UNIVERSITY OF ALBERTA
DEPARTMENT OF
RENEWABLE RESOURCES

Assessing Community Wildfire Exposure and Vulnerabilities in Alberta

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WILDFIRE ANALYTICS

City Building at the U of A
Conference 2024

Edmonton, October 24th, 2024

Connect

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Wildfire Analytics

EWF-031 near Edson, AB
May 4, 2023

Alberta has fire-prone landscapes

Provincial forest area

25.6 million hectares

(Provincial land area ~66.2 million hectares)

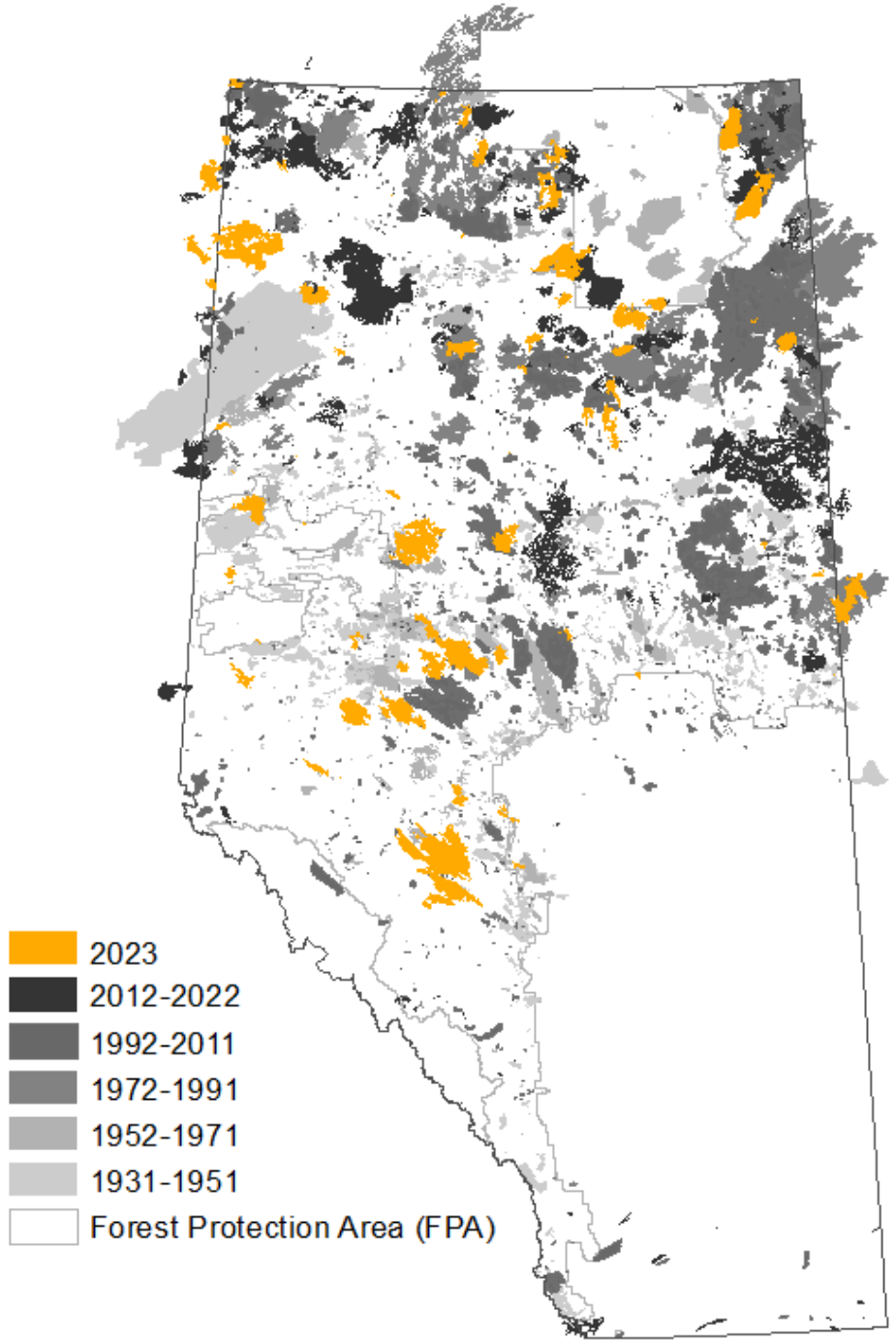
Forest area in the FPA

86%

Area burned 1918-2023

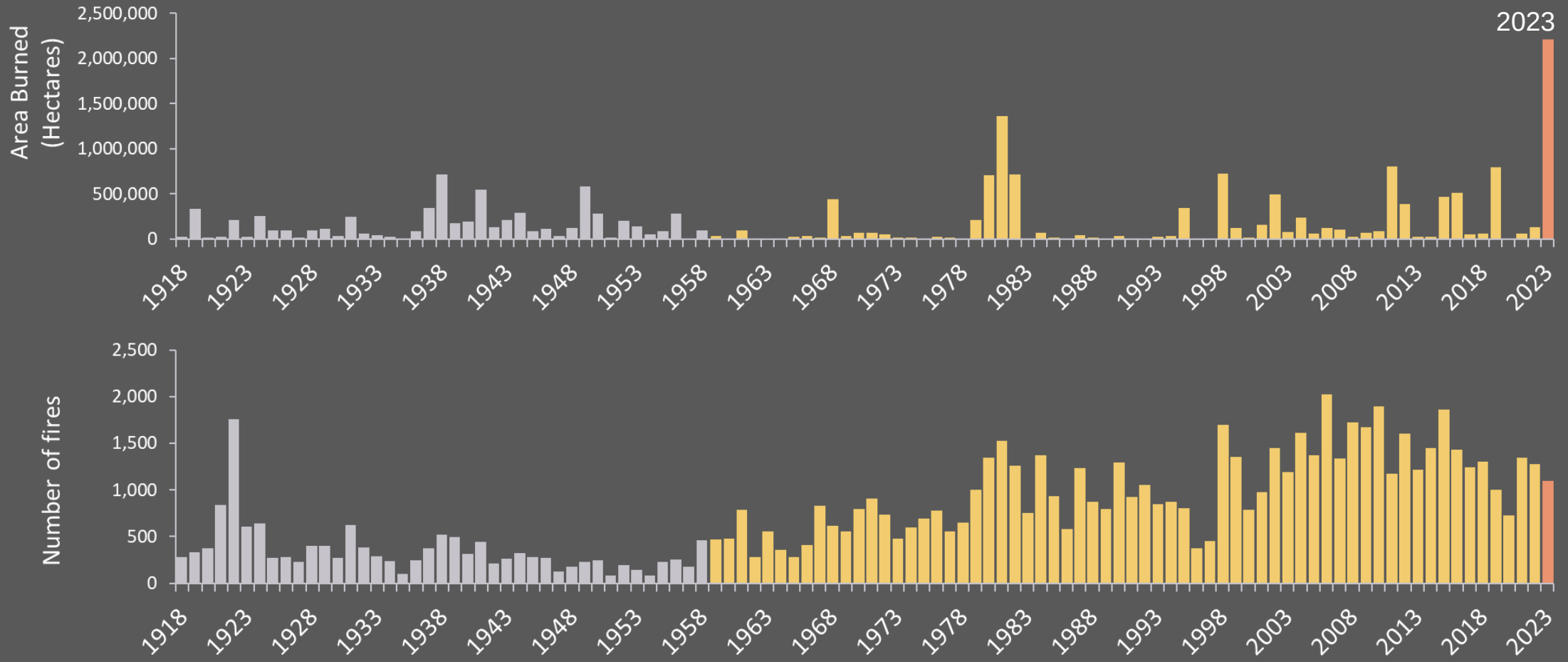
18.7 million hectares*

*Equivalent to ~85% of current forest area in the FPA



Area burned and numbers of fires 1918-2023

- 95% of area burned in 2023 was caused by **36 large fires ≥ 10,000 ha**
- These were **typical large fires** with respect to size, intensity, rate of spread and associated fire weather
- In 2023, **there were simply far MORE than usual**



Data source: 1961-2023 Alberta Forestry and Parks (2024), 1918-1960 Murphy (1985).

(Photo: Alberta Wildfire PWF034-2018)

Black spruce, lodgepole pine were built to burn

(Photo: Alberta Forestry and Parks, July 2023)

Wildfires have long posed threats to Canadian communities

Springer Link

Original Paper | Published: 20 March 2011

Wildfire evacuations in Canada 1980–2007

Jennifer L. Beverly & Peter Bothwell

Natural Hazards **59**, 571–596 (2011) | Cite this article

547 evacuations

497 homes destroyed

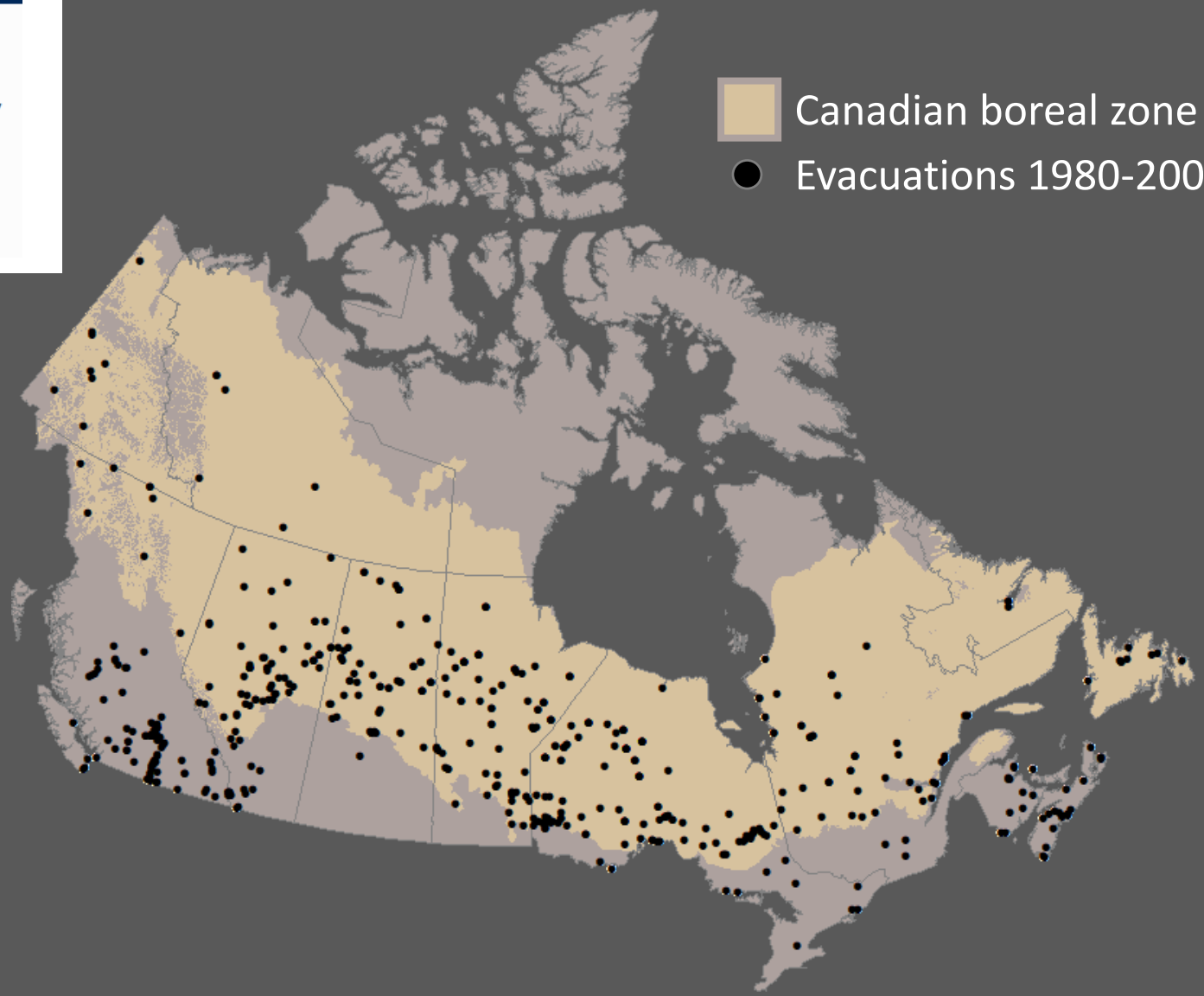
209,121 evacuees

Averages per year:

