

## Steven Schwartz

- I support the proposed ban on unconventional gas drilling in the Delaware River watershed
- I oppose the proposed regulation allowing for the withdrawal and export of water from the Delaware River Watersheds to other watersheds for the purposes of natural gas exploration and production
- This use is depletive and consumptive, the water withdrawn leaves the system
- The scale of the potential withdrawals is enormous. Industry analysts forecast 47,600 more Marcellus Shale oil and gas (O&G) wells may be drilled in Pennsylvania by 2045, fueling new natural gas power plants and petrochemical facilities in the state and beyond ([https://www.cna.org/cna\\_files/pdf/Maps1\\_WellProjections.pdf](https://www.cna.org/cna_files/pdf/Maps1_WellProjections.pdf) and attached). A buildout of this size will bring enormous impacts on air, land, and water and the communities proximate to these activities. Based on industry projections and current rates of consumption, the cumulative impact of the O&G buildout would require 583 billion gallons of fresh water depleted from the system
- This is precedent setting. Other than water withdrawals permitted by DRBC for food and beverage processing, there have been no other permitted exports of water for industrial use to my knowledge. All water withdrawals for current industrial uses are for processes and activities within the basin.
- As the DRBC knows, mandated releases from the NYC reservoirs to meet downstream water needs may detrimentally affect river flows and temperatures critical to maintaining a healthy aquatic habitat and is a very important issue in the Upper Delaware. If water is withdrawn from the West Branch of the Delaware or the Upper Delaware there is no way to account for the loss of water and no requirement for NYC to make up the flows.
- There has been a speculative proposal on the table to build multiple pipelines along an old RR ROW in Northern Wayne County. One of the pipelines was proposed to transport water for distribution to drilling sites. If withdrawals of billions of gallons of water for fracking were to be allowed, a water extraction station could well be built at the site at which this ROW crosses the West Branch, disrupting the river and riparian zone at that location, and the loss of water from extractions at that point would seriously harm the downstream aquatic habitat which includes critical native trout spawning areas and rare and endangered species of fresh water mussels.
- The DRBC Water Code establishes "Policy of Protection and Preservation" that states "The waters of the Delaware River Basin are limited in quantity and the Basin is frequently subject to drought warnings and drought declarations due to limited water supply storage and streamflow during dry periods. Therefore, it shall be the policy of the Commission to discourage the exportation of water from the Delaware River Basin."
- Water withdrawals from surface waterways have the potential to deplete downstream groundwater resources if set based on pass-by flows that do not take seasonality into account, including local benefits of high flows such as springtime flows or heavy precipitation events. Such a withdrawal may downstream cause some additional discharge from the aquifer to make up the loss of stream flow. This additional base flow will be contributed by shallow groundwater downstream of the withdrawal site, impacting aquifers. This presents the potential for loss of groundwater reserves that will discharge to the stressed waterway to maintain base flow that was lost to the withdrawal.
- The proposed application fees are capped at a withdrawal of 75 million gallons per month. There seems to be no financial disincentive for the amount of water to be withdrawn so there is incentive for an applicant to propose the maximum fee and withdraw far greater quantities of water.
- The applicant does not have to be the drilling company. A new company could be set up whose

sole purpose is to withdraw, transport and sell the water to out-of-basin industrial users. There would be little or no accountability on the part of that company and little or no recourse for the prosecution of violations committed by that company.

# Map Set 1: Development Projections

This series of maps displays information related to the potential environmental impacts of *additional* gas development in *Pennsylvania* if all remaining technically recoverable resources in the Interior Marcellus shale were developed using high volume hydraulic fracturing and horizontal drilling with eight wells per well pad.

This map set includes projections of well and well pad development by county and watershed (US Geological Survey Hydrologic Unit Code - 10 watersheds), as well as selected infrastructure development needed to support gas well development (access roads and gathering pipelines).

Note: These maps contain *projections* of natural gas development and associated environmental impacts under a particular set of circumstances and assumptions. They are not *predictions* of development or impacts, and should not be used for commercial purposes, to guide investment decisions, or for short-range planning decisions. Furthermore, the projected well locations should not be used to inform planning or decision making for geographic units smaller than the primary units of analysis (counties or HUC-10 watersheds).

