

Wildfire Initial Attack Planning Using Geospatial Tools

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Maps, Apps and Bridging Gaps

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**Hyatt Regency Columbus
Columbus, Ohio**

Wildfires in Ohio? You Bet!

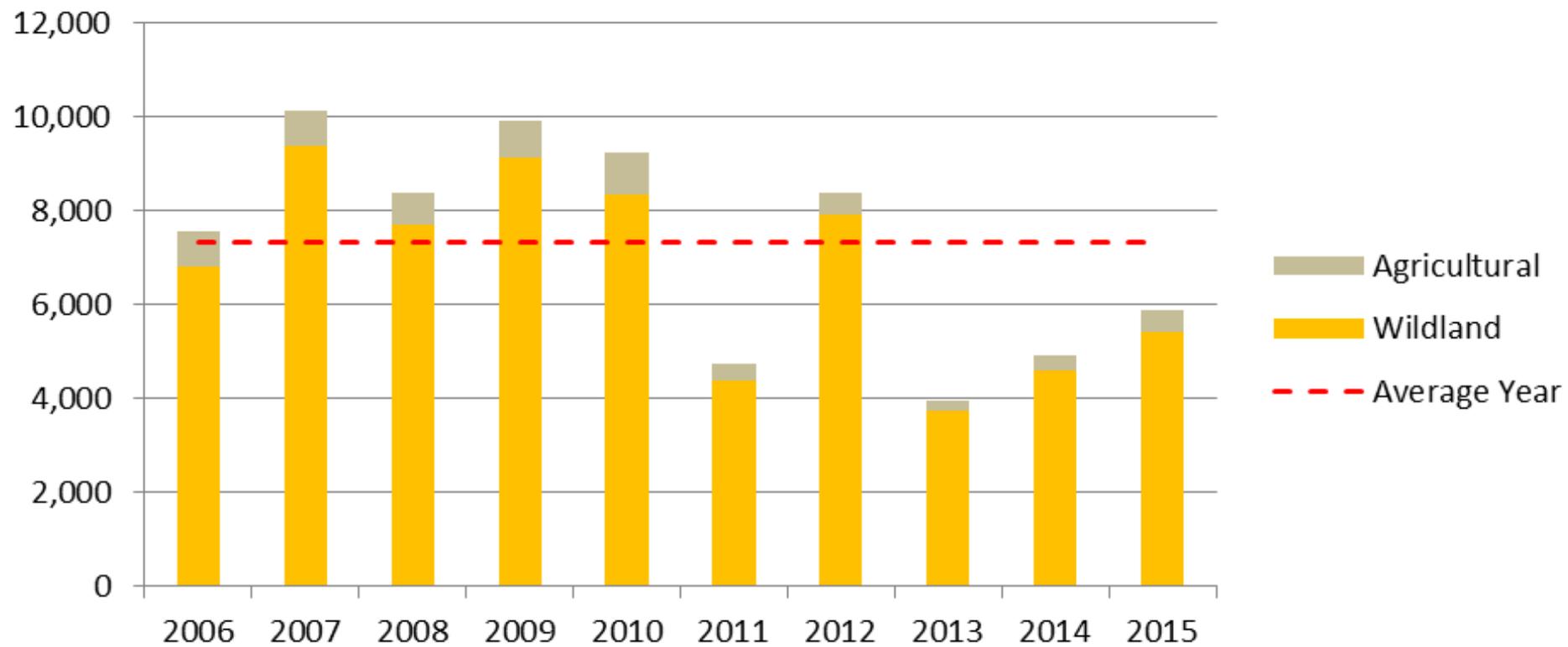
Average of 7,312 wildfires per year in Ohio during 2006-2015

6,745 fires in (92%) wildland fuels (brush, grass and forest)

567 (8%) fires in agricultural fuels (standing crops and residue)

