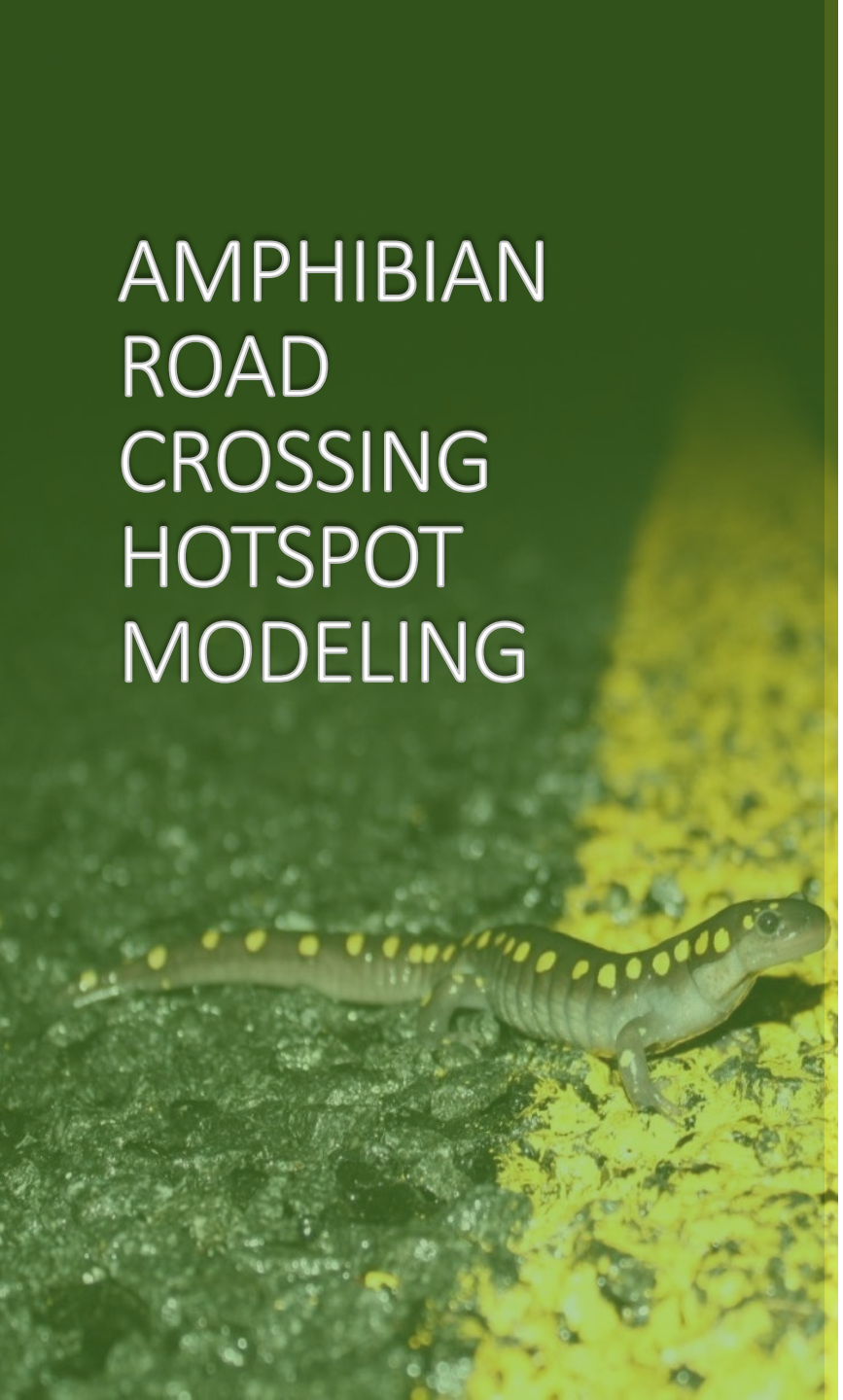
# AMPHIBIAN ROAD CROSSING HOTSPOT MODELING



VERMONT AGENCY OF TRANSPORTATION

**IN COLLABORATION WITH**

MCFARLAND JOHNSON, UVM SPATIAL ANALYSIS LAB AND JAMES S. ANDREWS

**PRESENTED BY:**

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**PRESENTED TO THE:**


VERMONT AGENCY OF TRANSPORTATION

McFarland Johnson

- The focus for wildlife connectivity and passage has been mainly on mammals
- Amphibians are the most threatened class of vertebrates worldwide, and are some of the most affected by roads
- VTrans wanted to identify potential amphibian road crossing “hotspots”

