



Photo: Tamara Gagnolet



Photo: Nels Johnson



Marcellus Gas Development and Habitat Impacts

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Pinchot Institute Marcellus Science Workshop
Academy of Natural Sciences , Philadelphia
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Pennsylvania Energy Impacts Assessment

- **Project Goal**: Develop projections of how new energy development could impact forest, freshwater, and rare habitats to shape strategies that avoid or minimize impacts
 - **Energy Types**: Energy types with most potential for land use change during the next twenty years in Pennsylvania:
 - *Marcellus natural gas*
 - *Woody biomass*
 - *Wind*
 - *Transmission lines (electric and gas)*
 - **Analytical Team**: Twelve staff from The Nature Conservancy, Western Pennsylvania Conservancy, Audubon Pennsylvania
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Pennsylvania Energy Impacts Assessment

- **Assumptions:**

- 20-year time period
- Stable and sufficient prices and capital investment for steady development growth
- Continued recent trends and patterns of energy development

- **Keep in mind** that:

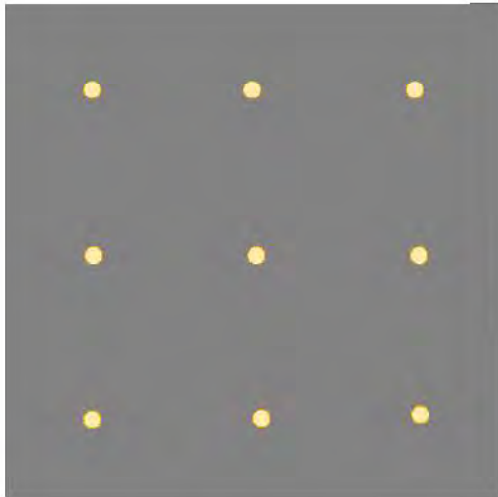
- Energy projections are informed scenarios – not predictions
 - The assessment focuses on habitat impacts and does not address other potential environmental impacts (water withdrawal, water quality, air quality, and migratory pathways)
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Marcellus Shale Natural Gas

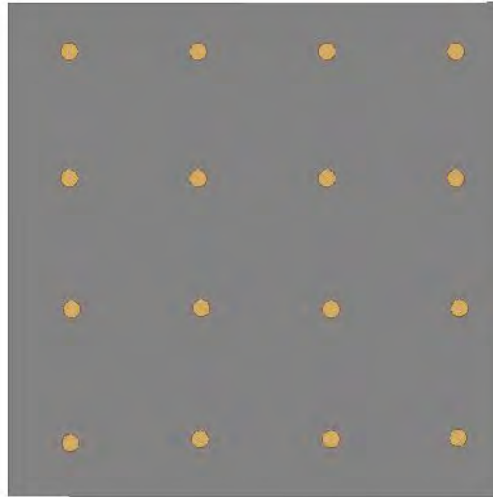


Photo: Tamara Gagnolet

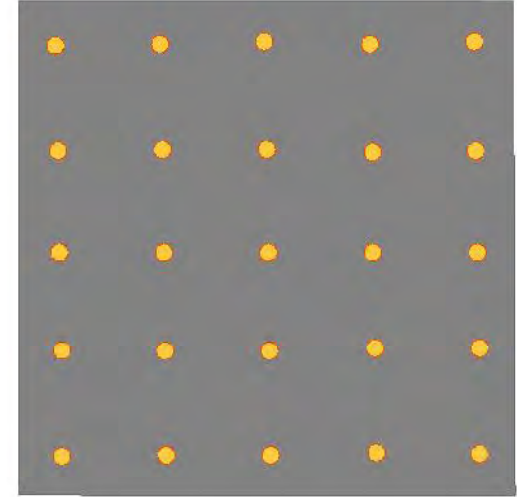
How Many Marcellus Well Pads?



Low Scenario
10 wells per pad
Pads spaced ~5,200 ft apart



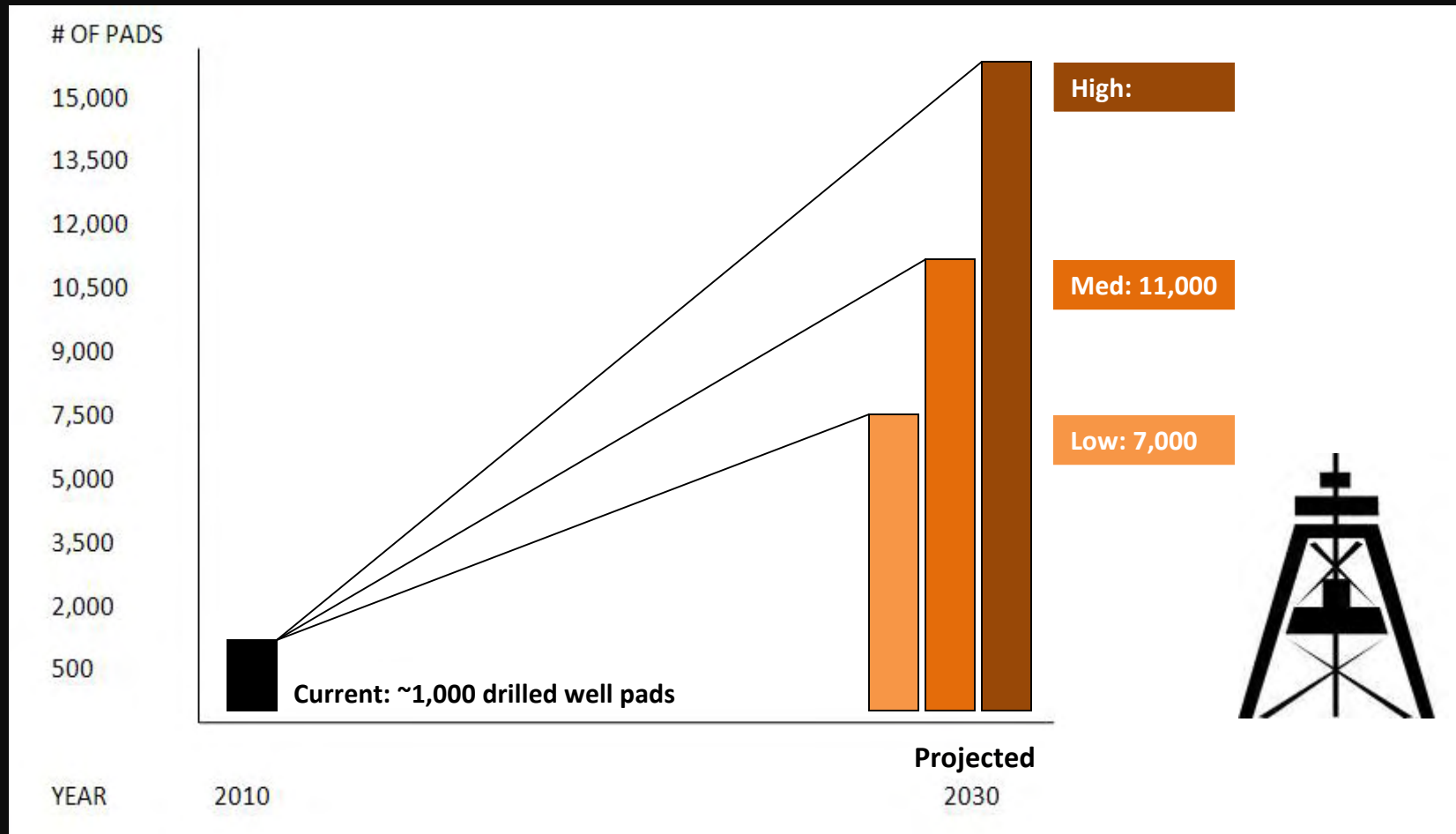
Medium Scenario
6 wells per pad
Pads spaced ~4,100 ft apart



