

# Fire Risk Indexes Measuring Public Fire Service Levels In Canada

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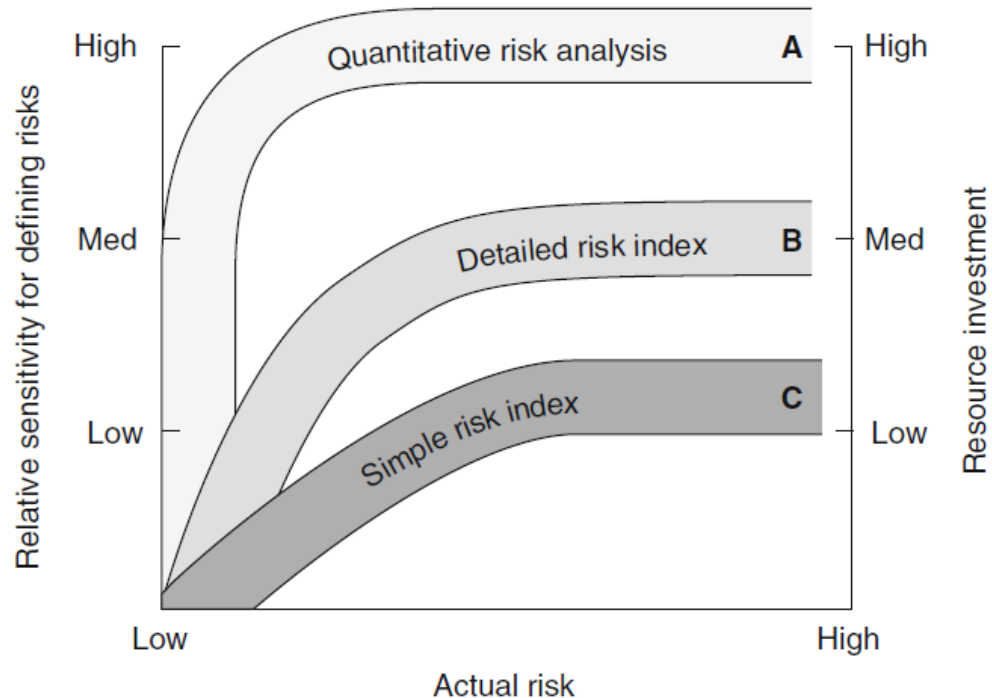
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International Association of Fire Fighters  
Canadian Policy Conference



# Fire Risk Indexes



- A risk index is defined as a single number measure of the risk associated with a facility.
- Insurance rates are fire risk indexes, as are the outputs of other similar schedules or scoring methods.
- Fire risk indexing is the process of modeling and scoring hazard and exposure attributes to produce a rapid and simple estimate of relative risk. The concept has gained widespread acceptance as a cost-effective prioritization and screening tool for fire risk assessment programs. It is a useful and powerful approach that can provide valuable information on the risks associated with fire.

(Watts, 2016)

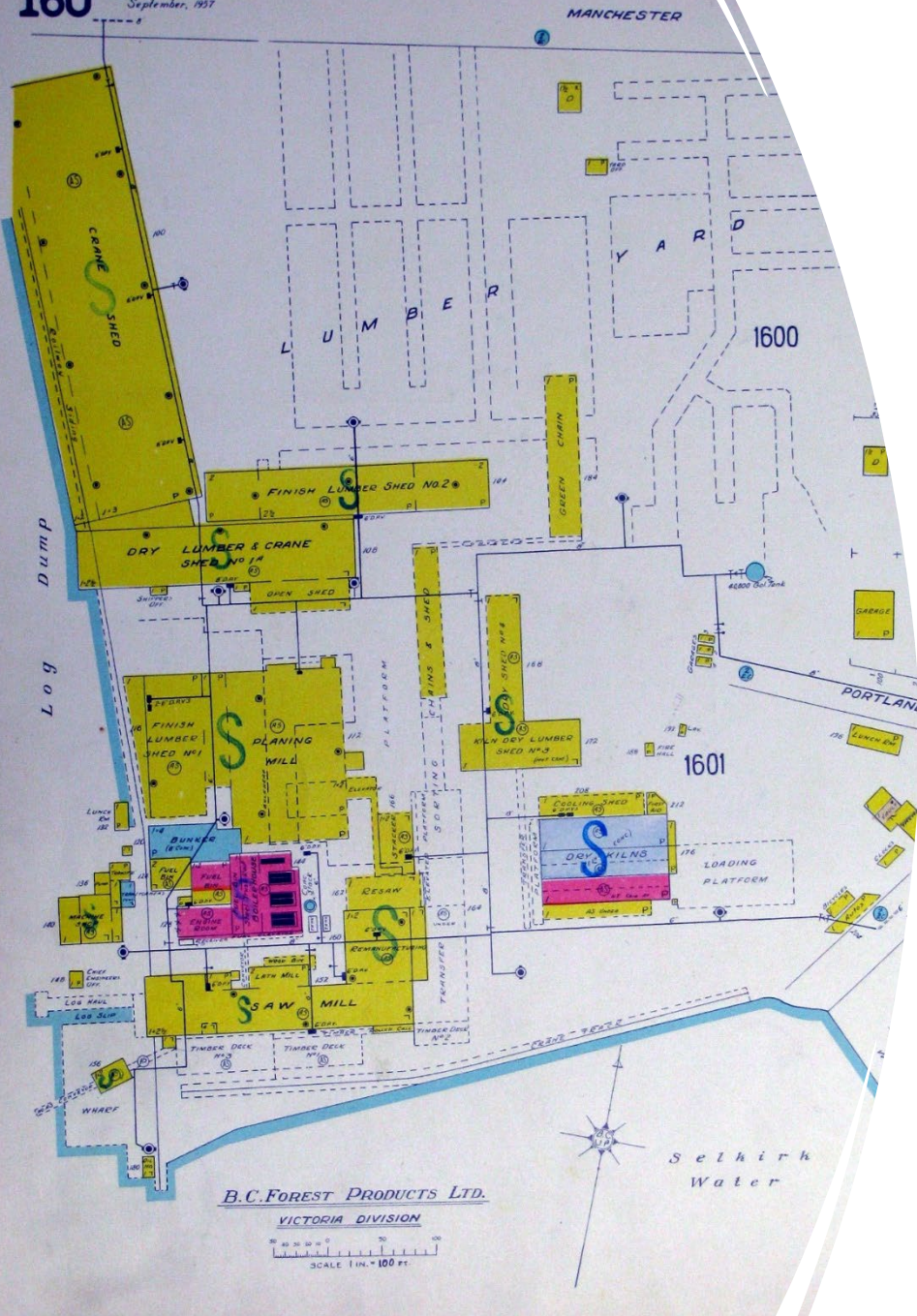
# Quantifying Risk

## – The Risk Triangle

- 'Risk' is the probability of a loss, and this depends on three elements, hazard, vulnerability and exposure.
- Ex. with property insurance, consider the frequency and severity of the hazard; the vulnerability of the insured property to that hazard, (the extent to which it will suffer damage or loss), and the exposure of the property to the hazard, for example its value and location.
- The severity of the risk can be thought of as being the area of the triangle, then by simple geometry, we know that this in turn depends on the size of each of the three 'sides' of the risk triangle. If any one component or 'side' of the triangle is zero, then there is no risk.

(Crichton, 1999)





# Canadian Fire Insurance Grading Index

- A Fire Risk Index (FRI) developed over 100 years ago by CFUA to manage risk of catastrophic fires that started inside communities
- Group of engineers created a standardized FRI for measuring:
  - the level of structure fire risk in all Canadian communities
  - the capacity of fire protection including
    - Fire department response capacity, and
    - Water supply infrastructure to support fire fighting
- Created maps of communities, infrastructure and the built environment (buildings, construction types, etc.)
- Each community risk assessed periodically and recommendations provided for community risk reduction
- Result in largely standardized systems of public fire protection with over \$5b in annual funding across Canada, and almost complete reduction of catastrophic level losses from structure fires starting in buildings

(Hives, 1985)

# Community Risk Reduction (CRR)



Becoming standard best practice  
for municipal risk control

NFPA 1300 Standard on  
Community Risk Assessment and  
Community Risk Reduction Plan  
Development

Process is aligned with insurance  
industry Fire Risk Indexes

“Economic Incentive” identified  
as a foundational element

(National Fire Protection  
Association, 2019)



# Economic Incentive

Fire Risk Indexes are a key component of Economic Incentives

- Local governments may have difficulty justifying spending of tax dollars to prevent and respond to fires, or other types of emergency incidents
- Funding for prevention and suppression often only become available reactively after damaging events highlight the need
- Knowledge that the level of emergency response capacity is a factor in property insurance pricing assists communities to make proactive decisions around managing fire risk, and preparing for suppression

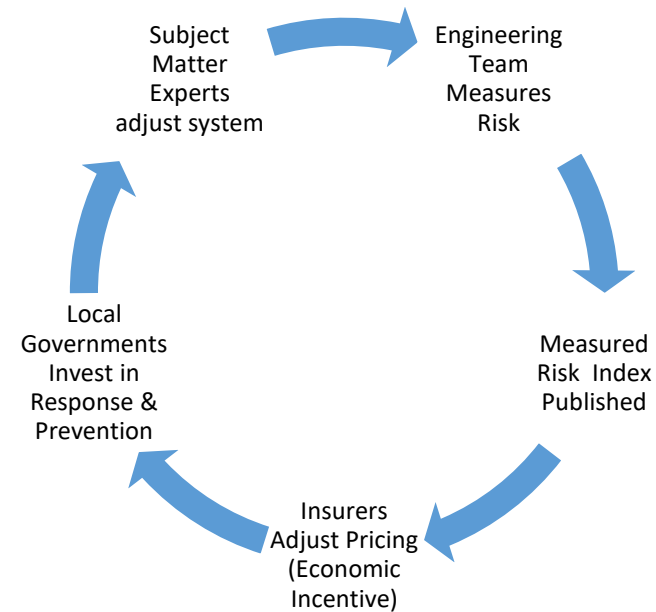
# Fire Risk Indexes Connect Insurers and Municipalities with an Economic Feedback Loop

Fire Risk Indexes provide simple, standardized measures of risk that are used to adjust insurance pricing.