# Initial Pilot Study

High-resolution LiDAR and land use mapping became available in 2016

Opportunity to model potential amphibian crossings – as a screening tool

VTrans conducted a pilot study in 2018

Extended statewide under this project

**WHERE DO SALAMANDERS CROSS THE ROAD? DEVELOPMENT OF A GIS MODEL TO IDENTIFY AMPHIBIAN ROAD-CROSSING HOTSPOTS**

Final Report Submitted to the
Vermont Agency of Transportation

January 16, 2019

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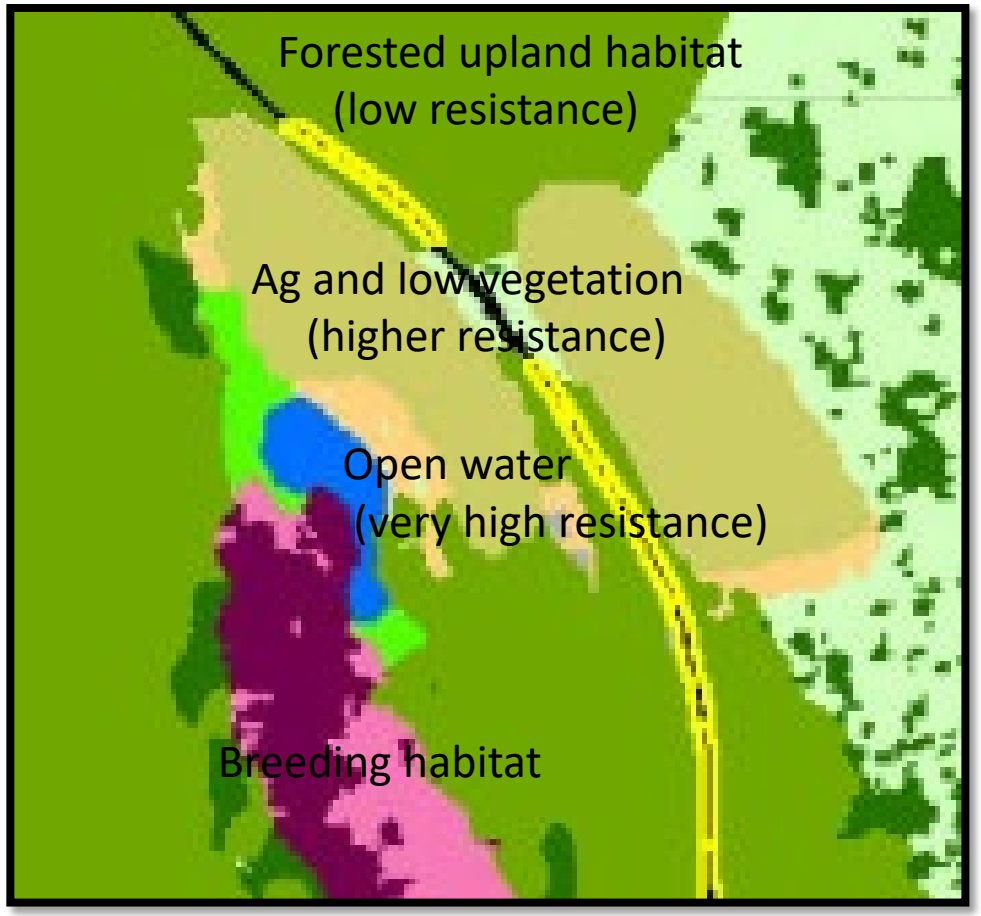
# Least-Cost Distance Approach

Follows approach used by Patrick et al. in central New York State study

Some habitats are more conducive to amphibian movement than others

Least-cost distance approach: The ability of amphibians to move from point A to point B is based on how conducive the terrain is to their movement. Each different land use class is given a resistance factor, or “cost”, of amphibian movement through it. The resistance factor is multiplied by the distance traveled in that habitat. The resulting distance is compared to the normal migration distance of the species.

