MODELLING THE SWINLEY-CROWTHORNE FOREST FIRE

@DrTELS
@KCLGEOGRAPHY

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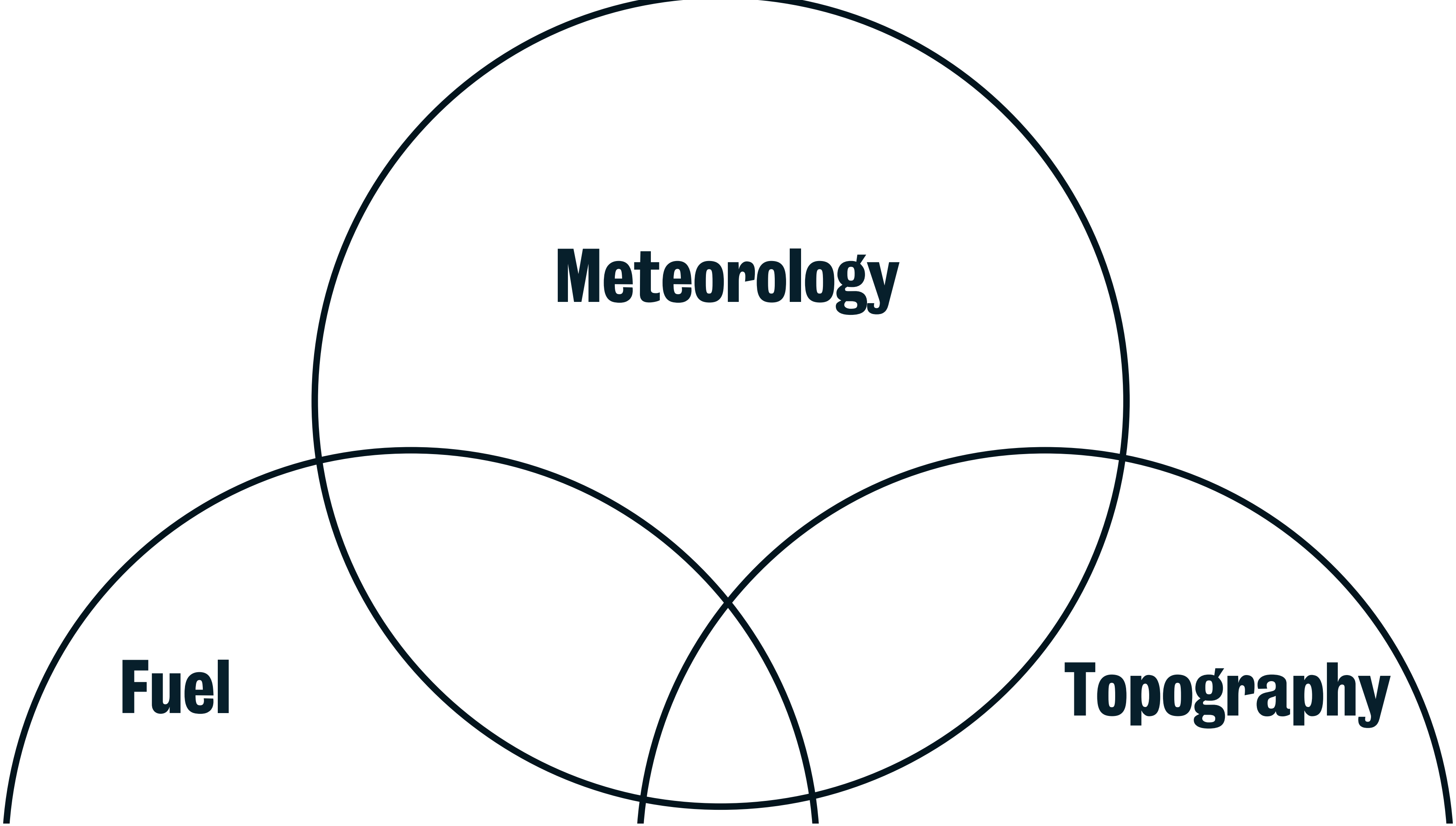
KING'S College LONDON
Geography

OVERVIEW

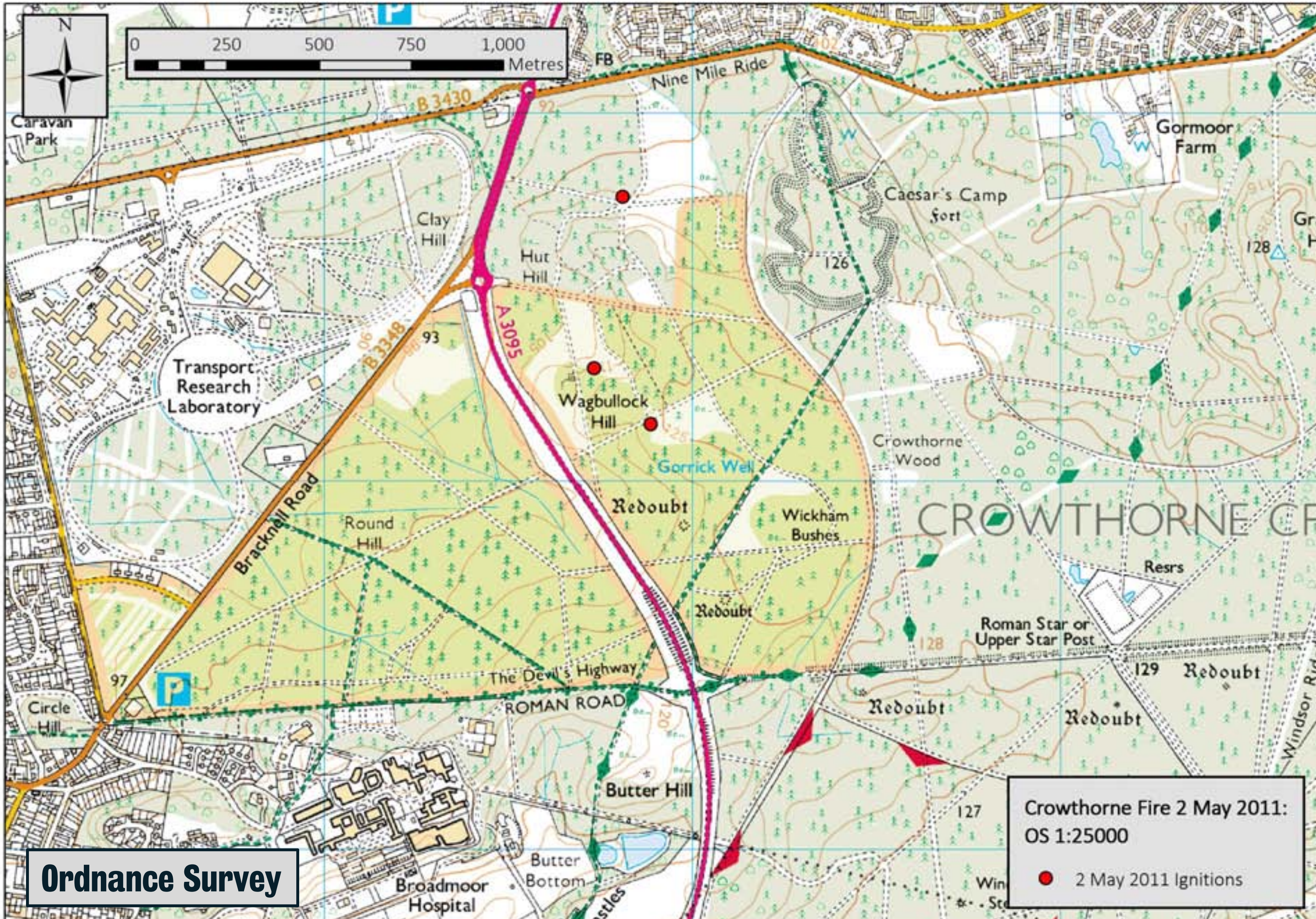
- Model inputs
  - Fuels
  - Topography
  - Weather + modified weather
  - Ignition

- Wildfire spread models
  - Evaluation of modelled fire spread

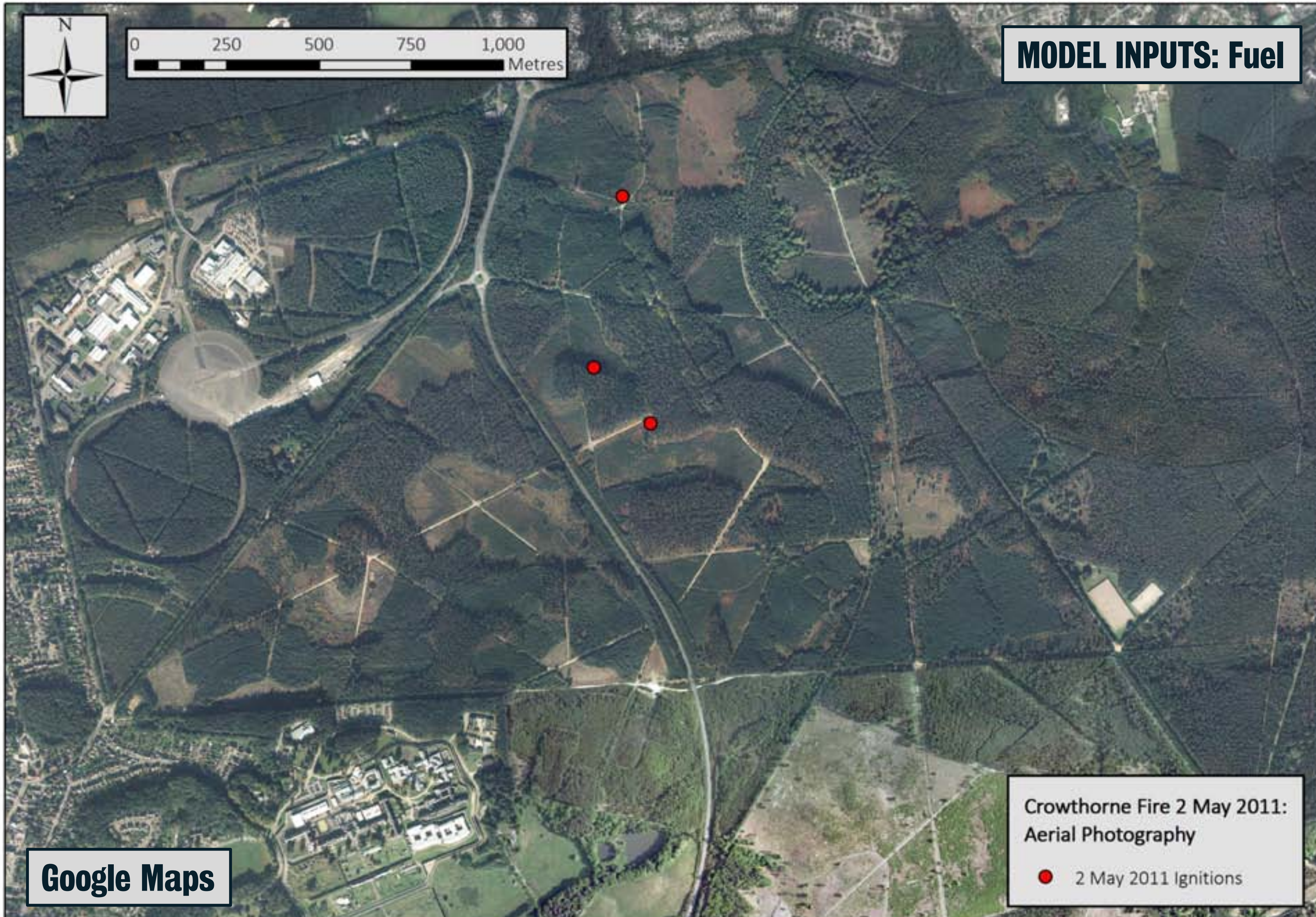
- Fire spread vs observed spread
- Scenarios of wildfire spread