## Development Projections Maps

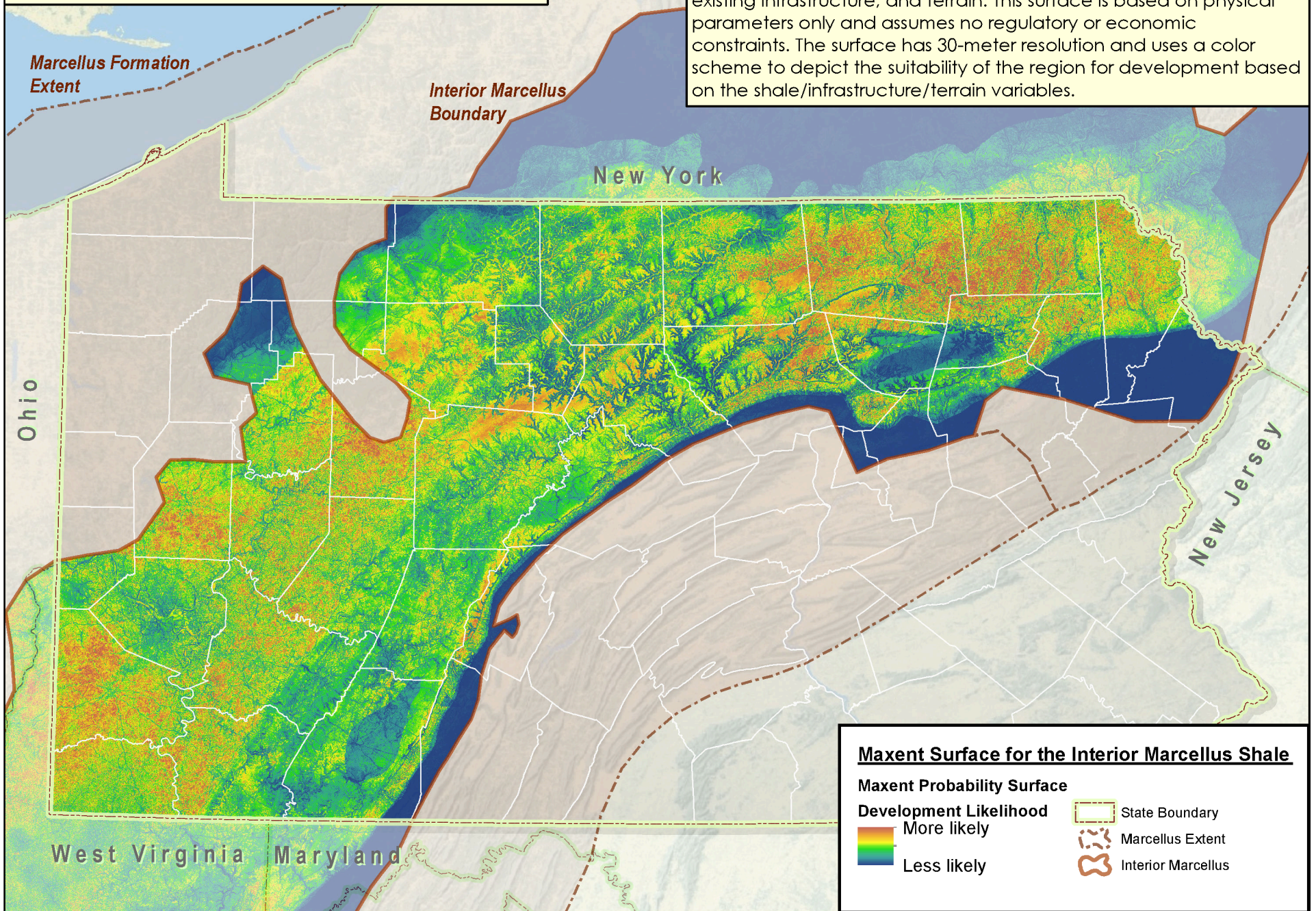
This map set includes the following maps:

- 1.1 Probability surface for well pad development in the Interior Marcellus
- 1.2 Projected well pad development locations
- 1.3 Projected well development by county
- 1.4 Projected well development by watershed
- 1.5 Projected well development density
- 1.6 Projected natural gas infrastructure by county

For additional documentation and methodology used to create these maps, please download the research report at: [www.cna.org/PA-Marcellus](http://www.cna.org/PA-Marcellus)

**Map 1.1 - Probability Surface for Potential Well Pad Development in the Interior Marcellus Shale**

This map shows the probability surface generated by the Maxent program based on existing well locations, shale characteristics, existing infrastructure, and terrain. This surface is based on physical parameters only and assumes no regulatory or economic constraints. The surface has 30-meter resolution and uses a color scheme to depict the suitability of the region for development based on the shale/infrastructure/terrain variables.



**Maxent Surface for the Interior Marcellus Shale**

**Maxent Probability Surface**

**Development Likelihood**

- █ More likely
- █ Less likely

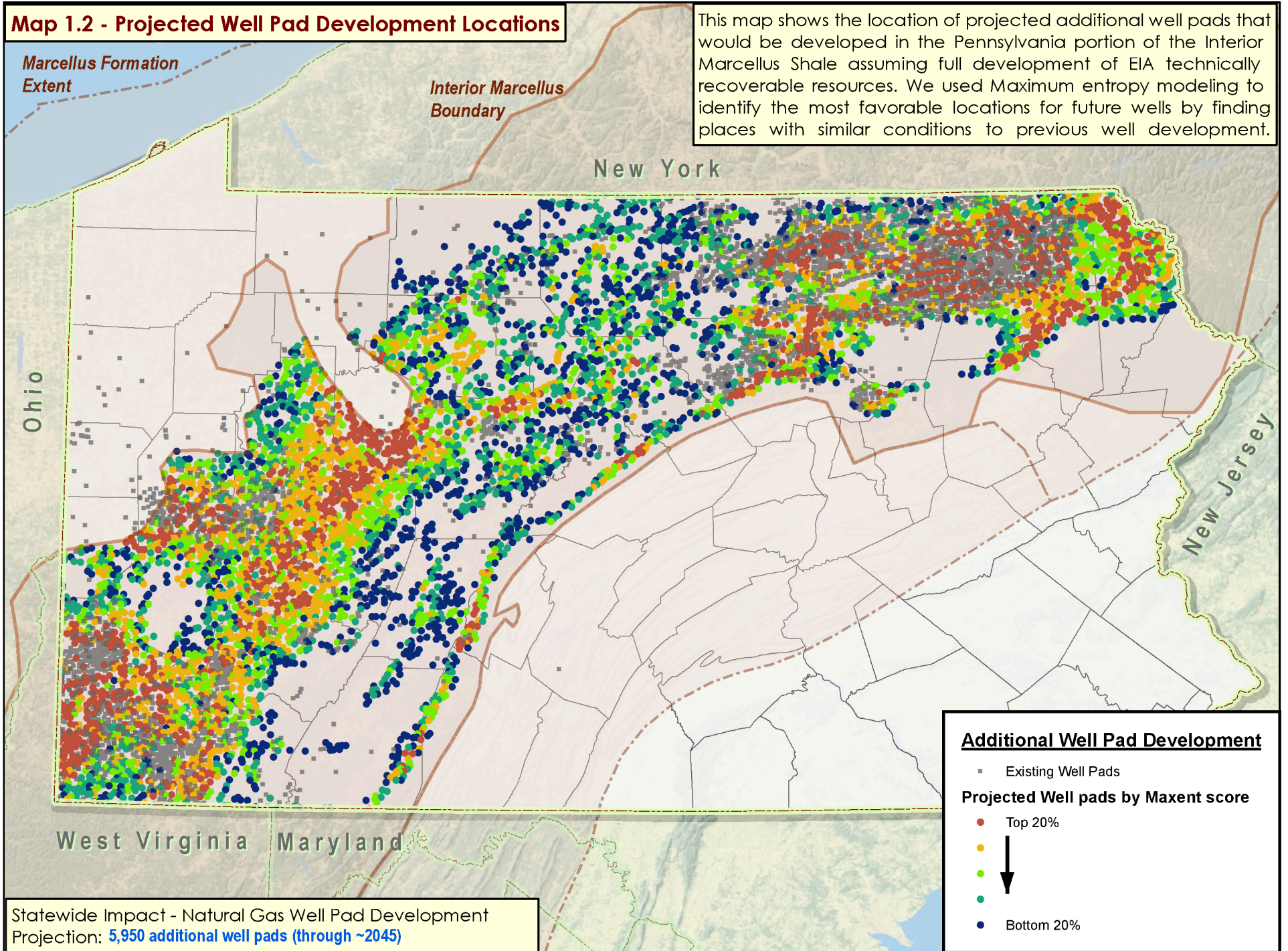
- State Boundary
- Marcellus Extent
- Interior Marcellus