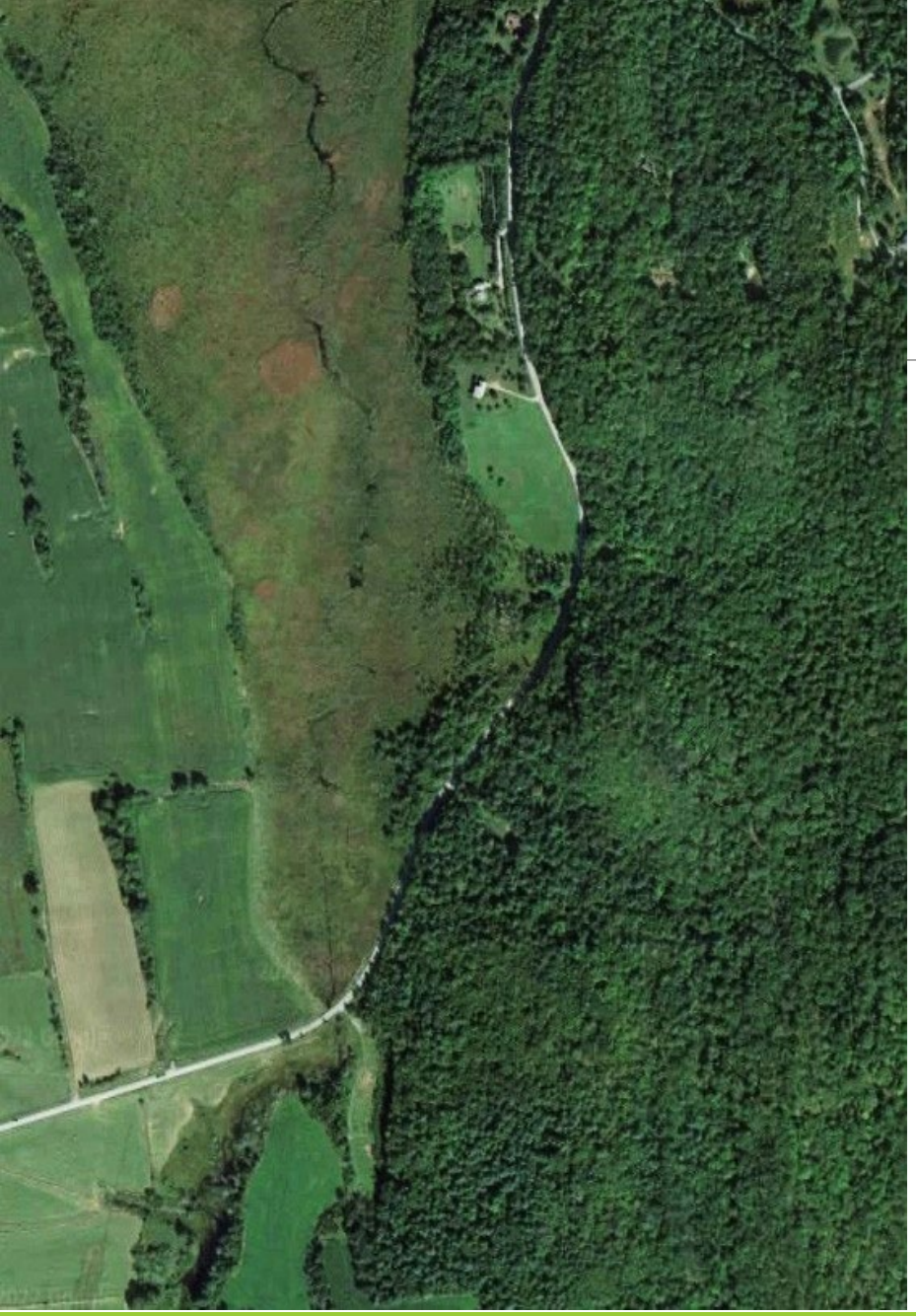
# Least-Cost Distance Approach - Illustration



# Focal Species

Amphibian species with large spring migrations and similar habitat requirements

- Jefferson Salamander (*Ambystoma jeffersonianum*) and hybrids
- Blue-spotted Salamander (*Ambystoma laterale*) and hybrids
- Spotted Salamander (*Ambystoma maculatum*)
- Four-toed Salamander (*Hemidactylium scutatum*)
- Gray Tree Frog (*Hyla versicolor*)
- Spring Peeper (*Pseudoacris crucifer*)
- Wood Frog (*Lithobates sylvaticus*)



