



UNIVERSITY OF ALBERTA
DEPARTMENT OF
RENEWABLE RESOURCES

Wildfire Exposure Assessment

A planning tool for identifying values at risk
and prioritizing mitigation effort



FireSmart Wildfire Exposure Assessment

A planning tool for identifying
values at risk and prioritizing
mitigation effort.

Jen Beverly
University of Alberta



wildfireanalytics.org

Presented at the FireSmart Community Series
Fort McMurray, Alberta
October 3, 2018



UNIVERSITY OF ALBERTA
DEPARTMENT OF
RENEWABLE RESOURCES

Acknowledgements

Forest Resource Improvement Association of Alberta
(FRIAA) FireSmart Program —Project FFP-16-46



FireSmart
Wildfire Exposure
Assessment

A planning tool for identifying
values at risk and prioritizing
mitigation effort.

Alberta Wildfire

Geoff Braid
Liz Chapman
Stuart Kelm
Wendell Pozniak

FireSmart Canada

Laura Stewart
Kelly Johnston

Fuse Consulting Ltd.

Kate Broadley
Matthew Pyper



Acknowledgements — continued

Participants in group discussions – various meetings:

Alberta Wildfire

Brett Moore
Chad Morrison
Chris McGuinty
Clifton McKay
Cordy Tymstra
Dale Thomas
Dan Martin
Dave Finn
David Schroeder
Ed Trenchard
Gavin Hojka
Jason Cottingham
Jason Pankratow
Jordan Sykes

Kelsy Gibos
Marc Gamache
Margriet Berkhout
Maria Sharpe
Mark Handel
Mark Newman
Mike Williamson
Morgan Kehr
Neal McLoughlin
Philip Reid
Ryan Good
Sam Davies
Wade Colwell

Other Agencies

Dana Hicks
Greg Baxter
Karl Cox
Marty Alexander
Rex Hsieh
Rick Arthur
Steve Hvenegaard



FireSmart
**Wildfire Exposure
Assessment**

A planning tool for identifying
values at risk and prioritizing
mitigation effort.

It started with a paper and a fire



Wildfire Exposure Assessment

A planning tool for identifying values at risk and prioritizing mitigation effort.

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

Assessing the exposure of the built environment to potential ignition sources generated from vegetative fuel

J. L. Beverly^{A,B}, P. Bothwell^A, J. C. R. Conner^A and E. P. K. Herd^A

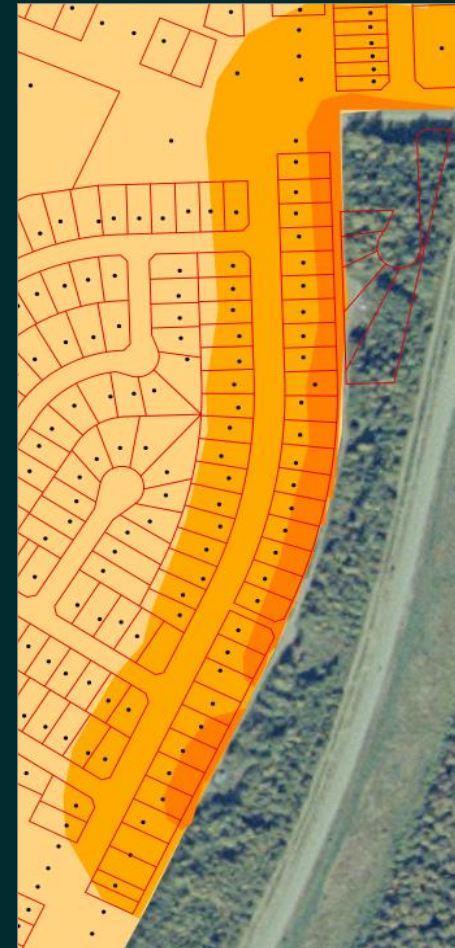
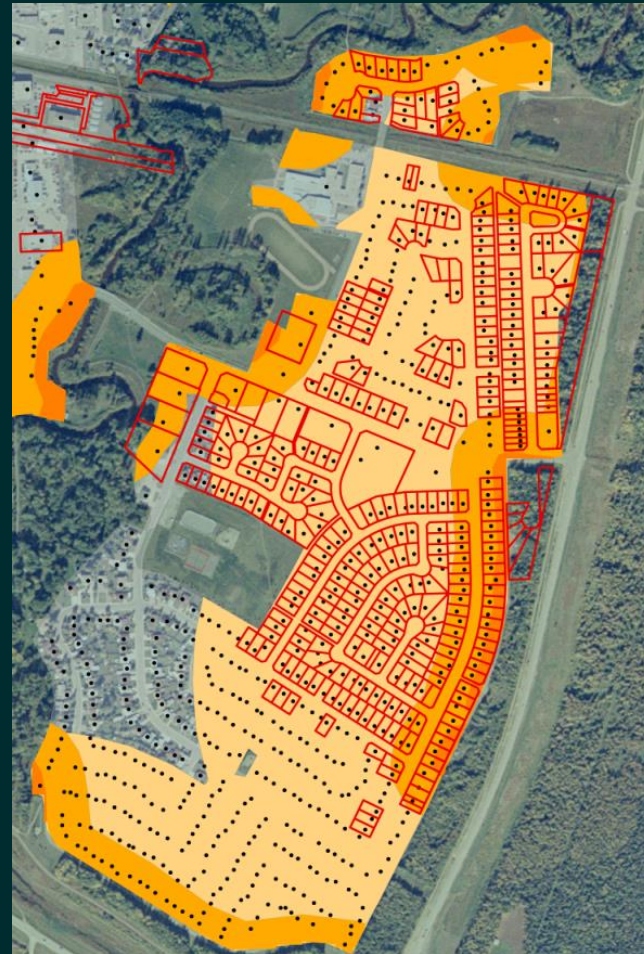


Slave Lake
May 15, 2011
7,000 residents evacuated
Over 430 homes destroyed

Damaged areas aligned with mapped exposure

FireSmart
Wildfire Exposure
Assessment

A planning tool for identifying
values at risk and prioritizing
mitigation effort.