0 20 40 80 Miles

Note: Maximum entropy (Maxent) is a geospatial analysis method that correlates location of existing with characteristics of underlying geospatial layers. A higher 'Maxent' score means there is there is a higher probability that the underlying layers have conditions similar to those where existing have been developed.

**Map 1.2 - Projected Well Pad Development Locations**

This map shows the location of projected additional well pads that would be developed in the Pennsylvania portion of the Interior Marcellus Shale assuming full development of EIA technically recoverable resources. We used Maximum entropy modeling to identify the most favorable locations for future wells by finding places with similar conditions to previous well development.



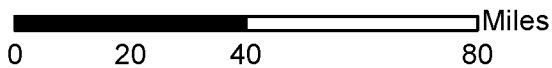
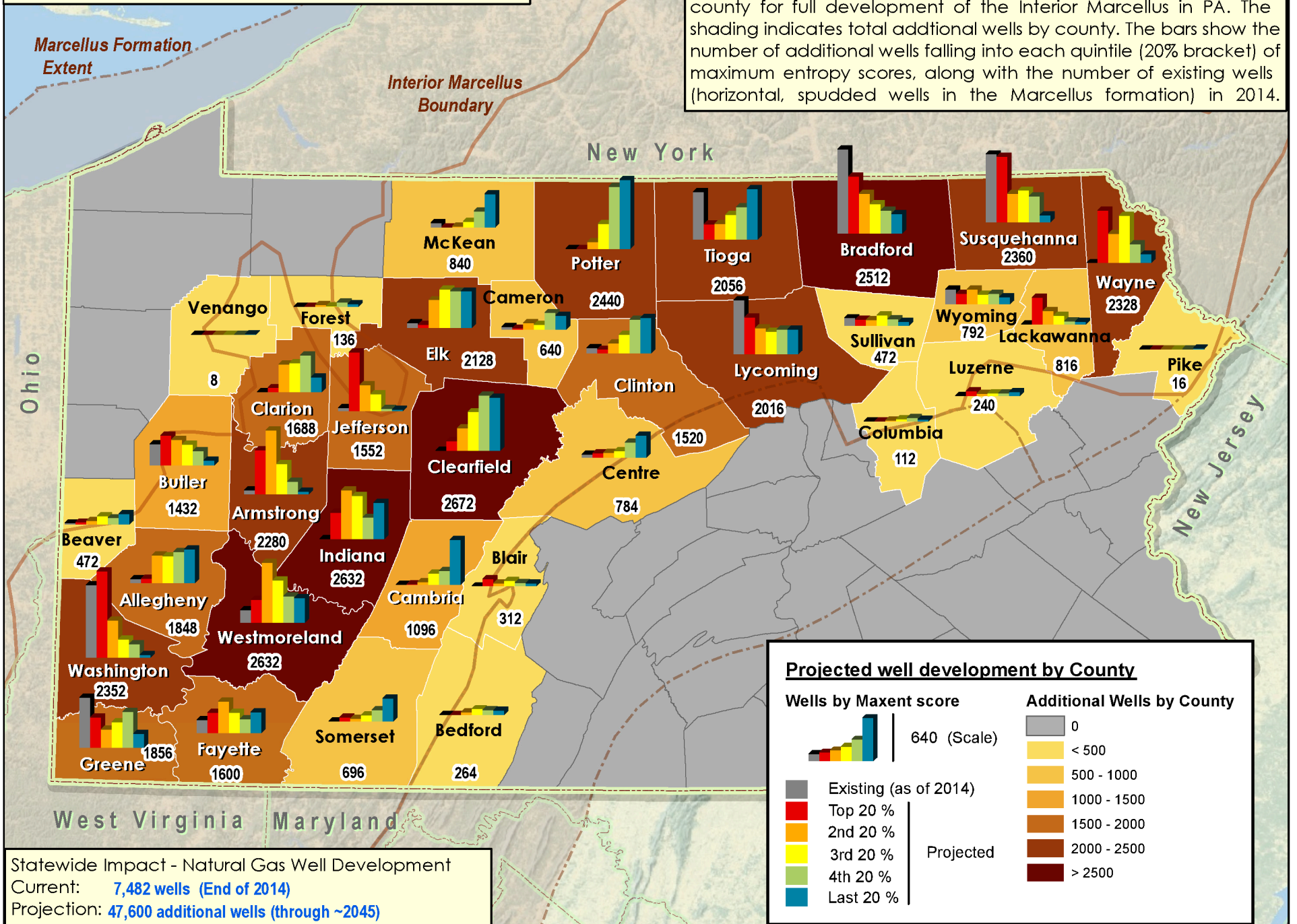
Statewide Impact - Natural Gas Well Pad Development  
Projection: **5,950 additional well pads (through ~2045)**