High Scenario
4 wells per pad
Pads spaced ~3,350 ft apart

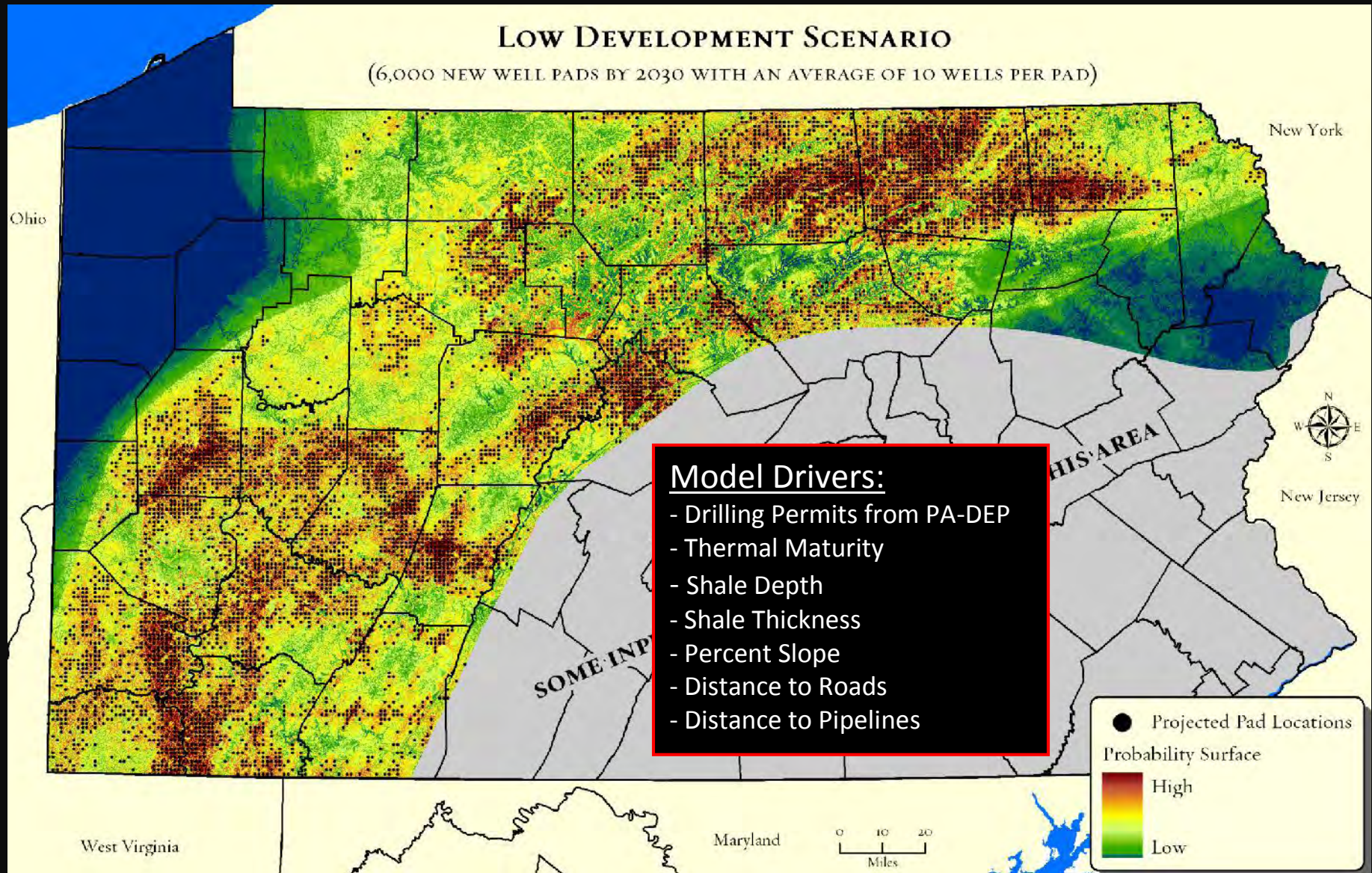
Key drivers: number of rigs, number of wells per pad.

How Many Marcellus Well Pads?

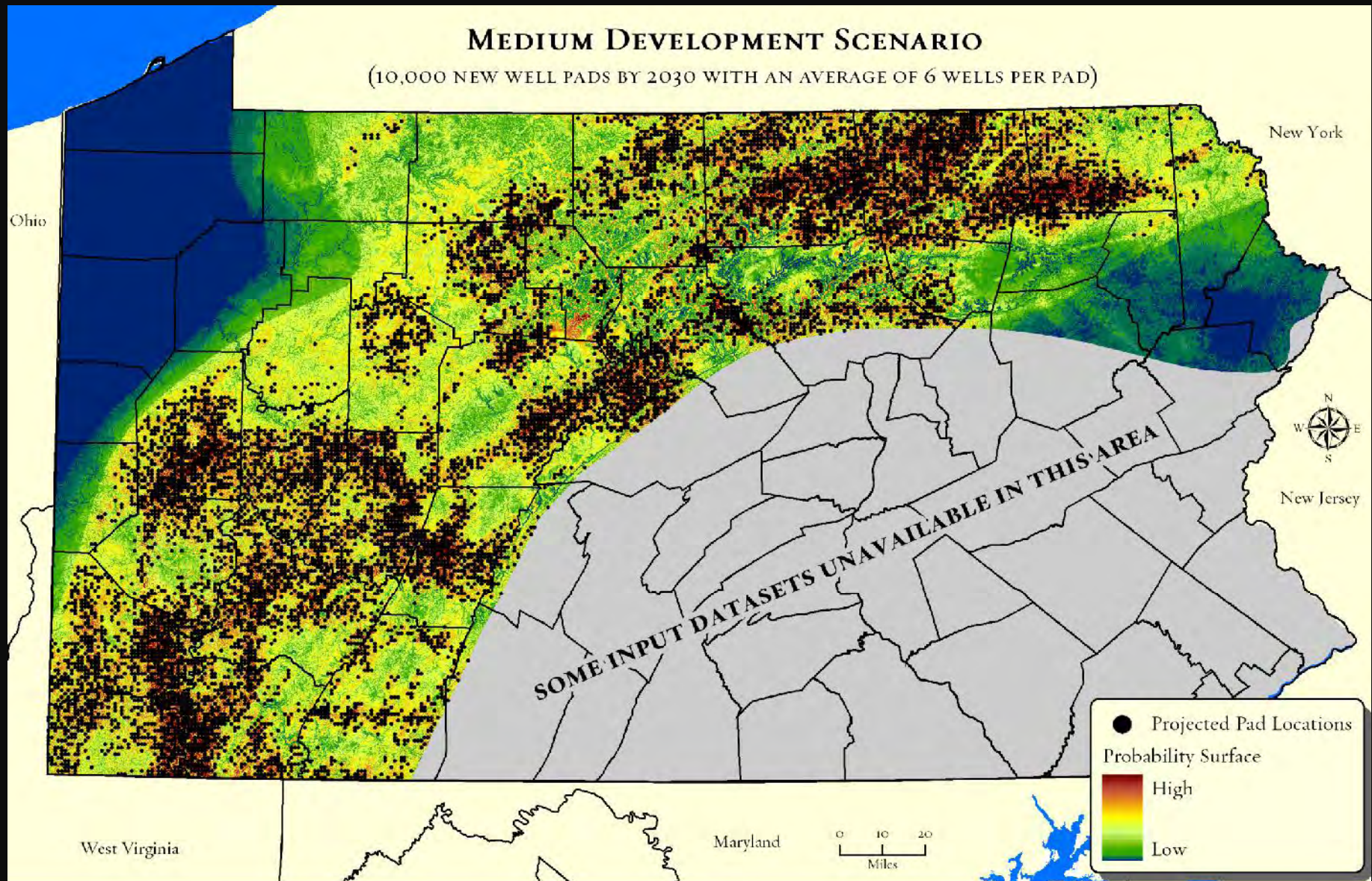


Key drivers: number of rigs, number of wells per pad.

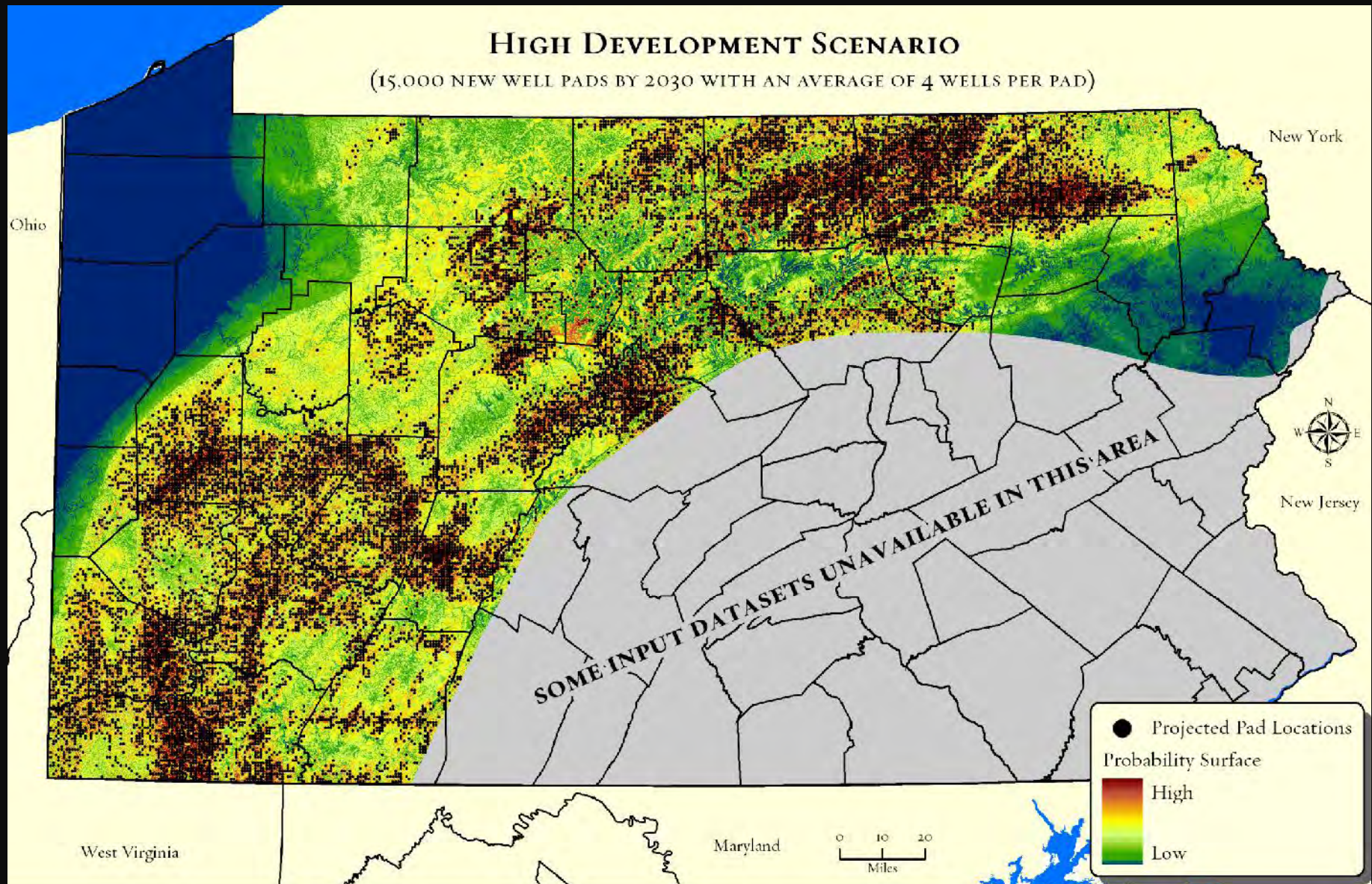
Where Is Marcellus Development Most Likely?