- Radiant heat 0.1 – 30 m
- Embers 0.1–100 m
- Embers 100.1 – 500 m
- 2011 fire-damaged areas
- Structures

With interest from
Alberta Wildfire and
funding from FRIAA,
we set out to share
the approach

Filling the gap – community scale assessment

 **FireSmart**
Wildfire Exposure
Assessment

A planning tool for identifying
values at risk and prioritizing
mitigation effort.

HOME ASSESSMENT



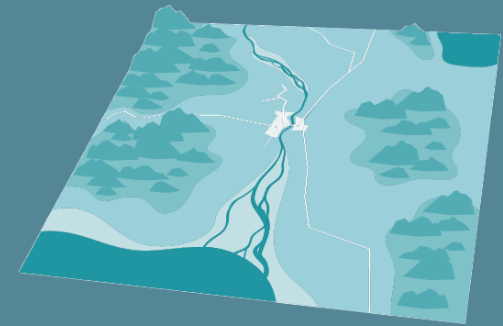
How easily will the
structure and site ignite?

COMMUNITY ASSESSMENT



We asked – what question
are we addressing in a
community scale
assessment?

LANDSCAPE ASSESSMENT



What is the likelihood of a
wildfire occurring?

1. Scale and process need to align

 **FireSmart**
Wildfire Exposure
Assessment

A planning tool for identifying
values at risk and prioritizing
mitigation effort.



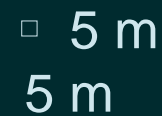
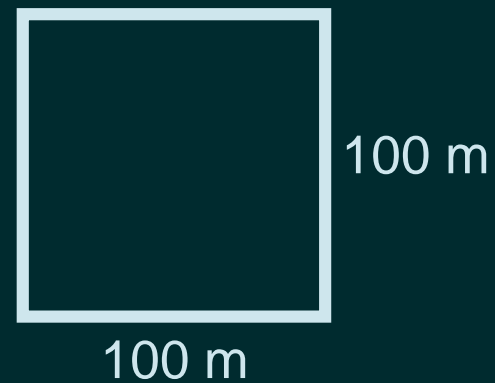
Wildfires are an ecological
process that operate at a
landscape scale



A community scale
assessment can't address
processes operating
beyond it's boundaries

1. Scale and process need to align

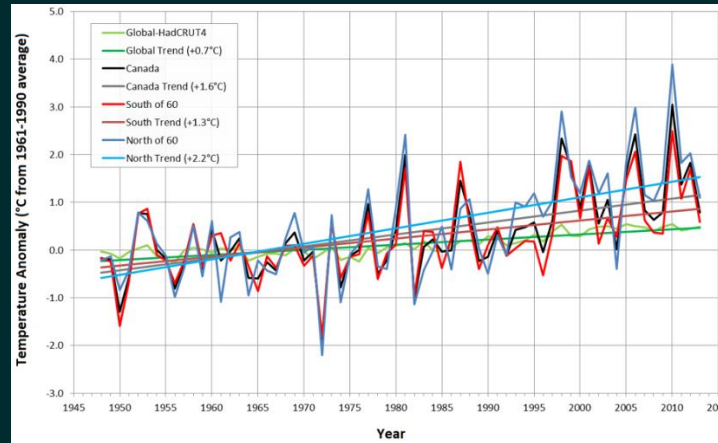
 **FireSmart**
Wildfire Exposure Assessment
A planning tool for identifying values at risk and prioritizing mitigation effort.



2. The past is a fragile guide to the future

FireSmart
Wildfire Exposure
Assessment

A planning tool for identifying
values at risk and prioritizing
mitigation effort.



Historical data is always
incomplete, and
possibly irrelevant






Fires modify their
environment, so past fire
activity may not be indicative
of current or future possibilities

3. Considering #1 and #2, be wary of probabilities

 **FireSmart**
Wildfire Exposure
Assessment

A planning tool for identifying
values at risk and prioritizing
mitigation effort.

Fire Susceptibility

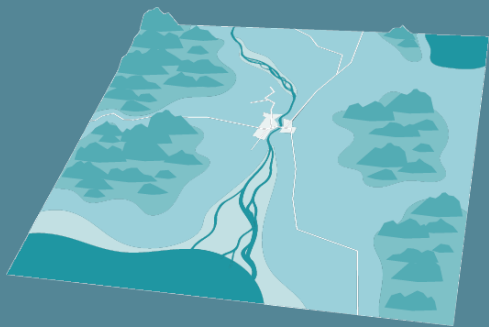
-  Very unlikely – 99.2% of time, no burn
-  Highly unlikely – 99.7% of time, no burn
-  Exceptionally unlikely – 99.9% of time, no burn

Study area, west
central Alberta



(Beverly et al. 2009)

LANDSCAPE ASSESSMENT



What is the
likelihood of a
wildfire occurring?

