2018 - 2019 Webinar Series
October 23, 2018

WeatherSHIELD: a system for forecasting fire weather and indices.

Aaron Stacey
MES, Fire Science and Planning Specialist (Peterborough)
Aviation, Forest Fire and Emergency Services, Ontario

Audio will start at 2 PM Eastern / 1 PM Central.
This webinar is listen only – to ask questions please use the chat box in lower right of screen.

WeatherSHIELD

Short & **I**ntermediate **E**nsemble & **L**ong-term **D**ynamic Scenarios - Prototype

Oct 23, 2018
Presentation: Aaron Stacey and Colin McFayden
Webinar for Lake States Fire Science Consortium

Who am I?

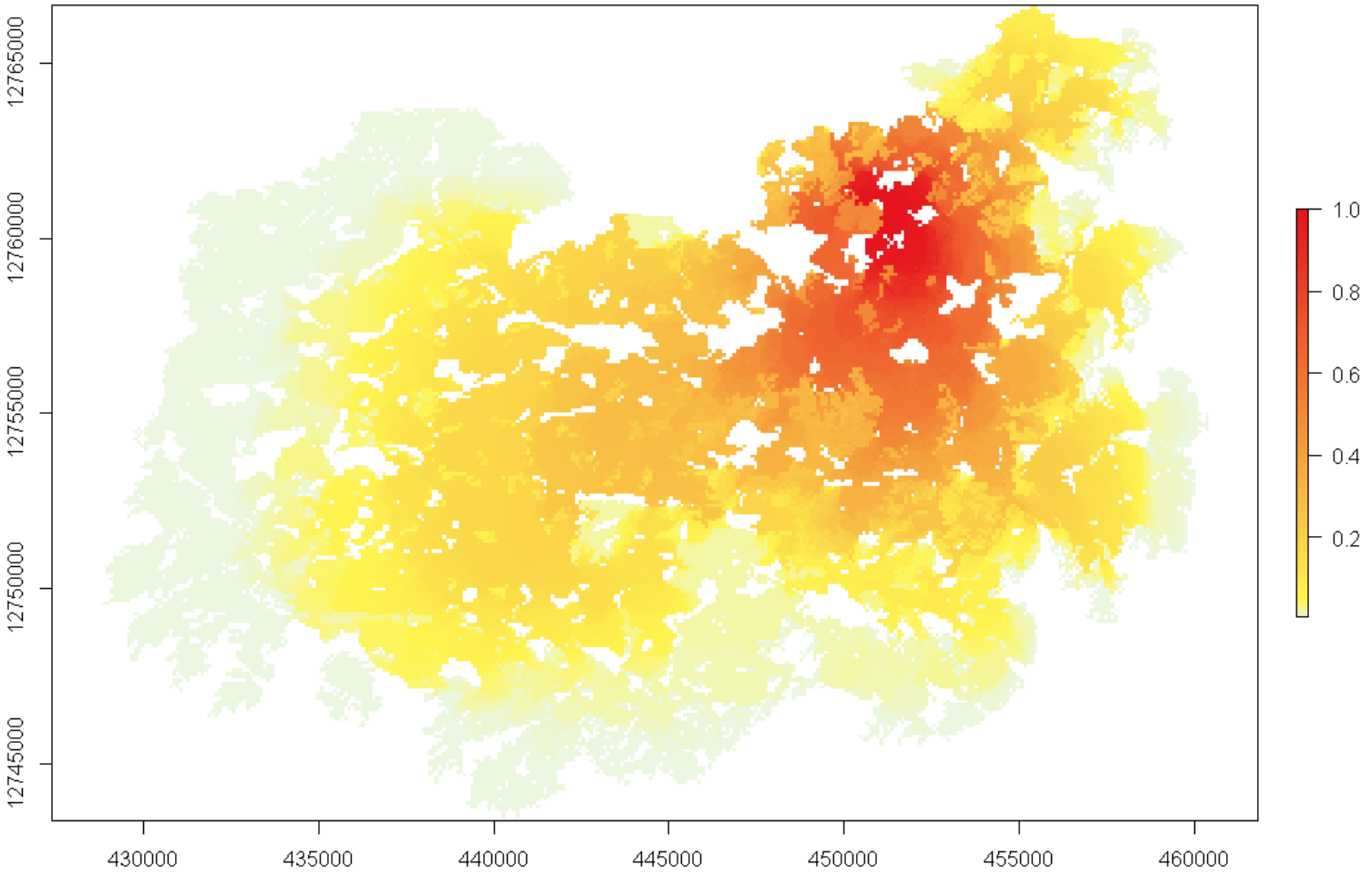
Aaron Stacey

Fire Science and Planning Specialist with Aviation, Forest Fires & Emergency Services, Ontario (Peterborough)

- Masters of Environmental Studies and a Bachelors Degree in Computer Science
- Advisory Board member for Lake States Fire Science Consortium

Agenda

- The beginning for WeatherSHIELD
- What did it become?
- The next steps for WeatherSHIELD


12765000
12760000
12755000
12750000
12745000
430000
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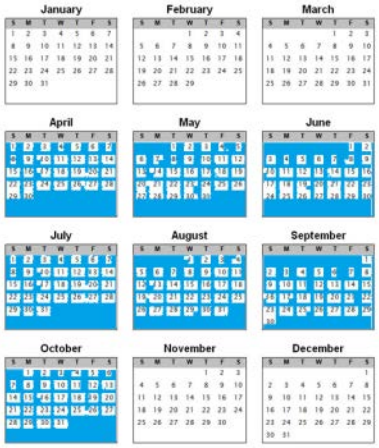
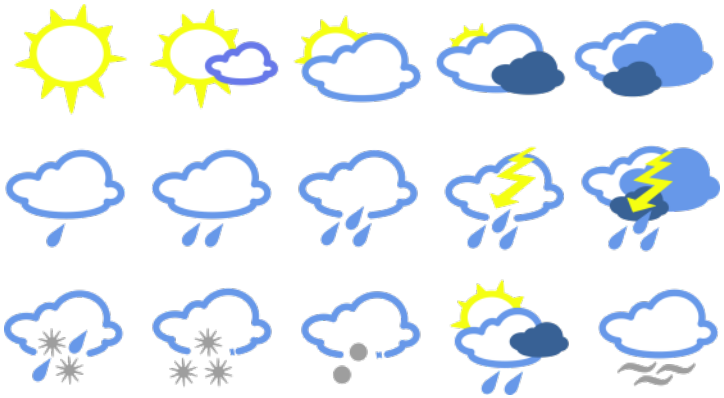
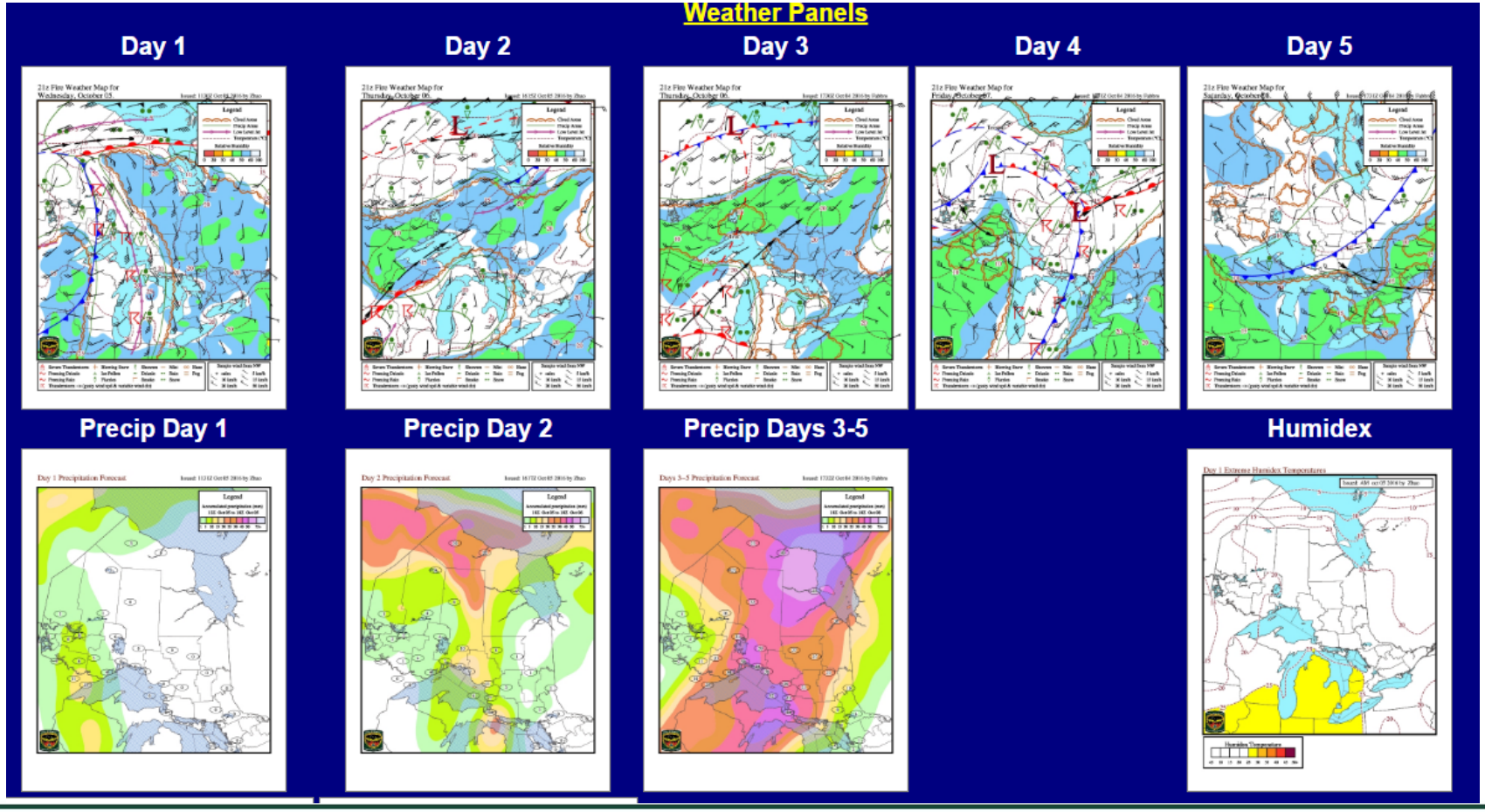
455000
460000
1.0
0.8
0.6
0.4
0.2

The Idea


January
February
March
April
May
June
July
August
September
October
November
December