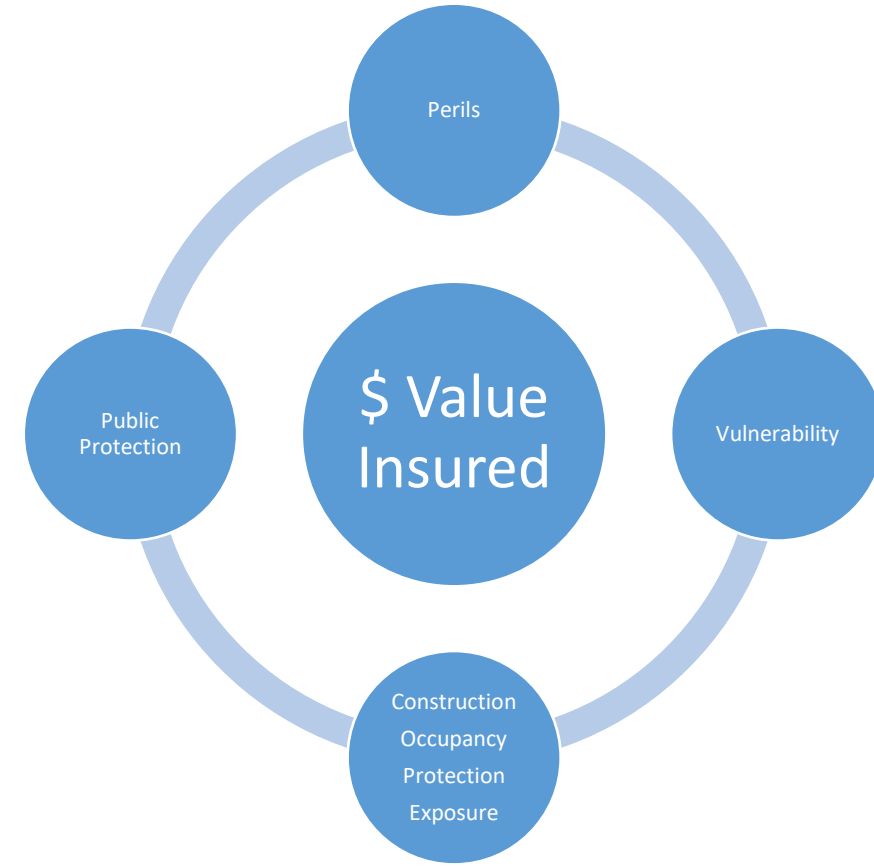
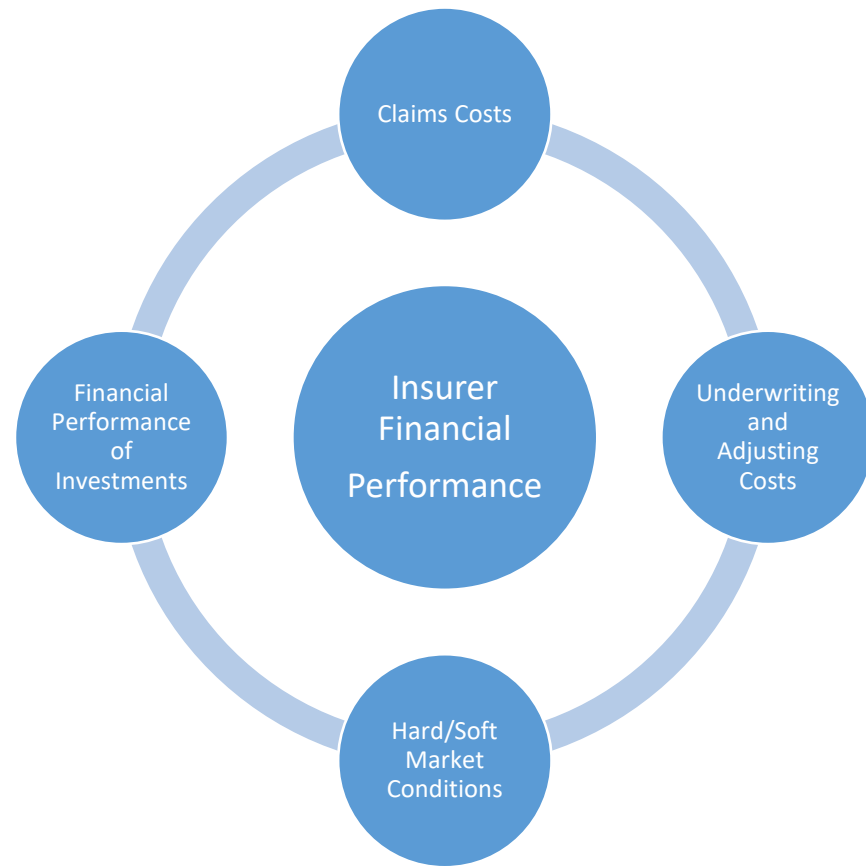
Adjustment of insurance pricing is a key economic incentive

Proactive and long-term approach as opposed to reactive one-off approach

Emphasis on local government level data for prevention and suppression



# Insurance Pricing Factor Examples





# Fire Risk Grouping in Canada

- National Building Code:
  - Part 9 – Residential
  - Part 3 – Other
- NFPA Sprinkler Design:
  - 13D – Dwelling
  - 13R – Multifamily Residential (Small)
  - 13 – Other
- Canadian Property Insurance
  - Personal Lines
  - Commercial Lines
- FUS Ratings of Public Fire Protection:
  - Dwellings Protection Grades
  - Public Fire Protection Classifications

# Different Risk Indexes for different event scales

Dwelling Protection Grades  
(DPG)