If not probabilities, then what?

 **FireSmart**
Wildfire Exposure
Assessment

A planning tool for identifying
values at risk and prioritizing
mitigation effort.

Focus on **possible impact** not on probability weighted impact

Think the unthinkable – how bad might it actually be?

Scenario identification – what combination of events might occur?

Horizon scanning – what is happening elsewhere?

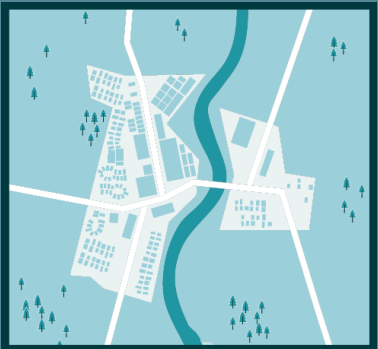
Take a **broader, more creative** approach to risk identification

Risk management through **contingency planning**

Reverse stress testing

Apply **Noah's rule** (predicting rain won't save anyone, build an ark)

COMMUNITY
ASSESSMENT



4. Complexity can be the problem, not the solution

 **FireSmart**
Wildfire Exposure
Assessment

A planning tool for identifying
values at risk and prioritizing
mitigation effort.



Must weigh a complex array of physical and atmospheric factors. To write it down as an optimal control problem, you would need to apply Newton's Law of Gravity.

(Haldane and Madouros 2012)

It turns out, there's a simple rule of thumb



Wildfire Exposure Assessment

A planning tool for identifying values at risk and prioritizing mitigation effort.



Run at a speed so that the angle of gaze to the Frisbee remains roughly constant.



Simple decision rules can trump complexity

 **FireSmart**
Wildfire Exposure
Assessment

A planning tool for identifying
values at risk and prioritizing
mitigation effort.



The more complex the environment, the greater the perils of complex control.

In complex environments, decision rules based on one, or a few, good reasons can trump sophisticated alternatives.

The Dog and the Frisbee,
Haldane and Madouros (2012)

Map what's **possible** based on things we know



FireSmart
Wildfire Exposure
Assessment

A planning tool for identifying values at risk and prioritizing mitigation effort.

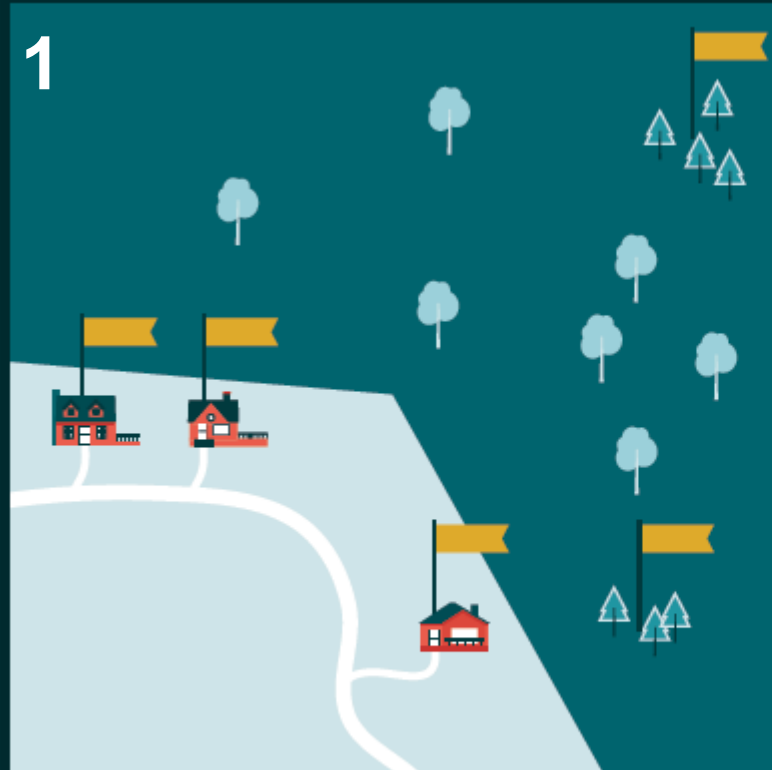
The exposure assessment was very deliberately designed to rely on:

- A scale aligned with process (ignition)
- One variable with known attributes (fuels)
- No probability
- No prediction
- No past

Where will you prioritize your efforts?

 **FireSmart**
Wildfire Exposure
Assessment

A planning tool for identifying
values at risk and prioritizing
mitigation effort.



Values and hazard that are close together are high priorities

What do we mean by a value?

 **FireSmart**
Wildfire Exposure
Assessment

A planning tool for identifying
values at risk and prioritizing
mitigation effort.