A. Forecast 1 to 5 days by Staff Weather Forecasters



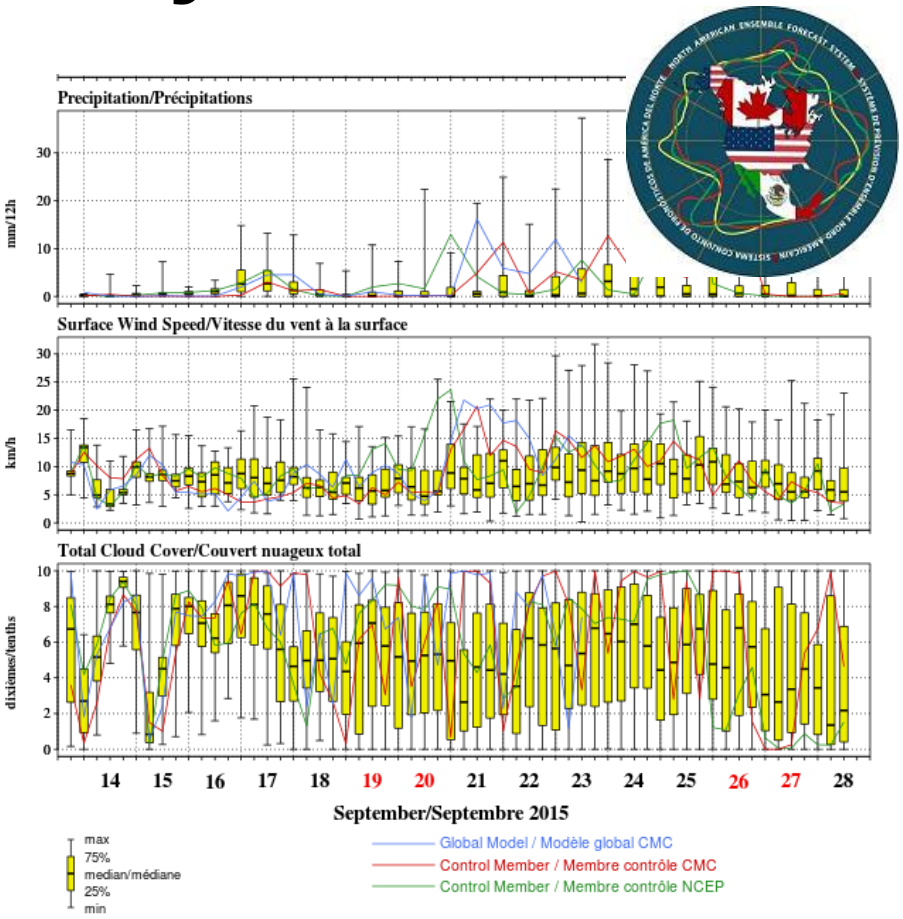
B. Forecast 1 to 15 days

NAEFS Ensemble

- Meteorological Service of Canada
- US National Weather Service
- Mexico National Meteorological Services

Numerical Weather Models

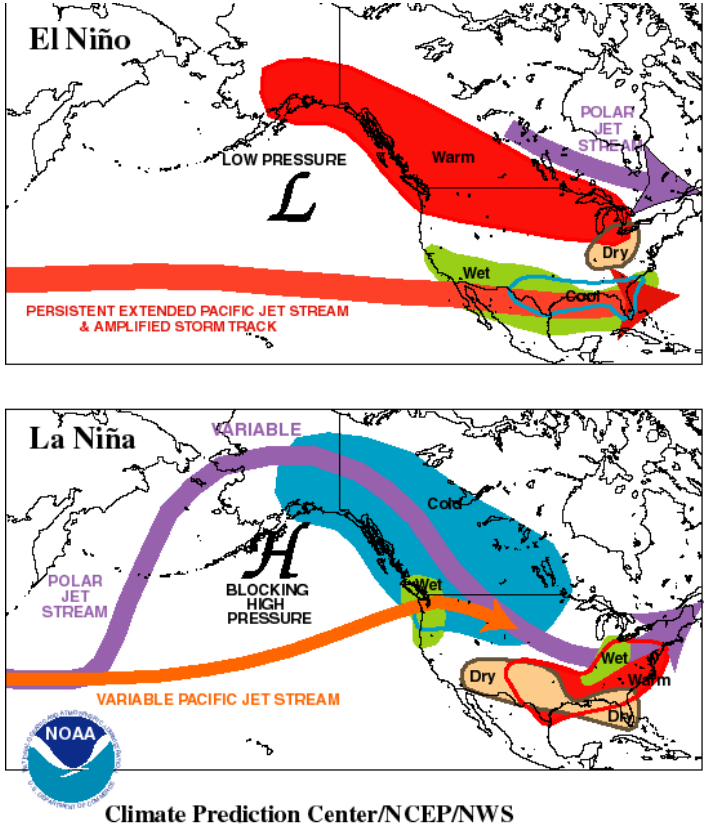
Many scenarios by changing initial conditions and model parameters



C. Forecast after 15 days

- Ocean temperature patterns (oscillations) are known to influence weather
- **Assumption:** similar set-up of ocean temperature patterns will result in similar weather (time and location)
- **Challenge:** finding correlation between these oscillations between current and previous ocean temperature patterns and choosing the years accordingly

(ENSO), (PDO),(AMO)

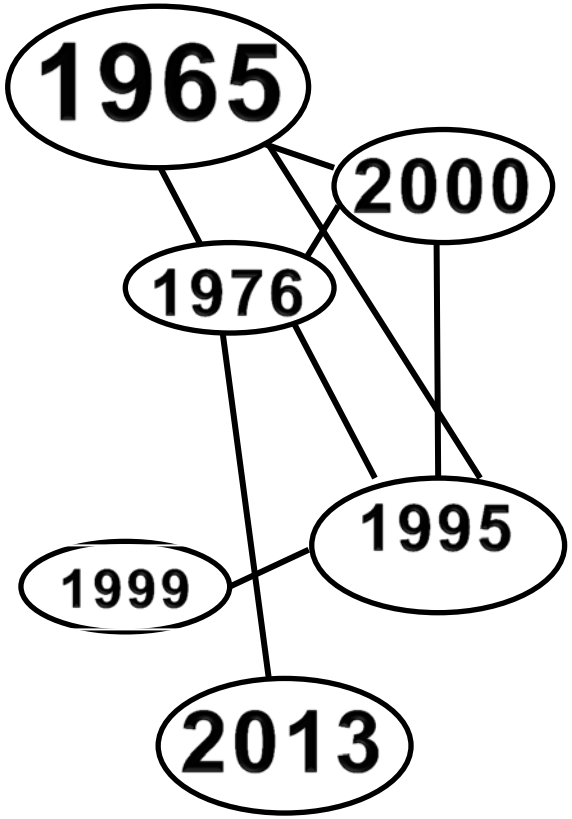


Images:www.cpc.ncep.noaa.gov/products/analysis_monitoring/ensocycle/nawinter.shtml

Pattern Matching Ocean Temperature Oscillations

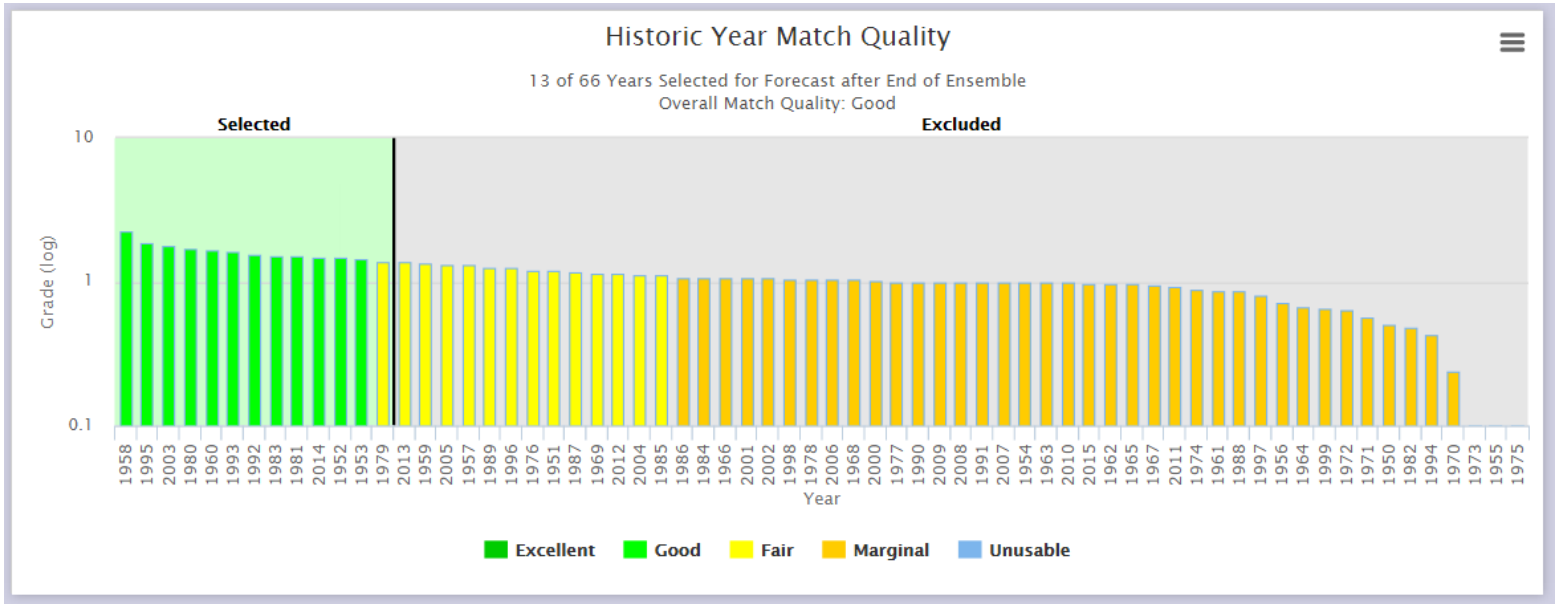
Outline of Steps:

1. Forecast ocean temperature indexes
2. Match (score) ocean temperatures from past to the present for upcoming months (temperature, range, trend)
3. Rank the years according to representativeness
4. Select an appropriate number of years to 1) capture the signal and 2) not over/understate the variability
5. Probability-weight the years

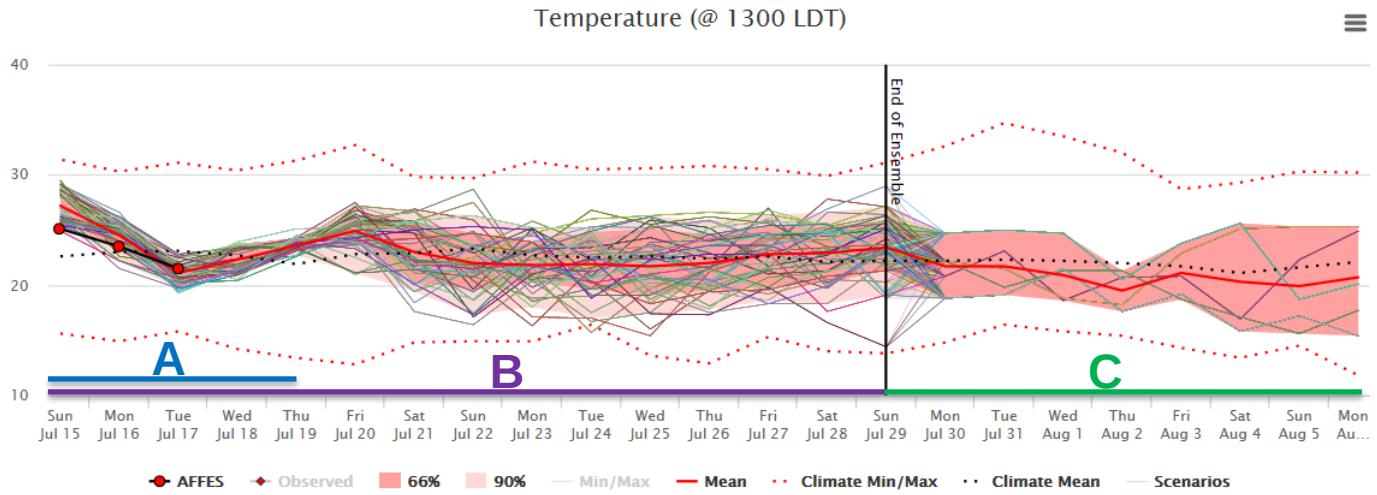


Selecting Years

- Include too many years and you are approaching climatology
- Include too few years and there is not enough variability
- Years selected based on the sum of the year score to a target
- Probability weighting for each year derived from Year Score