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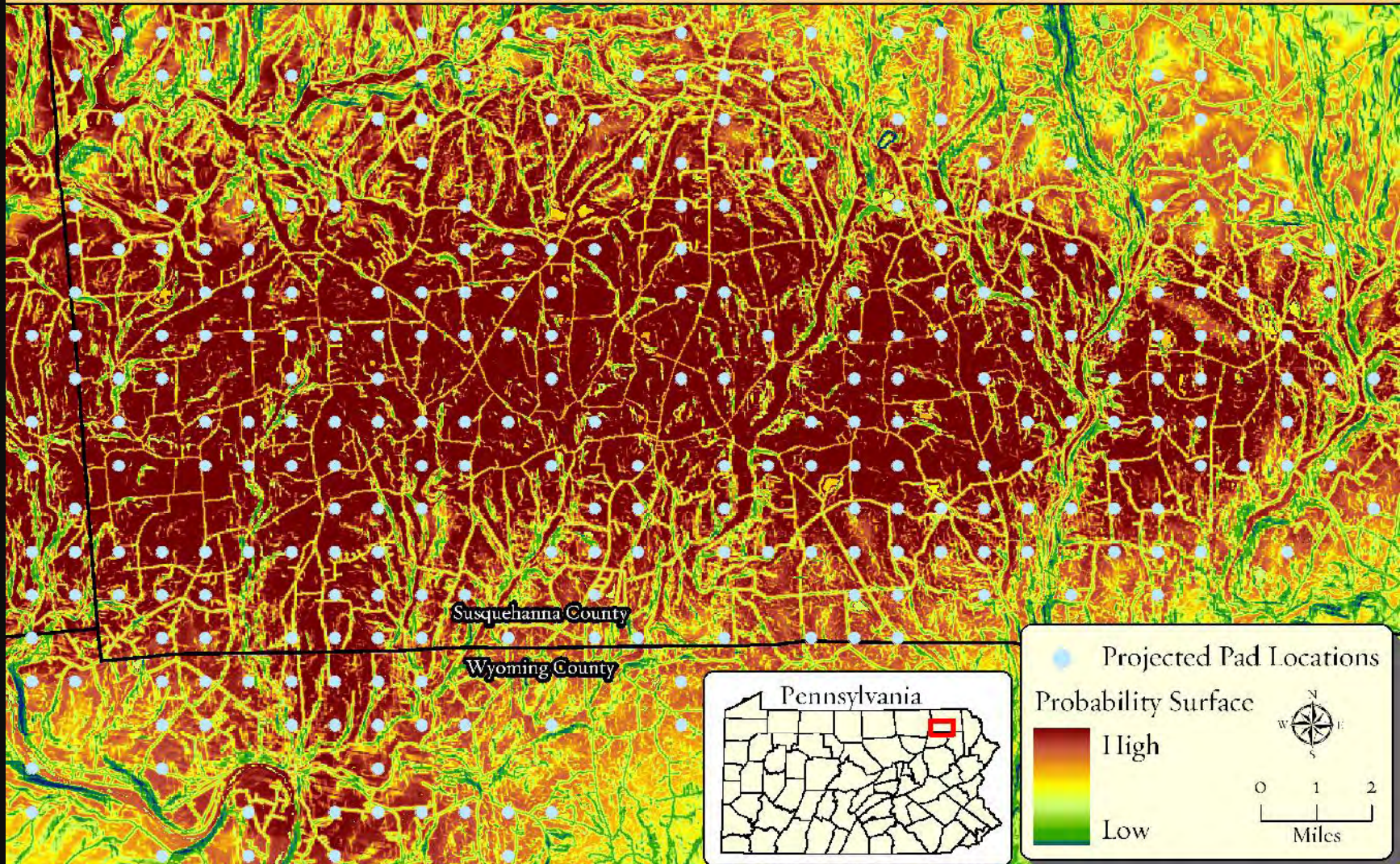


Where Is Marcellus Development Most Likely?



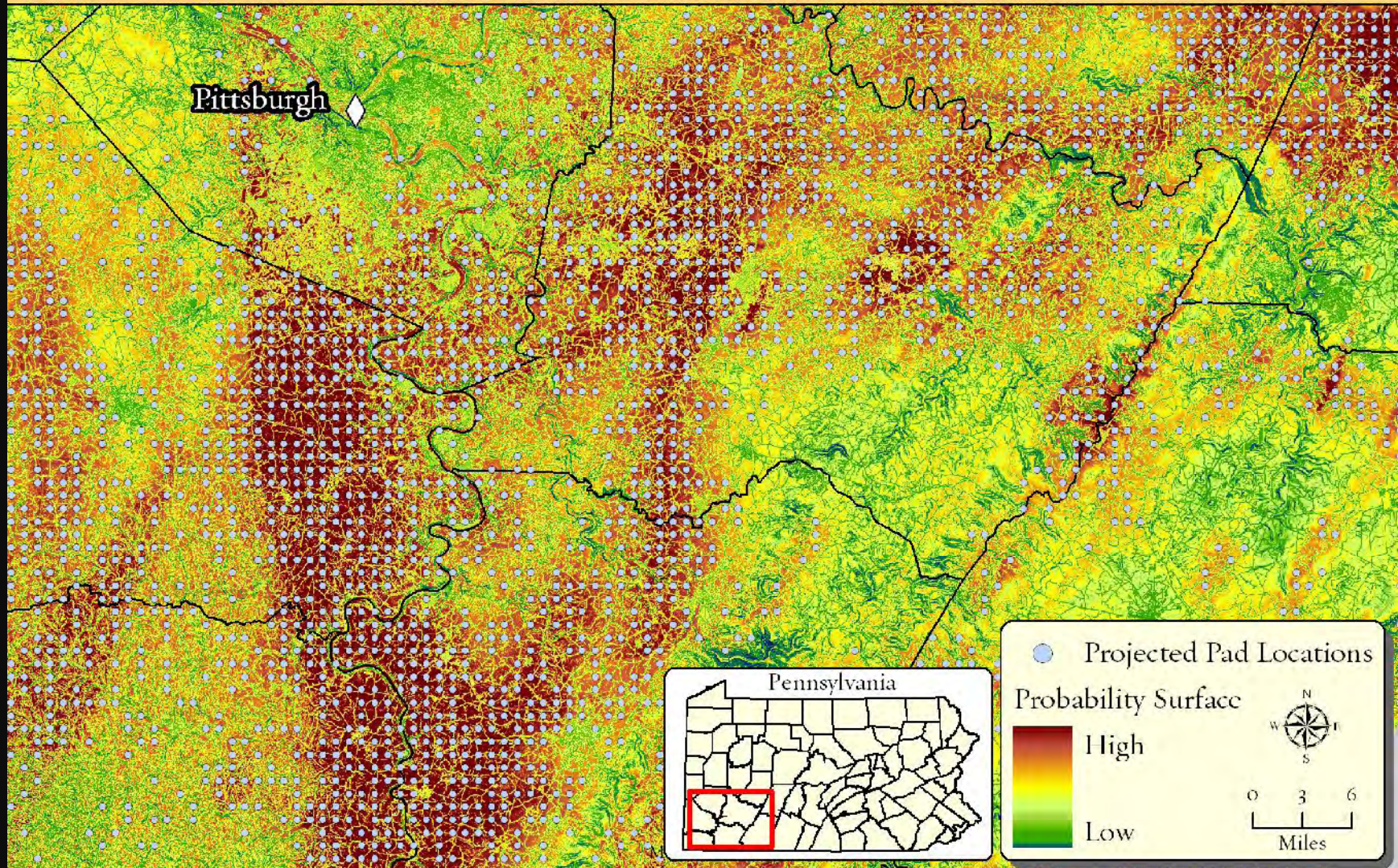
Where Is Marcellus Development Most Likely?