Anything of worth can be deemed a value for
conducting an exposure assessment



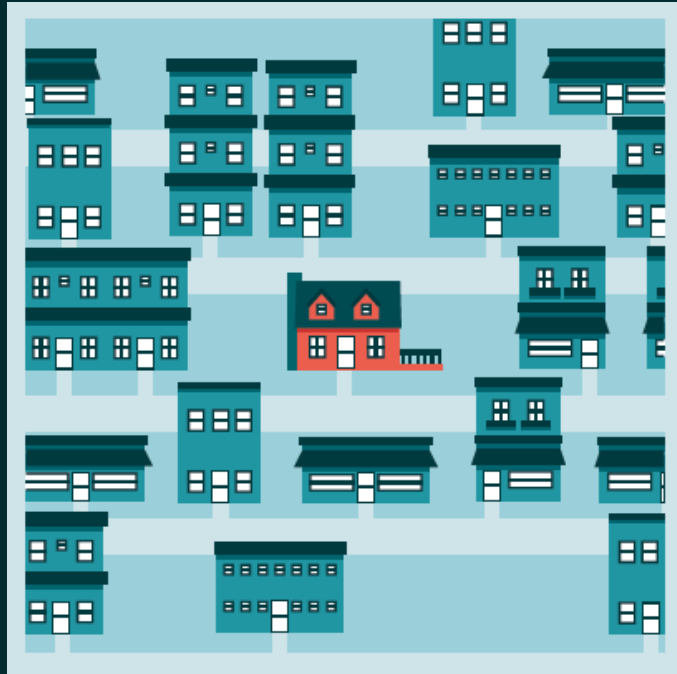
- Homes
 - Businesses
 - Infrastructure
 - Cultural or Historic sites
 - Natural Resources
 - Industrial Facilities
 - Recreation Areas
 - Critical Habitat
 - Natural Areas
- ...or anything else of value

Proximity of hazard fuels to values matters

 **FireSmart**
Wildfire Exposure
Assessment

A planning tool for identifying
values at risk and prioritizing
mitigation effort.

1



2



A house surrounded by concrete has a different level
of risk than a house surrounded by dense forest

Ignitions are the pathways by which fuel hazards impact values

 **FireSmart**
Wildfire Exposure
Assessment

A planning tool for identifying
values at risk and prioritizing
mitigation effort.



Radiant heat can ignite
adjacent areas



Falling embers thrown aloft and
transported by air currents and wind



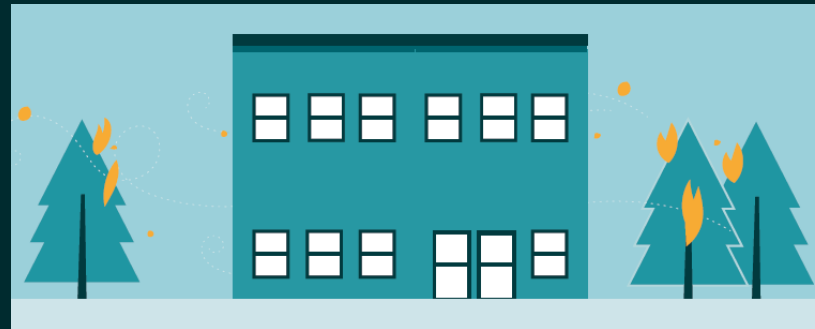
Direct contact with flames also
causes ignition (distances
addressed in FireSmart
home assessments)





Not all locations are receptors to ignitions

The physical characteristics of the receiving structure or site will determine if exposure to ignition produces fire



HOME ASSESSMENT



How easily will the structure and site ignite?

- Roofing
- Siding
- Construction materials
- Eaves and vents
- Ground to siding clearance
- Set-backs from other structures, slopes

Receptive + Exposed = Problem

 **FireSmart**
Wildfire Exposure
Assessment

A planning tool for identifying
values at risk and prioritizing
mitigation effort.



High priority areas are exposed to AND
receptive to ignitions

 **FireSmart**

**HOME
ASSESSMENT**

FireSmart Begins at Home

 **FireSmart**
Wildfire Exposure
Assessment

A planning tool for identifying
values at risk and prioritizing
mitigation effort.

Start with a target area

Your community is likely the primary target area, but other examples could include:

- neighborhood or zone in your community
- group of built structures
- hamlet, town, or summer village
- critical infrastructure
- industrial installation
- critical wildlife habitat or a watercourse
- cultural or historic site
- recreation area
- trails
- valued timber or other natural resources



THE STUDY AREA:

- TARGET AREA
- BUFFER



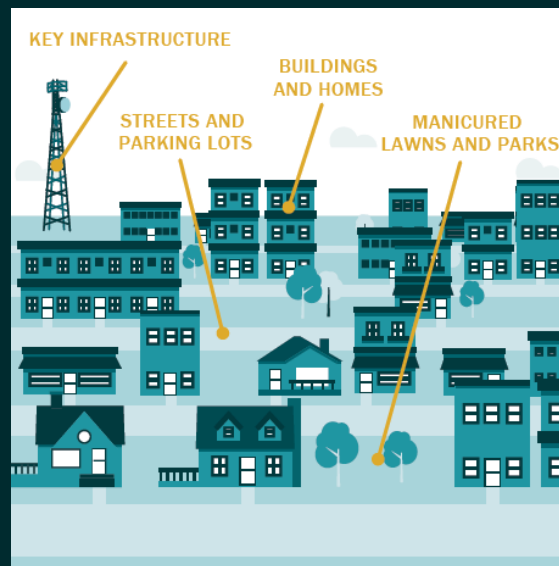
Study Area = Target Area and buffer ≥ 600 m

Map land cover in your study area

FireSmart
Wildfire Exposure
Assessment

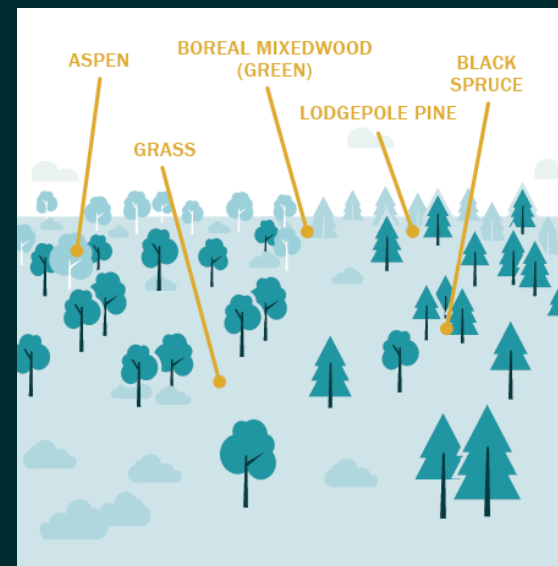
A planning tool for identifying
values at risk and prioritizing
mitigation effort.