0 20 40 80 Miles

Note: Maximum entropy (Maxent) is a geospatial analysis method that correlates locations of existing wells with underlying geospatial layers. A higher 'Maxent score' means there is higher probability that the underlying layers have conditions similar to those where existing wells have been developed.

**Map 1.3 - Projected Well Development by County**

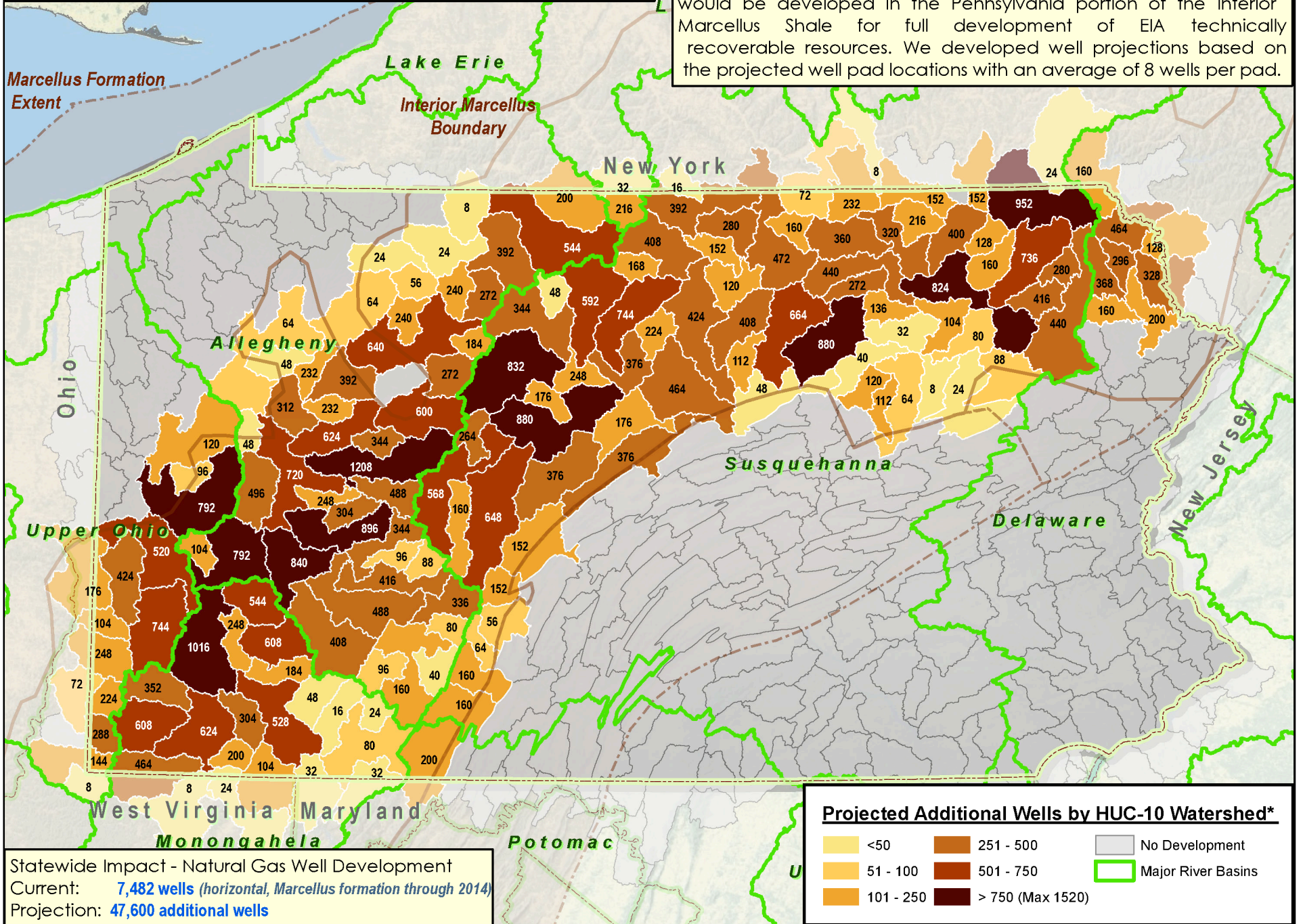
This map shows the distribution of the projected additional wells by county for full development of the Interior Marcellus in PA. The shading indicates total additional wells by county. The bars show the number of additional wells falling into each quintile (20% bracket) of maximum entropy scores, along with the number of existing wells (horizontal, spudded wells in the Marcellus formation) in 2014.