MEDIUM DEVELOPMENT SCENARIO IN NORTHEAST PA
(10,000 NEW WELL PADS IN PA BY 2030 WITH AN AVERAGE OF 6 WELLS PER PAD)



Where Is Marcellus Development Most Likely?

MEDIUM DEVELOPMENT SCENARIO IN SOUTHWEST PA
(10,000 NEW WELL PADS IN PA BY 2030 WITH AN AVERAGE OF 6 WELLS PER PAD)



Spatial Footprint – Marcellus Gas

2006 Aerial Imagery - Greene County



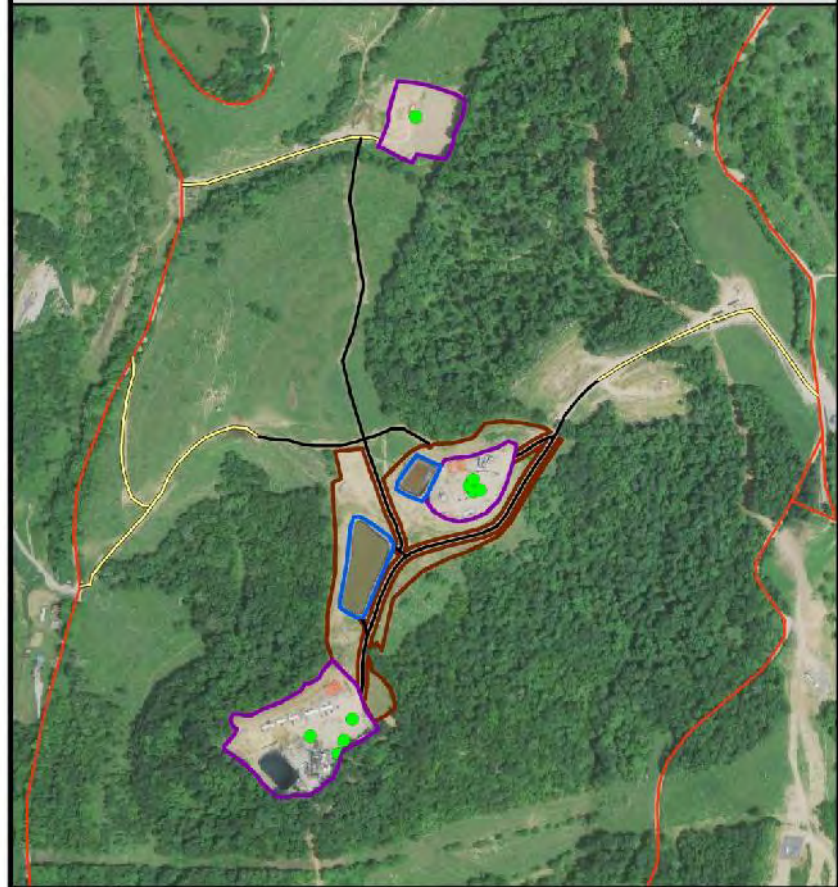
Reference Data

- Marcellus Shale Active Permitted Wells
- All Other Active Permitted Wells
- Existing Public Roads



0 50 100 200 Meters

2009 Aerial Imagery - Greene County



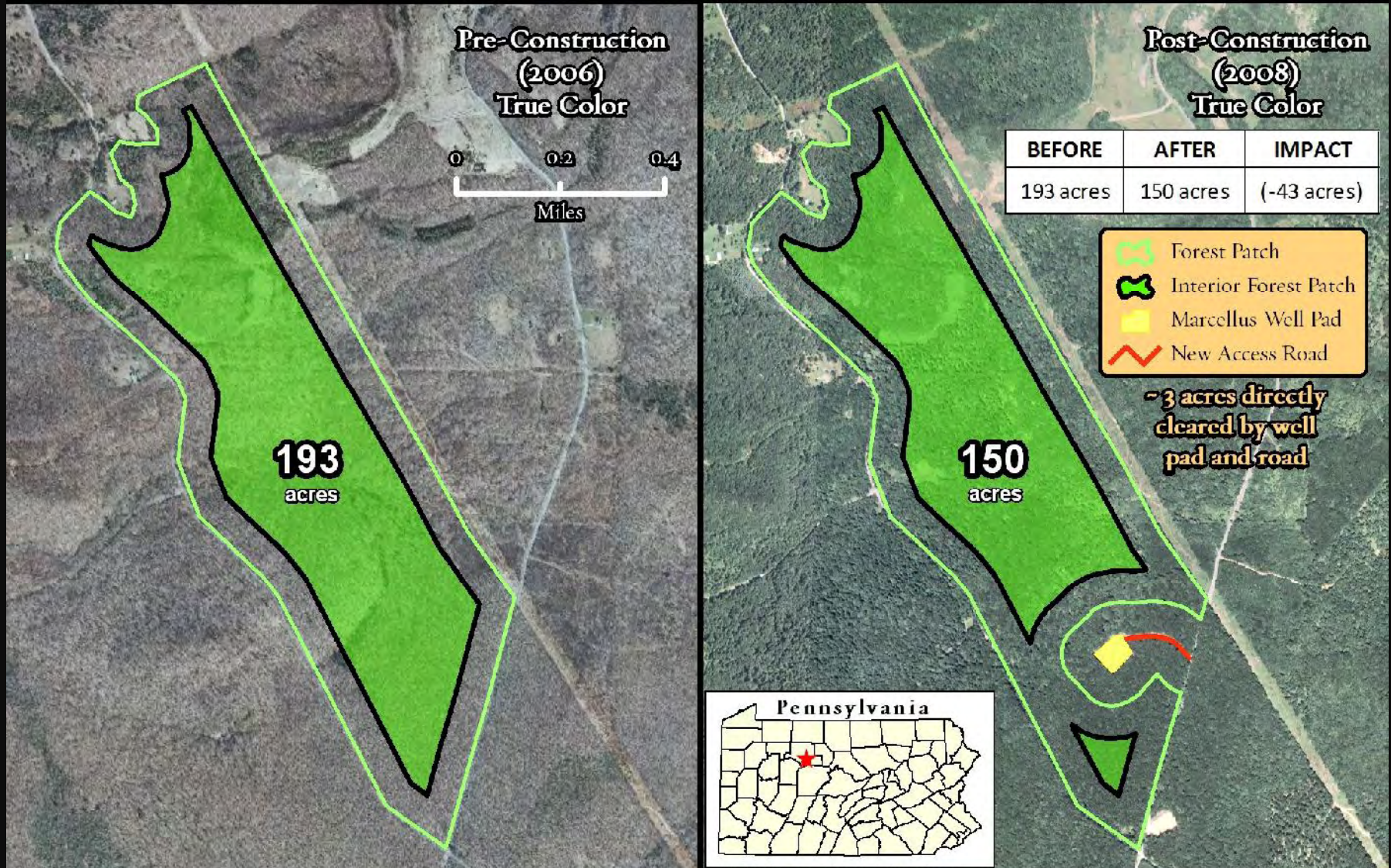
Footprint Data

- Well Pads
- Containment Pits
- Other Cleared Area
- New Roads
- Existing Improved Roads