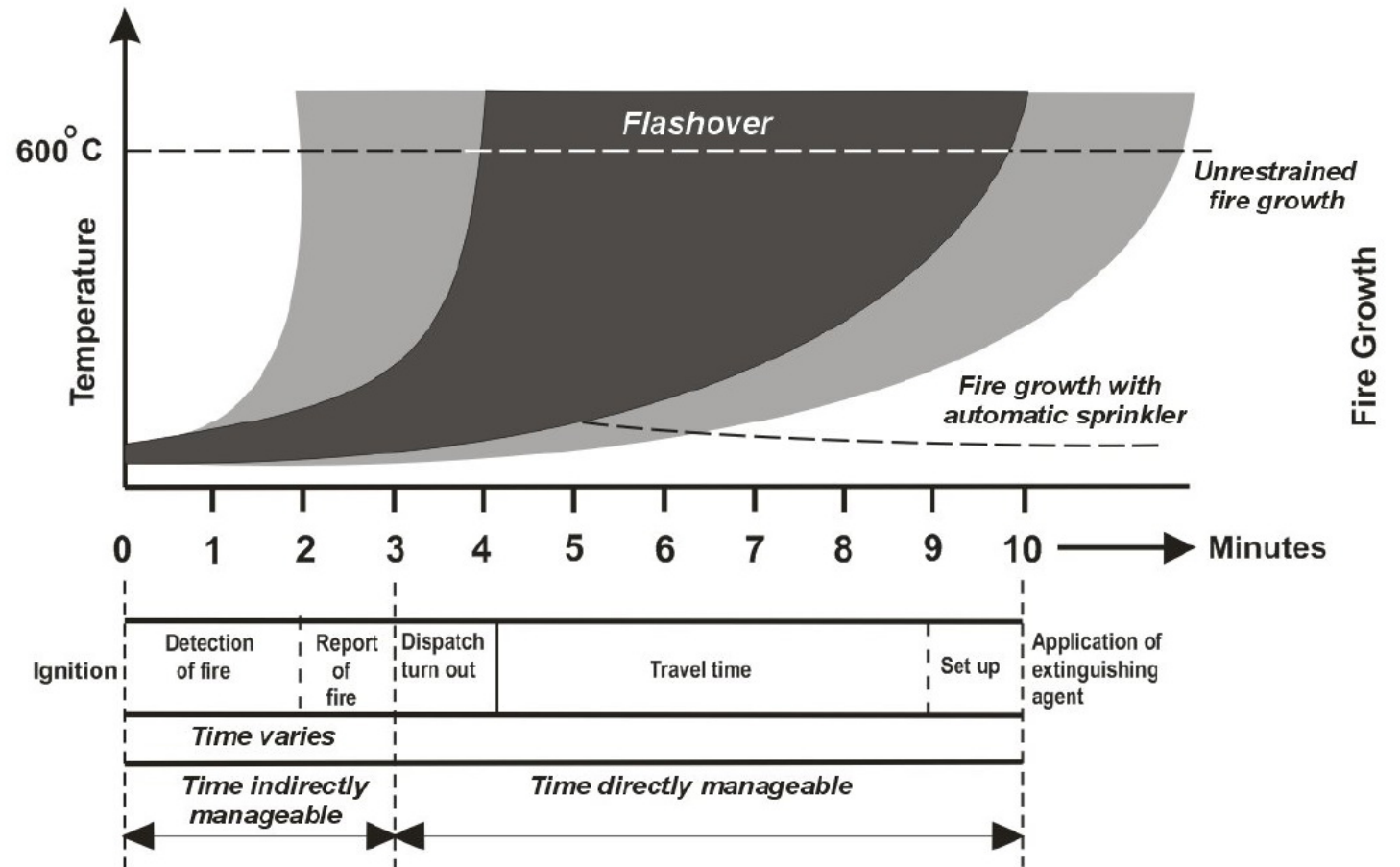


Public Fire Protection  
Classifications (PFPC)




Time frame for application of fire streams significantly impacts probability of losses.

# Fire propagation curves and flashover



# PFPC Determination Process

- Risk Assessment
- Fire Department Review
- Water Supply Review
- Prevention Review
- Communications Review



Use Classification Standard for Public Fire Protection to determine PFPC



# Brief Overview of Risk Assessment



*Footprint Area: 1,310 m<sup>2</sup>*

*No. Stories: 18*

*Construction: 0.8*

*Occupancy: -15%*

*Partial Sprinkler: -15%*

*Exposure: 5%*

RFF = 4,600 IGPM

# Required fire flows a function of construction type and size



*Footprint Area: 140 m<sup>2</sup>*

*No. Stories: 12*

*Construction: 1.5*

*Occupancy: -15%*

*Sprinkler: 0%*

*Exposure: 5%*

**RFF = 1,200 IGPM**



*Footprint Area: 1,500 m<sup>2</sup>*

*No. Stories: 6*

*Construction: 1.5*

*Occupancy: -15%*

*Sprinkler: 50%*

*Exposure: 12%*

**RFF = 3,000 IGPM**



# EXAMPLE RISK ASSESSMENT

Required Fire Flows determined based on the “Water Supply for Public Fire Protection”

Required Fire Flows

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

Where:

C = coefficient related to type of construction

A = Effective building area

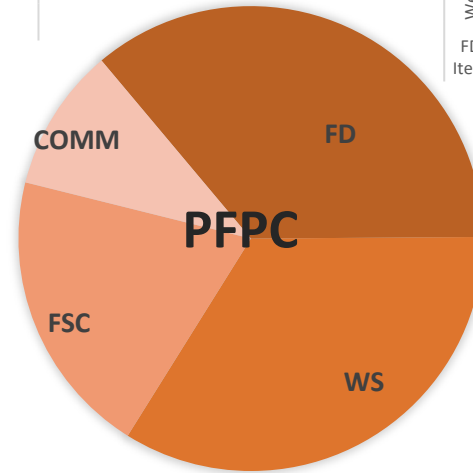
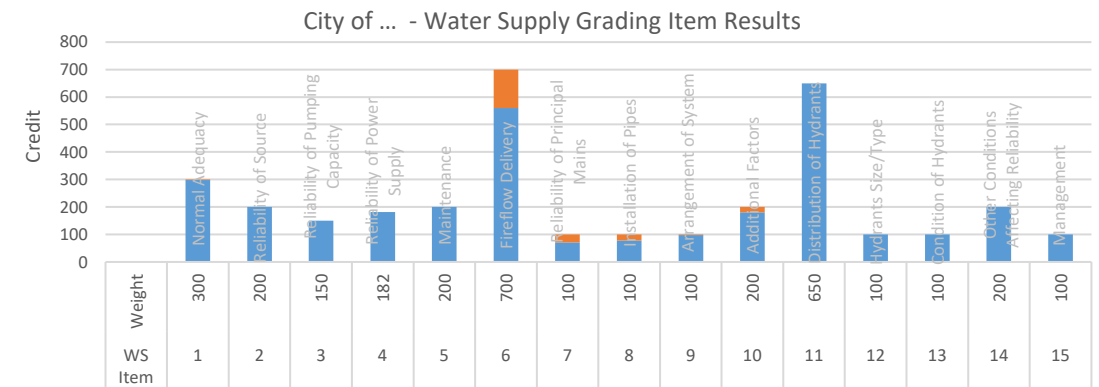
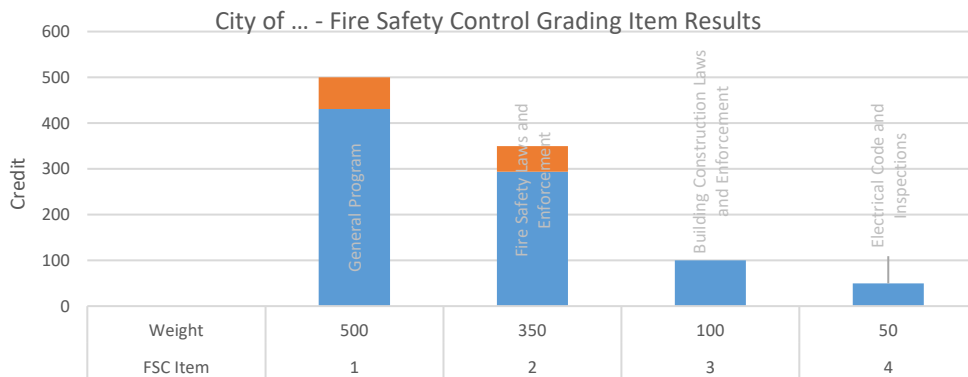
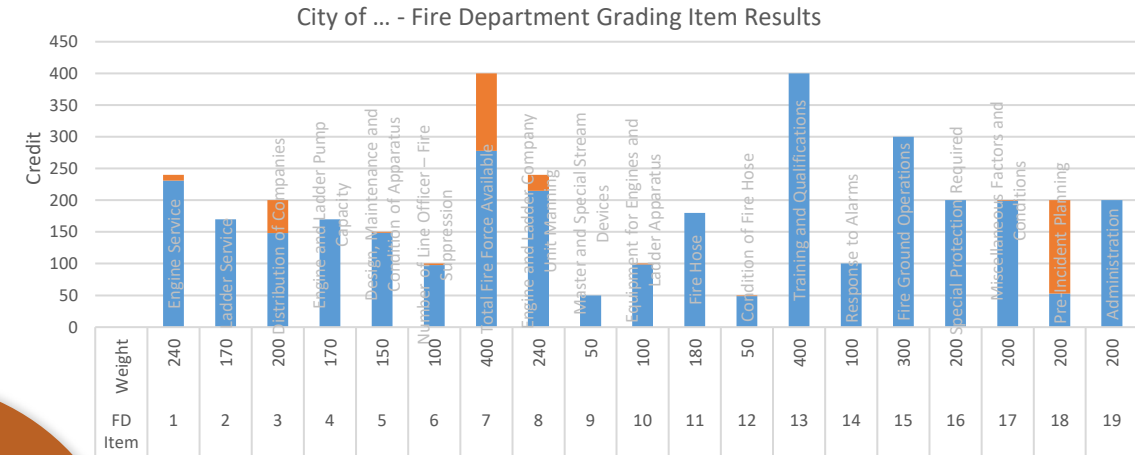
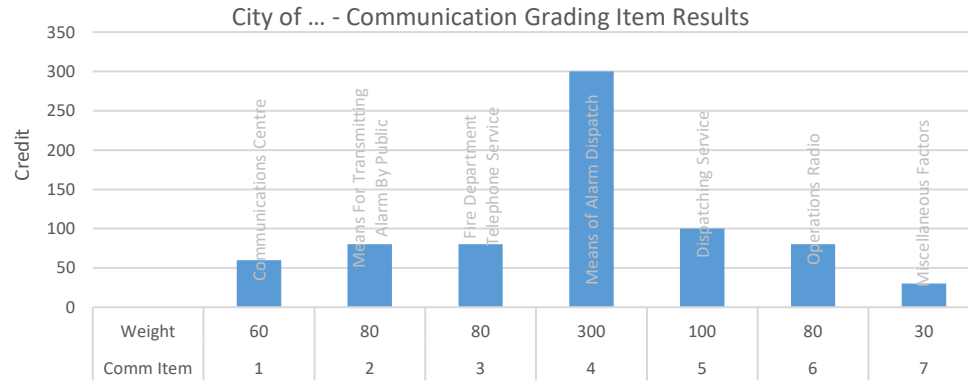
Further adjustments based on:

- Sprinkler systems
- Occupancy
- Exposures

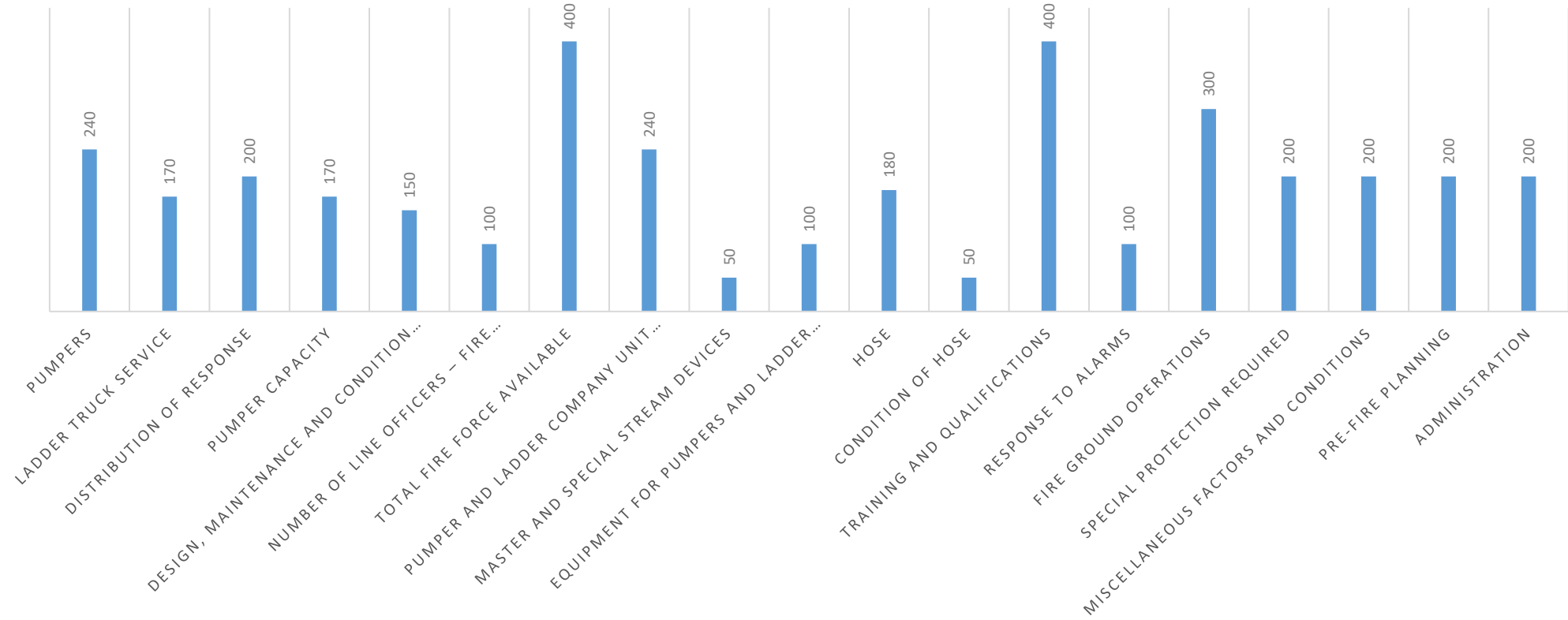
See: Water Supply for Public Fire Protection in Canada 2020



## PFPC Breakdown



## CANADIAN FIRE DEPARTMENT CREDIT AREAS

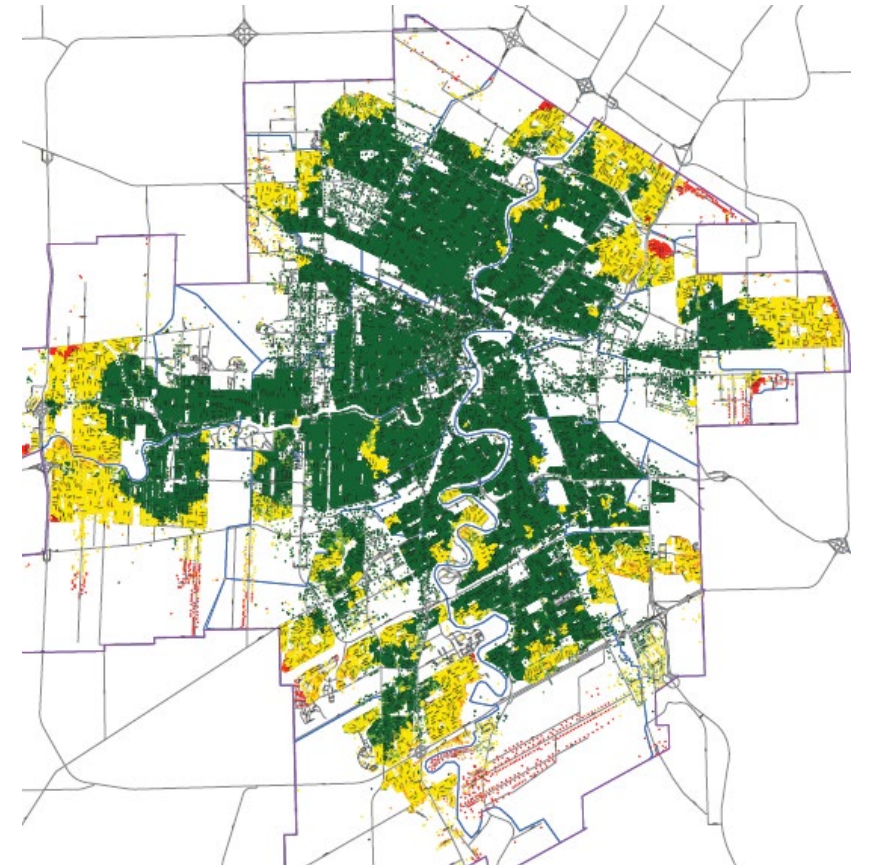




# Fire Department Focus Areas

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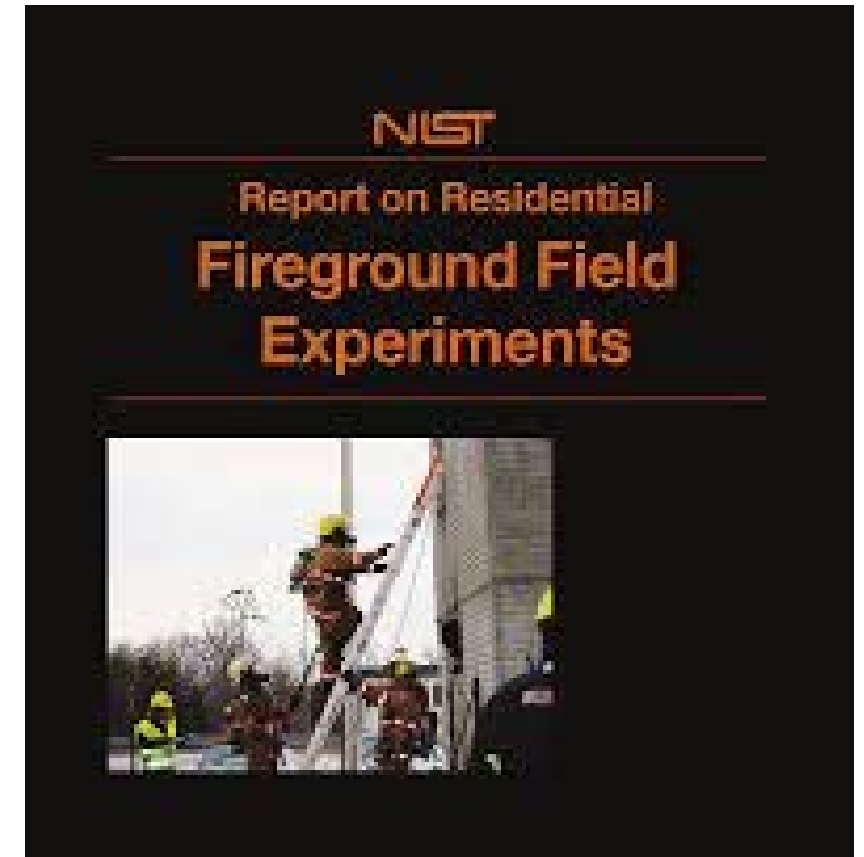
- Risk Controls (keep Required Fire Flows lower)
  - Response Effectiveness relative to the risk in the built environment
    - Response Capacity
      - Available Fire Force
      - Layers of response
- Training
- Response Times - Distribution
- Apparatus
- Other Equipment
- Facilities
- Organization and Administration
- Special Hazards