CONSTRUCTED FEATURES



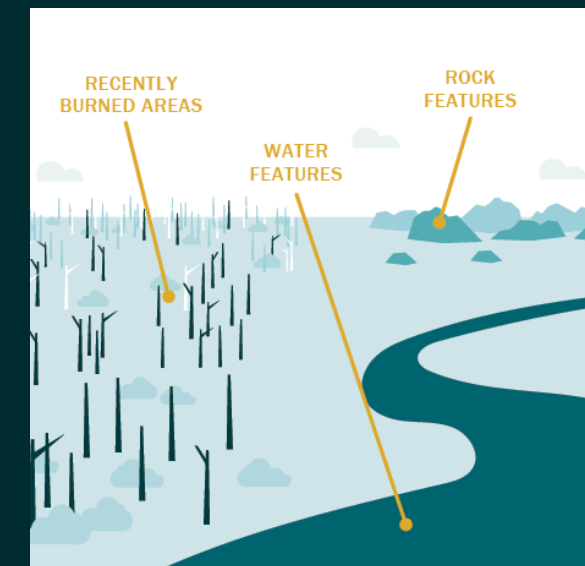
The built
environment

FUEL



Any vegetation
capable of generating
ignitions

NON-FUEL NATURAL AREAS



Natural areas that
are resistant to
burning

Consider distance ranges of ignition pathways

 **FireSmart**
Wildfire Exposure
Assessment

A planning tool for identifying
values at risk and prioritizing
mitigation effort.

**RADIANT
HEAT**



**SHORT-RANGE
EMBERS**



**LONG-RANGE
EMBERS**



Identify hazard fuels

 **FireSmart**
Wildfire Exposure
Assessment

A planning tool for identifying
values at risk and prioritizing
mitigation effort.

THE LANDCOVER TYPES:

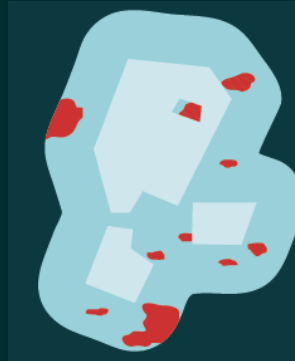
CONSTRUCTED
FEATURES

FUELS
(MANY TYPES)