0 50 100 200 Meters

Forest Habitat Impacts – Marcellus Gas

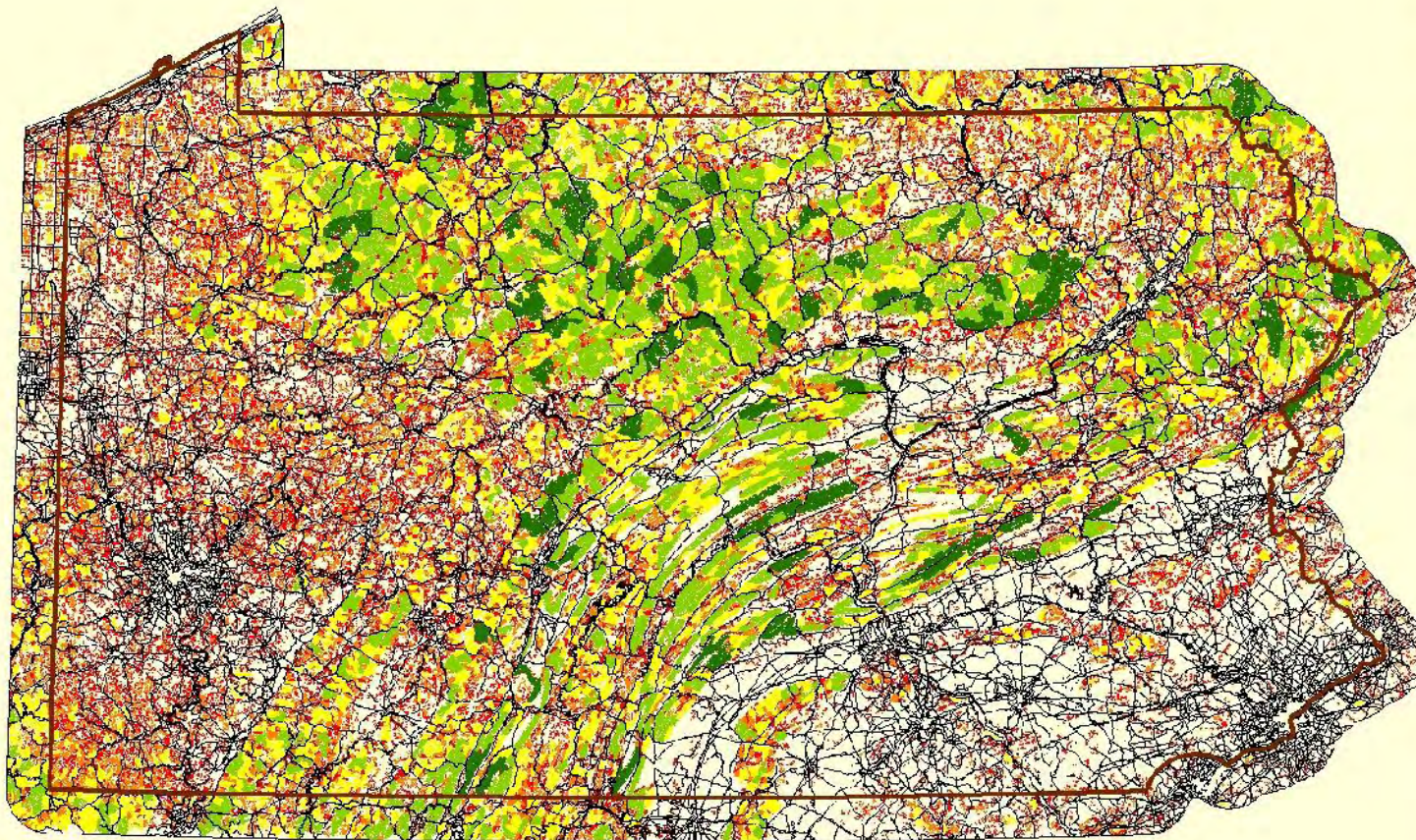


Forest Habitat Impacts – Marcellus Gas

Average Spatial Disturbance for Marcellus Shale Well Pads in Forested Context (acres)

Forest cleared for Marcellus Shale well pad	3.1	8.8
Forest cleared for associated infrastructure (roads, pipelines, containment pits, etc.)	5.7	
Indirect forest impact from new edges	21.2	
TOTAL DIRECT AND INDIRECT IMPACTS	30	

Pennsylvania Forest Conservation Analysis





January 2007


0 15 30 60
Miles





Forest Patch Acreages


 > 10,000 acres

 3,001 - 10,000

 1,001 - 3,000

 501 - 1,000

 100 - 500

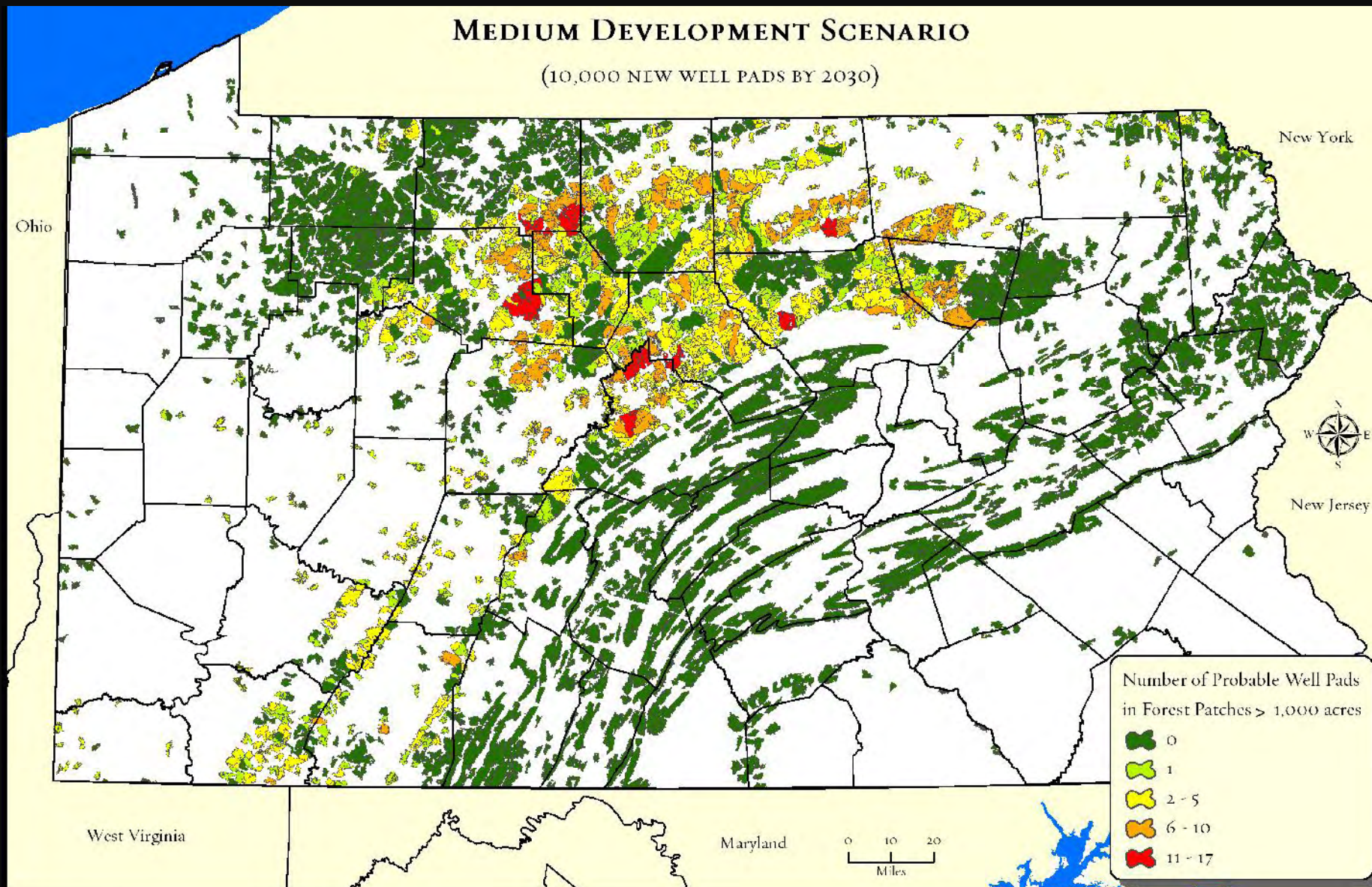
 Landscape Blocks

 PA Boundary

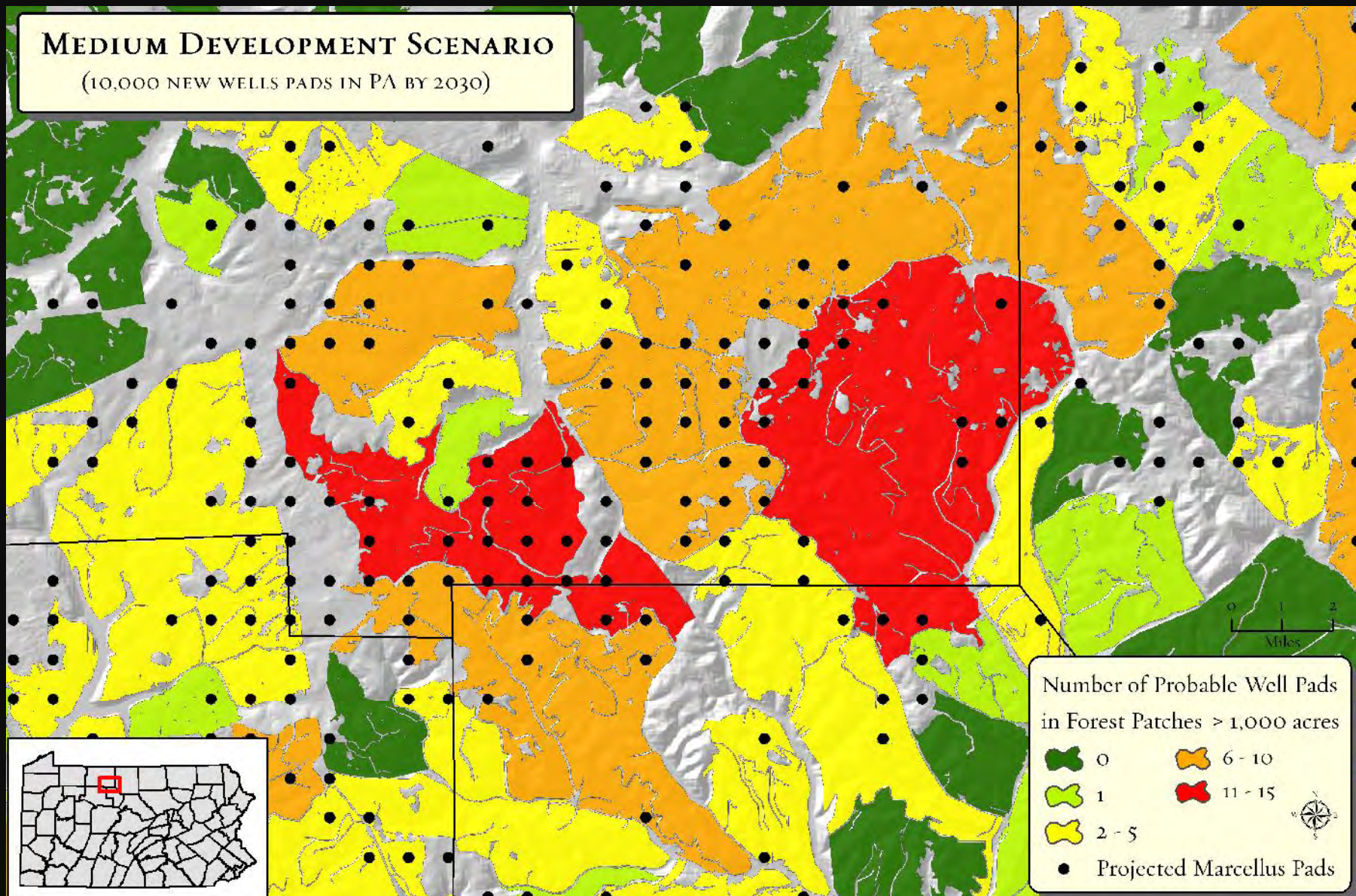
The Pennsylvania Forest Conservation Analysis was conducted by the Western Pennsylvania Conservancy (WPC) and The Nature Conservancy (TNC) with support from WPC, TNC, the Pennsylvania Department of Conservation and Natural Resources, & the Pennsylvania Environmental Council in 2007.