7,469 evacuated

18 homes lost

Civilian fatalities 1



2023: A single severe fire season affecting multiple regions that vary by forest type, management intensity and land use **suggests large-scale climatic factors figured prominently.**

Kelowna 2003

60-70 km h^{-1} winds
27,000 evacuated
239 homes destroyed
$200M in damages

Slave Lake 2011

80 km h^{-1} winds
7,000 evacuated
480 homes destroyed
$700M insured damages

Fort McMurray 2016

40 km h^{-1} winds
90,000 evacuated
2,500 dwelling units destroyed
$3.6B insured damages
2 indirect civilian fatalities

Lytton 2021

35 km h^{-1} winds gusting at 50 km h^{-1} or greater
1,000 evacuated
Village 90% destroyed
$78M insured damages
2 direct civilian fatalities

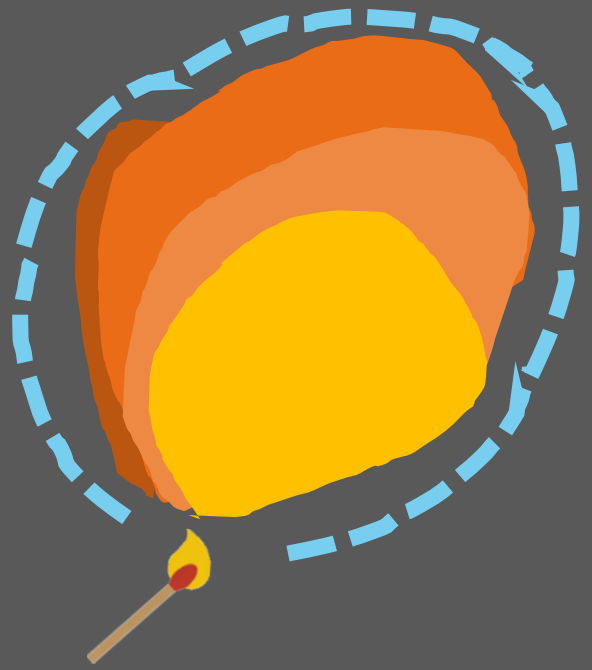
Jasper 2024

150 km h^{-1} winds
25,000 evacuated
358 structures destroyed
$880M insured damages
1 firefighter fatality

Fire disaster events have shifted emphasis from fire response to proactive mitigation

(Photos: Andy Clark/Reuters; Town of Slave Lake; Twitter.com/Jerome Garot/EPA; Edith Loring-Kuhanga/Facebook, CBC/RadioCanada)

Where can we expect fires to burn?

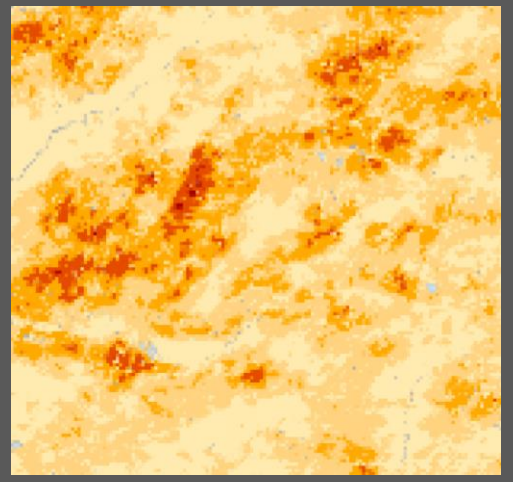


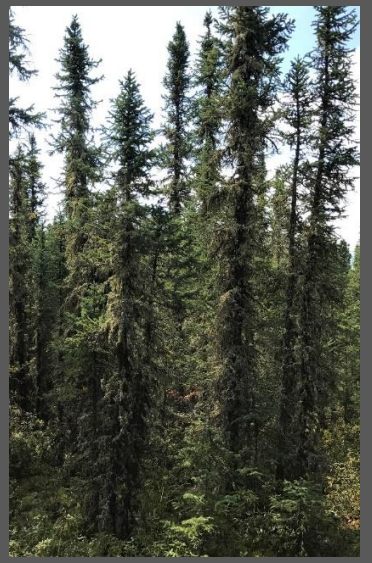
Fire Response

- Point location
- Minutes, hours, days
- Receptivity to ignition
- Spread distance
- Intensity, severity

Mitigation

- Landscape
- Next or several years
- Map hotspots
- Prioritize locations to treat (fuel reduction)





It takes a perfect storm…

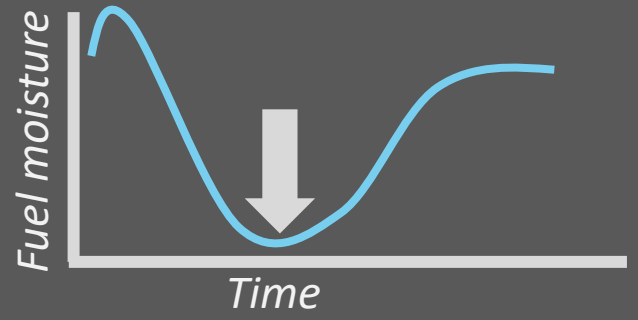
4 **Upwind of more places fire can transmit to**
(fuel aligned along wind trajectory)

3 **that receives an ignition**
(human, lightning, fire)

5 **Leading to a vulnerable location**
(potential negative impacts)

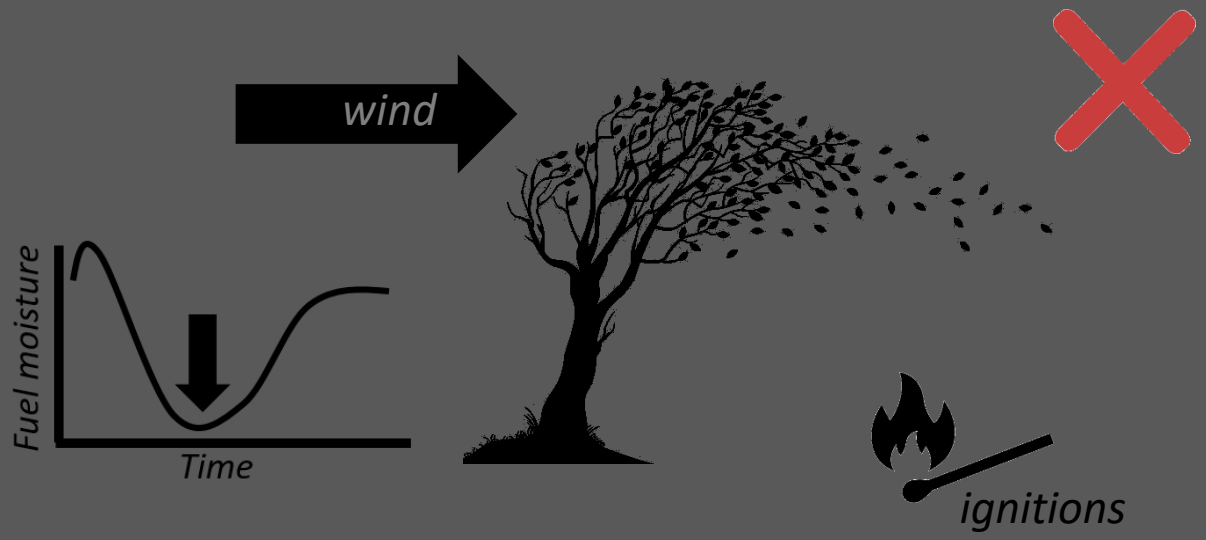
1 **a place fire can transmit to**
(fuel proximate to possible ignition sources)

2 **at a time when its receptive**
(fuel moisture is low – its dry)



Where can we expect fires? Focus on fixed not variable factors

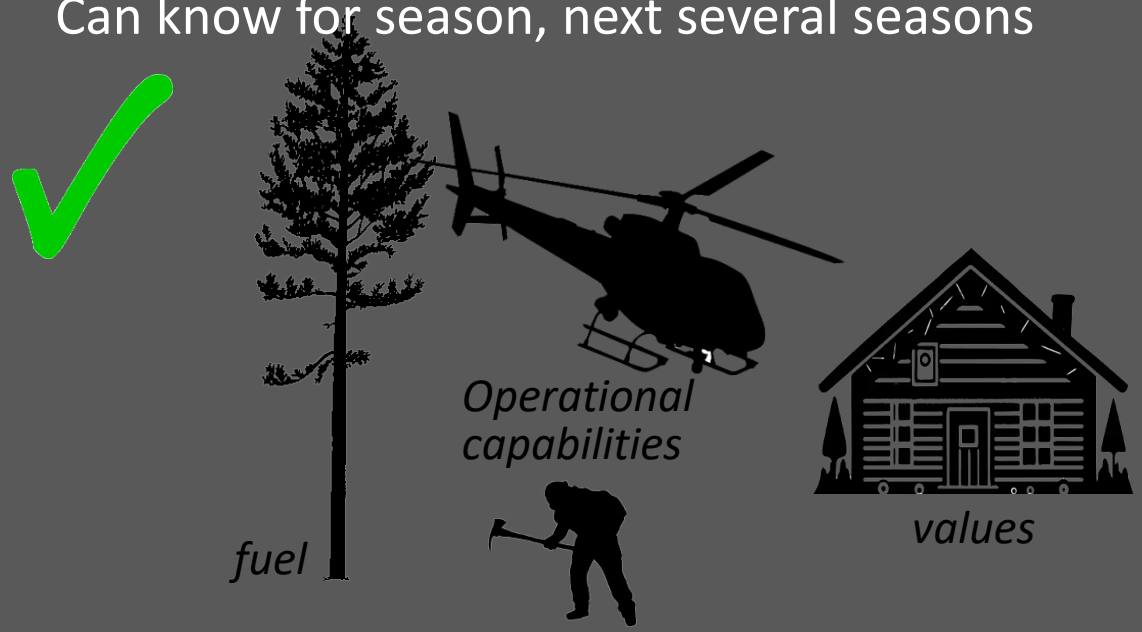
Can know today, next several days (at best)



- Fuel moisture (receptivity)
- Wind speed, direction
- Ignition agents

Highly variable within a fire season (lots of predictive uncertainty)

Can know for season, next several seasons



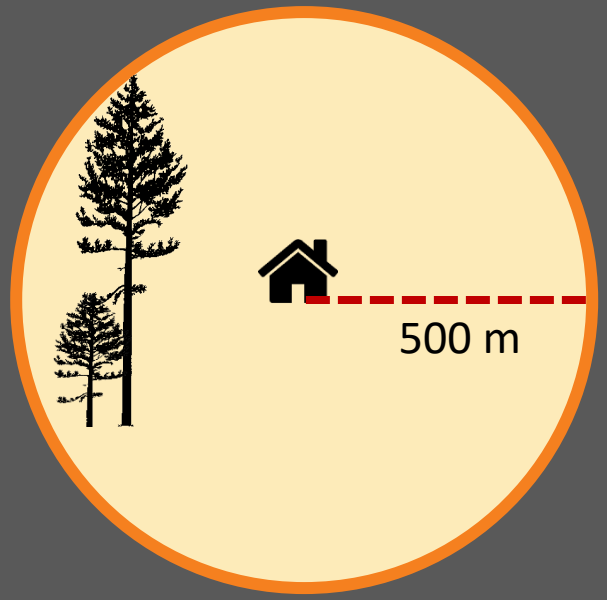
- What burns, where it is (fuel)
- Location of values (receptors)
- Operational capabilities

Mostly fixed within a fire season (lots of certainty)

Exposure based on transmission distances

International Journal of Wildland Fire **2010**, *19*, 299–313

Beverly et al. (2010)