NON-FUEL
NATURAL AREAS



Radiant Heat



Short-Range Embers



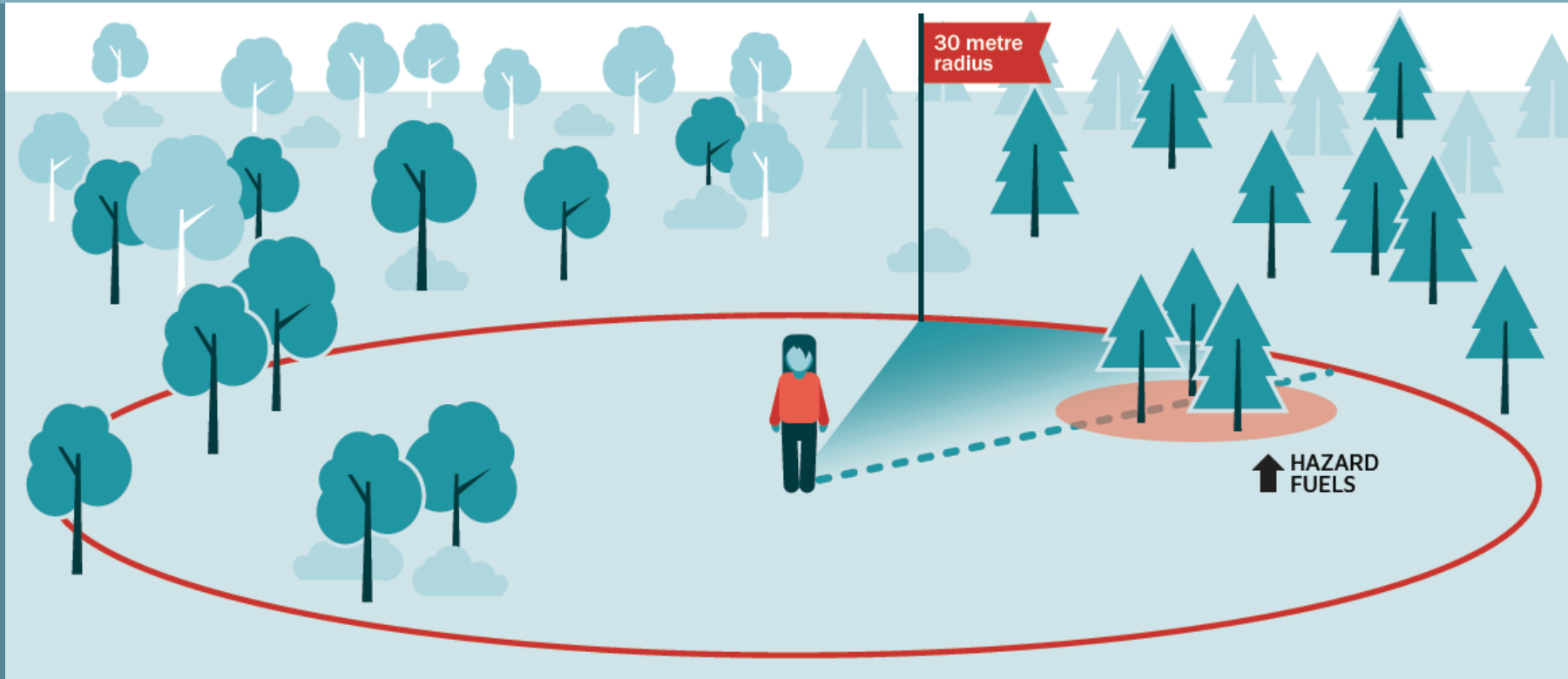
Long-Range Embers



Evaluate exposure in your target area

FireSmart
Wildfire Exposure
Assessment

A planning tool for identifying
values at risk and prioritizing
mitigation effort.

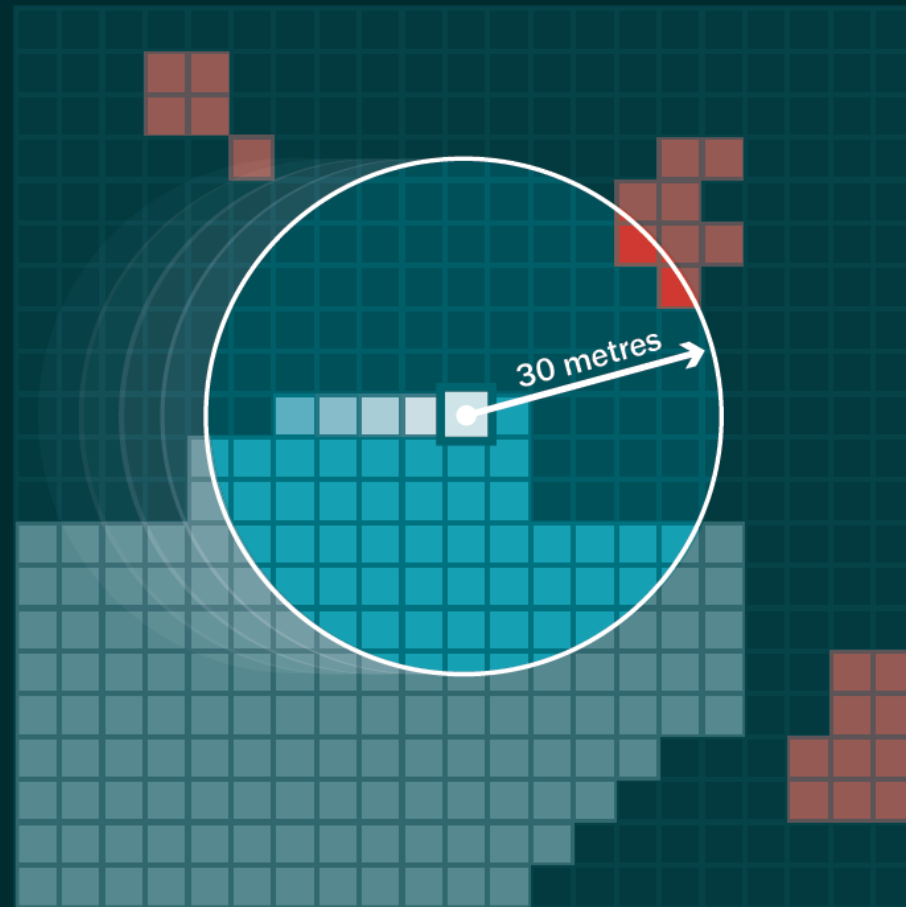


To assess radiant heat exposure at a location – search for hazard fuels within a circle with a 30 m radius

Use mapping software with a moving window

FireSmart
Wildfire Exposure
Assessment

A planning tool for identifying
values at risk and prioritizing
mitigation effort.



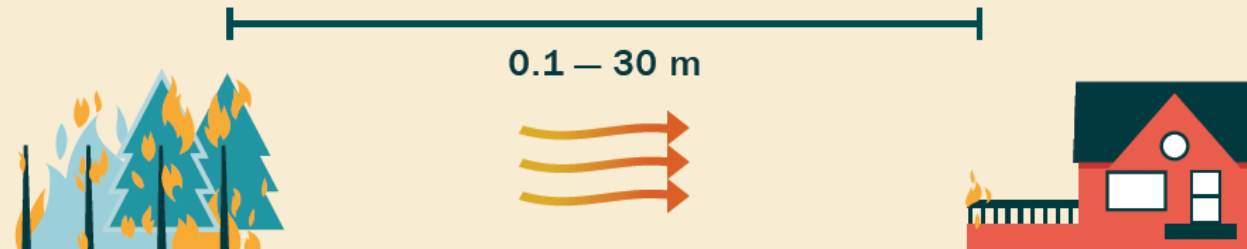
-  TARGET AREA
-  HAZARD FUEL
-  GRID SQUARE BEING ASSESSED
-  SEARCH WINDOW

Repeat for each distance range (ignition pathway)

FireSmart
Wildfire Exposure
Assessment

A planning tool for identifying
values at risk and prioritizing
mitigation effort.

