as confirmed by the Water and Waste Department. There appears to be a general misunderstanding of this information by the fire department personnel.

City of Winnipeg received **93%** credit for this grading item.

Recommendation 34 Colour-coding system of hydrant

It would be worthwhile to engage discussion between fire service and the Water and Waste Department in order to gather consensus on an appropriate colour-coding system. In this regard, NFPA 291 is recommended. More importantly, correct information on colour-coding system should be distributed to fire service staff as the current colour-coding system might have a significant impact on the choice of water hydrant in terms of flow capacity. In any case, the understanding of the colour-coding of hydrants should be clearly conveyed to all personnel using hydrants.

Recommendation 35 Review Hydrant Record Database

It would be advantageous to further develop and maintain a comprehensive hydrant record, preferable a digital database that keeps record of inspection, maintenance history, and related information that is also available to fire service personnel especially those on responding apparatus.

10.6.14. Other Conditions Affecting Adequacy and Reliability

This grading item covers pertinent factors or conditions not considered in other grading items. Specifically this grading item reviews:

- plans and records of the water system
- emergency provisions, and
- construction and hazards of buildings.

Plans and Records

Complete, up-to-date plans and records essential for the proper operation and maintenance of the system should be available in a convenient form, suitably indexed and safely filed. These should include plans of the source as well as records of its yield and a reliable estimate of the safe yield; plans of the supply works including dams, intakes, wells, pipelines, treatment plants, pumping stations, storage reservoirs and tanks; and a map of the distribution system showing mains, valves, and hydrants.

Detailed distribution system plans, in a form suitable for field use, should be available for maintenance crews. Records of consumption, pressures, storage levels, pipes, valves, hydrants, and the operations of the supply works and distribution system, including valve and hydrant inspections and repairs should be maintained.

The system is well mapped and GIS data for the system is readily available. Valve maintenance records are paper based.

Emergency Provisions

Emergency crews, provided with suitable transportation, tools, and equipment, should be on duty in larger systems and be readily available. Response of an emergency crew should be made to multiple alarms of fire to assist the fire department in making the most efficient use of the water system, and to maintain the best possible service in the event of a water main break or other emergency.

Construction and Hazards of Buildings
Pumping stations, treatment plants, control centres and other important structures should be located, constructed, arranged, and protected so that damage by fire, flooding, or other causes will be held to a minimum. Structures should be of non-combustible construction and contain no combustible materials.

Overall the security of water facilities appeared reasonable.

City of Winnipeg received **90%** credit for this grading item.

Recommendation 36 Review Valve Record Database

It would be advantageous to further develop and maintain a comprehensive valve record, preferable a digital database that keeps record of inspection, maintenance history, and related information.

10.6.15. Management

A water supply system should be well administered and have adequate plans for development to keep pace with the growth of a community or municipality. Supervisory personnel should be qualified to perform their duties efficiently and should have competent assistants. Credit may be reduced in this grading item if the capability of the water system to provide fire protection is hindered by management.

The Winnipeg Water System is well managed. Qualified individuals are responsible for overseeing the water system to ensure it is operating effectively in regards to meeting the fire protection needs of the community.

However, it was noted that the fire department does not have access to up-to-date hydrant status. Any maintenance issues with hydrants are not automatically transferred to fire department. This type of information is currently communicated to the fire service dispatch centre which is then sent to fire stations by fax. Due to the lack of efficient communication for transmission of hydrant information, some credit points have been taken off for this grading item.

City of Winnipeg received **90%** credit for this grading item.

Recommendation 37 Communication of hydrant status with Fire Department

It would be advantageous to further facilitate the transfer of information on hydrant status improve between the fire service and hydrant maintenance personnel in order to distribute the most up-to-date information on out-of-service hydrants in a more effective manner.

10.7. Summary of Recommendations

Recommendation #
Recommendation 32 Private Hydrant Tracking

Recommendation 33 Private Hydrant Maintenance at Fire Halls
Recommendation 34 Colour-coding system of hydrant
Recommendation 35 Review Hydrant Record Database
Recommendation 36 Review Valve Record Database
Recommendation 37 Communication of hydrant status with Fire Department

11. FIRE INSURANCE GRADING

Fire insurance grades are calculated as a single point in time measurement of fire risk and fire protection. The measurement is intended to be representative of the normal level of fire risk and fire protection resources in a community or a municipality at some given point in time and is considered from the perspective of property protection as opposed to life safety. In reality, fire protection capacity changes continuously as does fire risk.

The fire insurance grades have been calculated for the City of Winnipeg in 2014 based on information acquired throughout the field survey and described in this report.

11.1. PFPC - Fire Insurance Grading Areas

To determine the final fire insurance grades, four separate relative classifications (with differing weights) have been determined:

- Fire Department (40%)
- Water Supplies (30%)
- Fire Prevention and Safety Control (20%)
- Emergency Communications (10%)

Each of these areas is further broken down and scored in a number of separate items with differing weights based on the importance of the item with respect to control of losses.

11.2. Fire Department Assessment within the Fire Insurance Grading

Fire Department contributes 40 percent of the overall grade in the calculation of Public Fire Protection Classification. Relative classifications are based on a 1 to 10 scale with 1 being the highest level.

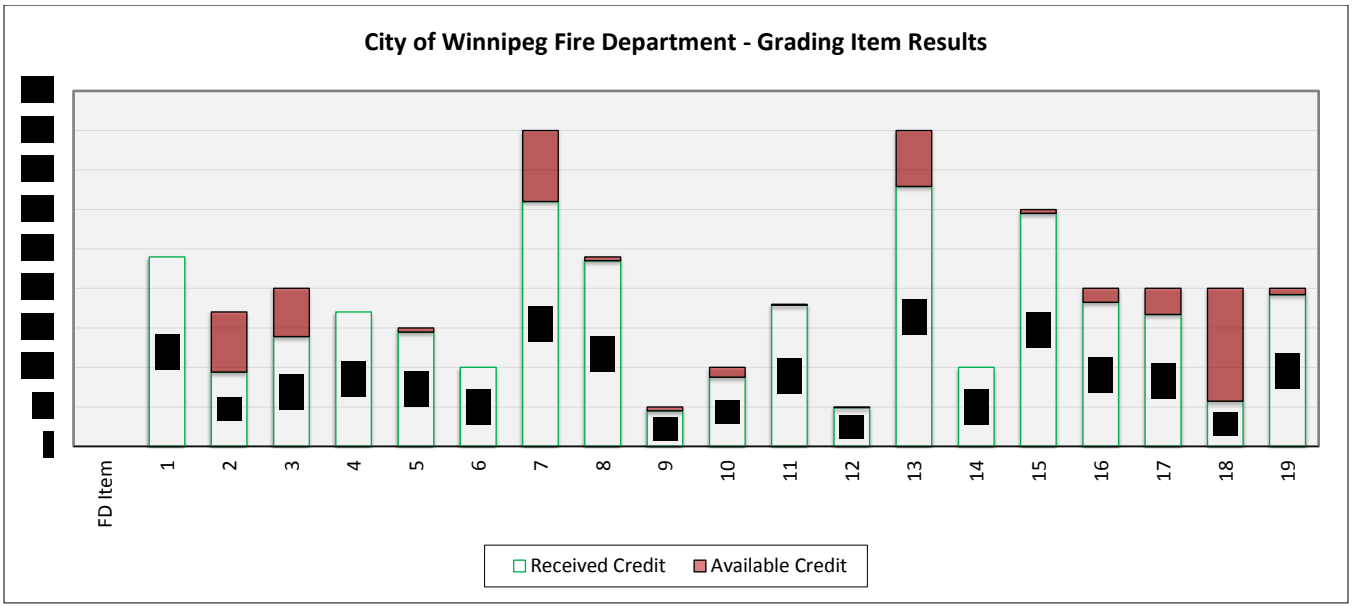
The weighting system is a two level system and the first level designates a specific number of available credit points for each item graded. Results are shown in Table 20 and Figure 24.

Table 20 Fire Department Grading Items Overall Summary

Grading Item	Category	Credit Received	Maximum Credit	% of FD	% of All
FD-1	Engine Service	[redacted]	[redacted]	[redacted]	[redacted]
FD-2	Ladder Truck Service	[redacted]	[redacted]	[redacted]	[redacted]
FD-3	Distribution of Companies and Type of Apparatus	[redacted]	[redacted]	[redacted]	[redacted]
FD-4	Pumper Capacity	[redacted]	[redacted]	[redacted]	[redacted]
FD-5	Design, Maintenance and Condition of Apparatus	[redacted]	[redacted]	[redacted]	[redacted]
FD-6	Number of Line Officers – Fire Suppression	[redacted]	[redacted]	[redacted]	[redacted]
FD-7	Total Fire Force Available	[redacted]	[redacted]	[redacted]	[redacted]
FD-8	Pumper and Ladder Company Unit Manning	[redacted]	[redacted]	[redacted]	[redacted]
FD-9	Master and Special Stream Devices	[redacted]	[redacted]	[redacted]	[redacted]

FD-10	Equipment for Pumpers and Ladder Trucks, General				
FD-11	Hose				
FD-12	Condition of Hose				
FD-13	Training and Qualifications				
FD-14	Response to Alarms				
FD-15	Fire Ground Operations				
FD-16	Special Protection Required				
FD-17	Miscellaneous Factors and Conditions				
FD-18	Pre-Fire Planning				
FD-19	Administration				
Weight in Grading	40			Credit Received	28.12
Relative Classification 3					

Figure 24 Fire Department Grading Items Overall Summary



The relative classification of the City of Winnipeg Fire Department portion is 3.

11.3. Water Supplies within the Fire Insurance Grading

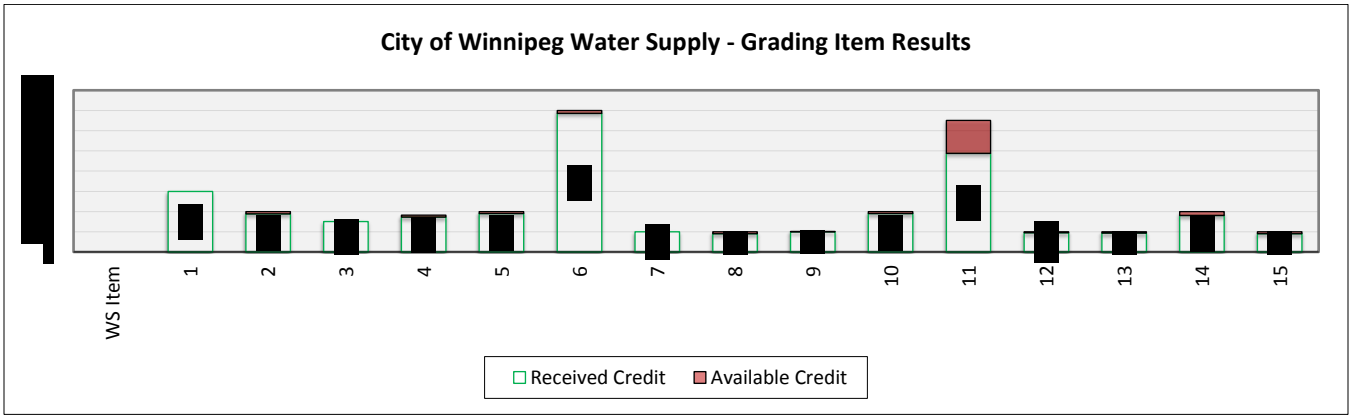
Water Supply contributes 30 percent of the overall grade in the calculation of Public Fire Protection Classification. Relative classifications are based on a 1 to 10 scale with 1 being the highest level.

As previously noted this item is graded with two tiers of weight. Results are shown in Table 21 and Figure 25.

Table 21 City of Winnipeg Water Supply - Grading Item Results

Grading Item	Category	Credit Received	Maximum Credit	% of WS	% of All
WS-1	Normal Adequacy of Supply Works				
WS-2	Reliability of Sources of Supply				
WS-3	Reliability of Pumping Capacity (Pumps and Drivers)				
WS-4	Reliability of Power Supply				
WS-5	Reliability, Condition, Arrangement, Operation, and Maintenance of System Components				
WS-6	Fireflow Delivery by Mains				
WS-7	Reliability of Principal Mains				
WS-8	Installation of Pipes				
WS-9	Arrangement of Distribution System				
WS-10	Additional Factors and Conditions Relating To Supply and Distribution				
WS-11	Distribution of Hydrants				
WS-12	Hydrants – Size, Type, and Installation				
WS-13	Hydrants – Condition and Inspection				
WS-14	Other Conditions affecting Adequacy and Reliability				
WS-15	Management				
Weight in Grading	30			Credit Received	25.20
Relative Classification 2					

Figure 25 City of Winnipeg Water Supply - Grading Item Results



The relative classification of the City of Winnipeg Water Supply portion is 2.

11.4. Fire Safety Control within the Fire Insurance Grading

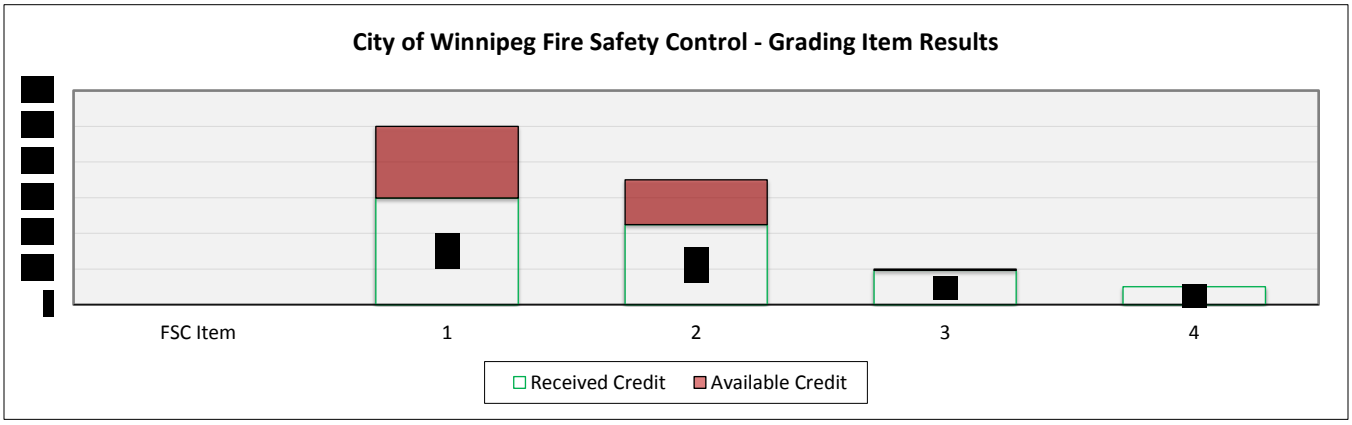
Fire safety control contributes 20 percent of the overall grade in the calculation of Public Fire Protection Classification. Relative classifications are based on a 1 to 10 scale with 1 being the highest level.

As noted above in the sections of the Fire Department and Water Supply, Fire Service Communications is graded similarly with two tiers of weight. Results are shown in Table 22 and Figure 26.

Table 22 City of Winnipeg Fire Safety Control - Grading Item Results

Grading Item	Category	Credit Received	Maximum Credit	% of FSC	% of All
FSC-1	General Program	[redacted]	[redacted]	[redacted]	[redacted]
FSC-2	Codes and Enforcement	[redacted]	[redacted]	[redacted]	[redacted]
FSC-3	Building Construction Laws and Enforcement	[redacted]	[redacted]	[redacted]	[redacted]
FSC-4	Electrical Code and Inspections	[redacted]	[redacted]	[redacted]	[redacted]
Weight in Grading	20			Credit Received	13.38
Relative Classification 4					

Figure 26 Fire Safety Control Grading Items Summary



The relative classification of the City of Winnipeg Fire Safety Control portion is 4.

11.5. Fire Service Communications within the Fire Insurance Grading

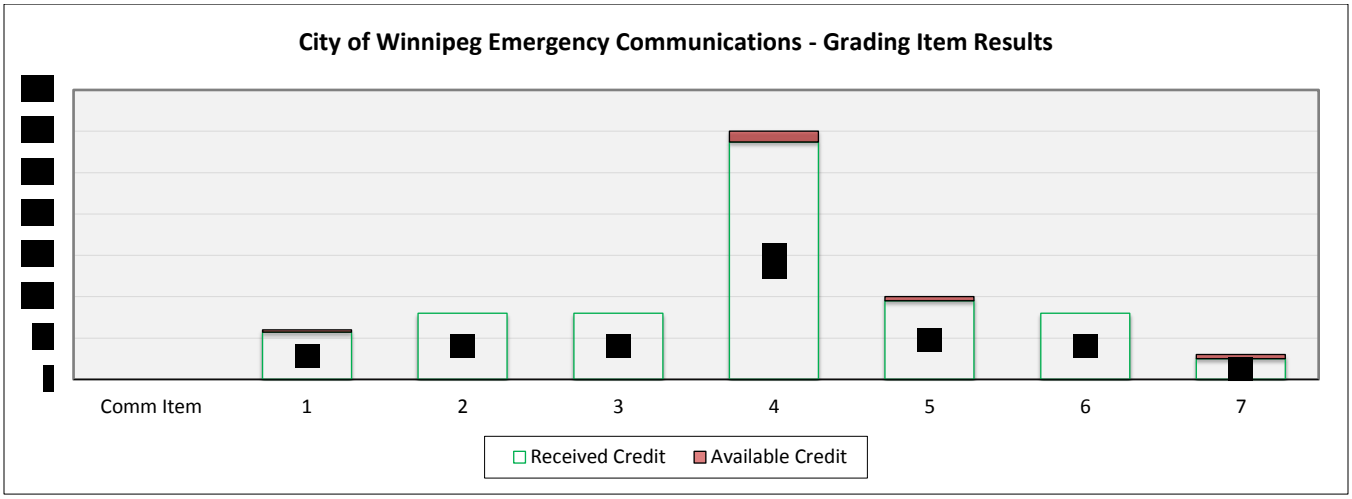
Fire service communications contributes 10 percent of the overall grade in the calculation of Public Fire Protection Classification. Relative classifications are based on a 1 to 10 scale with 1 being the highest level.

As noted above in the sections of the Fire Department and Water Supply, Fire Service Communications is graded similarly with two tiers of weight. Results are shown in Table 21 and Figure 27

Table 23 City of Winnipeg Emergency Communications - Grading Item Results

Grading Item	Category	Credit Received	Maximum Credit	% of Comm	% of All
Comm-1	Communication Center	[redacted]	[redacted]	[redacted]	[redacted]
Comm-2	Means for Transmitting Alarm by Public	[redacted]	[redacted]	[redacted]	[redacted]
Comm-3	Fire Department Telephone Service (Incoming from Public)	[redacted]	[redacted]	[redacted]	[redacted]
Comm-4	Means of Alarm Dispatch	[redacted]	[redacted]	[redacted]	[redacted]
Comm-5	Dispatching Service	[redacted]	[redacted]	[redacted]	[redacted]
Comm-6	Operations Radio	[redacted]	[redacted]	[redacted]	[redacted]
Comm-7	Miscellaneous Factors	[redacted]	[redacted]	[redacted]	[redacted]
Weight in Grading	10			Credit Received	9.48
Relative Classification 1					

Figure 27 City of Winnipeg Emergency Communications - Grading Item Results



11.6. Summary of PFPC Fire Insurance Grading

The overall Public Fire Protection Classification grade is determined by totalling the credit received per grading item. A summary of the relative classifications and results of each grading area is provided in Table 24.

Table 24 Summary of Public Fire Protection Classification Grading Areas

Area of Grading	Weight within Grading	Credit Received 2014	Relative Classifications 2014
Fire Department	40	28.12	3
Water Supply	30	25.2	2
Fire Safety Control	20	13.38	4
Fire Service Communications	10	9.48	1

Divergence Penalty		-2.05	
Special Hazard Analysis		-3.31	
Total Credit Score		70.81	

The City of Winnipeg's overall credit score for the Public Fire Protection Classification in 2014 is 70.81. The final PFPC for the City of Winnipeg is PFPC 3.
Table 25 indicates the credit range of each PFPC grade. The final PFPC for the City of Winnipeg is PFPC 3.

Table 25 PFPC Credit Range

Overall PFPC	Credit Range Per PFPC Grade
1	90.00 – 100.00
2	80.00 – 89.99
3	70.00 – 79.99
4	60.00 – 69.99
5	50.00 – 59.99
6	40.00 – 49.99
7	30.00 – 39.99
8	20.00 – 29.99
9	10.00 – 19.99
10	0.00 – 9.99

11.7. DPG – Fire Insurance Grading

To determine Dwelling Protection Grade many of the details were used to calculate the Public Fire Protection Classification. Dwelling Protection Grade 1 applies to the City of Winnipeg. The minimum requirements for the Dwelling Protection Grade system are provided in APPENDIX G Dwelling Protection Grade Summary of Basic Requirements.

12. Fire Insurance Grading Classification Potential Reassignment

12.1. Fire Insurance Grading Reassignment

The City of Winnipeg fire protection area has been reviewed. A Public Fire Protection Classification of 3 and a Dwelling Protection Grade 1 were determined based on the fire insurance grading review.

Table 26 shows the fire insurance grades that were applied to the City of Winnipeg prior to this survey and report and the updated grades in 2014. Fire insurance grades will be maintained as those currently published on the Fire Insurance Grading Index except that these grades will be noted as provisional. A provisional status is assigned to allow the City to decide on whether they wish to implement some of the recommendations in this report. If there is no plan to implement the recommendations in this report the City should advise our office and the updated PFPC 3 will be published.

Table 26 City of Winnipeg Fire Insurance Grading Classifications

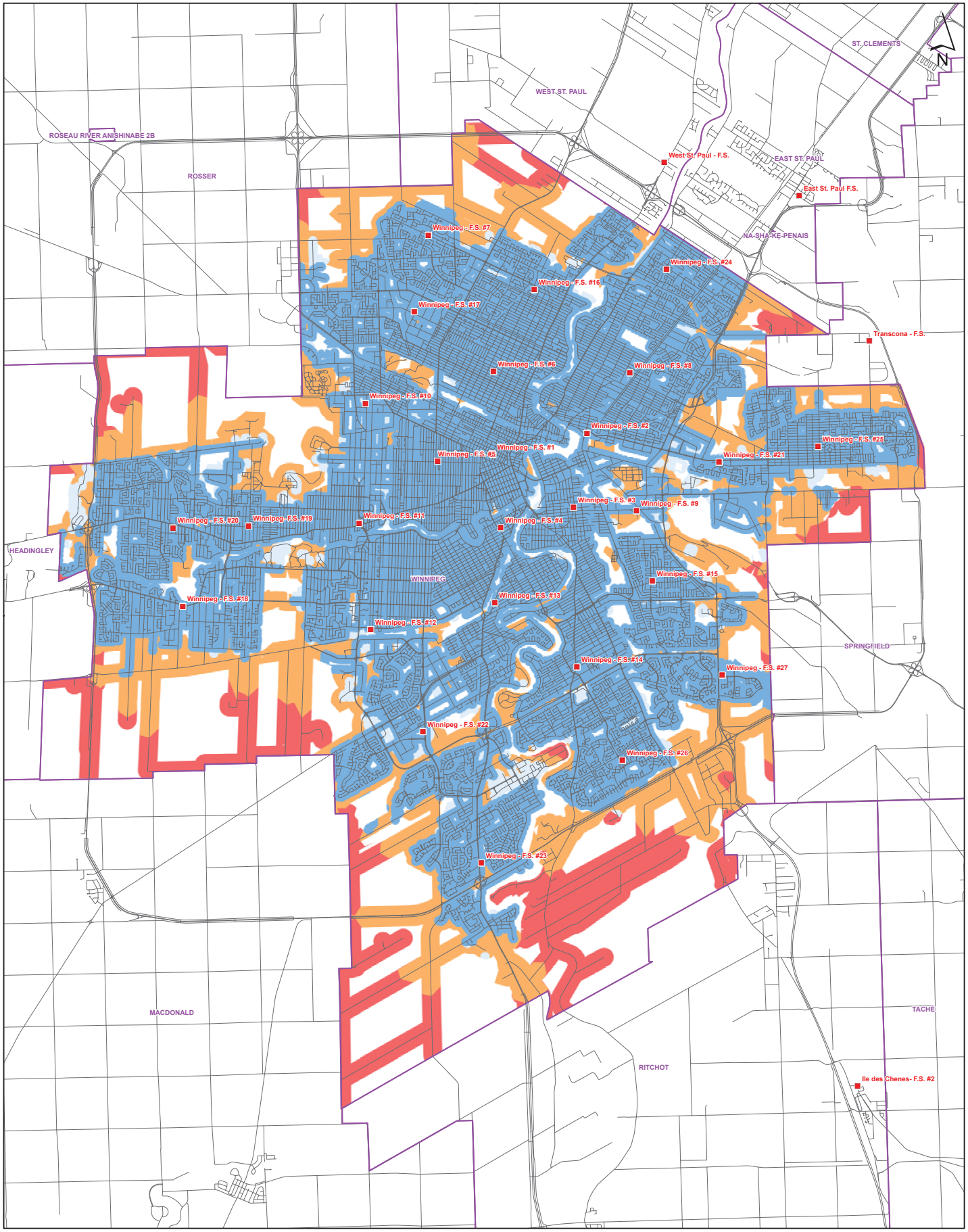
SUB DISTRICT(S)	PPFC 1988	PFPC 2014	COMMENTS
Winnipeg – all F.S. - HPA[5]	2	3	Hydrant Protected – Commercial Lines insured properties within specified distances of a hydrant on the City of Winnipeg water system and within specific distances of City of Winnipeg Fire Halls.
Winnipeg – all F.S.	9	9	Fire Hall Protected – Commercial Lines insured properties within specified distances of a hydrant on the City of Winnipeg water system and beyond 5km of City of Winnipeg Fire Halls.
Areas beyond 5km road response distance	10	10	Unprotected – Commercial Lines insured properties not within 5 road km of City of Winnipeg Fire Halls.

SUB DISTRICT(S)	DPG 1988	DPG 2014	COMMENTS
Winnipeg – all F.S. - HPA	1	1	Hydrant Protected – Personal Lines insured properties within 300 m of a fire hydrant on the City of Winnipeg water system and within 8 road km of City of Winnipeg Fire Halls.
Winnipeg –F.S. #23 Winnipeg – all F.S.	3B 4	3B 4	Fire Hall Protected – Personal Lines insured properties not within 300 m of hose lay of a hydrant on the City of Winnipeg water system but within 8 road km of City of Winnipeg Fire Halls.

[5] HPA – Hydrant Protected Area

Areas beyond 8km road response distance	5	5	Unprotected – Personal Lines insured properties not within 8 road km of a City of Winnipeg Fire Hall

These Grades are illustrated in Figure 28 and Figure 29 below.



City of Winnipeg

Scale = 1:38,000

0 500 1,000 2,000
Meters

Figure 28 City of Winnipeg PFPC Grades 2014

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Legend

- Fire Hall
- Road
- Fire Protection Boundary
- 1
- 1 (Private Hydrant Protected)
- 2
- 2 (Private Hydrant Protected)
- 3
- 3 (Private Hydrant Protected)
- 4
- 4 (Private Hydrant Protected)
- 5
- 5 (Private Hydrant Protected)
- 6
- 6 (Private Hydrant Protected)
- 7
- 7 (Private Hydrant Protected)
- 8
- 8 (Private Hydrant Protected)
- 9
- 9P
- 10

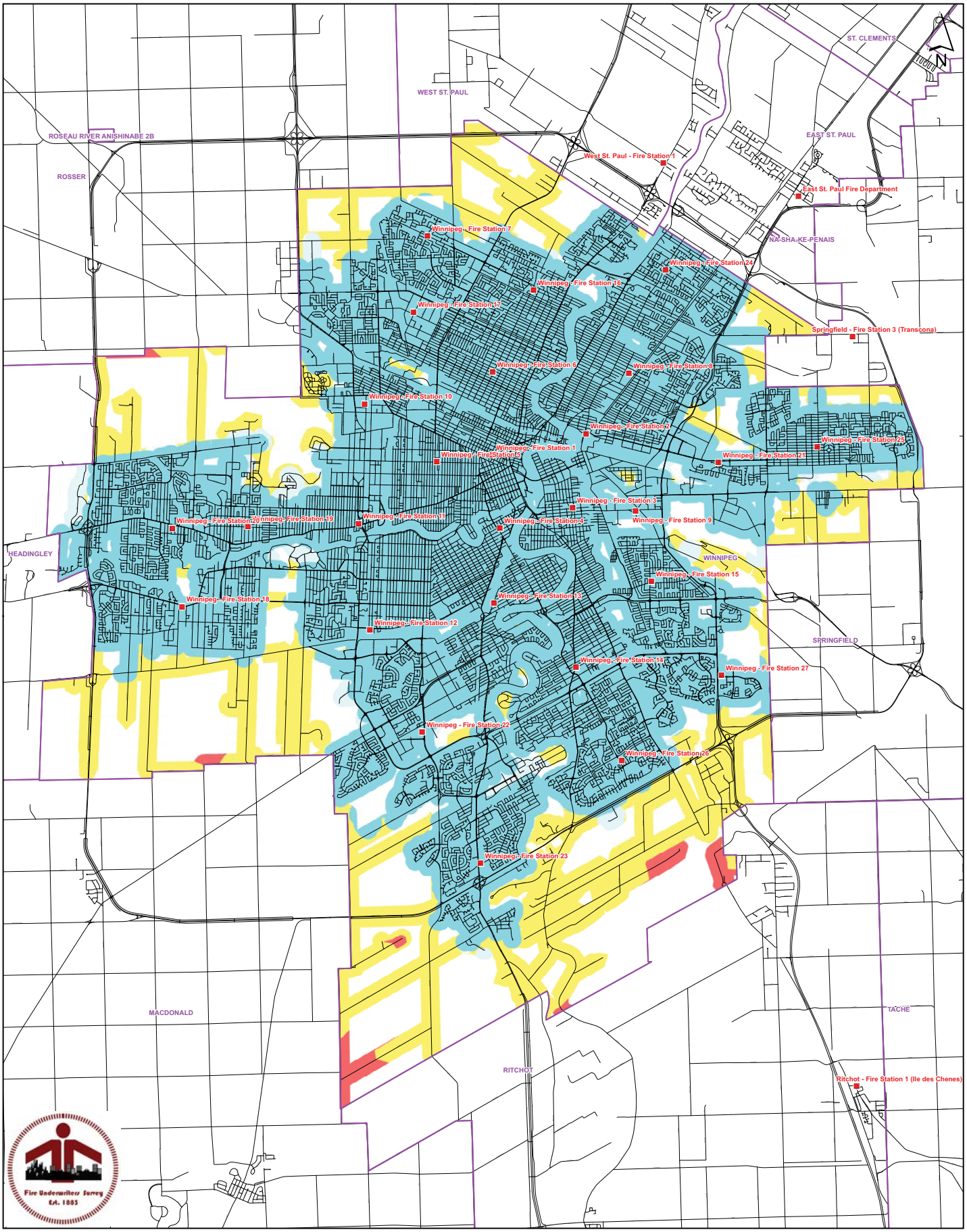
These maps and figures are not intended to illustrate the exact response distance or fire insurance grade coverage areas but can be used to aid in determining the fire insurance grade that should be applied to the property in question. Fire Underwriters Survey does not warrant or make any representations with respect to the quality, completeness, currency or accuracy of anything contained in this map, the fitness of this map for any purpose or results obtained using information contained in this map and is not responsible for any action taken in reliance on information contained in this map. In all cases, field data should be used to confirm the data and accuracy of these maps; if differences are noted please contact Fire Underwriters Survey at 1-800-665-5661.

Date Drawn: 2017-09-14

Drawn By: JU

☐ *Preliminary* ■ *Final*

■ *Commercial* ☐ *Personal*



City of Winnipeg

Scale = 1:38,000 (0, 500, 1,000, 2,000 Meters)

Figure 29 City of Winnipeg - DPG Grades 2014

Fire Underwriters Survey

Legend

- Fire Hall
- Road
- Fire Protection Boundary
- 1
- 1 (Private Hydrant Protected)
- 2
- 2 (Private Hydrant Protected)
- 3A
- 3A (Private Hydrant Protected)
- 3B(F)
- 3B(L)
- 3B(S)
- 3B
- 4
- 5

These maps and figures are not intended to illustrate the exact response distance or fire insurance grade coverage areas but can be used to aid in determining the fire insurance grade that should be applied to the property in question.

Fire Underwriters Survey does not warrant or make any representations with respect to the quality, completeness, currency or accuracy of anything contained in this map, the fitness of this map for any purpose or results obtained using information contained in this map and is not responsible for any action taken in reliance on information contained in this map. In all cases, field data should be used to confirm the data and accuracy of these maps; if differences are noted please contact Fire Underwriters Survey at 1-800-665-5661.

Date Drawn: 2014-11-12

Drawn By: LZ

☐ Preliminary ■ Final

☐ Commercial ■ Personal

13. Traffic Pre-emption System Analysis

13.1. Overview

The intent of fire department response is to arrive at a fire scene with the necessary resources before the point of flashover. This was further discussed in section 7.4.2. The fire propagation curve (Figure 13 Fire Propagation Curve (source NFPA)) shows a typical fire evolution increasing with time to the point of flashover where offensive firefighting tactics are typically no longer possible. While there are various ways to improve response time, such as career staffing at an emergency response facility or strategic Fire Hall location planning, one further option is a Traffic Pre-emption System (TPS).

Various types of TPS exist and are all based on the same principle. A request is made through a transmitter device, which is typically located on the emergency response vehicle, and received at a traffic signal. This request indicates the direction the vehicle is coming from. The traffic signal controller then implements a plan to provide a green light as quickly as possible. This typically has the effect of clearing traffic ahead of the response vehicle and providing a red light in the transverse direction. This allows emergency response vehicles to quicker and easier navigate the traffic signal intersection and has shown to reduce response times. As a result using a TPS can also reduce resource needs such as the number of response facilities. A second purpose of TPS is to reduce accidents at traffic signal intersections.

TPS can be located at a Fire Hall. The City of Winnipeg currently has some TPS devices installed at some facilities. It was noted through discussions with the Public Works Department that complaints are sometimes received indicating that the TPS at the Fire Hall is not working; however, typically upon further investigation it becomes apparent that responding fire fighters at the facility were unaware of the need to activate the TPS using a push button. These systems located at emergency response facilities generally activate certain predefined signals to aid access only in the immediate vicinity of the Fire Hall.

TPS is more typically mounted on the emergency response vehicle. These systems are generally one of four types, i.e. radio frequency, acoustical, optical, GPS. These are typically vendor based; however, municipalities can implement these systems in-house (http://www.firefightingincanada.com/research/road-to-success-13630) which can lead to a system that is easier to expand and develop. GPS type systems allow for more integrated services such as pre-fire planning creation, access, and updates. Additionally GPS allows for development of better response analysis tools in order to optimize the use of emergency response resources. It was noted during discussions with Public Works that Public Works vehicles are currently being installed with GPS. WFPS should consider the GPS systems currently being installed to understand how they can be used with a TPS system.

Further details and statistics concerning these systems are provided in APPENDIX H. While a complete proposal to introduce a TPS system to the City of Winnipeg is beyond the scope of this report, this section of the report will look at the effects of introducing a TPS system on the Fire Insurance Grades for the City of Winnipeg. These effects make an important part of a TPS proposal.

13.2. TPS and Fire Insurance Grades for City of Winnipeg

The response model described in section 7.4.3 was used to determine the effects of using a TPS within the City of Winnipeg. With TPS in place traffic signal impedance was set to 0 for each intersection. Response to each RFF point was again calculated. A summary of the response time for the first apparatus on-scene with a TPS versus the current scenario is shown in Figure 30. With a TPS in place, response times have improved with 80% of RFF

points now receiving a response within 3 minutes versus the current scenario where 75% of RFF points receive a response within 3 minutes road travel time; an improvement in response to 5% of all properties within the City. With 198,651 RFF points this now results in 9933 additional RFF points now being within 3 minutes road response time. To further illustrate where the improved response is seen throughout the City a 144 square grid was placed over the City and the average response time was calculated for each grid. The current average response time to each grid is shown in Figure 34. The average improved response time to each grid with a TPS in place is shown in Figure 35. The difference in average response times is summarized in Figure 31. Improved response times are seen in almost all grids.