Ensembles



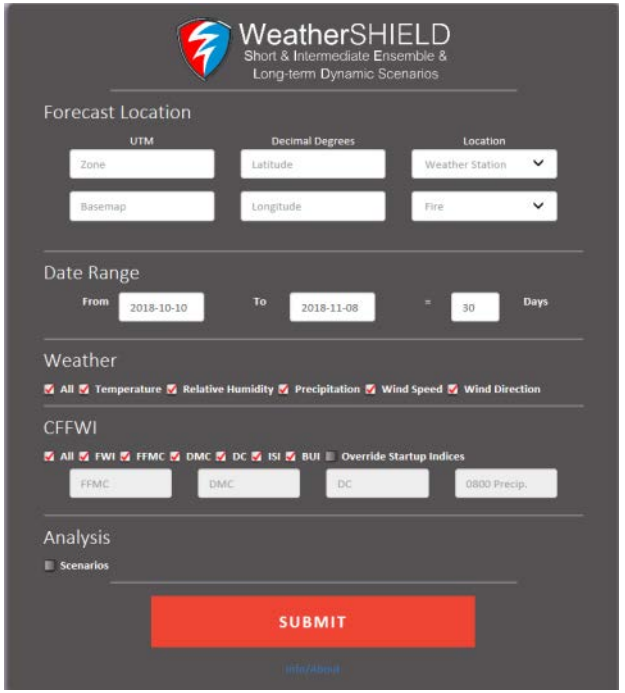
A. 1 to 5 days
   - AFFES staff weather forecasters

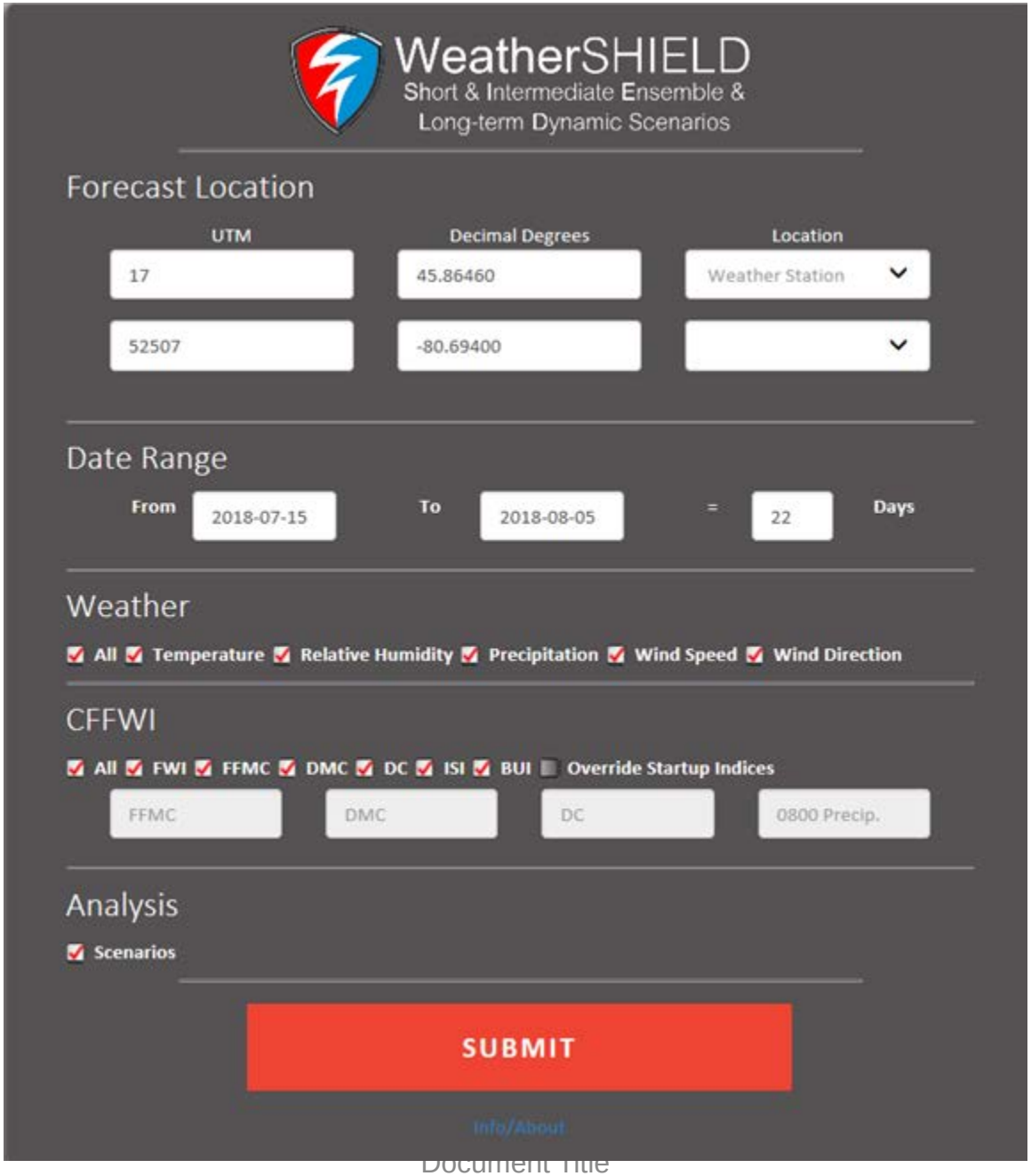
B. 1 to 15 days
   - Ensemble forecasts from Numerical Weather Models (NAEFS)

C. 16 days to 6 months and longer
   - Historical weather data from years where we attempt to match with similar ocean temperature patterns: El Nino/La Nina, etc

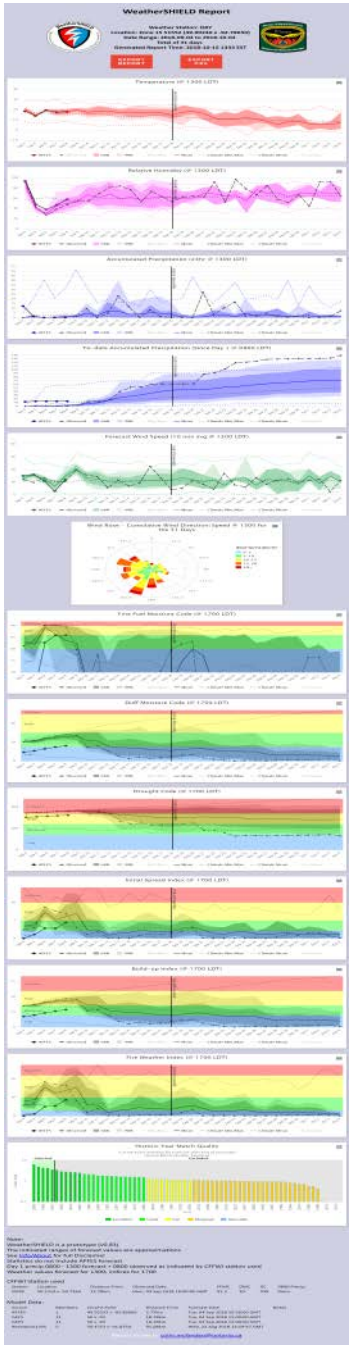
What is WeatherSHIELD?

- An AFFES web based tool
- Compiles and displays forecasting products to create weather scenarios
- Select anywhere in ontario
- Start any day of the year and run for long periods of time (up to 6 months)




WeatherSHIELD
Short & Intermediate Ensemble &
Long-term Dynamic Scenarios
Forecast Location
UTM
Decimal Degrees
Location
17
45.86460
Weather Station
52507
-80.69400
Date Range
From
2018-07-15
To
2018-08-05
=
22
Days
Weather
All
Temperature
Relative Humidity
Precipitation
Wind Speed
Wind Direction
CFFWI
All
FWI
FFMC
DMC
DC
ISI
BUI
Override Startup Indices
FFMC
DMC
DC
0800 Precip.
Analysis
Scenarios
SUBMIT
Info/About