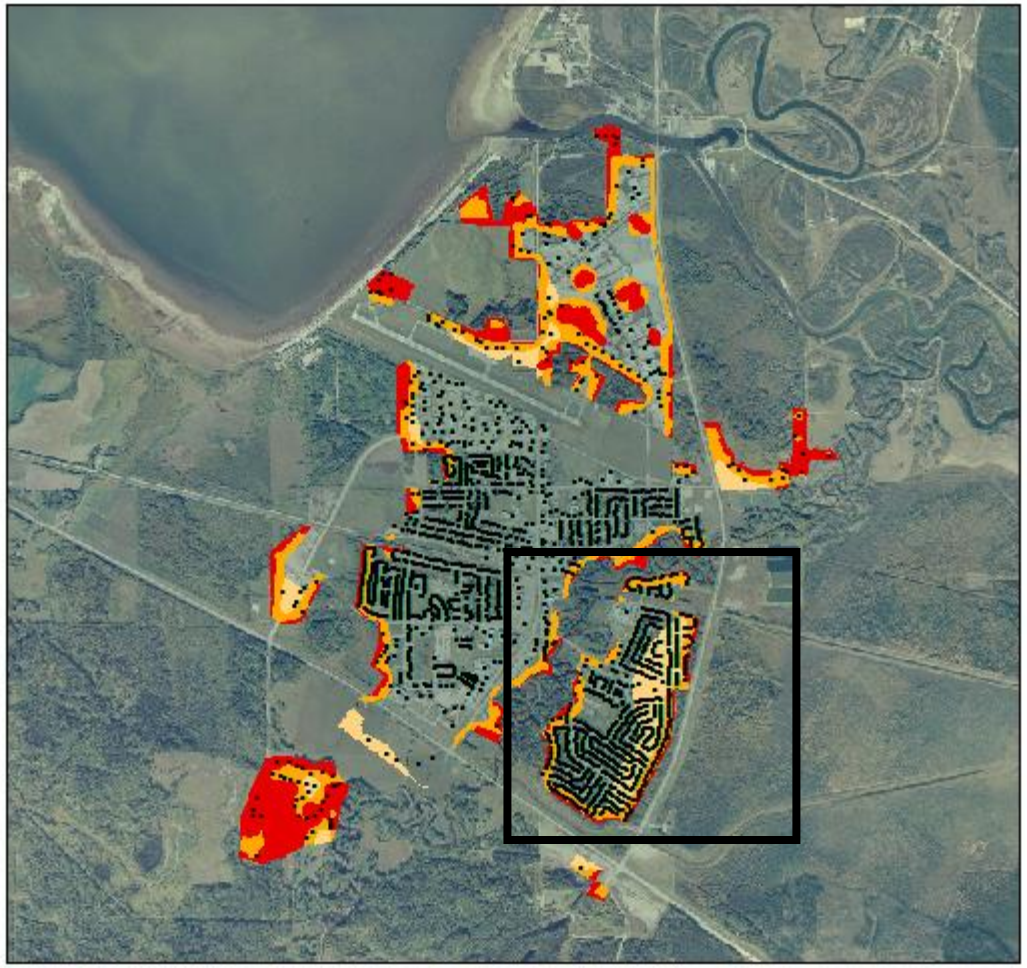


Longer range embers

Shorter range embers

Radiant Heat

Funded by Forest Resource Improvement Association of Alberta (FRIAA)