Figure 30 First apparatus on-scene (current vs TPS)

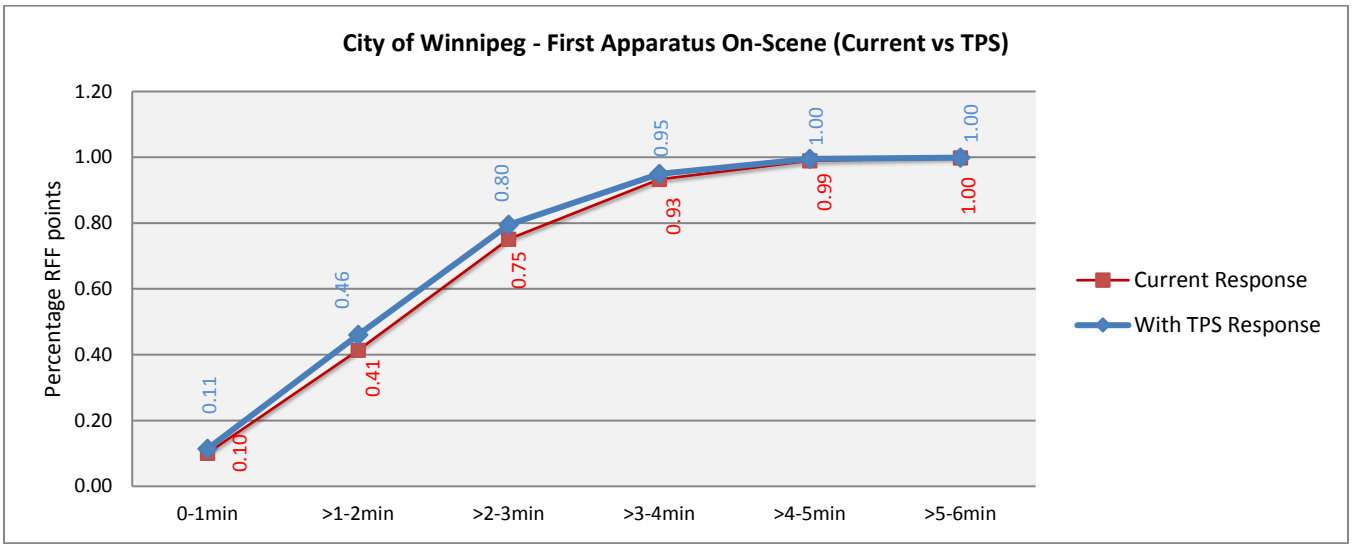
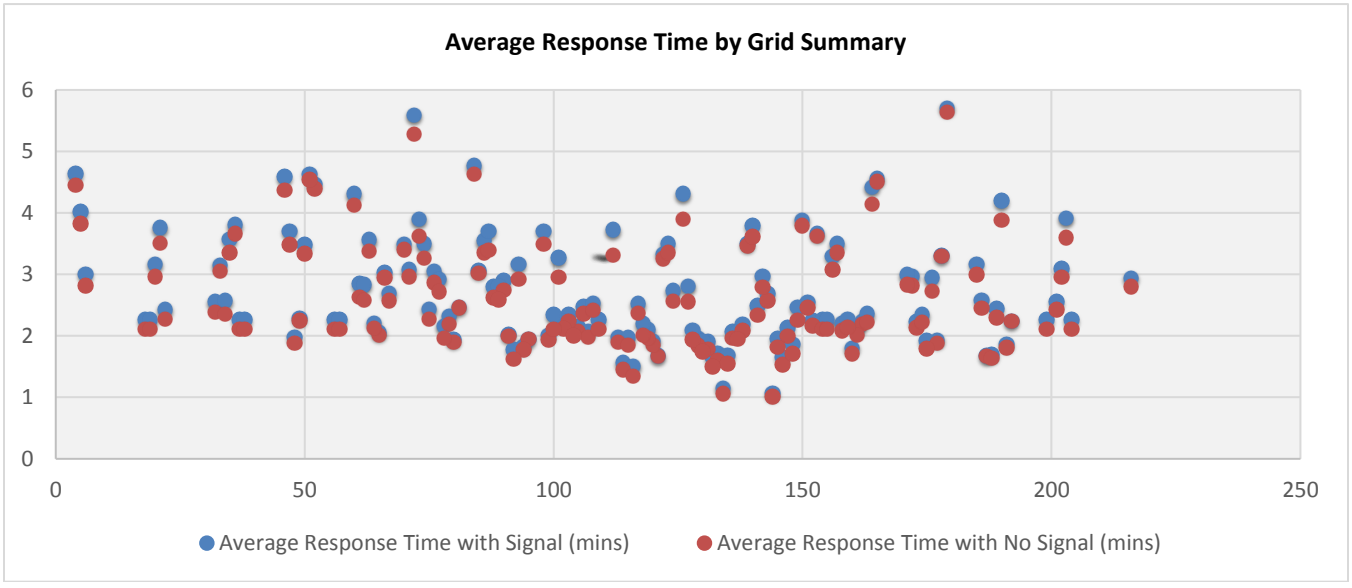


Figure 31 Summary Average Response Time by Grid



As a result of this improved response time less resources are now needed within the Fire Suppression Rating Schedule calculation. As already stated in section 7.2., using a location-allocation GIS tool the optimal location and number of facilities to provide 90% coverage to RFF points under first due response time was found to be an

additional 19. Again using the location-allocation tool the optimal location and number of facilities to provide 90% coverage to RFF points under first due response time was found to be an additional 17. This shows that with the Fire Suppression Rating Schedule, implementing a TPS for the City reduces the distribution needs by 2 response facilities. These optimized locations are shown in Figure 36.

Similarly, the optimal location and numbers to provide 90% coverage of RFF points for ladder response was found to be an additional 9 as opposed to the current situation where an additional 11 are needed. These optimized locations are shown in Figure 37.

Furthermore, under the distribution of response portion of the Fire Suppression Rating Schedule, see section 7.4.3., the number of RFF points meting the benchmark level of response increases as shown in Figure 32 and Figure 33. The overall effect on the Fire Insurance Grade is that the Public Fire Protection Classification credit score goes from 70.81 (= PFPC 3) to 72.72.

Figure 32 Distribution of Pumper Response (TPS comparison)

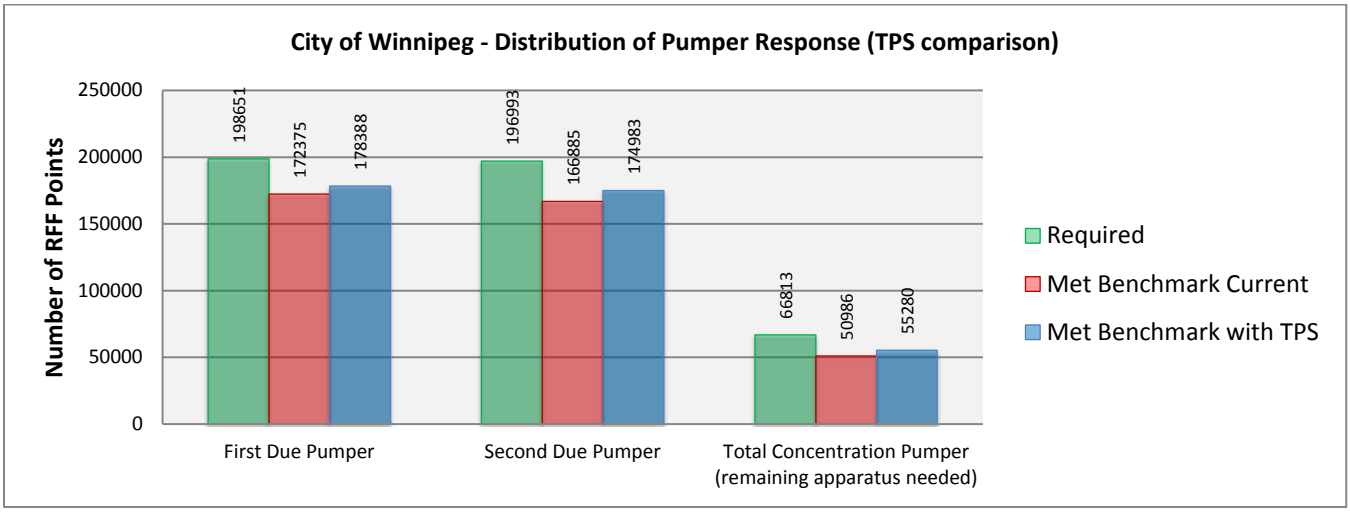
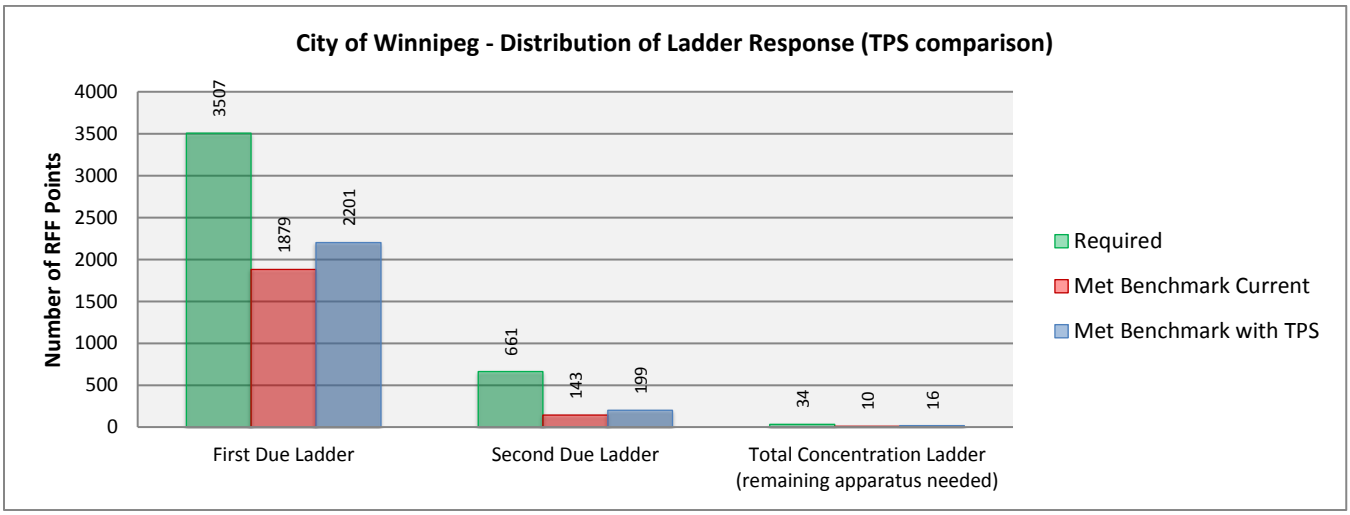
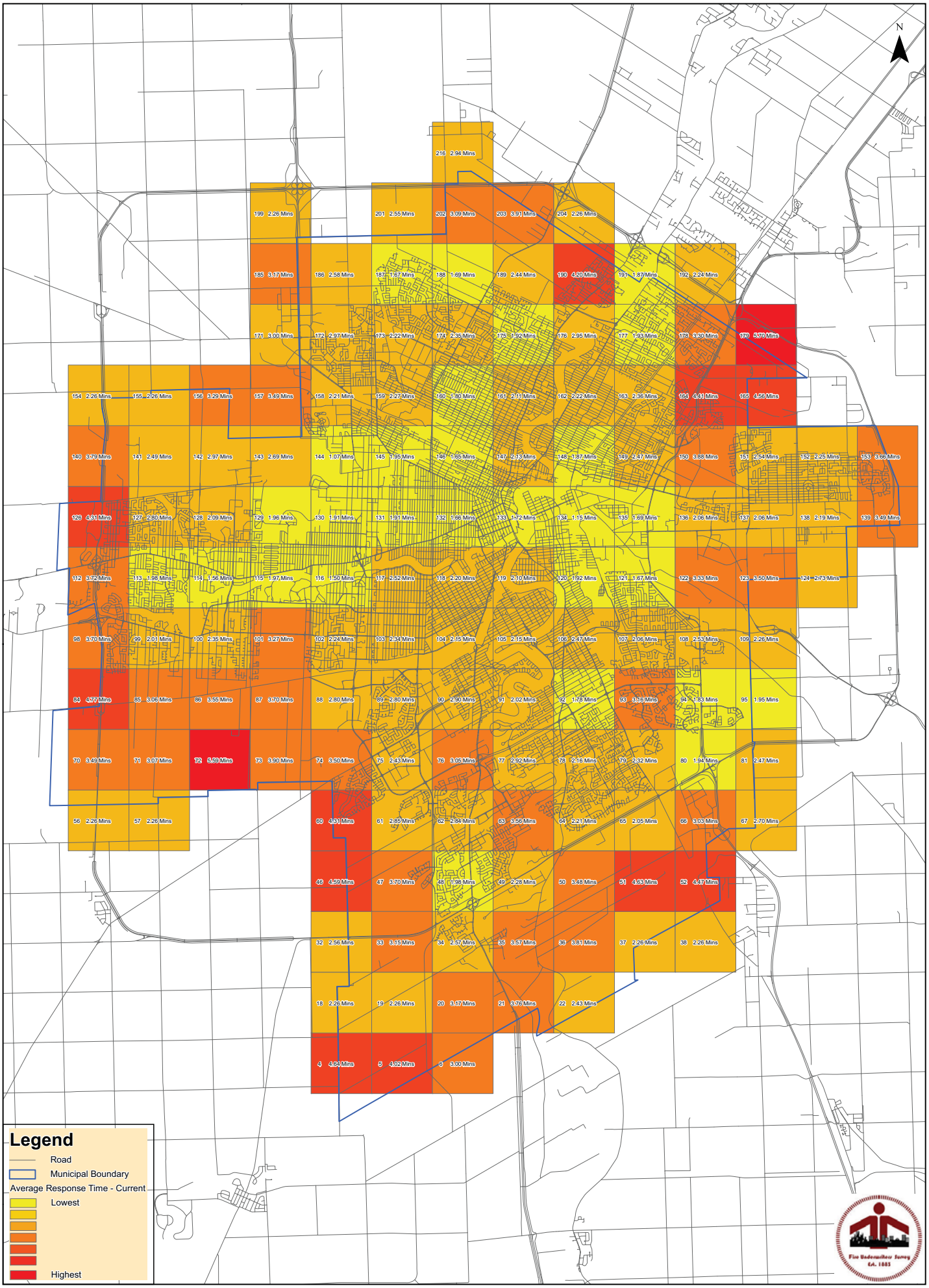


Figure 33 Distribution of Ladder Response (TPS comparison)



Recommendation 38 Develop Proposal for Implementation of a Traffic Pre-emption System.

Analysis shows that a traffic pre-emption system in the City of Winnipeg would improve the level of response and would have the resultant effect of reducing Fire Department resource needs. A complete proposal should be developed for implementation of a TPS system within the City of Winnipeg.

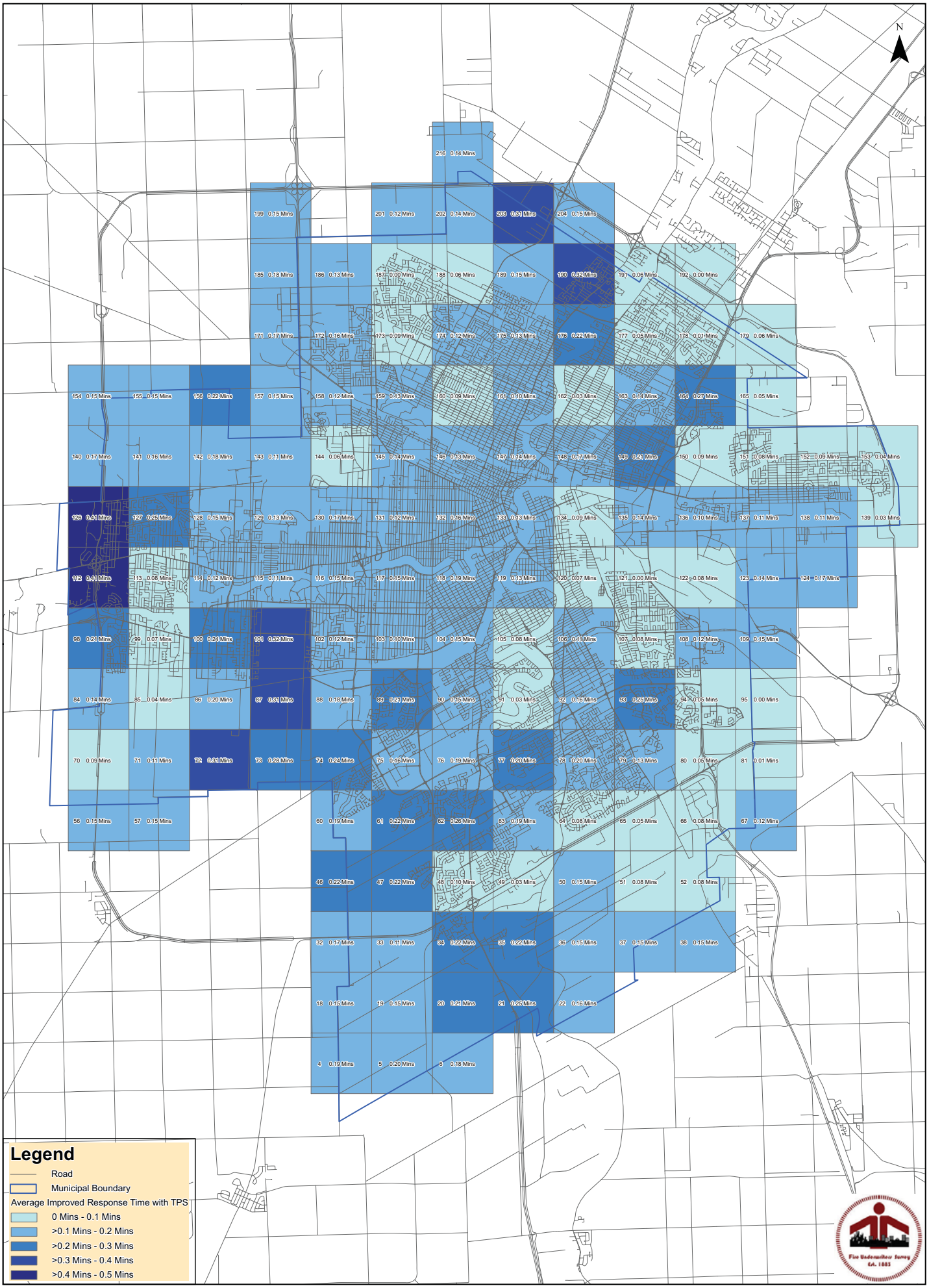


City of Winnipeg

Figure 34 - Average Response Time - Current

Scale = 1:38,000 0 500 1,000 2,000 3,000 Meters

Fire Underwriters Survey

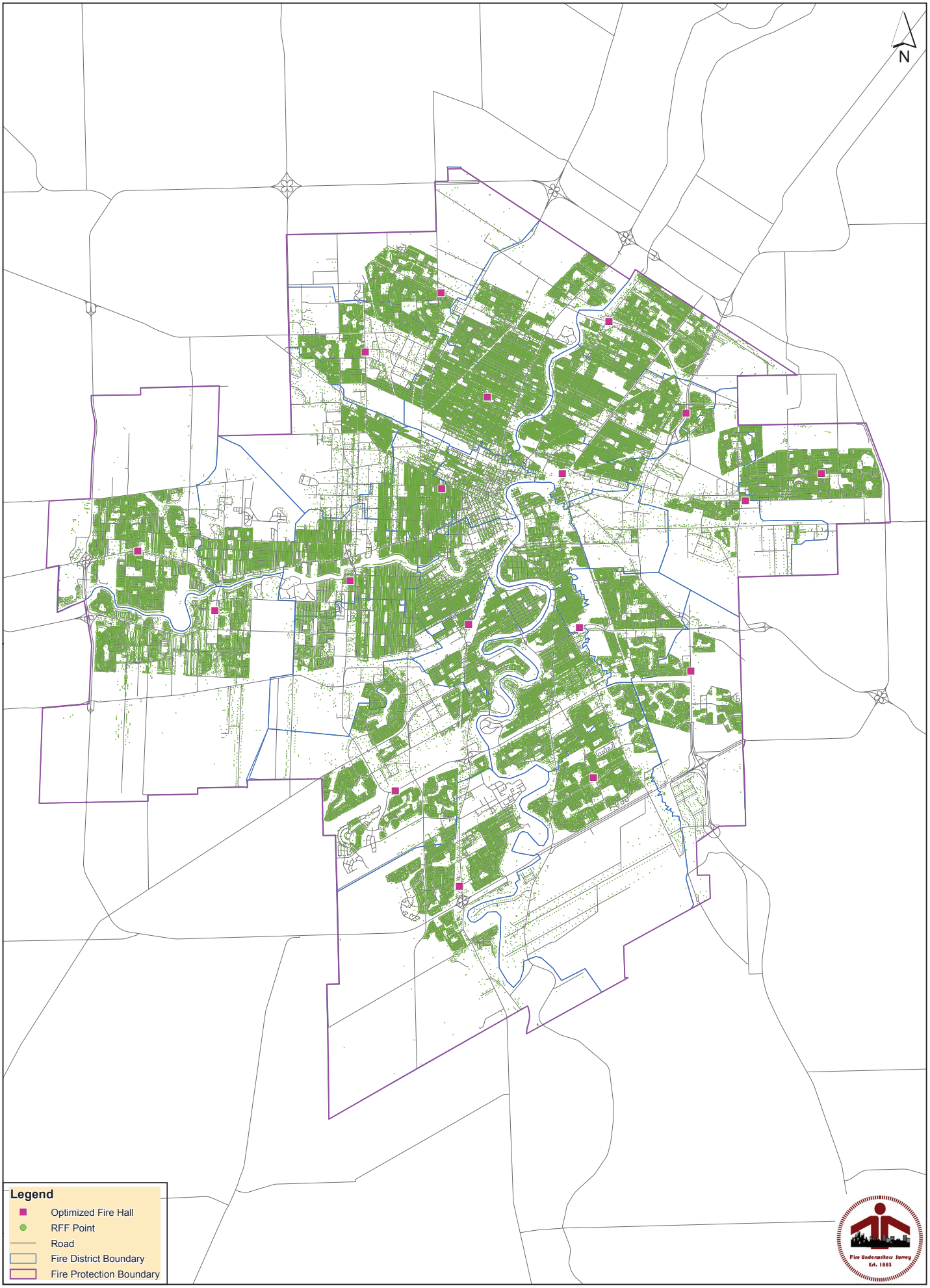


City of Winnipeg

Figure 35 - Average Improved Response Time with TPS

Scale = 1:38,000 0 500 1,000 2,000 3,000 Meters

Fire Underwriters Survey



City of Winnipeg

Figure 36 - Optimal Location of Facilities for 90% Coverage under First Due Pumper with TPS

Scale = 1:38,000 0 500 1,000 2,000 3,000 Meters

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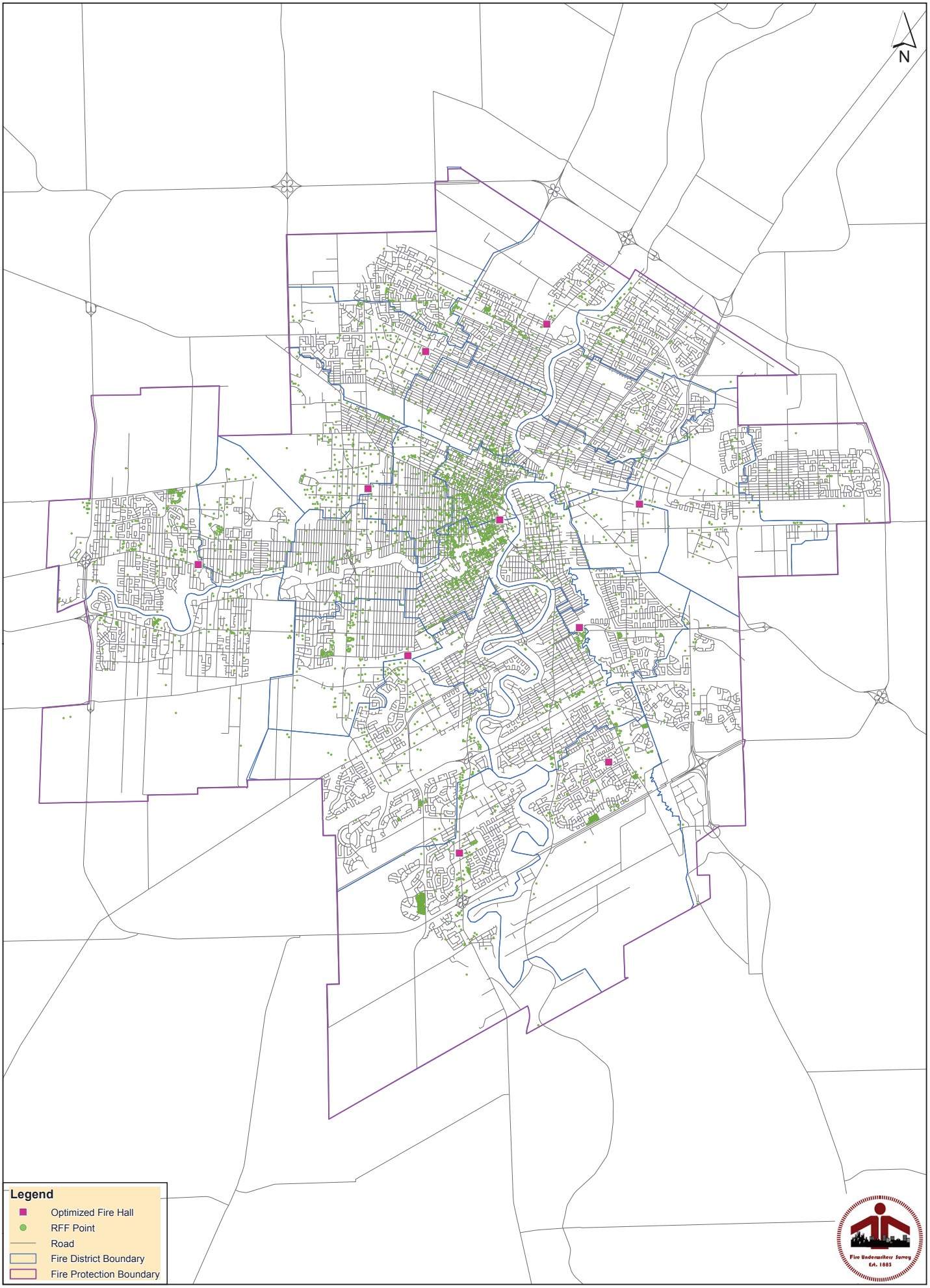

City of Winnipeg

Figure 37 - Optimal Location of Facilities for 90% Coverage under First Due Ladder with TPS

Scale = 1:38,000 0 500 1,000 2,000 3,000 Meters

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14. Additional Fire Hall Location Analysis

14.1. Overview

Multiple optimization analyses were completed as part of this study. All optimizations were based on fire response coverage of properties within the City of Winnipeg. All coverage analysis was provided in road response minutes. It should be noted that while spatial analytical tools can aid in researching potential locations of Fire Halls, the results from different models can vary depending on the constraints applied and the importance of each constraint for the particular project.

In section 7.2, pumper apparatus resource needs were determined based on providing 90% coverage of properties under property specific first due response times. GIS tools were used to show that 20 Fire Halls could provide 90% coverage under first due. Currently 27 Fire Halls provide 86.7% coverage under first due. In section 13.2 it was shown that with a Traffic Pre-emption System in place it was possible to provide 90% coverage under first due with 18 Fire Halls.

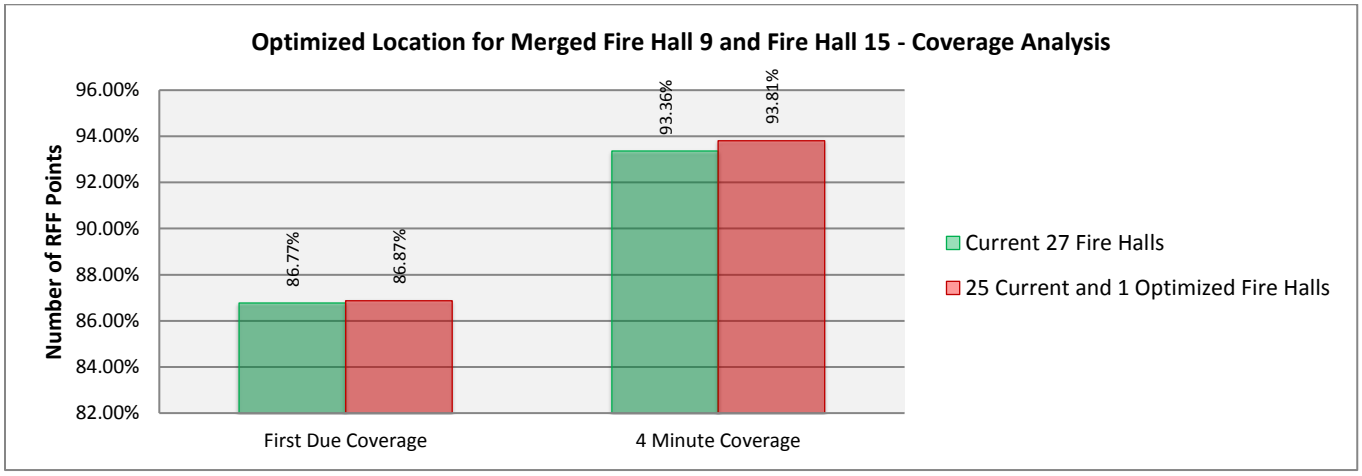
In section 7.3, ladder apparatus resource needs were determined based on providing 90% coverage of properties (requiring ladder response) under specific first due response times. GIS tools were used to show that 12 Fire Halls housing ladder apparatus could provide 90% coverage under first due. The current coverage of properties is 53.6%. In section 13.2 it was shown that with a Traffic Pre-emption System in place it was possible to provide 90% coverage under first due with 10 Fire Halls.

This section looks at 2 further location analyses. Both Fire Hall 9 and Fire Hall 15 are aging facilities, see Figure 20 and APPENDIX D. An analysis was completed to assess the coverage impact and identify an optimal location for merging these facilities. Additionally Fire Hall 5 is an aging facility and the coverage impact of removing this Fire Hall was assessed.

14.2. Merge Fire Hall 9 and Fire Hall 15

Fire Hall 15 and Fire Hall 9 were built in 1970 and 1955, respectively. Both are aging facilities with Fire Hall 15 in lesser condition. Figure 7 indicates that Fire Hall 9 received 848 calls in 2013 and Fire Hall 15 receiving 1028 calls. Figure 8 indicates that Fire Hall 9 was unavailable for response for a total of 3.58% of the year and Fire Hall 15 was unavailable for a total of 4.89% of the year. The current coverage of RFF points under first due distances within the City of Winnipeg is 86.77%. A GIS location-allocation tool was used to optimize maximum coverage of RFF points under first due by removing Fire Hall 9 and Fire Hall 15 and replacing with one optimized Fire Hall. The optimized location can be seen in Figure 39 which also shows the 4 minute road response buffer derived from the road network established in this study. Note that this scenario does not consider a TPS in place. Coverage analysis is provided in Figure 38.

Figure 38 Optimized Location for Merged Fire Hall 9 and Fire Hall 15 - Coverage Analysis



It can be seen that based on this analysis slightly better coverage can be achieved by merging Fire Hall 9 and Fire Hall 15. Percentage coverage under first due increases by 0.1% (approximately 200 RFF points) and coverage at 4 minutes increases by 0.45% (approximately 900 RFF points). Additionally, the total time unavailable for the year 2013 for both halls combined is still less than 10%. This analysis indicates that there would actually be a positive effect on coverage from merging these 2 Fire Halls.

14.3. Comments on Future Development

The City of Winnipeg produced a municipal development plan in 2011 called “OurWinnipeg”. The City of Winnipeg Charter is a provincial legislation that requires the City to adopt, by bylaw, a development plan that sets out long-term plans and policies respecting its purposes; it’s physical, social, environmental and economic objectives; sustainable land uses and development; and measures for implementing the plan. OurWinnipeg is a 25 year vision for the City. It was noted in the plan that Winnipeg is growing at an increasing rate with 180,000 new people anticipated to be living in the City by 2031 with a total expected population in the City of 849,000. OurWinnipeg further discusses community development in the Direction Strategy document “Complete Communities”.

Complete Communities identifies proposed changes in the “Urban Structure” map, see APPENDIX I. Those areas that will likely be experiencing more development are identified in the map “Transformative Areas”. The following areas were identified as potentially having an impact on public fire protection resources and are shown in APPENDIX I:

- Downtown
- Regional Mixed-Use Centre and Corridors
- Major Redevelopment Sites
- New Communities
- Recent Communities

It is not possible to quantify the complete effect of these developments; however, the following comments are provided. Overall it is important that the Fire Department be more involved in the community planning and development processes as listed in Complete Communities.

14.3.1. Downtown

Downtown has been identified as one of the areas for development. Redevelopment has been planned for intensification. Direction 2 of the Complete Communities plan for the Downtown Area states the following:

"Promote intensification and high-density mixed use development within downtown in a way that supports and complements its unique districts, destinations and clusters"

More integrated residential development as well as office and commercial space has been identified for the Downtown area. Further growth of post-secondary campuses is also noted as well as further economic development. Overall this area is planned for large directional development with the expected results of increased population. This identified Downtown area is mostly covered by Fire District 1 and partially by Fire District 4. Currently Fire Hall 1 has the largest number of calls at 11565 with Fire Hall 4 having the next largest number of calls at 6062 which makes up a total of approximately 28% of all calls for the City of Winnipeg, see Figure 7. Furthermore Fire Hall 1 currently spends 44.32% of time for the year 2013 out on calls. While there are 2 pumper crews available at this hall, this is still significant when considering the percentage of time on calls for all Fire Halls, see Figure 8. While a large portion of these calls are for alarms it would be expected that increased population will lead to more call demand. This additional population in the Downtown core will likely lead to additional vehicle traffic which may further impede Fire Department response. This should be further considered when analyzing a traffic pre-emption system and overall traffic plan. Prevention and education programs can also be used to manage call volume.

14.3.2. Regional Mixed-Use Centre and Corridors

Regional Mixed-Use Centres as well as Mixed-Use Corridors have been identified for compact, mixed-use development. Overall these areas will see intensification over time. Area E (Kenaston and Sterling Lyon Avenue Area) and Area D (Kenaston and McGillivary Area) being on the outer areas of the City of Winnipeg currently receive a lesser overall fire response with additional apparatus having to come from Fire Halls that are further away, see Figure 18. These areas generally lie in Fire District 12 and 22. Fire Hall 12 and Fire Hall 22 experienced 1801 and 1696 calls in 2013 with each Fire Hall being out on call for 8.89% and 8.25% of the year. A traffic pre-emption system was shown to improve response times to this area of the community as can be seen in Figure 35.

Another area identified for Fire Department resources is Area G (Portage Avenue West at Racetrack Road). This area already receives a lower level of response especially ladder response.

Furthermore development along identified corridors would be expected to increase call volume in general but this can be managed through prevention and education programs. Traffic may be expected to increase and again a traffic pre-emption system can be considered.

14.3.3. Major Redevelopment Sites

Major Redevelopment Sites have been identified for significant residential and employment development. Some of these areas are located around rail lines and as such prevention programs and response plans outlined in this report should be considered. These sites may bring redevelopment and it is important that the Fire Department be involved in planning for the area. Only Area J (Tuxedo/Lafarge Lands) would appear notable at this time.

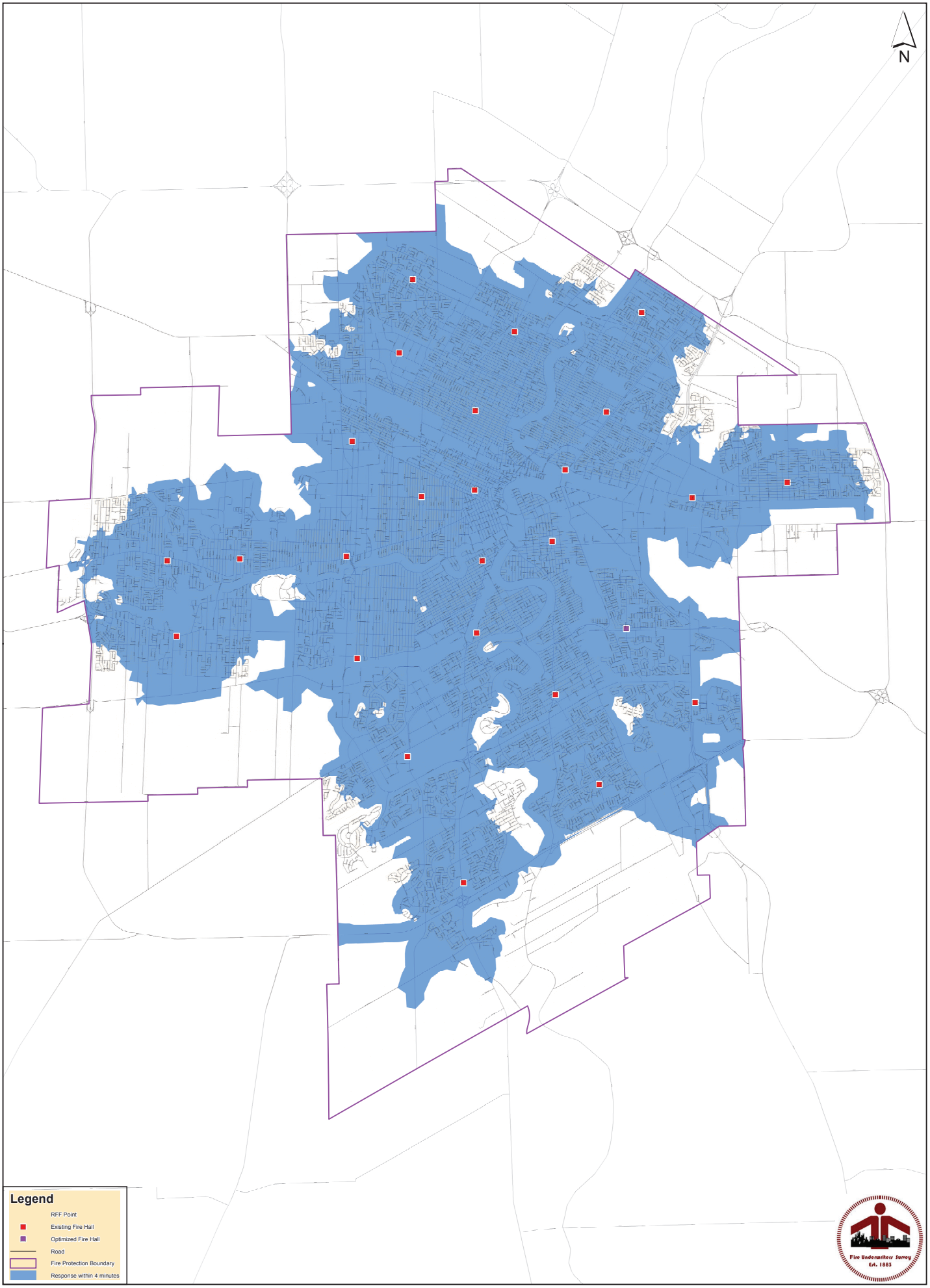
14.3.4. New Communities

This is the development area that will likely have the most significant impact for the WFPS. These areas have been noted as playing an important role in accommodating the City's projected population growth.

Areas in the north of the City of Winnipeg in Fire District 7 and Fire District 16 have been noted for new community development. Areas in the west in the vicinity of Fire District 18 and an area in the north of Fire District 20 have also been identified. Both of these areas have lesser response especially considering ladder response. While percentage of time on calls in these areas is currently low, see Figure 8, development in the area should be monitored as should duration and call volumes. A large increase in building numbers could reduce credit in certain areas of the grading as discussed throughout this report (section 7.2, 7.3, 7.4). Building heights should be monitored in these areas.

14.3.5. Recent Communities

Recent communities and emerging communities in particular are still under development (this was noted in section 7.3 concerning ladder needs) and as such should be visited regularly to review the risk levels present.