# Where Are Potential Road Crossings?

Where suitable breeding and nonbreeding habitat are on opposite sides of the road and within migrating distance of each other

- Breeding habitat: vernal pools, swamps, marshes, vegetated pond or lake margins
- Nonbreeding habitat: upland forest with some deciduous leaves on the forest floor
- Migrating distance: assumed maximum 600 feet

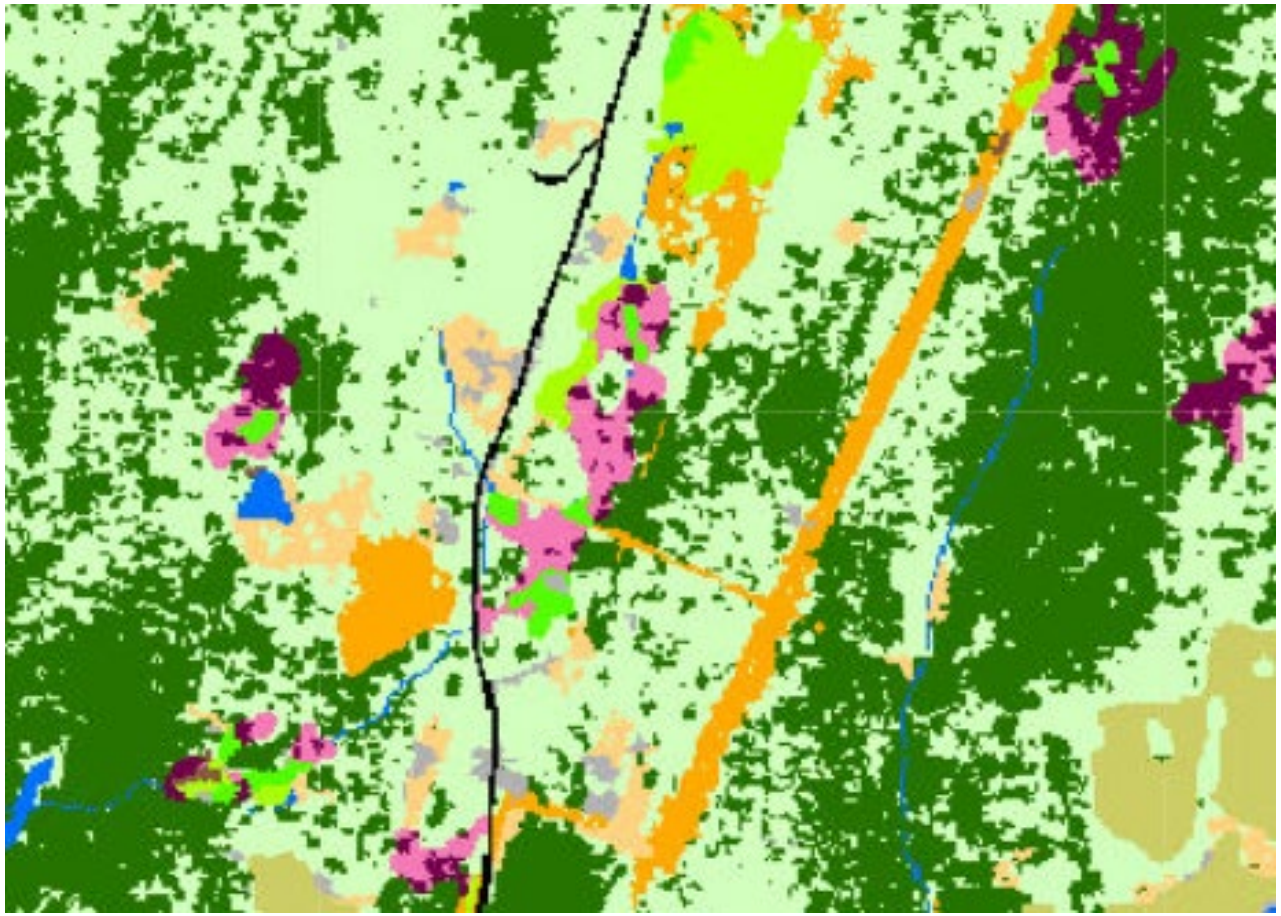
# Modeling

Two phases:

- Land cover modeling
- Hotspot modeling

# Land Cover: Sources of Data

- 2016 statewide Base Land Cover dataset
- Supplemental modeling (e.g., wetlands)
- Thematic datasets (e.g., vernal pools)
- Combined using eCognition
- 8 land use classes