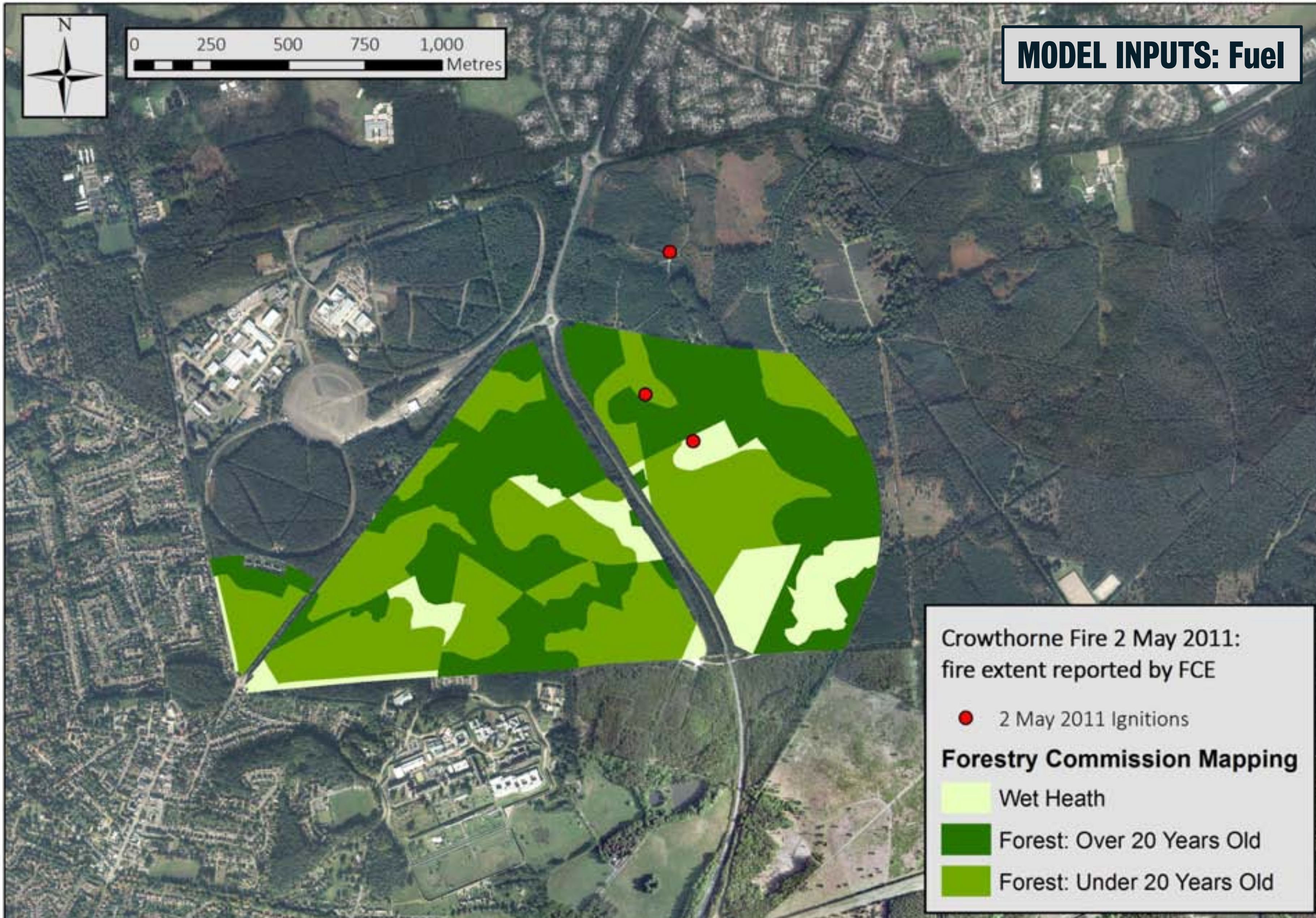
FIRE SPREAD MODEL INPUTS

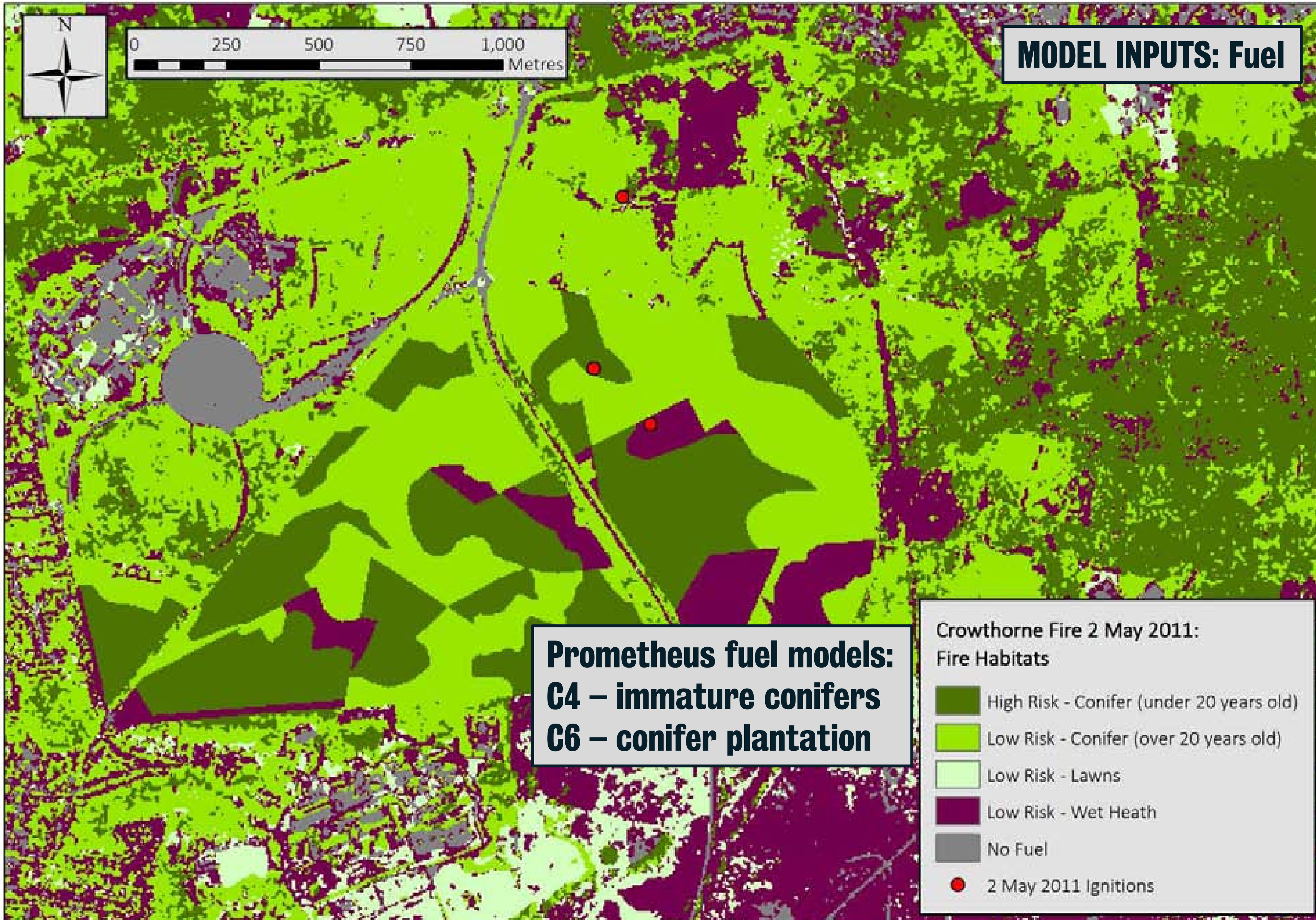


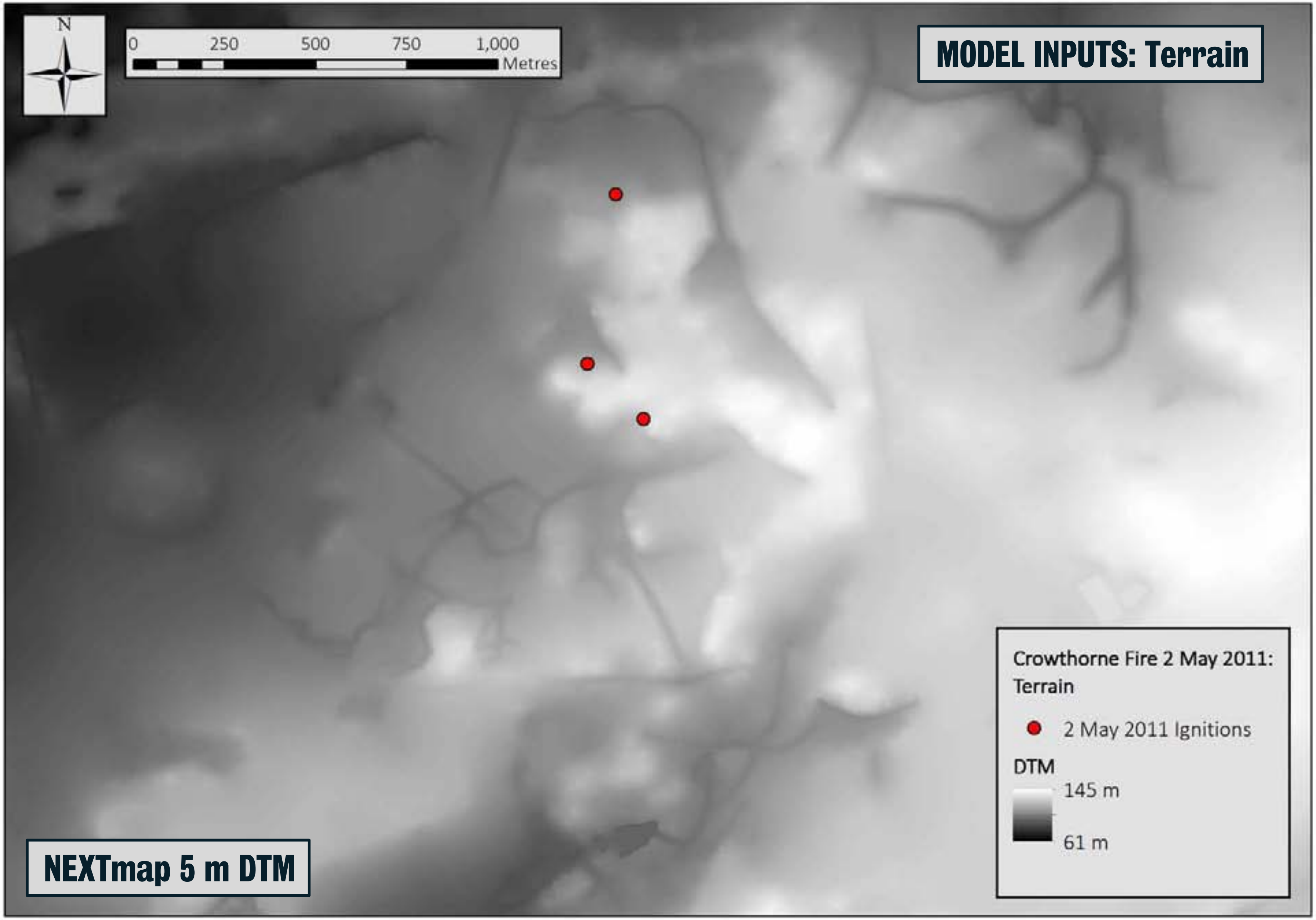
Ordnance Survey

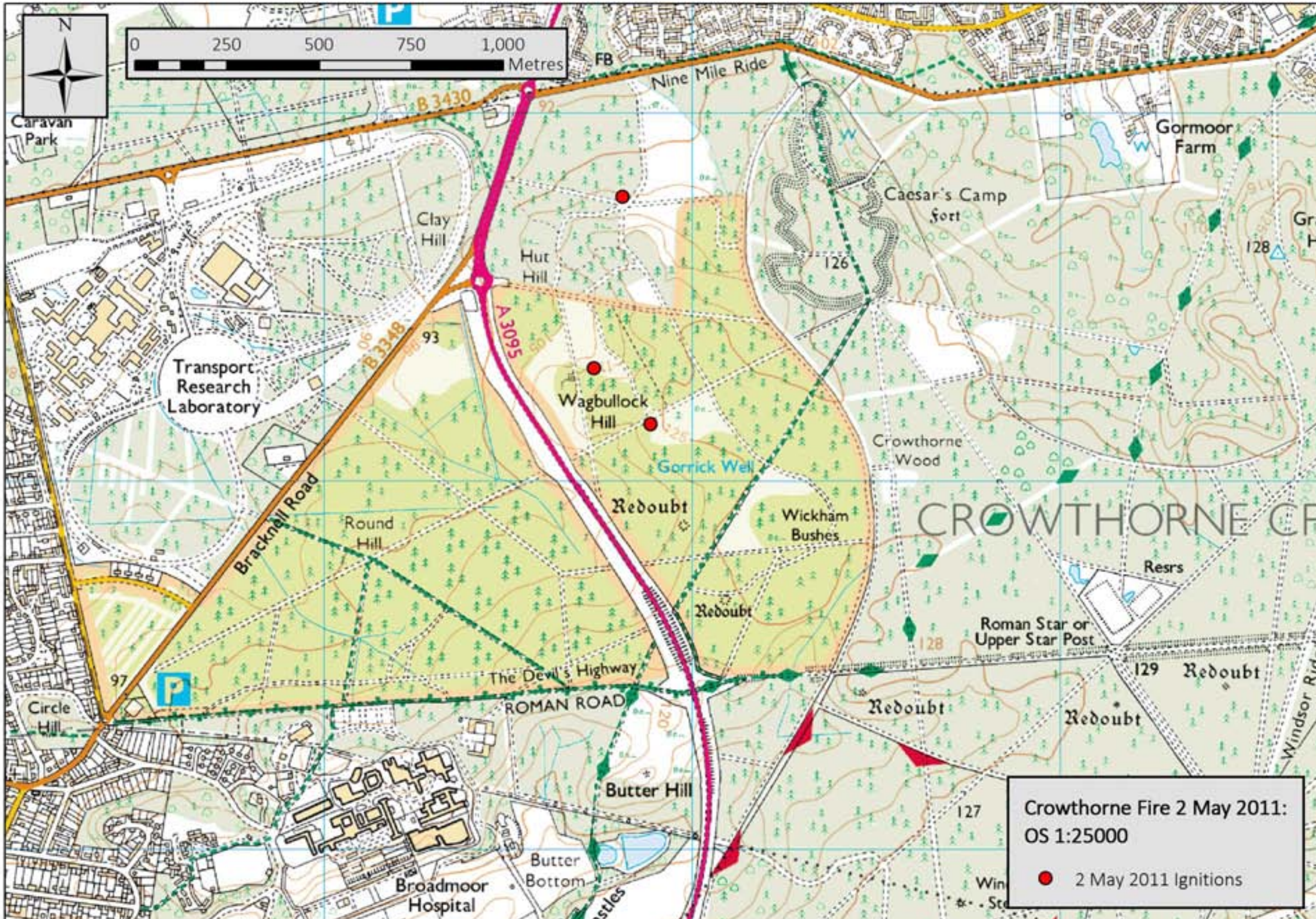

N
0
250
500
750
1,000
Metres
MODEL INPUTS: Fuel
Crowthorne Fire 2 May 2011:
Aerial Photography
2 May 2011 Ignitions
Google Maps

MODEL INPUTS: Fuel



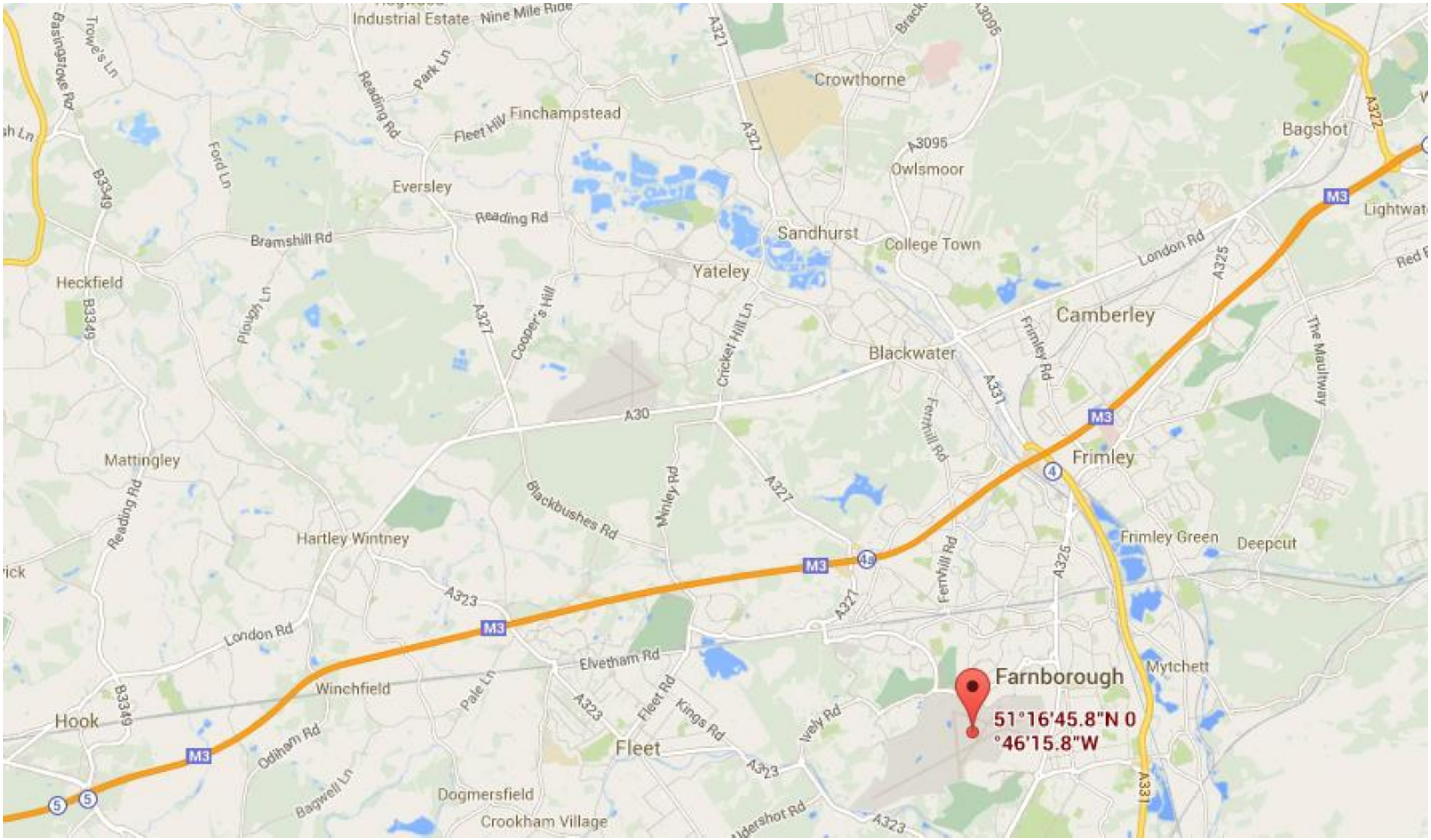

MODEL INPUTS: Fuel
N
0 250 500 750 1,000
Metres
Prometheus fuel models:
C4 – immature conifers
C6 – conifer plantation
Crowthorne Fire 2 May 2011:
Fire Habitats
High Risk - Conifer (under 20 years old)
Low Risk - Conifer (over 20 years old)
Low Risk - Lawns
Low Risk - Wet Heath
No Fuel
2 May 2011 Ignitions


N
0 250 500 750 1,000
Metres
MODEL INPUTS: Terrain
Crowthorne Fire 2 May 2011:
Terrain
2 May 2011 Ignitions
DTM
145 m
61 m
NEXTmap 5 m DTM

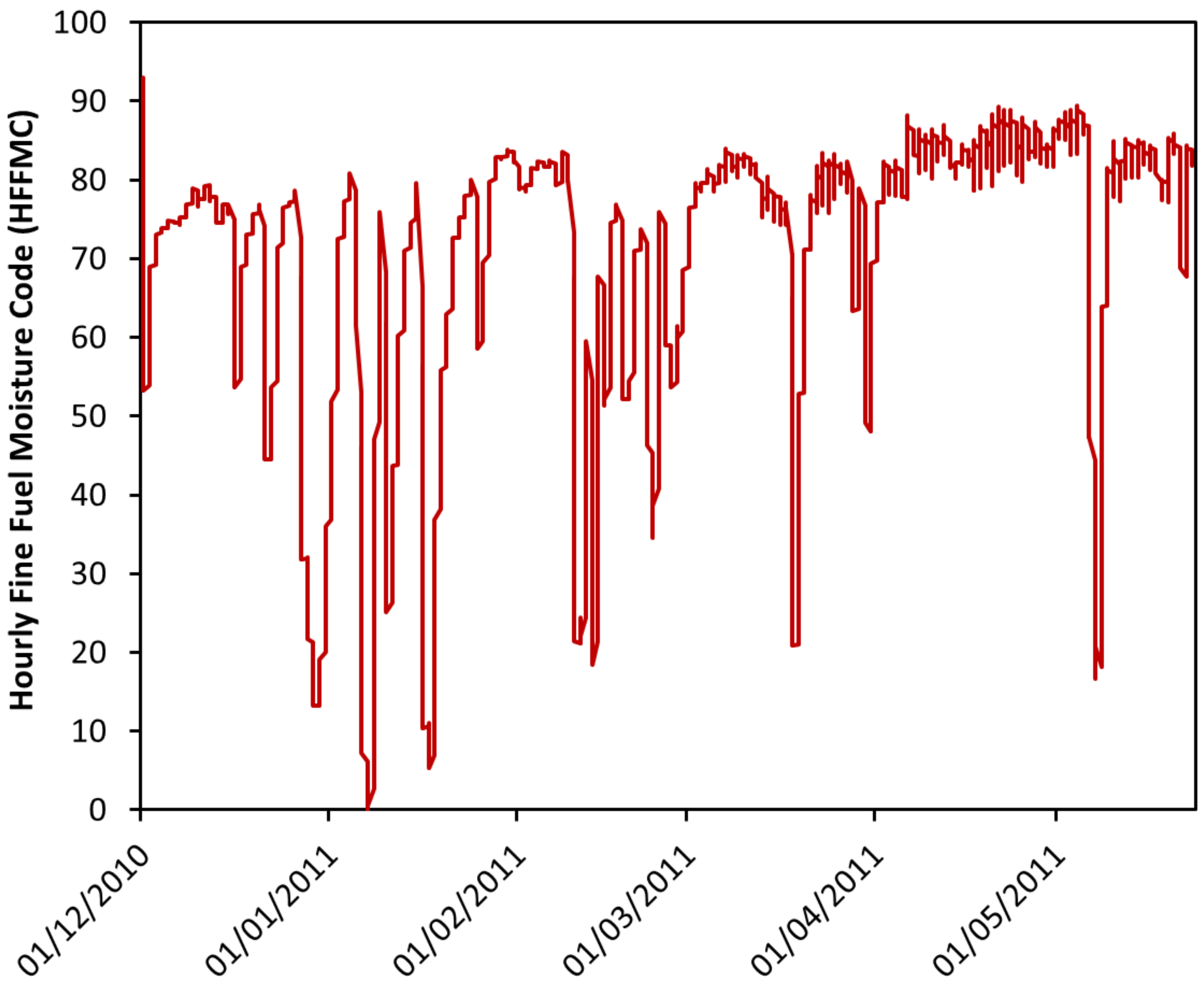


N
0 250 500 750 1,000
Metres
Caravan Park
FB
Nine Mile Ride
B 3430
Gormoor Farm
Caesar's Camp Fort
126
Clay Hill
Hut Hill
Gra Hi
128
Transport Research Laboratory
B 3348
93
A 3095
Wagbullock Hill
Gorrick Well
Crowthorne Wood
Redoubt
Wickham Bushes
CROWTHORNE CP
Bracknell Road
Round Hill
Resrs
Redoubt
Roman Star or Upper Star Post
128
129
Redoubt
Windsor Ride
97
The Devil's Highway
ROMAN ROAD
Circle Hill
Redoubt
Redoubt
Butter Hill
127
Butter Bottom
Broadmoor Hospital
Crowthorne Fire 2 May 2011: OS 1:25000
2 May 2011 Ignitions