City of Winnipeg

Figure 39 4 Minute Response from 25 Existing Fire Halls and 1 Optimized Fire Hall under First Due

Scale = 1:38,000 0 500 1,000 2,000 3,000 Meters

Fire Underwriters Survey
A Service to Insurers and Municipalities

15. How Fire Insurance Grades Affect Insurance Rates

A Cost Benefit Analysis (CBA) is a systematic approach for calculating and comparing benefits and costs of a decision, policy, or project. As a result, a very common question from municipalities relates to how Fire Insurance Grades affect insurance rates. There would be a benefit in being able to determine if the cost of investment in fire protection would be offset with a reduction in insurance premium. Naturally, a question of this type would be best answered by an actuary; however, as this is proprietary information they may be limited in what they can provide. Recently it has become apparent that insurance rate quotes determined from a rating calculator may not reflect what an insured would finally pay once specific client discounts are applied. In general, Fire Insurance Grades would apply a reduction to the base rate. The amount of reduction depends on the Grade and individual insurance company's proprietary underwriting guidelines. Further reductions are then applied based on specific client discounts.

15.1. Fire Underwriters Survey Timeline Overview

In order to better understand the underwriting procedure, as it related to Fire Insurance Grades, it is beneficial to provide a brief historical overview of rating regulation. The information prior to 1983 in this timeline is taken from *"The Underwriters: A Century of Service 1883 – 1983, by Christopher Hives, University Archivist, UBC"*.

Prior to the period, approximately 1880:
Insurance companies were collecting insufficient reserve capital for proper protection against the threat of serious conflagration (for example Toronto 1904). Insurance rates were driven very low due to stiff competition. Large conflagrations in municipalities would result in insurance companies going bankrupt.

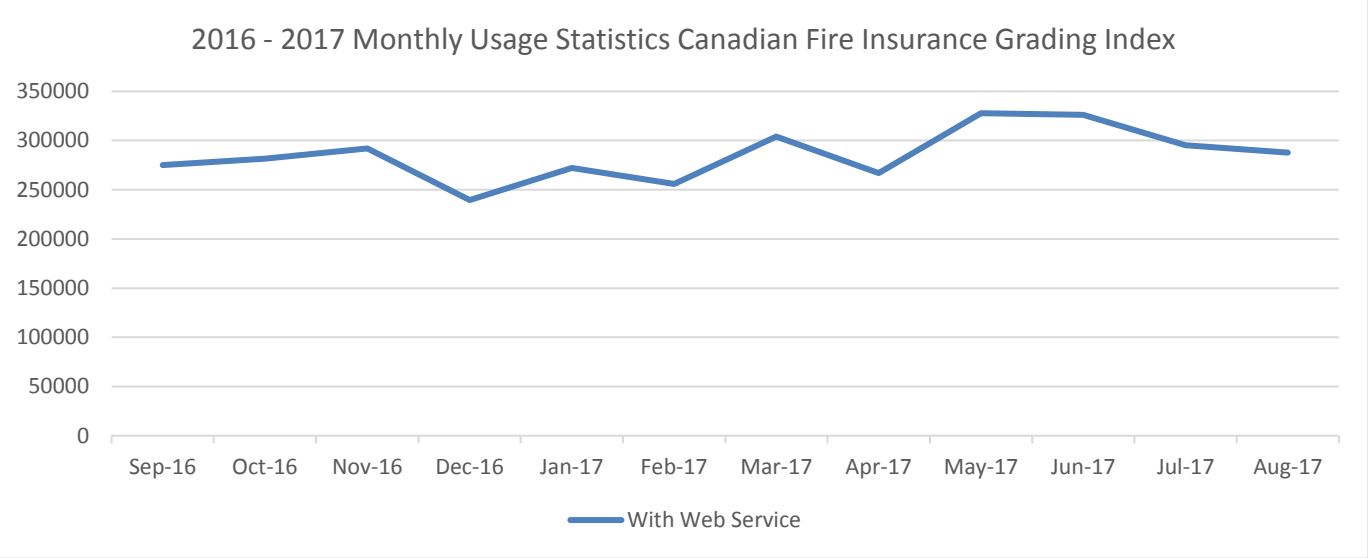
Introducing uniformity to the insurance industry, approximately 1883:
To address the issue the National Board of Fire Underwriters (NBFU) was set up in 1866 in the US. In Canada, the Canadian Fire Underwriters Association (CFUA) was set up in 1883. These groups introduced more insurance rate regulation as well as a more scientific approach to risk assessment. The CFUA set rates and members of the organization could not deviate. Coming closer to the period 1970, pressure was constantly applied to loosen the organizational structure of the CFUA (later Canadian Underwriters Association (CUA)), allowing for greater regional differences. In short insurance companies wanted more ability to set their own rates and compete better.

Regulatory bodies move from strict regulation to advisory, approximately 1970:
The CFUA/CUA is dissolved and the Insurer's Advisory Organization (IAO) is formed. This represented a major shift in the industry from a rigid, rule-oriented association to an organization whose primary function was to provide advice and information. IAO's mandate was to provide members with benchmark rates, supporting statistical data, and other information. The IAO produced the "Commercial Property Rating and Underwriting Manual" which detailed how to calculate insurance rates for commercial buildings. The manual detailed how the PFPC Grades are applied in the rating process.

Post IAO, approximately 2000:
The IAO was bought by the CGI Group who further developed the rating calculator "Commercial Property Rating and Underwriting Manual" and rating engines called "U-Rate" and "X-Rate". While these calculators are still used (although usage appears limited) it is understood that a large number of insurance companies have their

own internal rating systems which are based on the “Commercial Property Rating and Underwriting Manual”. In other words individual insurance company actuaries build their own derivatives of these calculators and factor in their own adjustments based on the Fire Insurance Grades. Today, the Fire Insurance Grades appear firmly involved in the rating process. This is apparent in the monthly usage statistics of Fire Insurance Grades through the Fire Insurance Grading Index as shown in Figure 41. June 2017 showing FUS Grades accessed 325,000 times in a month, which is 10,833 per day.

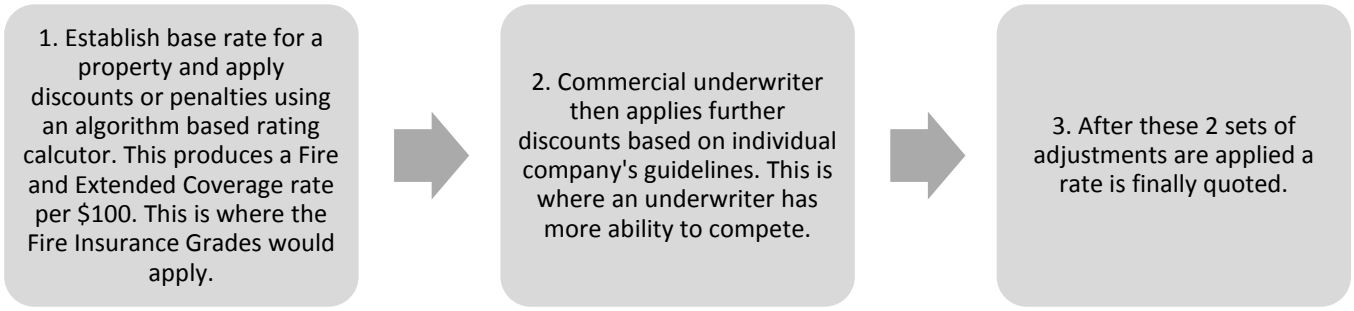
Figure 40 Fire Insurance Grading Index Usage



15.2. Underwriting Process and U-Rate Calculator

Under a more rigid, rule-oriented association such as the CFUA/CUA, it would be easier to determine a rate for a property. Today, with the rating algorithms and processes being decentralized by individual insurance companies, estimating rates is more difficult. Figure 42 below shows the general process.

Figure 41 Basic Rating Process



The following variables are just some of the items factored into a rating calculator such as U-Rate (https://www1.optaintel.ca/slweb/):

- Area

- Amount of Insurance
- Industry Code – there are hundreds of individual industry codes to choose from
- Construction, vertical openings, roof, interior finish
- Building hazards such as Heating, fuel types, electrical system wiring
- Exposures to neighbouring buildings
- Fire Insurance Grades, distance to fire hall, number of hydrants within specified distances
- Security of building
- Sprinkler systems, automatic fire detection, watchman service, fire extinguishers
- Number of years in business, years in building, claim history
- Other special hazards such as cooking operations, combustible liquid storage

Rating calculators then produce a rate per $100. A sample building was used to generate the rates per $100 shown in Figure 43 below. Depending on the different variables above these rates per $100 will differ. Due to the extremely large number of combinations it is impossible to comment on the percentage variations. The sample calculation shown in Figure 43 is provided to illustrate how the Fire Insurance Grades are factored into ratings. These should not be considered representative percentages for any other property type.

Figure 42 Rate per $100 difference for Fire and E.C for Sample Building from U-Rate.

PFPC Grade	2	3	4	10
Fire and EC rate per $100 form U-Rate	0.265	0.268	0.3	0.641
Percentage difference from PFPC 2 from U-Rate	0%	1%	13%	142%

Once this is complete an estimate of the rate cost can be generated by the underwriter. Further to this the underwriter may then apply further adjustments based on individual company underwriting guidelines before providing a quote (see step 2 in figure 42).

Due to the large number of variables used based on a specific client, building, occupancy, industry code, etc.; and underwriting algorithms and policies of individual insurance companies; an extrapolation of rates per $100 to all buildings in a community could over-, or under-, estimate savings of Fire Insurance Grades on building stock in a municipality. Even at a single building level reproducing a rate across the insurance industry is unlikely as this would affect business competition.

When speaking of Fire Insurance Grade benefits it may be better to speak in terms of approximate percentage differences. In fact the National Fire Protection Association (www.nfpa.org) added a section related to this in the 19th Edition of the Fire Protection Handbook (FPH™) (ref: Section 7, Chapter 2, p.7-42). While the NFPA Handbook speaks to the Fire Insurance Grading Classification system in the US, i.e. Public Protection Classification (PPC), a section of the text is included here as the Fire Insurance Rating systems in both the US and Canada are similar and have the same origins (although there are deviations):

> *"Theoretically, the better a city's classification, with Class 1 being the best class, the lower will be both insurance rates and insurance premiums when compared to a higher class number. This is generally true for a commercial property that is specifically rated by the insurance industry. Other factors, however, enter into the premium calculation, including the following:*
>
> - *Fire protection equipment such as installed fire extinguishers, early warning detection and fire alarm systems, smoke control systems in some occupancies, and most importantly, the installation of automatic sprinkler systems*

- *Fire loss, or loss costs, to the insurance industry in the city or county where the building risk is located*

Furthermore, some constant-risk commercial property, such as a drugstore, and all one- and two-family dwellings are grouped by insurers into PPC sets as Classes 1 to 6, Classes 7 and 8, Class 9, and Class 10. The loss costs in each set are so similar that individual class rate structures cannot be justified on the basis of underwriting experience. Under the preceding criteria, a residential home owner would not receive a premium reduction if a given city improved to a Class 5 or better. However, the general percentage reduction that commercial property owners can expect in premium reduction percentages is shown in Table 7.2.2.

Table 7.2.2 Percentage Reductions for Commercial Property Insurance

City Class Change	***Percent of Premium Decrease***
Class 10 to Class 9	*15*
Class 9 to Class 8	*9*
Class 8 to Class 7	*5*
Class 7 to Class 6	*5*
Class 6 to Class 5	*5*
Class 5 to Class 4	*5*
Class 4 to Class 3	*8*
Class 3 to Class 2	*3*
Class 2 to Class 1	*2*

“

Percentage differences should not be taken at face value and used for extrapolation as these will vary. The fact that the Fire Insurance Grades are used for rating (see figure 41 Fire Insurance Grading Index Usage) and that there is a difference provide a better interpretation of Grades and rating. As such Cost Benefit Analysis (CBA) is not possible at the municipal level. Choosing a single underwriter and single building for a single year would yield a better dollar saving result.

It should be carefully noted that due to the competitive nature of underwriting a municipality should not make a decision on the levels of public fire protection based on rate savings. A decision of this nature could likely have the adverse effect of reducing the levels of public fire protection.

15.3. Fire Insurance Grade Benefit of STSS

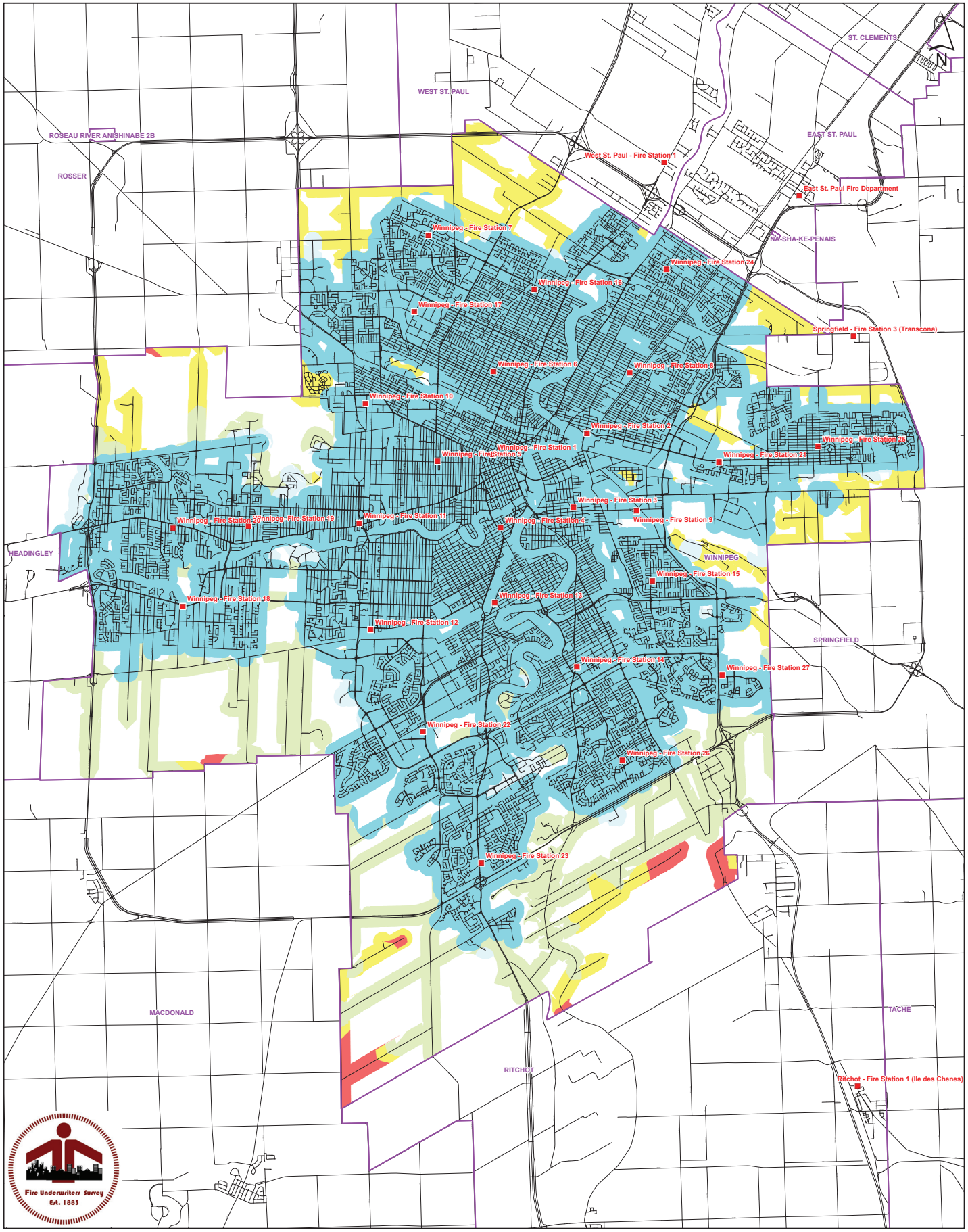
A map analysis was conducted to assess the possible impact of completing Superior Tanker Shuttle Service Accreditation for the following Fire Halls:

- Fire Hall 18
- Fire Hall 12
- Fire Hall 22
- Fire Hall 23
- Fire Hall 26

The complete accreditation package can be provided to the fire department should there be a wish to pursue testing. The basic concept is to show that 200IGPM (15 L/s) of water can be provided within 8km road distance of the Fire Hall and 5km road distance of a recognized water supply point for an Accredited Fire Hall. A separate analysis on the possibility of STSS Accreditation was not completed as part of this study.

Properties located in the green area of the map in Figure 43 would now receive the Fire Insurance Grade benefit of Dwelling Protection Grade (DPG) 3B(S). The dollar value rate impact cannot be estimated as it has been seen

to vary from province to province and from one insurance company to another insurance company. Some offices in the same insurance company may even treat STSS differently. Generally, we have seen that properties in an STSS Accredited area receive a rate benefit compared to those in areas without Accredited water supplies; however, there may be exceptions to this. FUS recommends that companies recognize this improved level of service.



City of Winnipeg

Scale = 1:38,000

0 500 1,000 2,000
Meters

Figure 43 Potential DPG Map with STSS

Fire Underwriters Survey
A Service to Insurers and Municipalities

Legend

- Fire Hall
- Road
- Fire Protection Boundary
- 1
- 1 (Private Hydrant Protected)
- 2
- 2 (Private Hydrant Protected)
- 3A
- 3A (Private Hydrant Protected)
- 3B(F)
- 3B(L)
- 3B(S)
- 3B
- 4
- 5

These maps and figures are not intended to illustrate the exact response distance or fire insurance grade coverage areas but can be used to aid in determining the fire insurance grade that should be applied to the property in question.

Fire Underwriters Survey does not warrant or make any representations with respect to the quality, completeness, currency or accuracy of anything contained in this map, the fitness of this map for any purpose or results obtained using information contained in this map and is not responsible for any action taken in reliance on information contained in this map. In all cases, field data should be used to confirm the data and accuracy of these maps; if differences are noted please contact Fire Underwriters Survey at 1-800-665-5661.

Date Drawn: 2014-11-26

Drawn By: LZ

☐ *Preliminary* ■ *Final*

☐ *Commercial* ■ *Personal*

Note on sprinkler and area charge[1]

Address	Building Name	Footprint Area	Number of Storeys	Effective Total Area	Coeff	Occupancy Charge	Sprinkler Protection Reduction	Exposure Charge	F_3	F_3
		m^2		m^2					*LPM*	*IGPM*
Fire District 24	RFF-100	2,450	13.0	31,850	0.8	-15%	-30%	15%	22,000	4,800
Fire District 24	RFF-101	6,910	1.5	10,365	0.8	0%	-40%	5%	12,000	2,600
Fire District 24	RFF-102	6,758	1.5	10,137	0.8	20%	-30%	15%	18,000	4,000
Fire District 24	RFF-103	1,600	17.0	27,200	0.8	-15%	-40%	5%	16,000	3,500
Fire District 24	RFF-104	7,312	2.0	14,624	1	-10%	0%	0%	24,000	5,300
Fire District 24	RFF-105	43,723	1.5	65,585	0.8	20%	-40%	0%	32,000	7,000
Fire District 24	RFF-106	985	3.0	2,955	1.5	-15%	0%	0%	15,000	3,300
Fire District 24	RFF-107	2,456	4.0	9,824	1.5	-15%	-40%	5%	18,000	4,000
Fire District 24	RFF-108	2,420	6.0	14,520	0.8	-15%	0%	10%	20,000	4,400
Fire District 24	RFF-109	2,790	2.0	5,580	1	-15%	0%	5%	14,000	3,100
Fire District 24	RFF-110	2,060	6.0	12,360	0.8	-15%	0%	25%	21,000	4,600
Fire District 8	RFF_111	38,888	1.5	58,332	0.8	10%	-40%	5%	31,000	6,800
Fire District 8	RFF-112	11,975	1.5	17,963	0.8	5%	-40%	5%	16,000	3,500
Fire District 8	RFF-113	9,728	1.5	14,592	0.8	-10%	-40%	5%	12,000	2,600
Fire District 8	RFF-114	15,953	1.5	23,930	0.8	10%	-40%	2%	18,000	4,000
Fire District 8	RFF-115	8,938	1.5	13,407	0.8	10%	-40%	2%	14,000	3,100
Fire District 8	RFF-116	8,744	1.0	8,744	1	-15%	-40%	5%	12,000	2,600
Fire District 8	RFF-117	3,212	3.0	9,636	1.5	-20%	-40%	8%	17,000	3,700
Fire District 8	RFF-118	1,213	3.0	3,639	1	-15%	0%	15%	13,000	2,900
Fire District 8	RFF-119	3,371	1.0	3,371	0.8	-10%	0%	15%	10,000	2,200
Fire District 8	RFF-120	1,178	5.0	5,890	1	-15%	0%	15%	17,000	3,700
Fire District 21	RFF-121	833	3.0	2,499	1.5	-15%	0%	20%	16,000	3,500
Fire District 21	RFF-122	15,518	2.0	31,036	0.8	-15%	-40%	0%	16,000	3,500
Fire District 21	RFF-123	3,531	3.0	10,593	1.5	-20%	-40%	0%	16,000	3,500
Fire District 21	RFF-124	1,411	3.0	4,233	1.5	-15%	0%	15%	21,000	4,600
Fire District 21	RFF-125	49,263	1.0	49,263	0.8	-10%	-40%	0%	21,000	4,600
Fire District 21	RFF-126	11,795	1.5	17,693	0.8	-5%	-40%	0%	13,000	2,900
Fire District 21	RFF-127	12,834	1.5	19,251	0.8	-15%	-40%	5%	13,000	2,900
Fire District 21	RFF-128	12,762	2.0	25,524	0.8	5%	-40%	0%	18,000	4,000
Fire District 21	RFF-129	7,503	1.5	11,255	0.8	-10%	-40%	0%	10,000	2,200
Fire District 21	RFF-130	8,325	1.5	12,488	0.8	10%	-40%	5%	14,000	3,100
Fire District 25	RFF-131	1,412	4.0	5,648	1.5	-15%	0%	5%	22,000	4,800
Fire District 25	RFF-132	1,011	3.0	3,033	1.5	-15%	0%	5%	16,000	3,500
Fire District 25	RFF-133	13,923	1.5	20,885	0.8	-10%	-40%	10%	16,000	3,500
Fire District 25	RFF-134	32,212	1.5	48,318	0.8	15%	-40%	0%	27,000	5,900
Fire District 25	RFF-135	643	6.0	3,858	0.8	-15%	-40%	20%	7,000	1,500

[1] It should be noted that while a majority of the sprinklered building data provided in these calculations was collected from the Fire Prevention Division some buildings chosen for calculation did not have details. In this case reasonable assumptions were made based on the Major Occupancy Classification of the building. Furthermore as the integrity of building separations could not be verified, typically the footprint area was treated as the complete area of the building. For community risk assessment for Fire Insurance Grading purposes this is adequate; however, values should be further verified for any use outside of the Fire Suppression Rating Schedule used to calculate Fire Insurance Grades.

Fire District 25	RFF-136	26,607	1.5	39,911	0.8	10%	-40%	10%	27,000	5,900
Fire District 25	RFF-137	6,236	2.0	12,472	0.8	25%	-40%	40%	25,000	5,500
Fire District 25	RFF-138	15,876	1.5	23,814	0.8	10%	-40%	0%	18,000	4,000
Fire District 25	RFF-139	3,672	1.0	3,672	1	-15%	-40%	20%	9,000	2,000
Fire District 25	RFF-140	5,021	1.3	6,527	1	-15%	0%	0%	15,000	3,300
Fire District 2	RFF-141	1,678	3.0	5,034	0.8	-15%	-40%	5%	7,000	1,500
Fire District 2	RFF-142	90	3.0	270	1.5	-20%	0%	40%	6,000	1,300
Fire District 2	RFF-143	1,189	1.5	1,784	1	-15%	-40%	5%	5,000	1,100
Fire District 2	RFF-144	1,053	11.0	11,583	0.8	-15%	-40%	0%	10,000	2,200
Fire District 2	RFF-145	1,186	6.0	7,116	0.8	-15%	-40%	0%	8,000	1,800
Fire District 2	RFF-146	11,479	1.5	17,219	0.8	5%	-40%	10%	17,000	3,700
Fire District 2	RFF-147	10,831	1.5	16,247	0.8	10%	-40%	5%	16,000	3,500
Fire District 2	RFF-148	4,563	1.5	6,845	0.8	5%	-40%	5%	10,000	2,200
Fire District 2	RFF-149	2,843	1.5	4,265	0.8	10%	-40%	5%	8,000	1,800
Fire District 2	RFF-150	10,692	1.5	16,038	1	-15%	0%	0%	24,000	5,300
Fire District 9	RFF-151	3,000	2.0	6,000	0.8	15%	-40%	0%	10,000	2,200
Fire District 9	RFF-152	6,188	1.5	9,282	0.8	10%	-40%	0%	11,000	2,400
Fire District 9	RFF-153	28,410	1.5	42,615	0.8	20%	-40%	0%	26,000	5,700
Fire District 9	RFF-154	24,029	1.5	36,044	0.8	15%	-40%	10%	27,000	5,900
Fire District 9	RFF-155	4,452	1.5	6,678	0.8	25%	-40%	10%	12,000	2,600
Fire District 9	RFF-156	2,702	1.5	4,053	0.8	20%	-40%	5%	9,000	2,000
Fire District 9	RFF-157	9,512	1.5	14,268	0.8	15%	-40%	0%	14,000	3,100
Fire District 9	RFF-158	9,261	1.5	13,892	0.8	10%	-40%	20%	18,000	4,000
Fire District 9	RFF-159	5,800	2.0	11,600	0.8	10%	-40%	0%	13,000	2,900
Fire District 9	RFF-160	3,608	1.5	5,412	0.8	15%	-40%	5%	10,000	2,200
Fire District 9	RFF-161	N/A	N/A	N/A	N/A	N/A	N/A	N/A	18,000	4,000
Fire District 9	RFF-162	N/A	N/A	N/A	N/A	N/A	N/A	N/A	18,000	4,000
Fire District 3	RFF-163	323	2.5	808	1.5	-15%	0%	10%	8,000	1,800
Fire District 3	RFF-164	16,110	4.0	64,440	0.8	-15%	-50%	10%	23,000	5,100
Fire District 3	RFF-165	3,930	2.0	7,860	0.8	10%	-40%	15%	13,000	2,900
Fire District 3	RFF-166	12,564	2.0	25,128	0.8	10%	-40%	0%	18,000	4,000
Fire District 3	RFF-167	2,529	4.0	10,116	0.8	-15%	-40%	5%	10,000	2,200
Fire District 3	RFF-168	2,968	4.0	11,872	1.5	-20%	-40%	15%	22,000	4,800
Fire District 3	RFF-169	1,982	7.0	13,874	0.8	-20%	-40%	25%	14,000	3,100
Fire District 3	RFF-170	302	3.0	906	1.5	-15%		50%	13,000	2,900
Fire District 3	RFF-171	5,230	2.0	10,460	1	-15%	-40%	5%	13,000	2,900
Fire District 3	RFF-172	2,180	2.0	4,360	1	-15%	0%	10%	14,000	3,100
Fire District 15	RFF-173	5,794	2.0	11,588	0.8	-15%	-40%	0%	10,000	2,200
Fire District 15	RFF-174	13,393	1.5	20,090	0.8	25%	-40%	10%	22,000	4,800
Fire District 15	RFF-175	8,228	1.5	12,342	0.8	10%	-40%	5%	14,000	3,100
Fire District 15	RFF-176	13,600	1.5	20,400	0.8	0%	-40%	5%	16,000	3,500
Fire District 15	RFF-177	1,646	3.0	4,938	1	-15%	-40%	15%	10,000	2,200
Fire District 15	RFF-178	967	3.0	2,901	1.5	-15%	0%	10%	17,000	3,700
Fire District 15	RFF-179	7,223	1.5	10,835	0.8	-5%	-40%	0%	10,000	2,200

Fire District 15	RFF-180	2,379	5.0	11,895	0.8	-15%	-40%	5%	10,000	2,200
Fire District 15	RFF-181	2,746	2.0	5,492	0.8	-10%	0%	5%	12,000	2,600
Fire District 15	RFF-182	1,309	2.5	3,273	1	-15%	0%	35%	15,000	3,300
Fire District 27	RFF-183	936	3.0	2,808	1.5	-15%	0%	15%	17,000	3,700
Fire District 27	RFF-184	1,163	3.0	3,489	1.5	-15%	0%	20%	19,000	4,200
Fire District 27	RFF-185	4,865	1.2	5,838	0.8	-10%	-40%	0%	7,000	1,500
Fire District 27	RFF-186	16,605	1.5	24,908	0.8	15%	-40%	0%	19,000	4,200
Fire District 27	RFF-187	15,155	1.5	22,733	0.8	15%	-40%	0%	19,000	4,200
Fire District 27	RFF-188	3,041	1.5	4,562	0.8	0%	-40%	0%	7,000	1,500
Fire District 27	RFF-189	1,507	1.0	1,507	0.8	-5%	0%	20%	8,000	1,800
Fire District 27	RFF-190	1,693	4.0	6,772	1.5	-20%	-40%	20%	17,000	3,700
Fire District 27	RFF-191	2,439	2.0	4,878	0.8	-15%	0%	0%	10,000	2,200
Fire District 27	RFF-192	2,055	1.5	3,083	0.8	10%	0%	0%	11,000	2,400
Fire District 14	RFF-193	1,346	1.0	1,346	1	0%	0%	15%	9,000	2,000
Fire District 14	RFF-194	3,057	2.0	6,114	1	-10%	-40%	30%	14,000	3,100
Fire District 14	RFF-195	1,970	3.0	5,910	1.5	-15%	0%	25%	27,000	5,900
Fire District 14	RFF-196	996	10.0	9,960	0.8	-15%	-40%	5%	10,000	2,200
Fire District 14	RFF-197	4,957	7.0	34,699	0.8	-15%	-40%	5%	18,000	4,000
Fire District 14	RFF-198	1,802	5.5	9,911	0.8	-15%	-40%	5%	10,000	2,200
Fire District 14	RFF-199	59,465	1.0	59,465	0.8	-5%	-40%	15%	31,000	6,800
Fire District 14	RFF-200	1,024	9.0	9,216	0.8	-15%	-40%	10%	10,000	2,200
Fire District 14	RFF-201	8,349	4.0	33,396	0.8	-15%	-40%	5%	18,000	4,000
Fire District 14	RFF-202	2,736	1.0	2,736	1	-15%	-40%	10%	7,000	1,500
Fire District 26	RFF-203	15,096	1.5	22,644	0.8	10%	-40%	0%	17,000	3,700
Fire District 26	RFF-204	1,388	3.0	4,164	1.5	-20%	0%	15%	19,000	4,200
Fire District 26	RFF-205	3,828	1.5	5,742	0.8	5%	-40%	25%	12,000	2,600
Fire District 26	RFF-206	4,871	4.0	19,484	1.5	-20%	-40%	5%	24,000	5,300
Fire District 26	RFF-207	4,685	4.0	18,740	1.5	-20%	-40%	5%	23,000	5,100
Fire District 26	RFF-208	6,306	4.0	25,224	1.5	-20%	-40%	5%	27,000	5,900
Fire District 26	RFF-209	6,517	1.5	9,776	0.8	-5%	-40%	5%	10,000	2,200
Fire District 26	RFF-210	1,667	4.0	6,668	1.5	-20%	-40%	5%	14,000	3,100
Fire District 26	RFF-211	2,237	3.0	6,711	1.5	-20%	0%	15%	25,000	5,500
Fire District 26	RFF-212	2,947	2.0	5,894	1	-15%	-40%	20%	12,000	2,600
Fire District 23	RFF-213	10,755	1.5	16,133	0.8	-10%	-40%	5%	13,000	2,900
Fire District 23	RFF-214	9,217	4.0	36,868	0.8	5%	-40%	5%	23,000	5,100
Fire District 23	RFF-215	9,119	1.5	13,679	0.8	-10%	-40%	0%	11,000	2,400
Fire District 23	RFF-216	13,154	1.5	19,731	0.8	-5%	-40%	0%	14,000	3,100
Fire District 23	RFF-217	2,676	3.0	8,028	1.5	-20%	-40%	0%	14,000	3,100
Fire District 23	RFF-218	1,997	9.0	17,973	0.8	-15%	-40%	2%	13,000	2,900
Fire District 23	RFF-219	1,881	4.0	7,524	1.5	-15%	-40%	15%	18,000	4,000
Fire District 23	RFF-220	1,982	1.0	1,982	1	-5%	0%	3%	10,000	2,200
Fire District 23	RFF-221	7,166	1.2	8,599	1	-10%	0%	0%	18,000	4,000
Fire District 23	RFF-222	838	3.0	2,514	1.5	-20%	0%	20%	16,000	3,500
Fire District 23	RFF-223	1,834	2.0	3,668	1.5	-10%	0%	0%	18,000	4,000
Fire District 22	RFF-224	5,161	2.0	10,322	0.8	10%	-40%	7%	13,000	2,900
Fire District 22	RFF-225	17,283	1.5	25,925	0.8	0%	-40%	0%	17,000	3,700

Fire District 22	RFF-226	60,330	1.5	90,495	0.8	10%	-40%	0%	35,000	7,700
Fire District 22	RFF-227	28,418	1.5	42,627	0.8	15%	-40%	0%	25,000	5,500
Fire District 22	RFF-228	11,078	1.5	16,617	0.8	-5%	-40%	10%	15,000	3,300
Fire District 22	RFF-229	7,208	2.0	14,416	0.8	-15%	-40%	0%	11,000	2,400
Fire District 22	RFF-230	1,337	3.0	4,011	1.5	-20%	0%	10%	18,000	4,000
Fire District 22	RFF-231	5,194	4.0	20,776	1.5	-20%	-40%	0%	23,000	5,100
Fire District 22	RFF-232	400	2.0	800	1.5	-20%	0%	50%	11,000	2,400
Fire District 22	RFF-233	4,844	1.0	4,844	1	-15%	0%	15%	15,000	3,300
Fire District 13	RFF-234	25,332	1.0	25,332	0.8	5%	-40%	5%	19,000	4,200
Fire District 13	RFF-235	1,034	18.0	18,612	0.8	-15%	-40%	5%	13,000	2,900
Fire District 13	RFF-236	4,745	1.0	4,745	1	-5%	-40%	15%	11,000	2,400
Fire District 13	RFF-237	16,974	1.5	25,461	0.8	10%	-40%	5%	20,000	4,400
Fire District 13	RFF-238	11,913	2.0	23,826	0.8	-15%	-40%	5%	15,000	3,300
Fire District 13	RFF-239	4,210	4.0	16,840	1	-10%	0%	5%	27,000	5,900
Fire District 13	RFF-240	383	3.5	1,341	1	-15%	0%	10%	7,000	1,500
Fire District 13	RFF-241	1,639	4.0	6,556	1.5	-20%	-40%	10%	15,000	3,300
Fire District 13	RFF-242	2,416	1.0	2,416	1	-15%	-40%	5%	6,000	1,300
Fire District 13	RFF-243	611	3.0	1,833	1	-15%	0%	30%	10,000	2,200
Fire District 4	RFF-244	10,084	6.0	60,504	0.8	-15%	-40%	5%	24,000	5,300
Fire District 4	RFF-245	2,412	3.0	7,236	1	-15%	-40%	5%	10,000	2,200
Fire District 4	RFF-246	1,848	5.0	9,240	0.8	-15%	-40%	0%	9,000	2,000
Fire District 4	RFF-247	847	7.0	5,929	0.8	-15%	0%	15%	14,000	3,100
Fire District 4	RFF-248	1,613	10.0	16,130	0.8	-15%	-40%	5%	12,000	2,600
Fire District 4	RFF-249	1,120	12.0	13,440	0.8	-15%	-40%	10%	12,000	2,600
Fire District 4	RFF-250	1,107	12.0	13,284	0.8	-15%	-40%	10%	12,000	2,600
Fire District 4	RFF-251	2,236	3.0	6,708	1	-15%	0%	10%	17,000	3,700
Fire District 4	RFF-252	3,005	4.0	12,020	1	-15%	0%	10%	22,000	4,800
Fire District 4	RFF-253	1,245	4.0	4,980	1	-15%	0%	40%	19,000	4,200
Fire District 1	RFF-254	480	3.0	1,440	0.8	-10%	-40%	34%	6,000	1,300
Fire District 1	RFF-255	14,000	6.0	84,000	0.8	-10%	-40%	15%	34,000	7,500
Fire District 1	RFF-256	2,000	32.0	64,000	0.8	-10%	-40%	20%	32,000	7,000
Fire District 1	RFF-257	1,700	20.0	34,000	0.8	-15%	-40%	25%	23,000	5,100
Fire District 1	RFF-258	4,250	1.0	4,250	0.8	-5%	0%	35%	14,000	3,100
Fire District 1	RFF-259	5,680	4.0	22,720	0.8	-10%	-40%	25%	21,000	4,600
Fire District 1	RFF-260	11,160	1.5	16,740	0.8	-10%	-40%	5%	13,000	2,900
Fire District 1	RFF-261	1,780	5.0	8,900	0.8	-10%	-40%	25%	13,000	2,900
Fire District 1	RFF-262	4,700	6.0	28,200	0.8	-10%	-40%	25%	23,000	5,100
Fire District 1	RFF-263	3,300	4.0	13,200	0.8	-10%	-40%	25%	15,000	3,300
Fire District 18	RFF-264	4,000	1.0	4,000	0.8	-15%	-40%	10%	7,000	1,500
Fire District 18	RFF-265	1,500	6.0	9,000	0.8	-15%	-40%	10%	10,000	2,200
Fire District 18	RFF-266	1,060	2.0	2,120	1.5	-15%	0%	10%	14,000	3,100
Fire District 18	RFF-267	3,800	2.0	7,600	0.8	-15%	0%	0%	13,000	2,900
Fire District 18	RFF-268	2,800	3.0	8,400	1	-15%	0%	0%	17,000	3,700
Fire District 18	RFF-269	10,200	1.0	10,200	0.8	-15%	-40%	5%	10,000	2,200
Fire District 18	RFF-270	1,050	1.0	1,050	0.8	-10%	0%	15%	6,000	1,300
Fire District 18	RFF-271	4,500	2.0	9,000	1	-15%	0%	5%	19,000	4,200