# Model Components: Nonbreeding Habitat

Upland forests with some deciduous leaf litter

Fine-grained source data produces patchy land cover

Rules for:

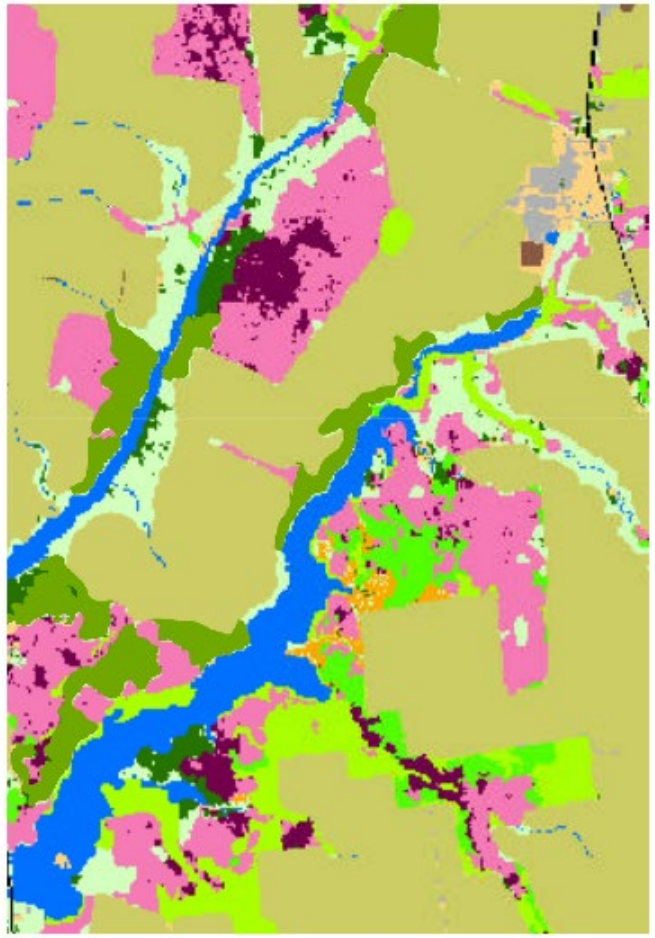
- Small canopy openings
- % deciduous/coniferous cover
- Minimum habitat size (4 ha)
- Densely developed areas

# Model Components: Breeding Habitat

Vegetated wetlands had to be modeled

Issues:

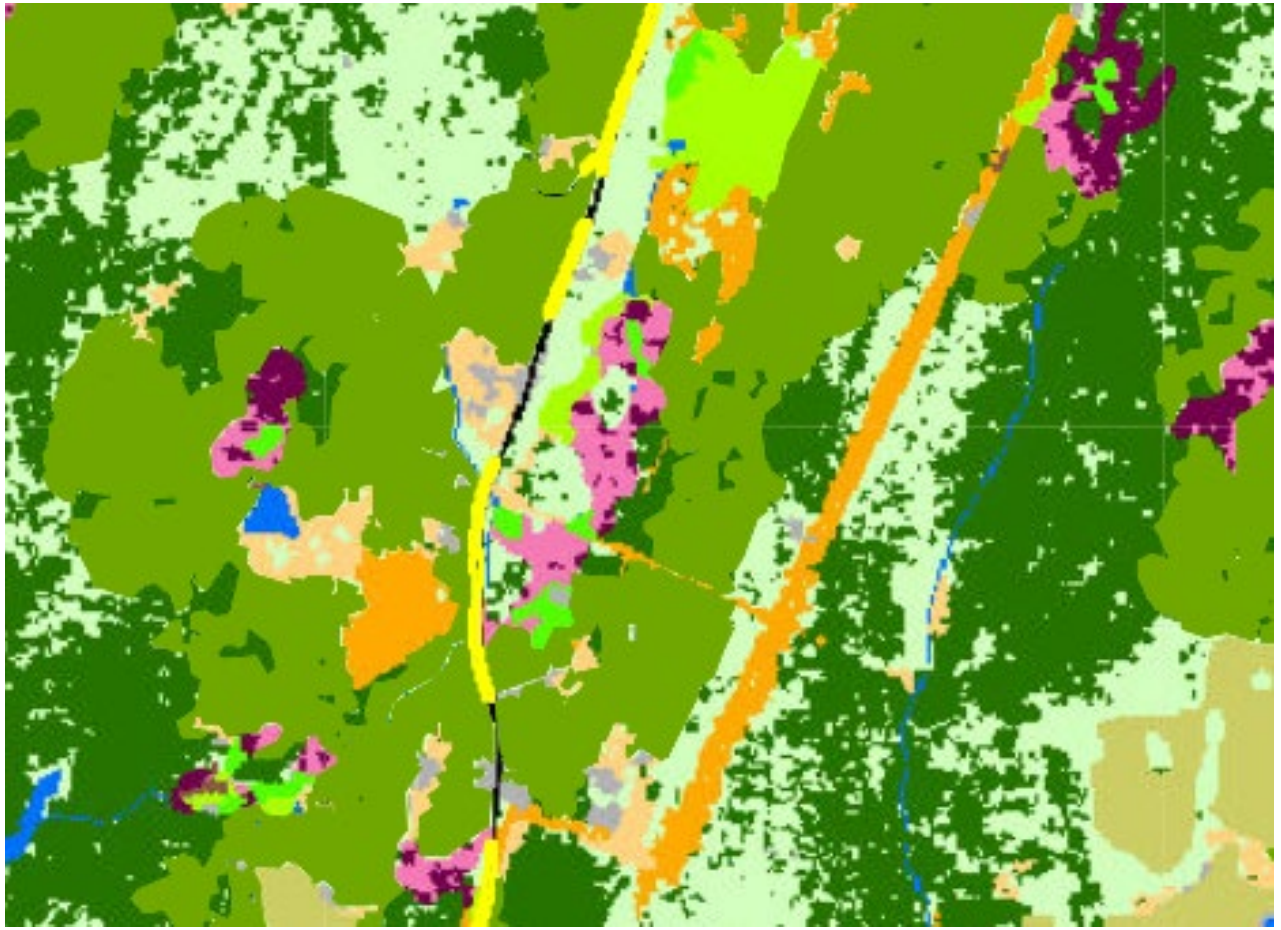
- Wetland hydroperiod
- Small unsuitable habitats



# Hotspot Modeling: Datasets

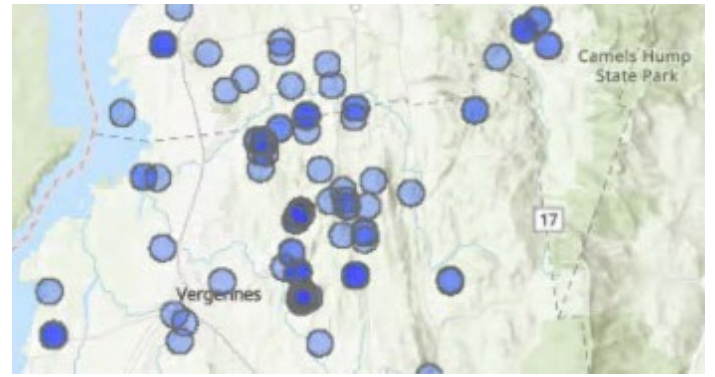
- Land cover mapping
- Roads and railroads: 50-meter segments
- National Elevation Dataset

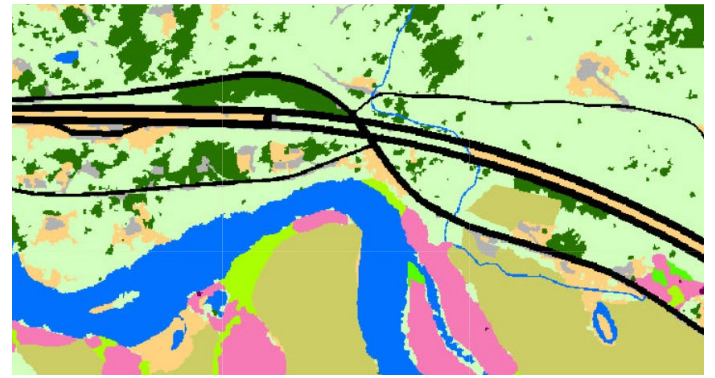
Manipulated using ArcGIS Pro



# Other Factors to Consider

- Road geometry
- Traffic volumes
- Breeding and nonbreeding habitat on same side of road
- Elevation differences
- Rare species