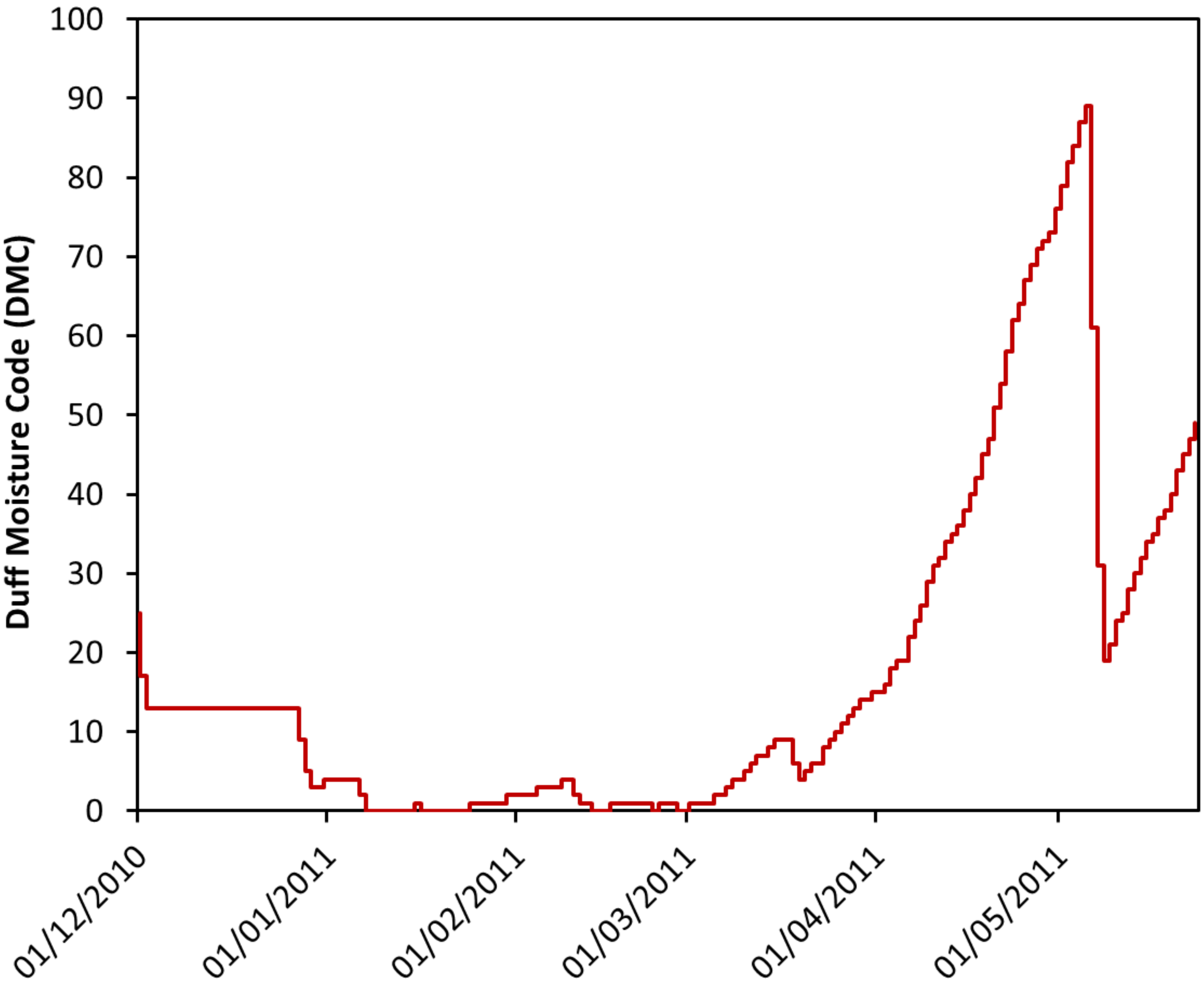
MODEL INPUTS: LONG-TERM WEATHER



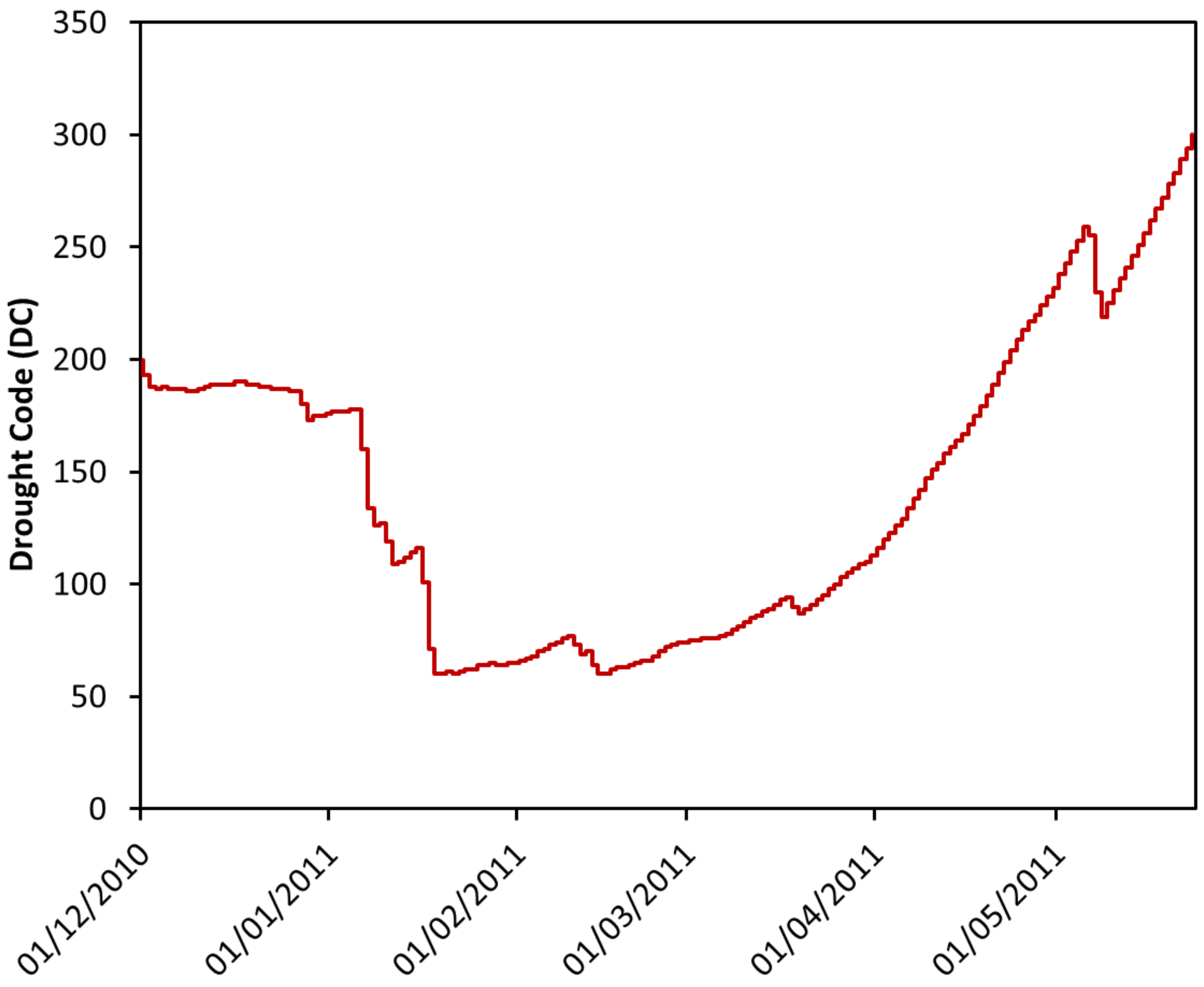
MODEL INPUTS: LONG-TERM WEATHER



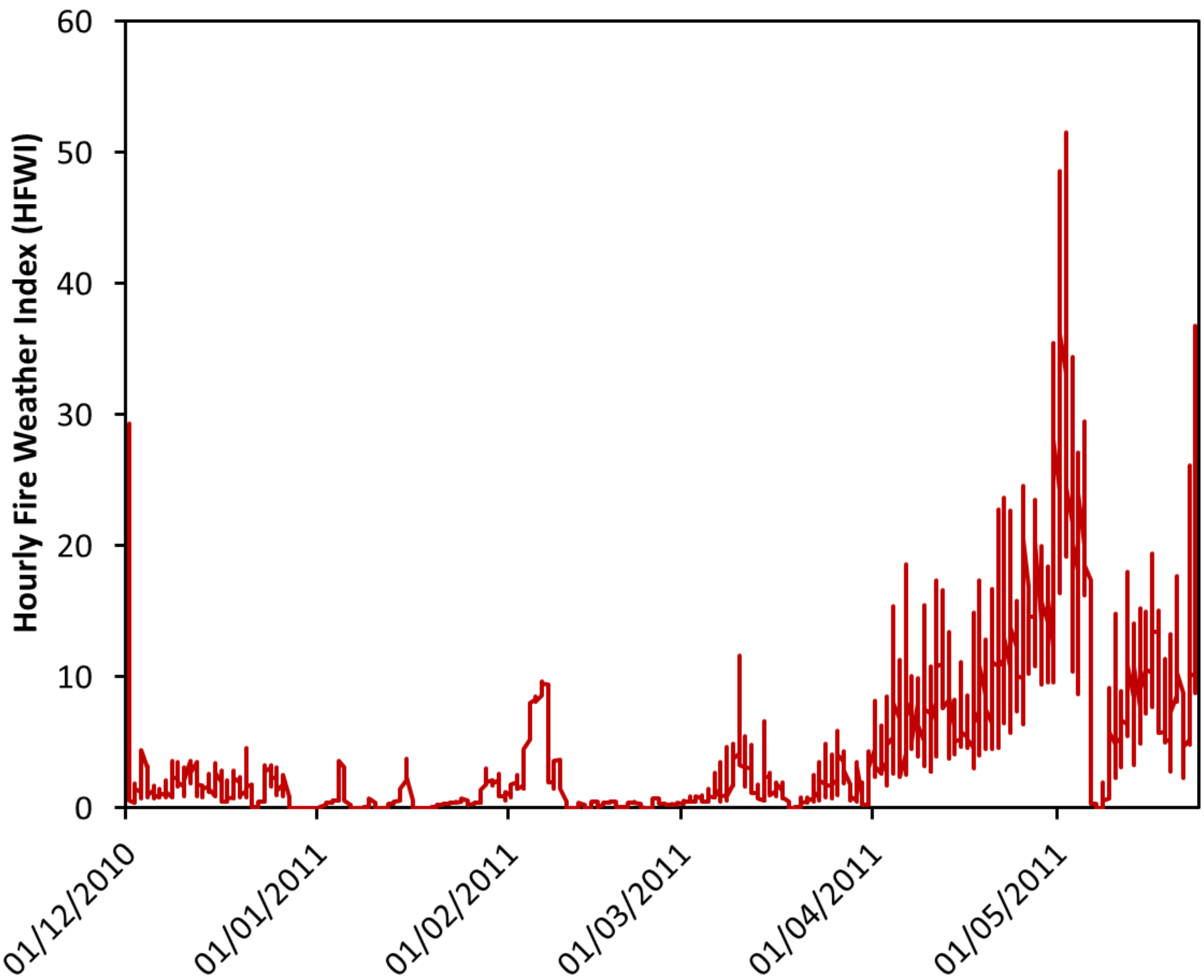
MODEL INPUTS: LONG-TERM WEATHER



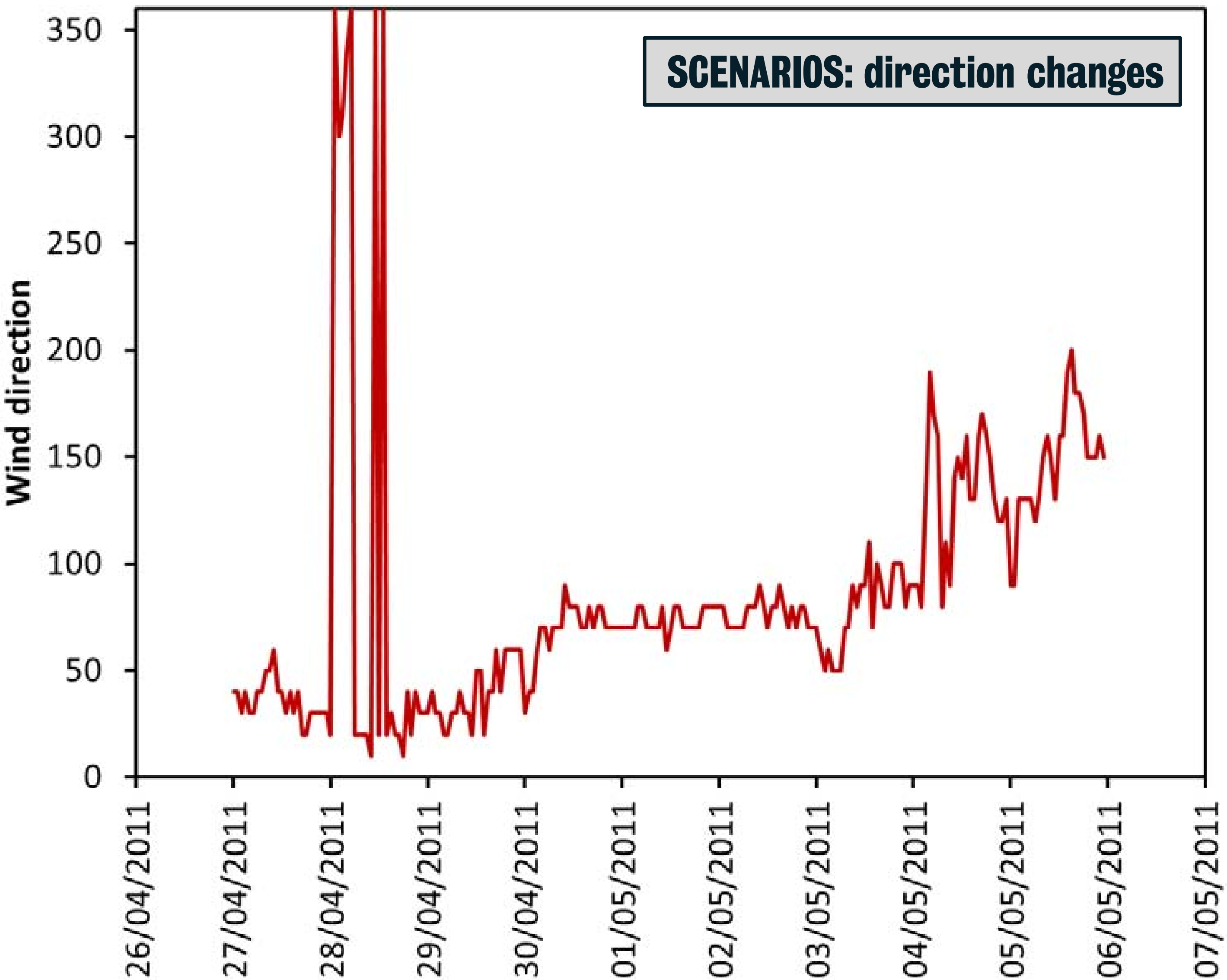
MODEL INPUTS: LONG-TERM WEATHER



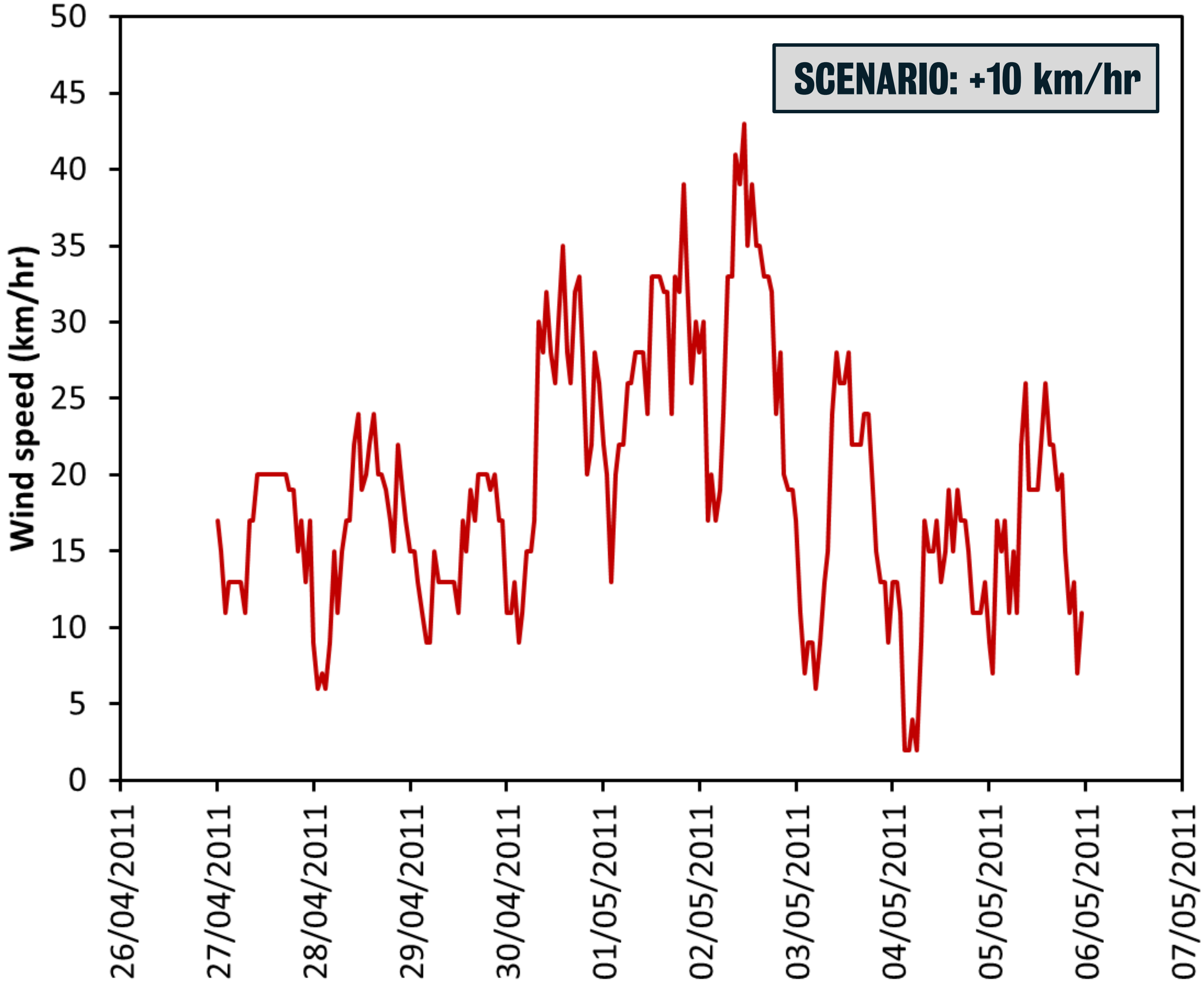
MODEL INPUTS: LONG-TERM WEATHER



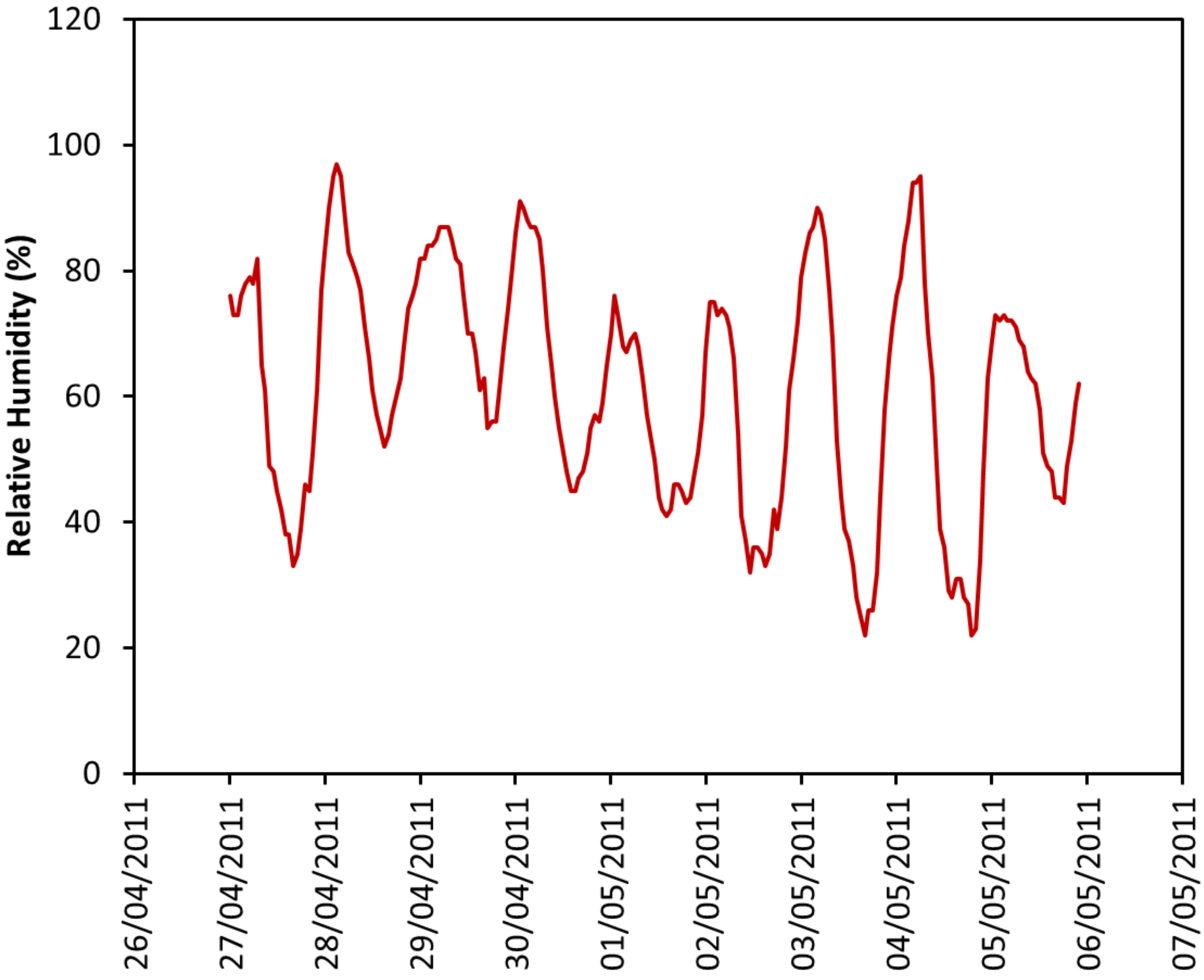
FIRE WEATHER FOR CROWTHORNE FIRE: WIND DIRECTION



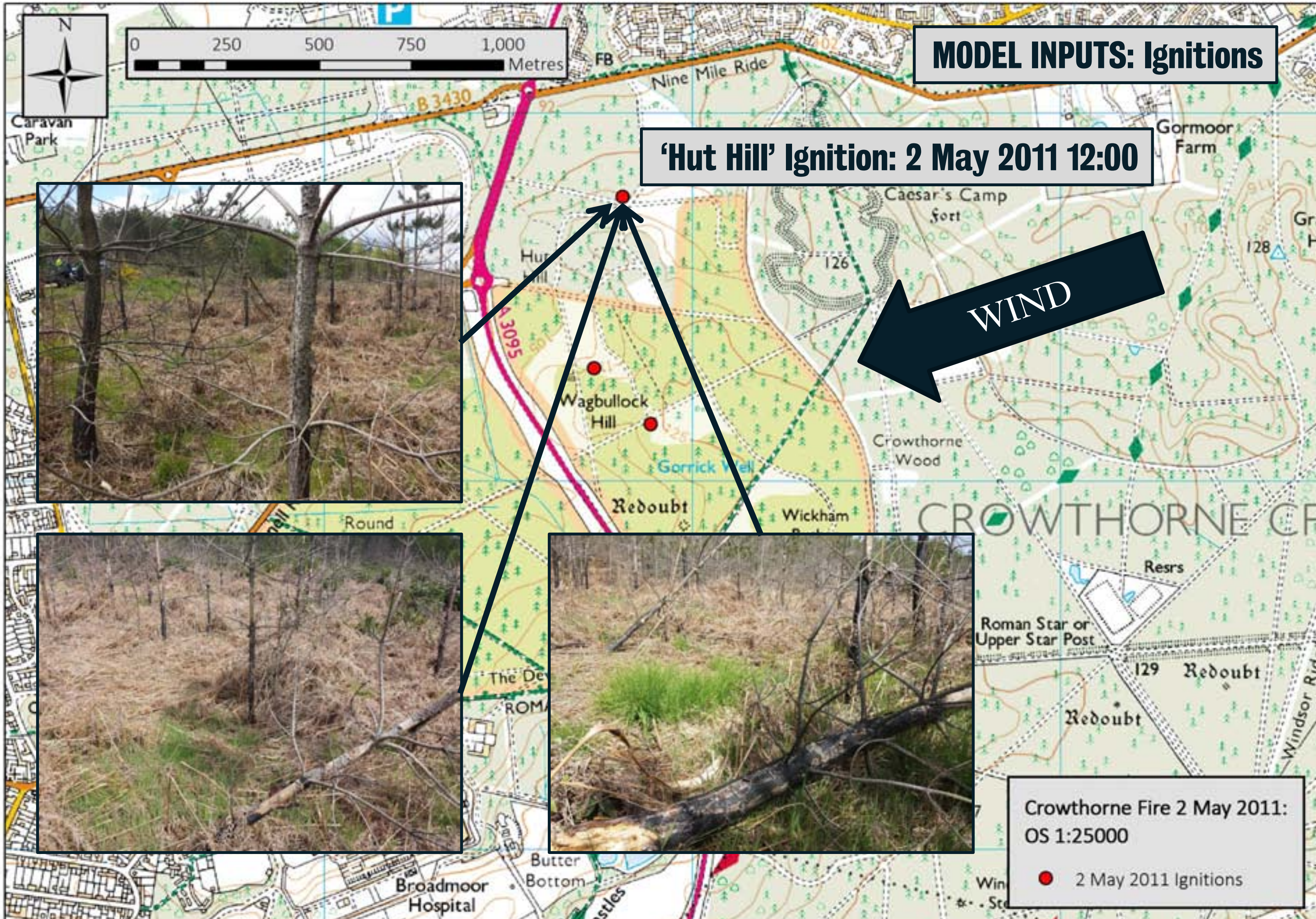
FIRE WEATHER FOR CROWTHORNE FIRE: WIND SPEED