Fire District 18	RFF-272	910	1.0	910	1.5	-15%	0%	20%	10,000	2,200
Fire District 18	RFF-273	1,290	1.0	1,290	1.5	-5%	0%	5%	12,000	2,600
Fire District 20	RFF-274	1,900	2.0	3,800	1	-10%	0%	15%	14,000	3,100
Fire District 20	RFF-275	2,000	2.0	4,000	0.8	-15%	0%	5%	10,000	2,200
Fire District 20	RFF-276	3,200	1.0	3,200	0.8	-15%	0%	0%	9,000	2,000
Fire District 20	RFF-277	4,400	1.0	4,400	0.8	-15%	-40%	5%	7,000	1,500
Fire District 20	RFF-278	1,200	3.0	3,600	1	-15%	0%	15%	13,000	2,900
Fire District 20	RFF-279	1,350	12.0	16,200	0.8	-15%	-40%	20%	15,000	3,300
Fire District 20	RFF-280	1,500	2.0	3,000	1	-15%	0%	15%	12,000	2,600
Fire District 20	RFF-281	8,000	1.0	8,000	0.8	-10%	-40%	15%	11,000	2,400
Fire District 20	RFF-282	2,600	3.0	7,800	1	-15%	0%	15%	19,000	4,200
Fire District 20	RFF-283	1,560	3.0	4,680	1	-15%	0%	20%	15,000	3,300
Fire District 19	RFF-284	57,500	1.0	57,500	0.8	-10%	-40%	0%	23,000	5,100
Fire District 19	RFF-285	45,300	1.0	45,300	0.8	25%	-40%	0%	28,000	6,200
Fire District 19	RFF-286	1,400	3.0	5,200	1	-15%	0%	15%	16,000	3,500
Fire District 19	RFF-287	1,385	2.0	2,770	1.5	-15%	0%	20%	17,000	3,700
Fire District 19	RFF-288	1,300	1.0	1,300	0.8	-10%	0%	15%	6,000	1,300
Fire District 19	RFF-289	1,170	4.0	4,680	1	-15%	-40%	10%	9,000	2,000
Fire District 19	RFF-290	4,700	1.0	4,700	0.8	-15%	-40%	10%	7,000	1,500
Fire District 19	RFF-291	1,325	6.0	7,950	0.8	-15%	-40%	15%	10,000	2,200
Fire District 19	RFF-292	3,450	5.0	17,250	0.8	-15%	-40%	0%	12,000	2,600
Fire District 19	RFF-293	4,300	7.0	30,100	0.8	-15%	-40%	15%	20,000	4,400
Fire District 11	RFF-294	9,500	1.0	9,500	1	-15%	-40%	20%	14,000	3,100
Fire District 11	RFF-295	1,090	6.0	6,540	0.8	-15%	-40%	0%	7,000	1,500
Fire District 11	RFF-296	1,000	2.0	2,000	1.5	-15%	0%	25%	16,000	3,500
Fire District 11	RFF-297	850	2.0	1,700	1.5	-15%	0%	25%	15,000	3,300
Fire District 11	RFF-298	8,330	2.0	16,660	0.8	-5%	0%	25%	27,000	5,900
Fire District 11	RFF-299	50,800	2.0	101,600	0.8	-15%	-40%	5%	31,000	6,800
Fire District 11	RFF-300	4,000	1.0	4,000	0.8	-15%	0%	10%	10,000	2,200
Fire District 11	RFF-301	4,900	1.0	4,900	0.8	-15%	0%	10%	11,000	2,400
Fire District 11	RFF-302	6,200	1.0	6,200	0.8	-10%	0%	10%	14,000	3,100
Fire District 11	RFF-303	2,300	3.0	6,900	1.5	-15%	-40%	5%	15,000	3,300
Fire District 10	RFF-304	9,900	1.0	9,900	0.8	0%	-40%	30%	16,000	3,500
Fire District 10	RFF-305	32,850	1.0	32,850	0.8	5%	-40%	20%	27,000	5,900
Fire District 10	RFF-306	10,700	1.0	10,700	0.8	-5%	-40%	20%	14,000	3,100
Fire District 10	RFF-307	10,160	1.0	10,700	0.8	-10%	-40%	15%	12,000	2,600
Fire District 10	RFF-308	8,500	2.0	17,000	0.8	-10%	-40%	0%	12,000	2,600
Fire District 10	RFF-309	24,000	1.0	24,000	0.8	-5%	-40%	20%	21,000	4,600
Fire District 10	RFF-310	59,000	1.0	59,000	0.8	-5%	-40%	0%	25,000	5,500
Fire District 10	RFF-311	5,060	1.0	5,060	0.8	-5%	-40%	25%	10,000	2,200
Fire District 10	RFF-312	10,200	2.0	20,400	0.8	-10%	-40%	0%	14,000	3,100
Fire District 10	RFF-313	7,240	1.0	7,240	0.8	-5%	-40%	0%	9,000	2,000
Fire District 10	RFF-314	43,071	1.5	64,607	0.8	5%	-40%	5%	31,000	6,800
Fire District 5	RFF-315	35,200	1.0	35,200	0.8	-5%	-40%	10%	22,000	4,800
Fire District 5	RFF-316	4,100	1.0	4,100	0.8	5%	-40%	20%	9,000	2,000
Fire District 5	RFF-317	2,380	1.0	2,380	0.8	-5%	-40%	32%	8,000	1,800

Fire District 5	RFF-318	3,230	1.0	3,230	0.8	-10%	-40%	35%	9,000	2,000
Fire District 5	RFF-319	3,000	1.0	3,000	0.8	0%	-40%	32%	9,000	2,000
Fire District 5	RFF-320	10,150	2.0	20,300	0.8	-15%	0%	0%	21,000	4,600
Fire District 5	RFF-321	4,130	1.0	4,130	0.8	-15%	0%	20%	11,000	2,400
Fire District 5	RFF-322	11,400	1.0	11,400	0.8	-10%	0%	5%	18,000	4,000
Fire District 5	RFF-323	13,600	1.0	13,600	0.8	10%	-40%	25%	20,000	4,400
Fire District 5	RFF-324	5,100	1.0	5,100	0.8	-10%	0%	25%	15,000	3,300
Fire District 6	RFF-325	4,120	1,2	5,110	1	-15%	0%	15%	16,000	3,500
Fire District 6	RFF-326	5,600	5.0	28,000	0.8	-25%	-40%	0%	13,000	2,900
Fire District 6	RFF-327	1,500	2.0	3,000	0.8	-10%	-40%	15%	7,000	1,500
Fire District 6	RFF-328	6,800	3.0	20,400	0.8	-10%	-40%	10%	16,000	3,500
Fire District 6	RFF-329	990	2.0	1,980	1.5	-15%	0%	20%	15,000	3,300
Fire District 6	RFF-330	2,760	1.0	2,760	0.8	-15%	0%	30%	10,000	2,200
Fire District 6	RFF-331	3,450	1.0	3,450	0.8	-15%	0%	5%	9,000	2,000
Fire District 6	RFF-332	4,440	1.0	4,440	0.8	5%	0%	30%	16,000	3,500
Fire District 6	RFF-333	2,980	2.0	5,960	0.8	5%	-40%	10%	10,000	2,200
Fire District 6	RFF-334	19,000	1.0	19,000	0.8	-10%	-40%	10%	15,000	3,300
Fire District 17	RFF-335	13,900	1.0	13,900	0.8	5%	-40%	0%	13,000	2,900
Fire District 17	RFF-336	8,000	1.0	8,000	0.8	5%	-40%	0%	10,000	2,200
Fire District 17	RFF-337	4,400	1.5	6,600	0.8	-15%	-40%	10%	8,000	1,800
Fire District 17	RFF-338	1,400	2.0	2,800	1.5	-15%	0%	10%	16,000	3,500
Fire District 17	RFF-339	4,100	1.0	4,100	0.8	-5%	0%	15%	12,000	2,600
Fire District 17	RFF-340	20,000	2.0	40,000	0.8	-10%	-40%	0%	19,000	4,200
Fire District 17	RFF-341	1,000	2.0	2,000	1.5	-15%	0%	25%	16,000	3,500
Fire District 17	RFF-342	8,400	2.0	16,800	0.8	10%	-40%	5%	16,000	3,500
Fire District 17	RFF-343	990	2.0	1,980	1.5	-15%	0%	20%	15,000	3,300
Fire District 17	RFF-344	18,370	1.0	18,370	0.8	10%	-40%	10%	18,000	4,000
Fire District 7	RFF-345	1,080	2.0	2,160	1.5	-15%	0%	20%	15,000	3,300
Fire District 7	RFF-346	13,300	1.5	19,950	0.8	-10%	-40%	5%	15,000	3,300
Fire District 7	RFF-347	1,700	3.0	5,100	1	-15%	0%	15%	16,000	3,500
Fire District 7	RFF-348	740	3.0	2,220	1	-15%	0%	20%	10,000	2,200
Fire District 7	RFF-349	3,300	2.0	6,600	0.8	-15%	-40%	15%	9,000	2,000
Fire District 7	RFF-350	1,300	4.0	5,200	1.5	-15%	-40%	20%	16,000	3,500
Fire District 7	RFF-351	5,000	2.0	10,000	1	-15%	-40%	20%	15,000	3,300
Fire District 7	RFF-352	2,270	4.0	10,880	1.5	-15%	-40%	20%	23,000	5,100
Fire District 7	RFF-353	3,370	4.0	13,480	1.5	-15%	-40%	3%	20,000	4,400
Fire District 7	RFF-354	3,780	3.0	11,340	1.5	-15%	-40%	10%	21,000	4,600
Fire District 16	RFF-355	4,585	1.0	4,585	0.8	-10%	-40%	14%	8,000	1,800
Fire District 16	RFF-356	3,015	1.0	3,015	0.8	-10%	0%	5%	9,000	2,000
Fire District 16	RFF-357	3,600	1.0	3,600	0.8	-15%	-40%	20%	7,000	1,500
Fire District 16	RFF-358	1,270	7.0	8,890	0.8	-15%	-40%	5%	9,000	2,000
Fire District 16	RFF-359	9,780	1.5	14,670	0.8	-15%	-40%	3%	11,000	2,400
Fire District 16	RFF-360	1,500	3.0	4,500	1.5	-15%	0%	20%	22,000	4,800
Fire District 16	RFF-361	820	1.0	820	1.5	-15%	0%	18%	9,000	2,000
Fire District 16	RFF-362	1,500	6.0	9,000	0.8	-15%	-40%	15%	11,000	2,400
Fire District 16	RFF-363	35,400	1.0	35,400	0.8	-15%	-40%	10%	20,000	4,400

Fire District 16	RFF-364	510	2.0	1,020	1.5	-15%	0%	10%	10,000	2,200
Fire District 12	RFF-365	2,500	2.0	5,000	0.8	-10%	-40%	15%	8,000	1,800
Fire District 12	RFF-366	1,400	2.0	2,800	1.5	-15%	0%	10%	16,000	3,500
Fire District 12	RFF-367	9,000	1.0	9,000	0.8	-10%	0%	5%	16,000	3,500
Fire District 12	RFF-368	24,200	2.0	48,400	0.8	0%	-40%	0%	23,000	5,100
Fire District 12	RFF-369	17,000	1.5	25,500	0.8	-10%	-40%	0%	15,000	3,300
Fire District 12	RFF-370	4,400	2.0	8,800	0.8	-10%	-40%	5%	10,000	2,200
Fire District 12	RFF-371	4,706	3.0	14,118	1.5	-20%	-40%	5%	20,000	4,400
Fire District 12	RFF-372	1,572	5.0	7,860	1	-15%	-40%	5%	11,000	2,400
Fire District 12	RFF-373	11,470	1.0	11,470	1	-15%	0%	0%	20,000	4,400
Fire District 12	RFF-374	2,844	1.0	2,844	0.8	-5%	-40%	5%	6,000	1,300

WATER SUPPLY
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1999

FIRE UNDERWRITERS SURVEY

A SERVICE TO INSURERS AND MUNICIPALITIES

For further information on this document or any matters relating to the Fire Underwriters Survey please contact the appropriate offices of CGI Risk Management Services (formerly the Insurers' Advisory Organization) as follows:

Western Canada	CGI Risk Management Services Fire Underwriters Survey 3999 Henning Drive Burnaby BC V5C 6P9	Local: 604-6841581 Toll Free: 1-800-665-5661 Fax: 604-688-6986
Central Canada	CGI Risk Management Services Fire Underwriters Survey Suite 800, 7015 Macleod Tr. SW Calgary Alberta T2H 2K6	Local: 403-296-1300 Toll Free: 1-800-465-4264 Fax: 403-296-1316
Quebec	CGI Risk Management Services Fire Underwriters Survey 1611 Crémazie Blvd. East Montreal, Quebec H2M 2P2	Local: 514-735-3561 Toll Free: 1-800-263-5361 Fax: 514-844-0777
Ontario	CGI Risk Management Services Fire Underwriters Survey Lock Box 200 150 Commerce Valley Drive, West Markham, Ontario L3T 7Z3	Local: 905-882-6300 Toll Free: 1-800-387-4356 Fax: 905-695-6543
Atlantic Canada	CGI Insurance Business Services Fire Underwriters Survey 238 Brownlow Avenue, Suite 300 Park Place Center Dartmouth, Nova Scotia B3B 1Y2	Telephone: 902-423-9287 Toll-Free: 1-800-639-4528 Fax: 902-423-7376

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WATER SUPPLY FOR PUBLIC FIRE PROTECTION

PREFACE

This guide summarizes the more significant recommendations of Fire Underwriters Survey with respect to fire protection requirements in municipal water works system design. It reflects the manner in which FUS assesses the water supply aspect of a municipality's fire risk potential during surveys on behalf of the Canadian property insurance industry and represents the accumulated experience of many years of study of actual fires. Water supply is one of a number of components evaluated by FUS in the municipal fire protection system. Recommendations applying to the fire departments and code enforcement are covered in other publications of Fire Underwriters Survey. FUS local offices are prepared to assist municipal officials or their consultants with advice on special problems, as time limits permit, in accordance with the intent of this guide. The minimum size water supply credited by FUS must be capable of delivering not less than 1000 L/min for two hours or 2000 L/min for one hour in addition to any domestic consumption at the maximum daily rate. Static suction supplies to fire department pumpers are recognized as a supplement to the piped system.

In the FUS assessment of a water supply system, the major emphasis is placed upon its ability to deliver **adequate** water to control major fires throughout the municipality on a **reliable** basis via sufficient and suitable **hydrants**. What is ultimately available to the fire department is the critical test in this fire protection evaluation.

Rates of flow for firefighting purposes are expressed in litres per minute as this is the adopted unit for the firefighting field.

In this edition all quantities are specified in S.I. units.

PART I

GENERAL

ADEQUACY AND RELIABILITY. An adequate and reliable water supply for firefighting is an essential part of the fire protection system of a municipality. This is normally a piped system in common with domestic potable water service for the community.

A water supply system is considered to be fully adequate if it can deliver the necessary fire flow at any point in the distribution gridiron for the applicable time period specified in the table “Required Duration of Fire Flow” with the consumption at the maximum daily rate (average rate on maximum say of a normal year). When this delivery is also possible under certain emergency or unusual conditions as herein specified, the system is considered to be reliable. In cities of population in excess of 250,000 (or smaller places with high fire incident and severe hazard conditions) it is usually necessary to consider the possibility of two simultaneous major fires in the area served by the system.

Fire flows are amounts of water necessary to control fires. These are determined as shown in Part II. System design should contemplate meeting the required fire flows existing or probable with the possible exception of gross anomalies where there is no fire threat to the remainder of the community. In these cases, the properties should preferably be modified in hazard to reduce the required flow as part of a coordinated community fire protection system.

The protection of buildings by automatic sprinkler systems is a significant contribution to the fire protection of the community and should be encouraged, not penalized by onerous service charges or metering requirements.

In order to provide reliability, duplication of some or all parts of the system will be necessary, the need for duplication being dependent upon the extent to which the various parts may reasonably be expected to be out of service as a result of maintenance and repair work, an emergency or some unusual condition. The introduction of storage, either as part if the supply works or on the distribution system, may partially or completely offset the need for duplicating various parts of the system, the value of the storage depending upon its amount, location and availability.

STORAGE. In general, storage reduces the requirements of those parts of the system through which supply has already passed. Since storage usually fluctuates, the normal daily minimum maintained is the amount that should be considered as available for fires. Because of the decrease in pressure when water is drawn down in standpipes, only the portion of this normal daily minimum storage that can be delivered at a residual pressure of 150kPa at the point of use is considered as available. As well as the quantity available, the rate of delivery of water to the system from storage for the fire flow period is critical to this consideration.

PRESSURE. The principal requirement to be considered is the ability to deliver water in sufficient quantity to permit fire department pumpers to obtain an adequate supply from hydrants. To overcome friction loss in the hydrant branch, hydrant and suction hose, a minimum residual water pressure of 150 kPa in the street main is required during flow. Under conditions of exceptionally low suction losses, a lower residual may be possible. This includes the use of 100 mm and larger outlets for fire department pumper use and hydrants with large waterways.

Higher sustained pressure is of importance in permitting direct continuous supply to automatic sprinkler systems, to building standpipe and hose systems, and in maintaining a water plan so that no portion of the protection area is without water, such as during a fire at another location. Residual pressures that exceed 500 kPa during large flows are of value as they permit short hose-lines to be operated directly from hydrants without supplementary pumping.

SUPPLY WORKS

NORMAL ADEQUACY OF SUPPLY WORKS. The source of supply, including impounding reservoirs, and each part of the supply works should normally be able to maintain the maximum daily consumption rate plus the maximum required fire flow. Each distribution service within the system should similarly support its own requirements. In large cities where fire frequency may result in simultaneous fires, additional flow must be considered in accordance with the potential. Filters may be considered as capable of operating at a reasonable overload capacity based upon records and experience. In general, overload capacity will not exceed 25 percent, but may be higher in well designed plans operating under favourable conditions.

The absolute minimum supply available under extreme dry weather conditions should not be taken as the measure of the normal ability of the source of supply such as supply from wells. The normal or average capacity of wells during the most favourable nine month period should be considered, or the normal sustained flow of surface supplies to the source.

RELIABILITY OF SOURCE OF SUPPLY. The effect on adequacy must be considered for such factors as frequency, severity and duration of droughts, physical condition of dams and intakes; danger from earthquakes, floods, forest fires, and ice dams or other ice formations; silting-up or shifting of channels; possibility of accidental contamination of watershed or source; absence of watchmen or electronic supervision where needed; and injury by physical means. Where there is a risk of disruption, special precautions or alternate supplies should be arranged.

Where the supply is from wells, some consideration should be given to the absolute minimum capacity of the wells under the most unfavourable conditions; also to the length of time that the supply from the wells would be below the maximum daily consumption rate, and the likelihood of this condition recurring every year or only at infrequent intervals. It should be recognized that some water is generally available from wells and that the most extreme conditions are not as serious as a total interruption of the supply, as would be the case in the breaking of a dam or shifting of a channel. The possibility of clogging, salinity, and the need for periodic cleaning and overhauling must be considered. Dependence upon a single well, even where records are favourable, may be considered a feature of unreliability.

Frequent cleaning of reservoirs and storage tanks may be considered as affecting reliability.

Continuity of, and delay in implementing water supplies obtained from systems or sources not under the control of the municipality or utility should be considered also from these aspects.

GRAVITY SYSTEMS. A gravity system delivering supply from the source to distribution directly without the use of pumps is advantageous from a fire protection point of view because of its inherent reliability, but a pumping system can also be developed to a high degree of reliability.

PUMPING

RELIABILITY OF PUMPING CAPACITY. Pumping capacity, where the system or service is supplied by pumps, should be sufficient, in conjunction with storage when the two most important pumps are out of service, to maintain the maximum daily consumption rate plus the maximum required fire flow at required pressure for the required duration. For smaller municipalities (usually up to about 25,000 population) the relative infrequency of fires is assumed as largely offsetting the probability of a serious fire occurring at times when two pumps are out of service. (The most important pump is normally, but not always, the one of largest capacity, depending upon how vital is its contribution to maintaining flow to the distribution system.)

To be adequate, remaining pumps in conjunction with storage, should be able to provide required fire flows for the specified durations at any time during a period of five days with consumption at the maximum daily rate. Effect of normal minimum capacity of elevated storage located on the distribution system and storage of treated water above low lift pumps should be considered. The rate of flow from such storage must be considered in terms of any limitation of water main capacity. The availability of spare pumps or prime movers that can quickly be installed may be credited, as may pumps of compatible characteristics which may be valved from another service.

POWER SUPPLY FOR PUMPS. Electric power supply to pumps should be so arranged that a failure in any power line or the repair or replacement of a transformer, switch, control unit or other device will not prevent the delivery, in conjunction with elevated storage, of required fire flows for the required durations at any time during a period of two days with consumption at the maximum daily rate.

Power lines should be underground from the station or substation of the power utility to water plants and pumping stations and have no other consumers enroute. The use of the same transmission lines by other consumers introduces unreliability because of the possibility of interruption of power or deterioration of power characteristics.

Overhead power lines are more susceptible to damage and interruption than underground lines and introduce a degree of un-reliability that depends upon their location and construction. In connections with overhead lines, consideration should be given to the number and duration of lightning, wind, sleet, and snow storms in the area; the type of poles or towers and wires; the nature of the country traversed; the effect of earthquakes, forest fires, and floods; the lightning and surge protection provided; the extent to which the system is dependent upon overhead lines; and the ease of, and facilities for, repairs.

The possibility of power systems or network failures affecting large areas should be considered. In-plant auxiliary power or internal combustion driver standby pumping are appropriate solutions to these problems in many cases, particularly in small plants where high pumping capacity is required for fire protection service. When using automatic starting, prime 'movers' for auxiliary power supply and pumping should have controllers listed by Underwriters' Laboratories of Canada to establish their reliability.

FUEL SUPPLY. At least a five day supply of fuel for internal combustion engines or boilers used for regular domestic supply should be provided. Where long hauls, condition of roads, climatic conditions, or other circumstances could cause interruptions of delivery longer than five days, a greater storage should be provided. Gas supply should be from two independent sources or from duplicate gas-producer plants with gas storage sufficient for 24 hours. Unreliability of regular fuel supply may be offset in whole or in part by suitable provisions for the use of an alternate fuel or power supply.

BUILDINGS AND PLANT

BUILDINGS AND STRUCTURES. Pumping stations, treatment plants, control centres and other important structures should be located, constructed, arranged, and protected so that damage by fire, flooding, or other causes will be held to a minimum. They should contain no combustible material in their construction, and, if hazards are created by equipment or materials located within the same structure, the hazardous section should be suitably separated by fire-resistive partitions or fire walls.

Buildings and structures should have no fire exposures. If exposures exist, suitable protection should be provided, Electrical wiring and equipment should be installed in accordance with the Canadian Electrical Code. All internal hazards should be properly safeguarded in accordance with good practice. Private in-plant fire protection should be provided as needed.

MISCELLANEOUS SYSTEM COMPONENTS, PIPING AND EQUIPMENT. Steam piping, boiler-feed lines, fuel-piping (gas or oil lines to boilers as well as gas, oil or gasoline lines to internal-combustion engines), and air lines to wells or control systems should be so arranged that a failure in any line or the repair or replacement of a valve, fuel pump, boiler-feed pump, injector, or other necessary device, will not prevent the delivery, in conjunction with storage, of the required fire flows for the specified duration at any time during a period of two days with consumption at the maximum daily rate.

Plants should be well arranged to provide for effective operation. Among the features to be considered are: ease of making repairs and facilities for this work, danger of flooding because of broken piping; susceptibility to damage by spray; reliability of priming and chlorination equipment; lack of semi-annual inspection of boilers or other pressure vessels; dependence upon common non-sectionalized electric bus bars; poor arrangement of piping; poor condition or lack of regular inspections of important valves; and factors affecting the operation of valves or other devices necessary for fire service such as design, operation, and maintenance of pressure regulating valves, altitude valves, air valves, and other special valves or control devices, provision of power drives, location of controls, and susceptibility to damage.

Reliability of treatment works is likely to be influenced by the removal from service of at least one filter or other treatment unit; the reduction of filter capacity by turbidity, freezing or other conditions of the water; the need for cleaning basins; and the dependability of power for operating valves, wash-water pumps, mixers and other appurtenances.

OPERATIONS. Reliability in operation of the supply system and adequate response to emergency or fire demands are essential. Instrumentation, controls and automatic features should be arranged with this in mind. Failure of an automatic system to maintain normal conditions or to meet unusual demands should result in the sounding of an alarm where remedial action will be taken.

The operating force should be competent, adequate, and continuously available as may be required to maintain both the domestic and fire services.

EMERGENCY SERVICES. Emergency crews, provided with suitable transportation, tools and equipment, should be continuously on duty in the larger systems and be readily available upon call in small systems. Spare pipe and fittings, and construction equipment should be readily available. Alarms for fires in buildings should be received by the utility at a suitable location where someone is always on duty who can take appropriate action as required, such as placing additional equipment in operation, operating emergency or special valves, or adjusting pressures. Receipt of alarms may be by fire alarm circuit, radio, outside alerting device, or telephone, but where special operations are required, the alarm service should be equivalent to that needed for a fire station.

Response of an emergency crew should be made to major fires to assist the fire department in making the most efficient use of the water system and to ensure the best possible service in the event of a water main break or other emergency. The increase of pressures by more than 25 percent for fires is considered to increase the possibility of breaks.

PIPING

RELIABILITY OF SUPPLY MAINS. Supply mains cut off for repair should not drastically reduce the flow available to any district. This includes all pipe lines or conduits on which supply to the distribution system is dependent, including intakes, suction or gravity lines to pumping stations, flow lines from reservoirs, treatment plant piping, force mains, supply and arterial mains, etc. Consideration should be given to the greatest effect that a break, joint separation or other failure could have on the delivery of the maximum daily consumption rate plus required fire flow at required pressure over a three day period. Aqueducts, tunnels or conduits of substantial construction may be considered as less susceptible to failure and equivalent to good mains with a long history of reliability.

INSTALLATION OF PIPE. Mains should be in good condition and properly installed. Pipe should be suitable for the service intended. Asbestos-cement, poly-vinyl chloride (PVC), cast and ductile iron, reinforced concrete and steel pipe manufactured in accordance with appropriate Canadian Standards Association or ANSI/AWWA standards, or any pipes listed by Underwriters' Laboratories of Canada for fire service are considered satisfactory. Normally, pipe rated for a maximum working pressure of 1000 kPa is required, Service records, including the frequency and nature of leaks, breaks, joint separations, other failures and repairs, and general conditions should be considered as indicators of reliability. When mains are cleaned they should be lined.

Mains should be so laid as not to endanger one another, and special construction should be provided to prevent their failure at stream crossings, railroad crossings, bridges, and other points where required by physical conditions; supply mains should be valved at one and one half kilometre intervals and should be equipped with air valves at high points and blow offs at low points. Mains should not be buried extremely deep or be unusually difficult to repair, though depths to ten feet may be required because of frost conditions.

The general arrangement of important valves, of standard or special fittings, and of connections at cross-overs, intersections, and reservoirs, as well as at discharge and suction headers, should be considered with respect to the time required to isolate breaks. The need for check valves on supply or force mains and for other arrangements to prevent flooding of stations or emptying of reservoirs at the time of a break in a main should also be considered, as well as the need for relief valves or surge chambers. Accessibility of suitable material and equipment and ease of making repairs should be considered.

Arterial feeder mains should provide looping throughout the system for mutual support and reliability, preferably not more than 1000 metres between mains. Dependence of a large area on a single main is a weakness. In general the gridiron of minor distributors supplying residential districts should consist of mains at least 150mm in size and arranged so that the lengths on the long sides of blocks between intersecting mains do not exceed 200 metres. Where longer lengths of 150mm pipe are necessary 200mm or larger intersecting mains should be used. Where initial pressures are unusually high, a satisfactory gridiron may be obtained with longer lengths of 150mm pipe between intersecting mains.

Where deadends and a poor gridiron are likely to exist for a considerable period or where the layout of the streets and the topography are not well adapted to the above arrangement, 200mm pipe should be used. Both the ability to meet the required fire flows and reliability of a reasonable supply by alternate routing must be taken into account in this consideration.

VALVES. A sufficient number of valves should be installed so that a break or other failure will not affect more than 400 metres of arterial mains, 150 metres of mains in commercial districts, or 250 metres of mains in residential districts. Valves should be maintained in good operating condition. The recommended inspection frequency is once a year, and more frequently for larger valves and valves for critical applications.

A valve repair that would result in reduction of supply is a liability, but because of the probable infrequency of occurrence, it might be considered as introducing only a moderate degree of unreliability even if it resulted in total interruption. The repair of a valve normally should be accomplished in two days. Valves opening opposite to the majority are undesirable and when they do occur they should be clearly identified.

HYDRANTS

SIZE, TYPE AND INSTALLATION. Hydrants should conform to American Water Works Standard for Dry Barrel Fire Hydrants or Underwriters' Laboratories of Canada listing. Hydrants should have at least two 65mm outlets. Where required fire flows exceed 5000 l/min or pressures are low there should also be a large pumper outlet. The lateral street connection should not be less than 150mm in diameter. Hose threads, operating and cap nuts on outlets should conform to Provincial Standard dimensions. A valve should be provided on lateral connections between hydrants and street mains.

Hydrants that open in a direction opposite to that of the majority are considered unsatisfactory. Flush hydrants are considered undesirable because of delay in getting into operation; this delay is more serious in areas subject to heavy snow storms. Cisterns are considered unsatisfactory as an alternative to pressure hydrants. The number and spacing of hydrants should be as indicated in the table titled "Standard Hydrant Distribution".

INSPECTION AND CONDITION. Hydrants should be inspected at least semi-annually and after use. The inspection should include operation at least once a year. Where freezing temperatures occur, the semi-annual inspections should be made in the spring and fall of each year. Because of the possibility of freezing they should be checked frequently during extended periods of severe cold. Hydrants should be kept in good condition and suitable records of inspections and repairs be maintained. Hydrants should be painted in highly visible colours so that they are conspicuous and be situated with outlets at least twelve inches above the grade. There should be no obstruction that could interfere with their operation. Snow should be cleared promptly after storms and ice and snow accumulations removed as necessary.

HYDRANT DISTRIBUTION. Hydrant locations and spacing should be convenient for fire department use. Hydrants should be located at intersections, in the middle of long blocks and at the end of long dead-end streets. To allow for convenient utilization of water supplies, distribution density of hydrants should be in accordance with the required fire flows indicated in the table titled "Standard Hydrant Distribution" (page 16). The maximum recommended spacing of hydrants in commercial, industrial, institutional and multi-family residential areas is 90 metres; in single family residential areas 180 metres is recommended. In areas where fire apparatus have access (e.g. large properties, private developments, etc.), hydrants should be required by bylaw. The planning of hydrant locations should be a cooperative effort between the water utility and fire department.

RECORDS

PLANS AND RECORDS. Complete, up-to-date plans and records essential for the proper operation and maintenance of the system should be available in a convenient form, suitably indexed and safely filed. These should include plans of the source as well as records of its yield and a reliable estimate of the safe yield; plans of the supply works including dams, intakes, wells, pipelines, treatment plants, pumping stations, storage reservoirs and tanks; and a map of the distribution system showing mains, valves, and hydrants. Plans and maps should be in duplicate and stored at different locations.

Detailed distribution system plans, in a form suitable for field use, should be available for maintenance crews. Records of consumption, pressures, storage levels, pipes, valves, hydrants, and of the operations of the supply works and distribution system, including valve and hydrant inspections and repairs should be maintained.

TABLES

STANDARD HYDRANT DISTRIBUTION	
Fire Flow Required (litres per minute)	Average Area per Hydrant (m^2)
2,000	16,000
4,000	15,000
6,000	14,000
8,000	13,000
10,000	12,000
12,000	11,000
14,000	10,000
16,000	9,500
18,000	9,000
20,000	8,500
22,000	8,000
24,000	7,500
26,000	7,000
28,000	6,500
30,000	6,000
32,000	5,500
34,000	5,250
36,000	5,000
38,000	4,750
40,000	4,500
42,000	4,250
44,000	4,000
46,000	3,750
48,000	3,500

REQUIRED DURATION OF FIRE FLOW	
Fire Flow Required (litres per minute)	Duration (hours)
2,000 or less	1.0
3,000	1.25
4, 000	1.5
5,000	1.75
6,000	2.0
8000	2.0
10,000	2.0
12,000	2.5
14,000	3.0
16,000	3.5
18,000	4.0
20000	4.5
22,000	5.0
24,000	5.5
26,000	6.0
28,000	6.5
30,000	7.0
32000	7.5
34,000	8.0
36,000	8.5
38,000	9.0
40,000 and over	9.5

Interpolate for intermediate figures

Area refers to surface area of blocks and bounding streets. For a street without adjacent streets, a depth of one-half block is used.

A water supply system is considered to be adequate for fire protection when it can supply water as indicated above with consumption at the maximum daily rate. Certain types of emergency supplies may be included where reasonable conditions for their immediate use exist. Storage on the system is credited on the basis of the normal daily minimum maintained insofar as pressure permits its delivery at the rate considered.

PART II

GUIDE FOR DETERMINATION OF REQUIRED FIRE FLOW
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N.B. It should be recognized that this is a "guide" in the true sense of the word, and requires a certain amount of knowledge and experience in fire protection engineering for its effective application. Its primary purpose is for the use of surveyors experienced in this field, but it is made available to municipal officials, consulting engineers and others interested as an aid in estimating fire flow requirements for municipal fire protection.

Required Fire Flow may be described as the amount and rate of water application required in firefighting to confine and control the fires possible in a building or group of buildings which comprise essentially the same fire area by virtue of immediate exposure. This may include as much as a city block.

1. An estimate of the fire flow required for a given area may be determined by the formula:

$$F = 220C\sqrt{A}$$

where

F = the required fire flow in litres per minute.

C = coefficient related to the type of construction.

= 1.5 for wood frame construction (structure essentially all combustible).

= 1.0 for ordinary construction (brick or other masonry walls, combustible floor and interior).

= 0.8 for non-combustible construction (unprotected metal structural components, masonry or metal walls).

= 0.6 for fire-resistive construction (fully protected frame, floors, roof).

Note: For types of construction that do not fall within the categories given, coefficients shall not be greater than 1.5 nor less than 0.6 and may be determined by interpolation between consecutive construction types as listed above. Construction types are defined in the Appendix.

A = The total floor area in square metres (including all storeys, but excluding basements at least 50 percent below grade) in the building being considered.

For fire-resistive buildings, consider the two largest adjoining floors plus 50 percent of each of any floors immediately above them up to eight, when the vertical openings are inadequately protected. If the vertical openings and exterior vertical communications are properly protected (one hour rating), consider only the area of the largest floor plus 25 percent of each of the two immediately adjoining floors.

For one family and two family dwellings not exceeding two storeys in height, see **Note J.**

2. The value obtained in No. 1 may be reduced by as much as 25% for occupancies having a low contents fire hazard or may be increased by up to 25% surcharge for occupancies having a high fire hazard. Those may be classified as to contents as follows:

Non-Combustible	-25%	Free Burning	+15%
Limited Combustible	-15%	Rapid Burning	+25%
Combustible	No Charge		

As guide for determining low or high fire hazard occupancies, see the list in the Appendix. The fire flow determined shall not be less than 2,000 L/min,

3. The value obtained in No.2 above may be reduced by up to 50% for complete automatic sprinkler protection depending upon adequacy of the system. The credit for the system will be a maximum of 30% for an adequately designed system conforming to NFPA 13 and other NFPA sprinkler standards. Additional credit of up to 10% may be granted if the water supply is standard for both the system and fire department hose lines required. The percentage reduction made for an automatic sprinkler system will depend upon the extent to which the system is judged to reduce the possibility of fires spreading within and beyond the fire area. Normally this reduction will not be the maximum allowed without proper system supervision including water flow and control valve alarm service. Additional credit may be given of up to 10% for a fully supervised system.

4. To the value obtained in No. 2 above a percentage should be added for structures exposed within 45 metres by the fire area under consideration. This percentage shall depend upon the height, area, and construction of the building(s) being exposed, the separation, openings in the exposed building(s), the length and height of exposure, the provision of automatic sprinklers and/or outside sprinklers in the building(s) exposed, the occupancy of the exposed building(s), and the effect of hillside locations on the possible spread of fire.

   The charge for any one side generally should not exceed the following limits for the separation:

Separation	Charge	Separation	Charge
0 to 3m	25%	20.1 to 30 m	10%
3.1 to 10m	20%	30.1 to 45m	5%
10.1 to 20m	15%		

   The total percentage shall be the sum of the percentage for all sides, but shall not exceed 75%.

   The fire flow shall not exceed 45,000 L/min nor be less than 2,000 L/min.

Notes to Calculation

Note A: The guide is not expected to necessarily provide an adequate value for lumber yards, petroleum storage, refineries, grain elevators, and large chemical plants, but may indicate a minimum value for these hazards.

Note B: Judgment must be used for business, industrial, and other occupancies not specifically mentioned.

Note C: Consideration should be given to the configuration of the building(s) being considered and accessibility by the fire department.

Note D: Wood frame structures separated by less than 3 metres shall be considered as one fire area.

Note E: Fire Walls: - In determining floor areas, a fire wall that meets or exceeds the requirements of the current edition of the National Building Code of Canada (provided this necessitates a fire resistance rating of 2 or more hours) may be deemed to subdivide the building into more than one area or may, as a party wall, separate the building from an adjoining building.

Normally any unpierced party wall considered to form a boundary when determining floor areas may warrant up to a 10% exposure charge.

Note F: High one storey buildings: When a building is stated as 1=2, or more storeys, the number of storeys to be used in the formula depends upon the use being made of the building. For example, consider a 1=3 storey building. If the building is being used for high piled stock, or for rack storage, the building would probably be considered as 3 storeys and, in addition, an occupancy percentage increase may be warranted.

However, if the building is being used for steel fabrication and the extra height is provided only to facilitate movement of objects by a crane, the building would probably be considered as a one storey building and an occupancy credit percentage may be warranted.

Note G: If a building is exposed within 45 metres, normally some surcharge for exposure will be made.

Note H: Where wood shingle or shake roofs could contribute to spreading fires, add 2,000 L/min to 4,000 L/min in accordance with extent and condition.