# Response Strength and Operational Effectiveness NIST 2010

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- Overall Scene Time
  - ***“The four-person crews operating on a low-hazard structure fire completed all the tasks on the fireground (on average) seven minutes faster—nearly 30%—than the two-person crews. The four-person crews completed the same number of fireground tasks (on average) 5.1 minutes faster—nearly 25%—than the three-person crews. On the low-hazard residential structure fire, adding a fifth person to the crews did not decrease overall fireground task times. However, it should be noted that the benefit of five-person crews has been documented in other evaluations to be significant for medium- and high-hazard structures, particularly in urban settings, and is recognized in industry standards.***
- Time to Water on Fire
  - *There was a 10% difference in the “water on fire” time between the two- and three-person crews. There was an additional 6% difference in the “water on fire” time between the three- and four-person crews. (i.e., four-person crews put water on the fire 16% faster than two person crews). There was an additional 6% difference in the “water on fire” time between the four- and five-person crews (i.e. **five-person crews put water on the fire 22% faster than two-person crews**).*
- Ground Ladders and Ventilation
  - *The **four-person crews** operating on a low-hazard structure fire completed laddering and ventilation (for life safety and rescue) **30% faster than the two-person crews** and 25% faster than the three-person crews.*



# Fire Force Credits

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- Heavily weighted
- Credit Scale 0-100%, maximum credit for on-duty responses
- Affects multiple areas within grading
- Measure the amount of credit for effective levels of response to each protected property and zone for first due through total concentration
- Information is aggregated at the response zone level, and at the community level
- Communities can get credit for responders that are called back if there is a formal written arrangement
- Communities can get credit for Auto and Mutual Aid if there is a formal written agreement





# Fire Apparatus

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- Designed to ULC S515 or NFPA 1901
- Third Party Certification
- Capacity to deliver Required Fire Flows
- Maintenance Programs
- Testing and Records
- Ancillary equipment
- Replacement cycle



# Firefighter Training Programs



Well documented



Records must be available  
for review



Training program aligned  
with SOG's



Training program  
integrates pre-incident  
planning

# Water Supplies

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- Available fire flows
- Hydrant Coverage
- Maintenance and records
- Alternatives to hydrants
- Key issue – Building Codes and Acts may limit communities ability to require adequate water for manual fire fighting
- Issue – defining manual fire fighting for the Building Code



# Concerns



Building Code: Communities may be prevented from providing adequate water supplies for manual fire fighting due to misinterpretation of what is manual fire fighting.

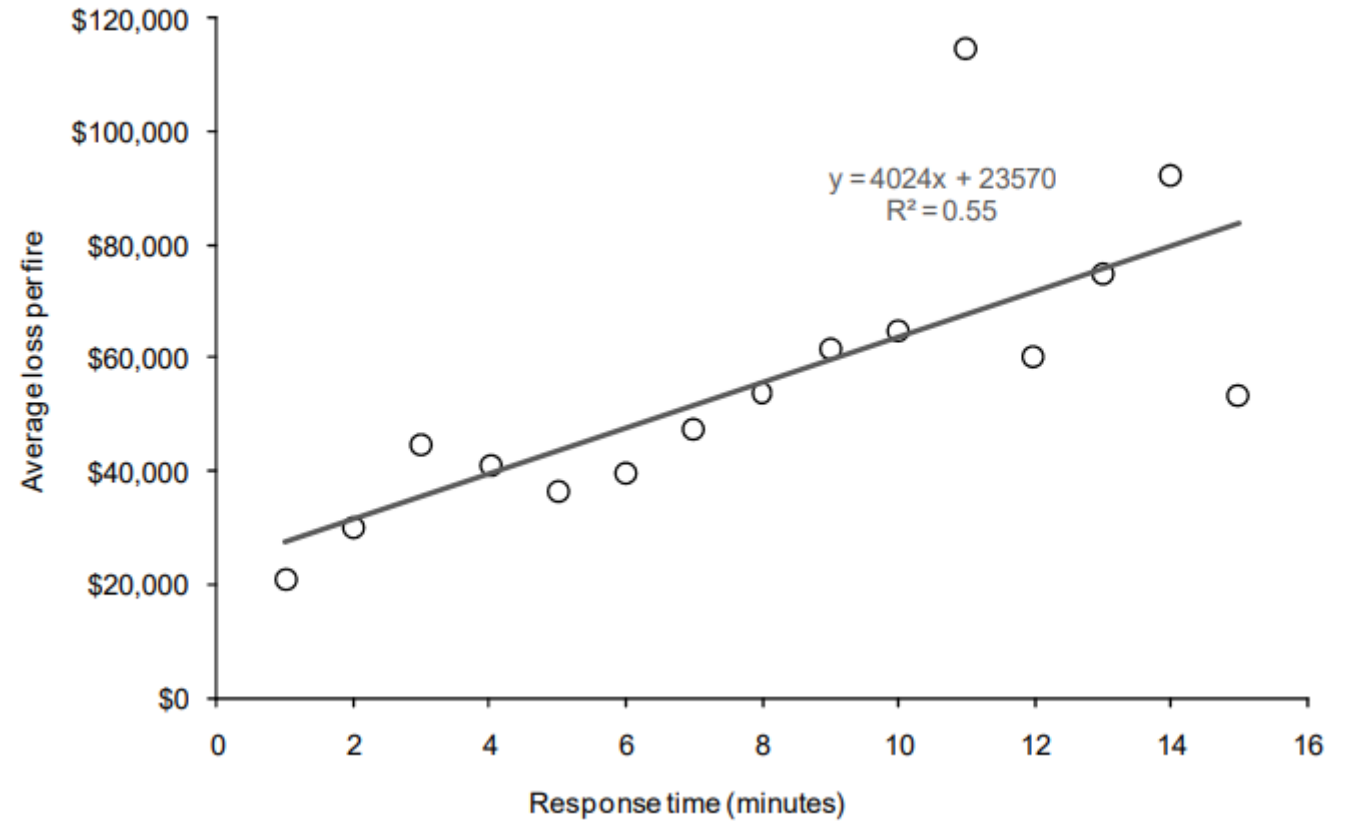


Building Act: Communities may be limited or prevented from providing a reasonable level of fire safety by using fire sprinklers in specific hazards or areas where standards of response are inadequate for the fire risk level.



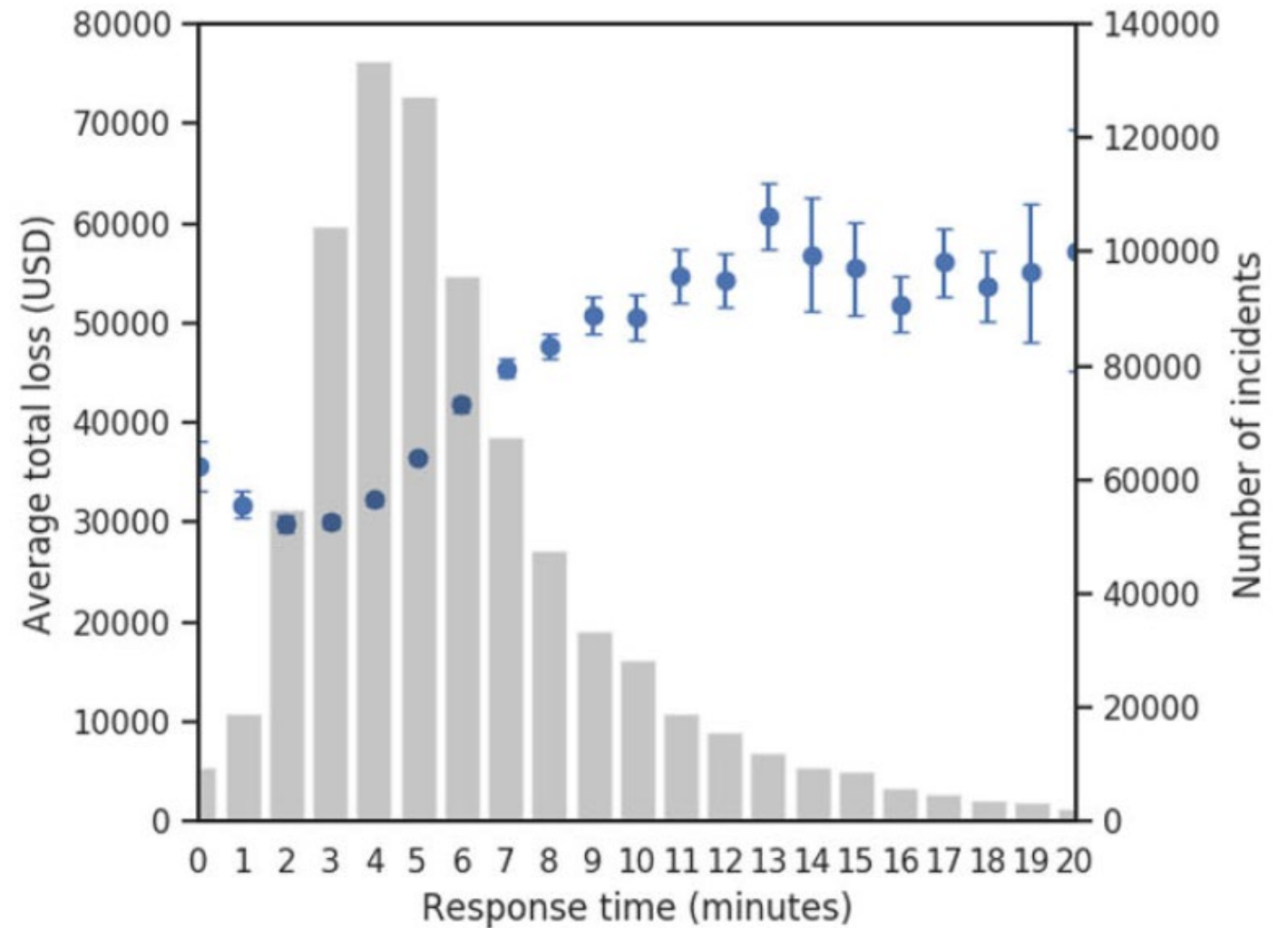
## Relationship Between Response Time and Loss