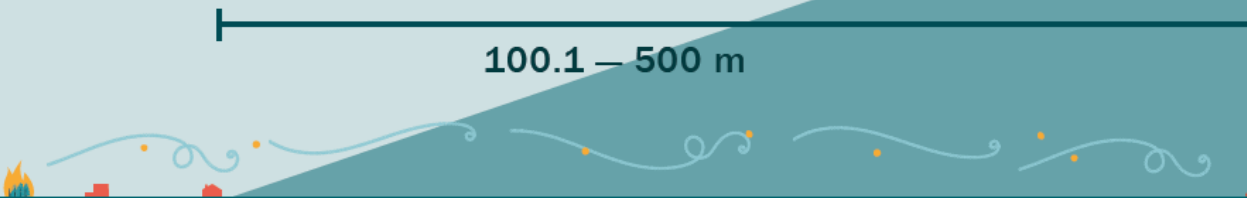
RADIANT HEAT



SHORT-RANGE EMBERS



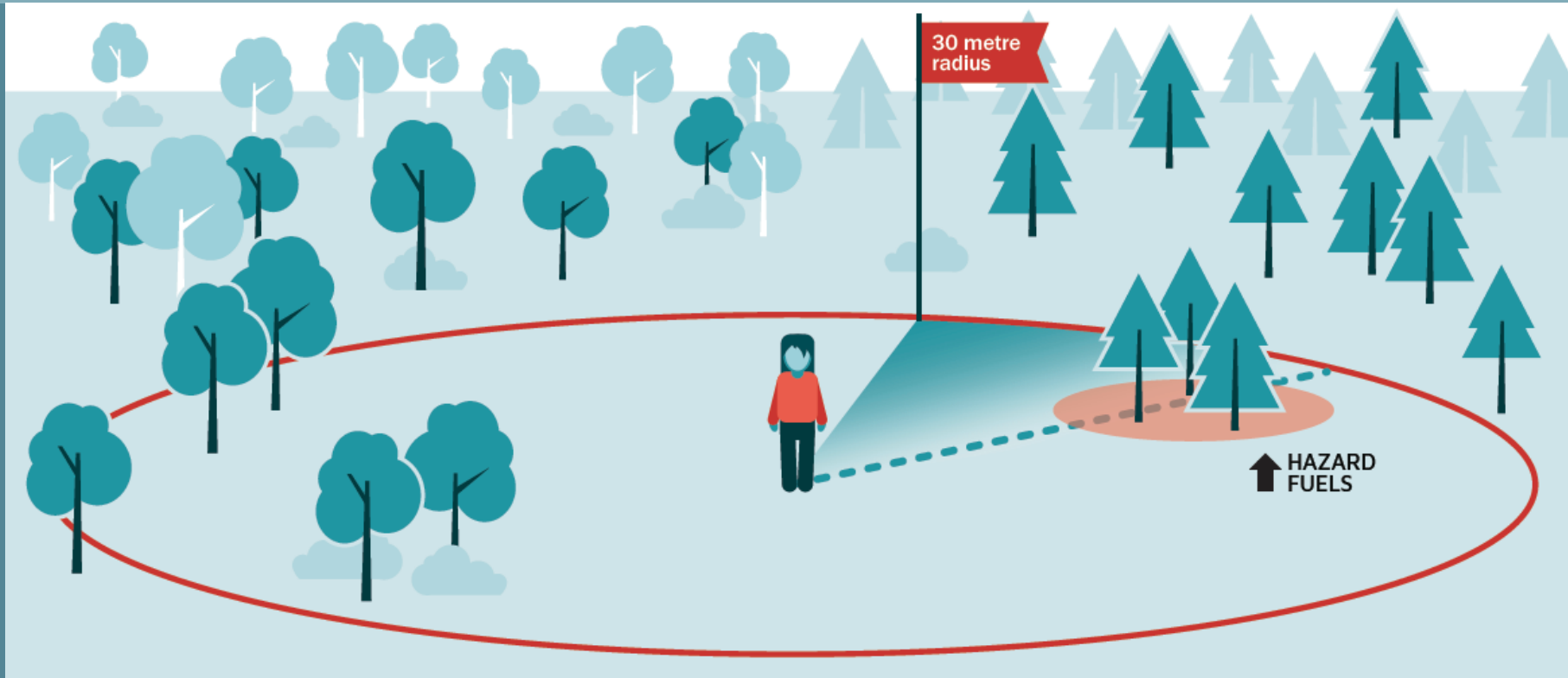
LONG-RANGE EMBERS



Adjust radius of your circle for each ignition pathway

FireSmart
Wildfire Exposure
Assessment

A planning tool for identifying
values at risk and prioritizing
mitigation effort.



Change the radius of the circle to search for exposure to hazard fuels capable of generating short-range embers (0.1 – 100 m) and then long-range embers (100.1 – 500 m)

Combine maps to display overall exposure

FireSmart
Wildfire Exposure
Assessment

A planning tool for identifying
values at risk and prioritizing
mitigation effort.