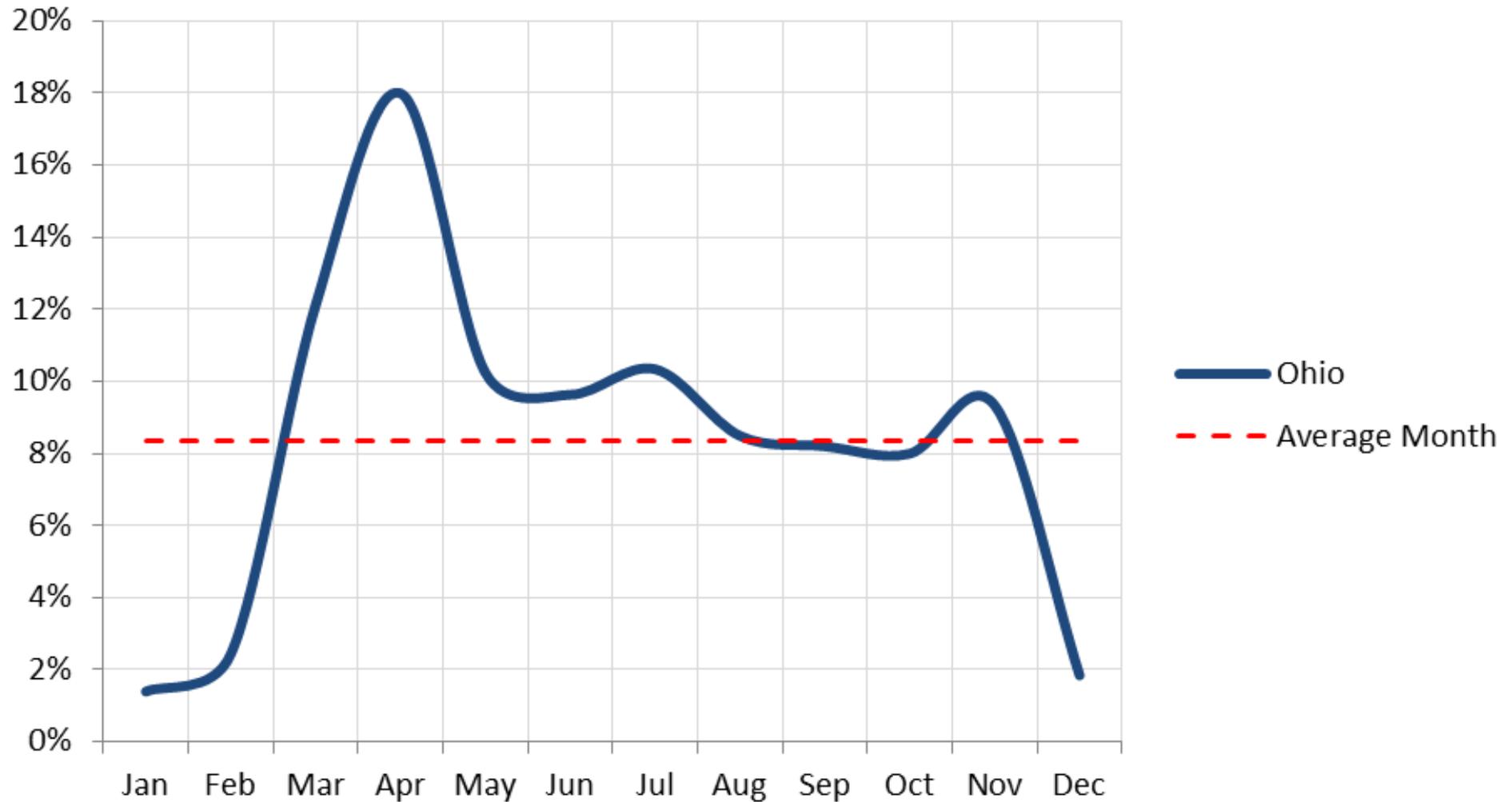


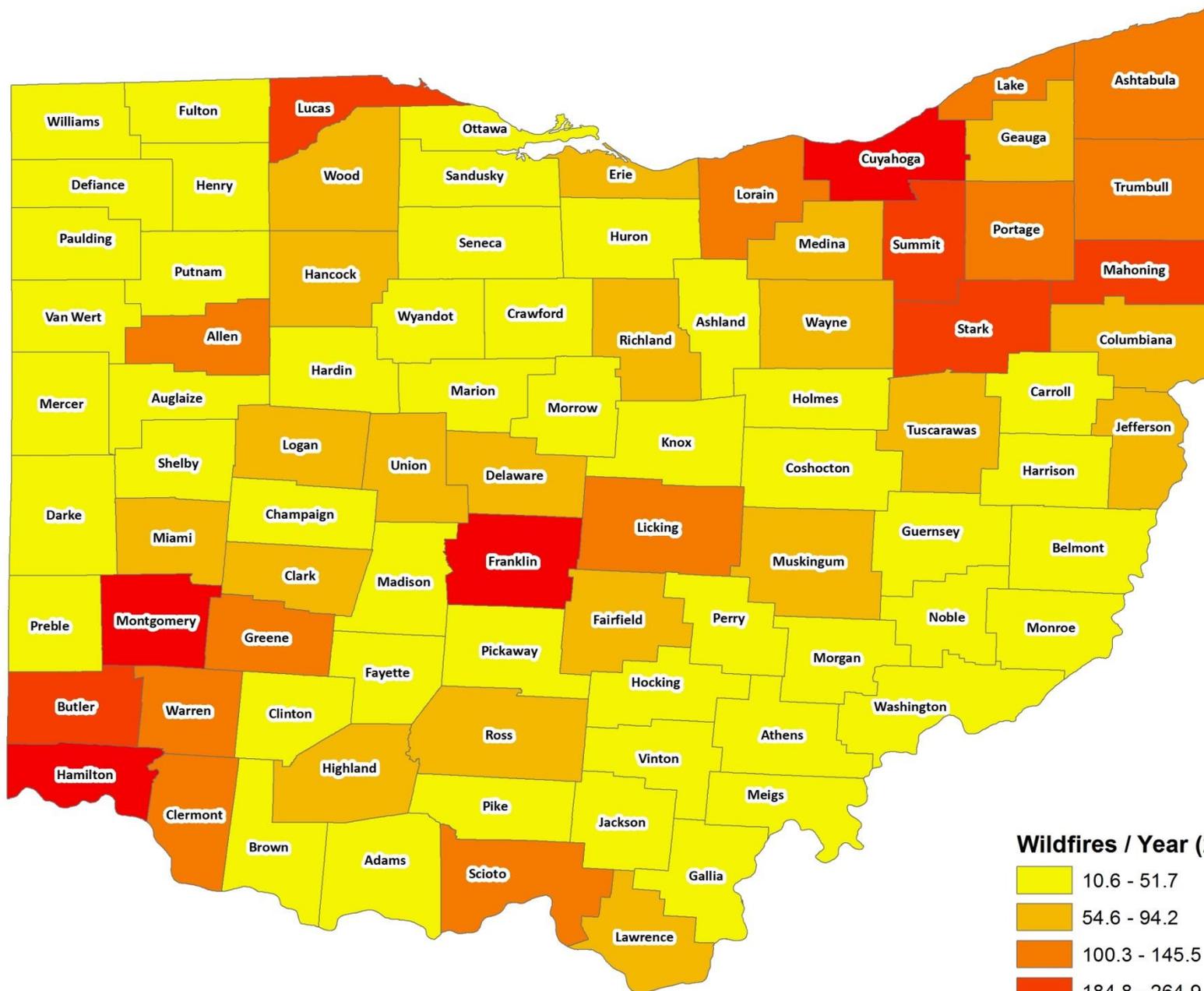
Wildfires: Ohio - Statewide



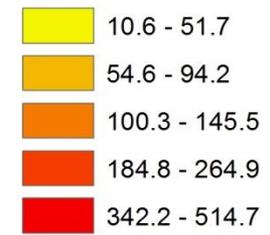
Wildfires: Distribution by Month

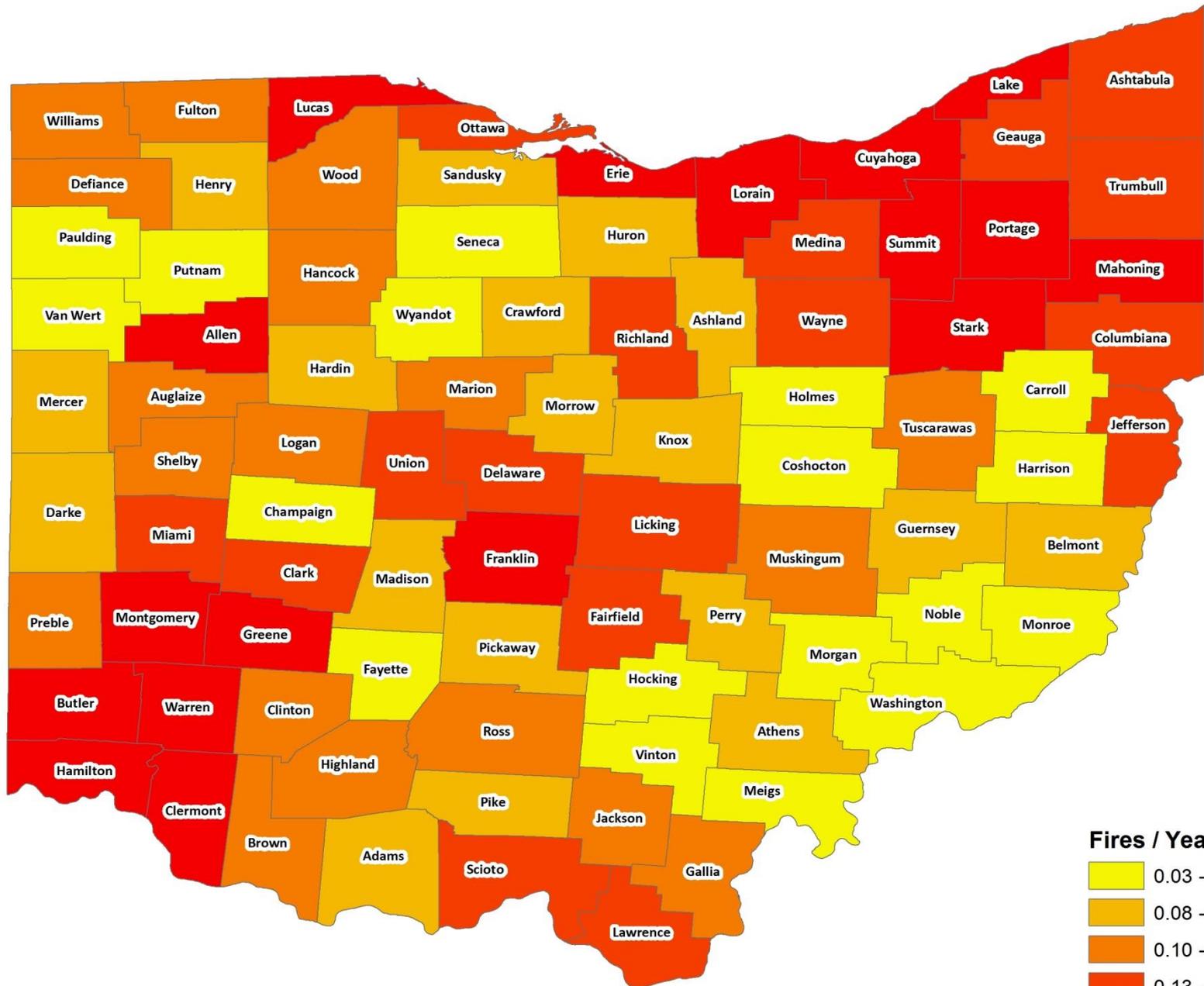
Wildland + Agricultural Fires



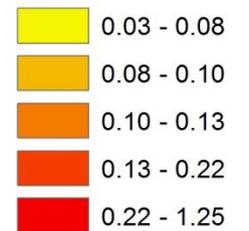


Wildfires / Year (2005-2016)





Fires / Year / Sq Mile



BELLEFONTAINE FIRE & EMS (LOGAN COUNTY, OHIO)

Provider of fire and EMS services for the City of Bellefontaine and two rural townships

- Total protected population: 15,668 (2,232 in rural areas)
- Total protected area: 40.8 square miles
- Only career department in county
11 x vol. fire dept. & 3 x EMS-only providers

Call Volume (2014): 2,473 total runs (6.8/day)

- 77% EMS; 23% fire and other
- 7% of runs are providing mutual aid

Apparatus:

- 1 x Aerial Ladder (L-21)
- 2 x Engine (Type 1) (E-21/22)
- 1 x Engine (Type 6) (G-21)
- 1 x Water Tender (Type S-3) (T-21)
- 3 x Ambulance (M-21/22/23)

Staffing:

- 1 x Department Chief (full time)
- 3 x Asst. Chief (Shift Supervisor) (full time)
- 14 x Firefighter/Paramedic (full time)
- 5 x Auxiliary FF/EMT (volunteer)
Typical shift: 1 x AC + 4-5 FF (24/48)