Report



Temperature

Relative Humidity

Accumulated Precipitation

To –date Accumulated Precipitation

Forecast Wind Speed

Wind Rose – Direction and Speed

FFMC

DMC

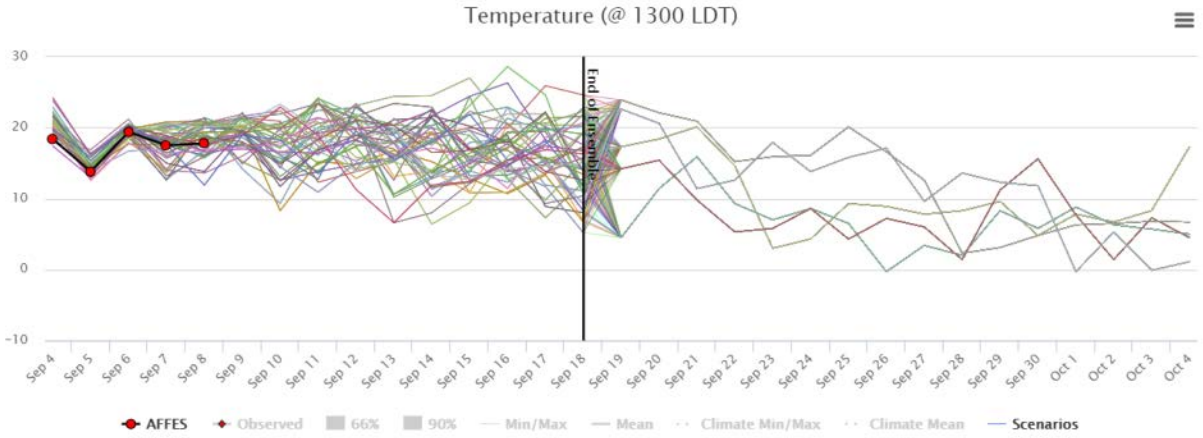
DC

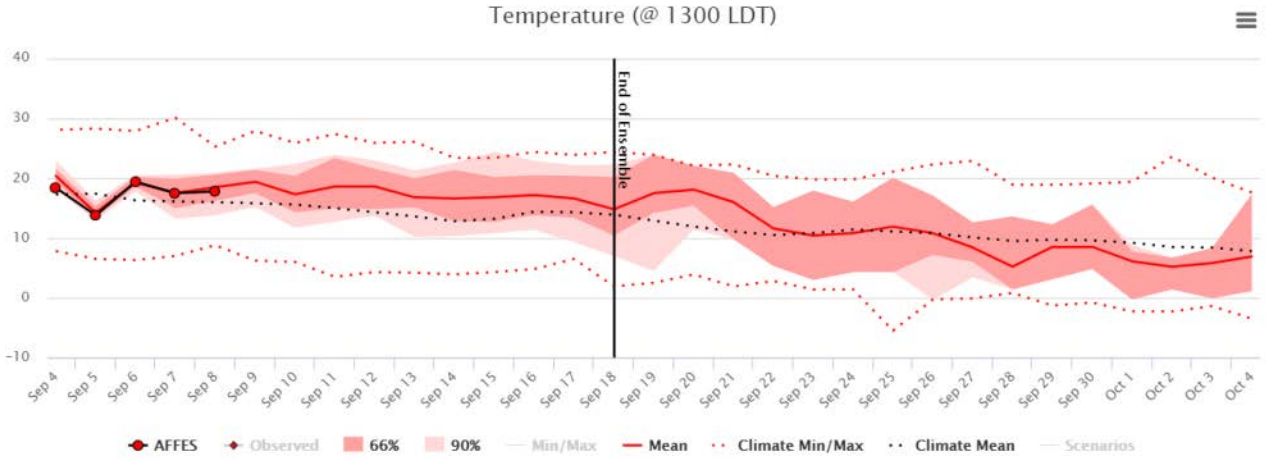
ISI

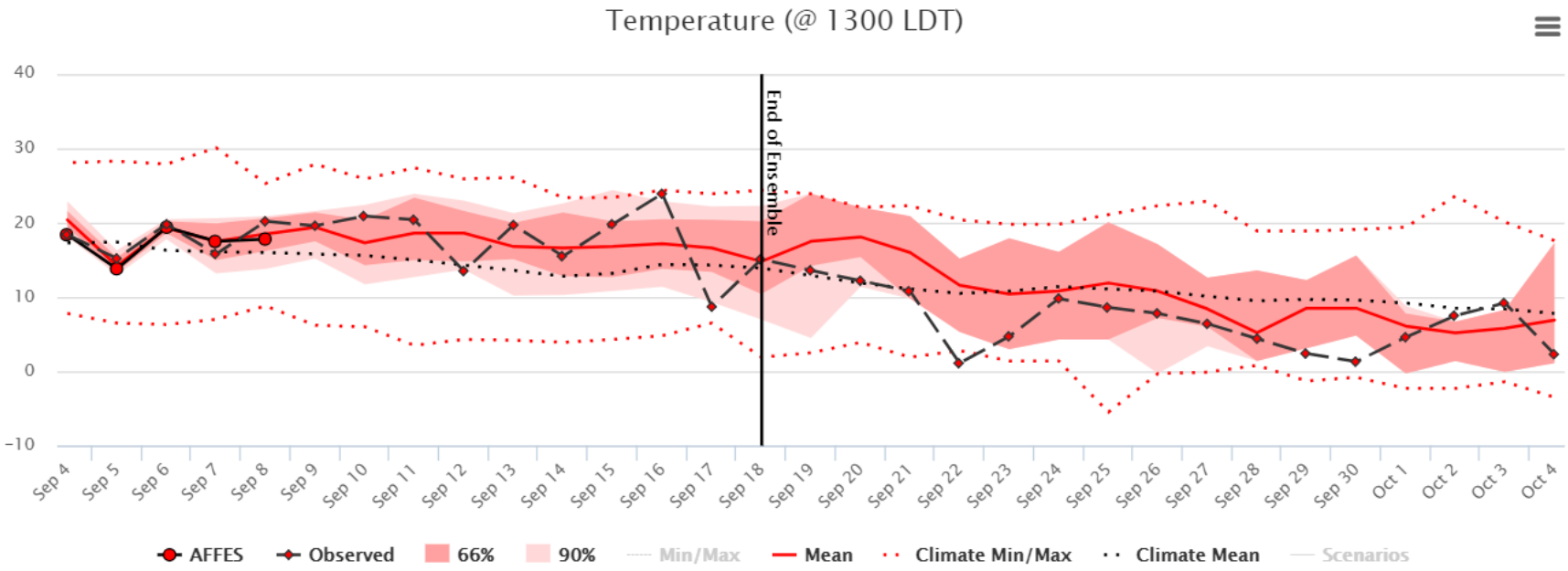
BUI

FWI

Year Matching

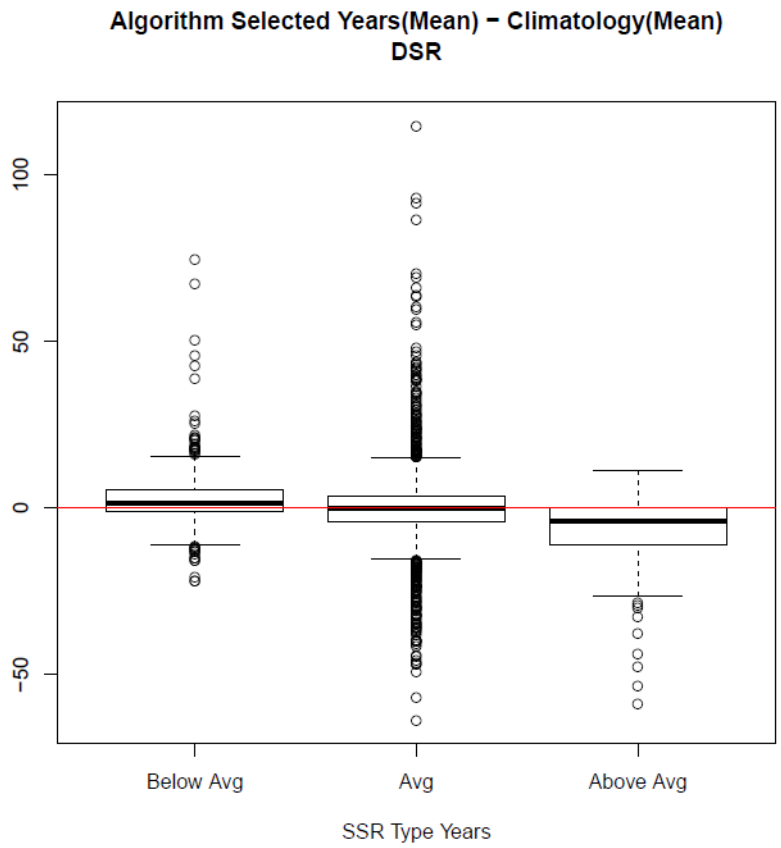

Temperature (@ 1300 LDT)
End of Ensemble
AFFES
Observed
66%
90%
Min/Max
Mean
Climate Min/Max
Climate Mean
Scenarios


Temperature (@ 1300 LDT)
End of Ensemble
AFFES
Observed
66%
90%
Min/Max
Mean
Climate Min/Max
Climate Mean
Scenarios


Temperature (@ 1300 LDT)
40
30
20
10
0
-10
End of Ensemble
Sep 4
Sep 5
Sep 6
Sep 7
Sep 8
Sep 9
Sep 10
Sep 11
Sep 12
Sep 13
Sep 14
Sep 15
Sep 16
Sep 17
Sep 18
Sep 19
Sep 20
Sep 21
Sep 22
Sep 23
Sep 24
Sep 25
Sep 26
Sep 27
Sep 28
Sep 29
Sep 30
Oct 1
Oct 2
Oct 3
Oct 4
AFFES
Observed
66%
90%
Min/Max
Mean
Climate Min/Max
Climate Mean
Scenarios


Historic Year Match Quality
5 of 68 Years Selected for Forecast after End of Ensemble
Overall Match Quality: Excellent
Selected
Excluded
10
1
0.1
Grade (log)
2009 2002 1969 2004 1991 1963 2006 2003 2014 1990 1965 1977 1968 1980 1994 1951 1953 1986 1987 1979 1982 1989 1972 1966 1959 1957 2005 2017 1996 1981 1960 2016 1978 2015 1992 1993 2013 2000 1958 1984 1985 1995 1976 2001 2012 1962 1967 1961 2008 1988 1954 1952 2007 1997 1956 1983 1964 1971 1974 1970 1998 2011 1999 1950 1973 2010 1975 1955
Year
Excellent
Good
Fair
Marginal
Unusable

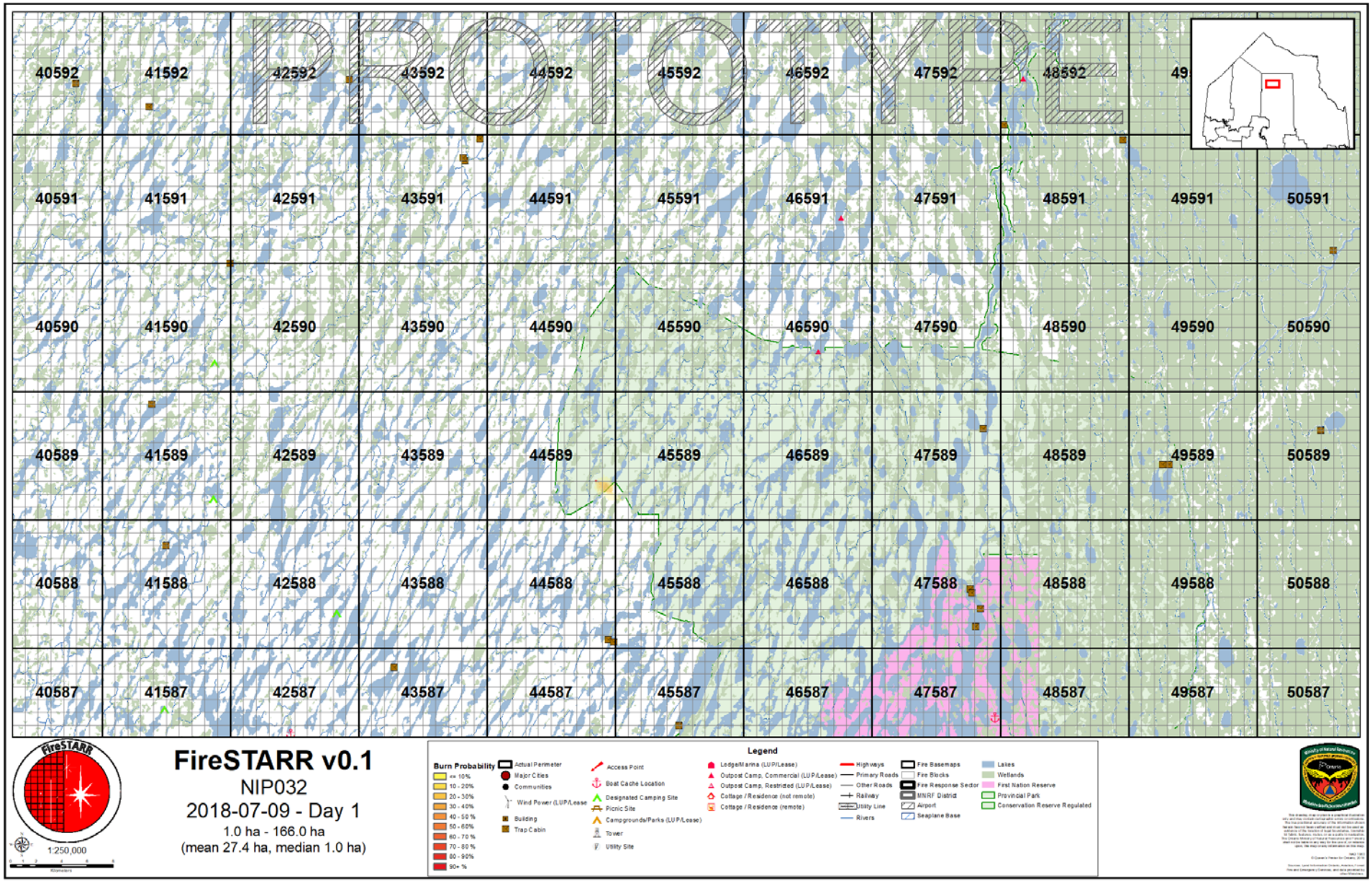
Validation



- Verifying weather prediction models has proven to be difficult
  - there is no ‘silver bullet’
  - Large province
  - Long term weather, did you get it wrong if you missed rain by a day?
  - What metric makes sense?