Note I: Any non-combustible building is considered to warrant a 0.8 coefficient.

Note J: Dwellings: For groupings of detached one family and small two family dwellings not exceeding 2 stories in height, the following short method may be used. (For other residential buildings, the regular method should be used.)

Exposure distances	Suggested required fire flow	
	Wood Frame	Masonry or Brick
Less than 3m	See Note "D"	6,000 L/min
3 to 10m	4,000 L/min	4,000 L/min
10.1 to 30m	3,000 L/min	3,000 L/min
Over 30m	2,000 L/min	2,000 L/min

If the buildings are contiguous, use a minimum of 8,000 L/min. Also consider Note H.

OUTLINE OF PROCEDURE

A. Determine the type of construction.

B. Determine the ground floor area.

C. Determine the height in storeys.

D. Using the fire flow formula, determine the required fire flow to the nearest 1,000 L/min.

E. Determine the increase or decrease for occupancy and apply to the value obtained in D above. Do not round off the answer.

F. Determine the decrease, if any, for automatic sprinkler protection. Do not round off the value.

G. Determine the total increase for exposures, Do not round off the value.

H. To the answer obtained in E, subtract the value obtained in F and add the value obtained in G.

The final figure is customarily rounded off to the nearest 1,000 L/min.

APPENDIX

TYPES OF CONSTRUCTION

For the specific purpose of using the Guide, the following definitions may be used:

Fire-Resistive Construction - Any structure that is considered fully protected, having at least 3-hour rated structural members and floors. For example, reinforced concrete or protected steel.

Non-combustible Construction - Any structures having all structural members including walls, columns, piers, beams, girders, trusses, floors, and roofs of non-combustible material and not qualifying as fire-resistive construction. For example, unprotected metal buildings.

Ordinary Construction - Any structure having exterior walls of masonry or such non-combustible material, in which the other structural members, including but not limited to columns, floors, roofs, beams, girders, and joists, are wholly or partly of wood or other combustible material.

Wood Frame Construction - Any structure in which the structural members are wholly or partly of wood or other combustible material and the construction does not qualify as ordinary construction.

OCCUPANCIES

Examples of Low Hazard Occupancies:

Apartments
Asylums
Churches
Clubs
Colleges & Universities
Dormitories
Dwellings
Hospitals
Hotels
Institutions
Libraries, except Large Stack Room Areas
Museums
Nursing, Convalescent and Care Homes
Office Buildings
Prisons
Public Buildings
Rooming Houses
Schools
Tenements

Generally, occupancies falling in National Building Code Groups A, B, C and D are of this class.

Examples of High Hazard Occupancies:

- Aircraft Hangars
- Cereal, Feed, Flour and Grist Mills
- Chemical Works - High Hazard
- Cotton Picker and Opening Operations
- Explosives & Pyrotechnics Manufacturing
- Shade Cloth Manufacturing
- Foamed Plastics, Storage or use in Manufacturing
- High Piled Combustibles Storage in excess of 6.5 metres high
- Linseed Oil Mills
- Match Manufacturing
- Oil Refineries
- Paint Shops
- Pyroxylin Plastic Manufacturing & Processing
- Solvent Extracting
- Varnish and Paint Works
- Woodworking with Flammable Finishing
- Linoleum and Oilcloth Manufacturing

Other occupancies involving processing, mixing storage and dispensing flammable and/or combustible liquids. Generally, occupancies falling in National Building Code Group F, Divisions 1 and 2 would be in this class.

For other occupancies, good judgment should be used, and the percentage increase will not necessarily be the same for all buildings that are in the same general category - for example "Colleges and Universities": this could range from a 25% decrease for buildings used only as dormitories to an increase for a chemical laboratory. Even when considering high schools, the decrease should be less if they have extensive shops.

It is expected that in commercial buildings no percentage increase or decrease for occupancy will be applied in most of the fire flow determinations. In general, percentage increase or decrease will not be at the limits of plus or minus 25%.

EXPOSURES

When determining exposures it is necessary to understand that the exposure percentage increase for a fire in a building (x) exposing another building (y) does not necessarily equal the percentage increase when the fire is in building (y) exposing building (x). The Guide gives the maximum possible percentage for exposure at specified distances. However, these maximum possible percentages should not be used for all exposures at those distances. In each case the percentage applied should reflect the actual conditions but should not exceed the percentage listed.

The maximum percentage for the separations listed generally should be used if the exposed building meets all of the following conditions:

a. Same type or a poorer type of construction than the fire building.
b. Same or greater height than the fire building.
c. Contains unprotected exposed openings.
d. Unsprinklered.

CONVERSION FACTORS

Multiply	By	To Obtain
Centimetre	0.3937	Inches
Cubic Foot	0.0283	Cubic Metres
Cubic Metre	35.3145	Cubic Feet
Cubic Metre	219.97	Imperial Gallons
Cubic Metre	1.000	Litres
Foot	0.3048	Metres
Horsepower	0.7457	Kilowatt
Imperial Gallon	4.546	Litres
Inch	2.54	Centimetres
Kilogram	2.2046	Pounds
Kilogram of Water	1	Litres
Kilopascal	0.1450	Pounds per sq. inch
Kilowatt	1.341	Horsepower
Litre	0.21997	Imperial Gallons
Litre of Water	1	Kilograms
Metre	3.281	Feet
Metre of Water	10	Kilopascals
Pound	0.4536	Kilograms
Pound per sq. inch	6.89476	Kilopascals
U.S. Gallons	0.8327	Imperial Gallons
Imperial Gallons	1.201	U.S.Gallons

TECHNICAL BULLETIN

FIRE UNDERWRITERS SURVEY™

A Service to Insurers and Municipalities

INSURANCE GRADING RECOGNITION OF USED OR REBUILT FIRE APPARATUS

The performance ability and overall acceptability of older apparatus has been debated between municipal administrations, the public fire service and many others for years. Fire Underwriters Survey (FUS) has reviewed experiences across Canada and in other countries and has developed a standard for acceptance of apparatus as the apparatus becomes less reliable with age and use.

The public fire service is unique compared to other emergency services in that fire apparatus vehicles are not continuously in use. However, when in use, the apparatus is subject to considerable mechanical stress due to the nature of its function. This stress does not normally manifest itself on the exterior of the equipment. It is effectively masked in most departments by a higher standard of aesthetic care and maintenance. Lack of replacement parts further complicates long term use of apparatus. Truck and pump manufacturers maintain a parts inventory for each model year for a finite time. After that period, obtaining necessary parts may be difficult. This parts shortage is particularly acute with fire apparatus due to the narrow market for these devices.

Fire Underwriters Survey lengthy experience in evaluating fire apparatus indicates that apparatus should be designed to an acceptable standard. The standard that is accepted throughout Canada by Fire Underwriters Survey is the Underwriters' Laboratories of Canada (ULC) Standard S515 (most updated version) titled, "Automobile Fire Fighting Apparatus," which was adopted as a National Standard of Canada in September 2004. Alternatively, NFPA 1901, the Standard for Automotive Fire Apparatus (most updated version) is also accepted by Fire Underwriters Survey with respect to apparatus design. Fire apparatus should be built by recognized manufacturers and tested by a suitably accredited third party.

Fire apparatus should respond to first alarms for the first fifteen years of service. During this period it has reasonably been shown that apparatus effectively responds and performs as designed without failure at least 95% of the time. For the next five years, it should be held in reserve status for use at major fires or used as a temporary replacement for out-of-service first line apparatus. Apparatus should be retired from service at twenty years of age. Present practice indicates the recommended service periods and protocols are usually followed by the first purchaser. However, at the end of that period, the apparatus is either traded in on new apparatus or sold to another fire department. At this juncture, the unit may have one or more faults which preclude effective use for emergency service. These deficiencies include:

a. Inadequate braking system
b. Slow pick-up and acceleration

c. Structurally weakened chassis due to constant load bearing and/or overloading
d. Pump wear

FUS has modified its application of the age requirement for used or rebuilt apparatus. Due to municipal budget constraints within small communities we have continued to recognize apparatus over twenty years of age, provided the truck successfully meets the recommended annual tests and has been deemed to be in excellent mechanical condition. The specified service tests are outlined below under the heading "Recommended Service Tests for Used or Modified Fire Apparatus". Testing and apparatus maintenance should only be completed by a technician who is certified to an appropriate level in accordance with NFPA 1071, *Standard for Emergency Vehicle Technician Professional Qualifications*.

Insurance grading recognition may be extended for a limited period of time if we receive documentation verifying that the apparatus has successfully passed the specified tests. If the apparatus does not pass the required tests or experiences long periods of "downtime" we may request the municipal authority to replace the equipment with new or newer apparatus. If replacement does not occur, fire insurance grading recognition may be revoked for the specific apparatus which may adversely affect the fire insurance grades of the community. This can also affect the rates of insurance for property owners throughout the community.

Table 1 Service Schedule for Fire Apparatus For Fire Insurance Grading Purposes

Apparatus Age	Major Cities [3]	Medium Sized Cities [4]	Small Communities [5] and Rural Centres
0 – 15 Years	First Line Duty	First Line Duty	First Line Duty
16 – 20 Years	Reserve	2nd Line Duty	First Line Duty
20 – 25 Years [1]	No Credit in Grading	No Credit in Grading *or* *Reserve* [2]	No Credit in Grading *or* *2nd Line Duty* [2]
26 – 29 Years [1]	No Credit in Grading	No Credit in Grading *or* *Reserve* [2]	No Credit in Grading *or* *Reserve* [2]
30 Years +	No Credit in Grading	No Credit in Grading	No Credit in Grading

[1] All listed fire apparatus 20 years of age and older are required to be service tested by recognized testing agency on an annual basis to be eligible for grading recognition. (NFPA 1071)

[2] Exceptions to age status may be considered in a small to medium sized communities and rural centres conditionally, when apparatus condition is acceptable and apparatus successfully passes required testing.

[3] Major Cities are defined as an incorporated or unincorporated community that has:
- *a populated area (or multiple areas) with a density of at least 400 people per square kilometre; AND*
- *a total population of 100,000 or greater.*

[4] Medium Communities are defined as an incorporated or unincorporated community that has:
- *a populated area (or multiple areas) with a density of at least 200 people per square kilometre; AND/OR*
- *a total population of 1,000 or greater.*

[5] Small Communities are defined as an incorporated or unincorporated community that has:
- *no populated areas with densities that exceed 200 people per square kilometre; AND*
- *does not have a total population in excess of 1,000.*

Table 2 Frequency of Listed Fire Apparatus Acceptance and Service Tests

	Frequency of Test					
	@ Time of Purchase New or Used	**Annual Basis**	**@ 15 Years**	**@ 20 Years** *See Note 4*	**20 to 25 Years (annually)**	**After Extensive Repairs** *See Note 5*
Recommended For Fire Insurance Purposes	Acceptance Test if new; Service Test if used & < 20 Years	Service Test	Acceptance Test	Acceptance Test	Acceptance Test	Acceptance or Service Test depending on extent of repair
Required For Fire Insurance Purposes	Acceptance Test if new; Service Test if used & < 20 Years	No Test Required	No Test Required	Acceptance Test	Acceptance Test	Acceptance or Service Test depending on extent of repair
Factor in FUS Grading	Yes	Yes	Yes	Yes	Yes	Yes
Required By Listing Agency	Acceptance Test	No	No	No	N/A	Acceptance Test
Required By NFPA *See Note 6*	Acceptance Test	Annual Service Test	Annual Service Test	Annual Service Test	Annual Service Test	Service Test

Note 1: See: 'Service Tests for Used or Rebuilt Fire Apparatus' for description of applicable tests
Note 2: Acceptance Tests consist of 60 minute capacity and 30 minute pressure tests
Note 3: Service Tests consist of 20 minute capacity test and 10 minute pressure test in addition to other listed tests
Note 4: Apparatus exceeding 20 years of age may not be considered to be eligible for insurance grading purposes regardless of testing. Application must be made in writing to Fire Underwriters Survey for an extension of the grade-able life of the apparatus.
Note 5: Testing after extensive repairs should occur regardless of apparatus age within reason.
Note 6: Acceptance Tests: See NFPA 1901, Standard for Automotive Fire Apparatus
Service Tests: See NFPA 1911, Standard for Service Tests of Fire Pump Systems on Fire Apparatus, Article 5.1

SERVICE TESTS FOR USED OR MODIFIED FIRE APPARATUS

The intent of this document is to ensure that all used or modified fire apparatus, equipped with a pump or used for tanker service, essentially meet the requirements of Underwriters' Laboratories of Canada (ULC) "Standard for Automobile Fire Fighting Apparatus" S515-04 or subsequent (current) editions of the Standard. Full adherence with the following specified tests is recommended when purchasing used apparatus.

Weight Tests

Load Balance Test:

When fully laden (including a 460kg (1000 lbs) personnel weight, full fuel and water tanks, specified load of hose and miscellaneous equipment), the vehicle shall have a load balance of 22% to 50% of total vehicle mass on the front axle and 50% to 78% of this mass on the rear axle.

Distribution of mass of 33% and 67% respectively on the front and rear axles is preferable for a vehicle having dual rear tires or tandem rear axles.

For a vehicle having tandem rear axles and dual tires on each axle, a loading of between 18% and 25% on the front axle with the balance of mass on the rear axles is permissible.

Road Tests

Acceleration Tests:

2.1.1) From a standing start, the apparatus shall attain a true speed of 55 km/h (35 mph) within 25 seconds for Pumpers carrying up to 3,150 litres (700 gallons) of water.

For apparatus carrying in excess of 3,150 litres (700 gallons) or apparatus equipped with aerial ladders or elevating platforms, a true speed of 55 km/h (35 mph) in 30 seconds should be attained.

2.1.2) The vehicle should attain a top speed of at least 80 km/h (50mph).

Braking Test:

The service brakes shall be capable of bringing the fully laden apparatus to a complete stop from an initial speed of 30 km/h (20 mph) in a distance not exceeding 9 metres (30 feet) by actual measurement. The test should be conducted on a dry, hard surfaced road that is free of loose material, oil and grease.

Pump Performance Tests

Hydrostatic Test

Recent evidence of hydrostatic testing of the pump for 10 minutes at a minimum pressure of 3,400 kPa (500 psi). APPLICABLE TO NEW OR REBUILT PUMPS ONLY (see 3.3).

Priming and Suction Capability Tests

Vacuum Test:

The pump priming device, with a capped suction at least 6 metres (20 feet) long, shall develop –75 kPa (22 inches of mercury) at altitudes up to 300 metres (1000 feet) and hold the vacuum with a drop of not in excess of 34 kPa (10 inches of mercury) in 10 minutes.

For every 300 metres (1000 feet) of elevation, the required vacuum shall be reduced 3.4 kPa (1 inch mercury).

The primer shall not be used after the 10-minute test period has been started. The test shall be made with discharge outlets uncapped.

Suction Capability Test:

The pump (in parallel or series) when dry, shall be capable of taking suction and discharging water with a lift of not more than 3 metres (10 feet) through 6 metres (20 feet) of suction hose of appropriate size, in not more than 30 seconds and not over 45 seconds for 6000 L/min (1320 Igpm) or larger capacity pumps. Where front or rear suction is provided on midship pumps, an additional 10 seconds priming time will be allowed. The test shall be conducted with all discharge caps removed.

Pump Performance

Capacity Test:

Consists of drafting water (preferably with a 10 feet lift) and pumping the rated capacity at 1000 kPa (150 psi) net pump pressure for a continuous period of at least 1 hour.

Pressure Test:

Under the same conditions as in 3.3.1 above pumping 50% of the rated capacity at 1700 kPa (250 psi) net pump pressure for at least ½ hour

For additional information on the above noted tests and test procedures, the following documents provide useful data:

- Underwriters Laboratories of Canada (ULC) publication titled S515 Standard for Automobile Fire Fighting Apparatus, latest edition.
- Fire Underwriters Survey (FUS) publication titled Fire Stream Tables and Testing Data latest edition.
- International Fire Service Training Association (IFSTA) publication titled Fire Department Pumping Apparatus, latest edition.
- National Fire Protection Association (NFPA) 1901 Standard for Automotive Fire Apparatus, latest edition.
- National Fire Protection Association (NFPA) 1911 Standard for the Inspection, Maintenance, Testing, and Retirement of In-Service Automotive Fire Apparatus, latest edition.
- National Fire Protection Association (NFPA) 1912 Standard for Fire Apparatus Refurbishing, latest edition.

For further information regarding the acceptability of emergency apparatus for fire insurance grading purposes, please contact:

Western Canada	Quebec	Ontario	Atlantic Canada
Risk Management Services Fire Underwriters Survey 3999 Henning Drive Burnaby, BC V5C 6P9 1-800-665-5661	Risk Management Services Fire Underwriters Survey 1611 Crémazie Blvd. East Montreal, Quebec H2M 2P2 1-800-263-5361	Risk Management Services Fire Underwriters Survey 150 Commerce Valley Drive, West Markham, Ontario L3T 7Z3 1-800- 268-8080	Risk Management Services Fire Underwriters Survey 238 Brownlow Avenue, Suite 300 Dartmouth, Nova Scotia B3B 1Y2 1-800-639-4528

Fire Hall 1

Items	
Address	65 Ellen Street
Response facility type	Fire and Paramedic
Year built	1965
Storeys	1 storey plus basement
Number of Bays	8
Drive through bays/single access	2 are drive through
Garage bay doors (motor/manual/motor & manual)	Motor and manual
Sprinklered/Non-sprinklered	Non-sprinklered
Back-up power supplies (Emergency generator/UPS (Uninterruptible Power Supply)/Both)	UPS (Uninterruptible Power Supply). Portable generator also available at the fire hall.
SCBA Filling Station	Yes
Vehicle exhaust system in place	Yes
Hose drying (Tower/Cabinet/None)	Tower
PPC washer and dryer	Yes
Bay area comments	Adequate space is available in the bay area. Minor housekeeping issues.
Administration space comments	Administration space appeared adequate. No noted space or housekeeping issues.
Training space comments	There is no overhead projector or screen; however, a television is used for the purposes of training. Classroom training is in the same space as the dining and living room. Fitness space is located in the rear of the apparatus bay area.
Living space comments	Living space in reasonable condition and generally adequate. CO monitors were not noted. Smoke alarms in place (testing unconfirmed).
Overall comments	Reasonable condition but aging facility for the fire hall with the highest call volume.

City of Winnipeg – Fire Hall 1 received **50%** credit for this grading item.

Fire Hall 2

Items	
Address	55 Watt Street
Response facility type	Fire and Paramedic
Year built	1990
Storeys	1 plus basement
Number of Bays	3
Drive through bays/single access	Single access
Garage bay doors (motor/manual/motor & manual)	Motor and manual
Sprinklered/Non-sprinklered	Non-sprinklered
Back-up power supplies (Emergency generator/UPS (Uninterruptible Power Supply)/Both)	UPS (Uninterruptible Power Supply) for computers only
SCBA Filling Station	No
Vehicle exhaust system in place	Yes
Hose drying (Tower/Cabinet/None)	Tower
PPC washer and dryer	Yes
Bay area comments	Adequate space is available in the bay area. Minor housekeeping issues in hose tower. The floor is sagging.
Administration space comments	Administration space appeared adequate. No noted space or housekeeping issues.
Training space comments	There is no overhead projector or screen; however, a television is used for the purposes of training. Classroom training is in the same space as the dining and living room.
Living space comments	Living space in reasonable condition and generally adequate. CO monitors were not noted. Smoke alarms in place (testing unconfirmed).
Overall comments	The fire hall appears to have been built in an area where high water is an issue. This has caused sinking of parts of the building. The bay floor has sagged. Sewer problems were reported and water in the boiler room was noted.

City of Winnipeg – Fire Hall 2 received **25%** credit for this grading item.

Fire Hall 3

Items	
Address	337 Rue DeMeurons
Response facility type	Fire
Year built	1967
Storeys	2
Number of Bays	3 main
Drive through bays/single access	Single access
Garage bay doors (motor/manual/motor & manual)	Motor and manual
Sprinklered/Non-sprinklered	Non-sprinklered
Back-up power supplies (Emergency generator/UPS (Uninterruptible Power Supply)/Both)	UPS (Uninterruptible Power Supply) for computers only
SCBA Filling Station	No
Vehicle exhaust system in place	Yes
Hose drying (Tower/Cabinet/None)	Tower
PPC washer and dryer	Yes
Bay area comments	Adequate space is available in the bay area. Minor housekeeping issues.
Administration space comments	Administration space appeared adequate. No noted space or housekeeping issues.
Training space comments	There is no overhead projector or screen; however, a television is used for the purposes of training. Computers in place for dedicated training purposes. Classroom training is in the same space as the dining and living room. Fitness space is located in the rear of the apparatus bay area.
Living space comments	Living space in good condition and generally adequate. CO monitors were not noted. Smoke alarms in place (testing unconfirmed).
Overall comments	Reasonable condition. Captains and District Chief Offices and dorms are accessed through apparatus bays. Storage of combustible materials in exit stairway.

City of Winnipeg – Fire Hall 3 received **50%** credit for this grading item.

Fire Hall 4

Items	
Address	150 Osborne Street
Response facility type	Fire
Year built	1955
Storeys	1
Number of Bays	3 main
Drive through bays/single access	Single access
Garage bay doors (motor/manual/motor & manual)	Motor and manual
Sprinklered/Non-sprinklered	Non-sprinklered
Back-up power supplies (Emergency generator/UPS (Uninterruptible Power Supply)/Both)	UPS (Uninterruptible Power Supply) for computers only
SCBA Filling Station	No
Vehicle exhaust system in place	Yes
Hose drying (Tower/Cabinet/None)	Tower
PPC washer and dryer	Yes
Bay area comments	Adequate space is available in the bay area however ceiling heights limit type of apparatus that can be stationed here.
Administration space comments	Administration space appeared adequate. No noted space or housekeeping issues.
Training space comments	There is no overhead projector or screen; however, a television is used for the purposes of training. Computers in place for dedicated training purposes. Classroom training is same space as dining and living room.
Living space comments	Living space in good condition and generally adequate. CO monitors were not noted. Smoke alarms in place (testing unconfirmed). Fitness space is located in dorm area.
Overall comments	Reasonable condition. Boiler/mechanical room contains significant storage of combustible materials.

City of Winnipeg – Fire Hall 4 received **50%** credit for this grading item.

Fire Hall 5

Items	
Address	845 Sargent Avenue
Response facility type	Fire and Paramedic
Year built	1919 (renovated and extended 1984)
Storeys	2
Number of Bays	4 main
Drive through bays/single access	3 drive through 1 single access
Garage bay doors (motor/manual/motor & manual)	Motor and manual
Sprinklered/Non-sprinklered	Non-sprinklered
Back-up power supplies (Emergency generator/UPS (Uninterruptible Power Supply)/Both)	UPS (Uninterruptible Power Supply) for computers only
SCBA Filling Station	No
Vehicle exhaust system in place	Yes
Hose drying (Tower/Cabinet/None)	Tower
PPC washer and dryer	Yes
Bay area comments	Floor slab has patching. West apparatus bay leaks water into basement. Heavy apparatus are no longer kept in this bay (only ambulance). Temporary shoring installed throughout basement. Ceiling height may limit type of apparatus that can be stationed in this fire station.
Administration space comments	Administration space appeared adequate. No noted space or housekeeping issues.
Training space comments	There is no overhead projector or screen; however, a television is used for the purposes of training. Computers in place for dedicated training purposes. Fitness area is in basement where shoring is being installed. Equipment was not covered up and has excessive dust throughout the floor space.
Living space comments	Floor in kitchen/living area sinking. CO monitors were not noted. Smoke alarms in place (testing unconfirmed). Fitness space is located in dorm area.
Overall comments	Poor condition. Electrical room has no door. Raceways for light switches not secured to wall. Concrete floor slab for apparatus leaks water and may no longer be stable enough to bare load of fire or EMS apparatus. Excessive accumulation of dust in basement including location where bunker gear dryers are located.

City of Winnipeg – Fire Hall 5 received **25%** credit for this grading item.

Fire Hall 6

Items	
Address	603 Redwood Avenue
Response facility type	Fire and Paramedic
Year built	1998
Storeys	2
Number of Bays	3
Drive through bays/single access	Single access
Garage bay doors (motor/manual/motor & manual)	Motor and manual
Sprinklered/Non-sprinklered	Non-sprinklered
Back-up power supplies (Emergency generator/UPS (Uninterruptible Power Supply)/Both)	UPS (Uninterruptible Power Supply)
SCBA Filling Station	No
Vehicle exhaust system in place	Yes
Hose drying (Tower/Cabinet/None)	Tower
PPC washer and dryer	Yes
Bay area comments	Ambulance blocks squad vehicle from response when parked in fire halls third bay. Consideration should also be given to improving general housekeeping.
Administration space comments	Administration space appeared adequate. No noted space or housekeeping issues.
Training space comments	There is no overhead projector or screen; however, a television is used for the purposes of training. There are computers in place for dedicated training purposes. Space for training is not adequate for full staffing compliment.
Living space comments	Living space inadequate with the amount of staffing found at station (Staff: 10 Fire; 2 Paramedic). CO monitors were not noted. Smoke alarms in place (testing unconfirmed). Large expansive gym facility in the basement.
Overall comments	Highly congested station, living space is not suitable for the amount of staff presently assigned to work out of this station.

City of Winnipeg – Fire Hall 6 received **25%** credit for this grading item.

Fire Hall 7

Items	
Address	10 Allen Blye Drive
Response facility type	Fire
Year built	1996
Storeys	1
Number of Bays	3
Drive through bays/single access	Single access
Garage bay doors (motor/manual/motor & manual)	Motor and manual
Sprinklered/Non-sprinklered	Non-sprinklered
Back-up power supplies (Emergency generator/UPS (Uninterruptible Power Supply)/Both)	UPS (Uninterruptible Power Supply)
SCBA Filling Station	No
Vehicle exhaust system in place	Yes
Hose drying (Tower/Cabinet/None)	Tower
PPC washer and dryer	Washer; no dryer
Bay area comments	Adequate space is available in the bay area for 3 apparatus with additional space for personnel manoeuvring around apparatus.
Administration space comments	Administration space appeared adequate. No noted space or housekeeping issues. Fire hall can accommodate more staff.
Training space comments	There is no overhead projector or screen; however, a television is used for the purposes of training. There are computers in place for dedicated training purposes.
Living space comments	Living space in good condition and generally adequate with room for growth or the addition of another crew. CO monitors were not noted. Smoke alarms in place (testing unconfirmed); consideration should be given to the proper placement of smoke alarms. Fitness room is large and provides a substantial amount of equipment.
Overall comments	Fire hall appears to be well maintained and in good operating condition. Minor issues include the improper placement of smoke alarms. This Fire Hall can accommodate further staffing enhancements along with apparatus.

City of Winnipeg – Fire Hall 7 received **75%** credit for this grading item.

Fire Hall 8

Items	
Address	640 Kimberly
Response facility type	Fire
Year built	1969
Storeys	1
Number of Bays	3 used for apparatus; 1 used to facilitate gym equipment
Drive through bays/single access	Single access
Garage bay doors (motor/manual/motor & manual)	Motor and manual
Sprinklered/Non-sprinklered	Non-sprinklered
Back-up power supplies (Emergency generator/UPS (Uninterruptible Power Supply)/Both)	UPS (Uninterruptible Power Supply)
SCBA Filling Station	No
Vehicle exhaust system in place	Yes
Hose drying (Tower/Cabinet/None)	Tower
PPC washer and dryer	Washer; with rack dryer
Bay area comments	Apparatus bay floor is limited in space between apparatus and utilises one apparatus bay to facilitate gym equipment. The size of apparatus bays are not ideal for the type and size of apparatus being built today.
Administration space comments	Administration space appeared adequate. No noted housekeeping issues.
Training space comments	There is no overhead projector; however, a LCD Screen is used for the purposes of training. There are also computers dedicated to delivering online training. Most theory training is completed in the kitchen/lounge area.
Living space comments	Living space is not conducive to the amount of personnel assigned to this station. CO monitors were not noted. Smoke alarms in place; however, location of smoke alarms should be reconsidered (testing unconfirmed). Fitness room in apparatus bay. Attending Captain at the fire hall indicated that a mould issue existed in the kitchen.
Overall comments	Poor condition. Air circulation and mould issues were reported by firefighters and captains at the station. Limited training space and a congested apparatus bay floor area.

City of Winnipeg – Fire Hall 8 received **25%** credit for this grading item.

Fire Hall 9

Items	
Address	864 Marion Street
Response facility type	Fire
Year built	1955
Storeys	1
Number of Bays	3 main
Drive through bays/single access	Single access
Garage bay doors (motor/manual/motor & manual)	Motor and manual
Sprinklered/Non-sprinklered	Non-sprinklered
Back-up power supplies (Emergency generator/UPS (Uninterruptible Power Supply)/Both)	UPS (Uninterruptible Power Supply) for computers only
SCBA Filling Station	No
Vehicle exhaust system in place	Yes
Hose drying (Tower/Cabinet/None)	Tower
PPC washer and dryer	Yes
Bay area comments	Adequate space is available in the bay area. Concrete slab has fractures/cracks leading from support column.
Administration space comments	Administration space appeared adequate. No noted space or housekeeping issues.
Training space comments	There is no overhead projector or screen; however, a television is used for the purposes of training. Computers in place for dedicated training purposes. Classroom training is same space as dining and living room.
Living space comments	Living space in good condition and generally adequate. CO monitors were not noted. Smoke alarms in place (testing unconfirmed).
Overall comments	Poor condition.

City of Winnipeg – Fire Hall 9 received **25%** credit for this grading item.

Fire Hall 10

Items	
Address	1354 Border Street
Response facility type	Fire
Year built	1955
Storeys	1
Number of Bays	3
Drive through bays/single access	Single access
Garage bay doors (motor/manual/motor & manual)	Motor and manual
Sprinklered/Non-sprinklered	Non-sprinklered
Back-up power supplies (Emergency generator/UPS (Uninterruptible Power Supply)/Both)	UPS (Uninterruptible Power Supply)
SCBA Filling Station	No
Vehicle exhaust system in place	Yes
Hose drying (Tower/Cabinet/None)	Tower
PPC washer and dryer	Yes
Bay area comments	Adequate space is available in the bay area. No noted space or housekeeping issues.
Administration space comments	Administration space appeared adequate. No noted space or housekeeping issues.
Training space comments	There is no overhead projector or screen; however, a television is used for the purposes of training. There is 1 computer in place for dedicated training purposes.
Living space comments	Living space in good condition and generally adequate. CO monitors and Smoke alarms are in place (testing unconfirmed). Fitness room appeared reasonable.
Overall comments	Reasonable condition.

City of Winnipeg – Fire Hall 10 received **75%** credit for this grading item.

Fire Hall 11

Items	
Address	1705 Portage Avenue
Response facility type	Fire and Paramedic
Year built	2013
Storeys	2
Number of Bays	4
Drive through bays/single access	Drive through
Garage bay doors (motor/manual/motor & manual)	Motor & manual
Sprinklered/Non-sprinklered	Sprinklered
Back-up power supplies (Emergency generator/UPS (Uninterruptible Power Supply)/Both)	UPS (Uninterruptible Power Supply)
SCBA Filling Station	No
Vehicle exhaust system in place	Yes
Hose drying (Tower/Cabinet/None)	Tower
PPC washer and dryer	Yes
Bay area comments	Adequate space is available in the bay area.
Administration space comments	Adequate administration space is available.
Training space comments	Dedicated training space available but not set-up at time of visit.
Living space comments	Living space in good condition and adequate.
Overall comments	Very good condition.

City of Winnipeg – Fire Hall 11 received **100%** credit for this grading item.

Fire Hall 12

Items	
Address	1780 Taylor Street
Response facility type	Fire
Year built	2012
Storeys	1
Number of Bays	2
Drive through bays/single access	Drive through bays
Garage bay doors (motor/manual/motor & manual)	Motor and manual
Sprinklered/Non-sprinklered	Non-sprinklered
Back-up power supplies (Emergency generator/UPS (Uninterruptible Power Supply)/Both)	UPS (Uninterruptible Power Supply)
SCBA Filling Station	No
Vehicle exhaust system in place	Yes
Hose drying (Tower/Cabinet/None)	No
PPC washer and dryer	Yes
Bay area comments	Adequate space is available in the bay area. No noted space or housekeeping issues.
Administration space comments	Administration space appeared adequate. No noted space or housekeeping issues.
Training space comments	There is no overhead projector or screen; however, a television is used for the purposes of training. Computer room in place for dedicated training purposes.
Living space comments	Living space in good condition and generally adequate. CO monitors are not noted. Smoke alarms are in place (testing unconfirmed). Fitness room appeared reasonable.
Overall comments	Reasonable condition. Captain on duty noted continual problems with ventilation system. 9 major leaks (water infiltration) in 2013.

City of Winnipeg – Fire Hall 12 received **75%** credit for this grading item.

Fire Hall 13

Items	
Address	7999 Lilac Street
Response facility type	Fire and Paramedic
Year built	1979
Storeys	1
Number of Bays	3
Drive through bays/single access	Single access
Garage bay doors (motor/manual/motor & manual)	Motor and manual
Sprinklered/Non-sprinklered	Non-sprinklered
Back-up power supplies (Emergency generator/UPS (Uninterruptible Power Supply)/Both)	UPS (Uninterruptible Power Supply)
SCBA Filling Station	No
Vehicle exhaust system in place	Yes
Hose drying (Tower/Cabinet/None)	Tower
PPC washer and dryer	Yes
Bay area comments	Just adequate. Housekeeping and storage an issue on the bay floor.
Administration space comments	Administration space appeared adequate. No noted space or housekeeping issues.
Training space comments	There is no overhead projector or screen; however, a television is used for the purposes of training. Housekeeping is reasonable.
Living space comments	Living dorm space and fitness area are in the same room. CO monitors are not noted. Smoke alarms in place (testing unconfirmed); however, some of these were not in wall/ceiling fixtures. Smoke alarm in paramedic room missing.
Overall comments	Smoke alarm disconnected from fixture in mechanical room. Roof leaking issues in old phone booth area and in water rescue storage area and in roof crawl space.

City of Winnipeg – Fire Hall 13 received **50%** credit for this grading item.

Fire Hall 14

Items	
Address	1057 St Mary's Road
Response facility type	Fire
Year built	1957
Storeys	1 storey plus basement
Number of Bays	2
Drive through bays/single access	Single access
Garage bay doors (motor/manual/motor & manual)	Motor and manual
Sprinklered/Non-sprinklered	Non-sprinklered
Back-up power supplies (Emergency generator/UPS (Uninterruptible Power Supply)/Both)	UPS (Uninterruptible Power Supply)
SCBA Filling Station	No
Vehicle exhaust system in place	Yes
Hose drying (Tower/Cabinet/None)	Tower
PPC washer and dryer	Yes
Bay area comments	Adequate space is available in the bay area. No noted space or housekeeping issues.
Administration space comments	Administration space appeared adequate. No noted space or housekeeping issues.
Training space comments	There is no overhead projector or screen; however, a television is used for the purposes of training. One computer in place for dedicated training purposes.
Living space comments	Living space in reasonable condition and generally adequate. CO monitors not noted. Smoke alarms are in place (testing unconfirmed). Fitness room appeared reasonable with minor housekeeping issues. No separate WC provided for female.
Overall comments	Reasonable condition.

City of Winnipeg – Fire Hall 14 received **50%** credit for this grading item.

Fire Hall 15

Items	
Address	1083 Autumnwood Drive
Response facility type	Fire
Year built	1970
Storeys	2
Number of Bays	2
Drive through bays/single access	Single access
Garage bay doors (motor/manual/motor & manual)	Motor and manual
Sprinklered/Non-sprinklered	Non-sprinklered
Back-up power supplies (Emergency generator/UPS (Uninterruptible Power Supply)/Both)	UPS (Uninterruptible Power Supply) for computers only
SCBA Filling Station	No
Vehicle exhaust system in place	Yes but not functional.
Hose drying (Tower/Cabinet/None)	Tower
PPC washer and dryer	Yes
Bay area comments	Odour from apparatus bay pits. Waste water mains reportedly leak into apparatus bay pits. Vehicle exhaust discharge located adjacent to air intake for air conditioning. Vehicle exhaust system not functioning during time of survey.
Administration space comments	Administration space appeared adequate. Captain office adjacent to bay area (mid floor) and door may not create adequate seal between office and bay space.
Training space comments	There is no overhead projector or screen; however, a television is used for the purposes of training. Computers in place for dedicated training purposes. Classroom training is same space as dining and living room. Fitness space located in adjacent bay area.
Living space comments	Washroom located inside hose tower. CO monitors were not noted. Smoke alarms in place (testing unconfirmed). Main washroom and shower has fan which does not function as intended. Floor in dorm area reportedly has rotten floor boards. Second floor board installed overtop of existing.
Overall comments	Fire station reportedly has several health and safety concerns including asbestos tiles throughout, door and window seals not maintained between apparatus bay space and adjacent spaces.

City of Winnipeg – Fire Hall 15 received **25%** credit for this grading item.

Fire Hall 16

Items	
Address	1001 McGregor Street
Response facility type	Fire and Paramedic
Year built	1971
Storeys	1
Number of Bays	3 (spacious)
Drive through bays/single access	Single access
Garage bay doors (motor/manual/motor & manual)	Motor and manual
Sprinklered/Non-sprinklered	Non-sprinklered
Back-up power supplies (Emergency generator/UPS (Uninterruptible Power Supply)/Both)	UPS (Uninterruptible Power Supply)
SCBA Filling Station	No
Vehicle exhaust system in place	Yes
Hose drying (Tower/Cabinet/None)	Tower
PPC washer and dryer	Yes washer; with rack dryer
Bay area comments	Adequate space is available in the bay area. Good housekeeping of station and apparatus.
Administration space comments	Administration space appeared adequate. No noted space or housekeeping issues. Provided with a Captain and Lieutenants office.
Training space comments	Training is typically conducted in the kitchen/lounge area using LCD Monitor. Sufficient space in the apparatus bay area to conduct some basic practicum training.
Living space comments	Living space was found in good condition and generally adequate. CO monitors not noted within the building. Smoke alarms were noted only relative to sleeping area (testing unconfirmed). Fire extinguishers were found throughout. The fitness room appeared reasonable.
Overall comments	Reasonable condition. Unisex facilities non-conventional, requires the washroom to be locked when in use as opposed to having designated washrooms per gender.