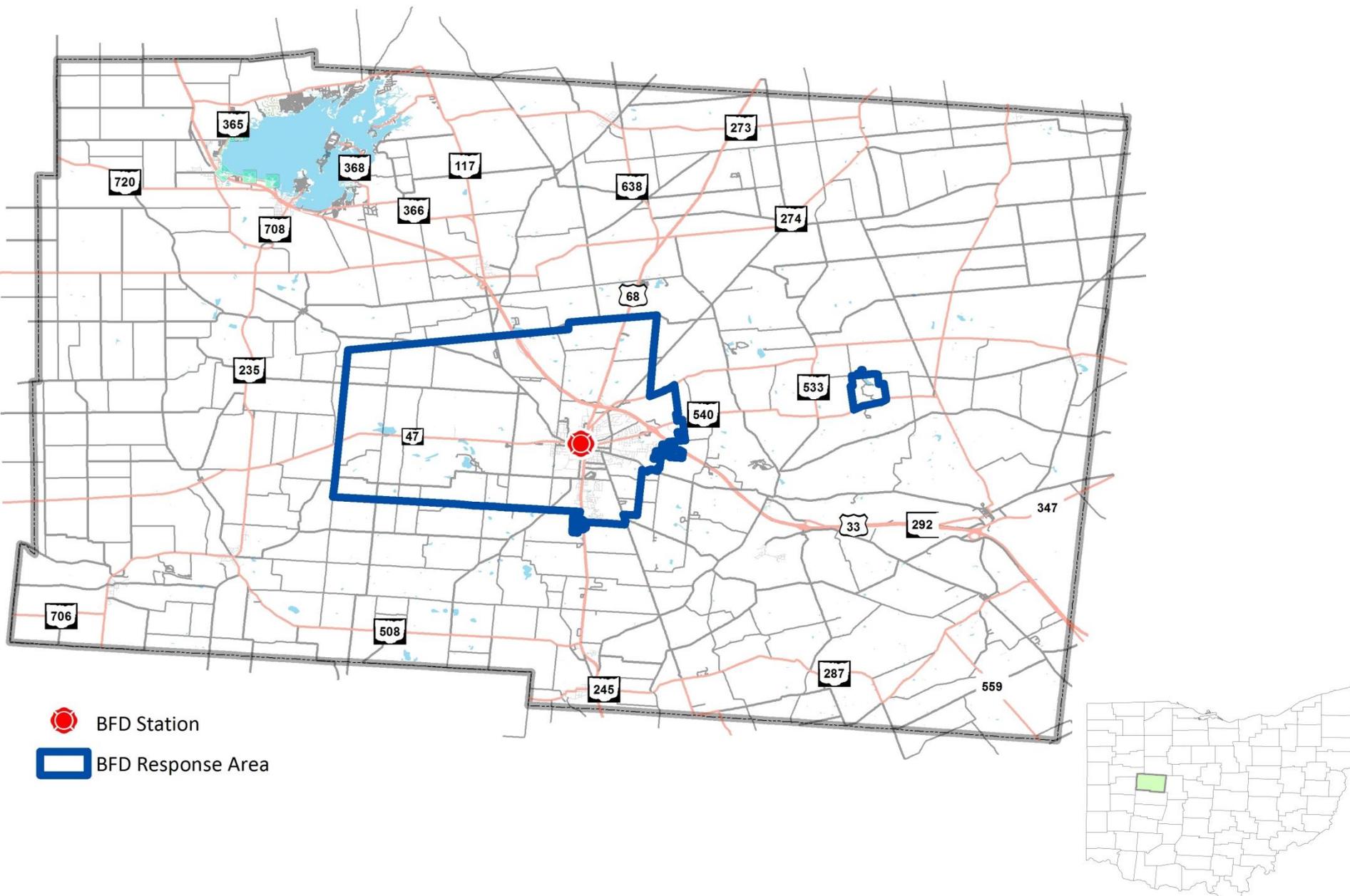


Prescribed burning, March 2016

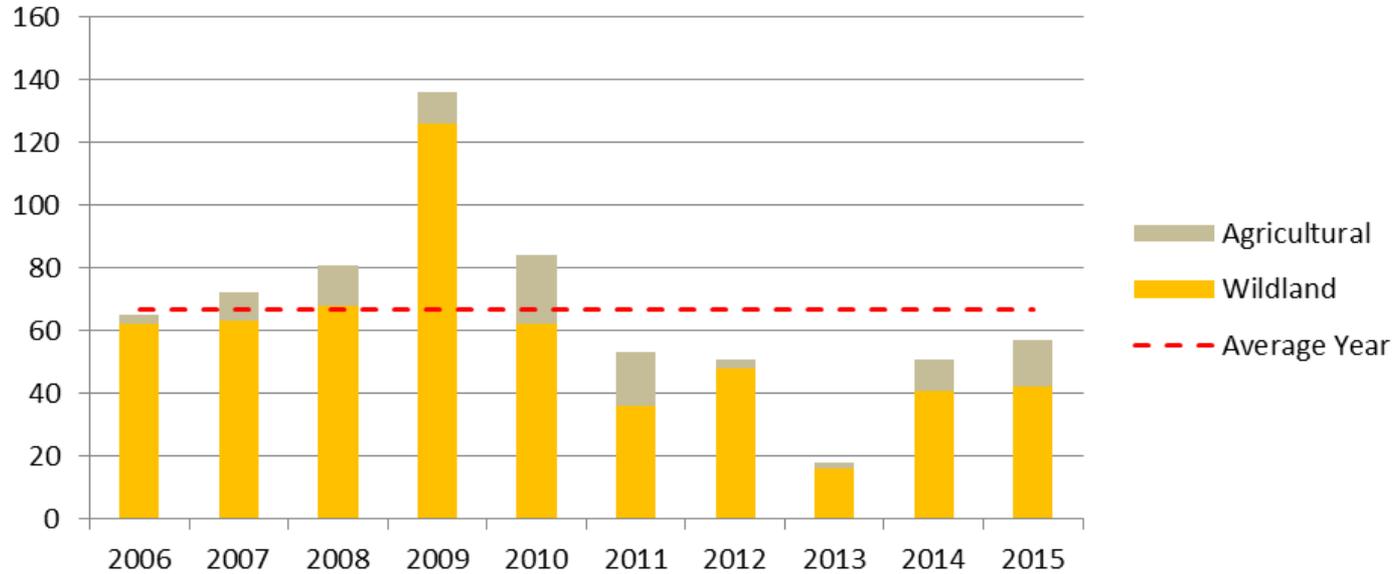


Bellefontaine FD Grass Rig (G-21)