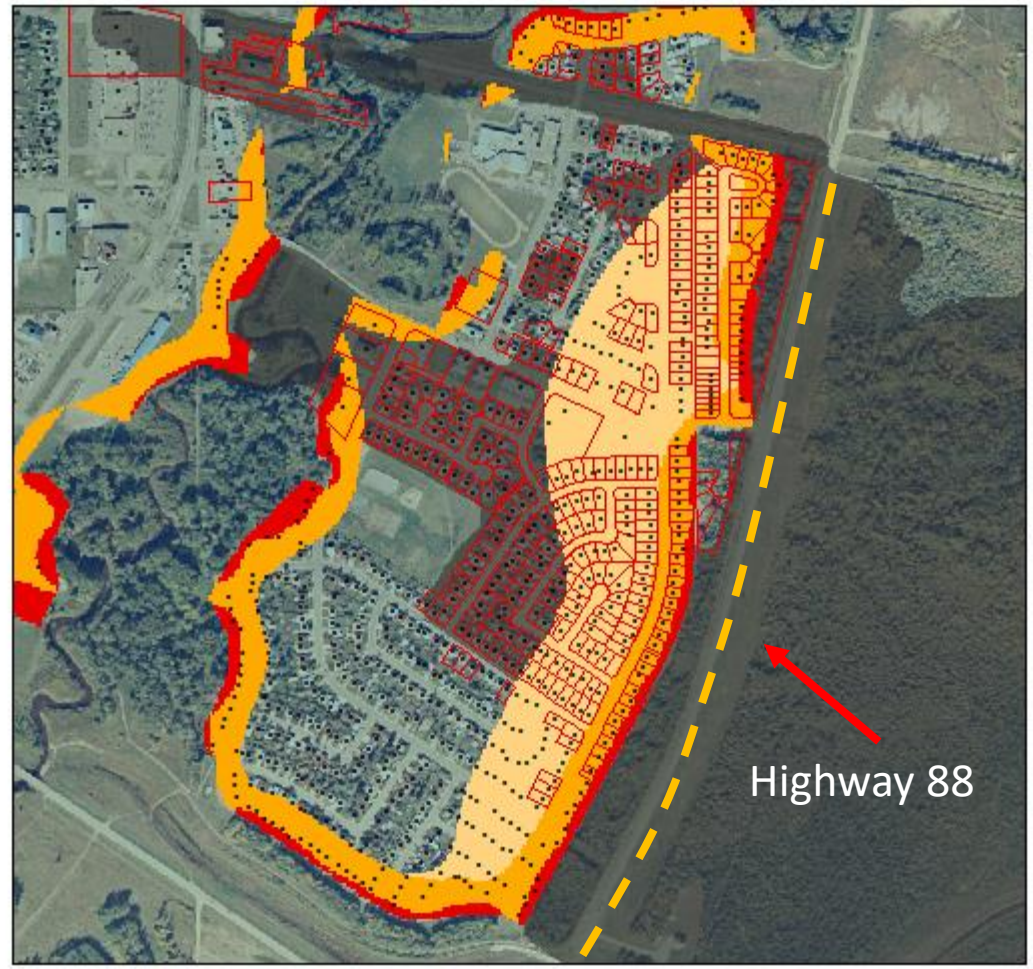
Exposure to Radiant Heat (30 m) ≥10%

Exposure to Shorter Range Embers (100 m) ≥10%

Exposure to Longer Range Embers (500 m) ≥10%

Structures

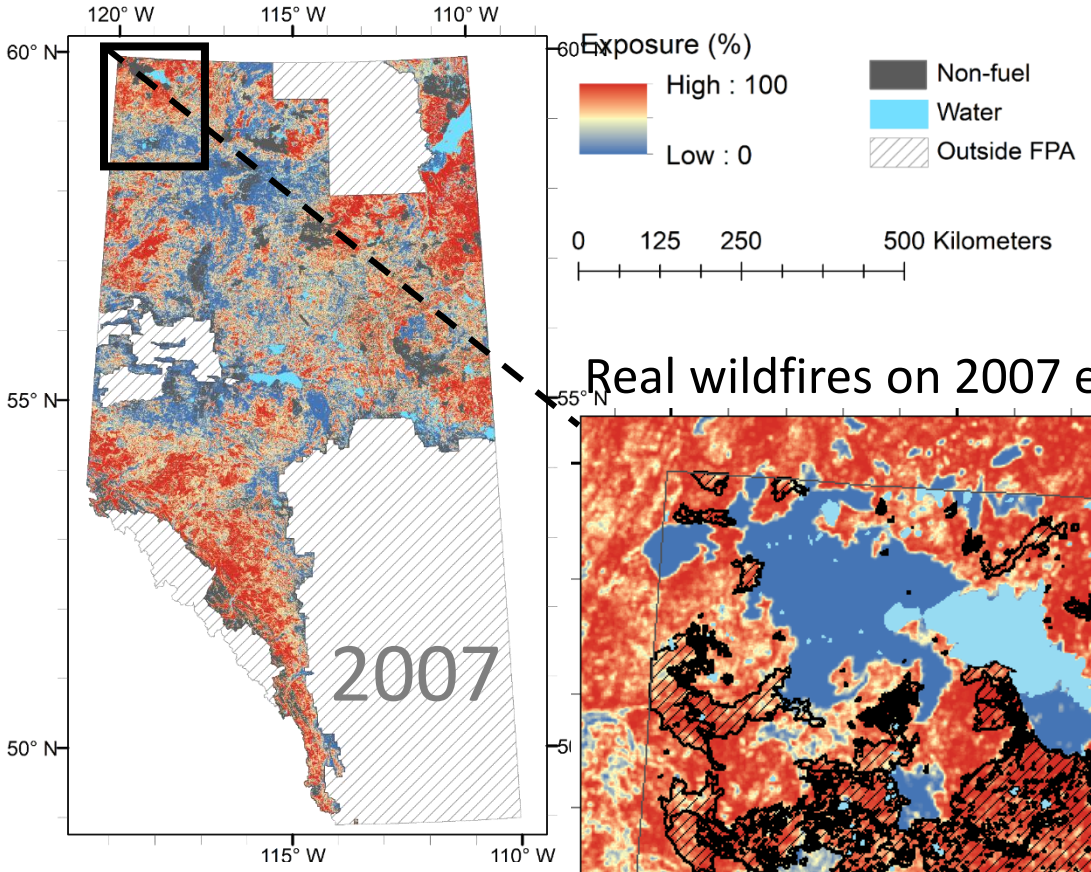
0 0.5 1 2 Kilometers



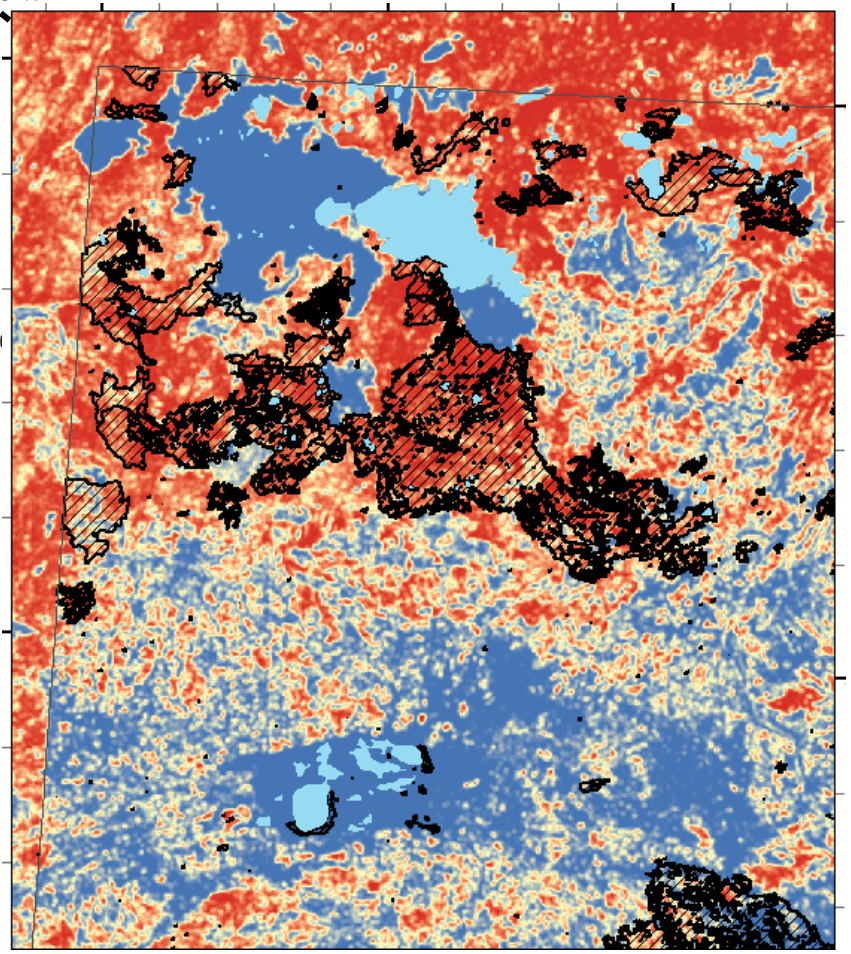
2011 structure damage

SWF-065-2011

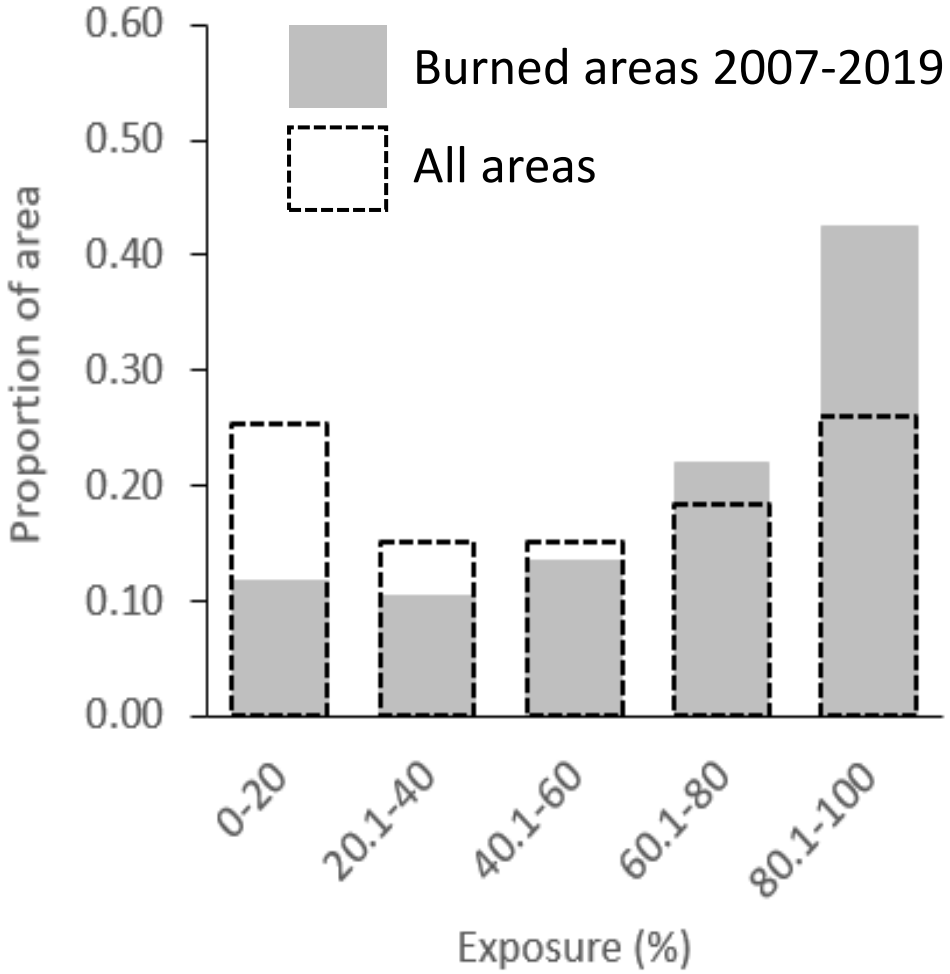
0 0.15 0.3 0.6 Kilometers



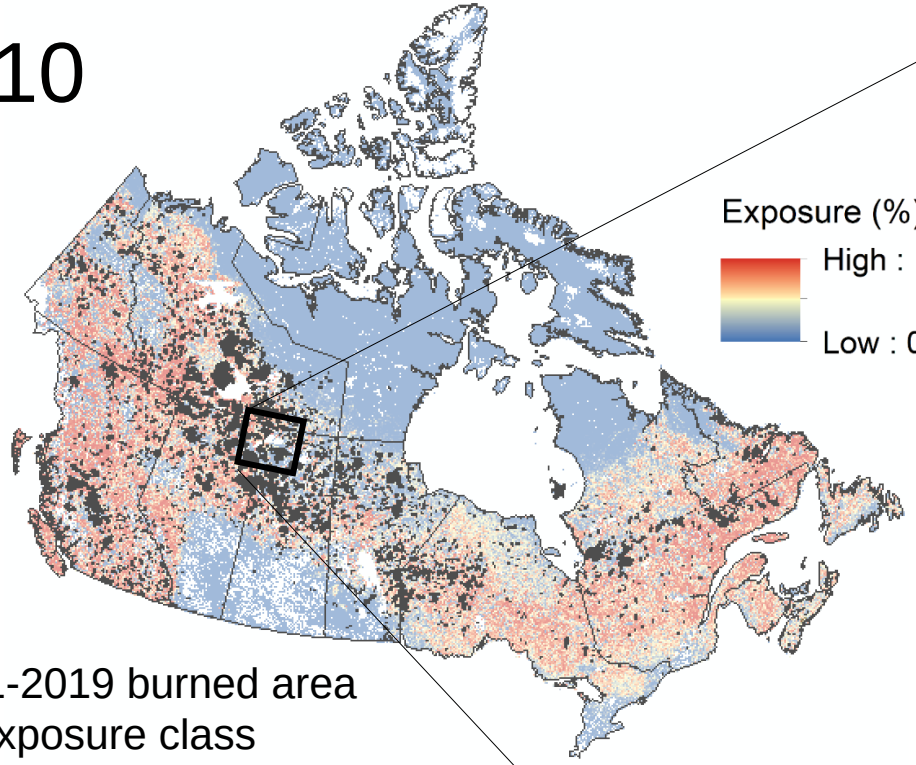
Real wildfires on 2007 exposure map



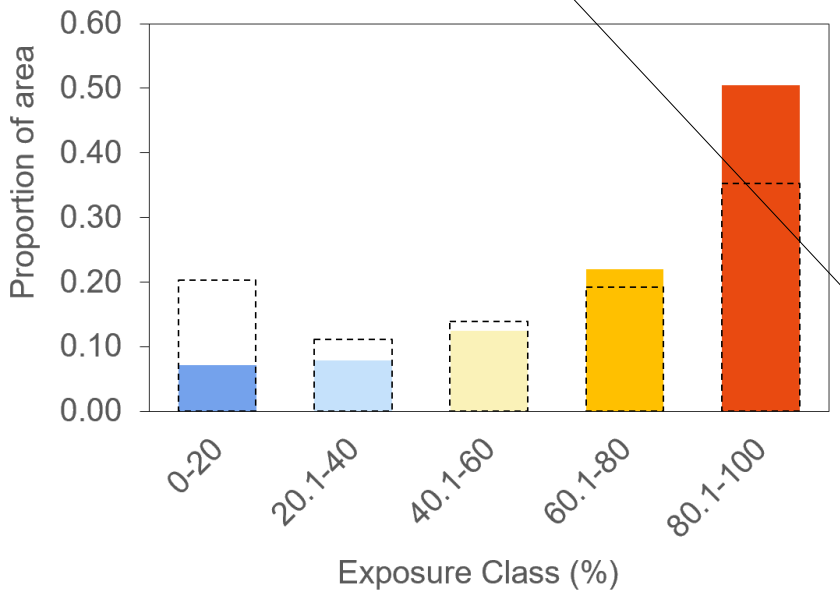
Beverly et al. (2021) Landscape Ecology 36: 785-801