The ‘Future’ of WeatherSHIELD

- Validation of weather trends
  - Initial validation focused on day to day accuracy, this did show promise for hot weather scenarios
- Incorporation into Fire Behaviour Prediction modeling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41592
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43592
44592
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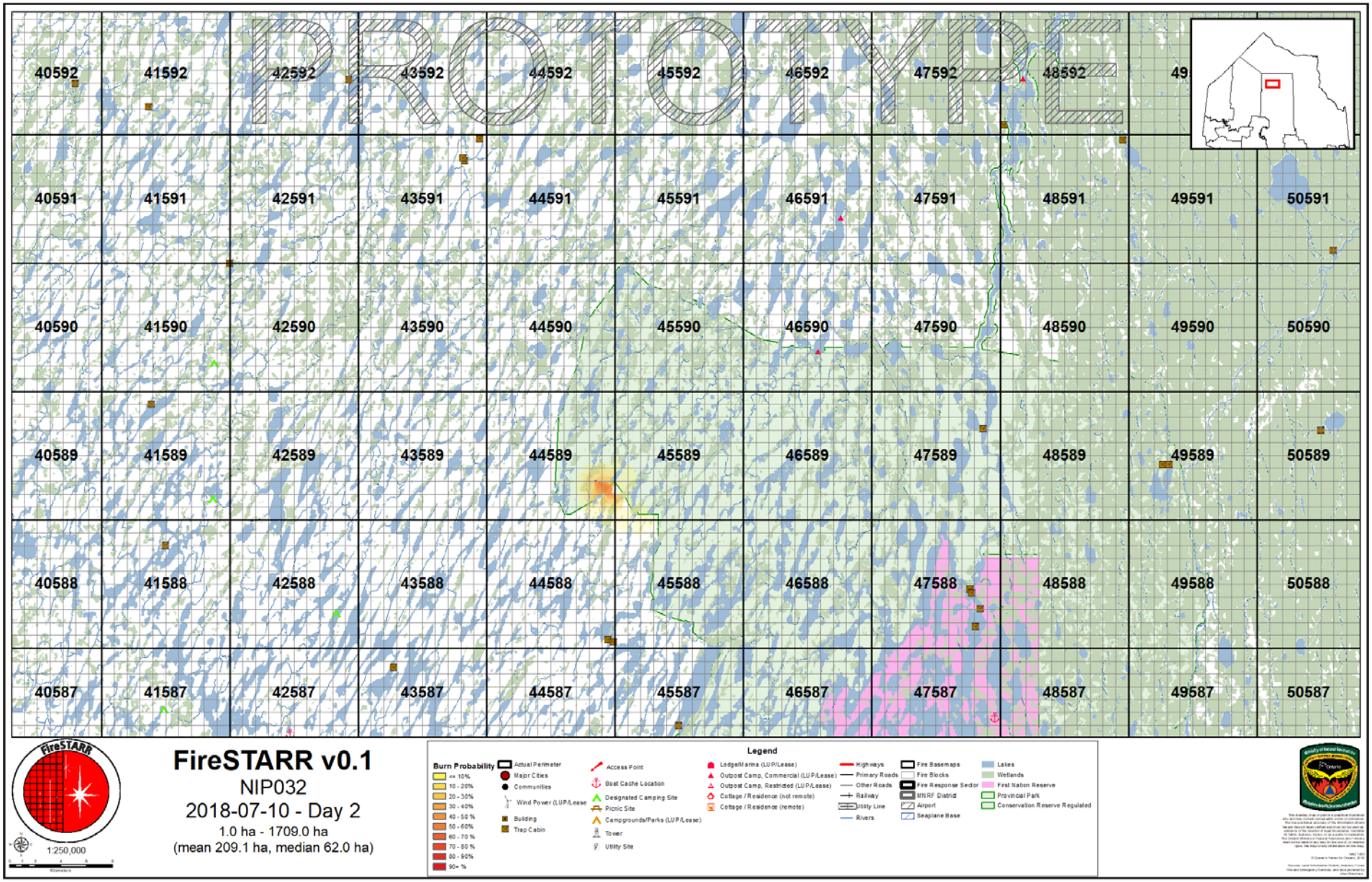
50588
40587
41587
42587
43587
44587
45587
46587
47587
48587
49587
50587
FireSTARR v0.1
NIP032
2018-07-09 - Day 1
1.0 ha - 166.0 ha
(mean 27.4 ha, median 1.0 ha)
1:250,000
Legend
Burn Probability
Actual Perimeter
Major Cities
Communities
Wind Power (LUP/Lease)
Building
Trap Cabin
Access Point
Boat Cache Location
Designated Camping Site
Picnic Site
Campgrounds/Parks (LUP/Lease)
Tower
Utility Site
Lodge/Marina (LUP/Lease)
Outpost Camp, Commercial (LUP/Lease)
Outpost Camp, Restricted (LUP/Lease)
Cottage / Residence (not remote)
Cottage / Residence (remote)
Highways
Primary Roads
Other Roads
Railway
Utility Line
Rivers
Fire Basemaps
Fire Blocks
Fire Response Sector
MNRF District
Airport
Seaplane Base
Lakes
Wetlands
First Nation Reserve
Provincial Park
Conservation Reserve Regulated


ROTOTYPE
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40587 41587 42587 43587 44587 45587 46587 47587 48587 49587 50587
FireSTARR v0.1
NIP032
2018-07-10 - Day 2
1.0 ha - 1709.0 ha
(mean 209.1 ha, median 62.0 ha)
1:250,000
Legend
Burn Probability
<= 10%
10 - 20%
20 - 30%
30 - 40%
40 - 50 %
50 - 60%
60 - 70 %
70 - 80 %
80 - 90%
90+ %
Actual Perimeter
Major Cities
Communities
Wind Power (LUP/Lease
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Cottage / Residence (remote)
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Airport
Seaplane Base
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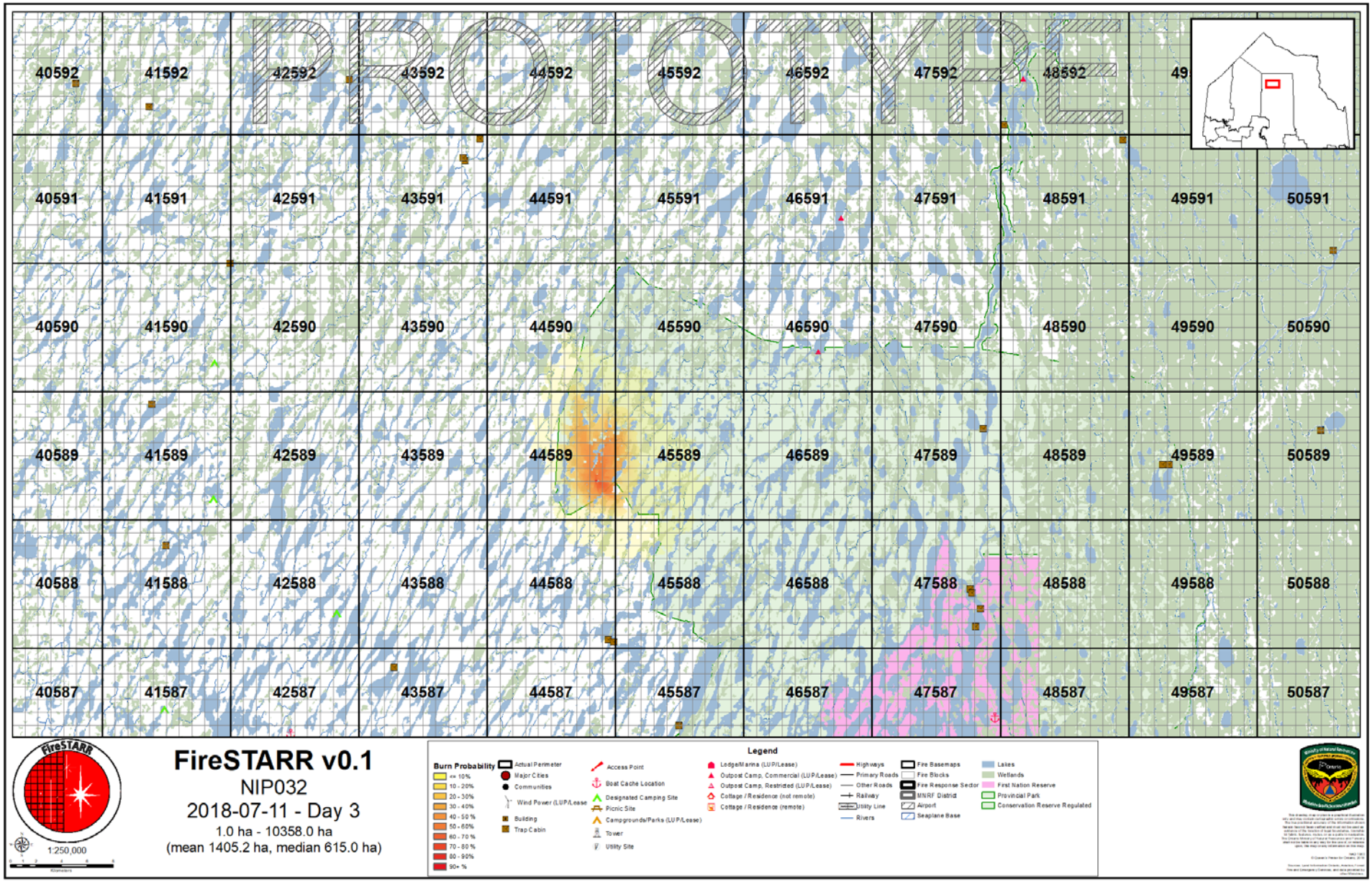
Wetlands
First Nation Reserve
Provincial Park
Conservation Reserve Regulated