- Cost of damage increases with response time at the rate of approximately NZ\$4,000 per minute per fire in study published by Challands, “The Relationships Between Fire Service Response Time and Fire Outcomes”



## Relationship Between Response Time and Loss

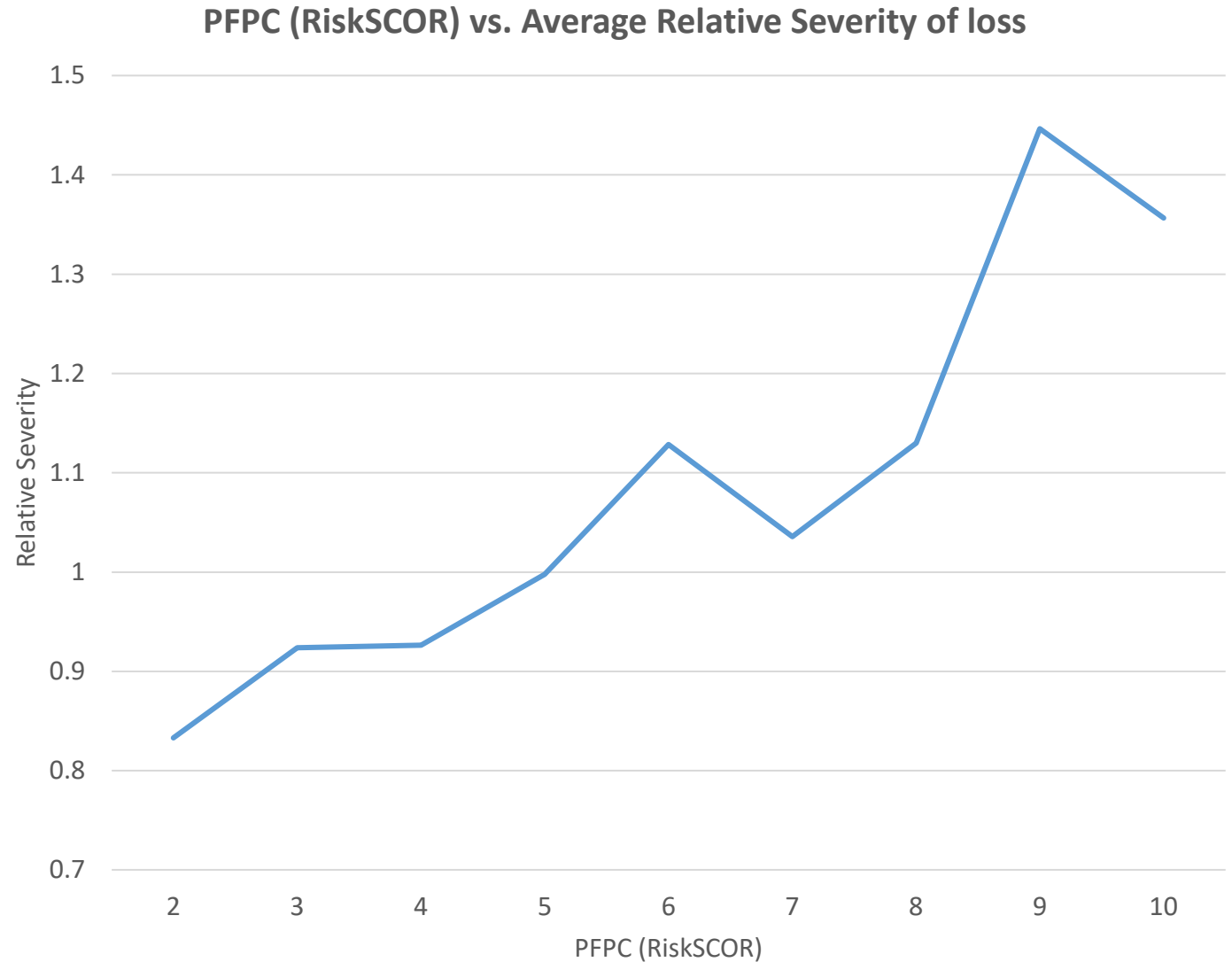
- Similar results created for US study using NFIRS data published in report “Statistical Analysis of Fire Department Response Times and Effects on Fire Outcomes in the United States. “



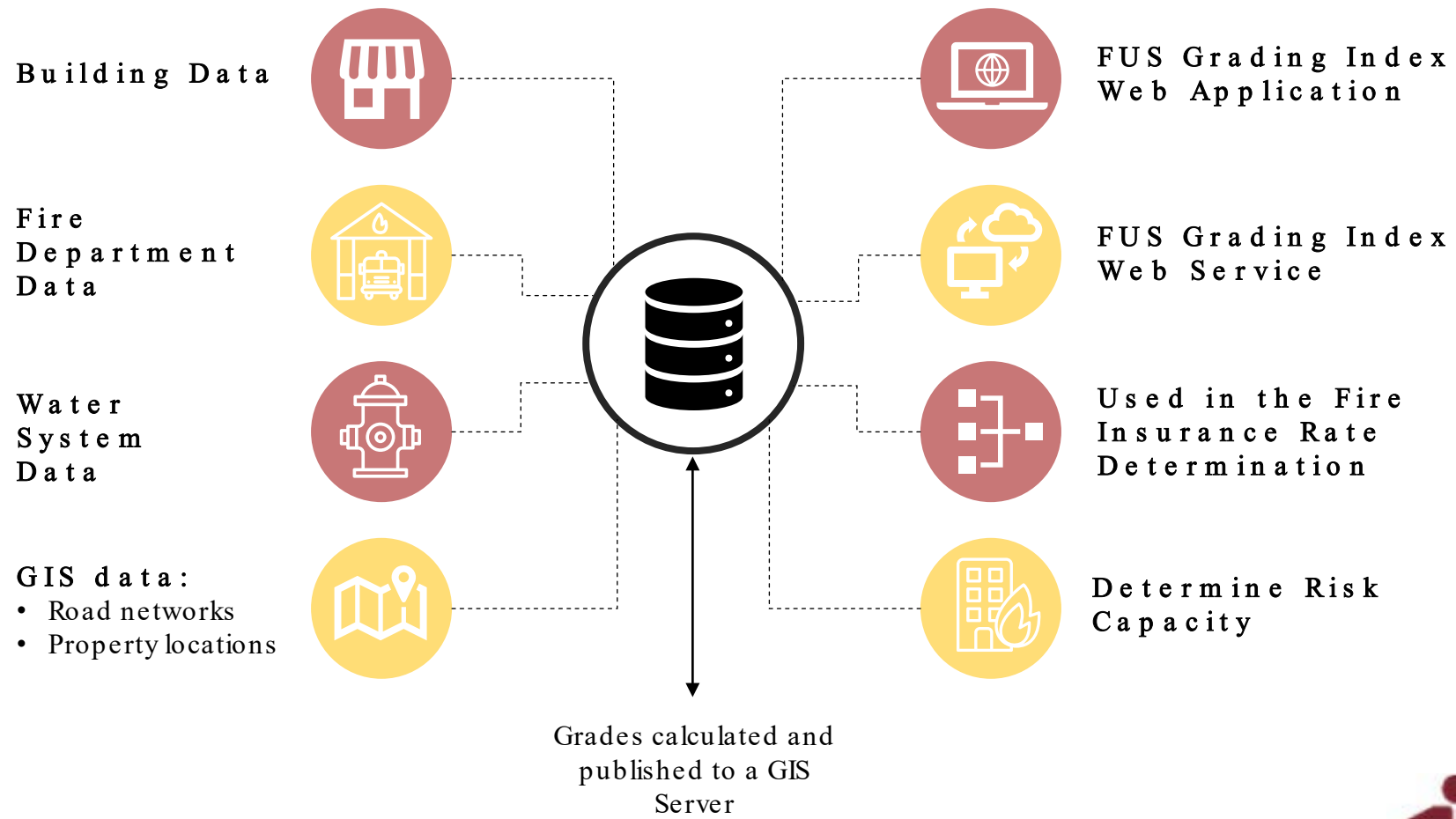


# Loss Correlation: Fire Grades and Claim Severity

*Compared over 13k records of Canadian fire losses over a 10 year period (dollar amount paid out) against the adjusted Public Fire Protection Classification (PFPC).*



# The Fire Insurance Grading Index of FUS



Property level details in assessing the Public fire protection

# FIRE INSURANCE GRADING INDEX – LATEST RELEASE

PROPERTY-LEVEL FIRE PROTECTION DETAILS BUILT ON GIS TECHNOLOGY

## BETTER GEO-CODING

We have moved the Grading Index to GIS server technology which allows better access to our civic address data which means better geo-coding accuracy. We now also include “geocode accuracy” information.