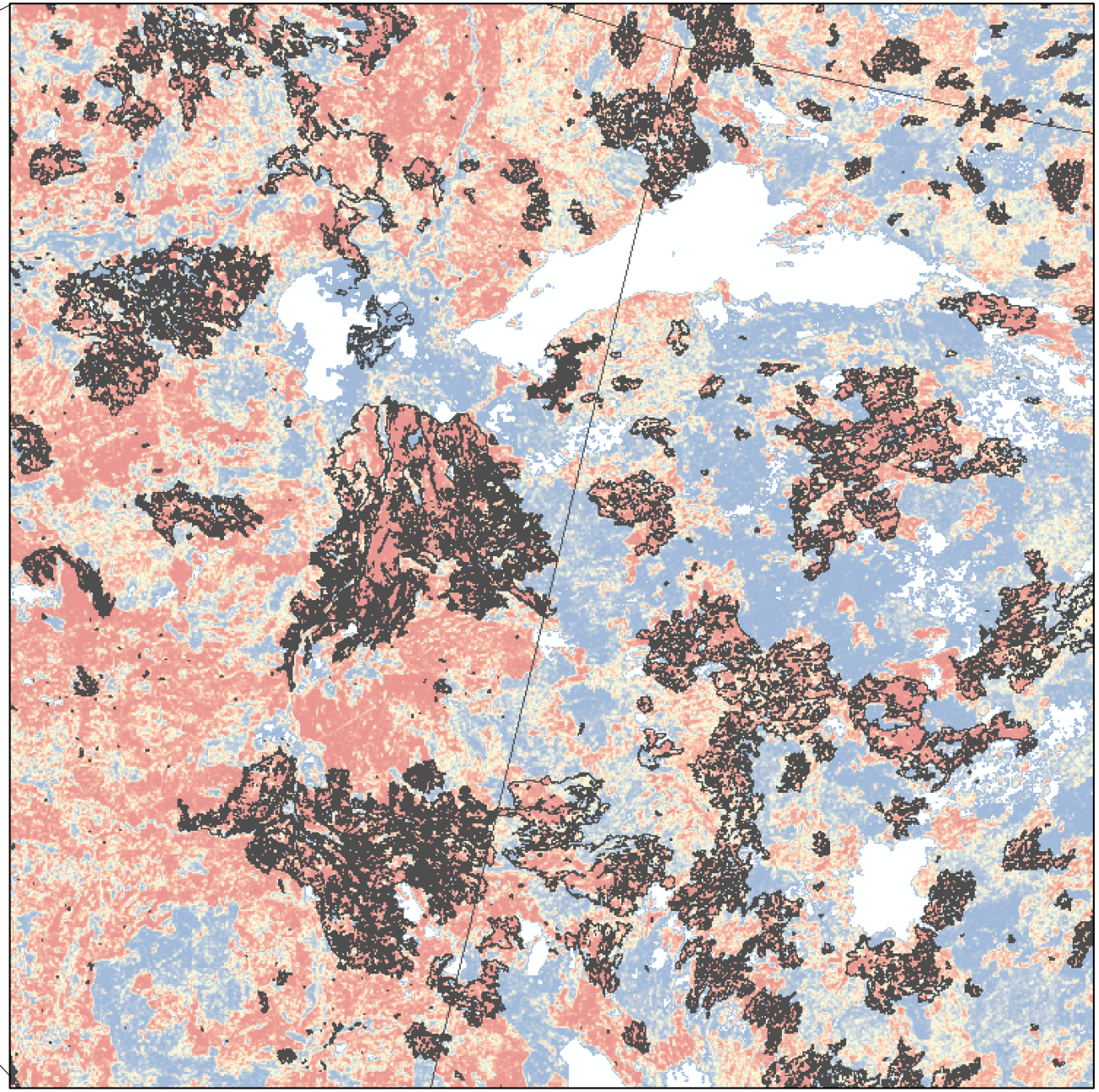


2010



2011-2019 burned area
by exposure class



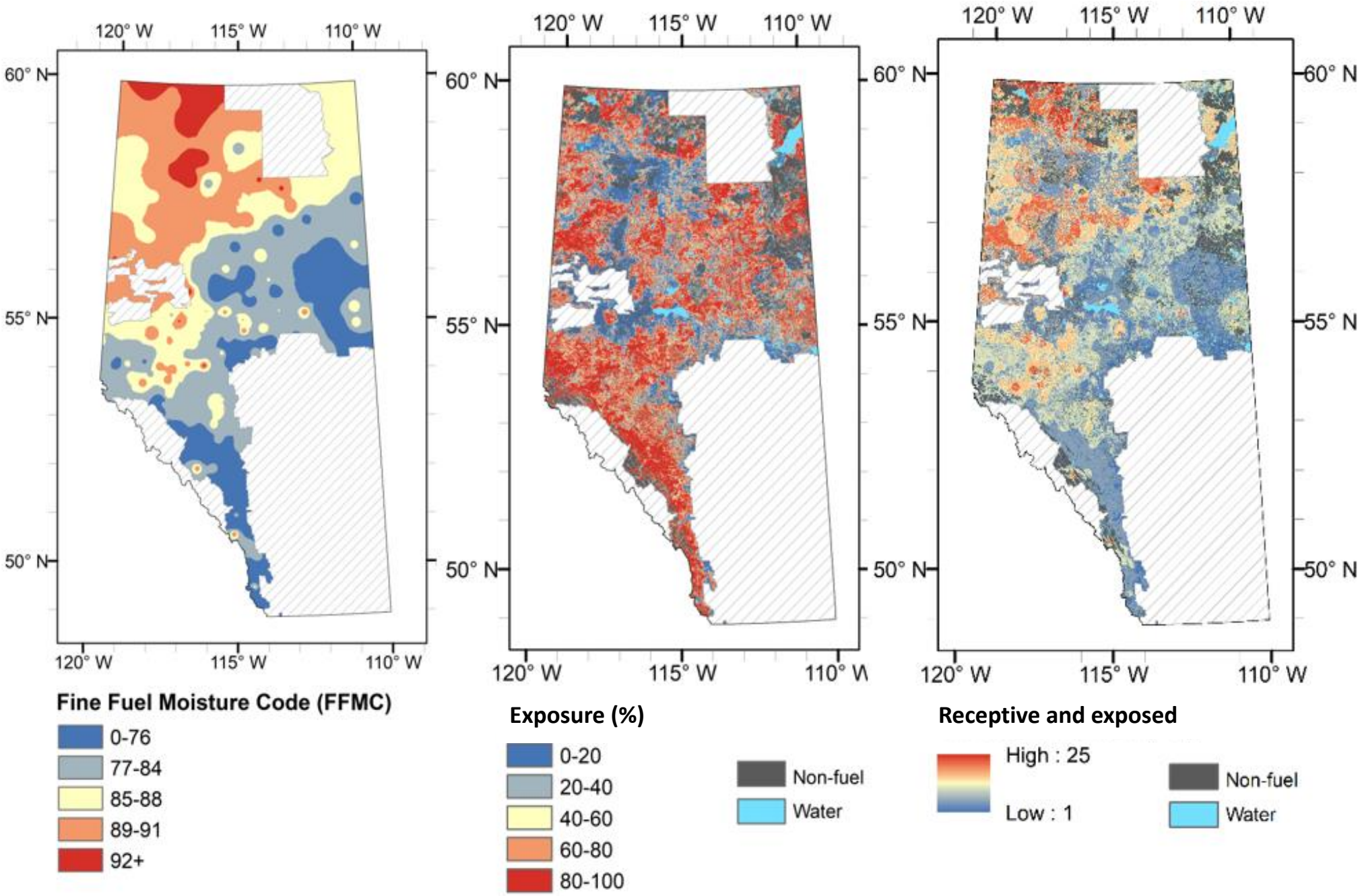


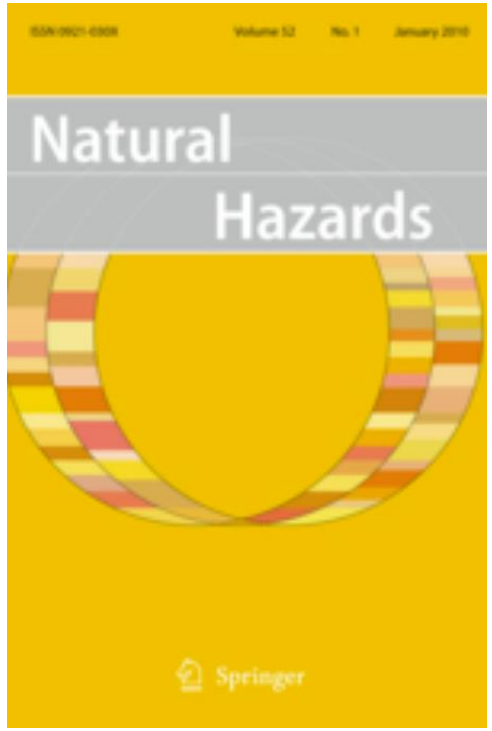
Based on method in Beverly et al. (2021). Input data: Landcover of Canada (Latifovic et al. 2020, North American Land Change Monitoring System (NALCMS))

Receptive to ignition

Exposed

Exposed AND Receptive





Natural Hazards
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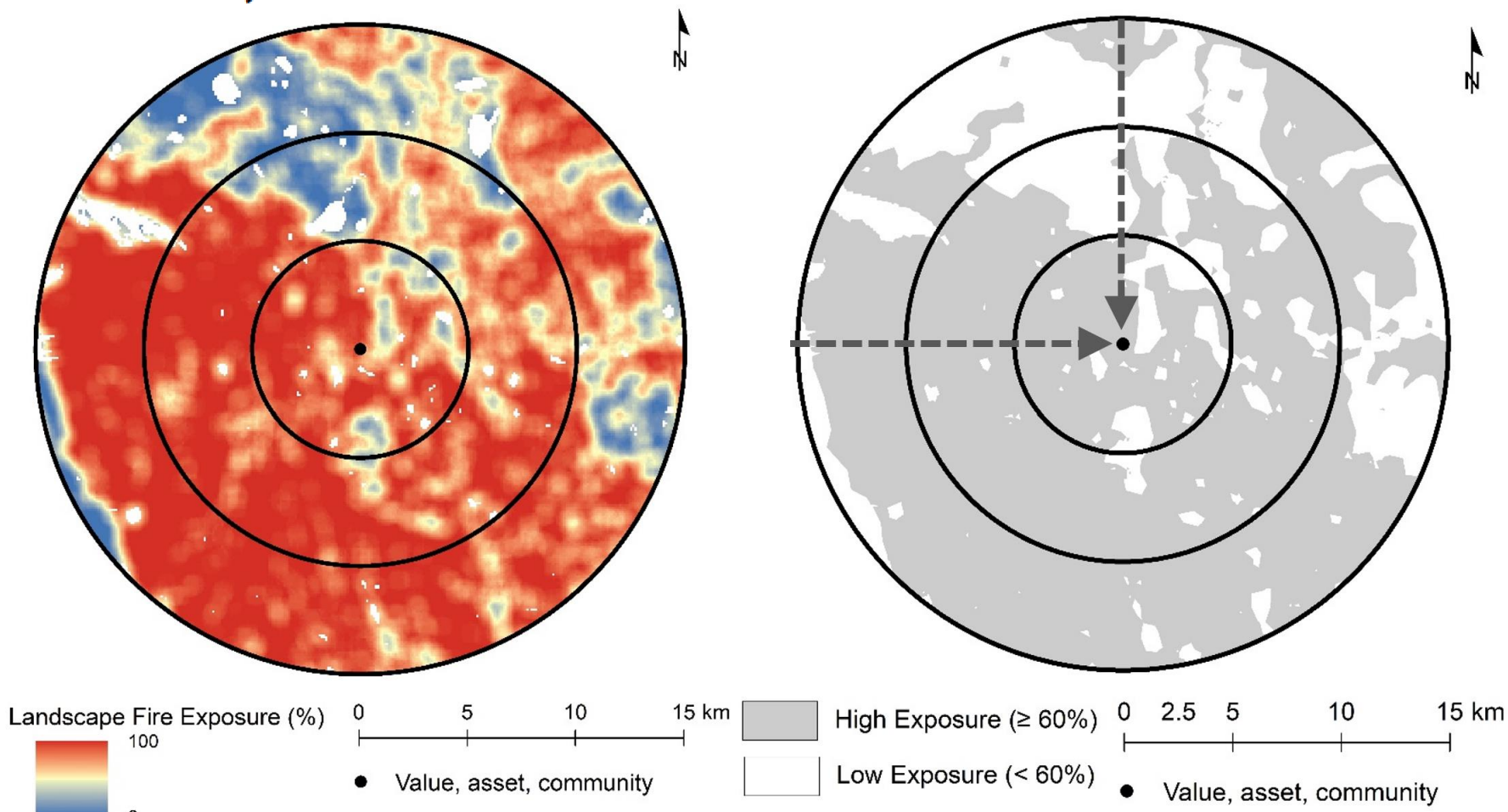
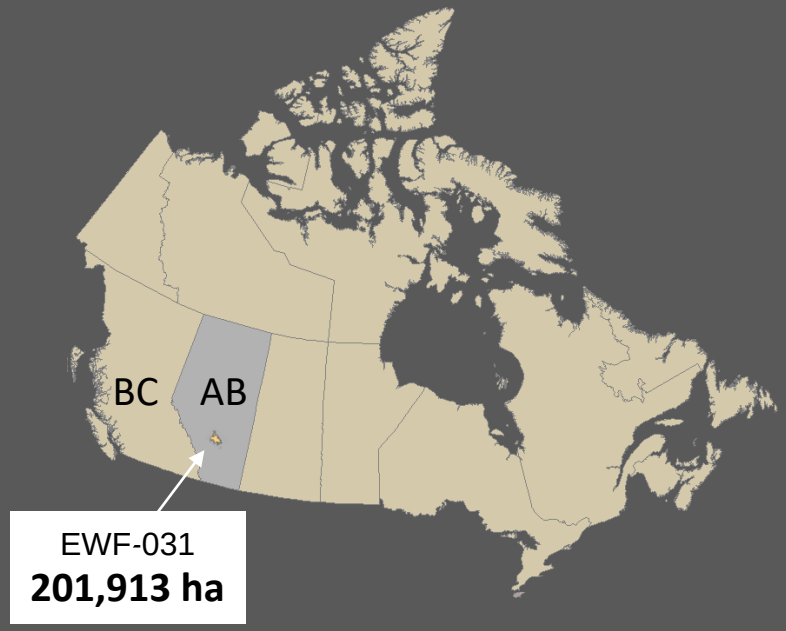
ORIGINAL PAPER

Assessing directional vulnerability to wildfire

Jennifer L. Beverly[1] · Air M. Forbes[1]





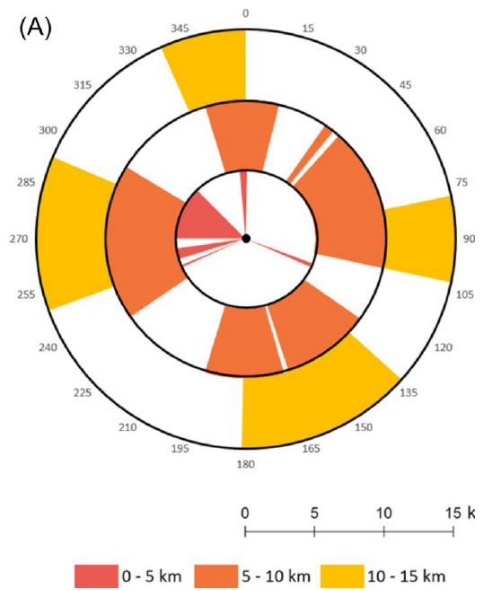
EWF-031
201,913 ha

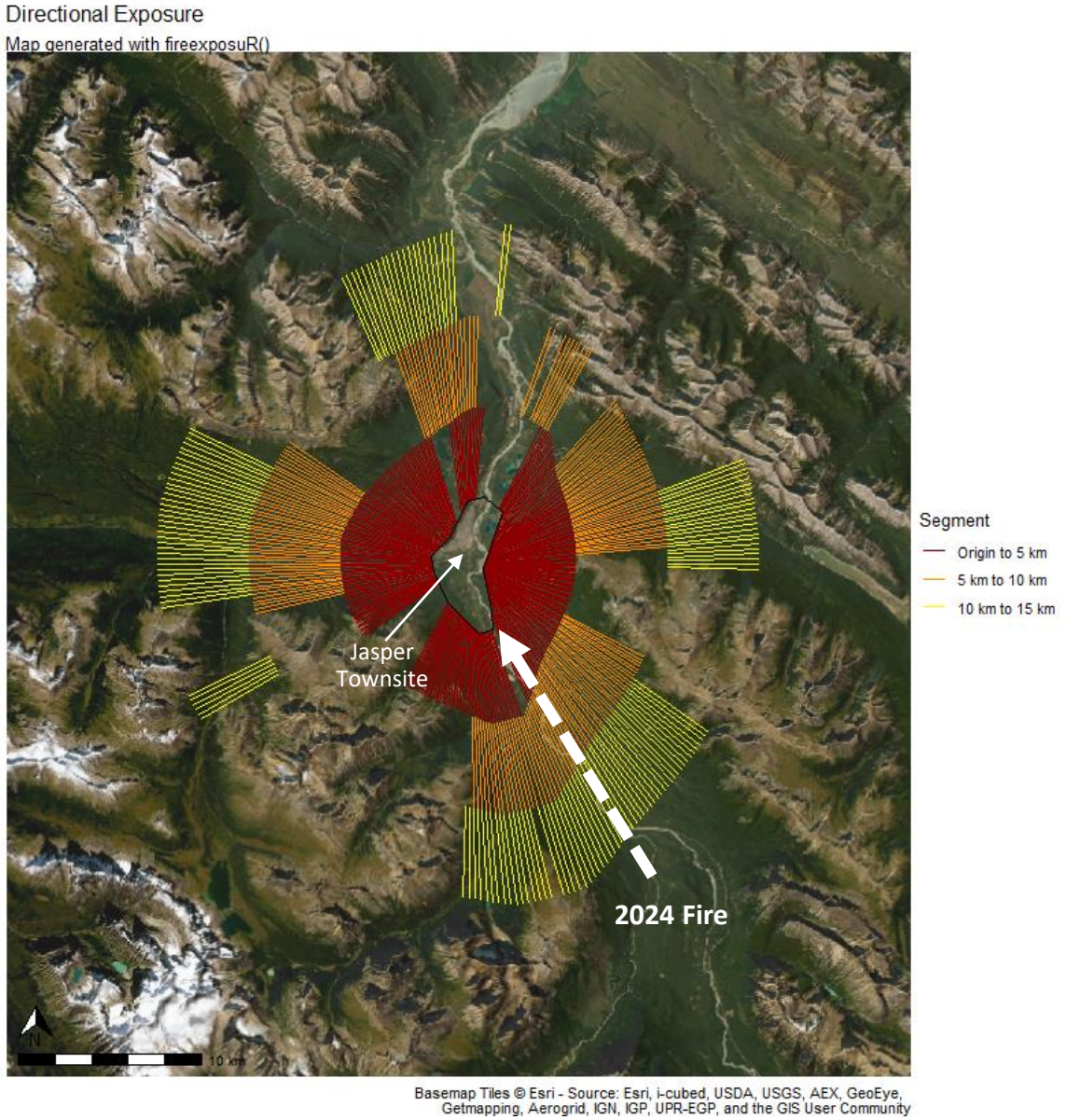
(Photo: Alberta Wildfire)