Note: Maximum entropy (Maxent) is a geospatial analysis method that correlates locations of existing wells with underlying geospatial layers. A higher 'Maxent score' means there is higher probability that the underlying layers have conditions similar to those where existing wells have been developed.

**Map 1.4 - Projected Well Development by HUC-10 Watershed**

This map shows the number of projected additional wells that would be developed in the Pennsylvania portion of the Interior Marcellus Shale for full development of EIA technically recoverable resources. We developed well projections based on the projected well pad locations with an average of 8 wells per pad.

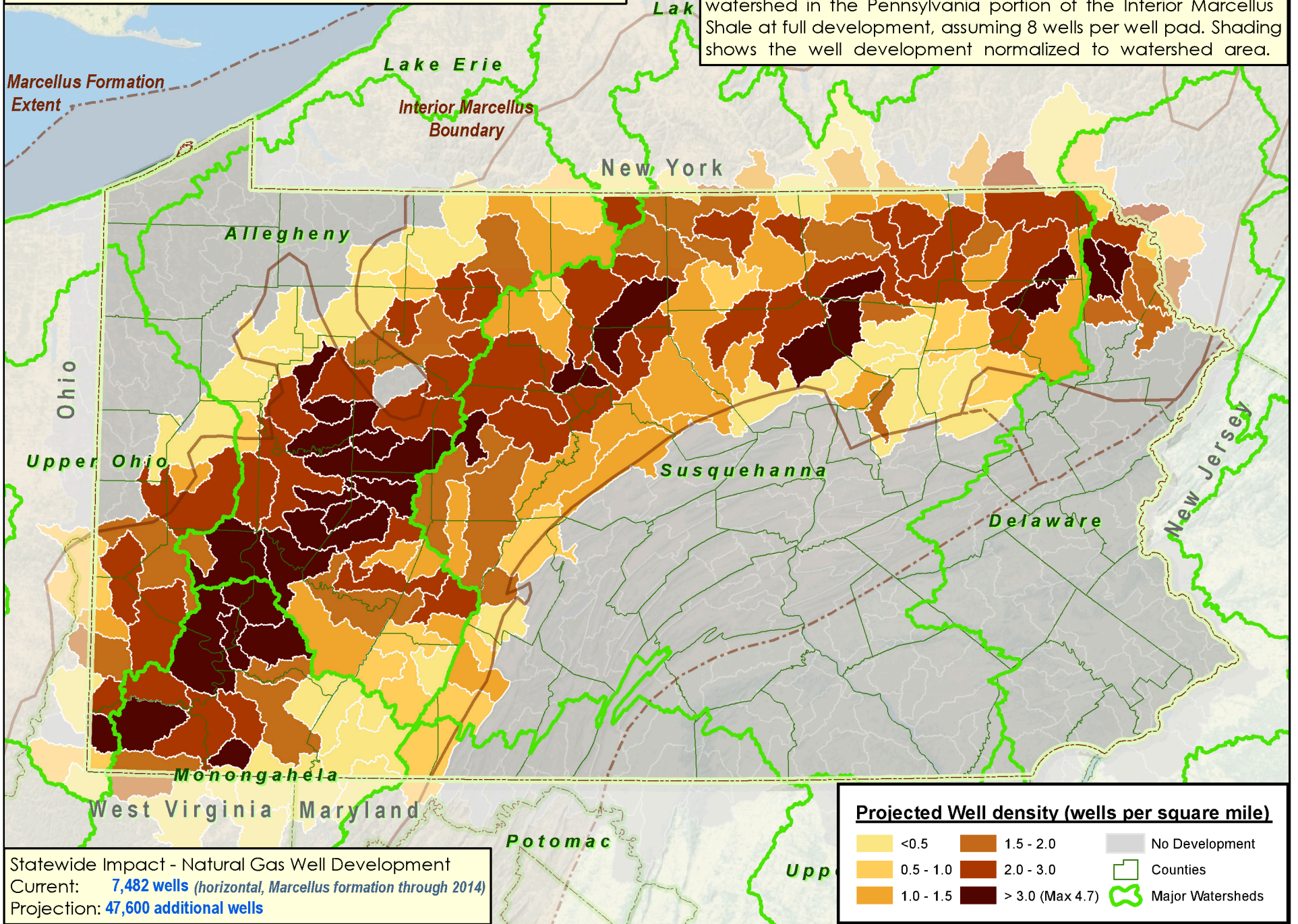


Statewide Impact - Natural Gas Well Development  
 Current: **7,482 wells** (horizontal, Marcellus formation through 2014)  
 Projection: **47,600 additional wells**

\* Hydrologic Unit Code (HUC) 10 watersheds are delineated by the US Geological Survey. There are 332 HUC-10s in PA with an average area of 162 square miles.

**Map 1.5 - Well Development Density by HUC-10 Watershed**

This map shows the projected density of new well development by watershed in the Pennsylvania portion of the Interior Marcellus Shale at full development, assuming 8 wells per well pad. Shading shows the well development normalized to watershed area.



Statewide Impact - Natural Gas Well Development  
 Current: **7,482 wells** (horizontal, Marcellus formation through 2014)  
 Projection: **47,600 additional wells**