ROTYRE
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40591 41591 42591 43591 44591 45591 46591 47591 48591 49591 50591
40590 41590 42590 43590 44590 45590 46590 47590 48590 49590 50590
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FireSTARR
1:250,000
FireSTARR v0.1
NIP032
2018-07-11 - Day 3
1.0 ha - 10358.0 ha
(mean 1405.2 ha, median 615.0 ha)
Legend
Burn Probability
<= 10%
10 - 20%
20 - 30%
30 - 40%
40 - 50 %
50 - 60%
60 - 70 %
70 - 80 %
80 - 90%
90+ %
Actual Perimeter
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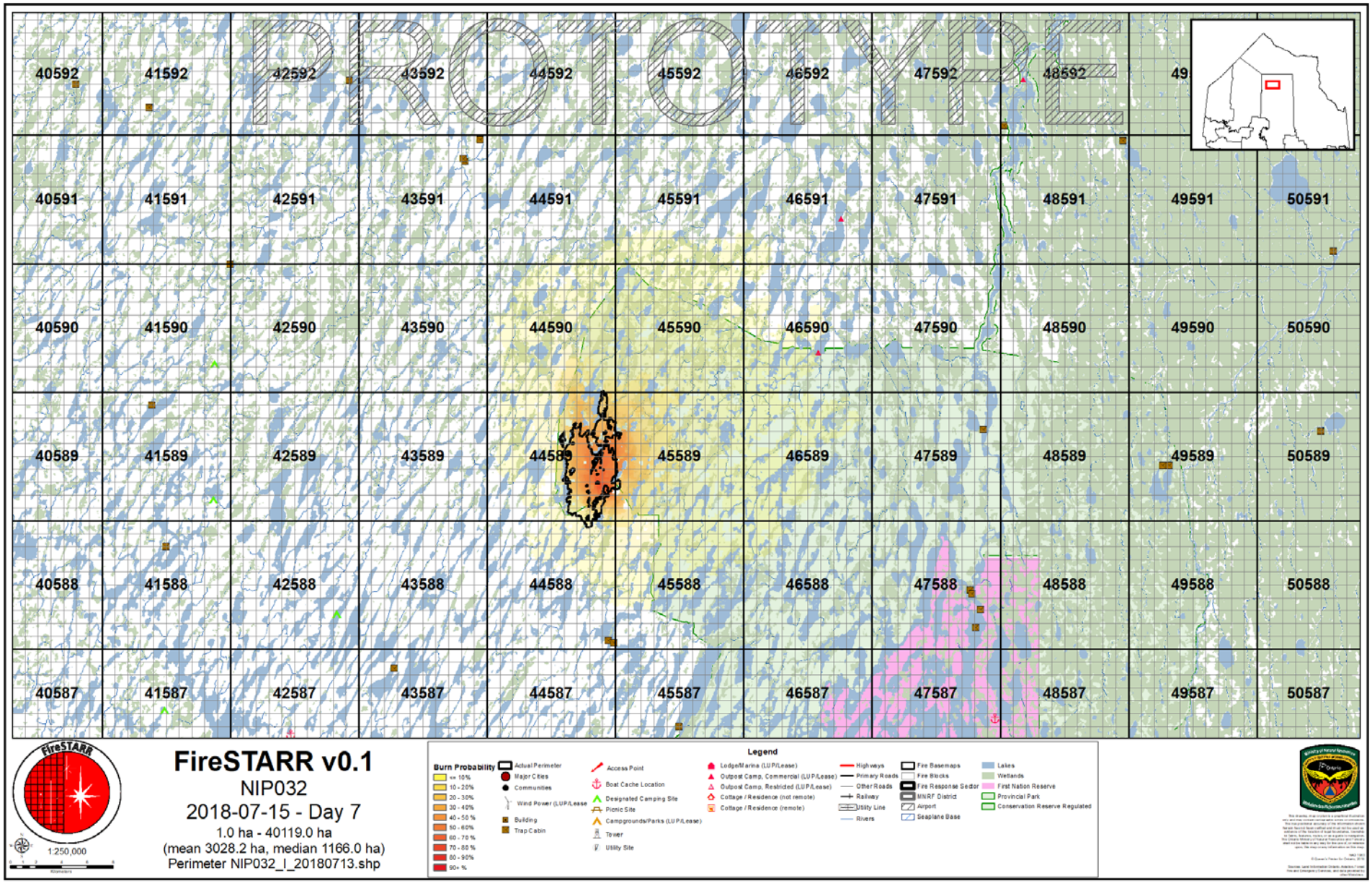
PROTOTYPE
40592 41592 42592 43592 44592 45592 46592 47592 48592 49
40591 41591 42591 43591 44591 45591 46591 47591 48591 49591 50591
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40587 41587 42587 43587 44587 45587 46587 47587 48587 49587 50587
FireSTARR
1:250,000
FireSTARR v0.1
NIP032
2018-07-15 - Day 7
1.0 ha - 40119.0 ha
(mean 3028.2 ha, median 1166.0 ha)
Perimeter NIP032_I_20180713.shp
Legend
Burn Probability
<= 10%
10 - 20%
20 - 30%
30 - 40%
40 - 50 %
50 - 60%
60 - 70 %
70 - 80 %
80 - 90%
90+ %
Actual Perimeter
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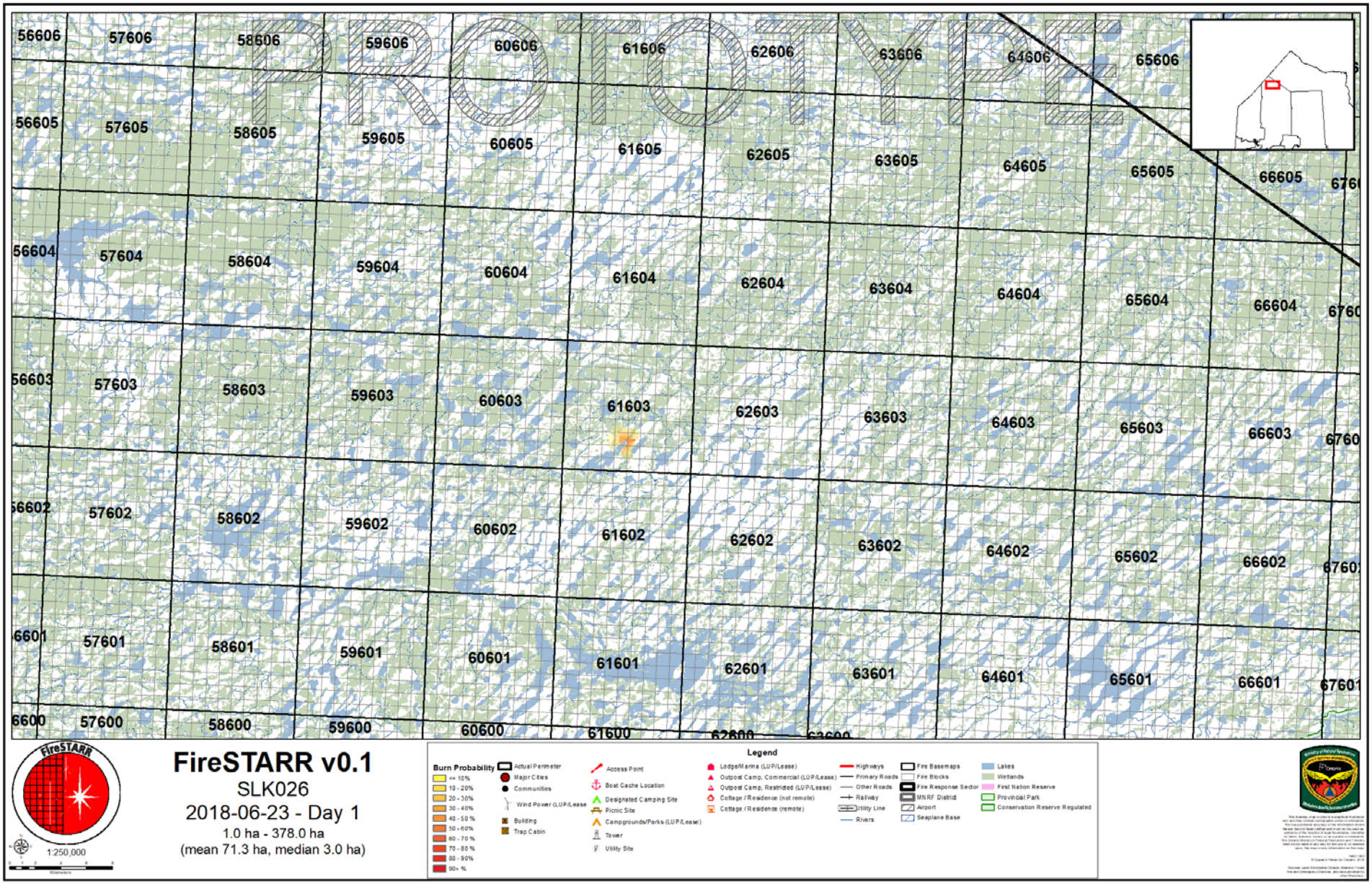
56606 57606 58606 59606 60606 61606 62606 63606 64606 65606
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56601 57601 58601 59601 60601 61601 62601 63601 64601 65601 66601
56600 57600 58600 59600 60600 61600
FireSTARR v0.1
SLK026
2018-06-23 - Day 1
1.0 ha - 378.0 ha
(mean 71.3 ha, median 3.0 ha)
1:250,000
Legend
Burn Probability
<= 10%
10 - 20%
20 - 30%
30 - 40%
40 - 50 %
50 - 60%
60 - 70 %
70 - 80 %
80 - 90%
90+ %
Actual Perimeter
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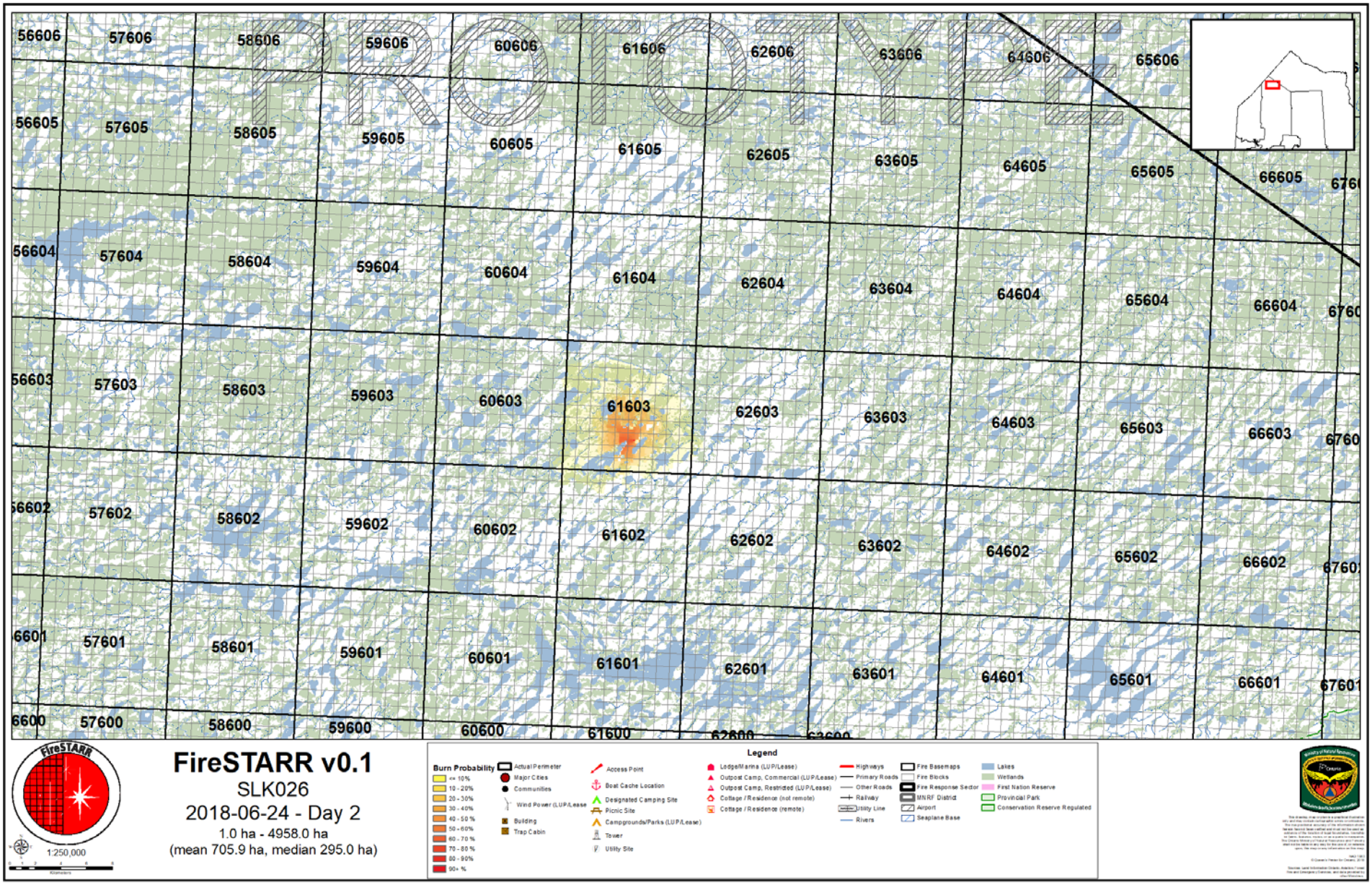
Wetlands
First Nation Reserve
Provincial Park
Conservation Reserve Regulated