## LAT/LONG AND DLS SEARCH

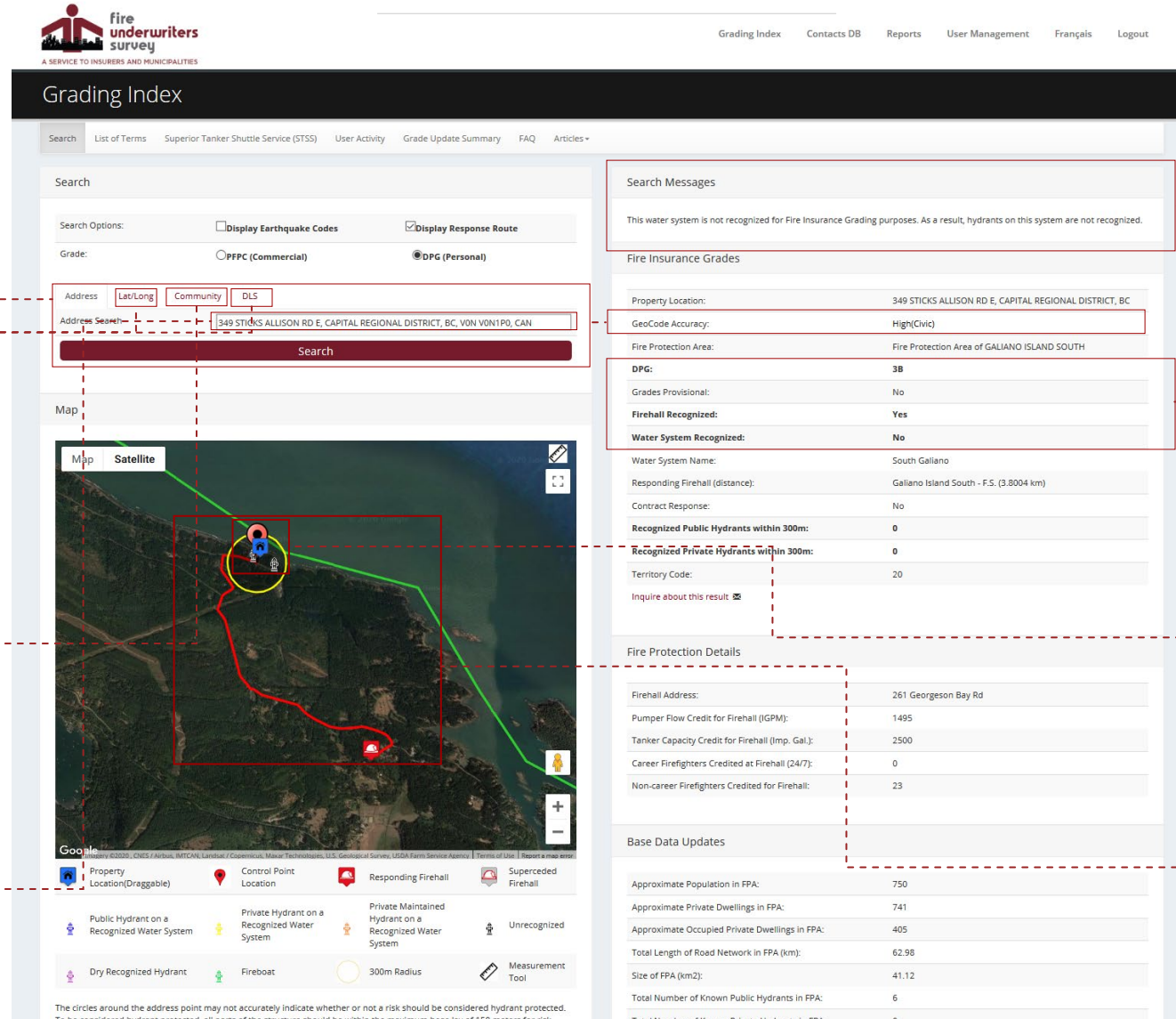
Find the Fire Insurance Grades for an exact location. More location search options.

## VIEW GRADE MAPS

Use the Community search feature to view Grade Maps for the entire community. See where the Grades change throughout the community.

## ADDRESS PRE-FILL

The address search is now pre-filled with municipal civic address data (where available). Municipal civic address data is the highest quality address location data. The address search also allows for much better address matching capabilities.



**Grading Index**

Search | List of Terms | Superior Tanker Shuttle Service (STSS) | User Activity | Grade Update Summary | FAQ | Articles

Search Options: ☐ Display Earthquake Codes ☒ Display Response Route

Grade: ☐ PFPC (Commercial) ☒ DPG (Personal)

Address:  Lat/Long:  Community:  DLS:

Address Search:  349 STICKS ALLISON RD E, CAPITAL REGIONAL DISTRICT, BC, V0N1P0, CAN

Search

Map

Map | Satellite

Search Messages

This water system is not recognized for Fire Insurance Grading purposes. As a result, hydrants on this system are not recognized.

Fire Insurance Grades

Property Location:	349 STICKS ALLISON RD E, CAPITAL REGIONAL DISTRICT, BC
GeoCode Accuracy:	High(Civic)
Fire Protection Area:	Fire Protection Area of GALIANO ISLAND SOUTH
DPG:	3B
Grades Provisional:	No
Firehall Recognized:	Yes
Water System Recognized:	No
Water System Name:	South Galiano
Responding Firehall (distance):	Galiano Island South - F.S. (3.8004 km)
Contract Response:	No
Recognized Public Hydrants within 300m:	0
Recognized Private Hydrants within 300m:	0
Territory Code:	20
Inquire about this result:	<a href="#">Inquire about this result</a>

Fire Protection Details

Firehall Address:	261 Georgeson Bay Rd
Pumper Flow Credit for Firehall (GPM):	1495
Tanker Capacity Credit for Firehall (Imp. Gal.):	2500
Career Firefighters Credited at Firehall (24/7):	0
Non-career Firefighters Credited for Firehall:	23

Base Data Updates

Approximate Population in FPA:	750
Approximate Private Dwellings in FPA:	741
Approximate Occupied Private Dwellings in FPA:	405
Total Length of Road Network in FPA (km):	62.98
Size of FPA (km2):	41.12
Total Number of Known Public Hydrants in FPA:	6
Total Number of Known Private Hydrants in FPA:	0

Property Location(Draggable) | Control Point Location | Responding Firehall | Superceded Firehall

Public Hydrant on a Recognized Water System | Private Hydrant on a Recognized Water System | Private Maintained Hydrant on a Recognized Water System | Unrecognized

Dry Recognized Hydrant | Fireboat | 300m Radius | Measurement Tool

The circles around the address point may not accurately indicate whether or not a risk should be considered hydrant protected. To be considered hydrant protected, all parts of the structure should be within the maximum hose lay of 150 meters for risk.

## SEARCH MESSAGES

When warranted, search messages are now provided to better understand cases such as private hydrants or unrecognized water systems.

## EASILY IDENTIFY GRADE AND RECOGNITION

Quickly identify the Fire Insurance Grade and whether a fire hall or water system is recognized.