Data sources: National Land Cover Database (2001), ESRI StreetMap, Pennsylvania Spatial Data Access (PASDA), PA Department of Environmental Protection, Federal Aviation Administration, PA Natural Heritage Program, WPC, TNC.

How Could Forests Be Affected?

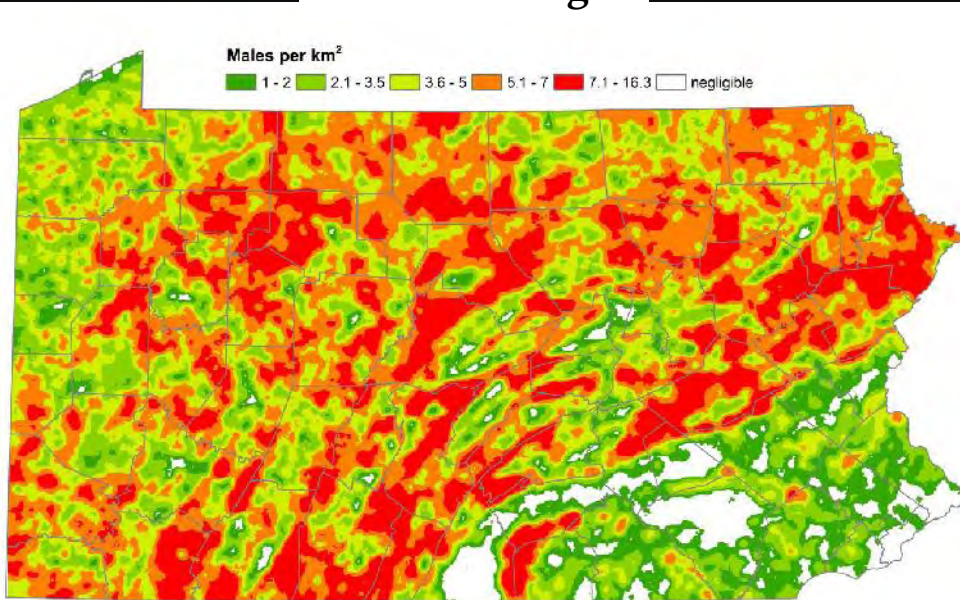


How Could Forests Be Affected?

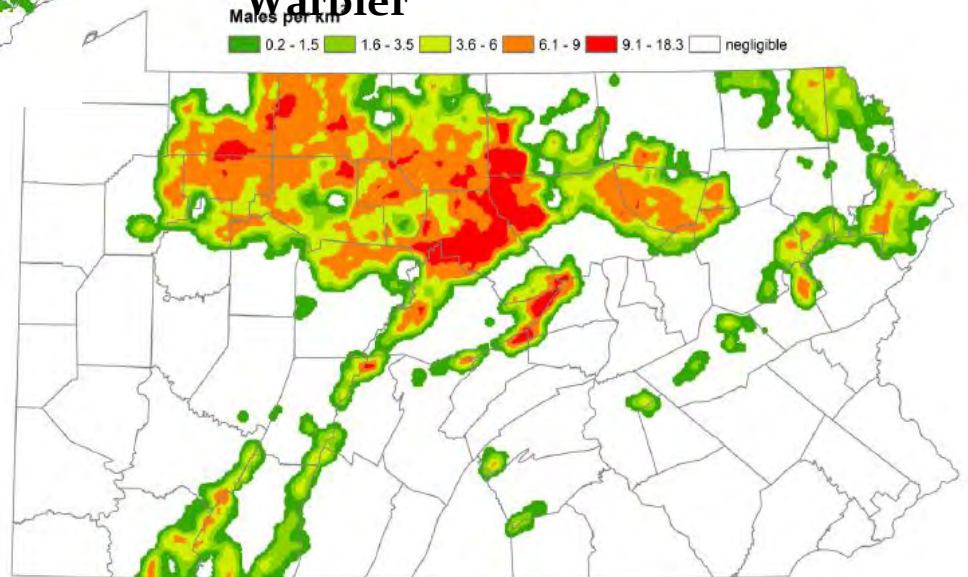


How Could Bird Species Be Affected?

Scarlet Tanager



Black-throated Blue Warbler

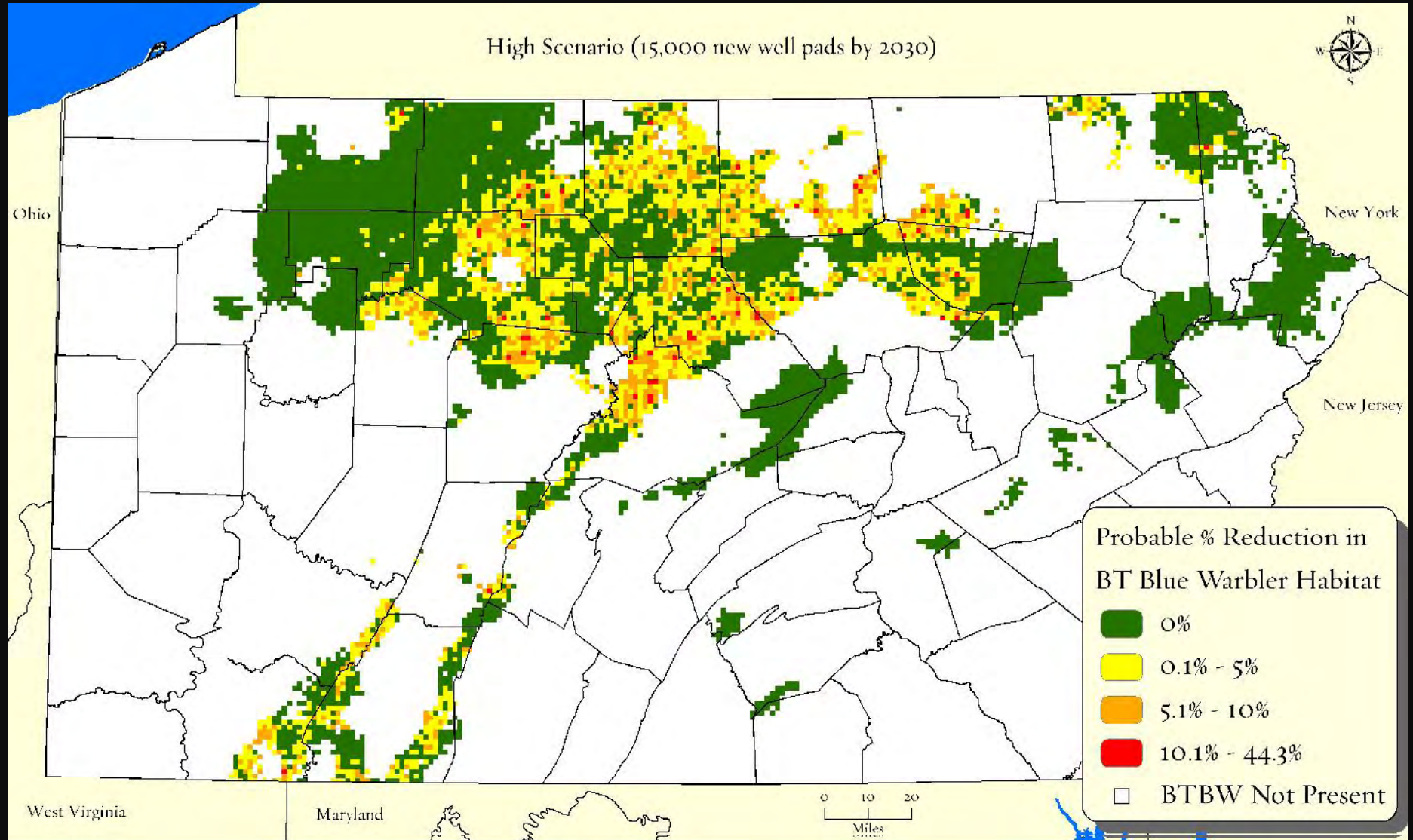


Source: Draft maps from 2nd Pennsylvania Breeding Bird Atlas (2010)



How Could Bird Species Be Affected?