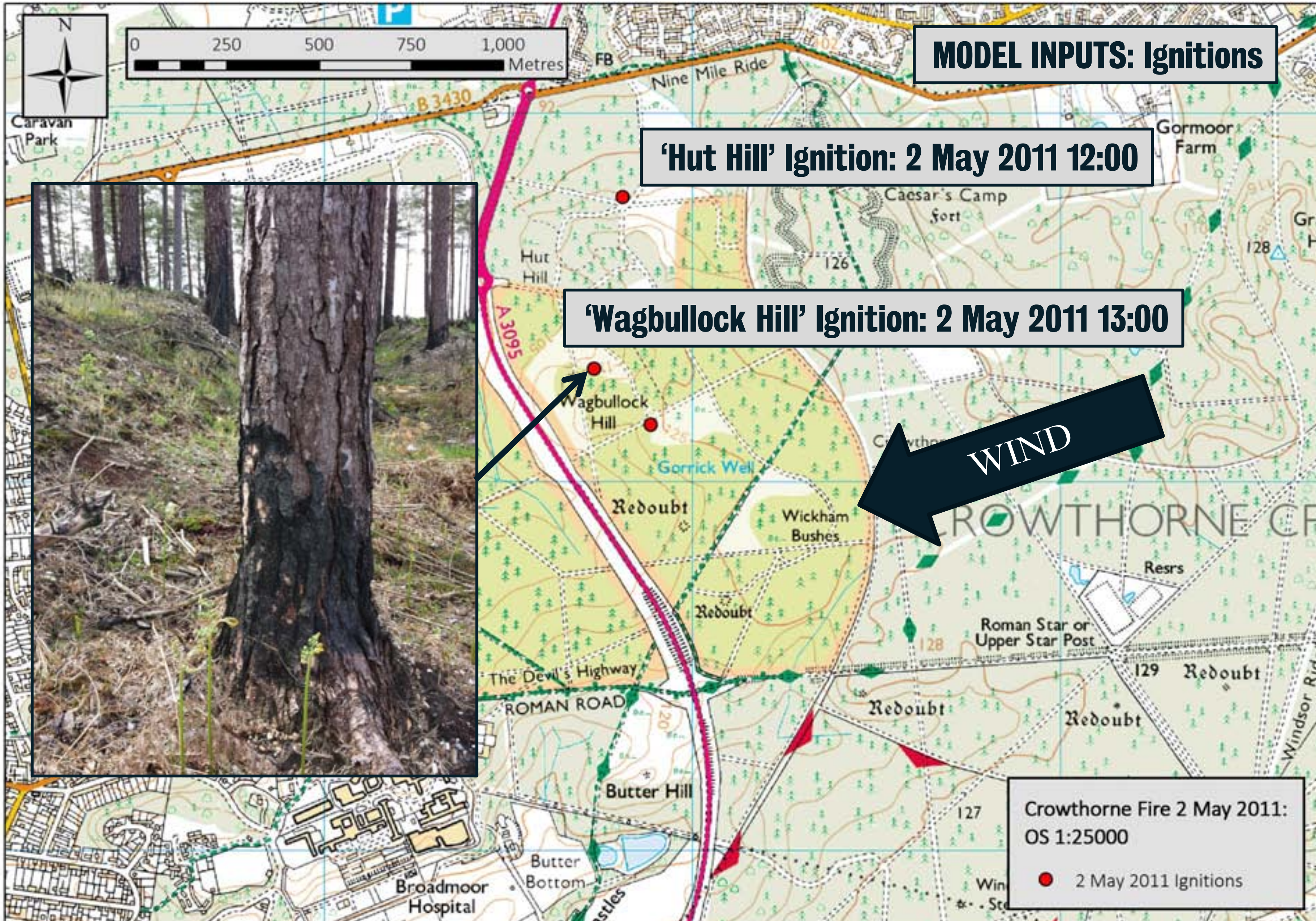


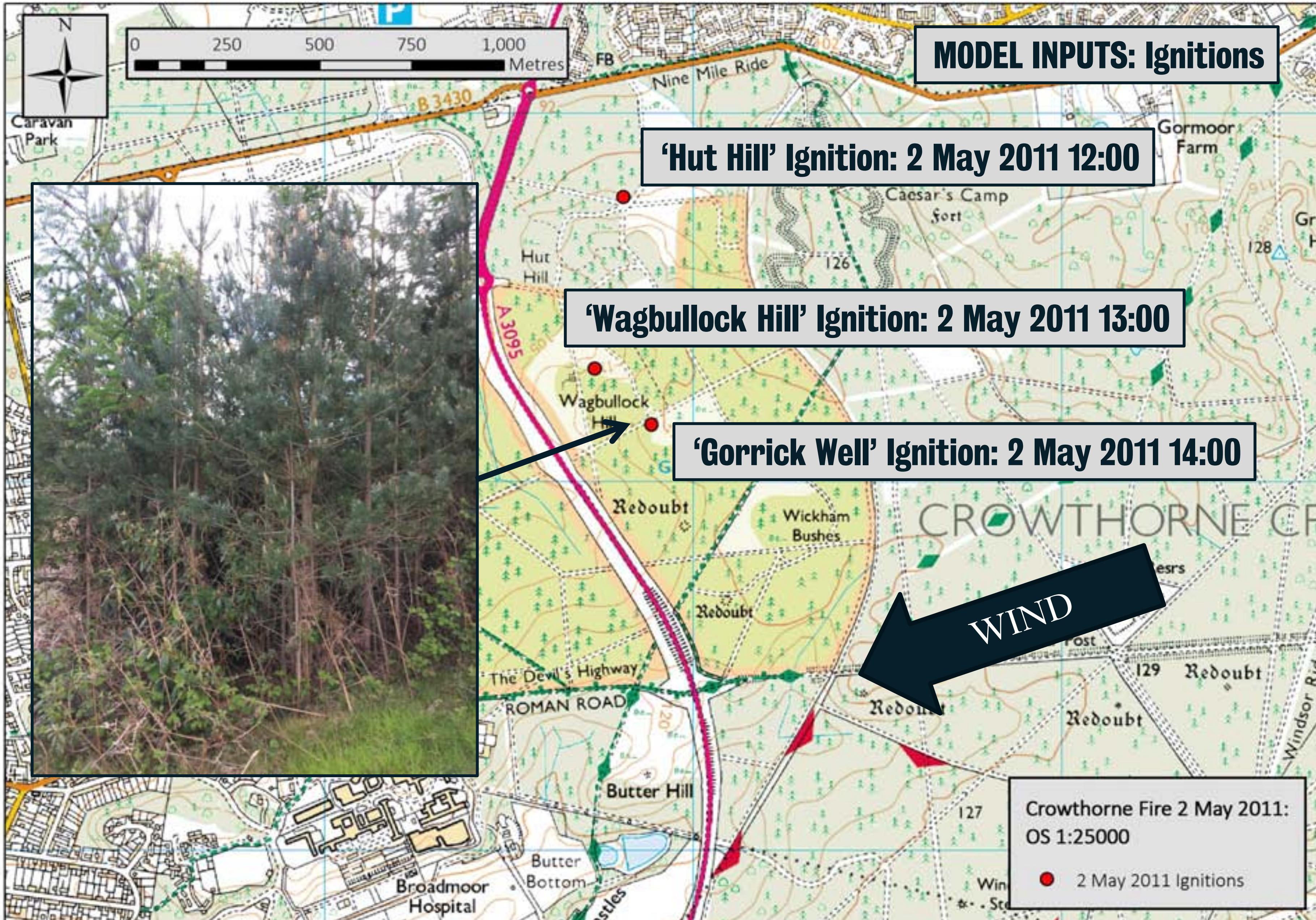
FIRE WEATHER FOR CROWTHORNE FIRE: RH



MODEL INPUTS: Ignitions



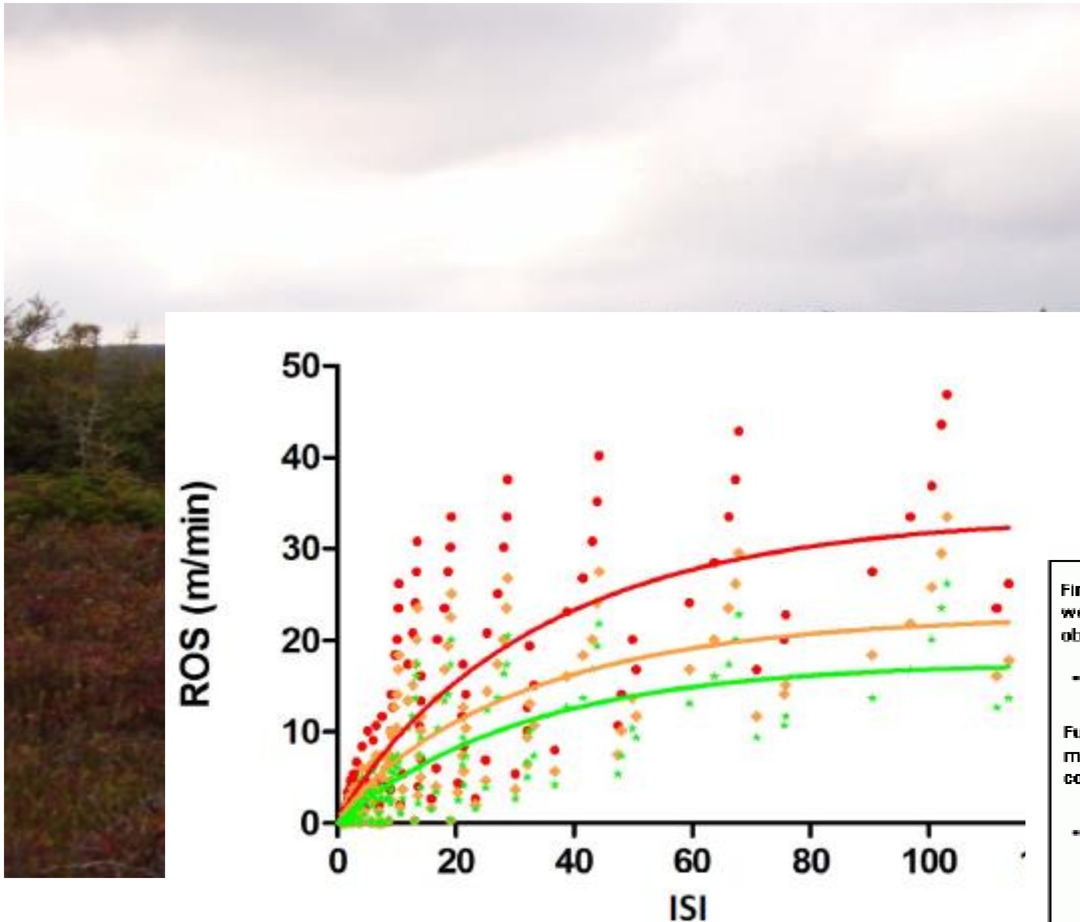

MODEL INPUTS: Ignitions
'Hut Hill' Ignition: 2 May 2011 12:00
'Wagbullock Hill' Ignition: 2 May 2011 13:00
WIND
Crowthorne Fire 2 May 2011:
OS 1:25000
2 May 2011 Ignitions
0
250
500
750
1,000
Metres
N
Nine Mile Ride
B 3430
A 3095
Caravan Park
Gormoor Farm
Caesar's Camp
Fort
Hut Hill
Wagbullock Hill
Gorrick Well
Redoubt
Wickham Bushes
CROWTHORNE CP
Resrs
Roman Star or Upper Star Post
The Devil's Highway
ROMAN ROAD
Butter Hill
Butter Bottom
Broadmoor Hospital
Windsor Ride

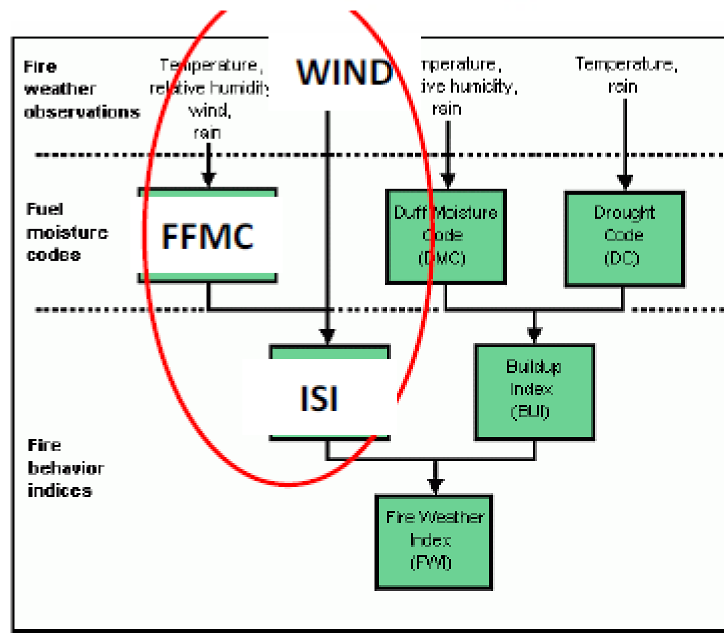

MODEL INPUTS: Ignitions
'Hut Hill' Ignition: 2 May 2011 12:00
'Wagbullock Hill' Ignition: 2 May 2011 13:00
'Gorrick Well' Ignition: 2 May 2011 14:00
WIND
Crowthorne Fire 2 May 2011:
OS 1:25000
2 May 2011 Ignitions
0
250
500
750
1,000
Metres
N
Nine Mile Ride
B 3430
A 3095
Caravan Park
Gormoor Farm
Caesar's Camp
Fort
Hut Hill
Wagbullock Hill
Redoubt
Wickham Bushes
CROWTHORNE CP
The Devil's Highway
ROMAN ROAD
Butter Hill
Butter Bottom
Broadmoor Hospital
Windsor Ride

FIRE SPREAD MODELLING

FUEL MODELS AND FIRE SPREAD IN PROMETHEUS

Empirical relationships between Canadian FWI parameters and ROS/FI



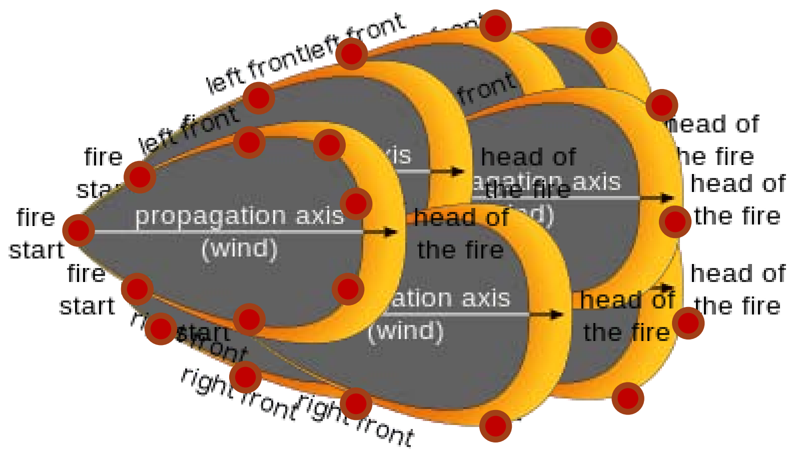


FUEL MODELS AND FIRE SPREAD IN FARSITE

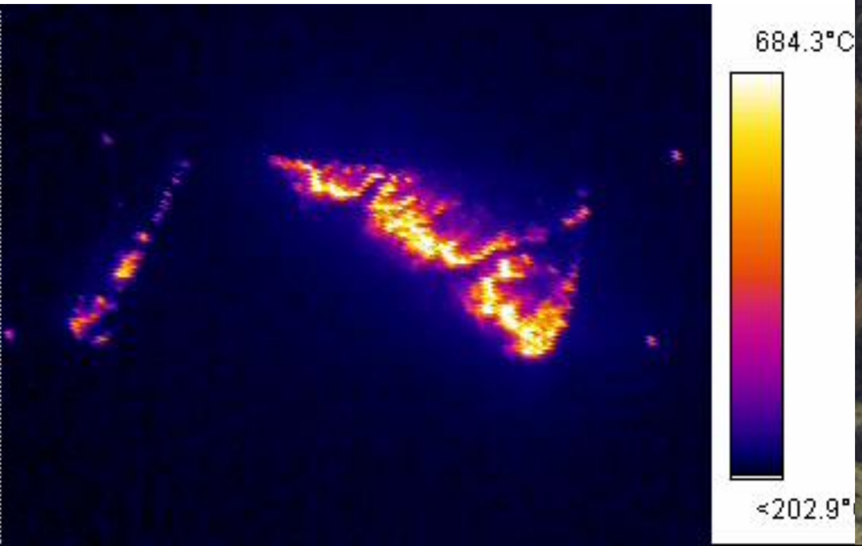
FM Code	FUEL LOADING (tons ha^{-1})					SURFACE AREA:VOLUME ($cm^2\ cm^{-3}$)			DEPTH (cm)	XtMoist (%)	HEAT CONTENT (kJ Kg^{-1})	
	1h	10h	100h	LH	LW	1h	LH	LW			Live	Dead
FM14 (HIGH)	2.73	0	0	0	12.17	96	88	100	42.4	25	20808	20808
FM14 (LOW)	1.28	0	0	0	6.5	96	88	100	19.7	25	20808	20808
SH6 (HIGH)	7.16	3.58	0	0	3.46	246	N/A	525	61	30	18608	18608
SH3 (LOW)	1.11	7.41	0	0	15.32	525	N/A	459	73	40	18608	18608