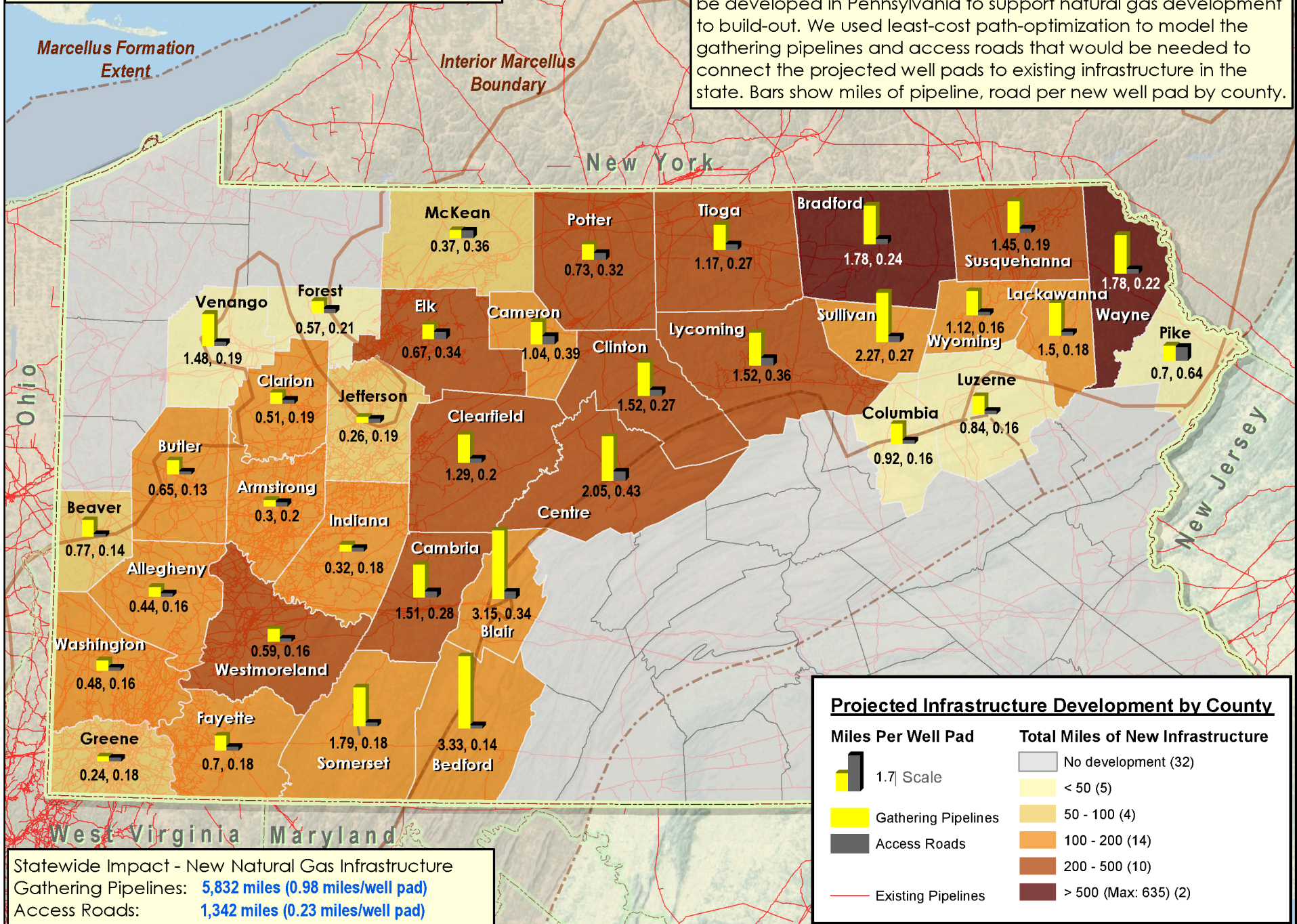
0 20 40 80 Miles

\* Hydrologic Unit Code (HUC) 10 watersheds are delineated by the US Geological Survey. There are 332 HUC-10s in PA with an average area of 162 square miles.

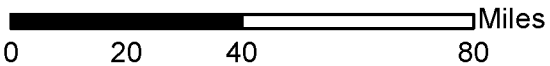


**Map 1.6 - New Infrastructure Length by County**

This map shows the amount of projected infrastructure that would be developed in Pennsylvania to support natural gas development to build-out. We used least-cost path-optimization to model the gathering pipelines and access roads that would be needed to connect the projected well pads to existing infrastructure in the state. Bars show miles of pipeline, road per new well pad by county.



Statewide Impact - New Natural Gas Infrastructure  
 Gathering Pipelines: **5,832 miles (0.98 miles/well pad)**  
 Access Roads: **1,342 miles (0.23 miles/well pad)**



Note: The pipeline projections are for gathering pipelines only and do not include additional interstate/intrastate transmission pipelines that may be developed.