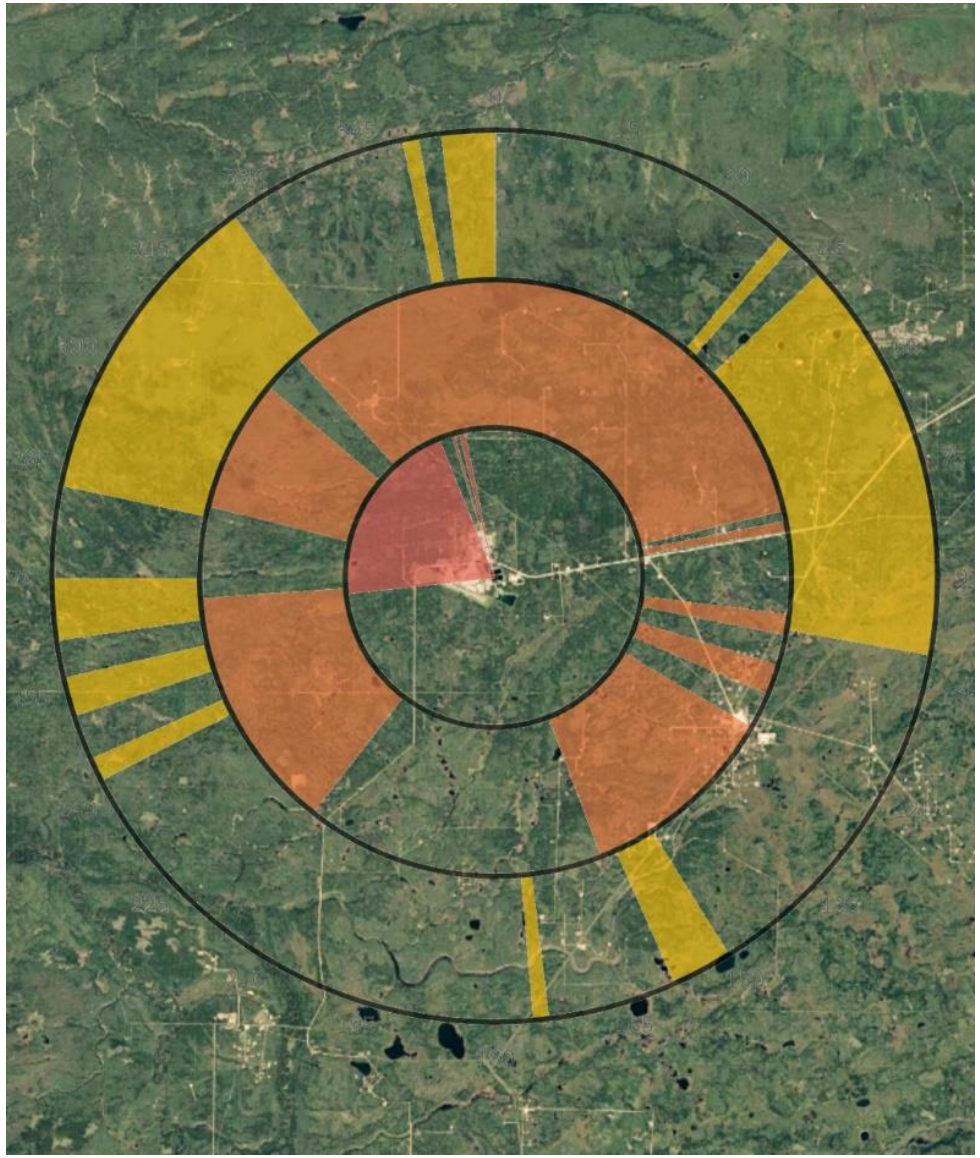
Table 2 Count of viable directional trajectories 5–15 km from centroid, by community. Only larger communities are shown (i.e., towns and villages) as well as selected hamlets and localities with populations > 1000

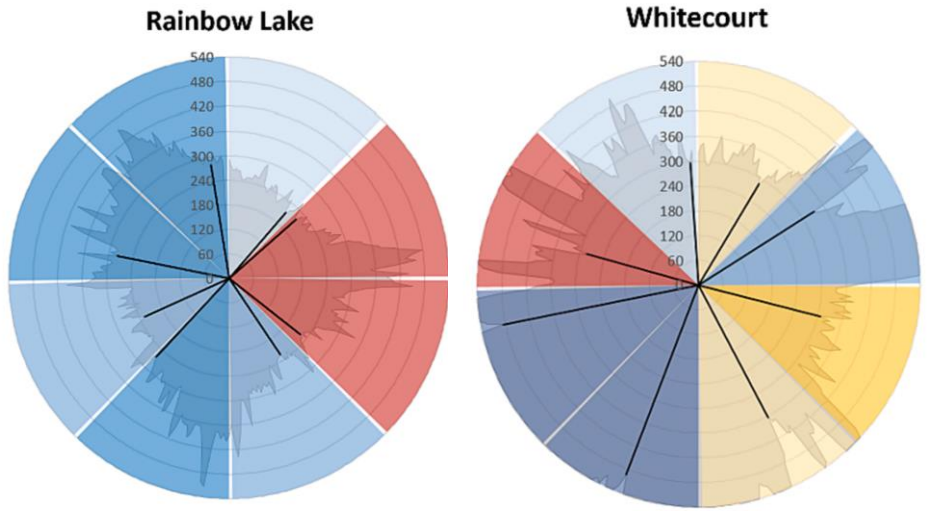
Community name	Community type	Count of viable directional trajectories (5–15 km from centroid)
Nordegg	Hamlet	213
Hinton	Town	147
Jasper	Locality	136
Grande Cache	Hamlet	98
Fox Creek	Town	82
Lake Louise	Hamlet	78
Swan Hills	Town	63
Banff	Town	41
Whitecourt	Town	31
Wabasca	Hamlet	21
Canmore	Town	19

Natural Hazards (2023) 117:831–849









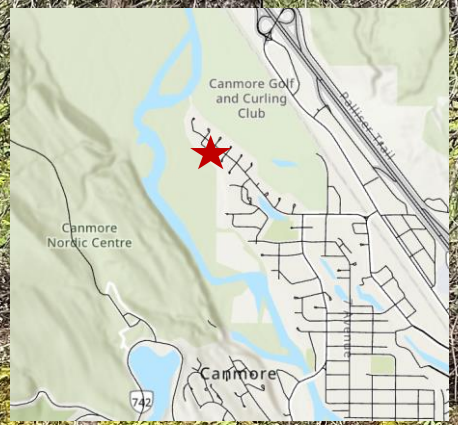
Safety Science
Volume 171, March 2024, 106378

Directional analysis of community wildfire evacuation capabilities

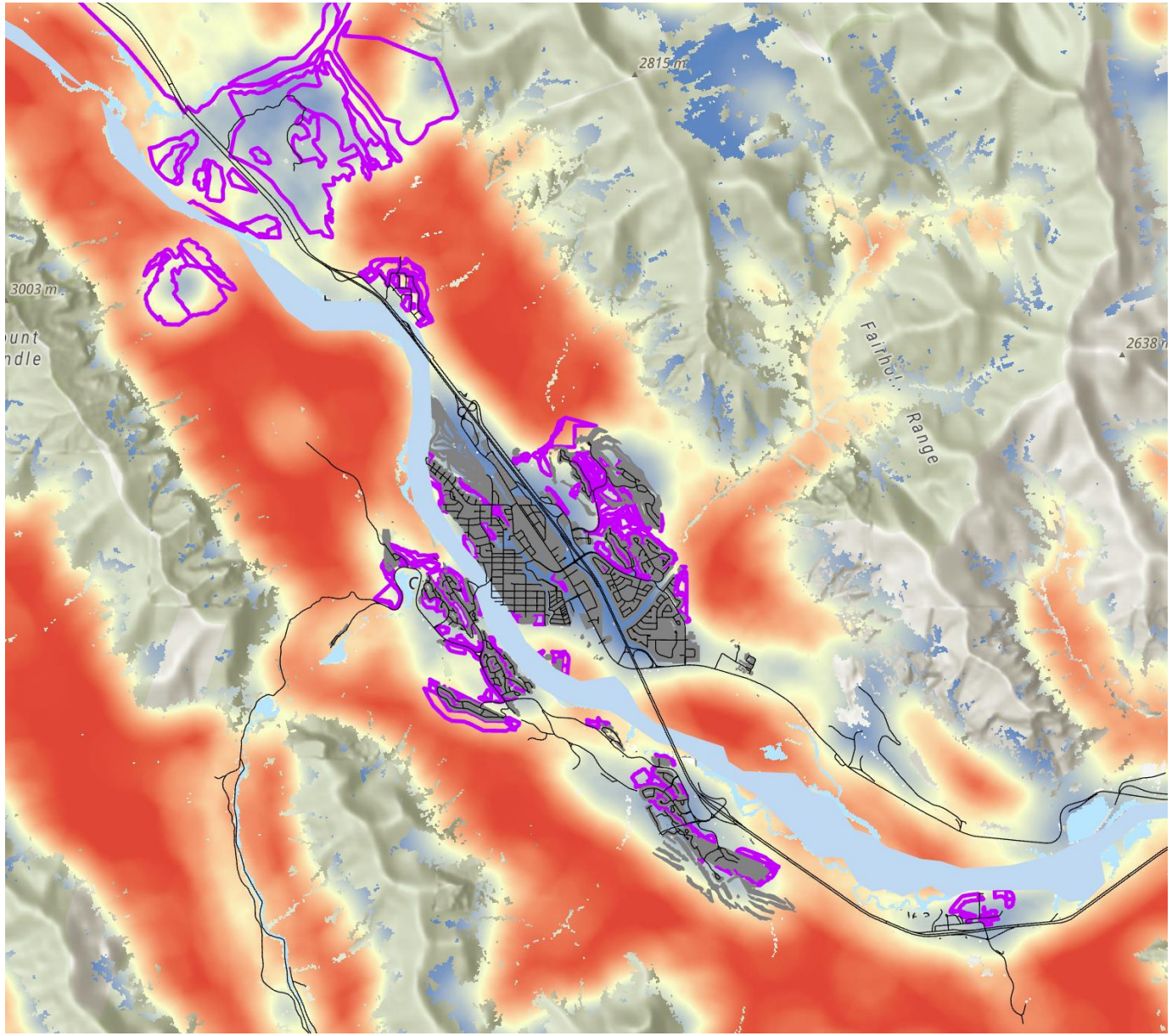
Amy M. Kim [a b], Jennifer L. Beverly [c], Abdullah Al Zahid [b]