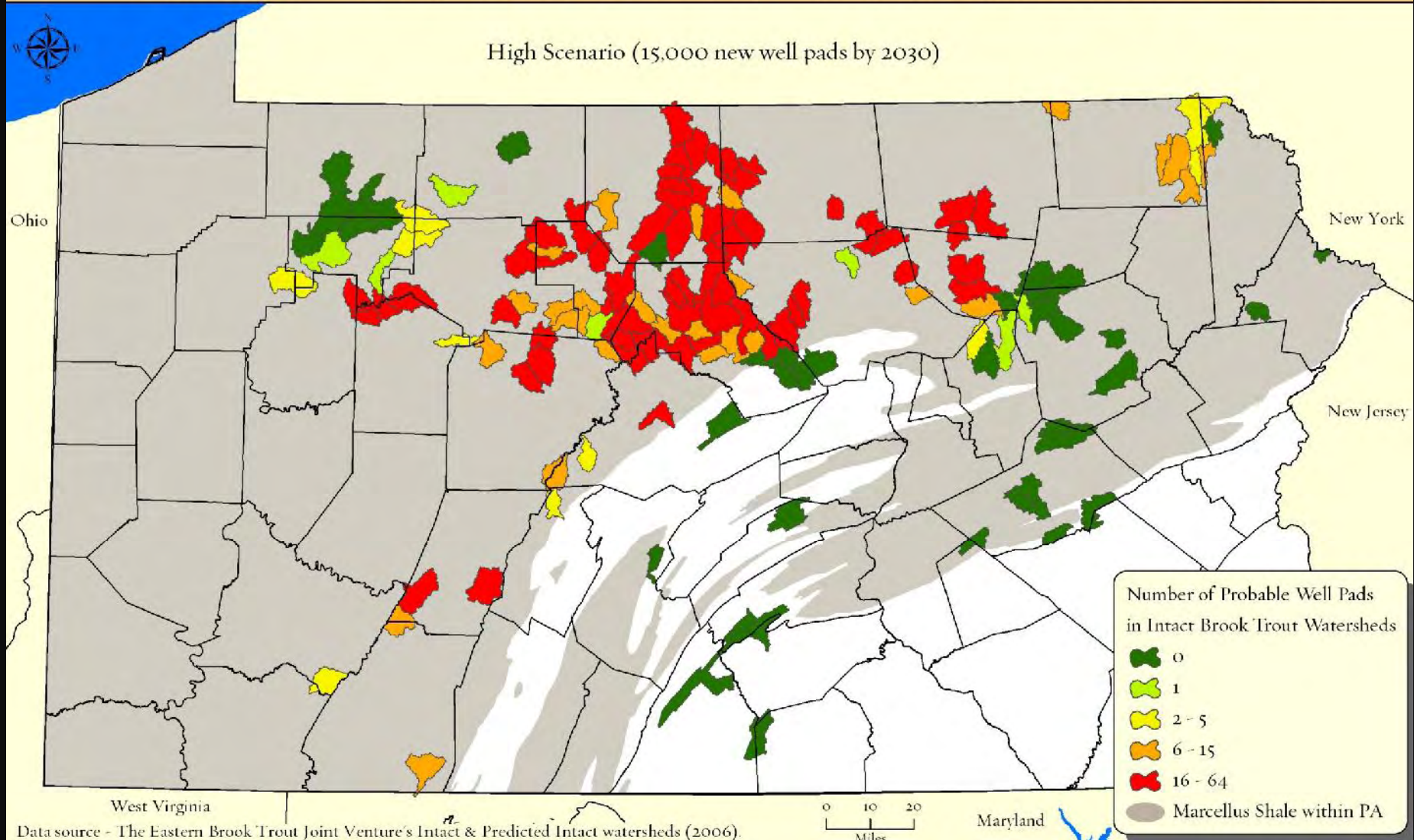
Black-Throated Blue Warbler





How Could Brook Trout Be Affected?

PROBABLE MARCELLUS SHALE WELL PAD DEVELOPMENT WITHIN BROOK TROUT WATERSHEDS



How Could Rare Species Be Affected?

Pennsylvania Natural Heritage Program (PNHP) records indicate that 329 tracked species (~31% of extant taxa in the state) have populations within pixels that have a relatively high modeled probability for Marcellus development. Nearly 40 percent (132) are considered to be globally rare, and most are critically endangered or imperiled in Pennsylvania.

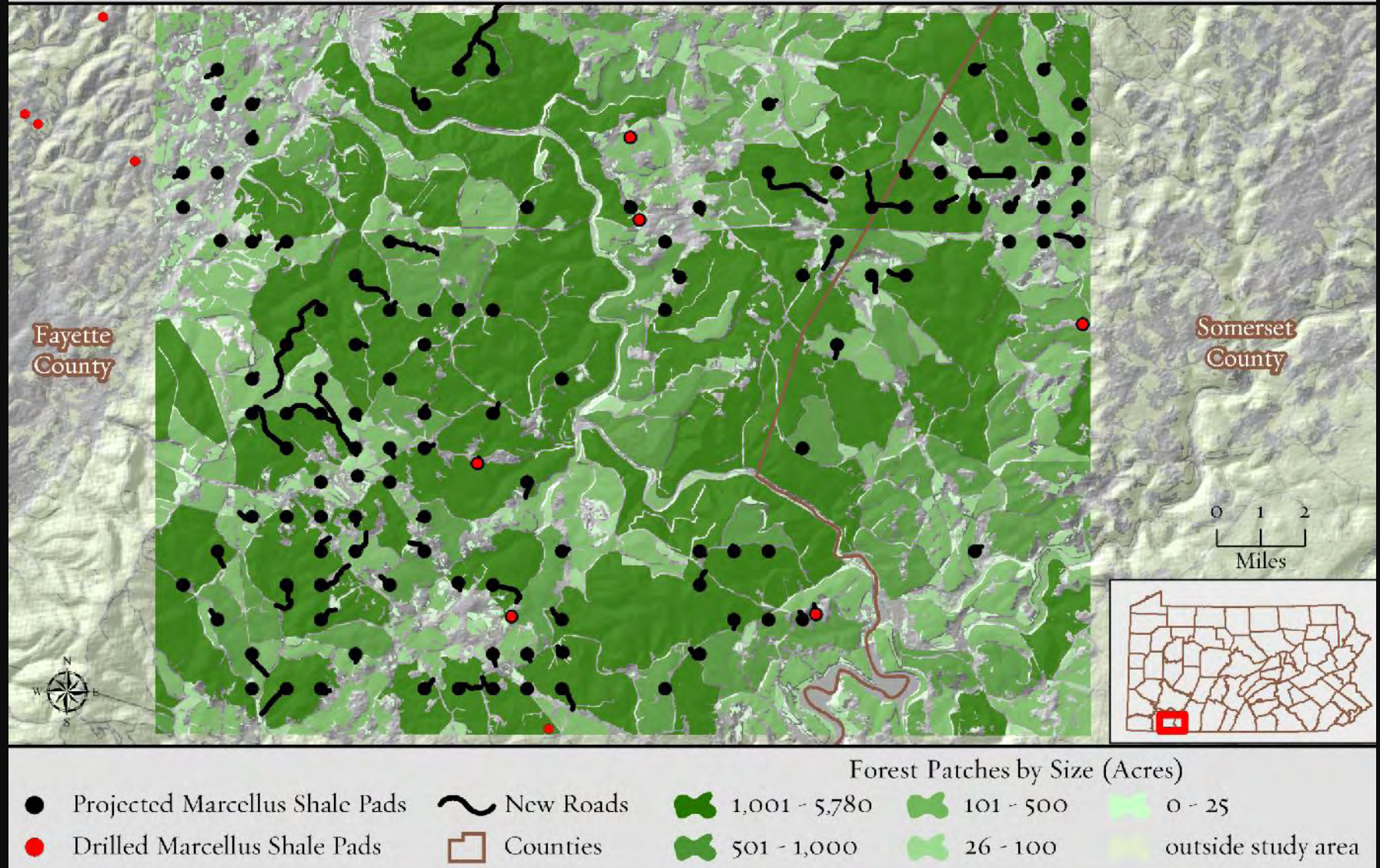
Two examples of species at risk are the green salamander (*Aniades aeneus*) with all known populations in relatively high probability Marcellus development pixels and snow trillium (*Trillium nivale*) with 73 percent of known populations in relatively high probability pixels.