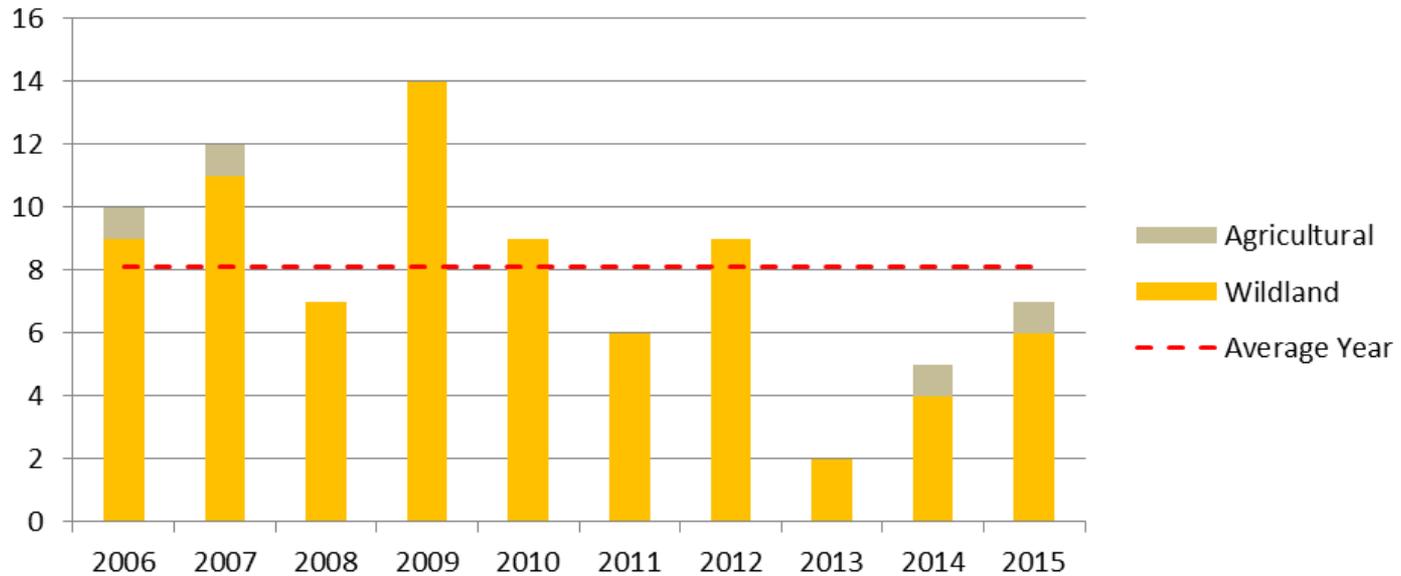
Bellefontaine Fire & EMS: Response Area



Wildfires: Logan County +

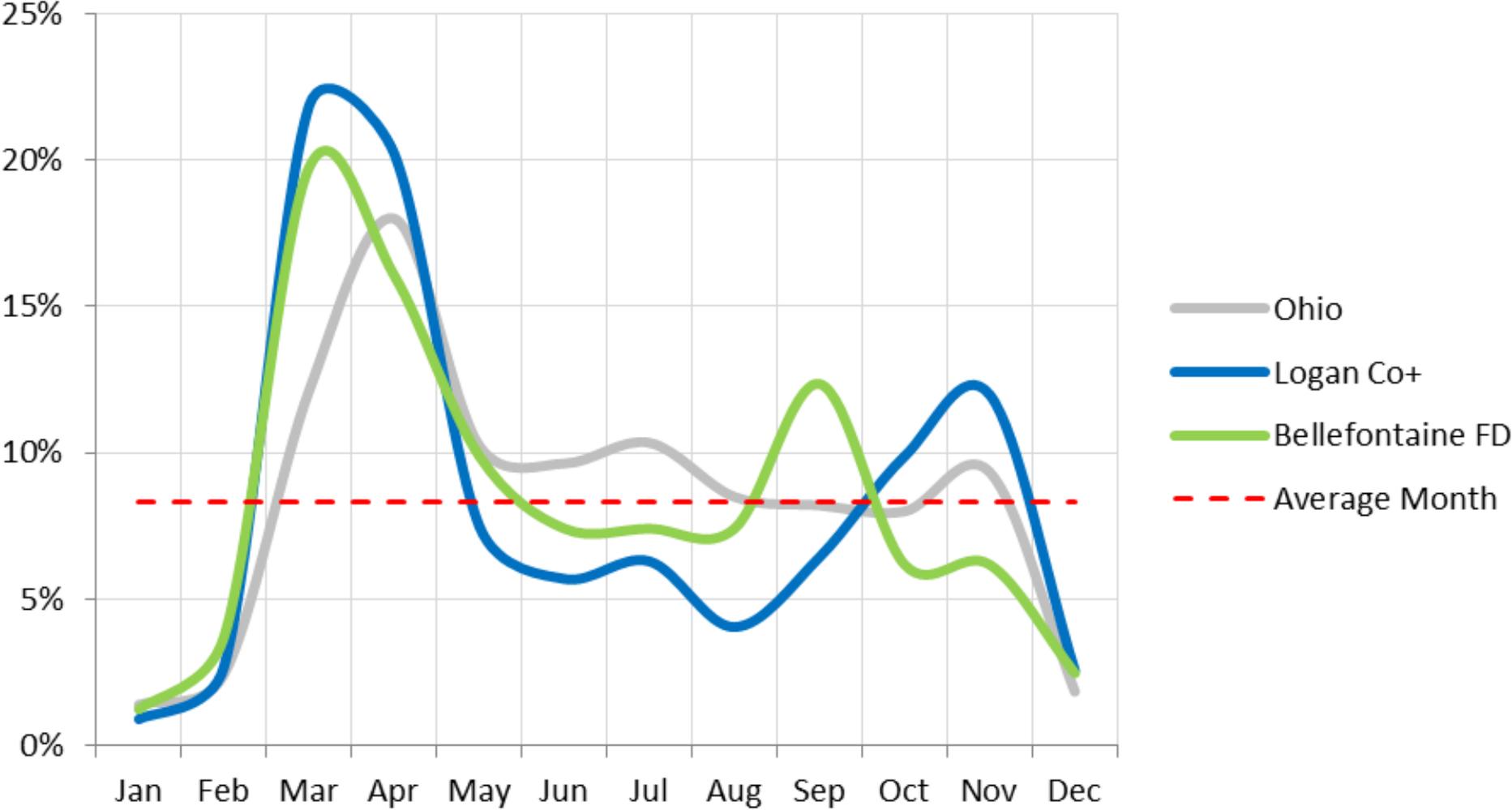


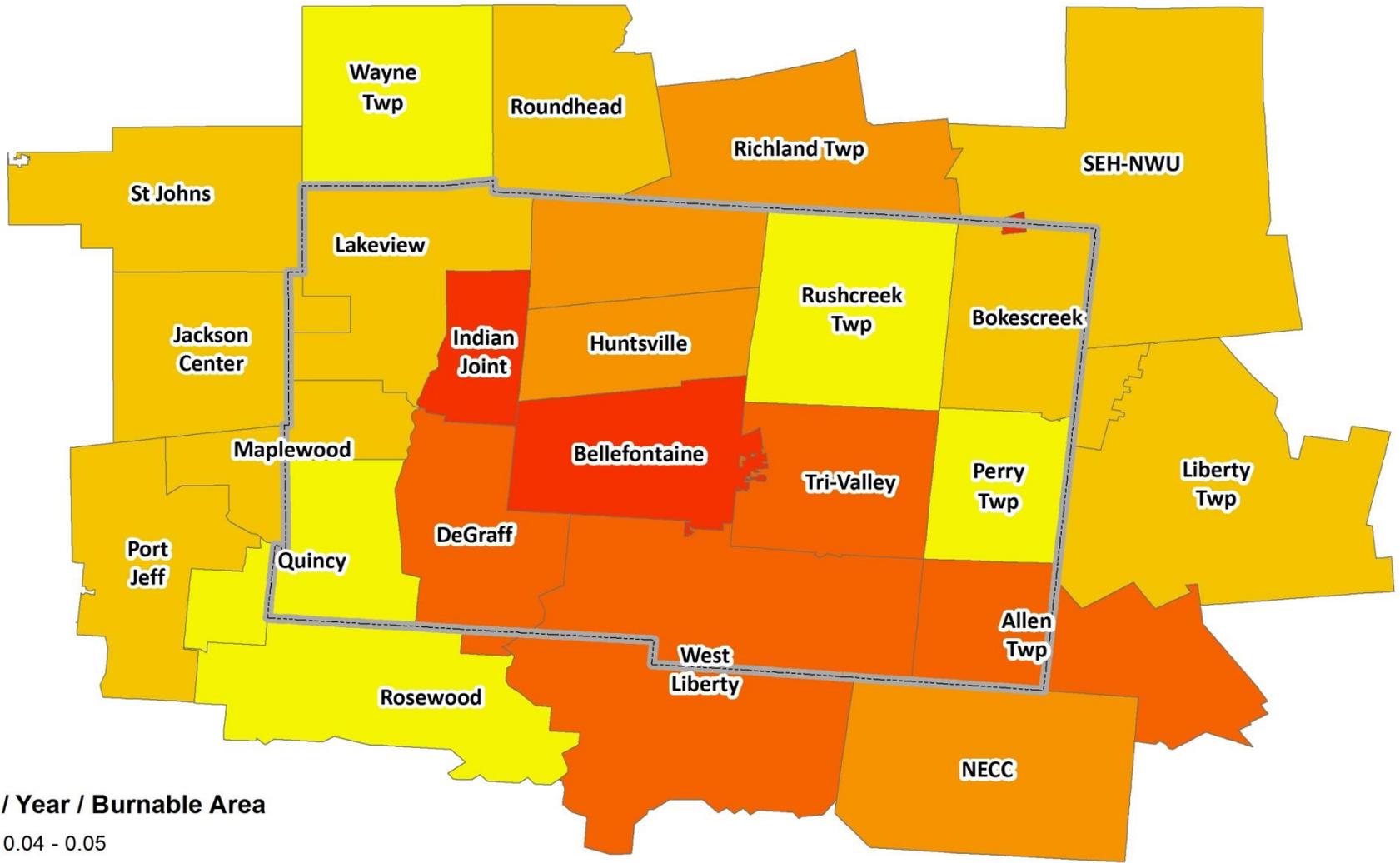
Wildfires: Bellefontaine Fire & EMS



Wildfires: Distribution by Month

Wildland + Agricultural Fires





Fires / Year / Burnable Area



RESOURCES

IA Resource Locations
23 wildland units

Response Time Delays
Historic dispatch data

NETWORK

Road Network
ODOT / LBRS

Barriers
Slope, intersections, RR crossings

USDA CropScape
Land cover raster dataset

NFIRS
Historic fire occurrence data

NOAA/NWS
Historic daily weather data

IA Resource Production Rates
CALFire study

Response Time Estimates
Station to incident

WEATHER

Fire Weather Scenarios
W01, W05, W10

Fuel Models
Rothermel FM1, FM3, FM9

FUELS

ArcGIS
Network Analyst

Incident Locations
2,194 centroids from wildland fuel polygons

ArcGIS
basic geoprocessing

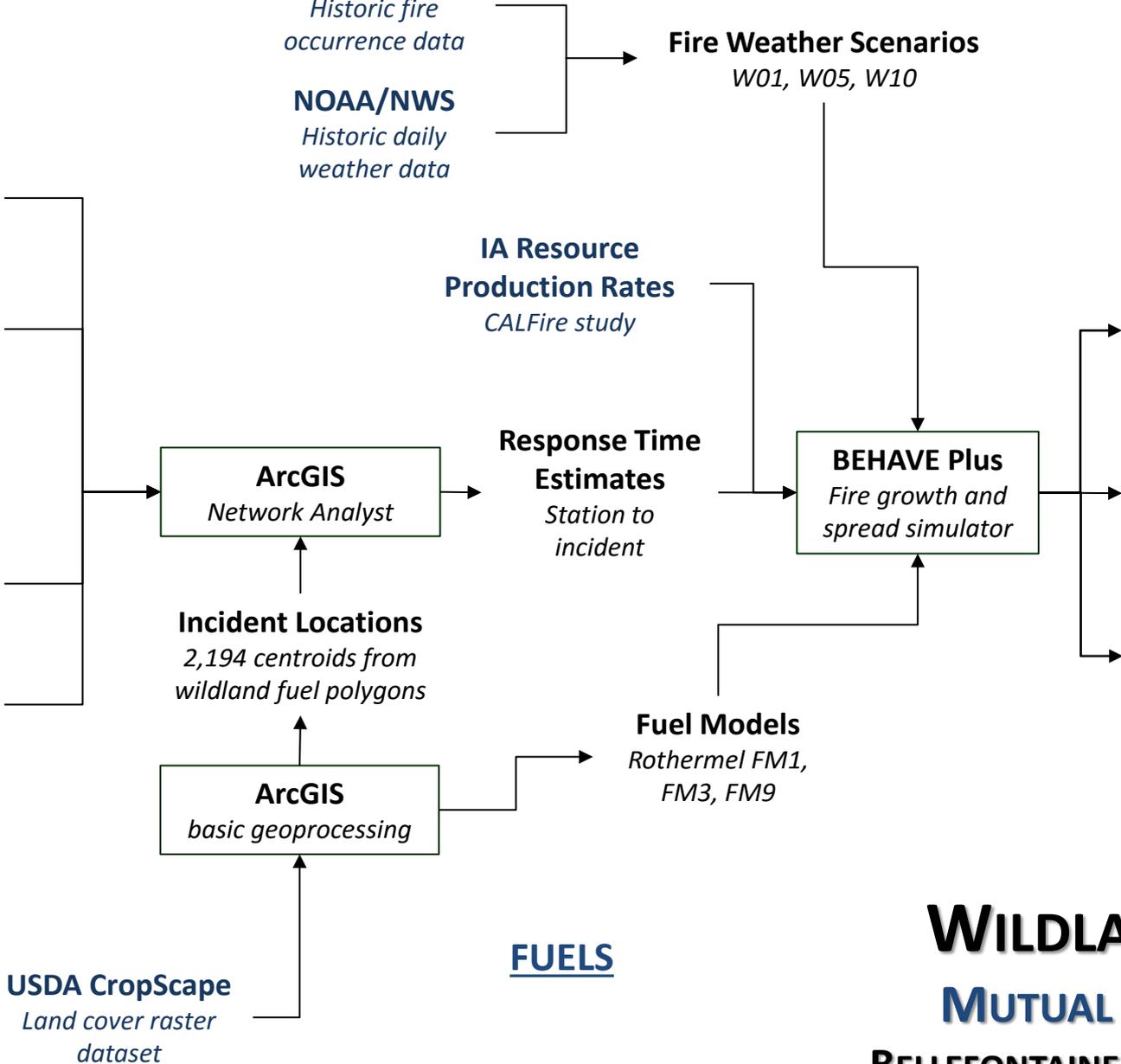
BEHAVE Plus
Fire growth and spread simulator