Fuel amount and arrangement (vertical and horizontal) dictates fire behaviour – **target of proactive mitigation**

1. **Remove**
2. **Reduce**
3. **Convert**
4. **Isolate**


Canmore Golf and Curling Club
Canmore Nordic Centre
Canmore
742

Canmore fire exposure and fuel treatments



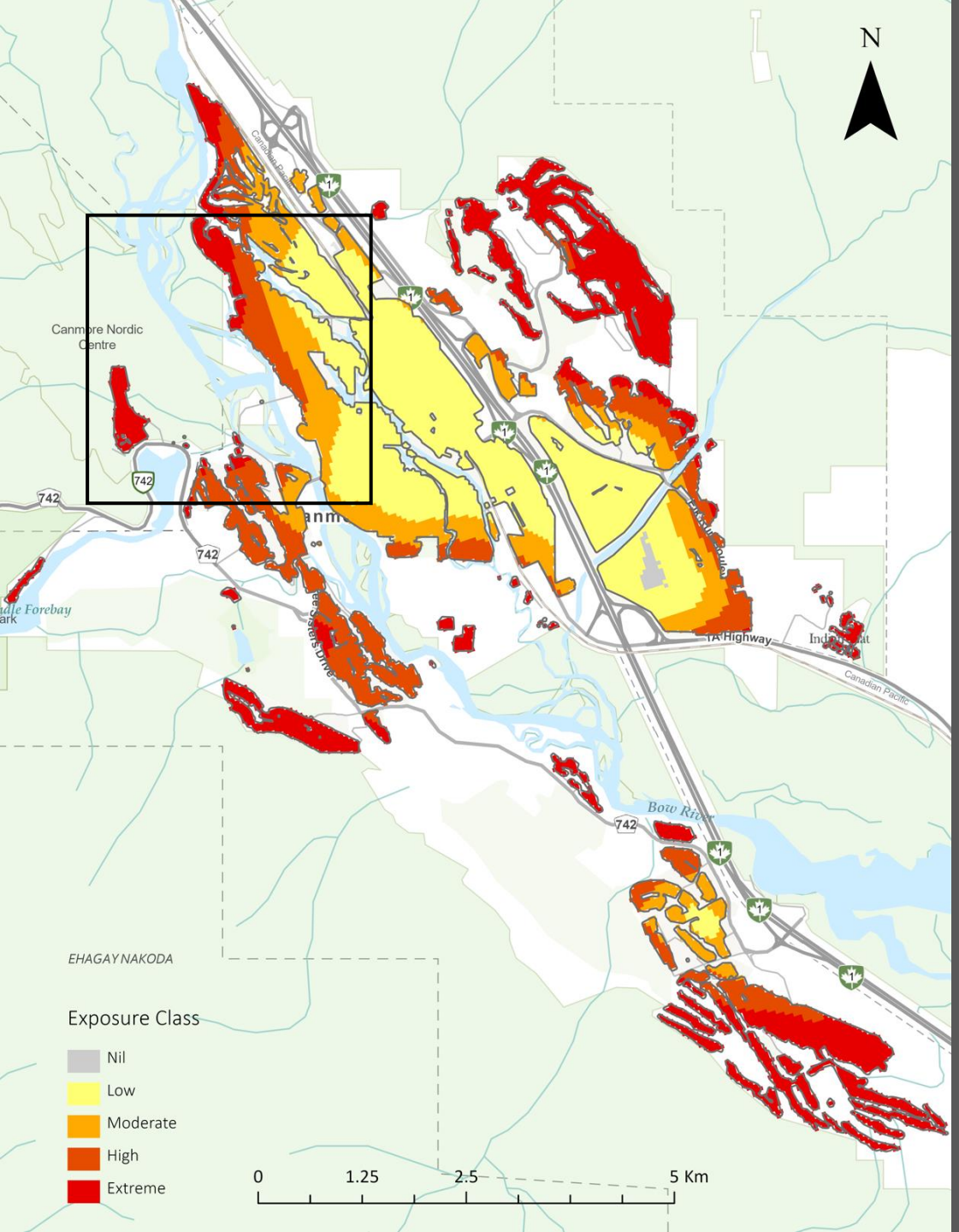
Exposure (%)

High : 100

Low : 0

Existing fuel treatments

Where can longer-range embers transmit to?



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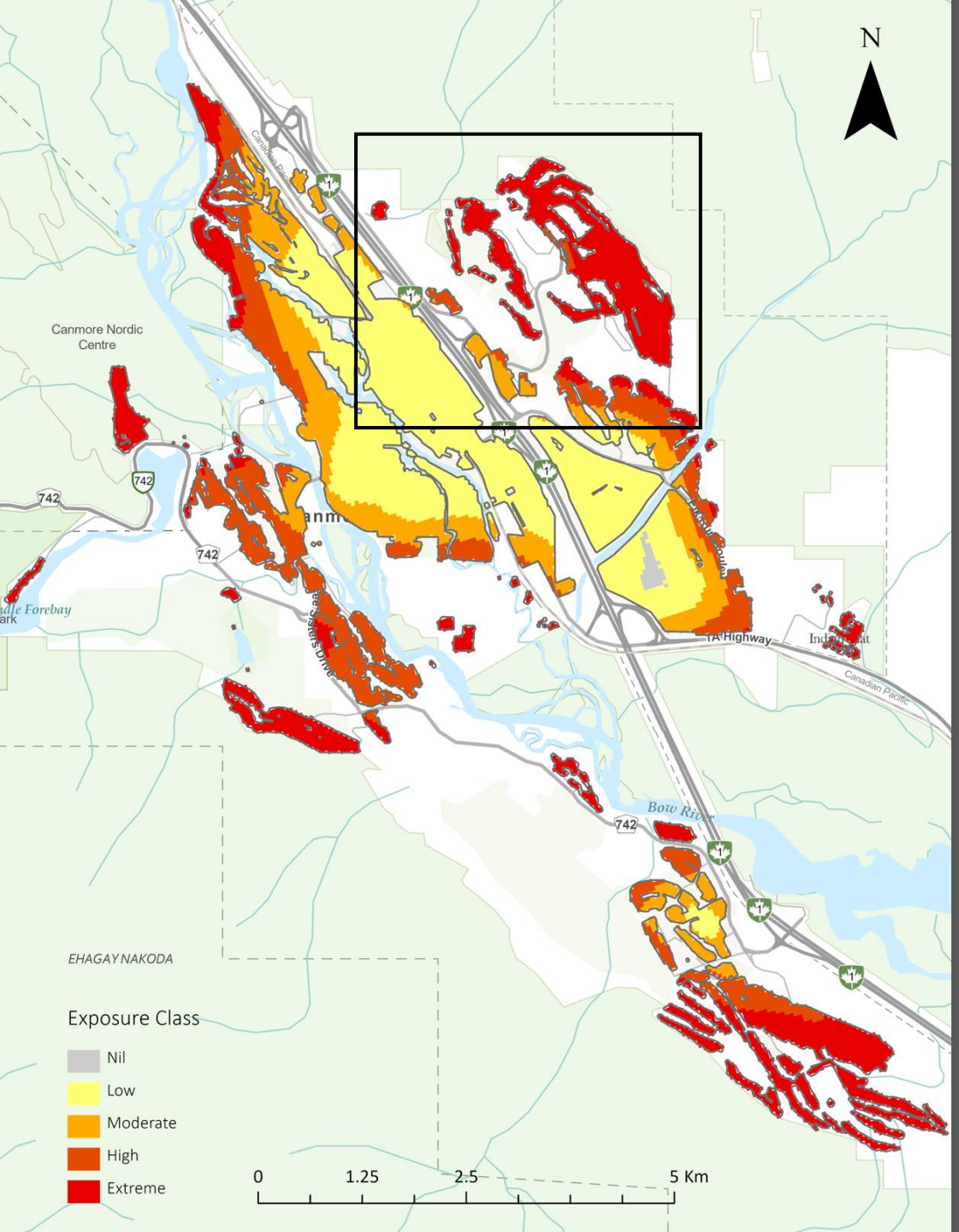
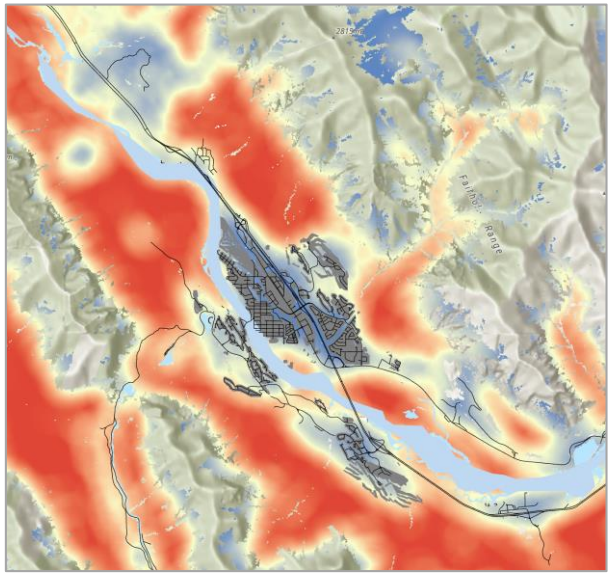
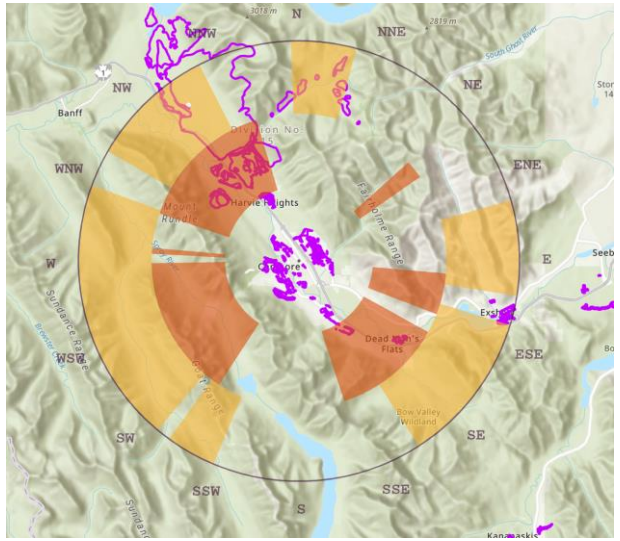
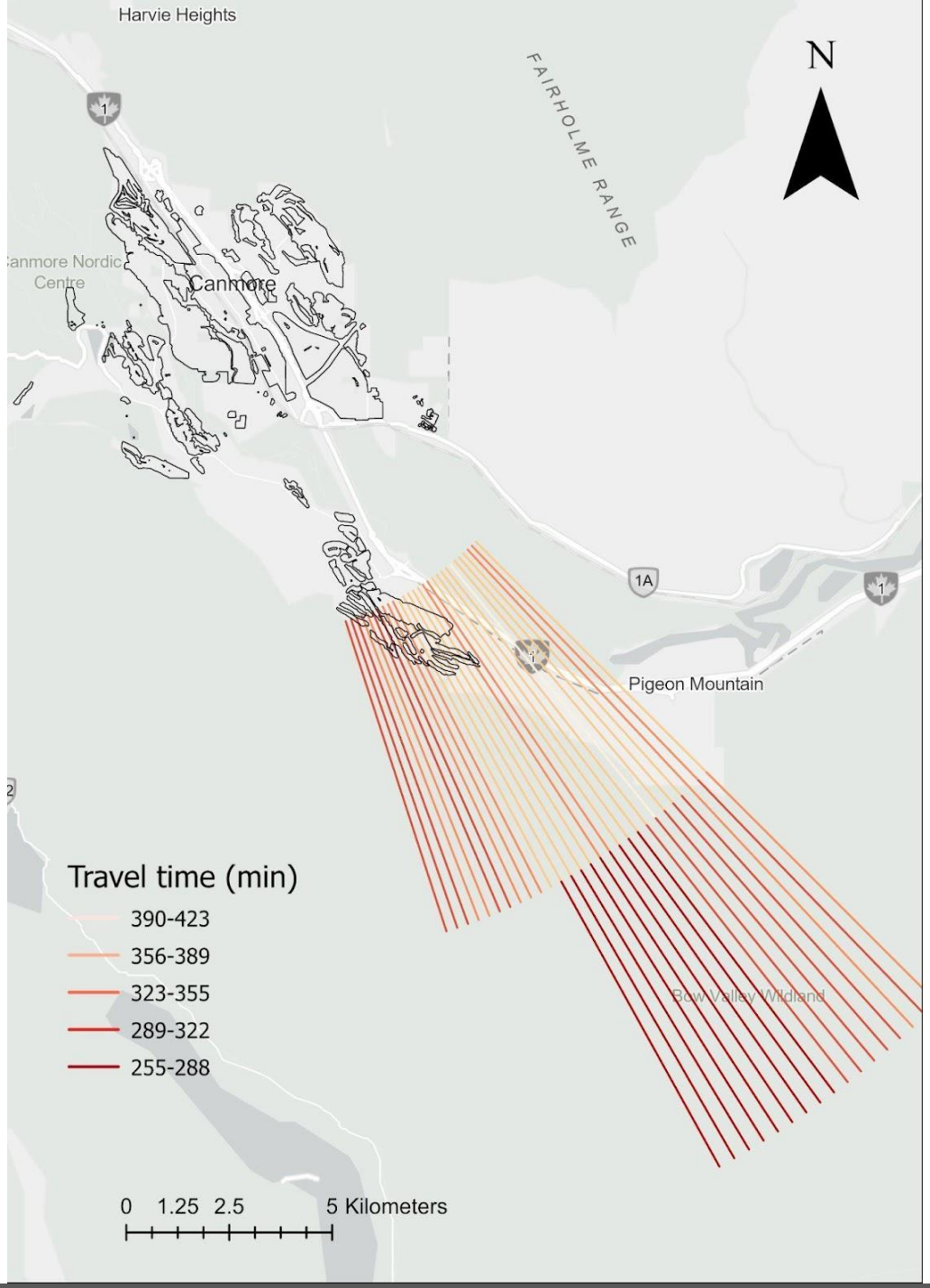