FM14: customised fuel model for heather (Davies, 2005)
SH6/SH3: 'built-in' FARSITE fuel model for shrubs (Scott & Burgan, 2005)

PROPAGATION



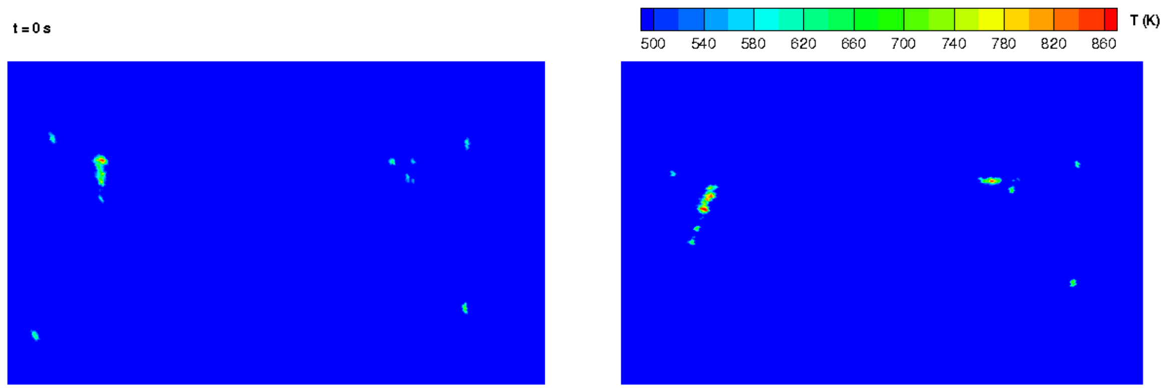
EVALUATING/ CUSTOMISING FUEL MODELS

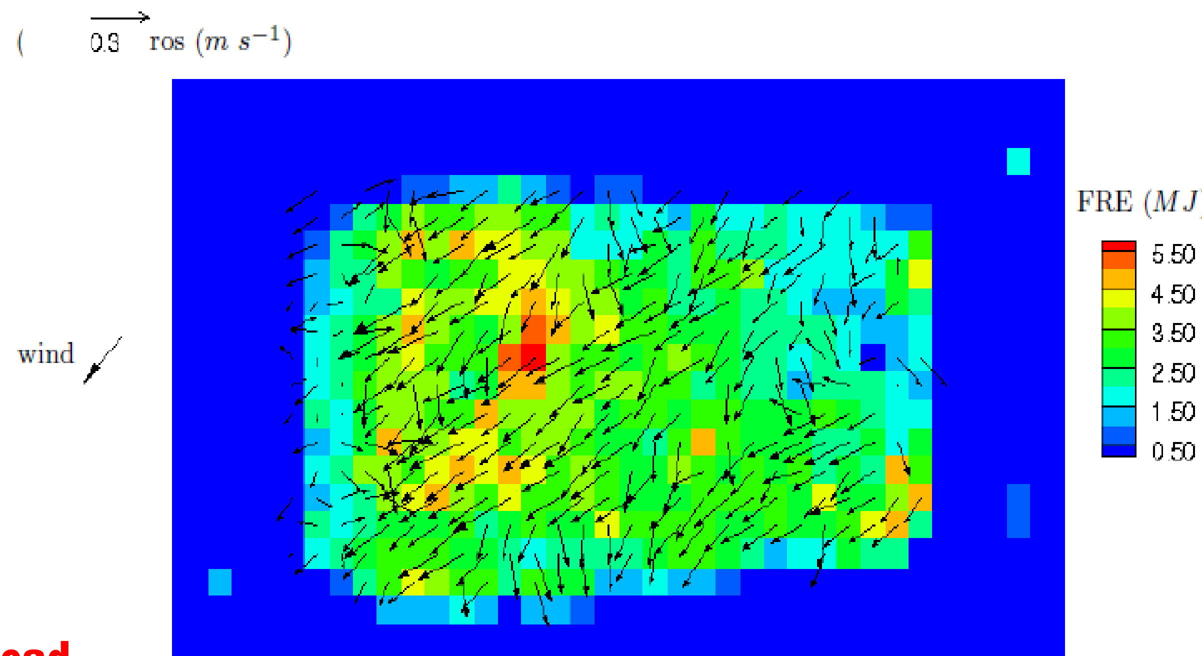


EVALUATING/CUSTOMISING FUEL MODELS

945 m² plot of heather

Methodology to geo-reference thermal imagery



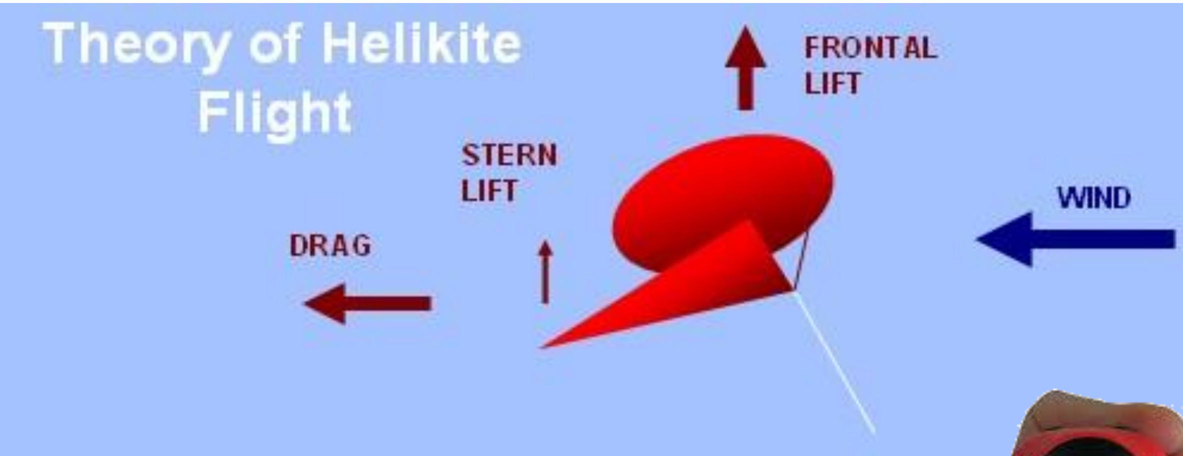


Paugam *et al.* (2013) IEEE Trans.

Tool to study **Energy Transfer** and derive **Rate Of Spread**

UAV FUEL MAPS AND FUEL MODEL EVALUATION

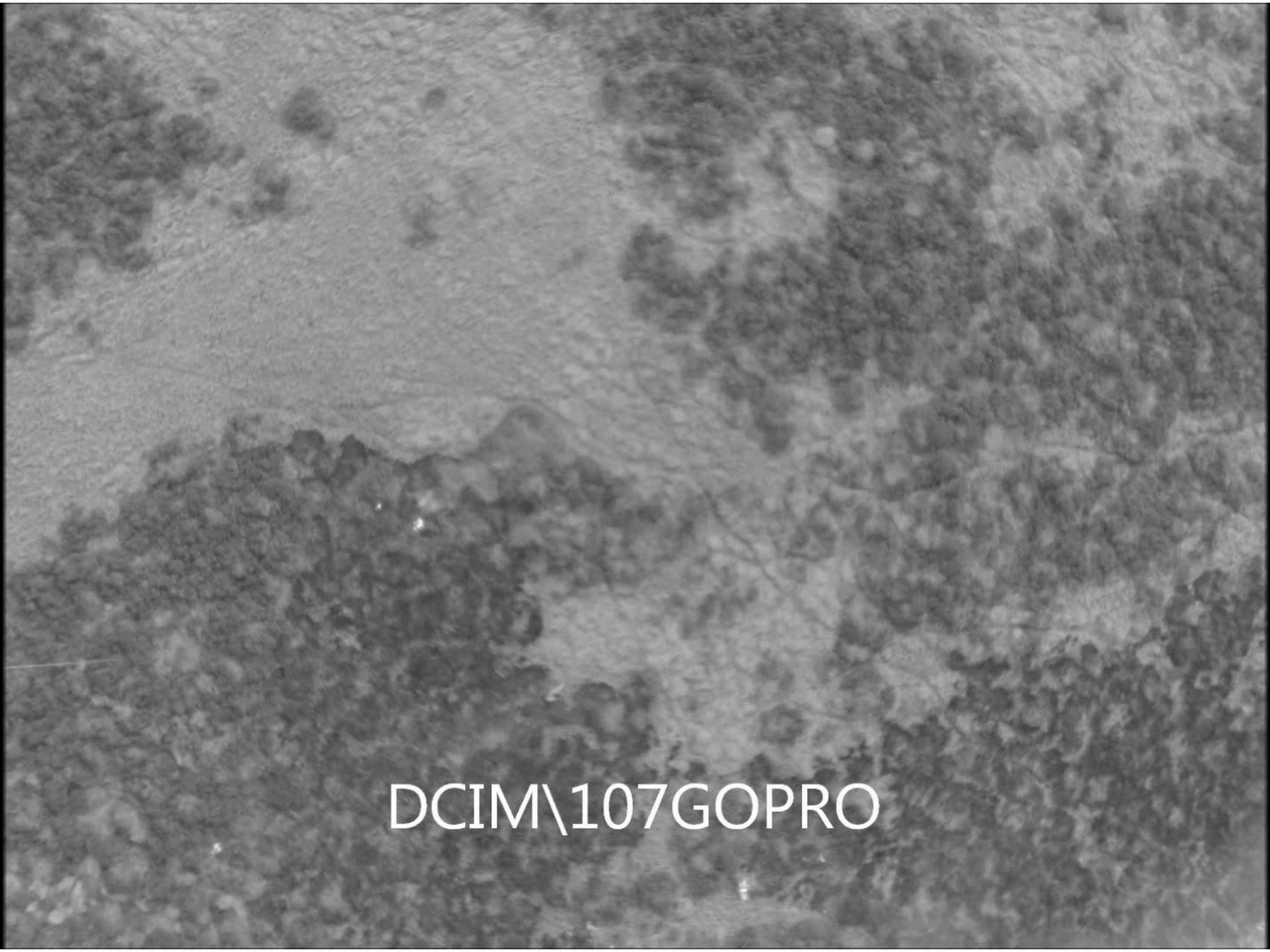
WHAT ABOUT HELIKITES?