FireSTARR v0.1
SLK026
2018-06-24 - Day 2
1.0 ha - 4958.0 ha
(mean 705.9 ha, median 295.0 ha)
1:250,000
Legend
Burn Probability
<= 10%
10 - 20%
20 - 30%
30 - 40%
40 - 50 %
50 - 60%
60 - 70 %
70 - 80 %
80 - 90%
90+ %
Actual Perimeter
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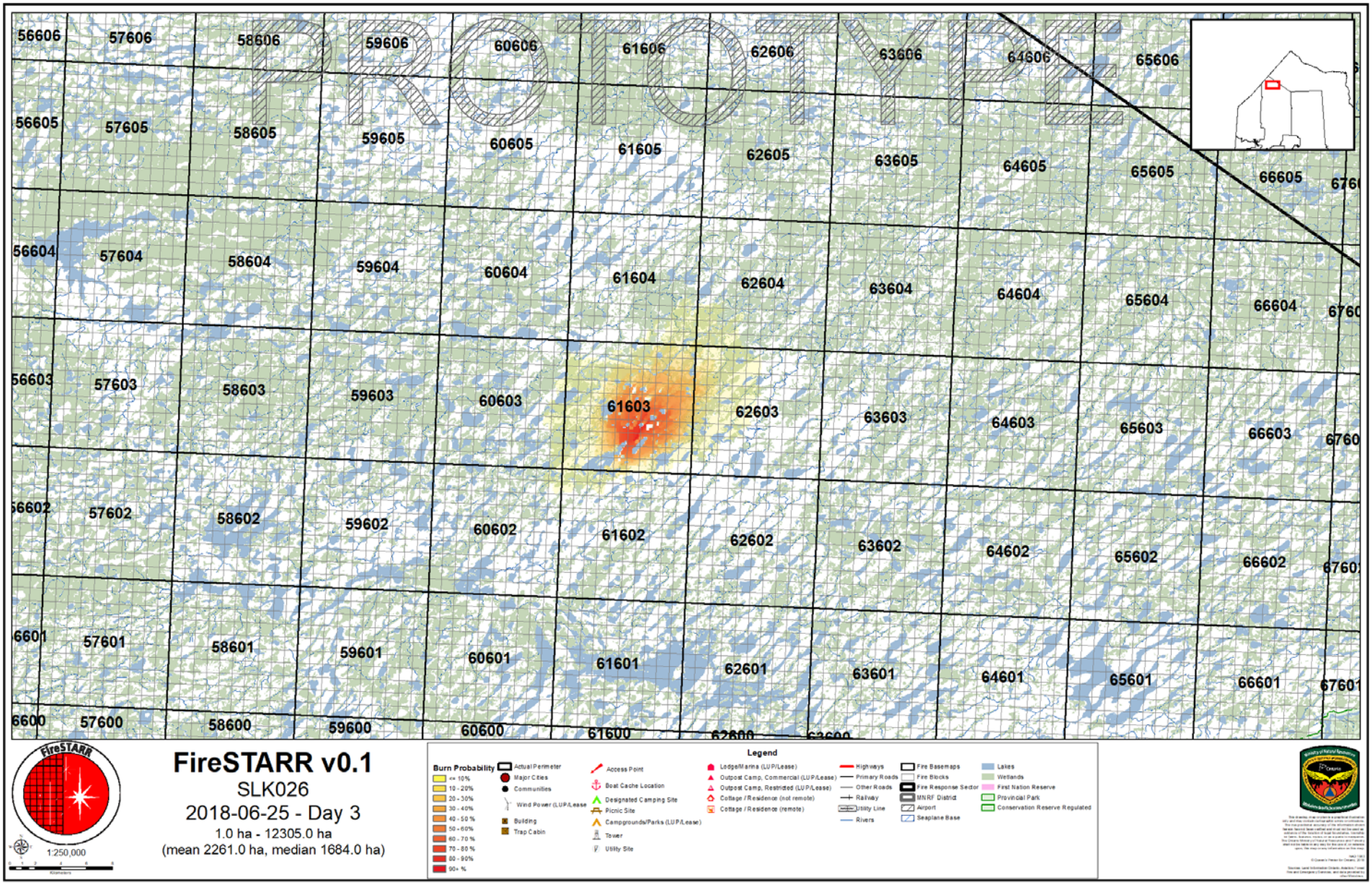
FireSTARR
FireSTARR v0.1
SLK026
2018-06-25 - Day 3
1.0 ha - 12305.0 ha
(mean 2261.0 ha, median 1684.0 ha)
1:250,000
Legend
Burn Probability
<= 10%
10 - 20%
20 - 30%
30 - 40%
40 - 50 %
50 - 60%
60 - 70 %
70 - 80 %
80 - 90%
90+ %
Actual Perimeter
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Outpost Camp, Restricted (LUP/Lease)
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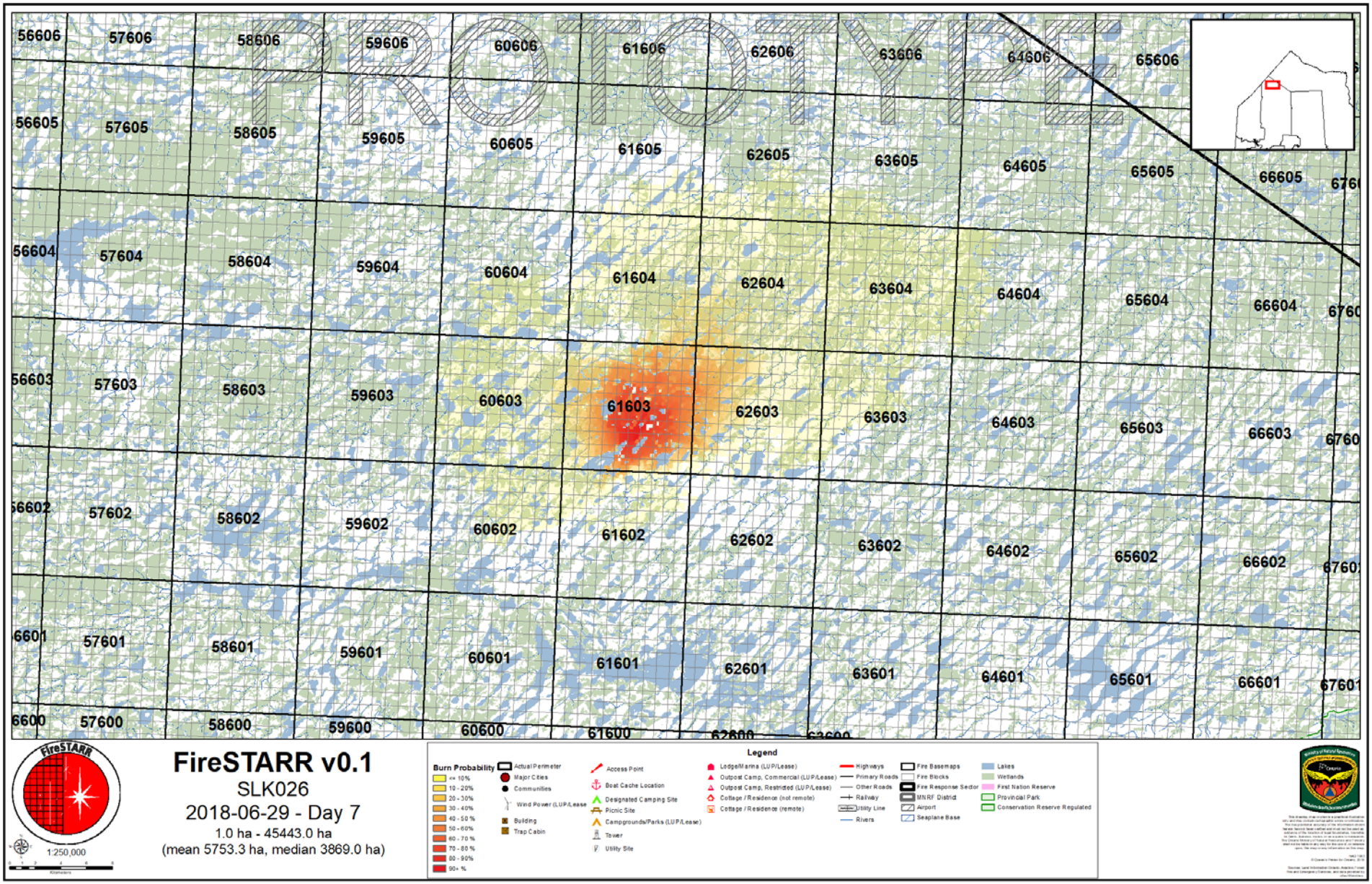
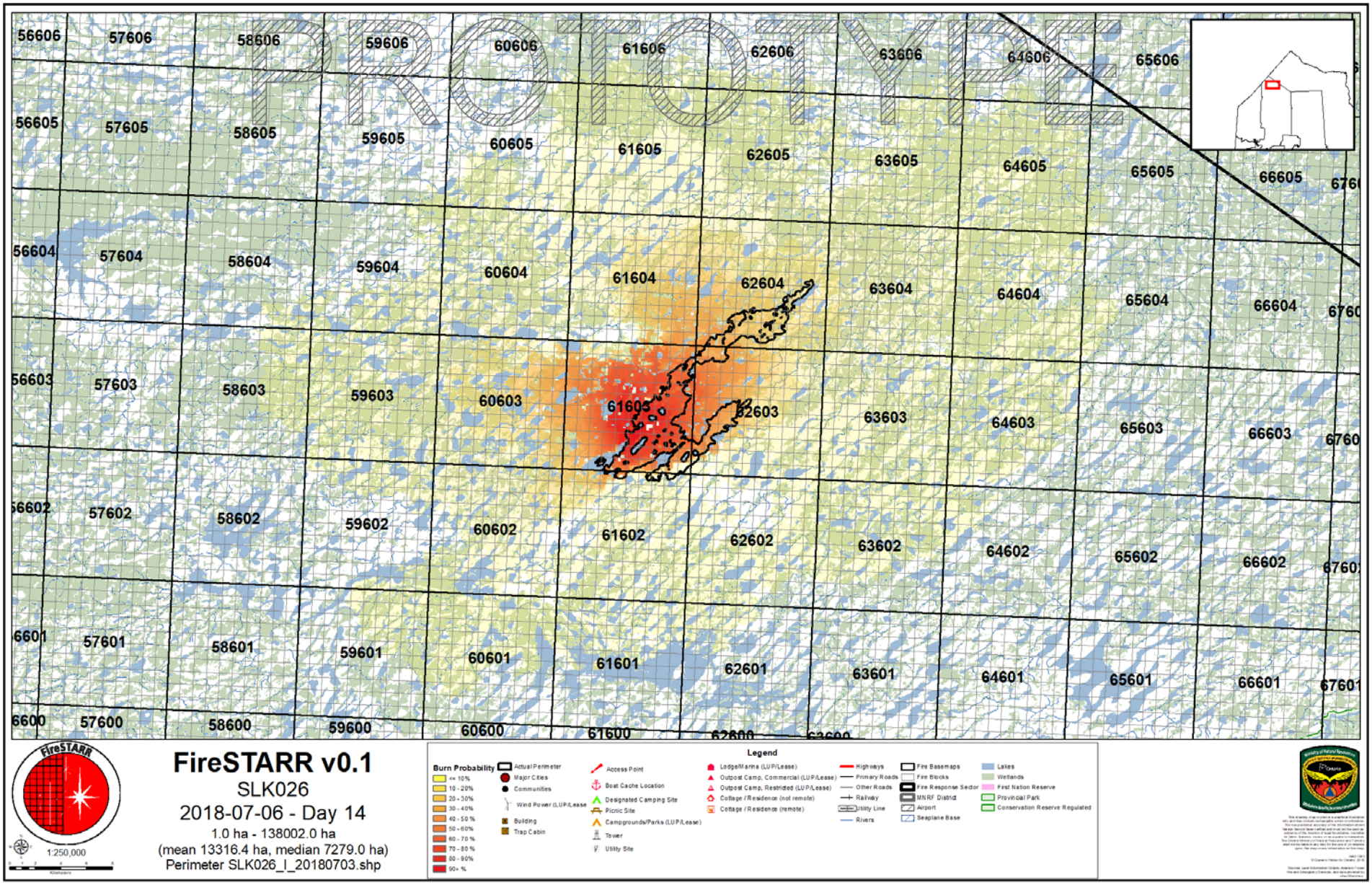