How Could Forests Be Affected?

LAUREL HIGHLANDS REGIONAL CASE STUDY:

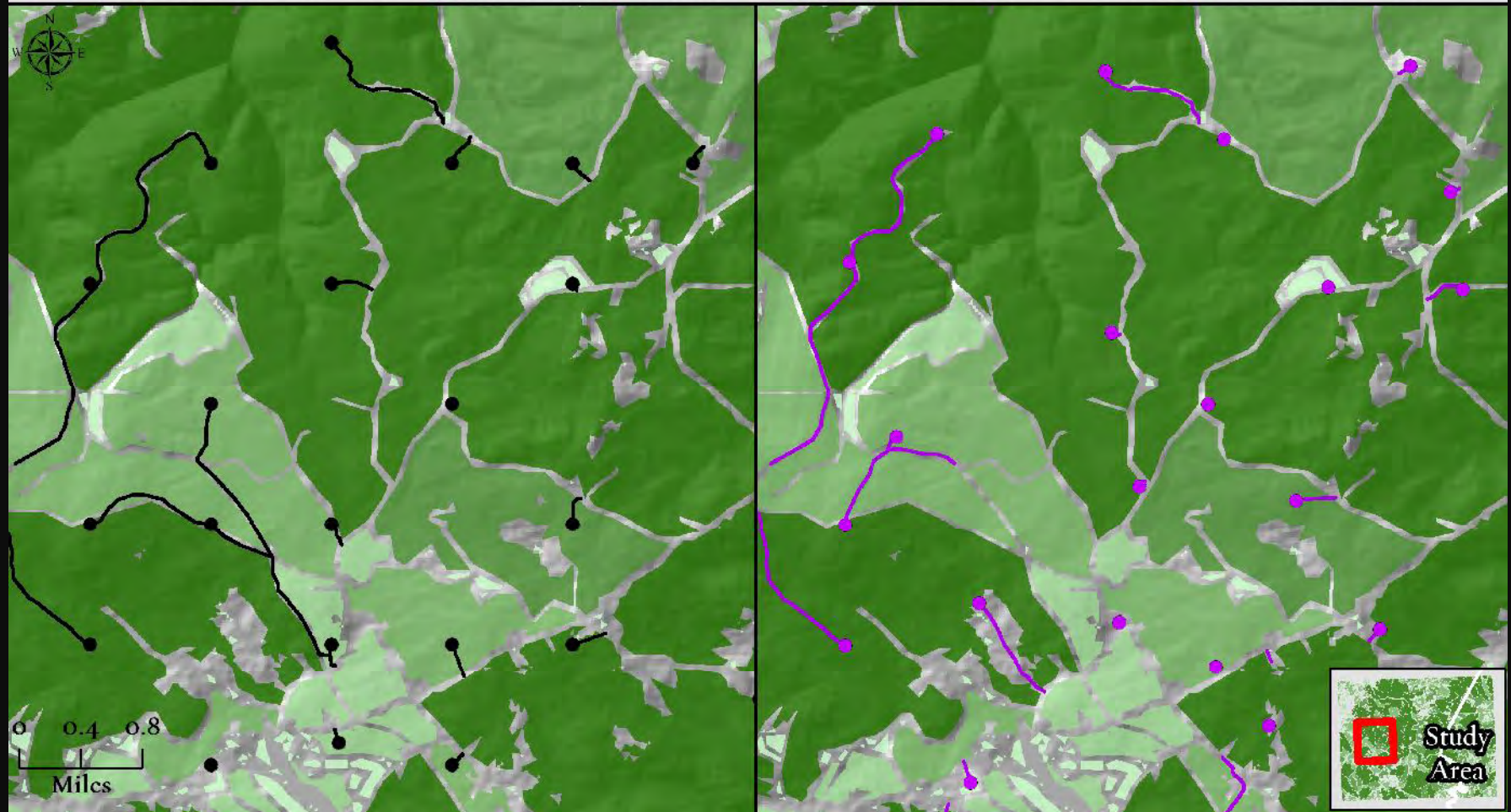
MEDIUM MARCELLUS SHALE DEVELOPMENT SCENARIO



How Does Pad Placement Pattern Impact Forest Habitat?

LAUREL HIGHLANDS REGIONAL CASE STUDY:

MEDIUM MARCELLUS SHALE DEVELOPMENT SCENARIO



● Projected Marcellus Shale Pads

~ New Roads

● Relocated Projected Pads

~ Relocated New Roads

Forest Patches by Size (Acres)

1,001 - 4,816

101 - 500

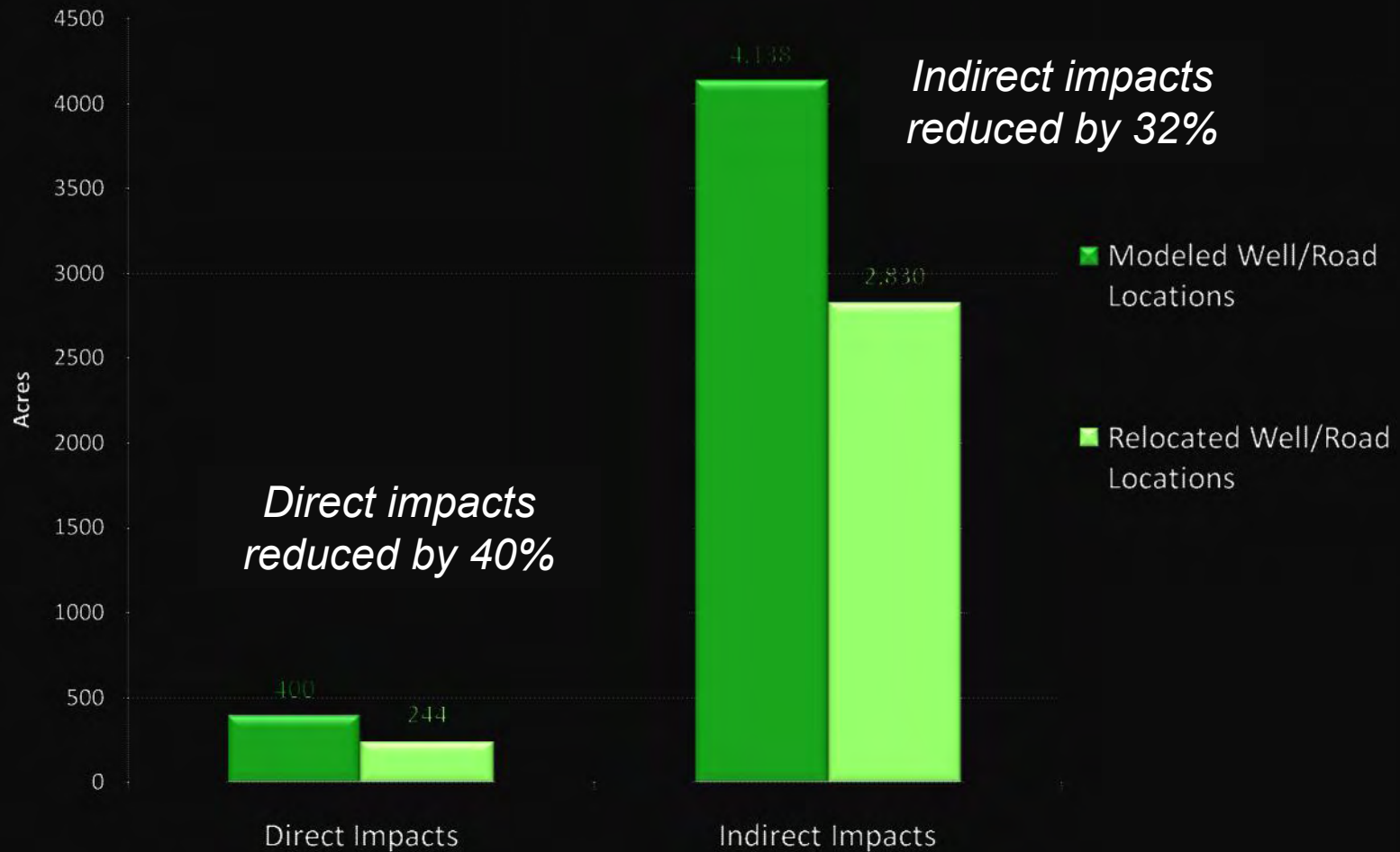
0 - 25

501 - 1,000

26 - 100

How Does Pad Placement Pattern Impact Forest Habitat?

Total Forested Acres Impacted



Questions / Comments

Pennsylvania Energy Impacts Assessment can be found at:

www.nature.org/paenergy

Interactive web map at: **maps.tnc.org/paenergy**



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