City of Winnipeg – Fire Hall 16 received **75%** credit for this grading item.

Fire Hall 17

Items	
Address	1501 Church Street
Response facility type	Fire and Paramedic
Year built	1969
Storeys	1
Number of Bays	3
Drive through bays/single access	Single access
Garage bay doors (motor/manual/motor & manual)	Motor and manual
Sprinklered/Non-sprinklered	Non-sprinklered
Back-up power supplies (Emergency generator/UPS (Uninterruptible Power Supply)/Both)	UPS (Uninterruptible Power Supply)
SCBA Filling Station	No
Vehicle exhaust system in place	Yes
Hose drying (Tower/Cabinet/None)	Tower
PPC washer and dryer	Yes
Bay area comments	Adequate space is available in the bay area and around apparatus. Practicum training can be conducted in bays.
Administration space comments	Administration space appeared adequate. No noted space or housekeeping issues.
Training space comments	LCD Screen is used for the purposes of training. There are also computers in place dedicated for training purposes. Training is conducted in the kitchen/lounge area with ample room in the apparatus bay area for some basic practicum training.
Living space comments	Non-commercial grade cooking appliances in kitchen. CO monitors were not noted. Smoke alarms in place (testing unconfirmed). Fitness room and dorm area share the same space.
Overall comments	The captain at the hall commented on security issues and reported incidents of theft. The captain also indicated that significant water leakage from windows occurs during heavy rain. Lounge/kitchen area where firefighters spend most of their time is the furthest portion of the building in relation to the apparatus bay floor area.

City of Winnipeg – Fire Hall 17 received **50%** credit for this grading item.

Fire Hall 18

Items	
Address	5000 Roblin Boulevard
Response facility type	Fire
Year built	2011-2012
Storeys	1
Number of Bays	2
Drive through bays/single access	Drive through bays
Garage bay doors (motor/manual/motor & manual)	Motor and manual
Sprinklered/Non-sprinklered	Non-sprinklered
Back-up power supplies (Emergency generator/UPS (Uninterruptible Power Supply)/Both)	UPS (Uninterruptible Power Supply)
SCBA Filling Station	No
Vehicle exhaust system in place	Yes
Hose drying (Tower/Cabinet/None)	No
PPC washer and dryer	Yes
Bay area comments	Adequate space is available in the bay area. No noted space or housekeeping issues.
Administration space comments	Administration space appeared adequate. No noted space or housekeeping issues.
Training space comments	There is no overhead projector or screen; however, a television is used for the purposes of training. One computer in place for dedicated training purposes.
Living space comments	Living space in reasonable condition and generally adequate. CO monitors and smoke alarms are in place (testing unconfirmed). Fitness room appeared relatively small compared to other fire stations.
Overall comments	Reasonable condition. Access across CN rail to one area of the fire station district.

City of Winnipeg – Fire Hall 18 received **75%** credit for this grading item.

Fire Hall 19

Items	
Address	320 Whytewold Road
Response facility type	Fire
Year built	1959
Storeys	1
Number of Bays	2; however, one bay is used as fitness area
Drive through bays/single access	Single access
Garage bay doors (motor/manual/motor & manual)	Motor and manual
Sprinklered/Non-sprinklered	Non-sprinklered
Back-up power supplies (Emergency generator/UPS (Uninterruptible Power Supply)/Both)	UPS (Uninterruptible Power Supply)
SCBA Filling Station	No
Vehicle exhaust system in place	Yes
Hose drying (Tower/Cabinet/None)	No
PPC washer and dryer	Yes
Bay area comments	Major space issues in bay area. Fitness area uses one of the apparatus bays.
Administration space comments	Administration space appeared to be an issue with 2 small rooms available.
Training space comments	There is no overhead projector or screen; however, a television is used for the purposes of training. Space is limited.
Living space comments	Living space in limited. CO monitors were not noted. Smoke alarms in place (testing unconfirmed). Fitness space inadequate.
Overall comments	Reasonable condition. Major space issues at the hall.

City of Winnipeg – Fire Hall 19 received **25%** credit for this grading item.

Fire Hall 20

Items	
Address	525 Banting Drive
Response facility type	Fire
Year built	1971
Storeys	1
Number of Bays	3 main and 1 additional side access (not used)
Drive through bays/single access	Single access
Garage bay doors (motor/manual/motor & manual)	Motor and manual
Sprinklered/Non-sprinklered	Non-sprinklered
Back-up power supplies (Emergency generator/UPS (Uninterruptible Power Supply)/Both)	UPS (Uninterruptible Power Supply)
SCBA Filling Station	No
Vehicle exhaust system in place	Yes
Hose drying (Tower/Cabinet/None)	Tower
PPC washer and dryer	Yes
Bay area comments	Adequate space is available in the bay area. Minor housekeeping issues.
Administration space comments	Administration space appeared adequate. No noted space or housekeeping issues.
Training space comments	There is no overhead projector or screen; however, a television is used for the purposes of training. There are 2 computers in place for dedicated training purposes.
Living space comments	Living space in good condition and generally adequate. CO monitors were not noted. Smoke alarms in place (testing unconfirmed). Fitness room appeared reasonable.
Overall comments	Reasonable condition. The captain at the hall commented on minor exit issues at the main intersection. The captain also indicated large call volumes in the area.

City of Winnipeg – Fire Hall 20 received **75%** credit for this grading item.

Fire Hall 21

Items	
Address	1446 Regent Avenue
Response facility type	Fire and Paramedic
Year built	2012
Storeys	1
Number of Bays	3
Drive through bays/single access	Single access
Garage bay doors (motor/manual/motor & manual)	Motor and manual
Sprinklered/Non-sprinklered	Non-sprinklered
Back-up power supplies (Emergency generator/UPS (Uninterruptible Power Supply)/Both)	UPS (Uninterruptible Power Supply)
SCBA Filling Station	No
Vehicle exhaust system in place	Yes
Hose drying (Tower/Cabinet/None)	No
PPC washer and dryer	Washer and Drying Rack
Bay area comments	Adequate space is available in the bay area for a multi-unit fire hall.
Administration space comments	Administration space appeared adequate. No noted space or housekeeping issues.
Training space comments	There is no overhead projector or screen; however, a television is used for the purposes of training. There are computers in place for dedicated training purposes. Limited space for training in the apparatus bay area with existing unit assignment.
Living space comments	Living space in good condition and generally adequate. CO monitors were noted, and smoke alarms in place (testing unconfirmed). Fitness room is expansive; located in the basement of the building.
Overall comments	Good condition, considered adequate for a multi company station.

City of Winnipeg – Fire Hall 21 received **100%** credit for this grading item.

Fire Hall 22

Items	
Address	1567 Waverley Street
Response facility type	Fire
Year built	1983
Storeys	1
Number of Bays	2
Drive through bays/single access	Single access
Garage bay doors (motor/manual/motor & manual)	Motor and manual
Sprinklered/Non-sprinklered	Non-sprinklered
Back-up power supplies (Emergency generator/UPS (Uninterruptible Power Supply)/Both)	UPS (Uninterruptible Power Supply)
SCBA Filling Station	No
Vehicle exhaust system in place	Yes
Hose drying (Tower/Cabinet/None)	Tower
PPC washer and dryer	Yes
Bay area comments	Adequate space is available in the bay area. Notable damage on concrete floor surface at bay entrance. No other noted space or housekeeping issues.
Administration space comments	Administration space appeared adequate. No noted space or housekeeping issues.
Training space comments	There is no overhead projector or screen; however, a television is used for the purposes of training. 2 computers in place for dedicated training purposes.
Living space comments	Living space in reasonable condition and generally adequate. CO monitors (close to ceiling level) and smoke alarms are in place (testing unconfirmed). Fitness equipment and bed were found in the same room.
Overall comments	Reasonable condition. PPC dryer located on mezzanine level and access to which via fixed ladder. Access door to boiler room inoperable.

City of Winnipeg – Fire Hall 22 received **75%** credit for this grading item.

Fire Hall 23

Items	
Address	880 Dalhousie Street
Response facility type	Fire
Year built	1962
Storeys	2 (garage and 2 split levels dorm)
Number of Bays	3
Drive through bays/single access	Single access
Garage bay doors (motor/manual/motor & manual)	Motor and manual
Sprinklered/Non-sprinklered	Non-sprinklered
Back-up power supplies (Emergency generator/UPS (Uninterruptible Power Supply)/Both)	UPS (Uninterruptible Power Supply)
SCBA Filling Station	No
Vehicle exhaust system in place	Yes
Hose drying (Tower/Cabinet/None)	Tower
PPC washer and dryer	Yes
Bay area comments	Adequate space is available in the bay area. Combustible roof. No noted space or housekeeping issues.
Administration space comments	Administration space appeared adequate. No noted space or housekeeping issues.
Training space comments	There is no overhead projector or screen but whiteboards; however, a television is used for the purposes of training. No computer noted in place for dedicated training purposes.
Living space comments	Living space in reasonable condition and generally adequate. CO monitors and smoke alarms are in place (testing unconfirmed). Fitness equipment and bed were found in the same room.
Overall comments	Reasonable condition. No smoke detectors at basement level. Sewer backflow problems in the past.

City of Winnipeg – Fire Hall 23 received **75%** credit for this grading item.

Fire Hall 24

Items	
Address	1665 Rothesay Street
Response facility type	Fire and Paramedic
Year built	1974
Storeys	1
Number of Bays	3
Drive through bays/single access	Single access
Garage bay doors (motor/manual/motor & manual)	Motor and manual
Sprinklered/Non-sprinklered	Non-sprinklered
Back-up power supplies (Emergency generator/UPS (Uninterruptible Power Supply)/Both)	UPS (Uninterruptible Power Supply)
SCBA Filling Station	No
Vehicle exhaust system in place	Yes
Hose drying (Tower/Cabinet/None)	Tower
PPC washer and dryer	Washer with rack dryer
Bay area comments	Adequate space is available in the bay area. Minor housekeeping issues.
Administration space comments	Administration space appeared adequate. No noted space or housekeeping issues. Adequate office space is provided for the District Chief and Captain's.
Training space comments	There is no overhead projector or screen; however, a television is used for the purposes of training. There are computers in place for dedicated training purposes.
Living space comments	Living space in good condition and generally adequate. CO monitors were not noted. Smoke alarms in place (testing unconfirmed). Fitness room located inside dorm room/sleeping area and lacks proper ventilation.
Overall comments	Consideration should be given to the proper placement of smoke alarms and carbon monoxide detectors.

City of Winnipeg – Fire Hall 24 received **50%** credit for this grading item.

Fire Hall 25

Items	
Address	701 Day Street
Response facility type	Fire and Paramedic
Year built	1984
Storeys	2
Number of Bays	3
Drive through bays/single access	Single access
Garage bay doors (motor/manual/motor & manual)	Motor and manual
Sprinklered/Non-sprinklered	Non-sprinklered
Back-up power supplies (Emergency generator/UPS (Uninterruptible Power Supply)/Both)	UPS (Uninterruptible Power Supply)
SCBA Filling Station	No
Vehicle exhaust system in place	Yes
Hose drying (Tower/Cabinet/None)	Tower
PPC washer and dryer	Washer and rack dryer
Bay area comments	Very little room between apparatus on bay floor. Minor housekeeping issues. Not enough space to perform basic training evolutions.
Administration space comments	Administration space appeared adequate. No noted space or housekeeping issues. Captain and Fire Prevention Officer offices provided.
Training space comments	There is no overhead projector or screen; however, a television is used for the purposes of training. There are computers in place dedicated for training purposes. Tarmac has significant space for pump operations training.
Living space comments	Living space in good condition and generally adequate. CO monitors were not noted. Smoke alarms in place (testing unconfirmed). Fitness room located within dorm/sleeping area.
Overall comments	Station staff reported that there are numerous leaks in doors and windows. In addition, heavy rains cause leakage in the washroom with visible signs of damage. Consideration should be given to the proper placement of smoke alarms and carbon monoxide detectors.

City of Winnipeg – Fire Hall 25 received **50%** credit for this grading item.

Fire Hall 26

Items	
Address	1525 Dakota Street
Response facility type	Fire and Paramedic
Year built	1991
Storeys	2
Number of Bays	3
Drive through bays/single access	Single access
Garage bay doors (motor/manual/motor & manual)	Motor and manual
Sprinklered/Non-sprinklered	Non-sprinklered
Back-up power supplies (Emergency generator/UPS (Uninterruptible Power Supply)/Both)	UPS (Uninterruptible Power Supply)
SCBA Filling Station	No
Vehicle exhaust system in place	Yes
Hose drying (Tower/Cabinet/None)	Tower
PPC washer and dryer	Washer with rack dryer
Bay area comments	Adequate space is available in the bay area for current fleet in addition to storing the Wildland Fire Unit.
Administration space comments	Administration space appeared adequate. No noted space or housekeeping issues.
Training space comments	There is no overhead projector or screen; however, a television is used for the purposes of training. There are computers in place for dedicated training purposes. Large whiteboard also available for training.
Living space comments	Living space in good condition and generally adequate. CO monitors were noted; some were not placed in proper location. Smoke alarms in place (testing unconfirmed). Fitness room located in dormitory/sleeping area.
Overall comments	Reasonable condition. Consideration should be given to the proper placement of smoke alarms and carbon monoxide detectors.

City of Winnipeg – Fire Hall 26 received **75%** credit for this grading item.

Fire Hall 27

Items	
Address	27 Sage Creek Blvd
Response facility type	Fire and Paramedic
Year built	2011
Storeys	1
Number of Bays	2
Drive through bays/single access	Drive through
Garage bay doors (motor/manual/motor & manual)	Motor and manual
Sprinklered/Non-sprinklered	Non-sprinklered, monitored fire/security alarm system
Back-up power supplies (Emergency generator/UPS (Uninterruptible Power Supply)/Both)	UPS (Uninterruptible Power Supply)
SCBA Filling Station	No
Vehicle exhaust system in place	Yes
Hose drying (Tower/Cabinet/None)	No
PPC washer and dryer	Yes
Bay area comments	Adequate space is available in the bay area. Bay area can store a maximum of two apparatus. Front and rear access.
Administration space comments	Administration space appeared adequate. No noted space or housekeeping issues.
Training space comments	There is no overhead projector or screen; however, a television is used for the purposes of training. There are 2 computers in place for dedicated training purposes.
Living space comments	Commercial grade cooking appliances and large kitchen/lounge area. Living space in good condition and generally adequate. Individual dorm rooms available for each firefighter. Exercise room adequate and located next to apparatus floor.
Overall comments	Brand new facility; well designed. Should be provided with automatic sprinkler protection.

City of Winnipeg – Fire Hall 27 received **100%** credit for this grading item.

TECHNICAL BULLETIN

FIRE UNDERWRITERS SURVEY™

A Service to Insurers and Municipalities

LADDERS AND AERIALS: WHEN ARE THEY REQUIRED OR NEEDED?

Numerous standards are used to determine the need for aerial apparatus and ladder equipment within communities. This type of apparatus is typically needed to provide a reasonable level of response within a community when buildings of an increased risk profile (fire) are permitted to be constructed within the community.

Please find the following information regarding the requirements for aerial apparatus/ladder companies from the Fire Underwriters Survey Classification Standard for Public Fire Protection.

Fire Underwriters Survey

Ladder/Service company operations are normally intended to provide primary property protection operations of

1.) Forcible entry;
2.) Utility shut-off;
3.) Ladder placement;
4.) Ventilation;
5.) Salvage and Overhaul;
6.) Lighting.

Response areas with 5 buildings that are 3 stories or 10.7 metres (35 feet) or more in height, or districts that have a Basic Fire Flow greater than 15,000 LPM (3,300 IGPM), or any combination of these criteria, should have a ladder company. The height of all buildings in the community, including those protected by automatic sprinklers, is considered when determining the number of needed ladder companies.
When no individual response area/district alone needs a ladder company, at least one ladder company is needed if the sum of buildings in the fire protection area meets the above criteria."

The needed length of an aerial ladder, an elevating platform and an elevating stream device shall be determined by the height of the tallest building in the ladder/service district (fire protection area) used to determine the need for a ladder company. One storey normally equals at least 3 metres (10 feet). Building setback is not to be considered in the height determination. An allowance is built into the ladder design for normal access. The maximum height needed for grading purposes shall be 30.5 metres (100 feet).

3999 Henning Drive
Suite 101
Burnaby, British Columbia
V5C 6P9

T: 604.609.4146
Toll Free: 1.800.665.5661
F: 604.688.6986

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www.optaintel.ca

Exception: When the height of the tallest building is 15.2 metres (50 feet) or less no credit shall be given for an aerial ladder, elevating platform or elevating stream device that has a length less than 15.2 metres (50 feet). This provision is necessary to ensure that the water stream from an elevating stream device has additional "reach" for large area, low height buildings, and the aerial ladder or elevating platform may be extended to compensate for possible topographical conditions that may exist. See Fire Underwriters Survey - Table of Effective Response (attached).

Furthermore, please find the following information regarding communities' need for aerial apparatus/ladder companies within the National Fire Protection Association.

NFPA

Response Capabilities: The fire department should be prepared to provide the necessary response of apparatus, equipment and staffing to control the anticipated routine fire load for its community.

NFPA *Fire Protection Handbook, 20th Edition* cites the following apparatus response for each designated condition:

HIGH-HAZARD OCCUPANCIES (schools, hospitals, nursing homes, explosive plants, refineries, high-rise buildings, and other high-risk or large fire potential occupancies):

*At least four pumpers, **two ladder trucks** (or combination apparatus with equivalent capabilities), two chief officers, and other specialized apparatus as may be needed to cope with the combustible involved; not fewer than 24 firefighters and two chief officers.*

MEDIUM-HAZARD OCCUPANCIES (apartments, offices, mercantile and industrial occupancies not normally requiring extensive rescue or firefighting forces):

*At least three pumpers, **one ladder truck** (or combination apparatus with equivalent capabilities), one chief officer, and other specialized apparatus as may be needed or available; not fewer than 16 firefighters and one chief officer.*

LOW-HAZARD OCCUPANCIES (one-, two-, or three-family dwellings and scattered small businesses and industrial occupancies):

*At least two pumpers, **one ladder truck** (or combination apparatus with equivalent capabilities), one chief officer, and other specialized apparatus as may be needed or available; not fewer than 12 firefighters and one chief officer.*

In addition to the previous references, the following excerpt from the 2006 BC Building Code is also important to consider when selecting the appropriate level of fire department response capacity and building design requirements with regard to built-in protection levels (passive and active fire protection systems).

Excerpt: National Building Code 2006

A-3 Application of Part 3.

In applying the requirements of this Part, it is intended that they be applied with discretion to buildings of unusual configuration that do not clearly conform to the specific requirements, or to buildings in which processes are carried out which make compliance with particular requirements in this Part impracticable. The definition of "building" as it applies to this Code is general and encompasses most structures, including those which would not normally be considered as buildings in the layman's sense. This occurs more often in industrial uses, particularly those involving manufacturing facilities and equipment that require specialized design that may make it impracticable to follow the specific requirements of this Part. Steel mills, aluminum plants, refining, power generation and liquid storage facilities are examples. A water tank or an oil refinery, for example, has no floor area, so it is obvious that requirements for exits from floor areas would not apply. Requirements for structural fire protection in large steel mills and pulp and paper mills, particularly in certain portions, may not be practicable to achieve in terms of the construction normally used and the operations for which the space is to be used. In other portions of the same building, however, it may be quite reasonable to require that the provisions of this Part be applied (e.g., the office portions). Similarly, areas of industrial occupancy which may be occupied only periodically by service staff, such as equipment penthouses, normally would not need to have the same type of exit facility as floor areas occupied on a continuing basis. It is expected that judgment will be exercised in evaluating the application of a requirement in those cases when extenuating circumstances require special consideration, provided the occupants' safety is not endangered.

The provisions in this Part for fire protection features installed in buildings are intended to provide a minimum acceptable level of public safety. It is intended that all fire protection features of a building, whether required or not, will be designed in conformance with good fire protection engineering practice and will meet the appropriate installation requirements in relevant standards. Good design is necessary to ensure that the level of public safety established by the Code requirements will not be reduced by a voluntary installation.

Firefighting Assumptions

The requirements of this Part are based on the assumption that firefighting capabilities are available in the event of a fire emergency. These firefighting capabilities may take the form of a

paid or volunteer public fire department or in some cases a private fire brigade. If these firefighting capabilities are not available, additional fire safety measures may be required.

Firefighting capability can vary from municipality to municipality. Generally, larger municipalities have greater firefighting capability than smaller ones. Similarly, older, well established municipalities may have better firefighting facilities than newly formed or rapidly growing ones. The level of municipal fire protection considered to be adequate will normally depend on both the size of the municipality (i.e., the number of buildings to be protected) and the size of buildings within that municipality. Since larger buildings tend to be located in larger municipalities, they are generally, but not always, favoured with a higher level of municipal protection.

Although it is reasonable to consider that some level of municipal firefighting capability was assumed in developing the fire safety provisions in Part 3, this was not done on a consistent or defined basis. The requirements in the Code, while developed in the light of commonly prevailing municipal fire protection levels, do not attempt to relate the size of building to the level of municipal protection. **The responsibility for controlling the maximum size of building to be permitted in a municipality in relation to local firefighting capability rests with the municipality. If a proposed building is too large, either in terms of floor area or building height, to receive reasonable protection from the municipal fire department, fire protection requirements in addition to those prescribed in this Code, may be necessary to compensate for this deficiency.** Automatic sprinkler protection may be one option to be considered.

Alternatively, the municipality may, in light of its firefighting capability, elect to introduce zoning restrictions to ensure that the maximum building size is related to available municipal fire protection facilities. This is, by necessity, a somewhat arbitrary decision and should be made in consultation with the local firefighting service, who should have an appreciation of their capability to fight fires.

The requirements of Subsection 3.2.3. are intended to prevent fire spread from thermal radiation assuming there is adequate firefighting available. It has been found that periods of from 10 to 30 minutes usually elapse between the outbreak of fire in a building that is not protected with an automatic sprinkler system and the attainment of high radiation levels. During this period, the specified spatial separations should prove adequate to inhibit ignition of an exposed building face or the interior of an adjacent building by radiation. Subsequently, however, reduction of the fire intensity by firefighting and the protective wetting of the exposed building face will often be necessary as supplementary measures to inhibit fire spread.

In the case of a building that is sprinklered throughout, the automatic sprinkler system should control the fire to an extent that radiation to neighbouring buildings should be minimal. Although there will be some radiation effect on a sprinklered building from a fire in a neighbouring building, the internal sprinkler system should control any fires that might be ignited in the building and thereby minimize the possibility of the fire spreading into the exposed building. NFPA 80A, “Protection of Buildings from Exterior Fire Exposures,” provides additional information on the possibility of fire spread at building exteriors.

The water supply requirements for fire protection installations depend on the requirements of any automatic sprinkler installations and also on the number of fire streams that may be needed at any fire, having regard to the length of time the streams will have to be used. Both these factors are largely influenced by the conditions at the building to be equipped, and the quantity and pressure of water needed for the protection of both the interior and exterior of the building must be ascertained before the water supply is decided upon. Acceptable water supplies may be a public waterworks system that has adequate pressure and discharge capacity, automatic fire pumps, pressure tanks, manually controlled fire pumps in combination with pressure tanks, gravity tanks, and manually controlled fire pumps operated by remote control devices at each hose station.

For further information regarding the acceptability of emergency apparatus for fire insurance grading purposes, please contact:

Western Canada	Quebec	Ontario	Atlantic Canada
Fire Underwriters Survey	Fire Underwriters Survey	Fire Underwriters Survey	Fire Underwriters Survey
3999 Henning Drive	1611 Crémazie Blvd. East	150 Commerce Valley Drive, West	238 Brownlow Avenue, Suite 300
Burnaby, BC V5C 6P9	Montreal, Quebec H2M 2P2	Markham, Ontario L3T 7Z3	Dartmouth, Nova Scotia B3B 1Y2
1-800-665-5661	1-800-263-5361	1-800- 268-8080	1-800-639-4528

Heavy Fleet Preventive Maintenance

Preventive A and B (B includes change of all fluids)
PM A conducted every 150 hours
PM B conducted annually

Engine:
- Oil sample taken
- Oil type
- Oil changed
- Amount of oil added
- Oil filter replaced
- Oil pressure gauge
- Crank case vent
- Crank case pressure

Engine RPM:
- Low idle RPM
- High idle
- PTO shift (dash)
- RPM control (dash)
- RPM control (pump panel or at aerial control)

Fuel System:
- Fuel leaks (out of service criteria)
- Fuel pump
- Fuel lines
- Fuel transfer pump
- Fuel tank
- Tank level gauge and sender
- Fuel filter replaced
- Fuel sample taken

Air Compressor:
- Governor
- Gauges
- Intake filter
- Air lines
- Air dryer
- Tanks
- Tank mounts
- Automatic moisture ejector
- Manual drain valves and cables
- Engine compartment
- Sound proofing
- Engine retarder

Power Steering:
- Oil level
- Power steering pump
- Power steering hoses
- Steering wheel assembly including horn ring and controls
- Power steering cylinder
- Pitman, draglinks and other steering components

Electrical:
- Alternator
- Regulator
- Wiring
- Volt meters (dash and panels)
- Fuses and breakers
- Electrical distribution panels
- Flashers
- Head lights
- Running lights
- Dash lights and switches

Air Intake System
- Air filter changes
- Air intake gauge
- Air intake plumbing
- Clamps
- Hangers

Exhaust
- Turbo
- Turbo lube lines and leaks
- Turbo intake side and heat exchanger
- Turbo exhaust side and exhaust pipes
- Exhaust manifold and gaskets
- Exhaust pipes
- Muffler
- Tail pipe
- Exhaust pipe clamps
- Exhaust pipe hangers
- Exhaust shields
- Exhaust extraction adapter (Nederman)
- Exhaust extraction adapter (Plymovent)

Cooling System
- Type of coolant
- Coolant level
- Coolant strength
- Coolant PH level
- Radiator
- Rad shroud
- Rad mounts
- Rad fan
- Hoses and clamps
- Hose insulation
- Belts
- Shutters
- Pulleys and adjusters
- Thermostat
- Temperature gauges (dash and panel)
- Heaters
- Heater motors
- Heater controls
- Heat ducts and diffusers

Air Conditioning
- Compressor, sensors and switches
- Condenser and fans
- Air compressor performance

Transmission (Standard or Manual)
- Oil level
- Oil sampled
- Oil type
- Oil filter (external)
- Oil filter (internal)
- Oil temperature (dash and panel)
- Oil pressure (dash and panel)
- Pall indicator (red or green)
- Transmission performance
- Output retarder

- Starter ignition switch
- Compartment lights
- Door ajar lights
- Other electrical equipment
- Batteries
- Water level
- Post and terminal (connections and corrosion)

Batteries:

- Battery post and terminals
- Auxiliary battery for ECU and aerial platform
- Battery electrolyte level
- Master switch
- Cables and ground connections
- Midtronics testing
- Condition of battery case and battery box

Suspension (Rear) Type:

- Lubricate suspension
- Condition on suspension
- Condition of walking beams, struts and bushings
- Condition of rear shocks and mounts

Tires (Front):

- Tire wear and thread depth
- Tire air pressure
- Rim
- Wheel nuts
- Trim

Tires (Rear):

- Tire wear
- Tire air pressure
- Rims
- Wheel nuts
- Trim

Cab Body:

- Cab lift
- Cab and body frame and mounts
- Front and rear bumpers and rub rail
- Corrosion and damage
- Condition of paint
- Decals
- Cab and body doors, latches and seals
- Door handles, grab handles and window cranks and controls
- Window, wipers, washers (fluid)
- Mirrors, frame, mount, controller, heat elements, lights
- Seats, seat frame, suspension, SCBA bracket, upholstery
- Trim interior
- Floors and floor covering in cab and compartments
- Hose bed (floors and separators) condition
- Ground Ladder rack (condition and operation)
- Pike pole, axe and other equipment mounts and brackets
- Dash (lights, gauges, switches, labels)
- Interior cab and compartment lights and switches
- Head lights and running lights
- Heaters (cab and compartment)
- Air circulation fans
- Radio (communications)
- Emergency lights, sirens and controller
- Scene lights

Aerial Ladders:

- Hydraulic oil level
- Sample hydraulic oil
- Hydraulic oil tank condition
- Oil leaks
- Road to pump shift operation

Drive Line

- Lubricate
- U-joints
- Slip joints
- Hangers
- Drive line (park brake)

Differential

- Oil level and condition
- Drain plug magnetic (contaminates)
- Case condition
- Oil leaks
- Condition of differential

Front Axles Assembly

- Front wheel bearings, seals, adjustment and lubrication
- King pins and bushings

Rear Axle Assembly

- Rear bearings, seals, adjustment and lubrication

Brakes (Hydraulic)

- Brake pedal and master cylinder
- Fluid level
- Hydrovac
- Brake lines
- Brake wheel cylinders

Brakes (Air)

- Foot valve operation
- Air pressure gauges
- Air pressure drop on application
- Park brake (yellow knob) operation
- Park brake override (Green knob) operation
- Air lines, relay and quick release valve
- Brake pots and lines
- Brake performance (traveling)
- Brake performance (park on incline)
- Slack adjusters (type)
- Brake adjustment all wheels
- Brake pads/shoes condition
- Brake drums/rotors condition
- Overall condition of brakes, bushing, shafts, rollers, etc.

Pump

- Pump compartment (Check pump and compartment mounts)
- Compartment doors, latches
- Pump panel and decals
- Pump compartment heater and lights
- Winter pan
- Vacuum test (primer operation, check oil level)
- Leak test at hydrant pressure
- Pump packing (40 to 60 drops per minute)
- Operate and lubricate all valves
- Control panel, controls, gauges, lights, warning systems
- Intake relief valve
- Outlet relief valve
- Drain valves
- Deluge gun, lubricate and operation
- Hose reel

Transfer Case

- Pump shift (remote and manual)
- Oil (check for level, water and contamination)
- Trans case and pump operation

Water Tank

• Tank fill cap, breather vent and vent filter • Hydraulic oil filters • Hydraulic oil screen • Hydraulic oil leaks • Hydraulic hoses and lines • Hydraulic cylinders and holding valves • PTO and pump shift operation • Hydraulic control operation and ground positions • Outrigger and stabilizer condition and operation • Ground pads, mounting brackets and safety pins • Level indicators • Safety and limit switches • Turntable • Lubricate turntable • Check turntable condition of rotation motor and brake • Check condition of turntable bull gear, pinion and bearings • Base ladder platform safety rail and gates • Base ladder control panel, condition, gauges, and controls • Ladder safety decals and instructions • Ladder condition bedded, corrosion, dirt lubrication • Ladder bed and locks, check structure, bolts, mounts, pins • Ladder glides and/or rollers condition, lubrication • Ladder raise, extension and rotation function • Check ladder for straightness and/or deflection • Check base rail, hand rail, struts and supports for damage • Check ladder rungs, rung covers and braces for damage • Check ladder lock operation • Clean and lubricate ladder as required • Cables, pulleys, condition, lubrication • Waterway, check for wear, clean and lubricate • Platform condition and operation • Platform structure and operation • Platform structure, gates and heat shield, equipment brackets • Platform waterway, water curtain, valves and monitor • Platform control panel and operation • Platform communications • Platform breathing air supply cylinders • Airway valves, regulator and connections • Air supply line to platform • Air line connections in platform • Ladder way energy chain/cat track, lines and wires	• Water tank frame and mounts • Water tank condition (corrosion, leaks, etc.) • Water tank level gauge operation • Tank fill and tank drain valves, lines and insulation • Top tank fill towers and covers Foam Tank • Foam tank level gauges • Foam pump oil level and condition • Foam pump and educator operation • Foam flow lines, sensors and gauges Air Compressor • Oil level • Compressor valve, lines, gauges and operation • Compressed air foam pump operation Tools • Generator, engine oil level and condition • Generator operation • Generator condition and mounts • Positive pressure fan • Engine oil level and condition • Fan condition and mounts • Fan operation • Condition of all equipment mounting brakes • Condition of all valves and nozzles • Condition of all hand tools • Condition of rescue tools • Condition of chain and cut-off saws • Condition of all fire extinguishers • Condition of hose • Condition of tarps • Pike poles • Ground ladders • SCBA and mounting brackets • SCBA air bottles and mounting brackets • Thermal image camera • Vetter bags • Tech rescue tools • Water rescue equipment • Trench rescue equipment • Condition of defibulator and first aid equipment • List other tools and equipment carried and inspected

VEMA Preventive Maintenance

Vehicle Maintenance Checklist	**PM1** – services performed every 6,000kms or 6 month interval (whichever comes first)	Services performed at	
		PM2 – 18,000kms, 36,000kms, 72,000kms, 108,000kms, 126,000kms, 144,000kms, 162,000kms, etc.	**PM3** – 54,000kms **PM4** – 90,000kms
Change engine oil and oil filter, check for fluid leaks.	Y	Y	Y
Check clean (air) filter, replace if required.	Y	Y	Y
Visually inspect tires (including spare tire) Adjust tire pressure and re-torque wheel nuts to specification Check jack, jack handle and wheel wrench (proper location and operation)	Y	Y	Y
Visually check and lubricate all steering, suspension and driveline components	Y	Y	Y

Lubricate components equipped with grease fitting			
Check operation of all vehicle safety equipment, including: • Mirrors • Emergency lighting • Speedometer • Windshield wipers and washers • Vehicle lighting • Horn • Gauges • seatbelts	Y	Y	Y
Check exhaust – visual	Y	Y	Y
Check: • All belts • Coolant hoses • All fluid levels, check for leaks • Battery terminals, check battery fluid levels • Heater and AC controls	Y	Y	Y
Lube all door and hood locks, latches and hinges	Y	Y	Y
Check and service charging and starting system, check battery fluid levels Perform complete charging system and AVR check (record reading) Clean battery cases and terminals		Y	Y
Replace fuel filter (diesel engine only) per Manufacturer's recommendation		Y	Y
Inspect brakes (remove wheels)		Y	Y
Road test		Y	Y
Repack and adjust wheel bearings (if required)		Y	Y
Check all warranty related components (if applicable)			Y

WFMA Preventive Maintenance

Vehicle Maintenance Checklist	PM A – 5,000kms or 182 days	PM B – 15,000kms	PM C – 30,000kms	PM D – 60,000kms	PM E – 90,000kms	PM F – 105,000kms	PM W2 – 55,000kms or 1030 days
Change engine oil and oil filter, check for fluid leaks.	Y	Y	Y	Y	Y	Y	Y
Check air filter(s), replace if required.	Y	Y (Check restriction indicator if applicable)	Y	Y	Y	Y (Check restriction indicator if applicable)	Y
Check/replace cab/pollen filter			Y	Y	Y		
Replace fuel filter		Y	Y	Y	Y	Y	
Check brake lines and hoses		Y		Y		Y	
Replace both front and rear brakes		Y		Y		Y	
Change transmission fluid and filter			Y	Y	Y		
Replace rear differential fluid			Y	Y	Y		
Flush cooling system and replace coolant (OEM coolant and additives)			Y	Y	Y		
Replace both front and rear brakes			Y	Y	Y		
Clean and repack all wheel bearings			Y	Y	Y		
Visually inspect tires (including spare tire) and record tire pressures	Y	Y	Y	Y	Y	Y	Y
Rotate tires		Y		Y		Y	
Record tire thread depth of all tires including spare	Y	Y	Y	Y	Y	Y	Y
Re-torque all wheels	Y	Y	Y	Y	Y	Y	Y
Lubricate and check all steering, suspension, and driveline components	Y	Y	Y	Y	Y	Y	Y
Check operation of all vehicle safety equipment, including: • Mirrors • Emergency lighting • Speedometer • Windshield • Vehicle lighting • Horn • Gauges • seatbelts	Y	Y	Y	Y	Y	Y	Y

wipers and washers							
Visually inspect exhaust system	Y	Y	Y	Y	Y	Y	Y
Check: • All belts • Coolant hoses • All fluid levels, check for leaks • Battery terminals, check battery fluid levels • Heater and AC controls	Y	Y	Y	Y	Y	Y	Y
Lube all doors and hood locks, latches and hinges	Y	Y	Y	Y	Y	Y	Y
Check coolant condition and level and pressure test system	Y	Y	Y	Y	Y	Y	Y
Check coolant supplement additive concentration and adjust if necessary	Y	Y	Y	Y	Y	Y	Y
Check and service charging and starting system: • Clean battery cases and terminals • Load test batteries and record • Perform starter draw test and record • Perform complete charging and AVR check • Perform charging output test and record		Y	Y	Y	Y	Y	
Check operation of vehicle back-up alarm	Y	Y	Y	Y	Y	Y	Y
Scan fuel management computer for codes			Y	Y	Y		
Road test vehicle and check front end alignment		Y	Y	Y	Y	Y	
Check operation of transfer case/hub (if applicable)		Y		Y		Y	
Change PTO/Transfer case/Gear box fluid (if applicable)			Y	Y	Y		
Start diesel re-gen (if applicable)		Y		Y		Y	
Check urea/DEF tank/fill (if applicable)		Y		Y		Y	
Replace belts/serpentine if original				Y			
Replace tires if original					Y		
Road test check, comprehensive and report					Y		Y
Transmission: Replace Fluid/Service filter/screen					Y		
Replace Oil rear Diff and Inspect/Front diff (if applicable					Y		
Pressure test cooling system, flush, replace coolant						Y	
Tune-up (if applicable)						Y	

Dwelling Protection Grade Summary of Basic Requirements per Fire Station[i]

DWELLING PROTECTION GRADE	WATER WORKS SYSTEM	FIRE DEPARTMENT		CORRELATION WITH PFPC[ii] Public Fire Protection Classification
		EQUIPMENT	FIREFIGHTERS[iii]	
1	Water supply system designed in accordance with Fire Underwriters Survey standard "Water Supply for Public Fire Protection" with a relative classification of 5 or better	Response from within 8 km by road of a triple combination pumper	Minimum Response: - On-duty: 3 career fire fighters, plus - Off-duty: fire chief or other officer	Water Supply and Fire Department must grade PFPC Relative Class 5 or better
2	Water supply system designed in accordance with Fire Underwriters Survey standard "Water Supply for Public Fire Protection" with a relative classification of 6 or better	Response from within 8 km by road of a triple combination pumper	Minimum Response: - On-duty: 1 career fire fighters, plus - On-call: 15 auxiliary fire fighters	Water Supply and Fire Department must grade PFPC Relative Class 6 or better
3A	Water supply system designed in accordance with, and meeting the minimum requirements of, Fire Underwriters Survey standard "Water Supply for Public Fire Protection"	Response from within 8 km by road of a triple combination pumper	15 auxiliary fire fighters	No Public Fire Protection Classification required
3B	Not required – however fire department must have adequate equipment, training and access to approved water supplies to deliver standard shuttle service in accordance with NFPA 1142, Standard on Water Supplies for Suburban and Rural Fire Fighting	2 units required. Triple combination pumper plus a mobile water supply with a combined water carrying capacity of not less than 6,820 L (1,500 IG)	15 auxiliary fire fighters	No Public Fire Protection Classification required
4[3]	Not required – however fire department must have adequate equipment, training and access to approved water supplies to deliver shuttle service in accordance with NFPA 1142, Standard on Water Supplies for Suburban and Rural Fire Fighting	2 units required. Triple combination pumper plus a mobile water supply with a combined water carrying capacity of not less than 6,820 L (1,500 IG)	15 auxiliary fire fighters	No Public Fire Protection Classification required
5	Unprotected communities or communities not qualifying for Grades 1, 2, 3A, 3B, or 4 above	Unprotected communities or communities not qualifying for Grades 1, 2, 3A, 3B, or 4 above	Unprotected communities or communities not qualifying for Grades 1, 2, 3A, 3B, or 4 above	No Public Fire Protection Classification required

[i] Refer to additional notes and requirements for interpretation

[ii] The P.F.P.C. is a sophisticated municipal fire protection grading system utilized for Commercial Lines insurance. PFPC fire insurance grades are scaled from 1 to 10. One (1) represents a high level of fire protection and 10 indicates little or no recognized fire protection. This system evaluates the ability of a community's fire defences to prevent and control major fires that may occur in commercial, industrial and institutional buildings and/or districts.