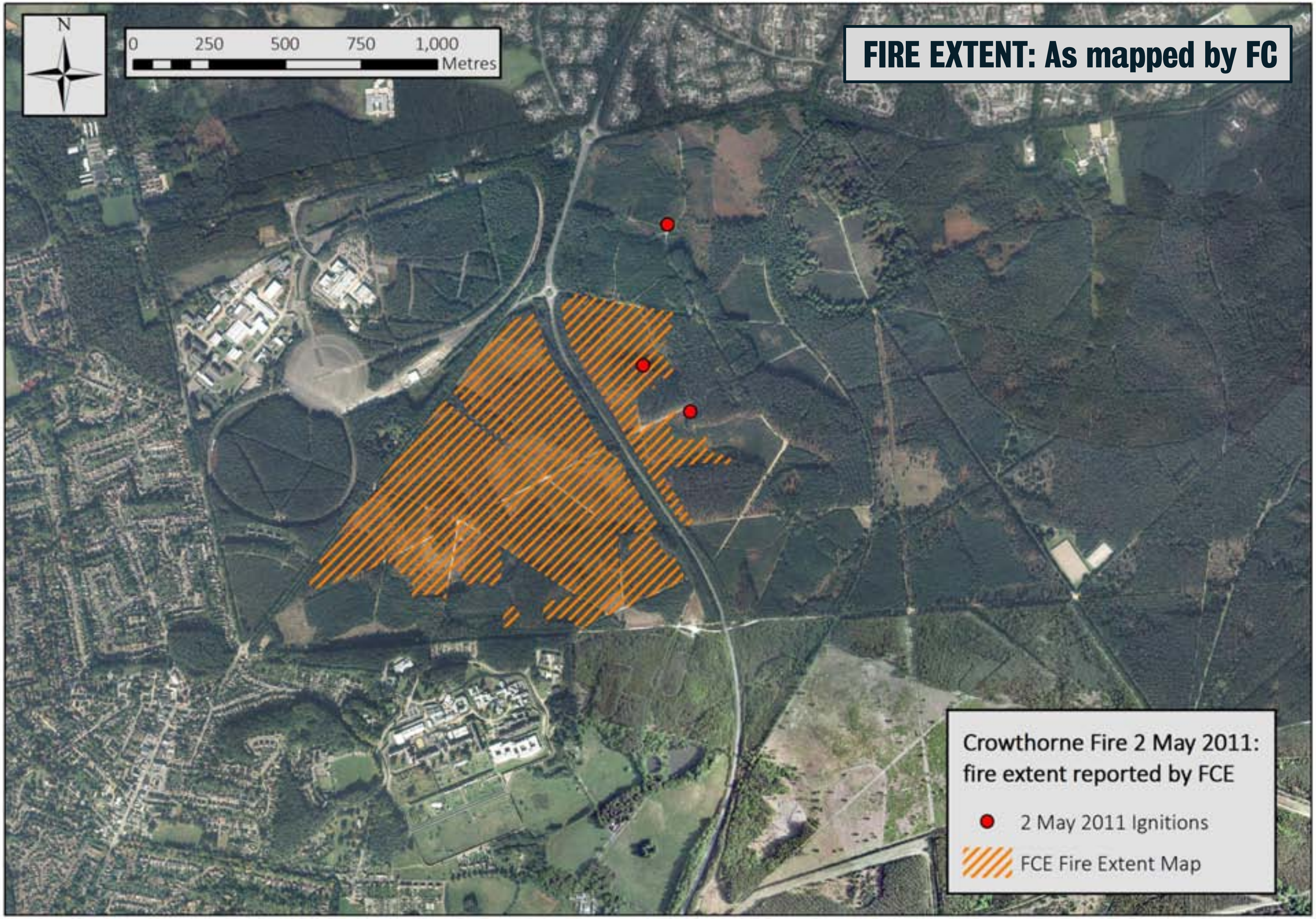
NEW MOOR BURN: 20 OCTOBER 2014

BURNSIDE FIRES: 2 APRIL 2015

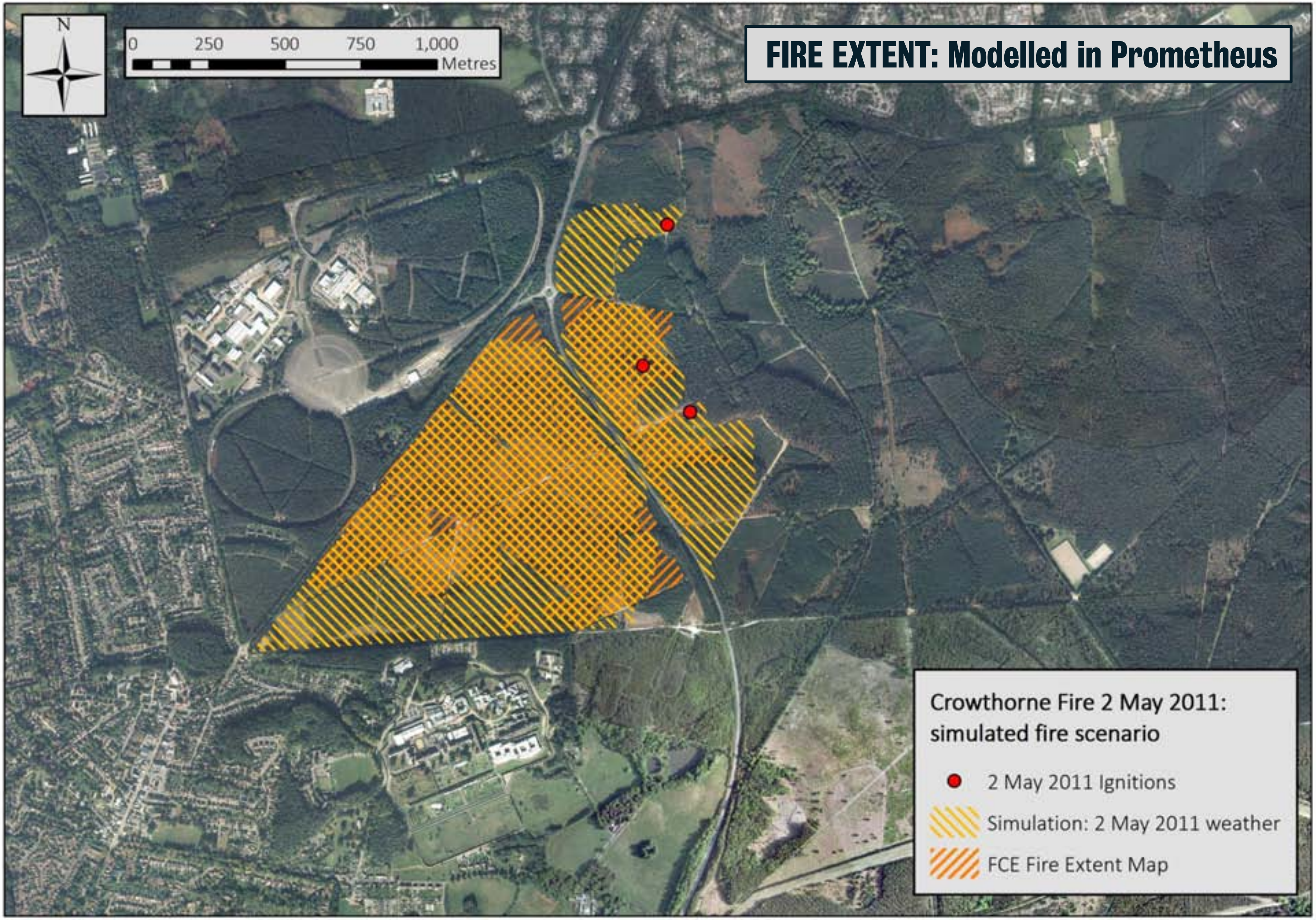
BURNSIDE FIRES: 2 APRIL 2015

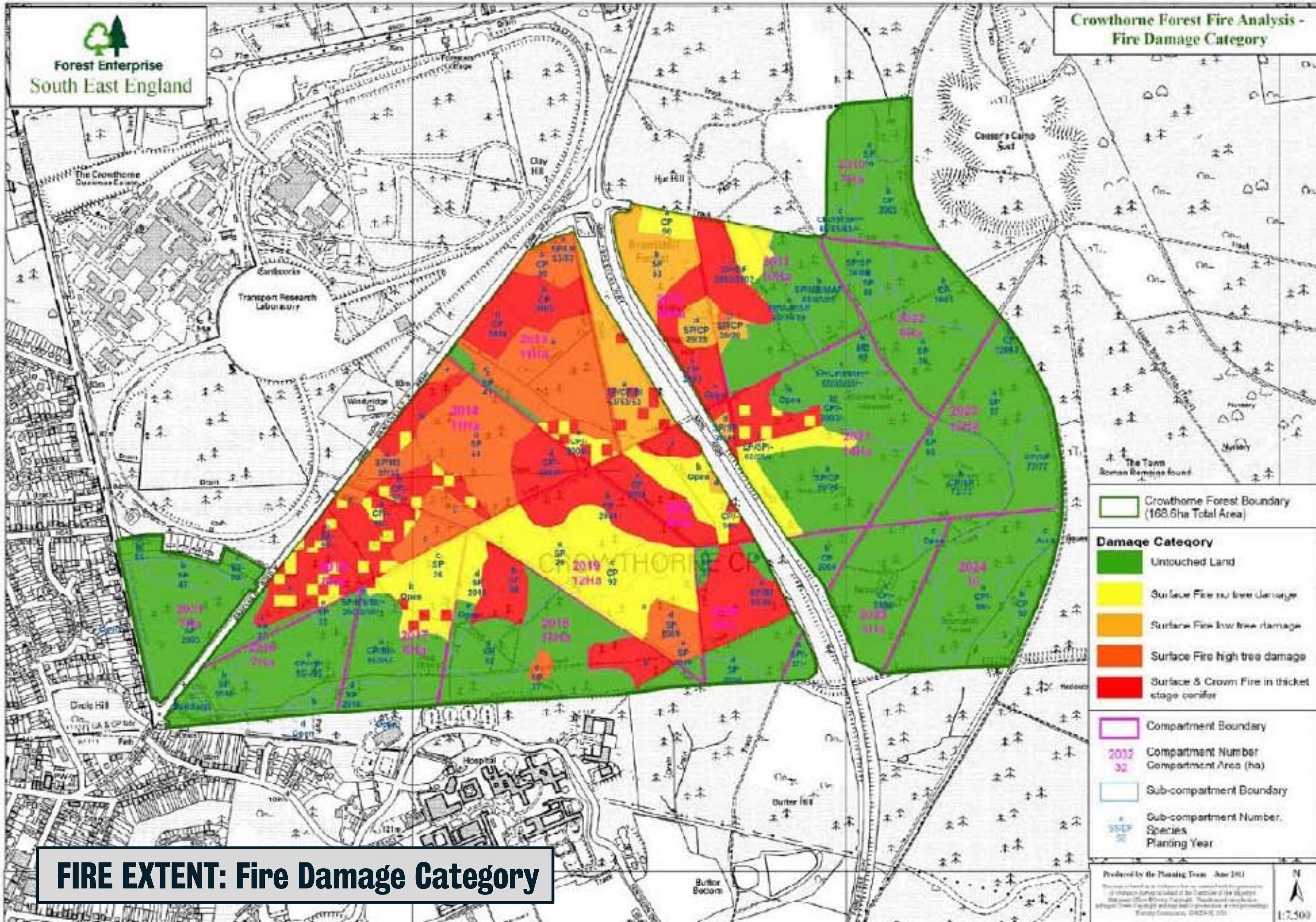


FIRE SPREAD MODELLING FOR SWINLEY-CROWTHORNE

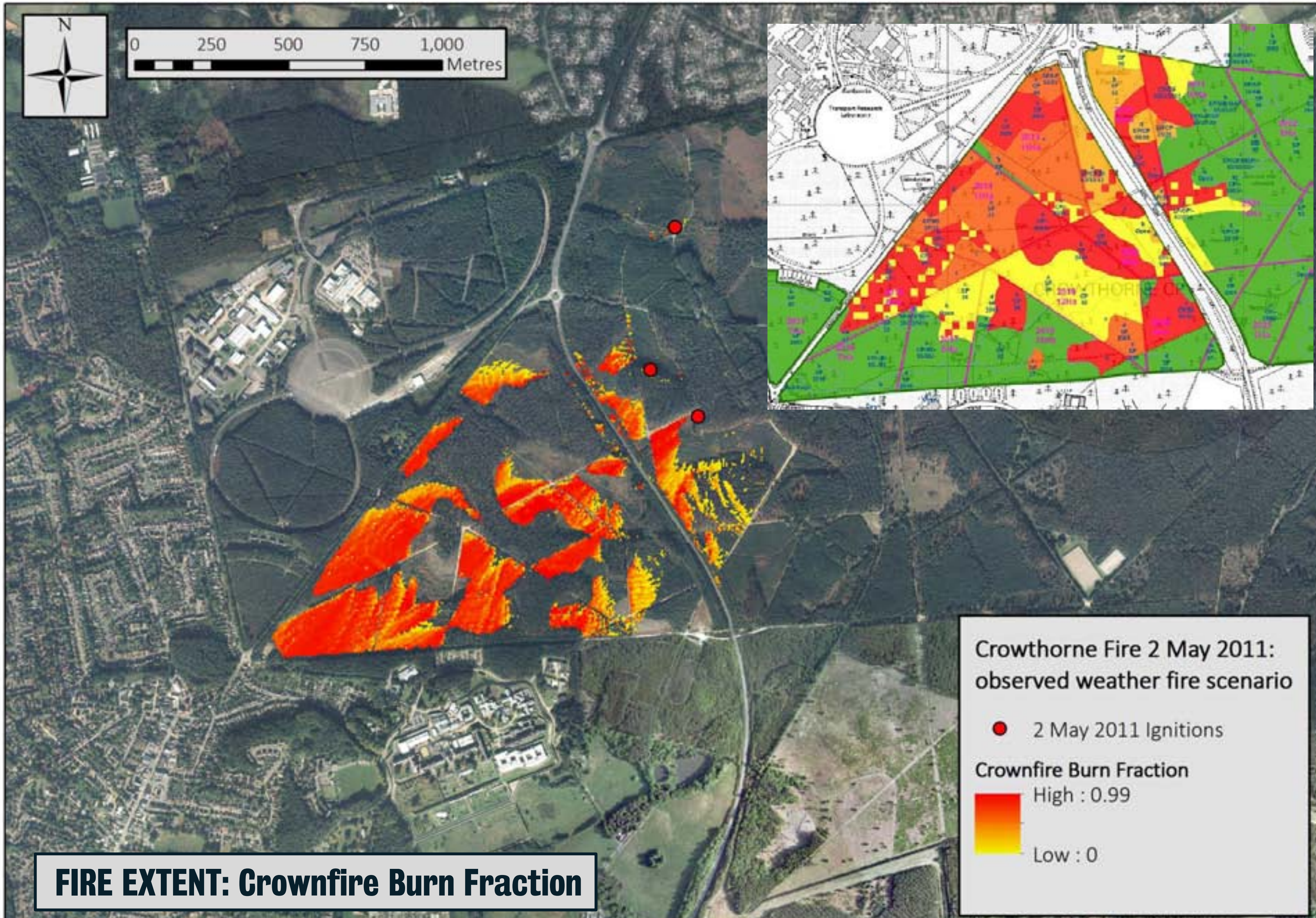


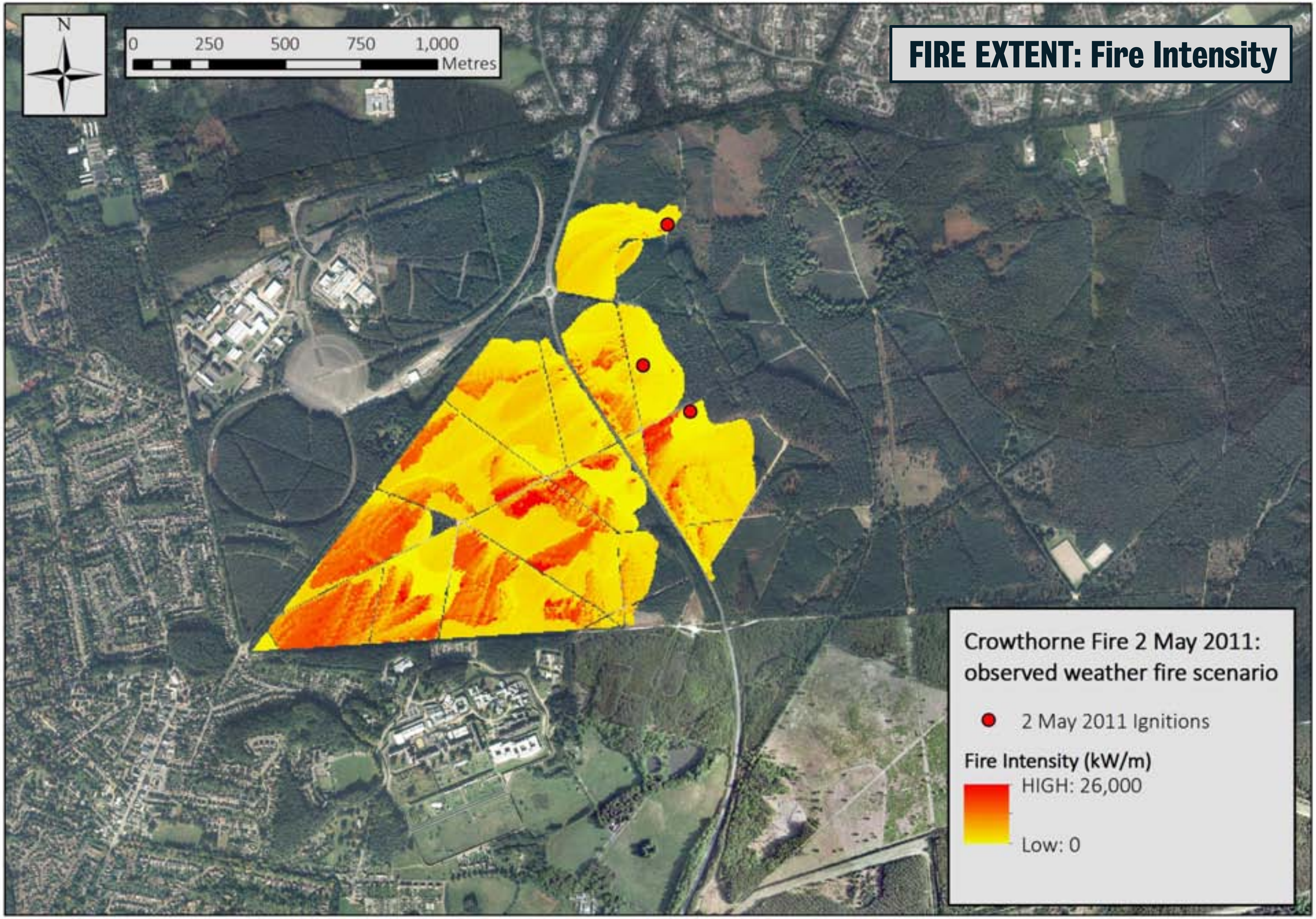
FIRE EXTENT: As mapped by FC
N
0
250
500
750
1,000
Metres
Crowthorne Fire 2 May 2011:
fire extent reported by FCE
2 May 2011 Ignitions
FCE Fire Extent Map

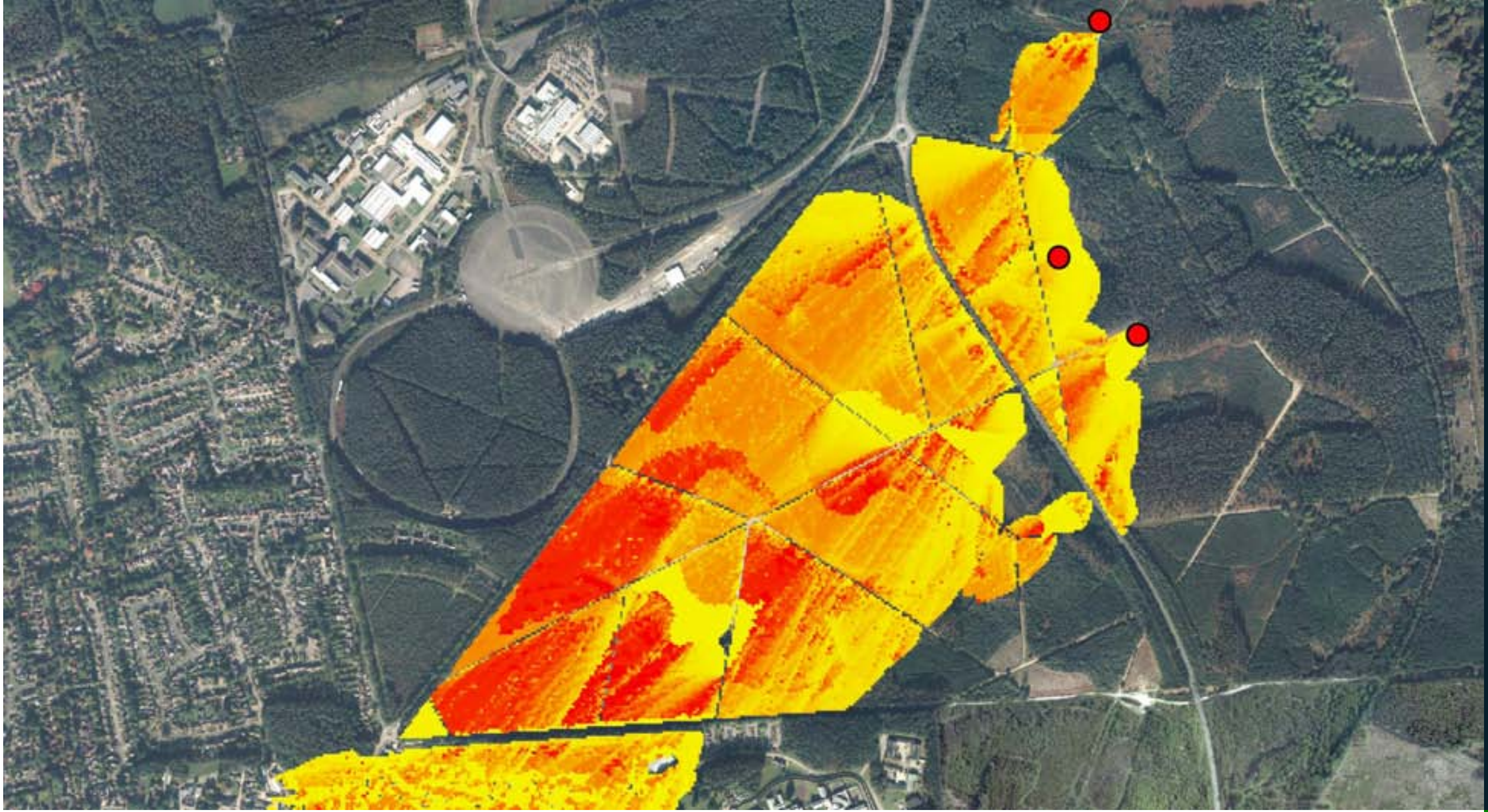

FIRE EXTENT: Modelled in Prometheus
N
0 250 500 750 1,000
Metres
Crowthorne Fire 2 May 2011:
simulated fire scenario
2 May 2011 Ignitions
Simulation: 2 May 2011 weather
FCE Fire Extent Map



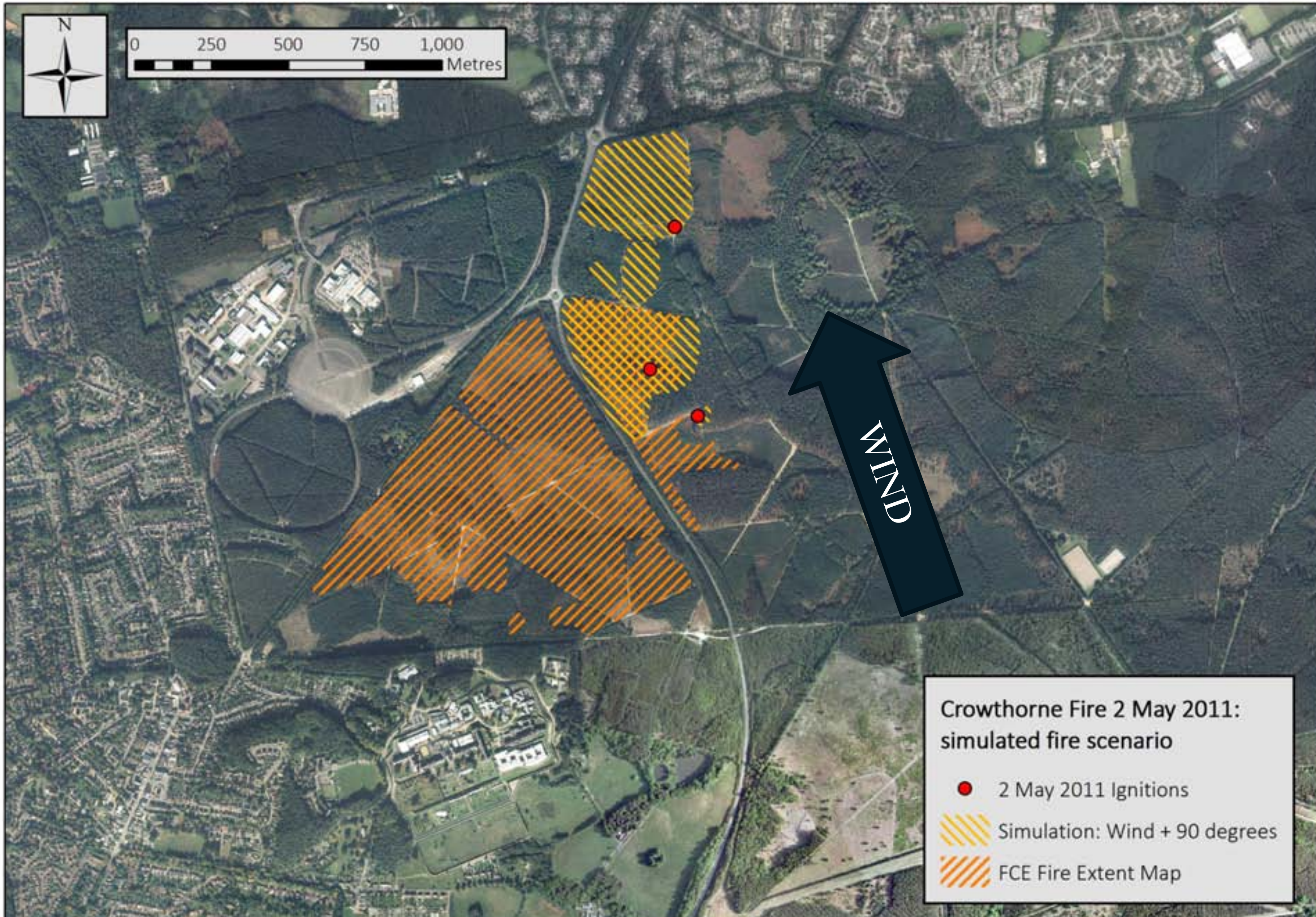
FIRE EXTENT: Fire Damage Category

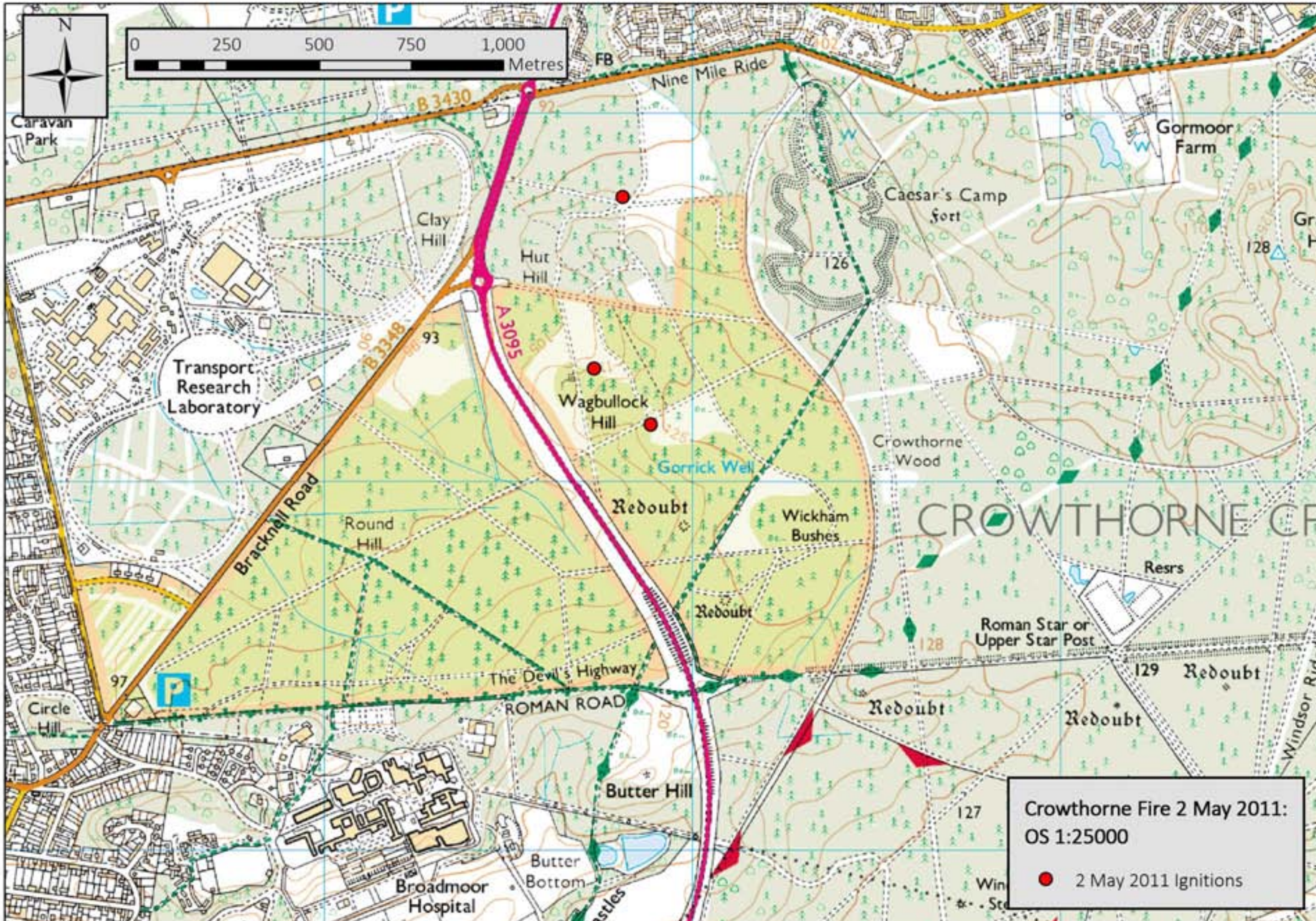

N
0 250 500 750 1,000
Metres
Crowthorne Fire 2 May 2011:
observed weather fire scenario
2 May 2011 Ignitions
Crownfire Burn Fraction
High : 0.99
Low : 0
FIRE EXTENT: Crownfire Burn Fraction