CONTAINMENT ESTIMATES

MUTUAL AID BOXES

TRIGGER POINTS

WILDLAND FIRE
MUTUAL AID STUDY
BELLEFONTAINE FIRE & EMS



Wildfire Simulation

Behave Plus v5

- Fire growth and spread simulation software developed by the US Forest Service
- Allows for iterative model runs with differing fuel, weather and response time conditions
- Optimized for relatively flat terrain

Required Inputs

- Fuel model
- Fire unit response times
- Weather conditions
- Fire unit production rates

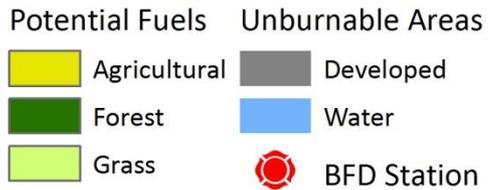
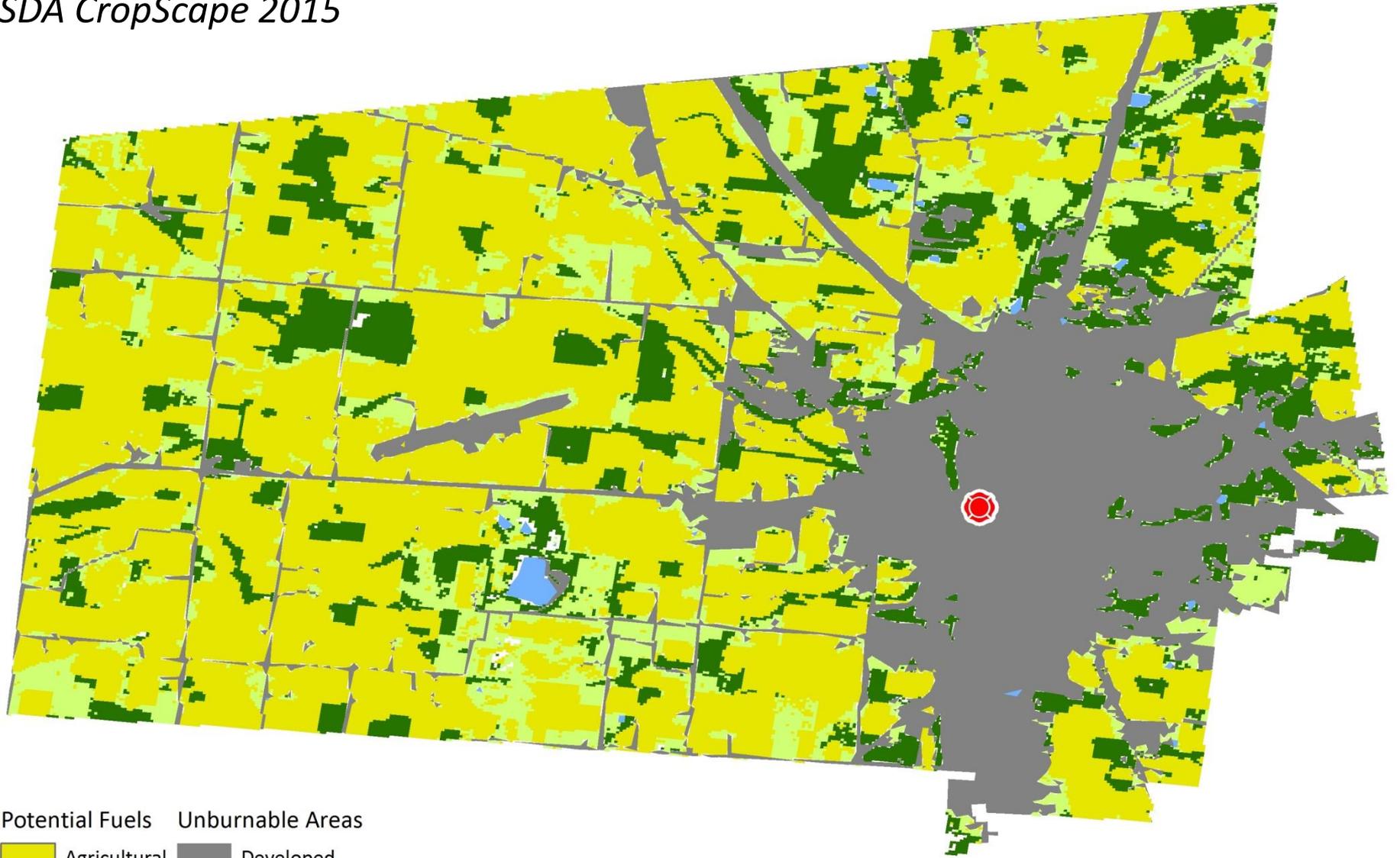
BehavePlus download site:

<https://www.frames.gov/partner-sites/behaveplus/software-manuals/>



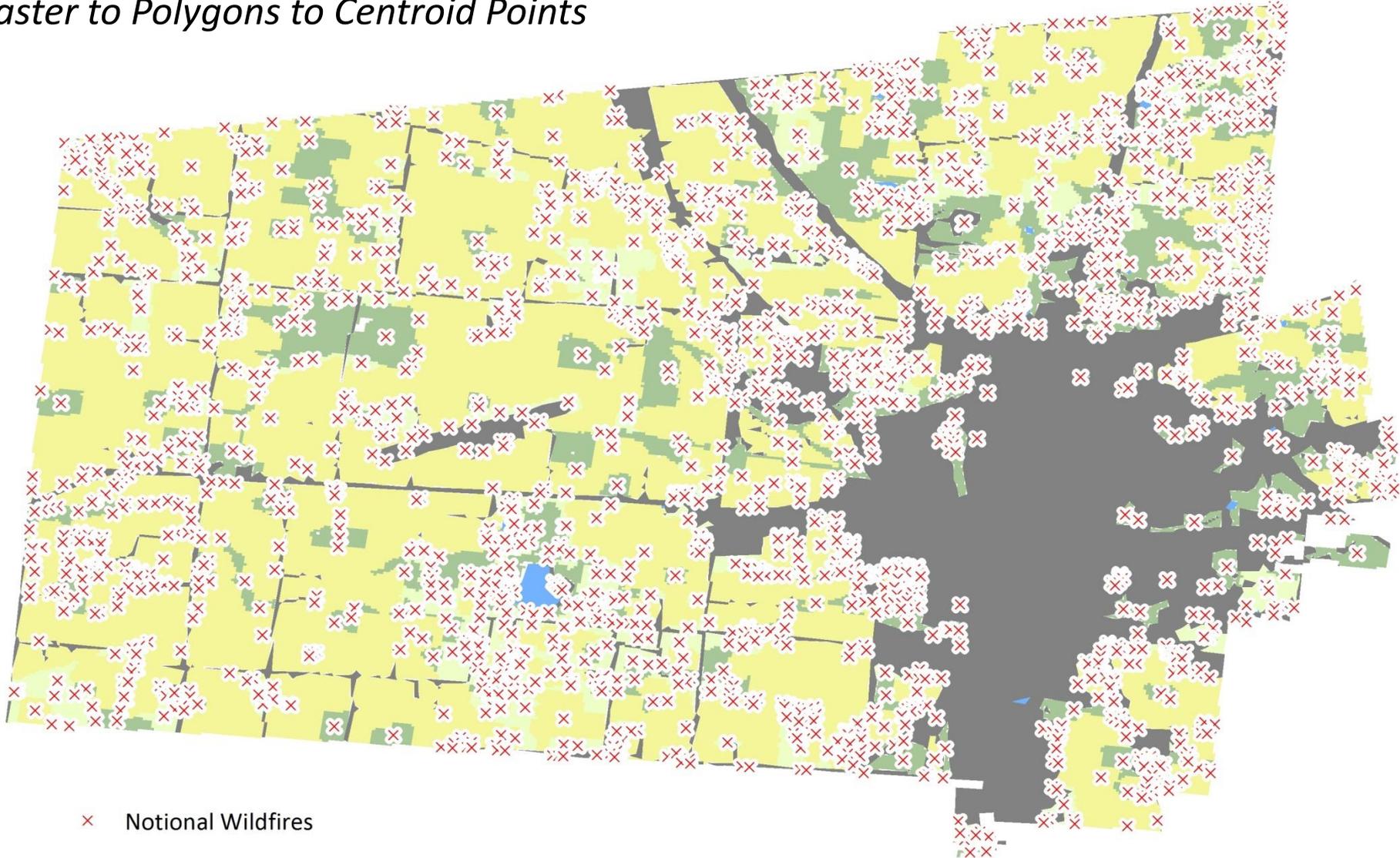
Wildland Fuel Environment

USDA CropScape 2015

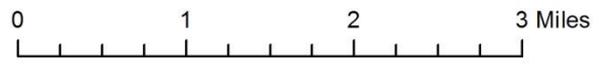


Notional Wildfires (2,194 Locations)