[iii] Requirements for Dwelling Protection Grade 4 are the same as for Dwelling Protection Grade 3B, however in some cases, an allowance may be considered for Dwelling Protection Grade 4 where all of the criteria for Dwelling Protection Grade 3B have been met with one exception. If more than one criteria has not been met (ex. less than 15 auxiliary fire fighters and a single pumper apparatus) Dwelling Protection Grade 5 is applied.

Where Dwelling Protection Grade 4 is applied, a signed letter of intent from the community is to be sent to Fire Underwriters Survey indicating that improvements will be made, within an agreed timeframe, to meet the criteria of Dwelling Protection Grade 3B.

It is important to note that the absolute minimum number of auxiliary fire fighters considered within the fire insurance grading is 10 and that maximum age of apparatus that can be considered is 30.

Running head: EVALUATING TRAFFIC PREEMPTION SYSTEMS FOR THE SAN

Evaluating Traffic Preemption Systems for the San Marcos Fire Department

Les Stephens

San Marcos Fire Department, San Marcos Texas

December 2010

CERTIFICATION STATEMENT

I hereby certify that this paper constitutes my own product, that where the language of others is set forth, quotation marks so indicate, and that appropriate credit is given where I have used the language, ideas, expressions, or writings of another.

Signed: _____

Abstract

The problem was that a proposal by the San Marcos Transportation Division Manager and the Fire Chief to implement traffic signal preemption failed to gain enough city council support for implementation. Despite having funds budgeted, city council members feared that the system was too expensive to be justified to their constituents. This evaluative research project compares three different brands and technologies of traffic preemption systems including Tomar IR, Opticom IR, and Opticom GPS, to determine which would best serve the needs of the citizens and firefighters of San Marcos, Texas. Statistical data obtained through the research demonstrates the benefits of the system and justifies the cost to citizens. Included are research questions, a literature review, an on-line questionnaire, and personal communications. Results illustrate that almost all current users of traffic preemption systems have seen improvements in responder safety and decreased response times and would recommend their current system to other fire departments considering traffic preemption. The recommendation was to move forward with a second presentation to the city council seeking approval for the installation of an Opticom GPS system along the most common emergency response corridors.

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APPENDICIES

Evaluating Traffic Preemption Systems for the San Marcos Fire Department

The fire department is of no value if we never arrive at the emergency. Regardless of our equipment, staff, training, motivation or capability to perform the various components of the job, if we never arrive at the emergency, we are absolutely useless to the person needing our services. There are emergencies where response time is almost as important as whether or not we arrive at all. Statistics show that how fast emergency responders arrive at calls involving heart attacks and structure fires has a direct correlation to the outcome. According to the American Heart Association, “Brain death and permanent death start to occur in just 4 to 6 minutes after someone experiences cardiac arrest” (American Heart Association, Inc., 2010, p. 1). Additionally, average fires double in size every minute and ultra-fast developing fires can double in size in as little as 15 seconds (3D Firefighting, 2007).

City and Fire Department administration have an obligation to the citizens to provide both effective and efficient fire protection and emergency medical services (EMS). It is our responsibility to stay abreast of best practices, trends, and technologies that improve the quality of service we deliver to our customers. The problem is that a proposal by San Marcos Fire Department (SMFD) Administration and the City's Transportation Division to implement a traffic preemption system (TPS) was rejected by the City Council in June of 2010. The City Manager and Fire Chief, both familiar with the benefits of TPS technology from their experience working in other Texas cities, believe the city of San Marcos would benefit from the implementation of a TPS. However, the Mayor and City Council were not as familiar with the system and its benefits and therefore did not believe the cost of the system could be justified to constituents.

The purpose of this applied research project is to identify and compare TPS systems to determine their effectiveness at reducing response times. Evaluative methodology will be used to compare the different brands and technologies of available TPS to determine which would be the best alternative for the City of San Marcos. The research questions are: What, if any, are the national, state, and local standards for fire department response times to emergency incidents? What are the different makes and models of traffic preemption systems? What are the traffic preemption system models used by other comparable emergency services departments and how do they compare in reducing response time? What, if any, traffic preemption system models do the stakeholders of San Marcos feel would best reduce the response times for the San Marcos Fire Department?

The U.S. Department of Transportation's, *Traffic Signal Preemption for Emergency Vehicles, A Cross-Cutting Study* advises that "a champion, be it an individual or an organization, is often key to success." The passage goes on to explain that in all three cities it examined for the study, "the preemption initiative progressed when one person or one group of people provided leadership and sponsorship of the effort" (U.S. Department of Transportation, 2006, pp. 1-2).

Background and Significance

Responding to and returning from alarms has consistently been the 2nd most common cause of firefighter fatalities annually. In his book *Safety and Survival on the Fire Ground*, Vincent Dunn explaines that "Highway/roadway intersections are extremely dangerous places for responding firefighters and civilian motorists alike." He goes on to say that "the intersection accident has proven to be the most deadly to all concerned" (Dunn, 1992). In 13 years, from 1997 to 2009, an average of 21.9 firefighters died each year in vehicle collisions. In 2009, that number decreased to 16, down from 28 in 2008 (U.S. Fire Administration, 2010). "Every year

there are a number of intersection accidents in which response vehicles are wrecked and personnel are injured or killed" (Blades, 1993, p. 8).

In February, 1996, the City of San Marcos adopted a City Master Plan that set forth the following policy: "Policy CF-2.3: The City shall locate fire stations such that all development within the city falls within a 1.5-mile radius or a three-minute response time distance, whichever is greater, from at least one fire station" (City of San Marcos, Planning and Development Services Department, 1996). In the 14 years since the City Master Plan was first adopted, only minimal progress has been made toward achieving that goal. Although two additional stations have been added, Station 4 in 2001 and Station 5 in 2010, 44.26 % of the incorporated city still falls outside the 1.5-mile buffer zone of all five fire stations (Appendix A). The average response time for the eight year period from 2000 to 2008, is 5.26 minutes (San Marcos Fire Department, 2008). This is 1.75 times higher than the desired response time average called for in the city's Master Plan.

The San Marcos Fire Department (SMFD) responded to 2,722 calls for service in 2009 (San Marcos Fire Department, 2009). The Department, which is comprised of 64 members, provides primary fire and first responder EMS protection to the 32.1-square mile incorporated city limits from 5 fire stations. The SMFD has set a goal of having a fire apparatus on scene within 5-minutes on 90% of our calls. The department achieved that goal only 56% of the time in 2009 and had an average response time for all calls of 5.45 minutes (San Marcos Fire Department, 2009).

San Marcos is centrally located between two major metropolitan cities including Austin, located 26 miles to the north, and San Antonio, located 45 miles to the south. In 2000, the City of San Marcos had a residential population of 34,733 (U.S. Census Bureau, 2001). Census

projections show the population may grow by as much as 53% to 53,205 in 2010 (U.S. Census Bureau, 2000). It is also home to Texas State University which is the 5th largest public university in the state" (San Marcos Economic Development Corporation, 2008). The university recorded its highest enrollment ever in Fall, 2010, of 32,586 students (San Marcos Daily Record, 2010, pp. 1-2). Additionally, San Marcos boasts the 4th most popular tourist destination in Texas. Premium (formerly Prime Outlet Mall) and Tanger Outlet Malls attract an estimated 10+ million tourists annually and accounted for most of the city's nearly $1 billion in gross retail sales in 2008 (San Marcos Economic Development Corporation, 2008).

A thoroughfare system that, in many cases is at or above capacity, is compounded by both a rapidly growing residential population as well as young inexperienced drivers that comprise the ever-changing student body of a major state university. This makes emergency response of fire department apparatus unnecessarily dangerous and excessively lengthy. To date, SMFD has not experienced a significant intersection accident involving a major fire apparatus while responding to an emergency. However, as both the city and university continue to experience explosive growth, the department call volumes will continue to increase causing the thoroughfare system to become even more crowded. This increases the odds of such an accident. All options to reduce risks to our citizens and firefighters while maintaining acceptable response times must be explored.

In addition to being a reference for other chief officers and departments who are investigating the benefits of traffic signal preemption, this Applied Research Project (ARP), which will be available through the National Fire Academy's (NFA) Learning Resource Center (LRC) and, will serve to better educate the San Marcos City Council so they can make a more informed decision regarding the need for traffic preemption in San Marcos. The ARP "relates to

and supports" the U.S. Fire Administration (USFA) strategic goal to "reduce risk at the local level through prevention and mitigation" (U.S. Fire Administration, 2010, pp. II-2).

This research correlates with the second of four courses that make up the NFA's Executive Fire Officer Program. By completing this research project and seeking City Council approval to implement a traffic preemption system within the city of San Marcos, the researcher has used knowledge gained from the Executive Analysis of Community Risk Reduction course (R-274) to create a safer environment for both the firefighters and citizens of San Marcos.

Literature Review

Although the State of Texas and the Texas Commission on Fire Protection no longer have standards for fire department response times to emergency incidents, there appear to have been applicable state standards in place at one time. Based on the review of a technical investigation report prepared for the City of San Marcos by consulting engineers Freese and Nichols, Inc., state criteria for adequate fire protection requires "a fire station's service area to have no more than a 1.5 mile radius…and…the response time should be no more than three minutes to anywhere in industrial, commercial, institutional, multi-family residential, or other high-value areas" (Freese and Nichols, Inc., 1980, p. 10). Additionally, it should require no more than 5 minutes to anywhere in single family residential areas (Freese and Nichols, Inc., 1980, p. 10). It is important to note that the above-referenced report was commissioned to assist the city with lowering its insurance Key Rate, a system that has since been replaced nationwide by the Insurance Services Office (ISO) rating system.

Although no current member of SMFD claims to know for certain, it is suspected that the city was referencing the above document when, in February of 1996, the City of San Marcos adopted a City Master Plan that set forth Policy CF-2.3. This policy states, "The City shall

locate fire stations such that all development within the city falls within a 1.5-mile radius or a three-minute response time distance, whichever is greater, from at least one fire station" (City of San Marcos, Planning and Development Services Department, 1996). At the time research was being conducted for this paper, no action had been taken to repeal Policy CF-2.3.

In 2005, the City of San Marcos solicited a report from Mike Pietsch, P.E. Civil Engineer, concerning the City's ISO Public Protection Classification. The report goes into great detail and offers numerous suggestions relating to apparatus, equipment, water supply, staffing, and future station locations. These are based on projected growth; however, it does not contain any discussion or recommendations regarding response times to emergency incidents (Pietsch W. , 2005).

The National Fire Protection Association (NFPA) and the city of San Marcos have both established guidelines regarding response time criteria for fire department emergency response. The Texas Commission on Fire Protection (TCFP), the state agency that oversees training and certification standards for all career fire departments in the State of Texas, has formally adopted seven NFPA Standards (Texas Commission on Fire Protection, 2010):

- NFPA 1971, 2007 Edition. *Standard on Protective Ensembles for Structural Fire Fighting and Proximity Fire Fighting*. Effective date August 17, 2006.
- NFPA 1851, 2008 Edition. *Standard on Selection, Care, and Maintenance of Protective Ensembles for Structural Fire Fighting and Proximity Fire Fighting*. Effective date: June 24, 2007.
- NFPA 1981, 2007 Edition. *Standard on Open-Circuit Self-Contained Breathing Apparatus (SCBA) for Emergency Services*. Effective date December 20, 2006.

- NFPA 1852, 2008 Edition, *Standard on Selection, Care, and Maintenance of Open-Circuit Self-Contained Breathing Apparatus (SCBA).* Effective date December 31, 2007.
- NFPA 1982, 2007 Edition. *Standard on Personal Alert Safety Systems (PASS).* Effective date December 1, 2006.
- NFPA 1989, 2008 Edition. *Standard on Breathing Air Quality for Emergency Services Respiratory Protection*. Effective date December 31, 2007.
- NFPA 1561, 2008 Edition. *Standard on Emergency Services Incident Management System*. Effective date December 31, 2007.

Even though the TCFP has only formally adopted certain NFPA Standards, career departments throughout the state endeavor to comply with most, if not all, of them. NFPA Standard 1710: *Standard for the Organization and Deployment of Fire Suppression Operations, Emergency Medical Operations, and Special Operations to the Public by Career Fire Departments* is the standard that sets forth performance objectives regarding fire department organization and service delivery objectives. Chapter 4, Organization, section 4.1.2 specifies "The fire department organizational statement shall provide service delivery objectives, including specific time objectives for each major service component… and objectives for the percentage of responses that meet the time objectives" (National Fire Protection Association, 2010 Edition, pp. 1710-7).

For emergency responses to a fire suppression incident, NFPA 1710 section 4.1.2.1 (3) allows 240 seconds for the arrival of the first engine company and 480 seconds for the arrival of the initial full alarm assignment. For emergency medical incidents, section 4.1.2.1 (4) allows 240 seconds for the arrival of a "first responder unit with automatic external defibrillator or higher

level capability" (National Fire Protection Association, 2010 Edition, pp. 1710-7). These response times are in addition to time allowed for alarm answering time, alarm processing time, and turnout time.

NFPA 1710 section 4.1.2.1 allows "80 seconds for turnout time for fire and special operations response and 60 seconds turnout time for EMS response" (National Fire Protection Association, 2010 Edition). It sets a "performance objective of having an alarm answering time of not more than 15 seconds for at least 95 percent of the alarms received and not more than 40 seconds for at least 99 percent of the alarms received, as specified by NFPA 1221" (National Fire Protection Association, 2010 Edition). The standard further specifies "the department shall establish a performance objective of having an alarm processing time of not more than 60 seconds for at least 90 percent of the alarms and not more than 90 seconds for at least 99 percent of the alarms, as specified by NFPA 1221" (National Fire Protection Association, 2010 Edition).

TPS are relatively simple systems. In his article *Emergency Vehicle Preemption*, J. P. Maczko describes their operation. "A request is made through a transmitter device installed in the fire station, or more commonly, on the emergency vehicle. The information is received through a receiver at a traffic signal control cabinet (there is one of these at every intersection) to indicate there is a vehicle coming from a certain direction. The traffic signal controller then implements a plan to provide a green light as quickly as possible in the direction of travel" (Maczko, 1999, pp. 10-11).

In his article, *Traffic Light Pre-Emption Devices*, Kevin Blades explains, "Traffic light pre-emption devices "pre-empt" or take control of a traffic light system allowing the emergency vehicle to proceed through an intersection with a green light instead of having to run a red light." He continues, "It clears traffic ahead of the response vehicle out of the intersection, it gives

traffic going transversely to the response vehicle a red light" (Blades, 1993, p. 8). An added benefit to this technology is that vehicles traveling in the same direction as the emergency vehicle are given a green light so they can safely proceed through the intersection, thus clearing the lane for the emergency vehicle. Several seconds later, the traffic signal controller recognizes that it is no longer receiving a signal to preempt the light, and it will return the intersection to its normal programmed operation.

Maczko cites several reasons fire and emergency service leaders are turning to devices like TSP "to help improve the safety of the emergency responder and the motoring public as well as improved response times to the people that are requesting service" (Maczko, 1999, pp. 10-11). Better insulated vehicles, a motoring public which has become preoccupied with everything from newspapers to cell phones, have rendered our sirens "less effective as a warning device" (Maczko, 1999, pp. 10-11).

According to Blades, there are basically two types of TPS available today: a land-based, dispatch controlled system or the vehicular mounted systems. The vehicle mounted systems are typically one of four types, radio frequency, acoustical, optical, and GPS, with optical being the most common (Olson, 2008). For the purpose of this paper, the researcher has chosen to limit the scope of the comparison to two competing brands of vehicle mounted systems Opticom and Tomar. This is done primarily for one reason. SMFD has worked closely with the Transportation Division manager on this project and the system we recommend must be compatible with their existing traffic signal control hardware. This research project would be nonproductive if the recommendation was to purchase from a manufacturer whose equipment was not deemed reliable or wasn't compatible with existing infrastructure.

Opticom and Tomar both offer an infrared (IR) system. Both are reputable companies with proven track records. According to their product literature, Tomar Electronics, located in Gilbert, AZ., has been "engineering, designing and manufacturing the highest quality, most reliable and extremely efficient audible and visual warning signals" for over 30 years (Tomar Electronics, Inc., 2010). Opticom, who claims to have started "a revolution in traffic management and safety", has been in business for over 35 years (Global Traffic Technologies, 2007 a).

According to Tomar's information and marketing packet, the three main components of Tomar's Strobecom II TPS are the optical preemption detectors (OPD), optical preemption emitters (OPE), and optical signal processor (OSP) cards. Tomar's 209X-SD and ST model detectors "sense the pulses emitted by properly equipped emergency vehicles" (Tomar Electronics, Inc., 2010). The devices are mounted at each intersection in such a manner as to receive the optical signal from the preemption emitters mounted on emergency apparatus. The emitter is a Xenon strobe light which can be mounted directly to the vehicle or incorporated into one of Tomar's light bars. The emitters can be installed so they shut off when the vehicle is in park or neutral gear. This prevents the device from locking up an intersection unintentionally once the emergency vehicle has arrived on-scene. The OSP receives the signal from the detectors, it validates the signal to determine that it is coming from an emergency vehicle requesting signal preemption, and once a "vehicle's signal is accepted as valid, the OSP sends a preemption request to the proper input of the traffic controller" (Tomar Electronics, Inc., 2010).

Tomar warranties most of its products for defects in materials and workmanship for 2 years with the exception of the Xenon strobe lamps which are warrantied for only 1 year. Texas

Buy Board pricing for the Tomar system, which was provided by Darold Cherry, President and CEO of Texas Highway Products, LTD, is as follows:

Table 1: Strobecom intersection pricing on buy board

	3140	3080	
1-Direction	$2,044.54	$1,493.80	Includes One 2091-ST Detector, One One-Channel OSP Card, One 1881 Card Cage, One Detector Mount, 500' Detector Cable
2-Direction	$2,675.20	$2,177.66	Includes Two 2091-ST Detectors, One Two-Channel OSP Card, One 1881 Card Cage, Two Detector Mounts, 500'Detector Cable
3-Direction	3,636.82	$3,245.22	Includes Three 2091-ST Detectors, One Three-Channel OSP Card, One 1881 Card Cage, Three Detector Mounts, 1000' Detector Cable
4-Direction	$4,293.08	$3,947.39	Includes Four 2091-ST Detectors, One Four-Channel OSP Card, One 1881 Card Cage, Four Detector Mounts, 1000' Detector Cable.
3140-SOFT	$71.22		3140 OSP Card Software
EMIT#-14	$629.85		Self-Contained Emitter
Labor	$1000.00		Labor and Installation/ Per Intersection

The Opticom IR system operates in much the same manner as the Tomar and uses basically the same three components including detectors, emitters and phase selectors. "Using coded IR transmitters mounted on your emergency vehicles, the Opticom IR system communicates securely with the intersection traffic controller to gain temporary right of way. The system has been proven effective in thousands of installations all over the world, thereby helping to elevate, protect, and minimize traffic disruptions, accelerate response times, improve service reliability, reduce crashes and save lives" (Global Traffic Technologies, 2007 b). Features available with the Opticom IR system include vehicle identification with time stamp and activity log, preemption logs individualized by vehicle for liability identification and diagnostic capability, compatibility with most traffic controllers with internal preemption and priority, first-come first served authorization, priority differentiation (emergency vehicles vs.

mass transit vehicles), confirmation of authorization, time of preemption and priority, direction, duration, and vehicle passage for up to 1,000 events (Global Traffic Technologies, 2007 b).

Global Traffic Technologies (GTT), the vendor for Opticom products in our region, offers a warranty for the benefit of the original end user on all Opticom IR equipment it sells. Specifically, "GTT's Exclusive Limited Warranty shall cover its Opticom Infrared System for a period of 10 years from the date of shipment by GTT. After the initial 5 year period, a fixed repair charge will apply for any component returned for repair. In the case of Emitters, a fixed repair charge will apply through the end of the Warranty Period either after the initial 5 year period or after the first three hundred million emitter flash counts, whichever occurs first" (Global Traffic Technologies, 2007 c). Jim MacKay, System Consultant, for GTT, supplied pricing for Opticom IR products (Appendix B):

Table 2: Opticom IR intersection pricing on Houston Galveston Area Co-Op

Quantity	Description	Unit. Price	Total
42	Model 380 Card Rack	$175.00	$7,350.00
168	Model 721 Opticom Detector	$456.50	$76,692.00
168	Narrow Mounting Hub	$20.00	$3,360.00
42	Model 754 Phase Selector	$2,751.00	$115,542
42	1000' Roll Model 138 Cable	$410.00	$17,220.00
336	Intersection installation hours	$150.00	$50,400.00
22	Model 795 Opticom Emitter	$995.00	$21,890.00
22	Emitter Installation	$500.00	$11,000.00
		Total	$303,454.00

As research progressed and more was learned about the installation and operation of IR traffic preemption systems, two issues were identified. The first issue relates to the installation of an IR system on existing traffic signals. Each signal light must be equipped with its own IR receiver for each direction of traffic you desire to control. This results in additional labor costs for installation and also requires that sufficient space exist within the various conduits to run the required cable. The second issue relates to the ongoing operation, or more specifically,

maintenance of the receivers. Because the receivers are mounted externally on traffic signal control arms, they are subject to the effects of weather. They can become misaligned due to wind and/or dirty, either requiring physical realignment of cleaning of the receiver.

Opticom offers a second type of TPS. Opticom's GPS system vehicle equipment brochure describes the operation of the system this way:

> Opticom GPS system vehicle equipment is mounted on the priority vehicle. Its GPS receiver obtains information from the constellation of global positioning satellites. This information is used to compute the location, speed, and heading of the vehicle. This information along with a priority request and the state of the vehicle's turn signal is broadcast using the 2.4 GHz spread spectrum transceiver.
>
> Opticom GPS system intersection equipment receives the radio transmission from the vehicle equipment. The intersection equipment then compares the information being received from the vehicle with the parameters stored in the intersection equipment's memory. If the vehicle is heading toward the intersection in a predefined approach corridor, is requesting preemption or priority and has met all other programmed parameters, the corresponding phase selector output is activated. This output is connected to the traffic controller. When activated, the controller cycles to grant a green light to the requesting vehicle or holds the green, allowing the vehicle to pass through the intersection" (Global Traffic Technologies, 2007 a, p. 1)

A GPS-based TPS offers numerous benefits: (a) reduced cost of installation because only one receiver is required per intersection no matter how many directions of travel are to be

preempted, (b) not as much conduit space is required because the system uses radio frequency to transmit signals rather than being hard-wired, and (c) reduced maintenance because the equipment is contained with the traffic signal cabinet and not subject to the elements.

Pricing for the Opticom GPS system (Appendix C):

Table 3: Opticom GPS intersection pricing on Houston Galveston Area Co-Op

Quantity	Description	Unit. Price	Total
42	GPS Phase Selector Model 1000	$2,096.00	$88,032.00
42	GPS Radio Unit Mast Arm Mount Model 1010	$2,144.00	$90,048.00
42	GPA Auxiliary Interface Panel Kit Model 1030	$240.00	$10,080.00
42	GPS Card Rack with Power Supply Kit	$340.00	$14,280.00
2	GPS Installation Cable 2500 ft. Spool	$1,350.00	$2,700.00
1	GPS Installation Cable 500 ft. Spool	$270.00	$270.00
1	Opticom GPS ITS Explorer Software Kit	$800.00	$800.00
22	GPS Vehicle Preemption Kit - High Priority	$2,400.00	$52,800.00
180	Intersection Installation	$150.00	$27,000.00
110	Vehicle Installation	$150.00	$16,500.00
		Total	$302,510.00

TPS are not new. The City of St. Paul, Minnesota, Fire and Safety Department began using the Opticom IR TPS in 1969. In a study spanning more than fifteen years from 1962-1976, they found that accidents involving emergency vehicles at intersections had declined by more than 70 after the system was installed. “This occurred despite increases in population, emergency runs (up 450%), and intersections (up 38%)” (Dick, 1981, p. 40). In 1977, the Denver Fire Department conducted a six-month study where it compared response times for two 90-day periods along the same response corridors. The study included 3 fire stations and 75 signalized intersections along the routes most commonly used by firefighters responding to a call. Their signals were controlled by the Opticom IR system. The study found a consistent reduction in response times “from a minimum of 14.3 percent to a maximum of 23.5 percent” and noticed “runs including the most traffic signals experienced the most improvement in response times”

(Wise, 1980, p. 77). The City of Jacksonville Fire Department also cited a 12-25% decrease in response times after installing the Opticom IR TPS (Dick, 1981).

The most comprehensive study of TSP was conducted by the U.S. Department of Transportation in 2006. *Traffic Signal Preemption for Emergency Vehicles; A Cross-Cutting Study*, focused predominantly on TPS in Fairfax County, Virginia; Plano, Texas; and St. Paul, Minnesota. The report details success achieved through traffic preemption in all three jurisdictions. In Plano, emergency vehicle accidents were reduced from an average of 2.3 per year to less than one every five years. In Fairfax, TPS have allowed emergency vehicles to pass more quickly through high-volume intersections, saving 30 to 45 seconds per intersection. In St. Paul, "crash rates per emergency vehicle responses were dramatically reduced in the years following deployment" (U.S. Department of Transportation, 2006, pp. 1-1).

Even though this ARP focuses primarily on evaluating the Opticom, Tomar IR and Opticom GPS types of TPS, there are other less prevalent systems available. There are systems that utilize digitally coded radio signals and others that recognize emergency vehicle sirens. What is most important is that the purchaser consider all options and select a system that will work for the specific application. In his article, *Traffic Light Pre-emption Devices*, Kevin Blades explains that, "the important thing to remember is that a pre-emption device of any make or manufacturer is there to serve two main purposes; prevent accidents, thereby protecting responders, and to increase response times" (Blades, 1993, p. 12).

Procedures

Evaluative research was selected for this project because it afforded the researcher the opportunity to further investigate and compare different brands and models of TPS. As indicated earlier, the purpose of this applied research project is to identify and compare TPS systems to

determine their effectiveness at reducing response times. The knowledge and information gained from this research will be utilized to prepare a second presentation for the San Marcos City Council seeking authorization to purchase and install a TPS along the most commonly traveled corridors of the city. Initial research for this project began in late 2009 when the city manager approved a budget of $287,500 in Capital Improvement Program funds to purchase a TPS. Further research began in earnest in June, 2010, after the San Marcos City Council voted 6-1 against a proposal made by the Transportation Division and San Marcos Fire Chief to purchase and implement a traffic preemption system because, based on their understanding of the system, they felt the cost would be hard to justify to their constituents.

In July, 2010 ,a request was made to the city's Risk Management Director, Cindy Conyers, for any statistics on accidents involving San Marcos fire apparatus or police vehicles at intersections while responding code 3. Fortunately, there were no such documented accidents within the previous ten years. At that time, Conyers sent an e-mail to the Texas Municipal League (TML) requesting information on accident statistics, cost of emergency vehicle accidents and the pros and cons of TPS. A reply was received from Carlos Carrillo, TML's Senior Loss Prevention Representative on August 27, 2010. The e-mail explained that TML did not track the requested accident data and referred her to other cities or TPS sales representatives (Appendix D).

On October 10, 2010, searches of the Learning Resource Center's on-line card catalog identified a total of 33 items of interest. These included ARP's, articles in periodicals, and one DVD. The ARPs that were available in PDF format were downloaded. The periodicals, ARPs, and the DVD, which were available only by interlibrary loan, were requested through the San Marcos Public Library. The articles were read and the ARPs reviewed for pertinent information.

The DVD was viewed and confirmed to be a digital version of a report previously downloaded from the internet.

A search of the San Marcos Public Library's card catalog was unsuccessful at yielding any additional sources for the literature review. Primarily, books from the department and researcher's libraries were reviewed. Although information was found regarding accident and injury data, no pertinent information on TPS was found. As each section of the ARP was completed, it was forwarded to Stacey Minor, a graduate student at, Texas State University, for both formatting and grammatical editing.

The literature review was successful at answering the first research question of what, if any, are the national, state, and local standards for fire department response times to emergency incidents? The San Marcos Fire Department's annual membership to the National Fire Protection Association was utilized to access and download the most current copy of NFPA 1710 which is cited herein. The Texas Commission on Fire Protection website was reviewed and no state standards were found. A review of the department's annual reports, the ISO consultant's report, the department's Strategic Master Plan, and the City of San Marcos' Master Plan were also conducted. These revealed the local requirements which are also cited herein.

The literature review also successfully answered the second research question, this being what are the different makes and models of traffic preemption systems? Phone calls and e-mails were sent to representatives from both Tomar and Opticom requesting additional product literature and any didactic information supporting their claims that TPS reduce response times and improve responder safety. Most of the articles suggested were previously located elsewhere.

To answer the fourth research question of what, if any, traffic preemption system model would best serve the city of San Marcos, by reducing the response times for the San Marcos Fire

Department, a follow-up meeting of all the stakeholders was held. On October 6, 2010, following a presentation by GTT regarding additional financing options available to the city, several department directors and managers discussed the various options. Those in attendance included Sabas Avila, the Transportation Division Manager, Tom Taggert, Director of Public Services, Police Chief Howard Williams, both Fire Department Assistant Chiefs Len Nored and Karl Kuhlman, and Fire Chief Les Stephens. All parties in attendance at this meeting were in unanimous agreement that Opticom GPS should be recommended for City Council approval.

A questionnaire was utilized to answer the third research question, specifically, what are the traffic preemption systems models used by other departments and how do they compare in response time reduction. On November 14, 2010, the questionnaire was created using Survey Monkey.com (Appendix E). On November 28, 2010, an e-mail was sent to representatives of sixty-six Texas fire departments asking them to complete the on-line questionnaire (Appendix F).

On December 27, 2010 the questionnaire results were downloaded (Appendix G). From the sample group of 66, a response rate of 53% was obtained from 35 responses. Even though the response level was marginal, the information collected was very compelling.

Results

The questionnaire was comprised of eight questions with four of these being forced choice and four being essay. Respondents were asked which department they represented and the approximate population served by their department to determine whether a geographical location or population served influenced whether or not a department utilized TPS. From this, no obvious correlation was noted. Responses to the survey, although not overwhelming in volume, were clear, consistent, and easy to understand. All survey responses have been compiled, including

responses to the essay questions and are included as Appendix H. Table 4 shows a breakdown of the responses by department to several of the questions.

Table 4: Traffic Preemption Questionnaire Results by Department

City	Population	Currently use TPS	Brand	Recommend	Reduce Response Times	Issues
Mesquite	139,700	Yes	Opticom IR	Yes	Yes	None
Denton	120,000	Yes	Opticom IR	Yes	Yes	None
Cedar Park		No				
Plano	267,000	Yes	Opticom IR	Yes	Yes	None
Ft. Worth	>700,000	Yes	Opticom IR	Yes	Yes	None
Sequin	26,000	No				
The Colony	52,000	Yes	Opticom IR	Yes	Yes	Old equipment and maintenance
Colleyville	24,000	Yes	Opticom IR	Yes	Yes	None
Decatur	15,000	No				
Longview	75,000	No				
Highland Village	17,000	Yes	Opticom IR	Yes	Yes	No
Travis County ESD #11	30,000	No				
Lake Travis	73,000	Yes	Opticom GPS	Yes	Yes	See #8 below
City of Alice		No				
Leander	35,000	Yes	Opticom GPS and Tomar IR	Yes	No	See #8 below
Gainesville	19,000	No				
College Station	94,000	Yes	Opticom IR	Yes	Yes	See #8 below
Little Elm	27,000	Yes	Opticom IR	Yes	Yes	None
Round Rock	100,000	Yes	Opticom IR	Yes	Yes	None

Rockwall	35,000	Yes	Opticom IR	Yes	Yes	See #8 below
Buda	27,000	No				
Midland	130,000	Yes	Opticom IR	Yes	Yes	None
Lewisville	95,000	Yes	Opticom IR and Tomar IR	Yes	Yes	None
Lockhart	14,000	No				
Dallas	1.3 million	No				
Trophy Club	9,000	Yes	Opticom IR	Yes	Yes	None
New Braunfels	60,000	No				
Georgetown	70,000	No				
Kyle	40,000	No				
Addison	15,000	Yes	Opticom IR	Yes	Yes	See # 8 Below
University Park	25,000	Yes	Opticom IR	Yes	Yes	None
Coppell	39,500	Yes	Opticom IR	Yes	Yes	None

Responses indicated that 22 of the 33 responding departments, or 62.9%, currently utilize some type of TPS. Of those, 86.4% use Opticom IR, 13.6% use Opticom GPS, and 9.1% use Tomar IR. The totals above are skewed slightly because three departments, Lewisville, Leander, and Lake Travis, are currently using two different systems. Lewisville is transitioning from Opticom IR to Tomar IR primarily due to cost. Leander is transitioning from Tomar IR to Opticom GPS. The three reasons they give for the change are: a) newer technology, b) unsightly sensors on the lights, and c) Opticom GPS does not hinder the use of different lighting packages. The third department that is currently using two systems is Lake Travis. They have been using Opticom IR and are transitioning to Opticom GPS. This is due to upgrading to newer technology as well as to phase out a system that is ten years old and experiencing increased maintenance issues. Regardless of the current brand or type of system being used, 100% of respondents

indicated they would recommend their current TPS to another department. When asked if the installation of a traffic preemption system reduced response times, 90.9% indicated yes while only 9.1% indicated no.

Discussion

The research clearly illustrates the benefits of TPS. With over 40 years of data demonstrating improved safety and reduced response times, the literature clearly supports the implementation of TPS.

With almost nineteen years of experience as a career firefighter, the researcher has never known an emergency response without the added benefits afforded by a TPS. Practical experience alone, however, has not sufficiently prepared him to advocate for a TPS in an area where people did not have first-hand experience with the system. This research project and the knowledge gained from it not only strengthens the argument that TPS is right for emergency responders and citizens in San Marcos, but it also provides better preparation to become the "champion" that is necessary for the project's success (U.S. Department of Transportation, 2006).

Considering the negligible cost difference, reduced cost of installation, reduced maintenance, increased vehicle tracking capabilities, and proven performance by a reputable company, the selection of the Opticom GPS TPS is evident. Moving forward, information learned from this ARP enables the researcher to be better prepared to present the benefits of a TPS to the city council and to help them explain the value of such a system to their constituents.

Recommendations

Information learned from this ARP will be used to prepare a second proposal for the implementation of a TPS in San Marcos. The recommendation will be to install an Opticom

GPS-based system on the 42 most critical intersections within the city in such a manner as to create response corridors for emergency vehicles. The proposal will then be added to the council's agenda for their first meeting in February, 2011.

There are several reasons for this recommendation. First, this research has substantiated that the installation of a TPS reduces response times while at the same time improving both responder and citizen safety. Second, the level of satisfaction among the current users of Opticom's IR and GPS systems are extremely high. Third, the manufacturer has been in business for over 35 years and has a proven performance record. Fourth, since the city does not already have an IR system in place, it will have access to the newest technology. Fifth, Opticom GPS will integrate easily with existing traffic management software and offers an improved ability to track vehicle location and intersection preemptions.

San Marcos Transportation Division Manager Sabas Avila favors Opticom GPS for ease of installation and believes the technology is better and more dependable. He explained that, with an IR system, four cables would have to be run through existing conduit, versus just one with a GPS system. He also pointed out that maintenance of the GPS system would be easier because there is only one device to change at each intersection if there is ever a problem whereas there would be four possible culprits with the IR system. There will also be no need to realign the IR receivers which would take a considerable amount of time for personnel (S. Avila, personal communication, December 27, 2010).

Several steps have already been taken to select the appropriate intersections for TPS. On April 27, 2010, an e-mail was sent to all fifteen station captains of the San Marcos Fire Department instructing them to a compile a list of the fifteen busiest intersections in the city (Appendix I). Those lists were then merged into one list of what the firefighters and officers

believed to be the twenty-five busiest intersections in the city (Appendix J). This information was shared with Transportation Division Manager, Sabas Avila, who compared the fire department's list with data from the city's 2007 Level of Service Report for city traffic signals (Avila, 2007). The report itself was too complex and lengthy to be attached; however, a one page excerpt has been included for illustration (Appendix K). The top of the report has the intersection location and in the middle of the page is the Intersection Level of Service (LOS). "2007 was the last year that we did intersection traffic counts so, it is conceivable, that the LOS has worsened by a letter grade at each intersection" (S. Avila, personal communication, December 27, 2010). The LOS grading system is as follows:

A = free flow, no delays

B = free flow, minimal delays

C = flow with moderate delays

D = just under capacity, traffic moving slowly

E = at Capacity, stop-and-go traffic

F = over capacity, excessive delays, excessive stops

From the fire department list and the intersection LOS report, Avila was able to pinpoint exactly which intersections would most greatly benefit from a TPS. Those intersections were then plotted on a map and used to create response corridors (Appendix L). It is believed, based on this research, that by preempting the signals along the most commonly used response corridors, we can reduce response times and increase safety.