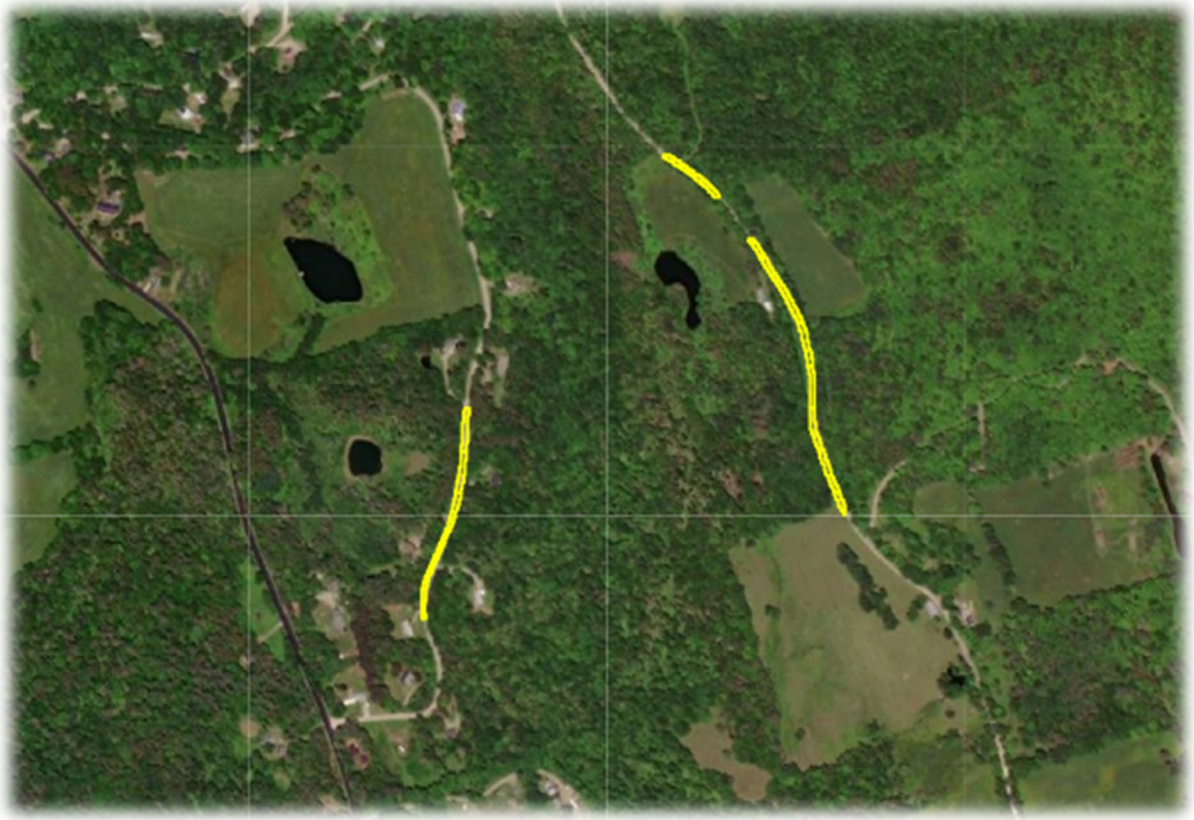
# Model Output

GIS dataset

- 688,971 statewide road/railroad segments
- 51,355 segments identified as potential crossings (7.5% of all road/railroad segments)

Screening tool indicating potential occurrence

Field review recommended



# Recommendations for Future Modeling

| |
|---|
| Wetland ID algorithm |
| Vernal pool mapping |
| Road geometry |
| Breeding and nonbreeding habitat configuration |
| Ranking? |
| Physical factors |
| Cost resistance factors |

# Model Components: Resistance Factors

| Name | Relative Cost |
|---|---|
| Deciduous upland forest | 10 |
| Coniferous upland forest | 20 |
| Low vegetation | 20 |
| Shrubs | 20 |
| Water | 300 |
| Palustrine forested deciduous | 30 |
| Palustrine forested coniferous | 30 |
| Palustrine scrub-shrub | 40 |
| Palustrine emergent | 40 |
| Vernal pool, confirmed | 25 |
| Vernal pool, potential | 25 |
| Barren land | 40 |
| Agriculture | 35 |
| Roads | 45 |
| Railroads | 40 |
| Other impervious surfaces | 50 |