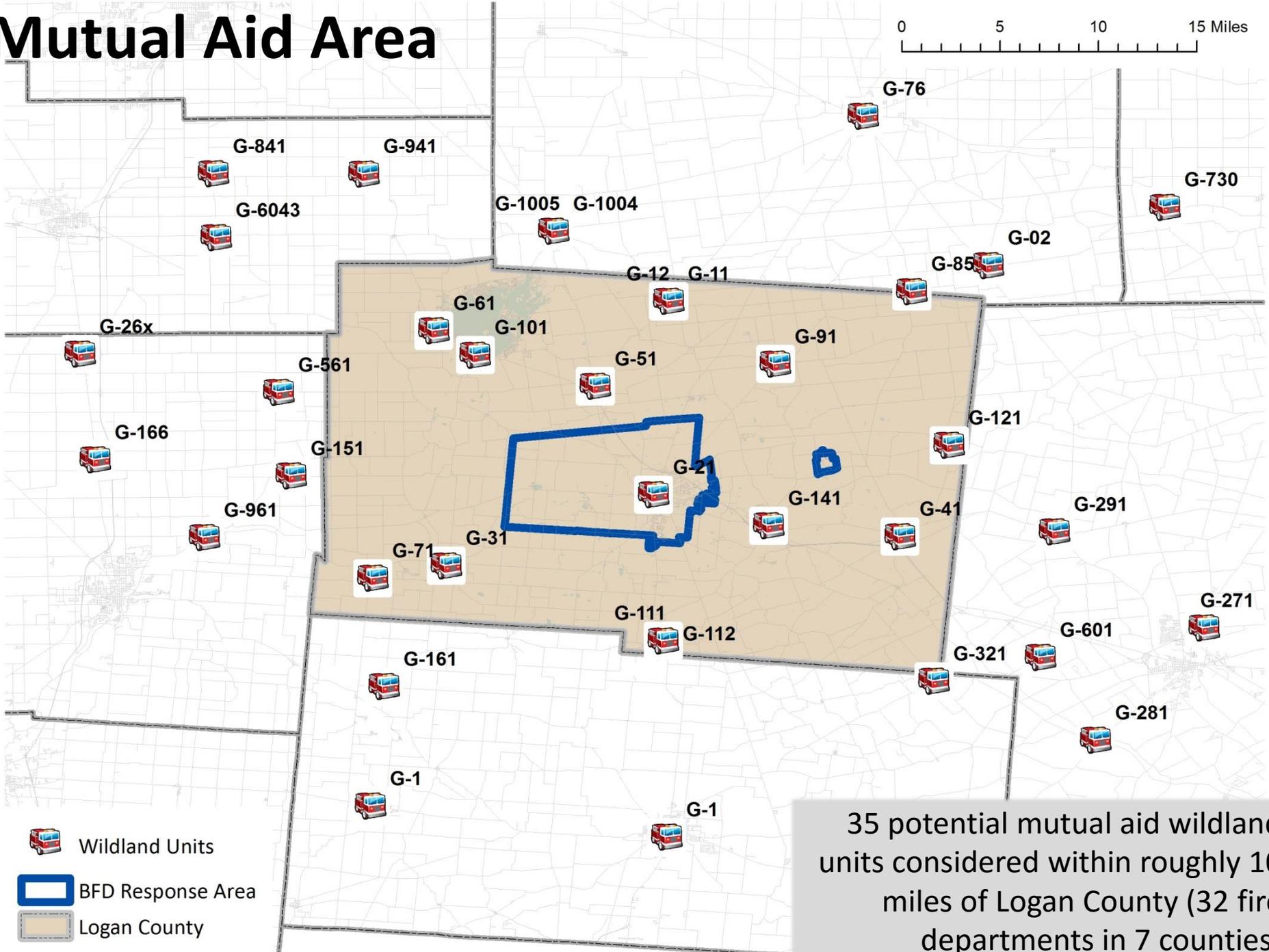
Raster to Polygons to Centroid Points



x Notional Wildfires



Mutual Aid Area



-  Wildland Units
-  BFD Response Area
-  Logan County

35 potential mutual aid wildland units considered within roughly 10 miles of Logan County (32 fire departments in 7 counties)

Response Time Estimates

Origin-Destination Matrix

(ArcGIS Network Analyst extension)

- Origin: 2,194 notional wildfire locations
- Destination: 36 potential wildland units

Roads Data

- Combined LBRS for Logan and six surrounding counties (Union County = local data)

Impedances

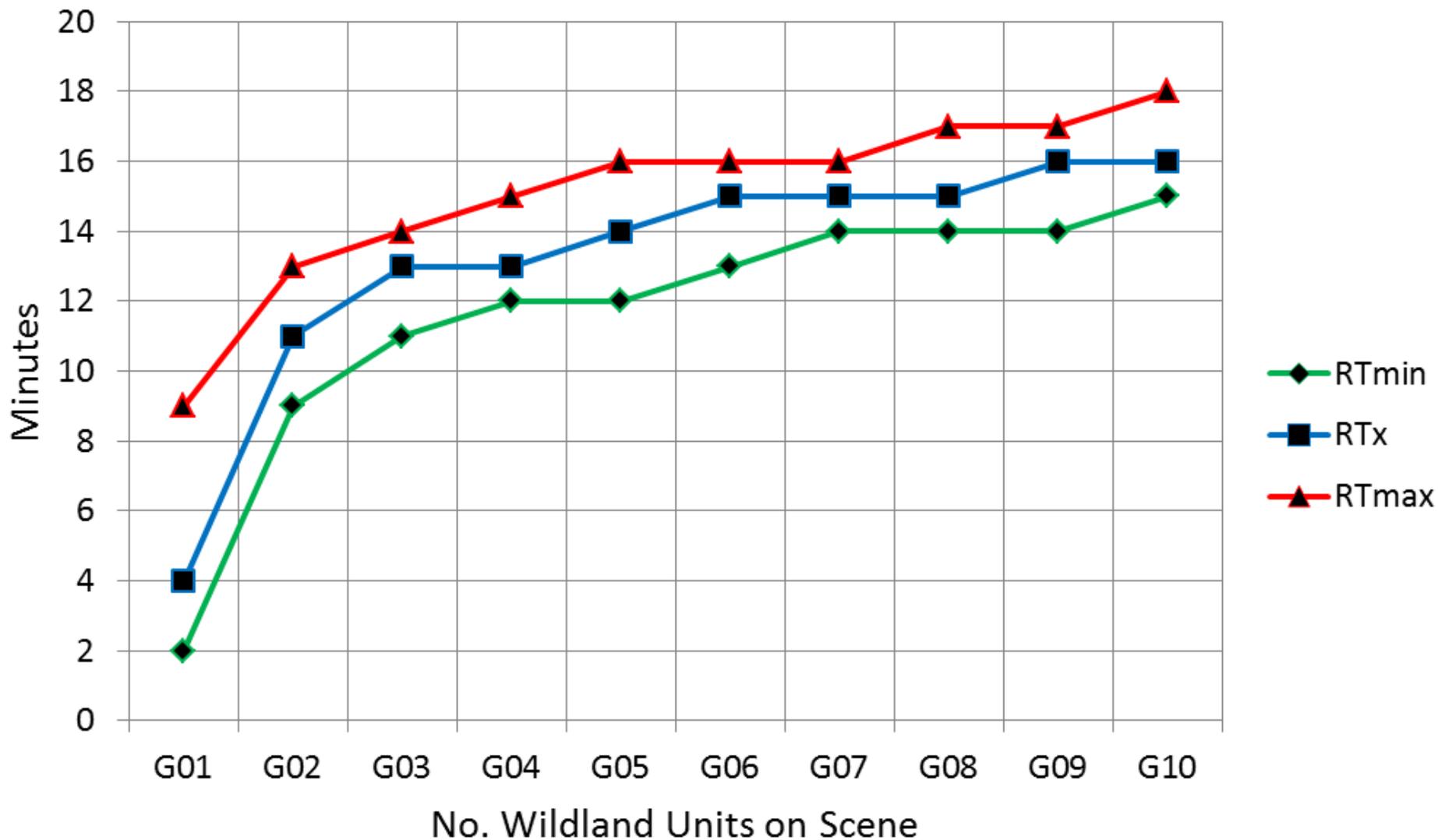
- Dispatch Delay: Time delay for each unit to respond based on historical 9-1-1 records
- Intersections: Delay to clear stop signs, yield signs, traffic signals
- Rail Crossings: Delay not barrier
- Slope: Polygons generated using 10-m DEM; impedance for road segments with slope >6%

Results

- 10 best solutions for each O/D combination, ranked by modeled response time (minutes)



Concentration Estimates



Of 36 units considered, 23 made up the first 10 on-scene for all notional wildfires

Fire Weather Environment

Data Source

- National Weather Service historical data for key fire events
- Geographically weighted average of weather stations surrounding study area

Weather vs. Fires

- Determined average weather conditions for three scenarios
- Based on historical fire reports for Logan County: Worst single day, worst five days, worst 10 days

| Scenario | No. Fires / Day | Max. Temperature | Min. Relative Humidity | Max. Wind Speed | Fine Dead Fuel Moisture |
|----------|-----------------|------------------|------------------------|-----------------|-------------------------|
| W01 | 14.0 | 62 F | 28% | 15 mph | 6% |
| W05 | 10.6 | 64 F | 29% | 16 mph | 6% |
| W10 | 8.0 | 64 F | 32% | 19 mph | 6% |

Resource Production Rates

- Primary fire control tactic is mobile attack by one or more brush units (engines)
- Production rate is length of fire perimeter controlled per unit time (feet per minute)
- Only one production study for this tactic
 - Fried & Gilles, 1989 study for California Department of Forestry (now CalFire)

Estimate Used:

3,960 feet/minute/unit
(60 chains/minute)



Model Outcomes

| Scenario | Fuel Model | Min. Units to Contain Fire | Time to Containment (minutes) | Area Burned (acres) |
|-------------|-----------------|----------------------------|-------------------------------|---------------------|
| W01 x RTmax | FM3 Tall Grass | 6 | 42 | 242 |
| | FM1 Short Grass | 4 | 36 | 72 |
| W01 x RTx | FM3 Tall Grass | 6 | 36 | 136 |
| | FM1 Short Grass | 4 | 36 | 72 |
| W10 x RTmax | FM3 Tall Grass | 7 | 54 | 411 |
| | FM1 Short Grass | 6 | 42 | 274 |
| W10 x RTx | FM3 Tall Grass | 7 | 36 | 231 |
| | FM1 Short Grass | 6 | 36 | 154 |