Additional steps have been taken to solicit updated pricing information from GTT and to explore alternative financing options, such as a lease purchase. This will give the city council

flexibility in their decision-making as well as alternatives to spending a large sum of money all at one time.

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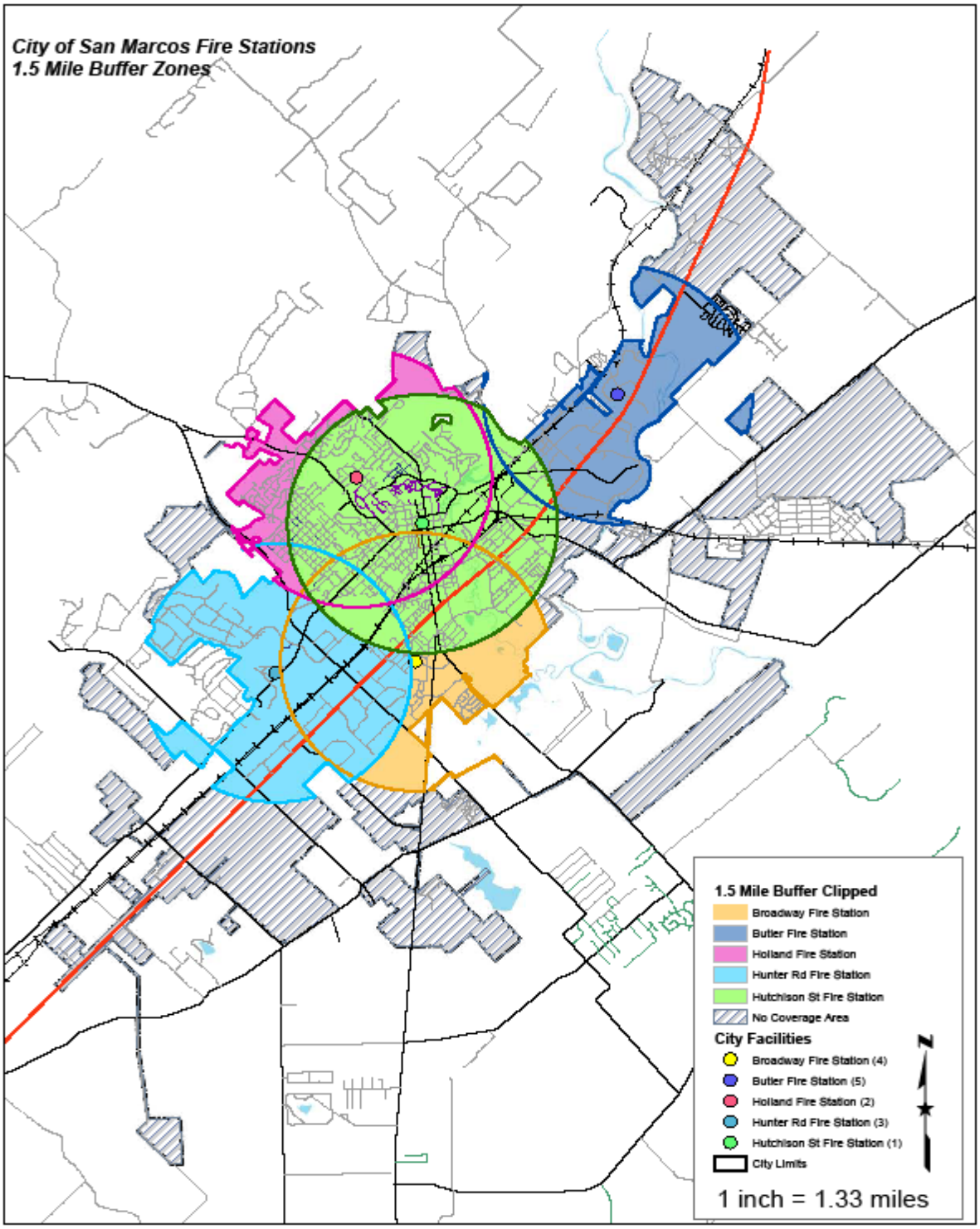
Appendix A
City of San Marcos Fire Stations 1.5 Mile Buffer Zones



Appendix A continued
City of San Marcos Fire Stations 1.5 Mile Buffer Zones

City limit Area	856346649.73	856346649.73
City Limit Acreage	19659.01	19659.01
Station 1 1.5 Mile Buffer Area	194555742.48	194555742.48
Station 1 Acreage	4466.39	4466.39
Station 1 Percentage	22.72	22.72
No overlap Area	24229541.92	24229541.92
No overlap Acreage	556.23	556.23
No overlap Percent	2.83	2.83
Station 2 1.5 Mile Buffer Area	155601269.13	155601269.13
Station 2 1.5 Mile Buffer Acreage	3572.11	3572.11
Station 2 1.5 Mile Buffer Percentage	18.17	18.17
No overlap Area	29681726.47	29681726.47
No overlap Acreage	681.40	681.40
No overlap Percent	3.47	3.47
Station 3 1.5 Mile Buffer Area	154480967.88	154480967.88
Station 3 1.5 Mile Buffer Acreage	3546.40	3546.40
Station 3 1.5 Mile Buffer Percentage	18.04	18.04
No overlap Area	73484528.15	73484528.15
No overlap Acreage	1686.97	1686.97
No overlap Percent	8.58	8.58
Station 4 1.5 Mile Buffer Area	165338079.80	165338079.80
Station 4 1.5 Mile Buffer Acreage	3795.64	3795.64
Station 4 1.5 Mile Buffer Percentage	19.31	19.31
No overlap Area	40769734.28	40769734.28
No overlap Acreage	935.94	935.94
No overlap Percent	4.76	4.76
Station 5 1.5 Mile Buffer Area	88075691.49	88075691.49
Station 5 1.5 Mile Buffer Acreage	2021.94	2021.94
Station 5 1.5 Mile Buffer Percentage	10.29	10.29
No overlap Area	79504474.90	79504474.90
No overlap Acreage	1825.17	1825.17
No overlap Percent	9.28	9.28
No Coverage Area	379041118.04	379041118.04
No Coverage Acreage	8701.59	8701.59
No Coverage Percent	44.26	44.26

Appendix B
Opticom IR Intersection Pricing on Houston Galveston Area Co-Op

HGACBuy — **CONTRACT PRICING WORKSHEET** — For Catalog & Price Sheet Type Purchases

Contract No.:	PE-05-09	Date Prepared:	12/27/2010

This Worksheet is prepared by Contractor and given to End User. If a PO is issued, both documents MUST be faxed to H-GAC @ 713-993-4548. Therefore please type or print legibly.

Buying Agency:	San Marcos	Contractor:	Consolidated Traffic Controls, Inc.
Contact Person:	Sabas Avila	Prepared By:	Bryan Jones
Phone:	512-393-8134	Phone:	800-448-8841
Fax:	512-396-3796	Fax:	800-448-8850
Email:	savila@sanmarcostx.gov	Email:	Bjones@ctc-traffic.com

Catalog / Price Sheet Name:	Traffic Control, Enforcement & Signal Preemption Equipment
General Description of Product:	GTT GPS Opticom Preemption System

A. Catalog / Price Sheet Items being purchased - Itemize Below - Attach Additional Sheet If Necessary

Quan	Description	Unit Pr	Total
42	Model 380 Card Rack	175	7350
168	Model 721 Opticom Detector	456.5	76692
168	Narrow Mounting Hub	20	3360
42	Model 754 Phase Selector	2751	115542
42	1000' Roll Model 138 Cable	410	17220
336	Intersection installation hours	150	50400
			0
22	Model 795 Opticom Emitter	995	21890
22	Emitter installation	500	11000
			0
			0
			0
		Total From Other Sheets, If Any:	
		Subtotal A:	303454

B. Unpublished Options, Accessory or Service Items - Itemize Below - Attach Additional Sheet If Necessary
(Note: Unpublished Items are any which were not submitted and priced in contractor's bid.)

Quan	Description	Unit Pr	Total
			0
			0
			0
			0
		Total From Other Sheets, If Any:	
		Subtotal B:	0

Check: The total cost of Unpublished Options (Subtotal B) cannot exceed 25% of the total from Section A.	For this transaction the percentage is:	0%

C. Other Allowances, Discounts, Trade-Ins, Freight, Make Ready or Miscellaneous Charges

Subtotal C:	0

Delivery Date:	60 to 90 Days ARO	D. Total Purchase Price (A+B+C):	303454

Appendix C
Opticom GPS Intersection Pricing on Houston Galveston Area Co-Op

HGACBuy	CONTRACT PRICING WORKSHEET For Catalog & Price Sheet Type Purchases	Contract No.:	PE-05-09	Date Prepared:	6/11/2010

This Worksheet is prepared by Contractor and given to End User. If a PO is issued, both documents MUST be faxed to H-GAC @ 713-993-4548. Therefore please type or print legibly.

Buying Agency:	San Marcos	Contractor:	Consolidated Traffic Controls, Inc.
Contact Person:	Sabas Avila	Prepared By:	Bryan Jones
Phone:	512-393-8134	Phone:	800-448-8841
Fax:	512-396-3796	Fax:	800-448-8850
Email:	savila@sanmarcostx.gov	Email:	Bjones@ctc-traffic.com
Catalog / Price Sheet Name:	Traffic Control, Enforcement & Signal Preemption Equipment		
General Description of Product:	GTT GPS Opticom Preemption System		

A. Catalog / Price Sheet Items being purchased - Itemize Below - Attach Additional Sheet If Necessary

Quan	Description	Unit Pr	Total
42	GPS Phase Selector Model 1000 78-8118-6970-6	2096	88032
42	GPS Radio Unit Mast Arm Mount Model 1010 78-8118-6978-9	2144	90048
42	GPS Auxilliary Interface Panel Kit Model 1030 78-8125-0435-1	240	10080
42	GPS Card Rack with Power Supply Kit (includes harness) Model 1040 78-8125-0455-9	340	14280
2	GPS Installation Cable 2500 ft. Spool 78-8125-0423-7	1350	2700
1	GPS Installation Cable 500 ft. Spool 78-8125-0421-1	270	270
1	Opticom GPS ITS Explorer Software Kit 78-8125-0450-0	800	800
22	GPS Vehicle Preemption Kit - High Priority 78-8125-0430-2	2400	52800
180	Intersection Installation	150	27000
110	Vehicle Installation	150	16500
42	Model 500 Narrow Monting Hub		0
			0
		Total From Other Sheets, If Any:	
		Subtotal A:	302510

B. Unpublished Options, Accessory or Service Items - Itemize Below - Attach Additional Sheet If Necessary
(Note: Unpublished Items are any which were not submitted and priced in contractor's bid.)

Quan	Description	Unit Pr	Total
			0
			0
			0
			0
		Total From Other Sheets, If Any:	
		Subtotal B:	0

Check: The total cost of Unpublished Options (Subtotal B) cannot exceed 25% of the total from Section A.	For this transaction the percentage is:	0%

C. Other Allowances, Discounts, Trade-Ins, Freight, Make Ready or Miscellaneous Charges

Subtotal C:	0

Delivery Date:	60 to 90 Days ARO	D. Total Purchase Price (A+B+C):	302510

Appendix D
E-mail response from Carlos Carrillo, Texas Municipal League

From: CCarrillo@tmlirp.org [mailto:CCarrillo@tmlirp.org]
Sent: Friday, August 27, 2010 10:03 AM
To: Conyers, Cindy
Subject: Re: Fire Chiefs question

Good morning Cindy,

I spoke to several people in our department regarding the Chief's question, including our fire services and law enforcement instructors. Obviously, there are pros and cons regarding the use of the Opticom system. Ronnie Sexton, our fire services training instructor, points out the importance of drivers understanding fully how the system works. He explained that although the System is a good tool, when used properly, it is still just another tool, and proper precautions should be taken. One cannot assume that all motorists will react equally and stop in time and or as required.

The Opticom Company offers white paper research information on their website. They might also be able to provide claims history information collected from clients which is tracked on their database. You might also want to contact other cities that use the system. Again, Opticom might be able to provide the names of cities in the Texas that are comparable to San Marcos that use the system.

I spoke to our MIS department and they informed me that there is no tracking mechanism in place to determine accidents that might have resulted due to the use of the Opticom system. I will keep researching other information and notify you if I find anything else that might help.

Thanks

Carlos F. Carrillo
Sr. Loss Prevention Representative
Texas Municipal League Intergovernmental Risk Pool
1821 Rutherford Ln, First Floor, Austin, TX 78754
Work Phone: 1 800 537 6655
Direct: (512) 491 2435
Fax: (512) 491 2388
ccarrillo@tmlirp.org

Appendix E

1. Which Fire Department do you represent and what is the approximate population served by your Department?

2. Does your department currently utilize any type of traffic preemption system?

If you answer "no" to this question, you are done. Thank you for your time and assistance. If you answer "yes" please complete the remaining questions.

- ☐ Yes
- ☐ No

3. What brand and type of traffic preemption system are you currently using?

- ☐ Opticom - Infrared System IR)
- ☐ Opticom - GPS System
- ☐ Tomar - Infrared System(IR)
- ☐ Other

4. Would you recommend your current brand/type of traffic preemption system to another department?

- ☐ Yes
- ☐ No

5. Did the installation of a traffic preemption system reduce response times for your department?

- ☐ Yes
- ☐ No

6. Marketing brochures for traffic preemption systems claim that, "studies show that an effective signal preemption system improves response times by an average of 20% while simultaneously reducing crashes at controlled intersections." What, if any, benefits has your department experienced as a result of installing a traffic preemption system?

7. What factors influenced your department's decision to select the brand/type of traffic preemption system you are currently using?

8. What, if any, issues have you experienced with your current traffic preemption system related to: installation difficulties, maintenance issues, lack of support from the manufacturer or supplier etc.?

Appendix F

From: Stephens, Les
Sent: Sunday, November 28, 2010 3:34 PM
To: Stephens, Les
Subject: Traffic Preemption Survey

Hello, my name is Les Stephens and I am the Fire Chief in San Marcos, Texas. I am currently working on a project and your assistance would be greatly appreciated. Last year, the City Manager budgeted almost $300,000 to install traffic preemption systems at all major intersections in the City of San Marcos. He was familiar with the benefits of the system from working in two other Texas cities as was I from working in Garland. Unfortunately the City Council was not as familiar with the systems, and their benefits, and voted against the project. Under the direction of the Interim City Manager we are planning to present the program again after the first of the year and I have decided that in order to be as prepared as possible I would write my 2nd EFO paper on the different brands and benefits of traffic preemption systems. Please take a few moments and complete the short survey which can be found at the attached link. Even if you don't currently have a traffic preemption system in your jurisdiction, your feedback is still greatly appreciated.

http://www.surveymonkey.com/s/8C5BW3N

Thanks again for your time,

Les Stephens
Fire Chief
City of San Marcos
630 East Hopkins
San Marcos, TX 78666
O 512.805.2661
F 512.805.2677
C 512.395.5557
LStephens@SanMarcosTX.gov

Appendix G
Questionnaire Responses

1. Which Fire Department do you represent and what is the approximate population served by your Department?

answered question	**35**
skipped question	**0**

2. Does your department currently utilize any type of traffic preemption system? If you answer "no" to this question, you are done. Thank you for your time and assistance. If you answer "yes" please complete the remaining questions.

answered question	**35**
skipped question	**0**

	Response Percent	Response Count
Yes	**62.9%**	**22**
No	37.1%	13

3. What brand and type of traffic preemption system are you currently using?

answered question	**22**

3. What brand and type of traffic preemption system are you currently using?

skipped question	**13**

	Response Percent	Response Count
Opticom - Infrared System IR)	**86.4%**	**19**
Opticom - GPS System	13.6%	3
Tomar - Infrared System(IR)	9.1%	2
Other	0.0%	0

4. Would you recommend your current brand/type of traffic preemption system to another department?

	Response Percent	Response Count
Yes	**100.0%**	**22**
No	0.0%	0

5. Did the installation of a traffic preemption system reduce response times for your department?

answered question	**22**

5. Did the installation of a traffic preemption system reduce response times for your department?

	Response Percent	Response Count
Yes	**90.9%**	**20**
No	9.1%	2

6. Marketing brochures for traffic preemption systems claim that, "studies show that an effective signal preemption system improves response times by an average of 20% while simultaneously reducing crashes at controlled intersections." What, if any, benefits has your department experienced as a result of installing a traffic preemption system?

answered question	**23**
skipped question	**12**

	Response Count

7. What factors influenced your department's decision to select the brand/type of traffic preemption system you are currently using?

answered question	**21**
skipped question	**14**

8. What, if any, issues have you experienced with your current traffic preemption system related to: installation difficulties, maintenance issues, lack of support from the manufacturer or supplier etc.?

answered question	**21**
skipped question	**14**

Appendix H
Traffic Preemption Questionnaire Results

City	Population	Currently use TPS	Brand	Recommend	Reduce Response Times	Issues
Mesquite	139,700	Yes	Opticom IR	Yes	Yes	None
Denton	120,000	Yes	Opticom IR	Yes	Yes	None
Cedar Park		No				
Plano	267,000	Yes	Opticom IR	Yes	Yes	None
Ft. Worth	>700,000	Yes	Opticom IR	Yes	Yes	None
Sequin	26,000	No				
The Colony	52,000	Yes	Opticom IR	Yes	Yes	Old equipment and maintenance
Colleyville	24,000	Yes	Opticom IR	Yes	Yes	None
Decatur	15,000	No				
Longview	75,000	No				
Highland Village	17,000	Yes	Opticom IR	Yes	Yes	No
Travis County ESD #11	30,000	No				
Lake Travis	73,000	Yes	Opticom GPS	Yes	Yes	See #8 below
City of Alice		No				
Leander	35,000	Yes	Opticom GPS and Tomar IR	Yes	No	See #8 below
Gainesville	19,000	No				
College Station	94,000	Yes	Opticom IR	Yes	Yes	See #8 below
Little Elm	27,000	Yes	Opticom IR	Yes	Yes	None
Round Rock	100,000	Yes	Opticom IR	Yes	Yes	None
Rockwall	35,000	Yes	Opticom IR	Yes	Yes	See #8 below
Buda	27,000	No				
Midland	130,000	Yes	Opticom IR	Yes	Yes	None
Lewisville	95,000	Yes	Opticom IR and Tomar IR	Yes	Yes	None
Lockhart	14,000	No				
Dallas	1.3 million	No				
Trophy Club	9,000	Yes	Opticom IR	Yes	Yes	None
New Braunfels	60,000	No				

Georgetown	70,000	No				
Kyle	40,000	No				
Addison	15,000	Yes	Opticom IR	Yes	Yes	See # 8 Below
University Park	25,000	Yes	Opticom IR	Yes	Yes	None
Coppell	39,500	Yes	Opticom IR	Yes	Yes	None

Questionnaire question #6: Marketing brochures for TPS claim that "studies show that an effective signal preemption system improves response times by an average of 20% while simultaneously reducing crashes at controlled intersections." What, if any benefits has your department experienced as a result of installing a TPS?

City	Comments
Mesquite	Safer intersections for citizens and reduced response times
Denton	We have always had them. It does a good job in clearing traffic.
Plano	20%+ reduction in response time and only 1 intersection crash in more than 25 years. In the 1 crash we did have the apparatus operator entered the intersection against the Opticom (on red signal)
Ft. Worth	Better control of intersections
The Colony	Safety first and reduced response times second.
Colleyville	We have the system on all intersections and the entrance to our Central Fire Station. The station entrance has shown to be the biggest help due to traffic volume on the state highway. We reduced response times at Central Station by controlling the driveway for our apparatus to exit.
Highland Village	We have two areas that the preemption system is a huge benefit in moving the flow of traffic. In an area that has no shoulders for traffic to move over on and with the preemption we are able to turn the signals green and allow traffic to move thus improving response time and reducing accidents
Lake Travis	I answered yes to #5 because I think it has and will show it over time. We have had the system installed for less than a year to date so I don't have good figures yet. I can tell you that we do not have to stop for red lights at 22 intersections in our district while responding to incidents. 15 of those intersections represent access to 5 major subdivisions or cities. Based on that, I truly feel we are not only safer now, but quicker.
Leander	Decrease possible crashes and decrease of traffic accidents caused by intersections going through intersections.
College Station	It helps move traffic in the direction of travel toward the emergency, and it does help prevent citizens from feeling the urge to push in to the intersection to get out of the way of responding units. As first responders we really don't want to push vehicles into the intersection when they have a red light, we see it when the light doesn't change. We have lots of center medians that make a counter flow driving to travel long distances, the Opticom units help keep us from these extended counter flow areas for traffic, and some have blind intersection areas that are dangerous. The Opticom's do work, and we now include them with every new red light installation.
Little Elm	Although response times are important our major concern is controlling the intersection. Having a preemption device moves only the traffic you need to move and keeps all other traffic in a holding pattern. This has reduced accidents and near misses to almost nil.

Round Rock	We have had it so long that it is really hard to say. Now that we serve a population of 100,000 we have been able to actually reduce responding code 3 to many calls thanks to the system. In our history with the system we have had only 1 wreck and that was due to someone running the red light anyway.
Rockwall	We do not have any records showing response time reduction percentages. I do know it reduced our response time when it was installed in 1984. I also am sure it has assisted us in reducing accidents because it controls the intersection.
Midland	I cannot say if this system has reduced response times significantly, but it has increased our ability to respond to emergency scenes safer which is just as, if not more, important.
Lewisville	Clears intersections faster and safer, improving response time.
Trophy Club	Can't tell a difference.
Addison	When they are working correctly, it opens up the intersections quickly by allowing traffic to move through ahead of our apparatus
Coppell	I have worked for the Coppell Fire Department for almost 18 years and we have always had the system. I know that it has helped because we have an SOG that we will stop at all red lights when responding. So with the green light we can proceed with caution without coming to a complete stop.

Questionnaire question #7: What factors influenced your department's decision to select the brand/type of traffic preemption system you are currently using?

City	**Comments**
Mesquite	Wanted to utilize same technology as neighboring cities to benefit all.
Plano	Previous experience with manufacturer and equipment type. It was one of the only brands on the market when we starting looking at them.
Ft. Worth	Cost
The Colony	Compatible with neighboring departments.
Colleyville	Most commonly used in our area.
Highland Village	We chose Opticom due to the data recording that it provided which the others didn't at that time.
Lake Travis	It was an upgrade from our previous system Opticom IR. Our old system was almost 10 years old and needed either full replacement or repair.
Leander	Opticom GPS is the new system we are moving to and have made it part of the bid standard for street lights, and development agreements. This system eliminates the ugly sensors on the lights and does not hinder the use of different lighting packages.
College Station	We picked Opticom because that what others were using when we purchased our first ones.
Little Elm	We use Opticom because they are tried and true and battle tested.
Round Rock	It was the only one on the market at the time.
Rockwall	3M was the only company that had a track record in 1984. Also we were the first City in the State of Texas allowed to install preemption systems on State Highways. Our City was going to be the test case to see if the State would change the rules and allow other jurisdictions to install these systems. So with that 3M installed our 12 intersections traffic signals for free to help the State of Texas decide. As each intersection was added we stayed with the system which had proven to be effective. We would like to have GPS

	system but we cannot justify the cost. We currently have 26 intersections.
Midland	This system is more secure and can only be used by fire personnel and it is difficult to duplicate.
Lewisville	We have transitioned to Tomar based on cost.
Trophy Club	Heavy traffic in our area.
Addison	Maintenance, accuracy, durability, and customer service.
Coppell	The system was in place prior to my employment here so I am not sure.

Questionnaire question #8: What, if any, issues have you experienced with your current TPS related to: installation difficulties, maintenance issues, lack of support from the manufacturer or supplier etc.?

City	Comments
Lake Travis	On a scale of 1-10, 10 being the highest – installation difficulties – initially 5, our fleet folks did not agree with the way Opticom was installed. After the concerns were addressed, CTC (our contractor) fixed all the problems and issues in a very timely manner at no charge – so after all was said and done I would give them an 8. We do have one isolated issue with one of our unit's MDC's connectivity and it may be interfering with Opticom. It is an issue that we are working on as we speak, it may not be an actual Opticom issue – just figured I'd add it. Not maintenance issues to report. Support- Our dealings are more with the Opticom vendor/contractor. When we signed the order we felt it was slow to get the project completed and had to stay on them for communication. They did mention that they close their office for two weeks at the end of December in advance to us signing so we knew that going into it. I would give the vendor a 7 as far as support. As far as Opticom reps – I would give them a 10. As soon as they hear of an issue or delay they are on the contractor to make it right and are very timely with follow up. I would recommend Opticom to another fire department.
Leander	None, we are just implementing the system and should be up with the system by May of 2011.
College Station	No major problems, we have them go out from time to time. Many times it's just getting the correct angle of them set up; then they work fine. We have had great success with them and they do work in helping first responders in reducing the effect of our "Code Three" responses on the driving public by helping control them by engineering in safety controls and measures in traffic flow. They still doesn't replace the driver's responsibility to show due regard when responding to an emergency, by driving "Defensively".
Rockwall	The equipment works great. Most of our issues are where TxDot comes and works on a signal and de-programs the preemption system from their control equipment. Our dealer has been wonderful and very timely in responding to our request for repairs on the 3M equipment. Currently we still have an agreement with TxDot that was put into place in 1984 that states if we furnish equipment on new intersections as they are constructed the state will have their sub-contractor install the equipment at no cost to the City. I am not aware of any other city which has that agreement. The City does not have any traffic signals on City streets they are all on State highways.
Lewisville	Tomar has been very reliable. No bad experience with support or manufacturer.
Addison	We have several that do not seem to work correctly. Different apparatus heights may be a cause and some just do not work consistently.

Appendix I
E-mail to Captains to rank busiest intersections

From: Stephens, Les
Sent: Tuesday, April 27, 2010 12:00 PM
To: Fire - Battalion Chiefs; Fire - A-Shift Officers; Fire - B-Shift Officers; Fire - C-Shift Officers
Cc: Nored, Len; Kuhlman, Karl; Stephens, Les
Subject: Reply required

I need all of you to submit to your BC, and the BCs to compile and forward to Chief Zook by May 7th a list of the busiest intersections in the City and the time of day when they are at their worst. For example: University Drive and Sessom from 0730-0900 and 1400-1600. Please submit these in rank order with worst being number 1 through whatever number you stop at. No less than 15 intersections per list. If you know of more, please include them.

We have been researching, and there is money budgeted for, traffic preemption systems (Opticom). We hope to have it on the City Council's agenda for approval in June and this is some of the supporting information we need.

Once all three BCs have received their lists from all their officers, forward them to Chief Zook. Chief Zook will need to compare all of the lists and put them in rank order and get them to me by May 10th. If you can get them to Chief Zook earlier, I'm sure he would greatly appreciate the extra time to work on this.

Thanks for your help,
Les

Appendix J
San Marcos Fire Department Busiest Intersections in Rank Order

1. Highway 80 at IH-35
2. Highway 123 at east access
3. Aquarena at IH-35 east access
4. University at Sessom
5. LBJ @ Hopkins
6. Guadalupe @ Hopkins
7. Broadway @ 123
8. Wonder World @ IH 35
9. Wonder World @ Hunter
10. Highway 80 @ Clarewood
11. CM Allen @ Hopkins
12. Thorpe @ Hopkins
13. Guadalupe @ IH 35
14. Highway 80 @ River Road
15. Hopkins @ Moore
16. Highway 123 @ Highway 621
17. LBJ @ San Antonio
18. Guadalupe @ San Antonio
19. 123 @ Wonder World
20. Cheatham @ Hopkins
21. Aquarena @ Post Road
22. Aquarena @ Thorpe
23. Sessom @ LBJ
24. RR12 @ Holland
25. RR12 @ Craddock
26. McCarty at IH-35 (mainly during weekday school opening and closing hours)

Appendix K
Excerpt from 2007 Level of Service Report on Traffic Signals

Volume
1: MOORE & HUTCHISON 12/27/2010

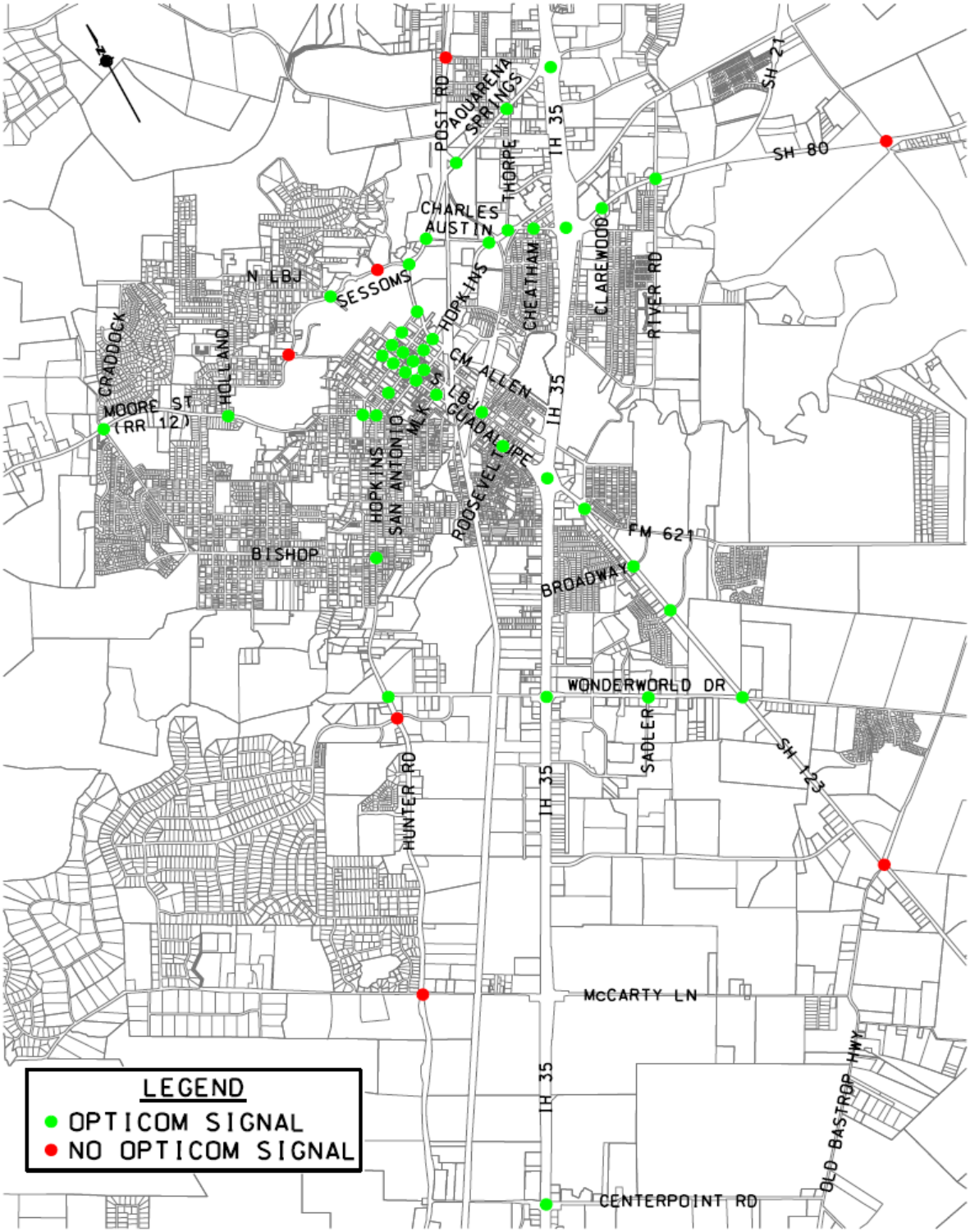
Lane Group	SEL	SET	SER	NWL	NWT	NWR	NEL	NET	NER	SWL	SWT	SWR
Lane Configurations												
Volume (vph)	108	467	7	26	561	19	10	49	13	15	96	210
Satd. Flow (prot)	0	3493	0	0	1848	0	0	1785	0	0	1848	1583
Flt Permitted		0.990			0.997			0.942			0.946	
Satd. Flow (perm)	0	3493	0	0	1848	0	0	1695	0	0	1762	1583
Satd. Flow (RTOR)		2			3			17				223
Lane Group Flow (vph)	0	660	0	0	763	0	0	96	0	0	152	223
Turn Type	Split			Split			Perm			Perm		Perm
Protected Phases	2	2		1	1			4			4	
Permitted Phases							4			4		4
Total Split (s)	24.0	24.0	0.0	43.0	43.0	0.0	23.0	23.0	0.0	23.0	23.0	23.0
Total Lost Time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Act Effct Green (s)		20.0			39.0			19.0			19.0	19.0
Actuated g/C Ratio		0.22			0.43			0.21			0.21	0.21
v/c Ratio		0.85			0.95			0.26			0.41	0.44
Control Delay		45.4			45.6			26.4			34.6	7.4
Queue Delay		0.0			110.7			0.0			0.0	0.0
Total Delay		45.4			156.4			26.4			34.6	7.4
LOS		D			F			C			C	A
Approach Delay		45.4			156.4			26.4			18.4	
Approach LOS		D			F			C			B	

Intersection Summary	
Cycle Length: 90	
Actuated Cycle Length: 90	
Offset: 38 (42%), Referenced to phase 2:SETL, Start of Green	
Control Type: Actuated-Coordinated	
Maximum v/c Ratio: 0.95	
Intersection Signal Delay: 83.8	Intersection LOS: F
Intersection Capacity Utilization 69.0%	ICU Level of Service C
Analysis Period (min) 15	

Splits and Phases: 1: MOORE & HUTCHISON

Appendix L

PROPOSED GPS PREEMPTION LOCATION FOR EMERGENCY MANAGEMENT VEHICLES



URBAN STRUCTURE

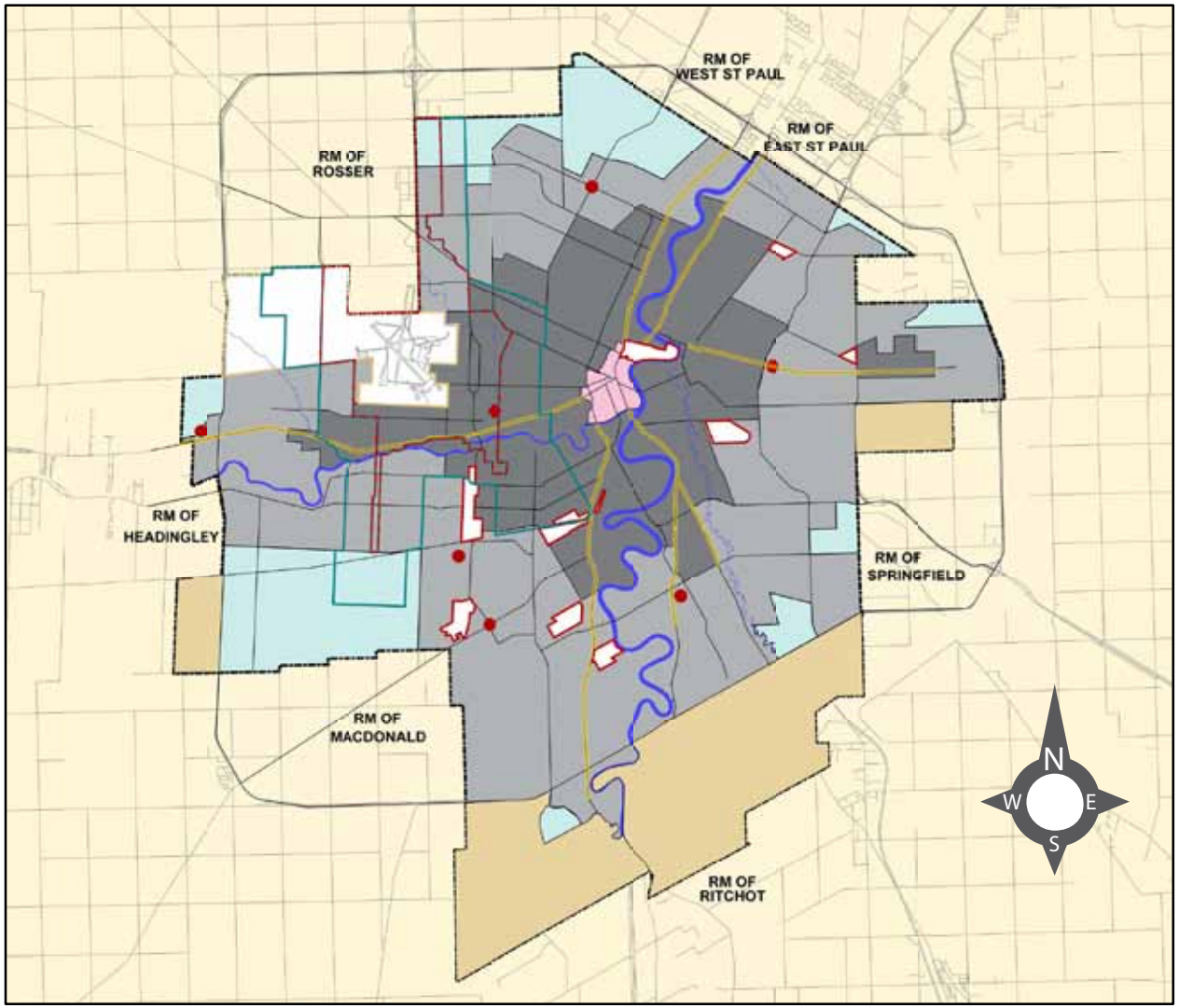


Figure 01a
Winnipeg's urban structure.

LEGEND

- Downtown
- Major Redevelopment Sites
- New Communities
- Regional Mixed Use Centre
- Regional Mixed Use Corridor
- Mature Communities
- Recent Communities
- Rural and Agricultural
- Airport Area
- Airport Vicinity Protection Area 1
- Airport Vicinity Protection Area 2