FIRE EXTENT: Fire Intensity
N
0 250 500 750 1,000
Metres
Crowthorne Fire 2 May 2011: observed weather fire scenario
2 May 2011 Ignitions
Fire Intensity (kW/m)
HIGH: 26,000
Low: 0



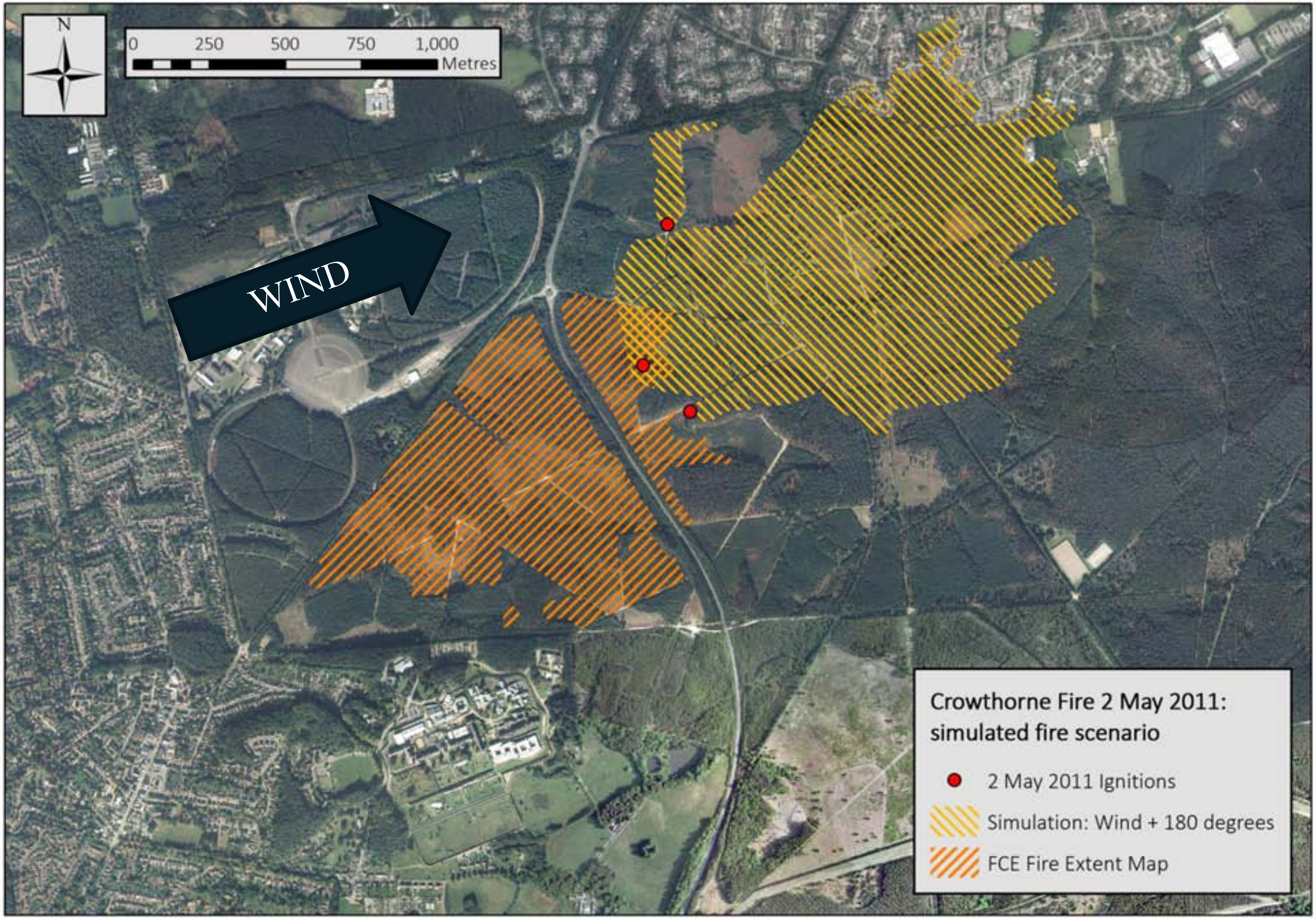
ALTERNATIVE SCENARIOS

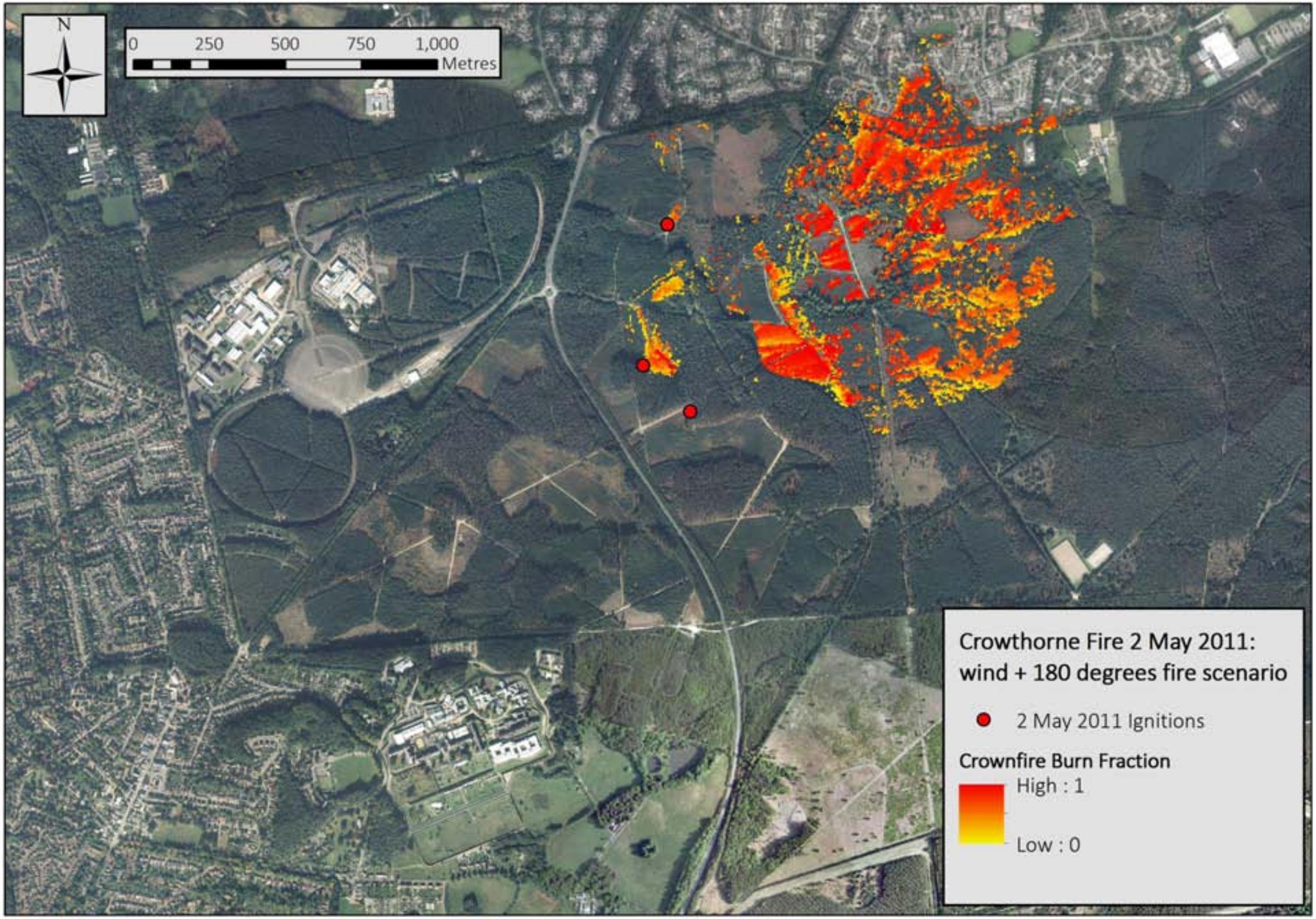

N
0
250
500
750
1,000
Metres
WIND
Crowthorne Fire 2 May 2011:
simulated fire scenario
2 May 2011 Ignitions
Simulation: Wind + 90 degrees
FCE Fire Extent Map



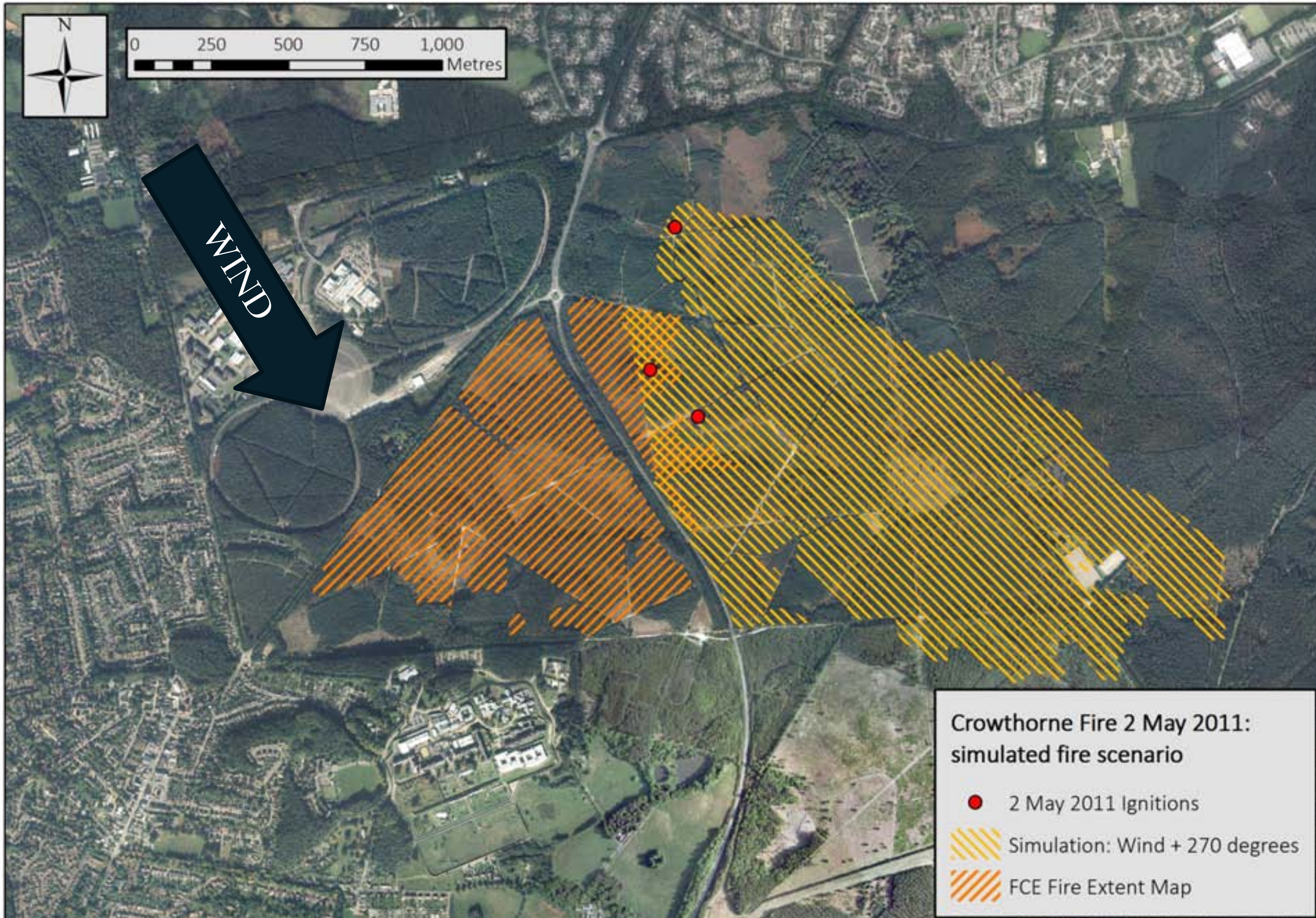
N
0 250 500 750 1,000 Metres
Nine Mile Ride
B 3430
FB
Caravan Park
Gormoor Farm
Caesar's Camp Fort
Clay Hill
Hut Hill
126
128
Transport Research Laboratory
B 3348
93
A 3095
Wagbullock Hill
Gorrick Well
Crowthorne Wood
Redoubt
Wickham Bushes
CROWTHORNE CP
Round Hill
Bracknell Road
Resrs
Roman Star or Upper Star Post
129
Redoubt
The Devil's Highway
ROMAN ROAD
97
Circle Hill
Butter Hill
127
Windsor Ride
Butter Bottom
Broadmoor Hospital
Crowthorne Fire 2 May 2011: OS 1:25000
2 May 2011 Ignitions

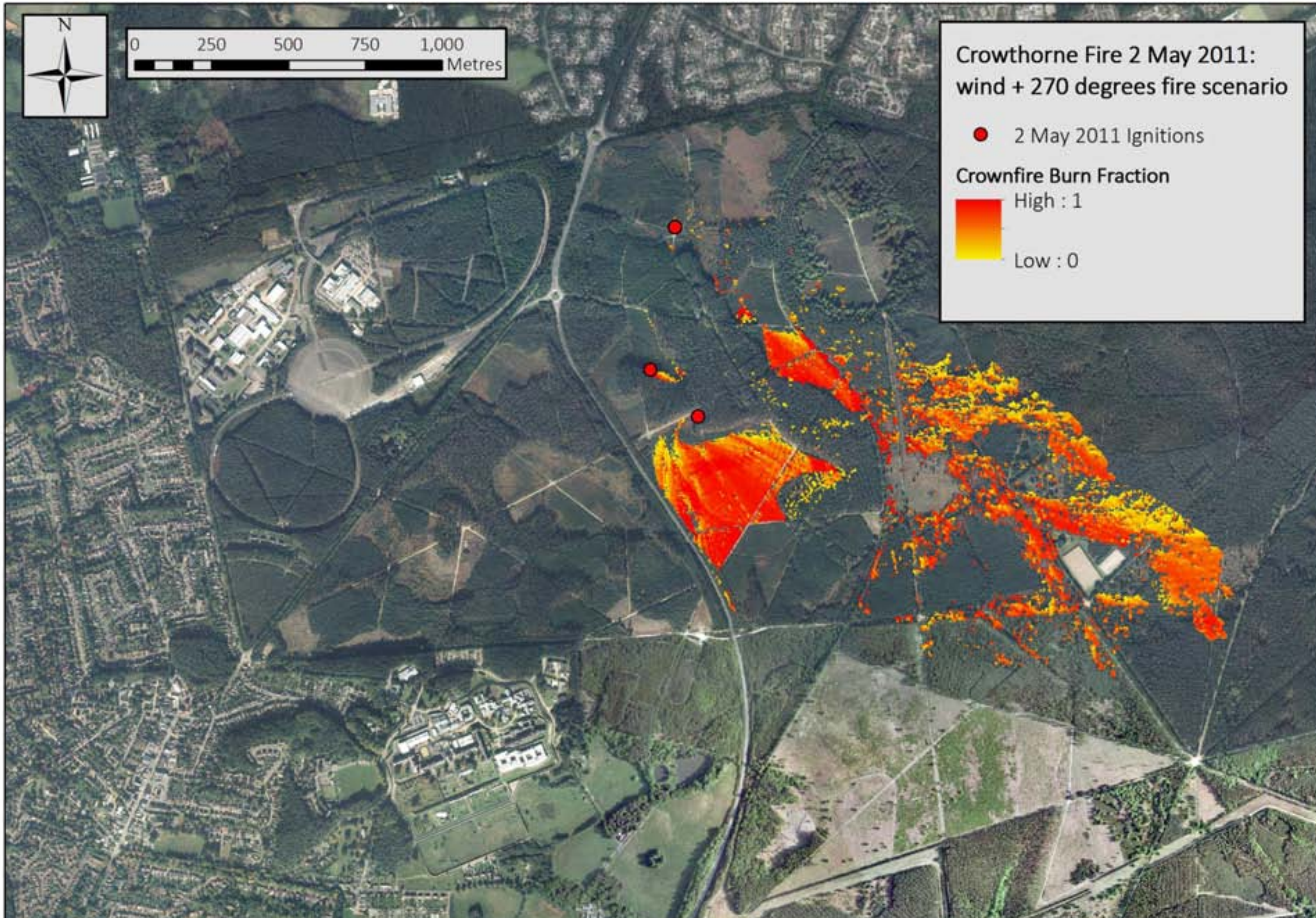
N
0 250 500 750 1,000
Metres
WIND
Crowthorne Fire 2 May 2011:
wind + 90 degrees fire scenario
2 May 2011 Ignitions
Crownfire Burn Fraction
High : 0.98
Low : 0