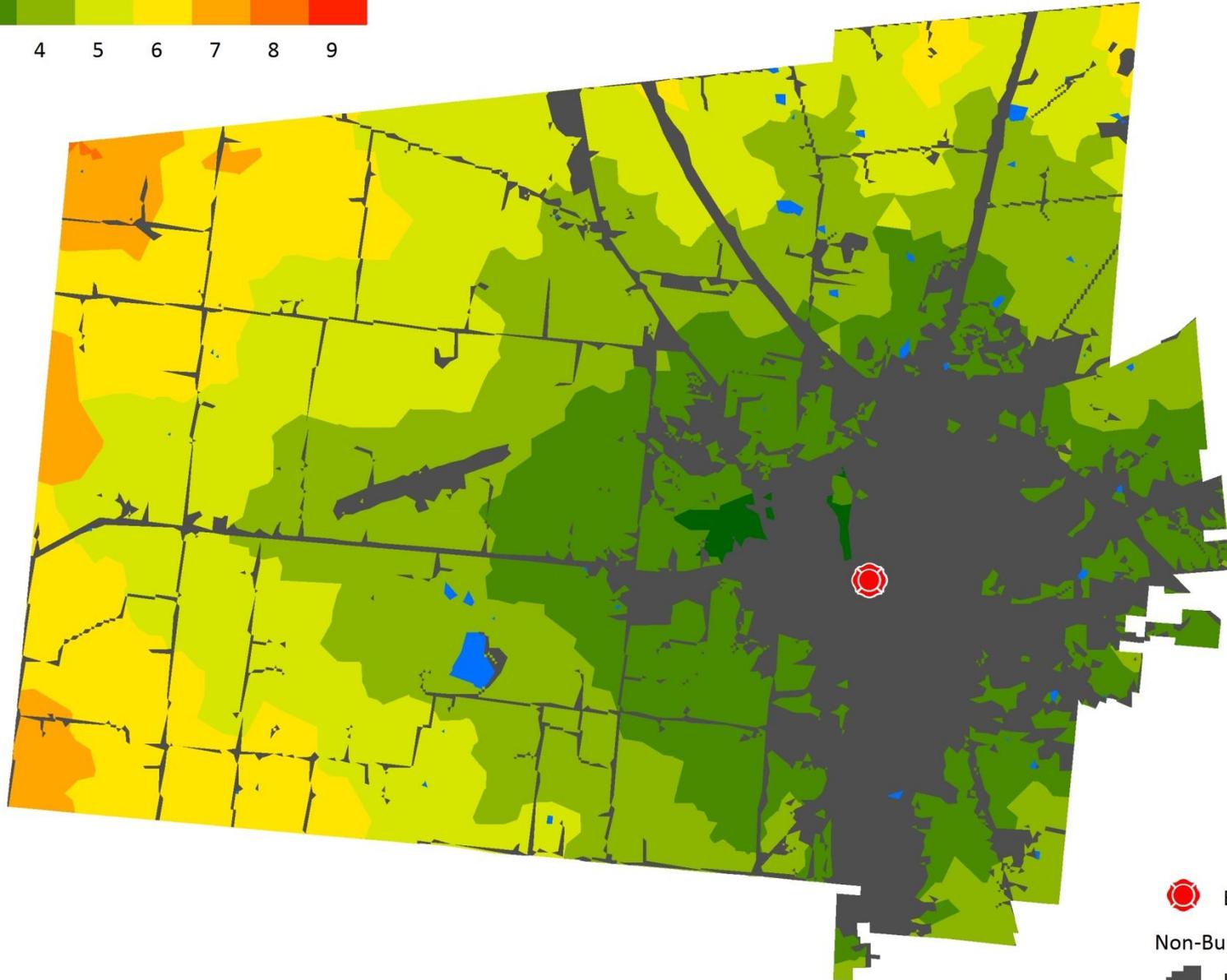
Key Events

- G01: First unit on-scene to begin size-up and attack
- G04: Four units on-scene; adequate for moderate conditions
- G07: Seven units on-scene; adequate for severe conditions
- G10: Ten units on-scene; maximum modelled (allows for contingency planning)

Time to G01 (minutes)



2 3 4 5 6 7 8 9

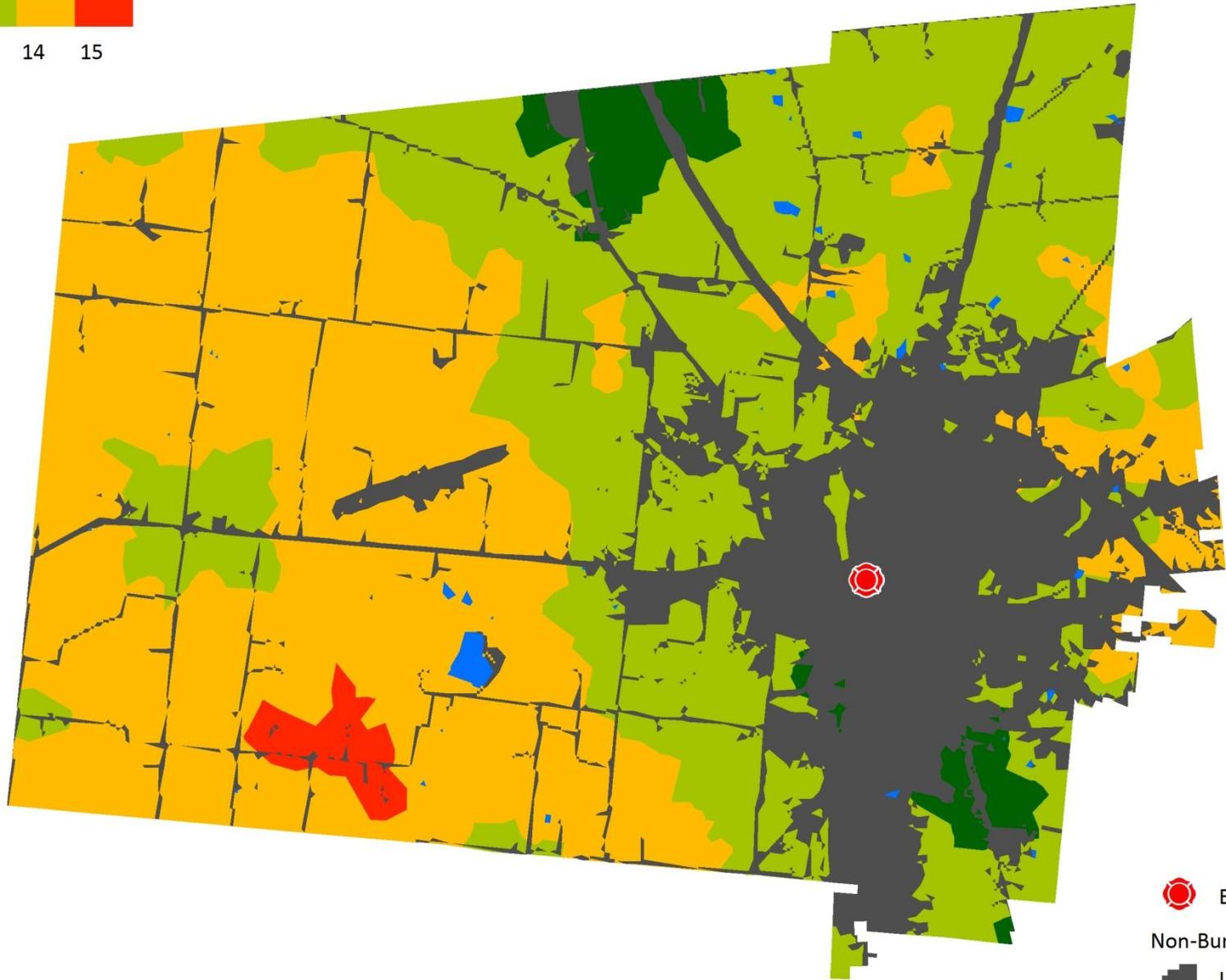


-  BFD Station
-  Non-Burnable Cover
-  Urban
-  Water

Time to G04 (minutes)