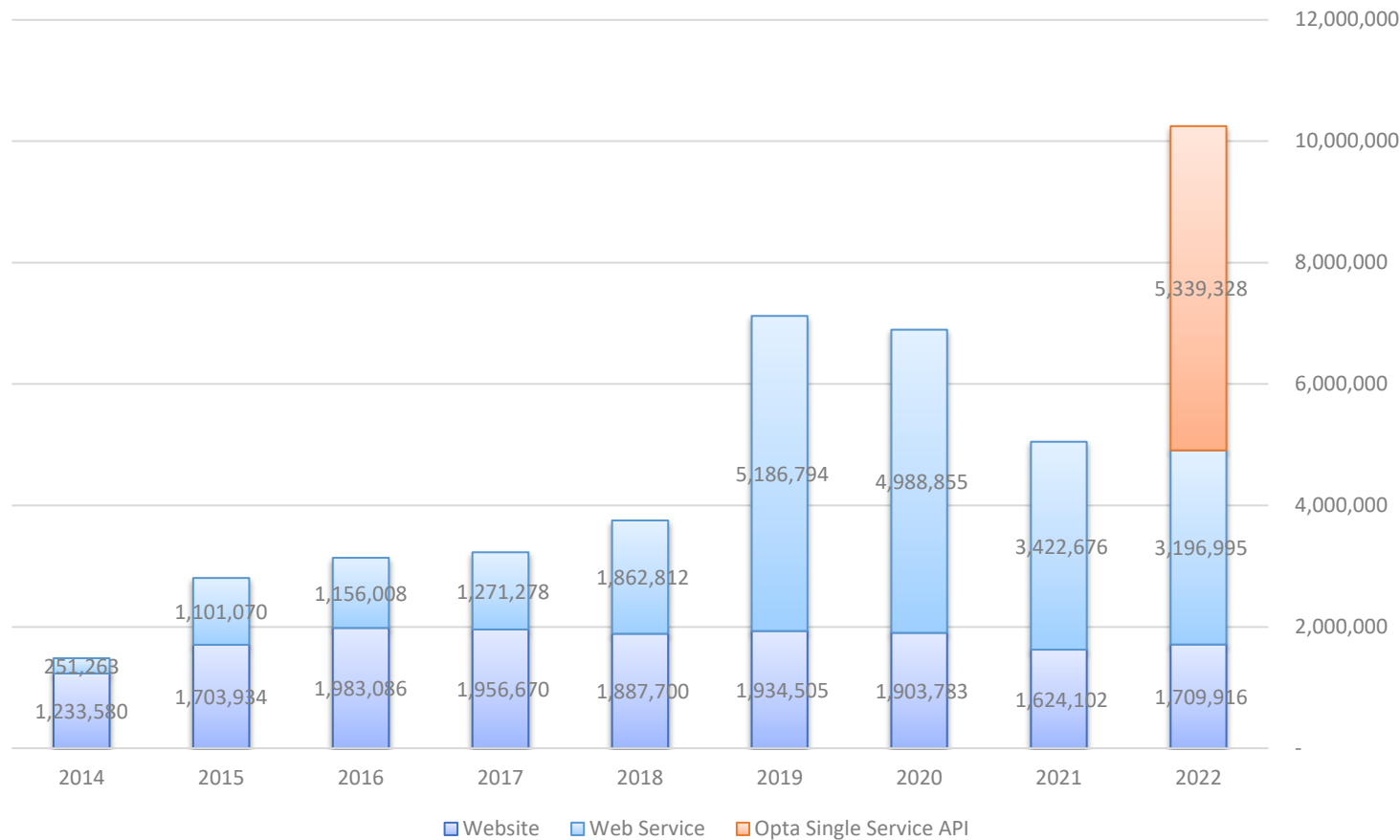
## DRAG-DROP SEARCH

Drag-and-drop the building icon to find the property details for a specific location

## ENHANCED GIS ROUTING

Shortest GIS routing from a fire hall to a property.

# Canadian Fire Insurance Grading Index Usage

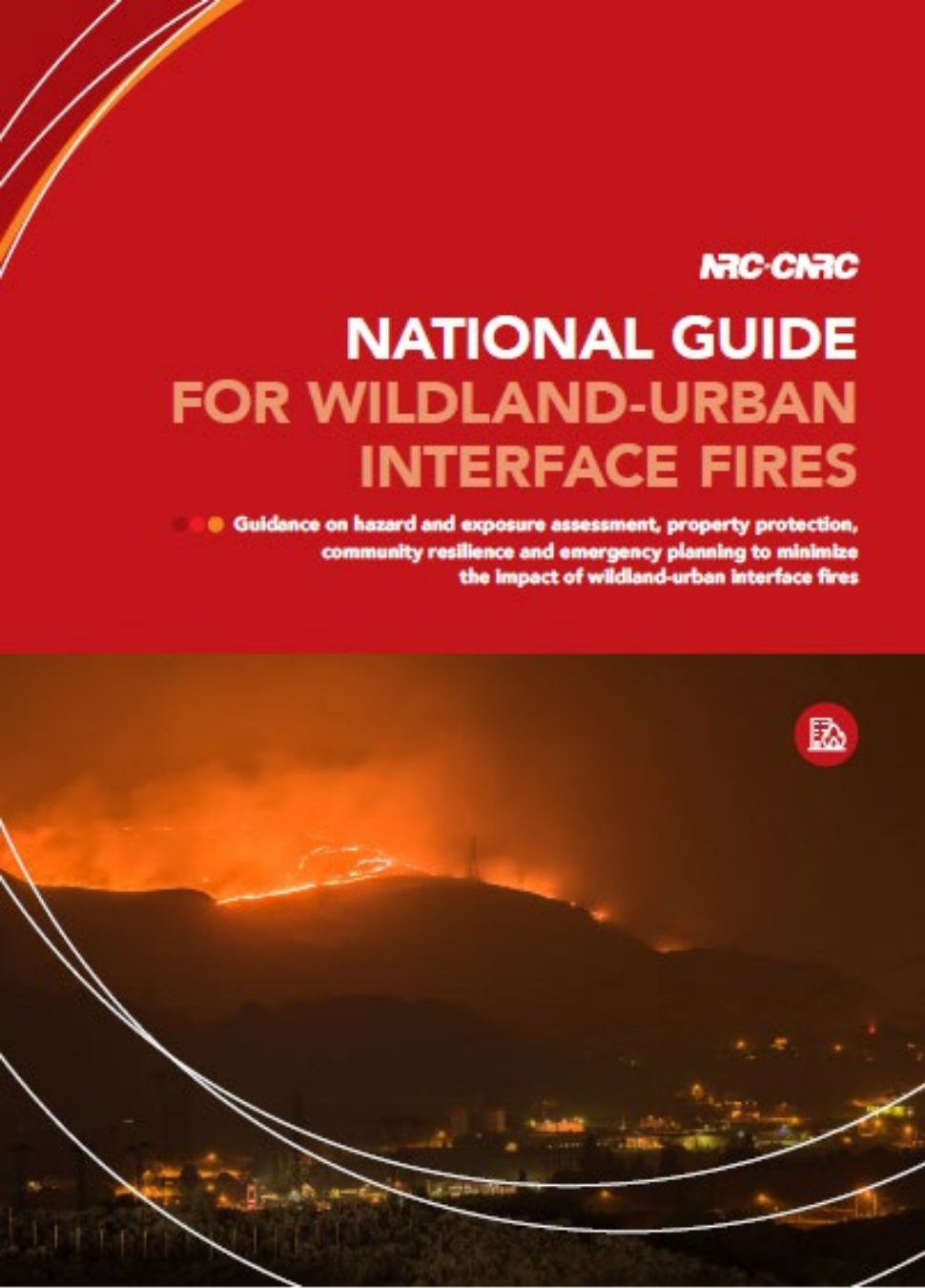


- Usage of the Index has increased dramatically over the past 10 years
- Major factors:
  - Digitization of systems
  - Automation of insurance underwriting systems
  - Insurance industry development of Broker Management Systems (ex. Applied, Vertafore, Guidewire, etc.)

# New Areas of Focus



**Densification of neighborhoods and  
impacts on**



NRC-CNRC

# NATIONAL GUIDE FOR WILDLAND-URBAN INTERFACE FIRES

● ● ● Guidance on hazard and exposure assessment, property protection, community resilience and emergency planning to minimize the impact of wildland-urban interface fires



## Wildland Urban Interface

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- New guidance available through National Research Council
- Provides comprehensive guidance on hazard and exposure assessment
- Work is ongoing to improve and update hazard mapping and possibly integrate to National Building Code (for new construction), possibly in Table C-2, Climatic Design Data for Selected Locations

(Bénichou, 2021)





# Wildland Urban Interface Fires

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- Large Outdoor Fires present significant challenges to local Fire Departments
- Past forest management practices have increased fuels loading
- Climate change has increased duration and intensity of fire season
- There will be an increasing number of wildfires putting Canadian communities at risk
- Canadian Fire Departments need to assess their risk and prepare to respond effectively
- Lytton Wildfire Disaster post fire analysis illustrates a Structure Ignition Problem (Cohen, Westhaver, 2022)
- Structure to structure fire spread caused majority of damage



# WUI Preparation



**Assess Risk**



**Form a Committee of Stakeholders**



**Establish a plan with priorities to mitigate risk where appropriate**



**Develop partnerships and practice with provincial and aid agencies**

# WUI Mitigation

FireSmart Canada has many resources

Buildings and properties in “at risk” areas should be inspected at a frequency commensurate with risk level

Inspectors should be qualified

Recommendations should encourage compliance and improvement of risk for location and exposures

Incentives should be used to encourage risk improvement

Bylaws and other tools (ex. Development Permit Areas) should be used to assist with managing risk in built environment



# Key Areas of Advocacy

- Insurers factor Public Protection levels into premium rates  
–*advocate for insurers to continue to adjust rates to reflect local investment in emergency response capacity*
- Water Supplies for Public Fire Protection, Building Codes and Acts – *advocate for adequate water for manual fire fighting*
- Changing areas of fire risk such as
  - Mass timber buildings and districts,
  - Lithium Ion Batteries,
  - Densified urban areas,
  - WUI Risk Zones,– *advocate for adequate resources for effective and safe response*





# Conclusion

- Using Fire Risk Indexes has helped Canadian communities to effectively control the risk of conflagrations from fires that start in structures and in communities.
- Fire Risk Indexes provide simplified, standardized numeric scores for fire risk for every insurable structure in Canada
- Fire Risk Indexes are connected to underwriting systems to provide cost benefit feedback loops that encourage local governments to be aware of risk, and to control risk
- Fire Risk Indexes provide a framework for standardization of risk control both in terms of prevention and suppression

# Thank you



**fire**  
**underwriters**  
**survey**

For more information, please  
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