LONG-RANGE EMBER
EXPOSURE MAP



SHORT-RANGE EMBER
EXPOSURE MAP



RADIANT HEAT
EXPOSURE MAP



OVERALL
EXPOSURE MAP

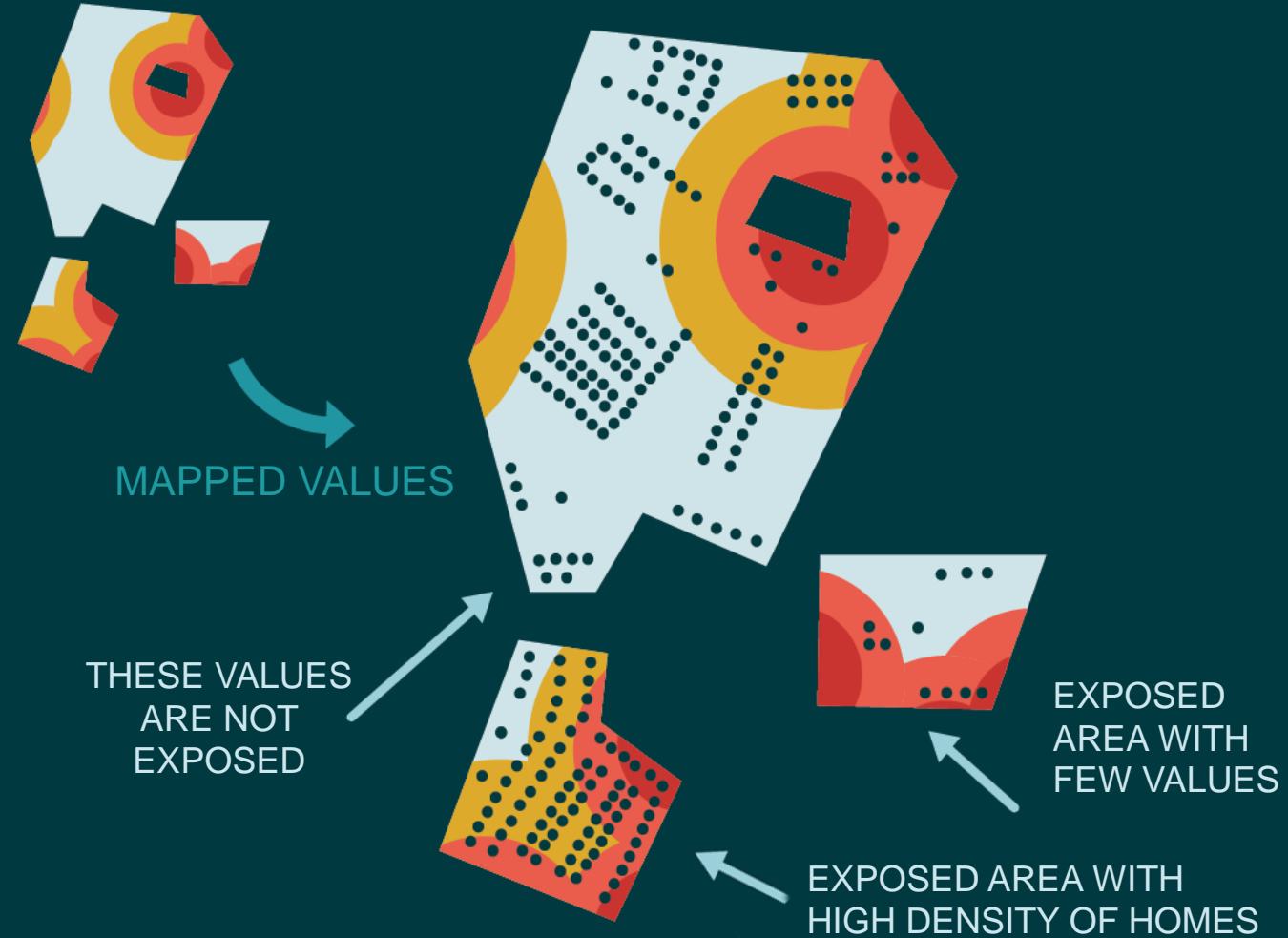


Overlay mapped values across your target area

FireSmart
Wildfire Exposure
Assessment

A planning tool for identifying
values at risk and prioritizing
mitigation effort.

OVERALL EXPOSURE



Consider which hazard fuels are causing exposure

FireSmart
Wildfire Exposure
Assessment

A planning tool for identifying
values at risk and prioritizing
mitigation effort.



Fuel treatments of an equivalent size can result in very
different reductions in values exposed

Finally, consider and integrate other assessments

FireSmart
Wildfire Exposure
Assessment

A planning tool for identifying
values at risk and prioritizing
mitigation effort.

HOME ASSESSMENT



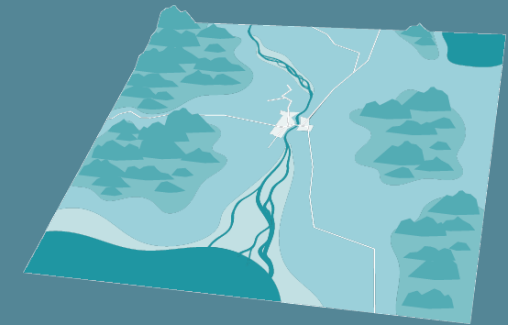
How easily will the
structure and site ignite?

COMMUNITY ASSESSMENT



In the event of a wildfire,
which locations will be
exposed to falling embers
and radiant heat?

LANDSCAPE ASSESSMENT



What is the likelihood of a
wildfire occurring?



UNIVERSITY OF ALBERTA
DEPARTMENT OF
RENEWABLE RESOURCES

Questions?



FireSmart
Wildfire Exposure
Assessment

A planning tool for identifying
values at risk and prioritizing
mitigation effort.



wildfireanalytics.org

Presented at the FireSmart Community Series
Fort McMurray, Alberta
October 3, 2018