12 13 14 15



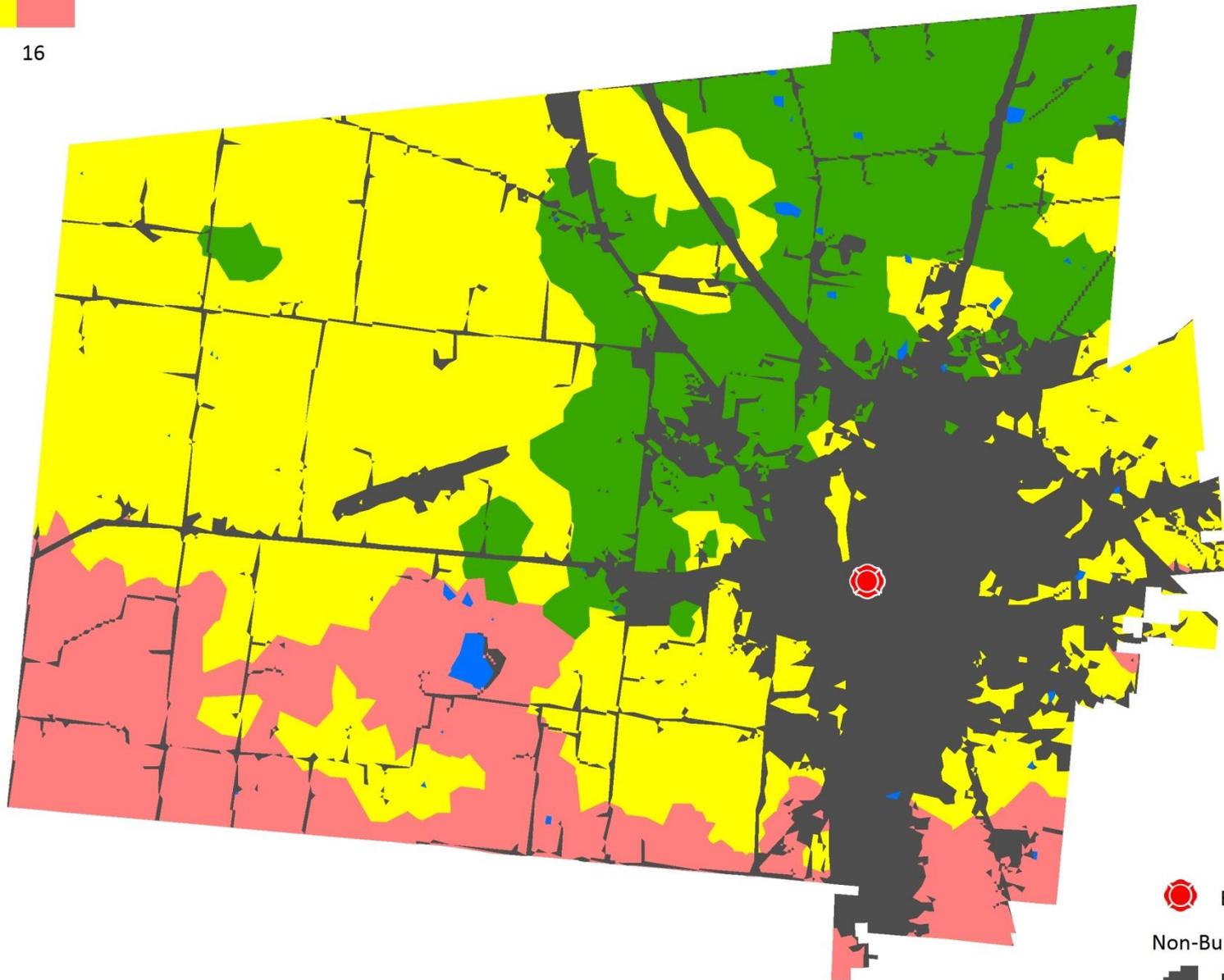
-  BFD Station
-  Non-Burnable Cover
-  Urban
-  Water



Time to G07 (minutes)



14 15 16



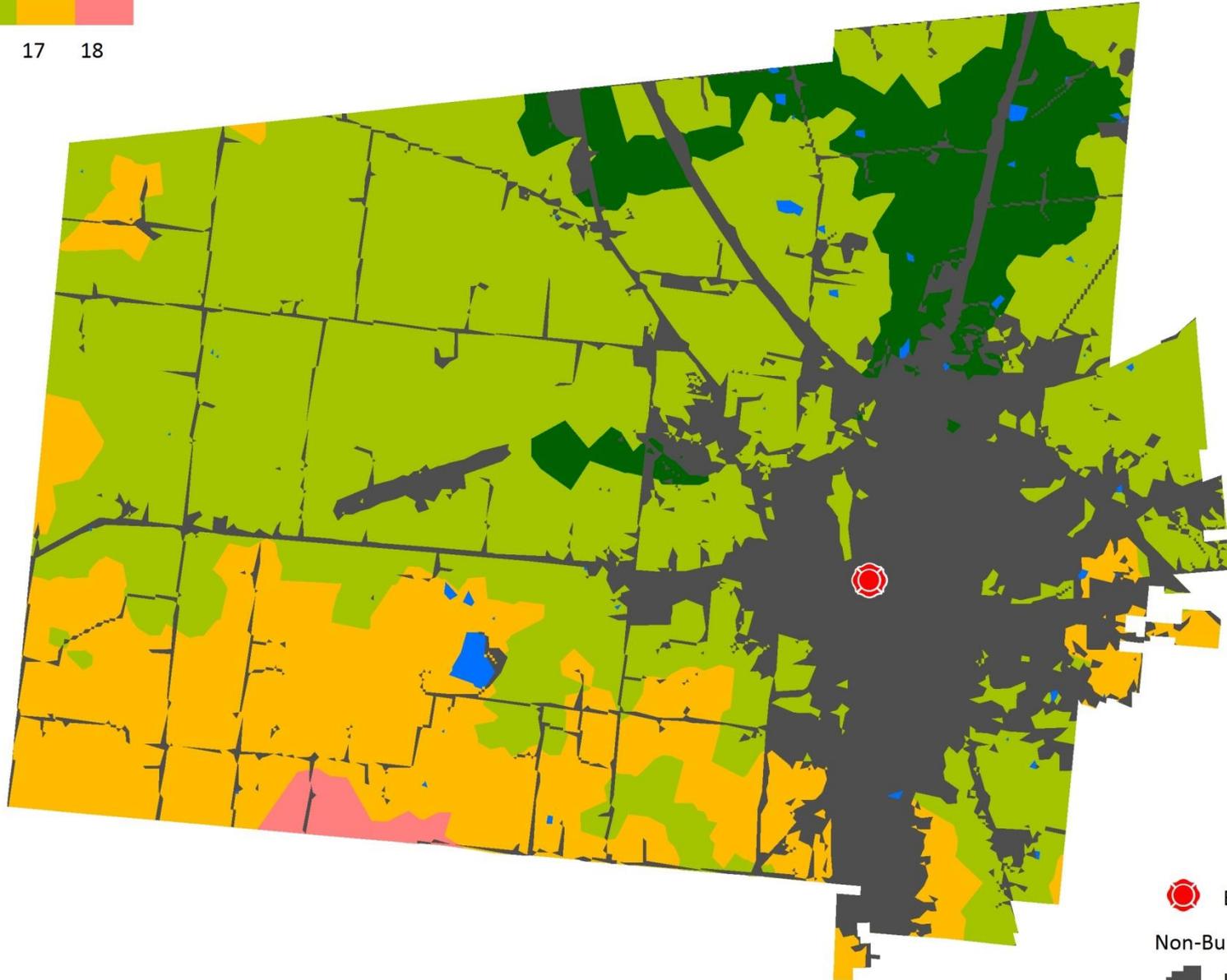
-  BFD Station
-  Non-Burnable Cover
-  Urban
-  Water



Time to G10 (minutes)



15 16 17 18



-  BFD Station
-  Non-Burnable Cover
-  Urban
-  Water



Northwest Ohio Wildland Fire Preparedness Matrix (Brush, Grass, Woods and Field Fires)

| Season | Threat | Prevent & Mitigate | Prepare | Respond |
|---|--|---|---|--|
| WINTER <i>December</i> <i>January</i> <i>February</i> | <ul style="list-style-type: none"> Minimal fire load Less active fire behavior | <ul style="list-style-type: none"> Educate: Continual messaging on debris burning in preparation for spring Mitigate: Promote FireWise and NFPA 1141 measures for rural residents and subdivisions Mitigate: Identify and pre-plan areas at greatest risk for wildfire | <ul style="list-style-type: none"> Schedule heavy maintenance of brush units for this period Schedule annual wildfire refresher training in preparation for spring Make purchases of tools, PPE, foam, etc. Update mutual aid agreements and response plans as needed | <ul style="list-style-type: none"> Less active fire behavior may allow for more aggressive tactics |
| SPRING <i>March</i> <i>April</i> <i>May</i> | <ul style="list-style-type: none"> Peak season for brush, grass and field fires Large fire load, especially during April Fires start easily, spread rapidly, and are difficult to contain | <ul style="list-style-type: none"> Educate: Focus on debris/trash burning by rural residents Enforce: Target illegal outdoor burning | <ul style="list-style-type: none"> Monitor fire weather forecasts daily and keep crews informed Consider augmented staffing of brush units Expand resources: Consider outfitting utility vehicles as brush trucks with skid units Participate in prescribed burning with natural resources agencies to increase wildfire experience | <ul style="list-style-type: none"> Expect very dangerous fire behavior and fast-moving fires Offensive attack may be ineffective on many days Focus on defensive tactics: Protect exposures and do not unnecessarily put firefighters at risk |
| SUMMER <i>June</i> <i>July</i> <i>August</i> | <ul style="list-style-type: none"> Brush fires continue, but fire load is lower due to seasonal vegetation green-up Field fires pick up in late July due to wheat harvest Fire behavior generally less intense, but extended dry periods can intensify severity | <ul style="list-style-type: none"> Educate: Focus on farm workers in advance of wheat harvest Educate/Enforce: Focus on fireworks around July 4th; target illegal fireworks for enforcement Mitigate: Train farm workers in appropriate action and incipient fire control for field/combine fires | <ul style="list-style-type: none"> Monitor fire weather forecasts daily when dry conditions prevail and during the wheat harvest Consider increased brush unit staffing during periods when higher fire activity is likely | <ul style="list-style-type: none"> Less active fire behavior may allow for more aggressive tactics Be alert for periods of higher fire danger when a switch to defensive tactics may be wise |
| FALL <i>September</i> <i>October</i> <i>November</i> | <ul style="list-style-type: none"> Brush fire activity picks up as vegetation cures, especially after first hard frost Field fire activity escalates due to soybean and corn harvest Fire behavior generally less intense, but periods of warm, dry weather can increase severity | <ul style="list-style-type: none"> Educate: Focus on farm workers in advance of corn/soybean harvest Mitigate: Train farm workers in appropriate action and incipient fire control for field/combine fires | <ul style="list-style-type: none"> Monitor fire weather forecasts daily when dry conditions prevail and during the corn/bean harvest Consider increased brush unit staffing during periods when higher fire activity is likely Participate in prescribed burning with natural resources agencies to increase wildfire experience | <ul style="list-style-type: none"> Less active fire behavior may allow for more aggressive tactics Be alert for periods of higher fire danger when a switch to defensive tactics may be wise |