FireSTARR v0.1
SLK026
2018-06-29 - Day 7
1.0 ha - 45443.0 ha
(mean 5753.3 ha, median 3869.0 ha)
1:250,000
Legend
Burn Probability
<= 10%
10 - 20%
20 - 30%
30 - 40%
40 - 50 %
50 - 60%
60 - 70 %
70 - 80 %
80 - 90%
90+ %
Actual Perimeter
Major Cities
Communities
Wind Power (LUP/Lease
Building
Trap Cabin
Access Point
Boat Cache Location
Designated Camping Site
Picnic Site
Campgrounds/Parks (LUP/Lease)
Tower
Utility Site
Lodge/Marina (LUP/Lease)
Outpost Camp, Commercial (LUP/Lease)
Outpost Camp, Restricted (LUP/Lease)
Cottage / Residence (not remote)
Cottage / Residence (remote)
Highways
Primary Roads
Other Roads
Railway
Utility Line
Rivers
Fire Basemaps
Fire Blocks
Fire Response Sector
MNRF District
Airport
Seaplane Base
Lakes
Wetlands
First Nation Reserve
Provincial Park
Conservation Reserve Regulated


FireSTARR v0.1
SLK026
2018-07-06 - Day 14
1.0 ha - 138002.0 ha
(mean 13316.4 ha, median 7279.0 ha)
Perimeter SLK026_I_20180703.shp
1:250,000
Legend
Burn Probability
<= 10%
10 - 20%
20 - 30%
30 - 40%
40 - 50 %
50 - 60%
60 - 70 %
70 - 80 %
80 - 90%
90+ %
Actual Perimeter
Major Cities
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Wind Power (LUP/Lease
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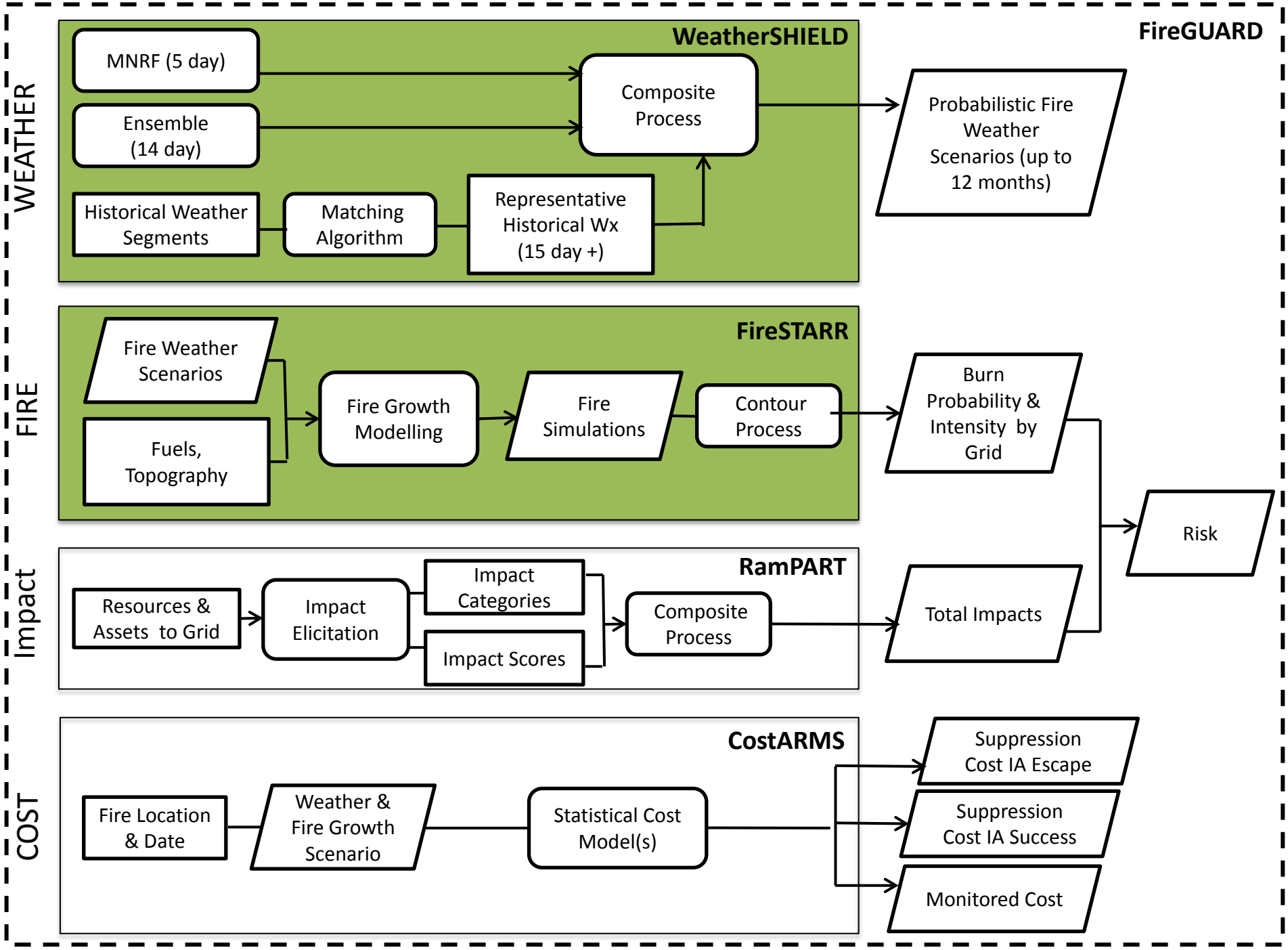
FireGUARD
WEATHER
WeatherSHIELD
MNRF (5 day)
Ensemble (14 day)
Historical Weather Segments
Matching Algorithm
Representative Historical Wx (15 day +)
Composite Process
Probabilistic Fire Weather Scenarios (up to 12 months)
FIRE
FireSTARR
Fire Weather Scenarios
Fuels, Topography
Fire Growth Modelling
Fire Simulations
Contour Process
Burn Probability & Intensity by Grid
Impact
RamPART
Resources & Assets to Grid
Impact Elicitation
Impact Categories
Impact Scores
Composite Process
Total Impacts
Risk
COST
CostARMS
Fire Location & Date
Weather & Fire Growth Scenario
Statistical Cost Model(s)
Suppression Cost IA Escape
Suppression Cost IA Success
Monitored Cost

Project Team

Leads: Colin McFayden & Den Boychuk

Project Manager: Bill Cole, [retired, Rob McAlpine]

Development: Jordan Evens, Randal Kuyvenhoven, Dan Leonard, Darren McLarty, Jerry Shields, and Aaron Stacey [retired, Jerry Leroux and Fred Welch]

Academic Collaboration:

Douglas Woolford (University of Western Ontario) statistical analysis of associations to SST and fire weather indicators and verification methods

Mike Wotton (Canadian Forest Service/University of Toronto)analysis and modelling of start-up and shut-down conditions for fire weather indices and calibration of the Reanalysis data.

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Questions?

Aaron Stacey – aaron.stacey@ontario.ca

2018 - 2019 Webinar Series
November 29, 2018

Sharp-tailed grouse reintroduction at Moquah Barrens.

Brian Heeringa
Wildlife Biologist
Washburn District
Chequamegon-Nicolet National Forests