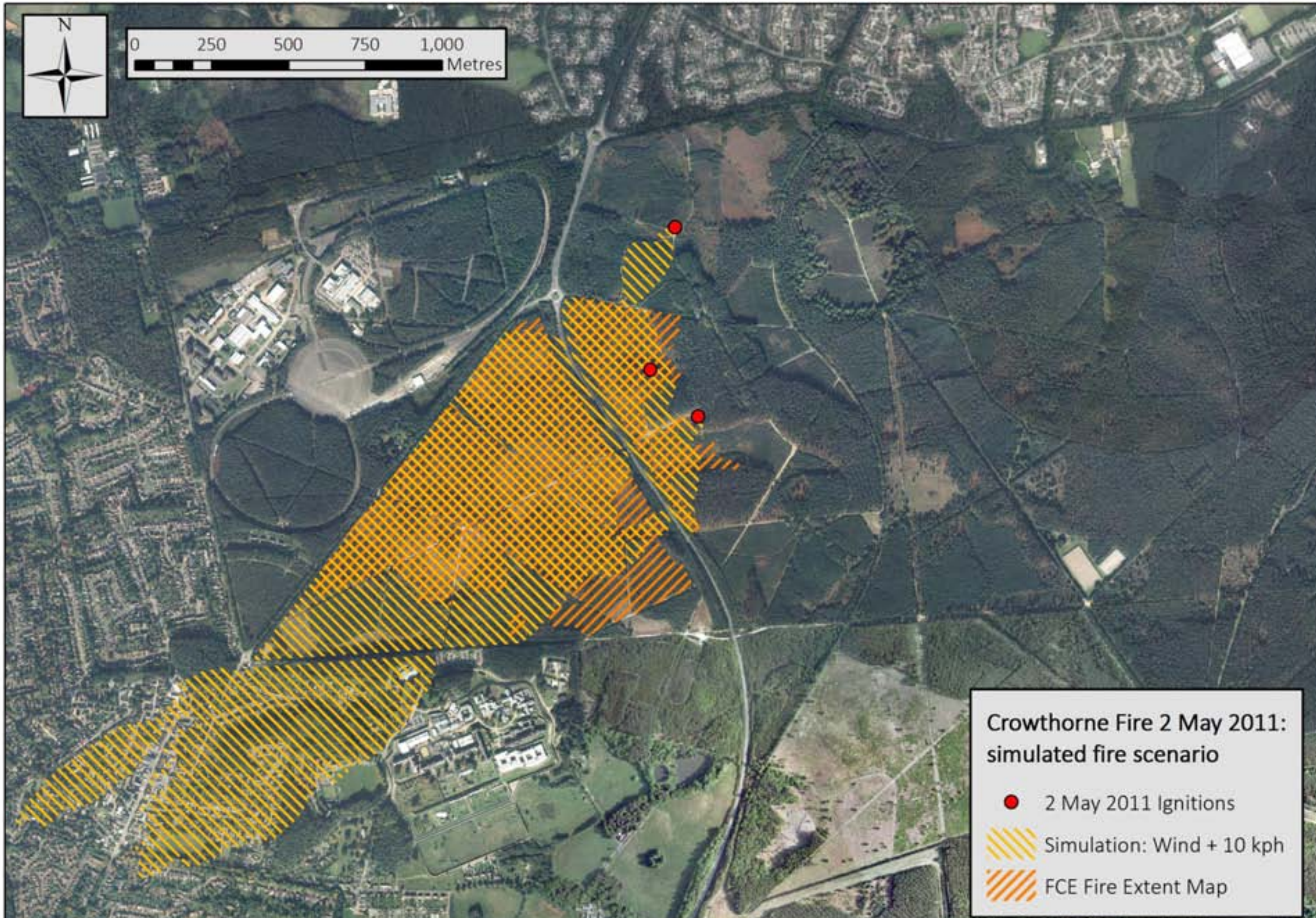

N
0 250 500 750 1,000
Metres
WIND
Crowthorne Fire 2 May 2011: simulated fire scenario
2 May 2011 Ignitions
Simulation: Wind + 180 degrees
FCE Fire Extent Map

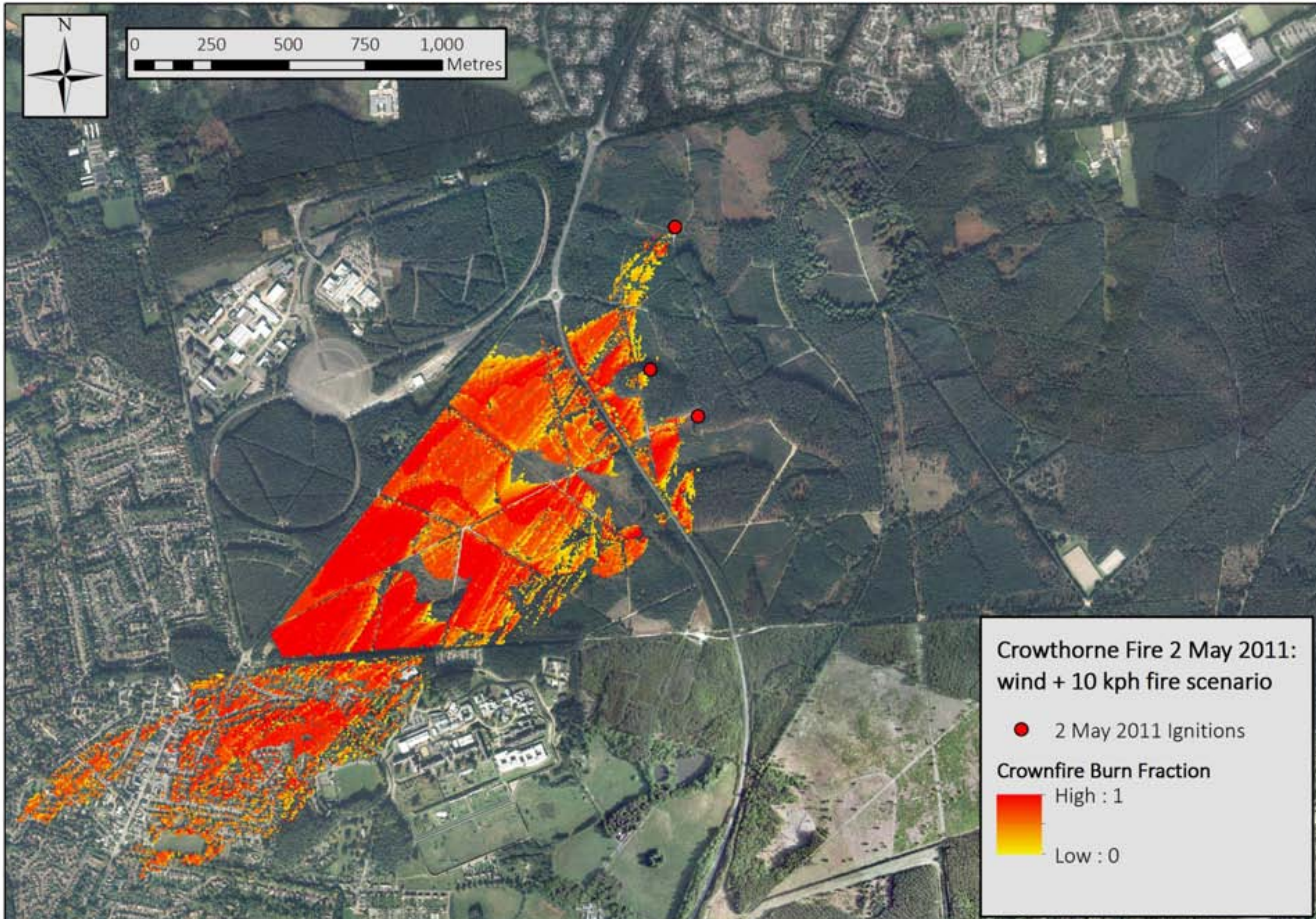


N
0
250
500
750
1,000
Metres
Crowthorne Fire 2 May 2011:
wind + 180 degrees fire scenario
2 May 2011 Ignitions
Crownfire Burn Fraction
High : 1
Low : 0

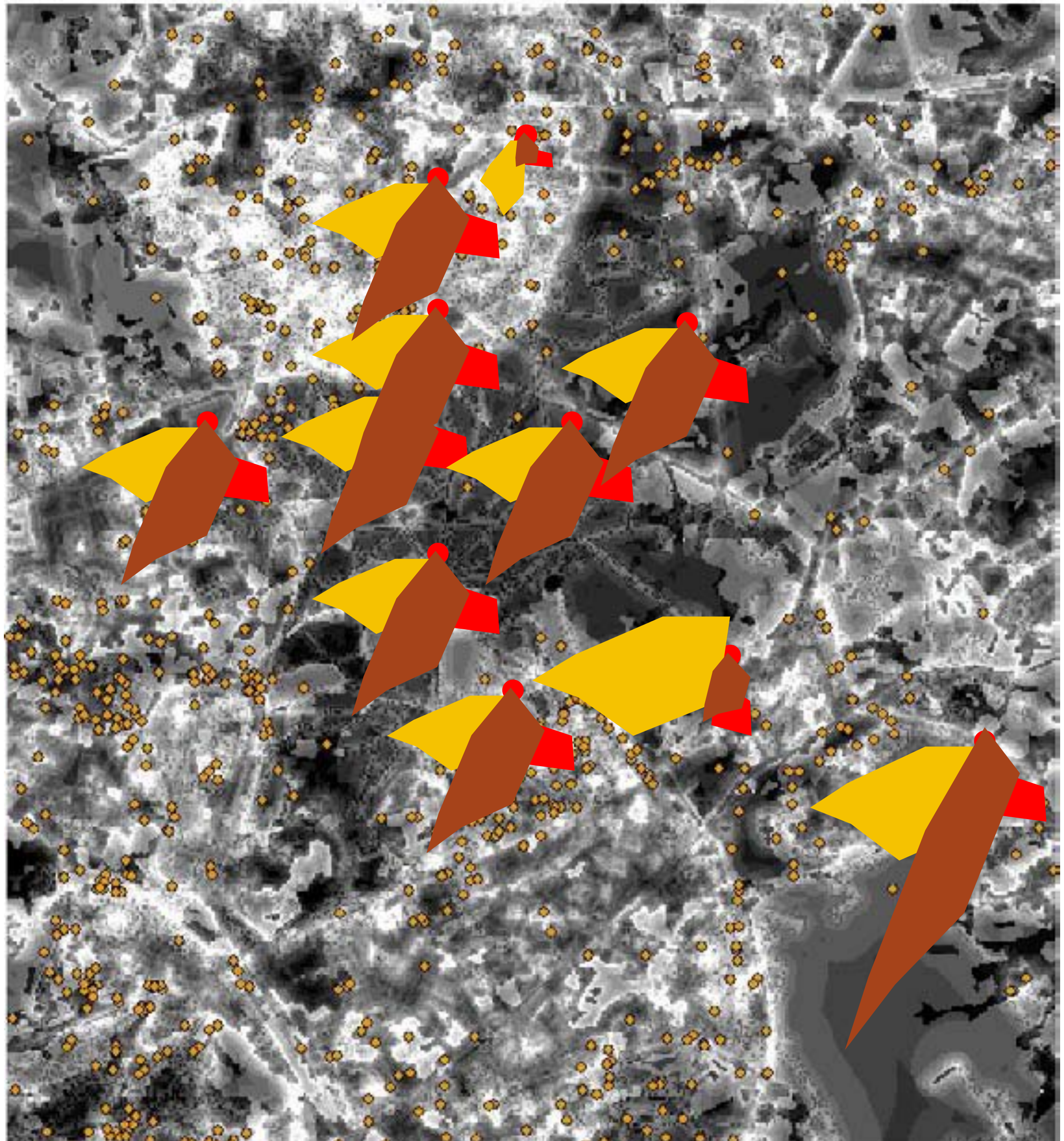

N
0 250 500 750 1,000
Metres
WIND
Crowthorne Fire 2 May 2011: simulated fire scenario
2 May 2011 Ignitions
Simulation: Wind + 270 degrees
FCE Fire Extent Map


N
0 250 500 750 1,000
Metres
Crowthorne Fire 2 May 2011:
wind + 270 degrees fire scenario
2 May 2011 Ignitions
Crownfire Burn Fraction
High : 1
Low : 0


N
0
250
500
750
1,000
Metres
Crowthorne Fire 2 May 2011:
simulated fire scenario
2 May 2011 Ignitions
Simulation: Wind + 10 kph
FCE Fire Extent Map


N
0 250 500 750 1,000
Metres
Crowthorne Fire 2 May 2011:
wind + 10 kph fire scenario
2 May 2011 Ignitions
Crownfire Burn Fraction
High : 1
Low : 0

TOWARDS "ENSEMBLE" FIRE SPREAD MODELLING



Risk of ignition

Weighting:

Land cover (expert judgement): 5
proximity to built-up areas: 3.5
Proximity to foot access routes: 3
Proximity to car access routes: 3
Access land: 3
Population density: 3
Infrastructure and installations: 1

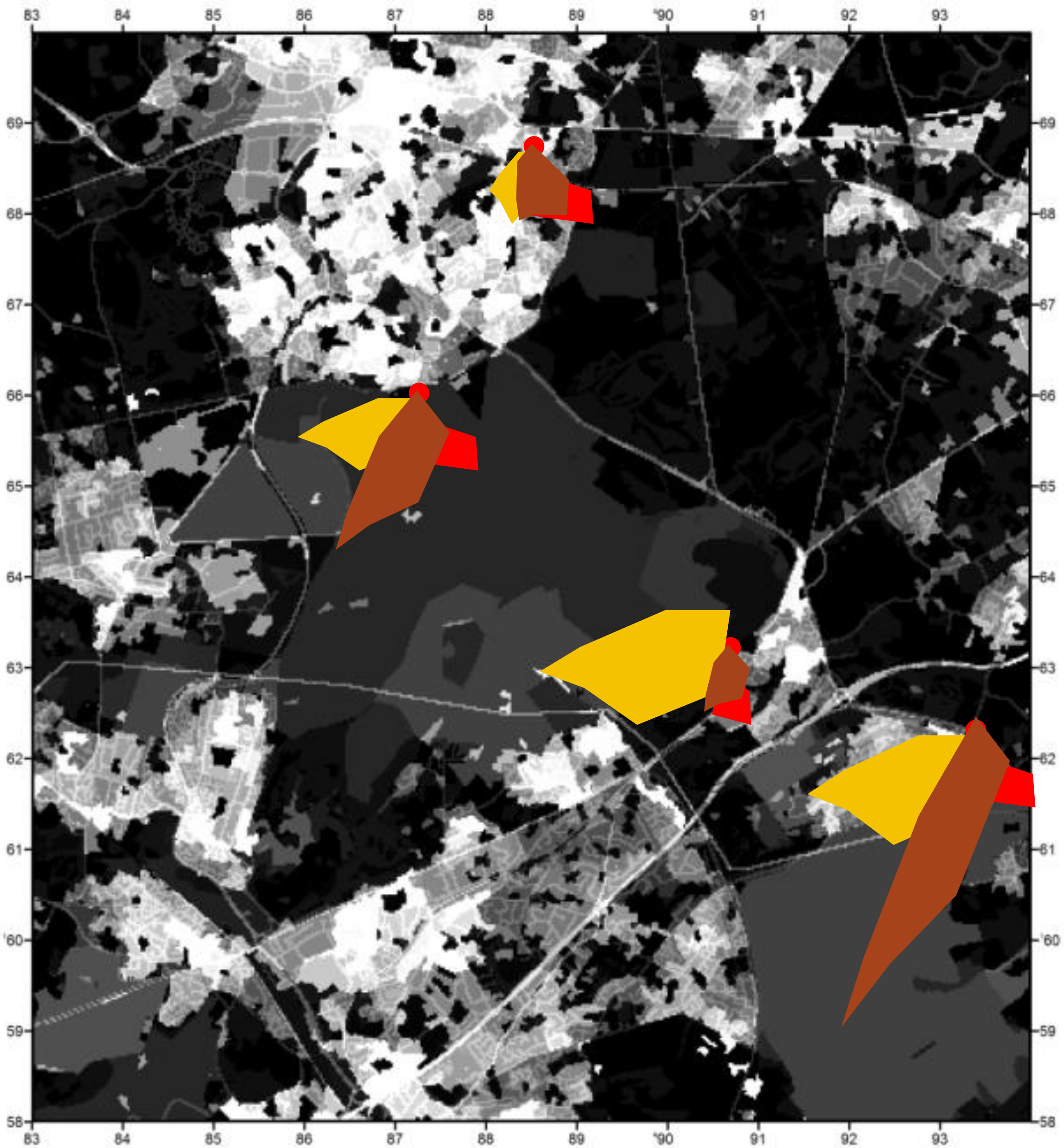
High

Low

Average fire size
Average fire intensity
Worst case scenario?

0 1 2 3 4 Kilometers

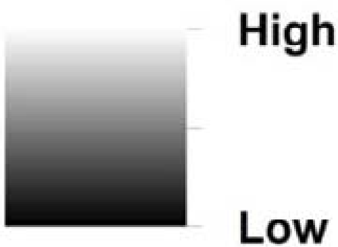
TOWARDS "ENSEMBLE" FIRE SPREAD MODELLING



Values at Risk

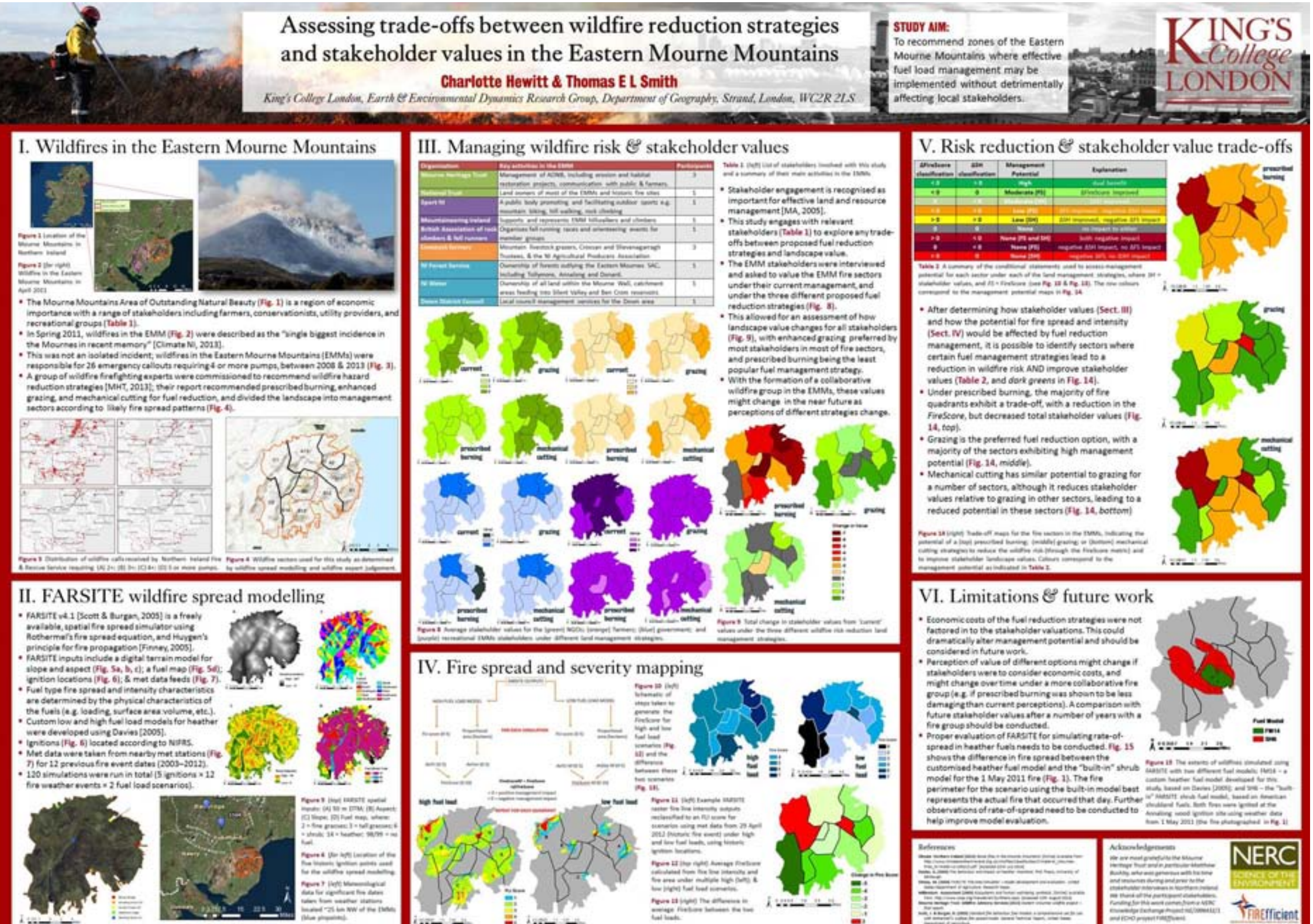
Weighted layers:

Health and well-being: 5
Property and inrastructure: 3
Ecosystem services: 1



Average fire cost
Worst case scenario?

POSTER: tinyurl.com/hewittsmith2014



QUESTIONS?

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NERC
SCIENCE OF THE ENVIRONMENT

National Centre for Earth Observation
NATURAL ENVIRONMENT RESEARCH COUNCIL

Field Spectroscopy Facility
NATURAL ENVIRONMENT RESEARCH COUNCIL

NORTHUMBERLAND WILDFIRE TEAM

FIREfficient
Operational tools for improving efficiency in wildfire risk reduction in EU landscapes

This project is co-funded by the European Union

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