Scenario planning







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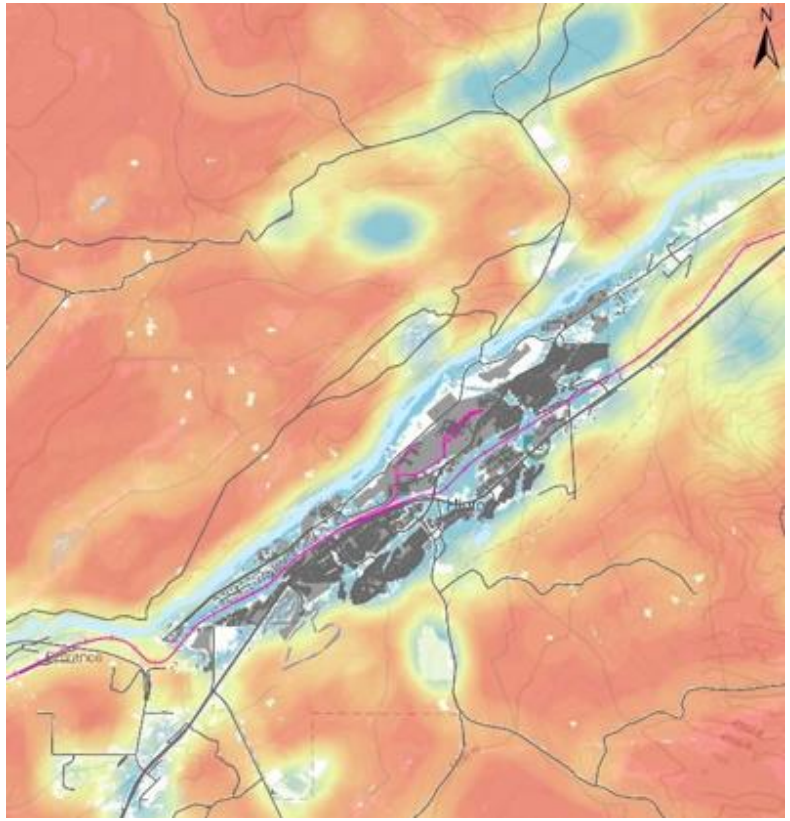
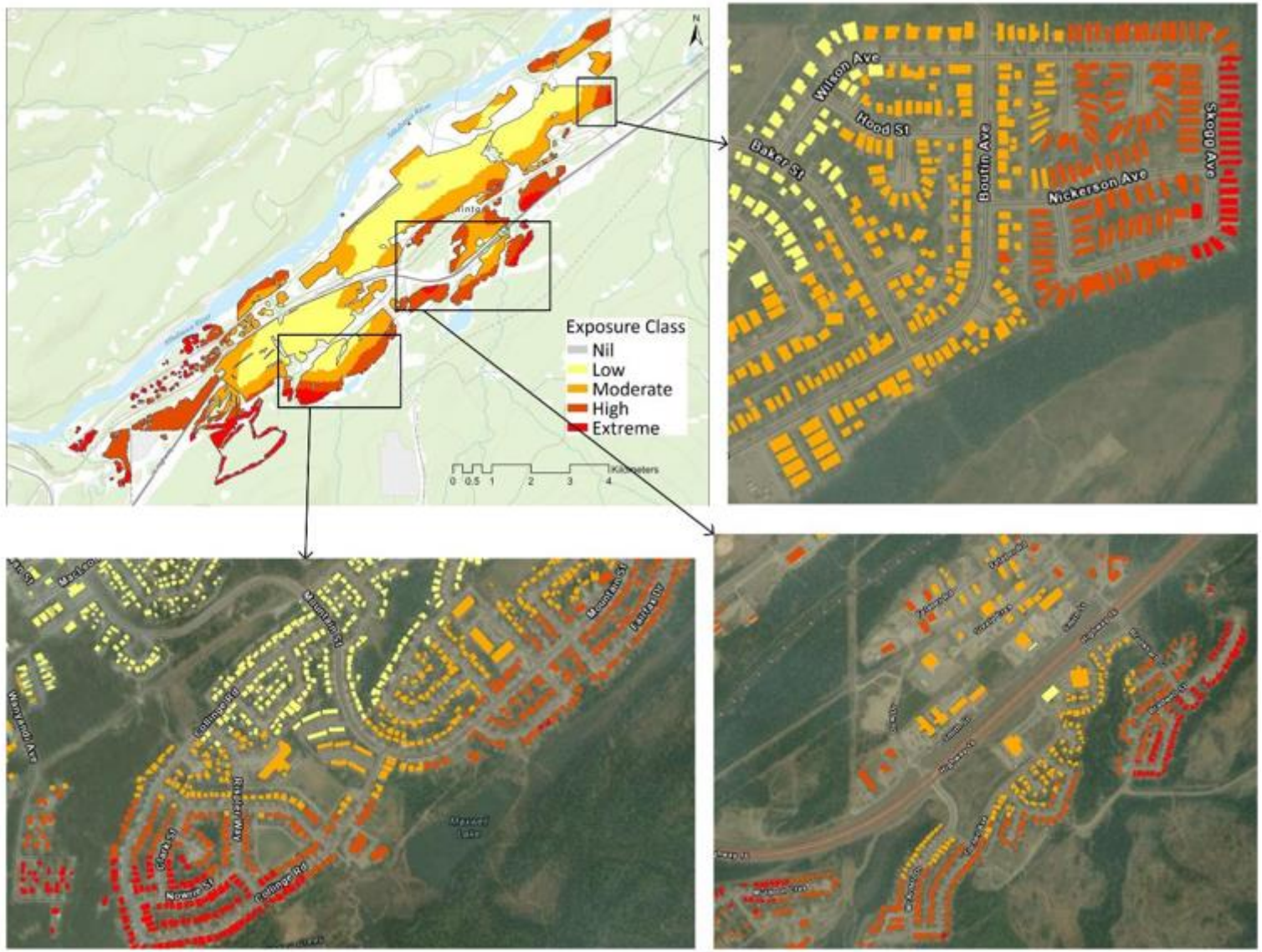
Research article

Optimizing fuel treatments for community wildfire mitigation planning

Nima Karimi, Patrick Mahler, Jennifer L. Beverly *

Department of Renewable Resources, University of Alberta, Edmonton, Alberta, T6G 2H1, Canada





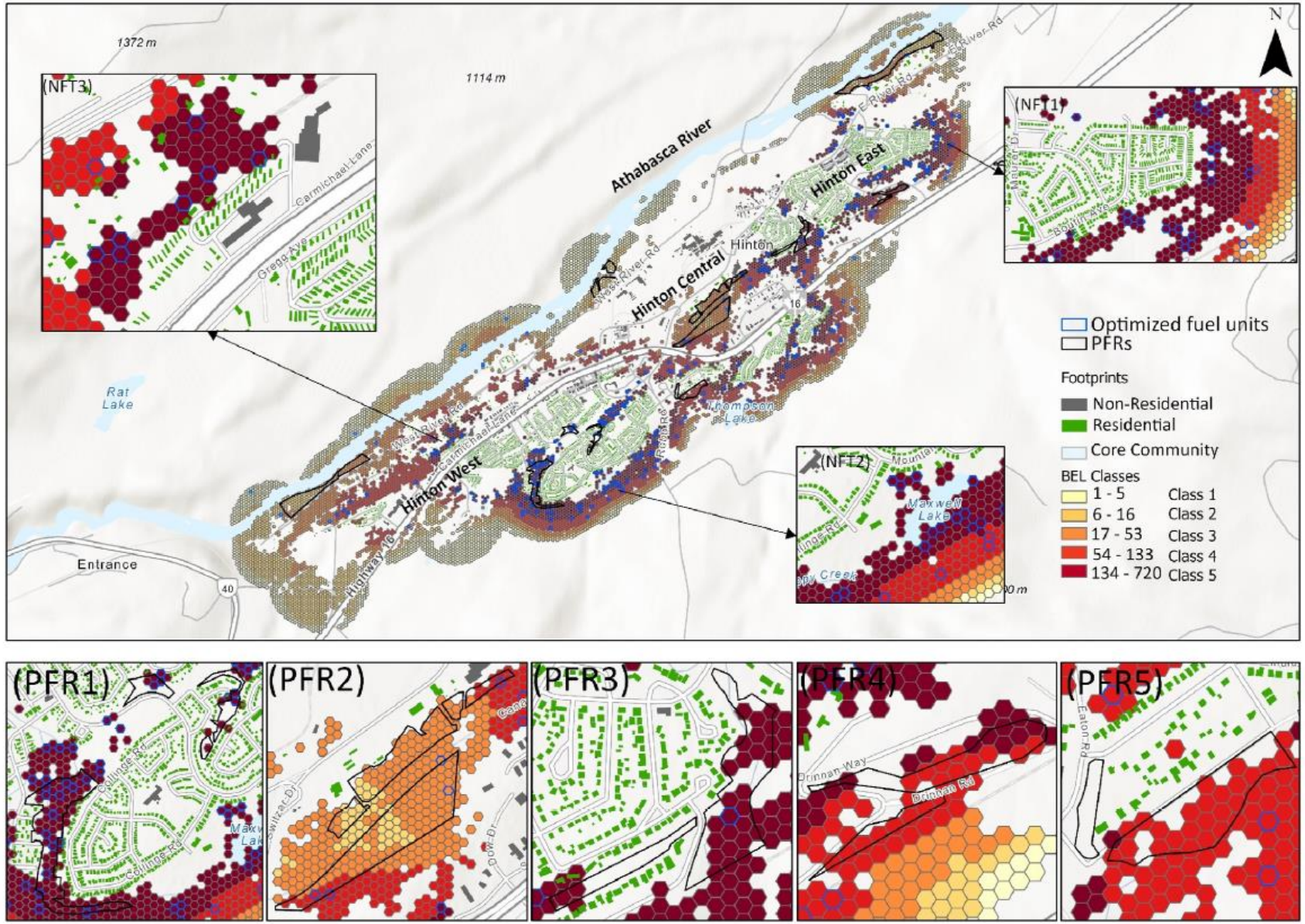


Fig. 6. BEL map (yellow-red colour ramp) along with optimized fuel units (blue outline) for the community of Hinton. New fuel treatment areas (such as NFT1, NFT2, NFT3) are shown as inset maps. Proposed fuel reduction areas (PFRs) are shown at the bottom of the map.

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Abdullah AL Zahid