Shale Gas Monitoring Report

Natural Gas Advisory Committee

April 16, 2014
State College

Seth Cassell, Chief
Forest Resource Planning & Information Division

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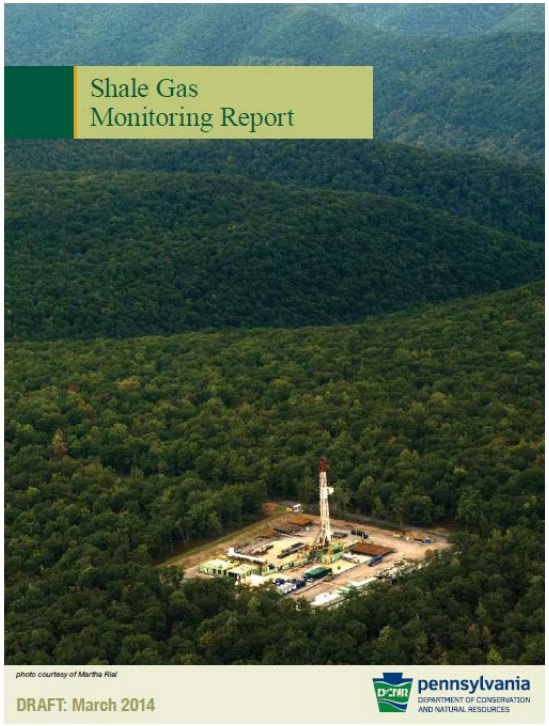
Shale Gas Monitoring Report

- Survey of report/key points and results
  - Introduction
  - Monitoring Values
  - External Partners/Research
- Questions/Discussion



Introduction

Our Mission

"To ensure the long-term health, viability and productivity of the Commonwealth's forest and to conserve native wild plants."

Introduction

Bureau of Forestry mission – State forest management

- Managing state forests under sound ecosystem management
- Retaining their wild character
- Maintaining biological diversity
- While providing …
  - pure water
  - opportunities for low-density recreation
  - habitats for forest plants and animals
  - sustained yields of quality timber
  - environmentally sound utilization of mineral resources.

State Forest System

- 2.2 million acres
- Established in 1898
- Original purpose: "*To provide a continuous supply of timber, lumber, wood and other forest products, to protect watersheds … and furnish opportunities for healthful recreation to the public.*"
- Largest single ownership in PA
- 1/8 of the forests
- "Owned" by the citizens of PA
- Managed in the public trust

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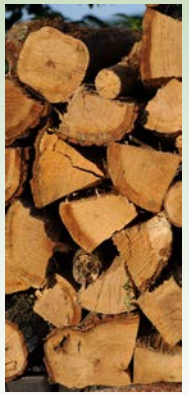
State Forest System

Our challenge:

Balancing many uses and values across the state forest system



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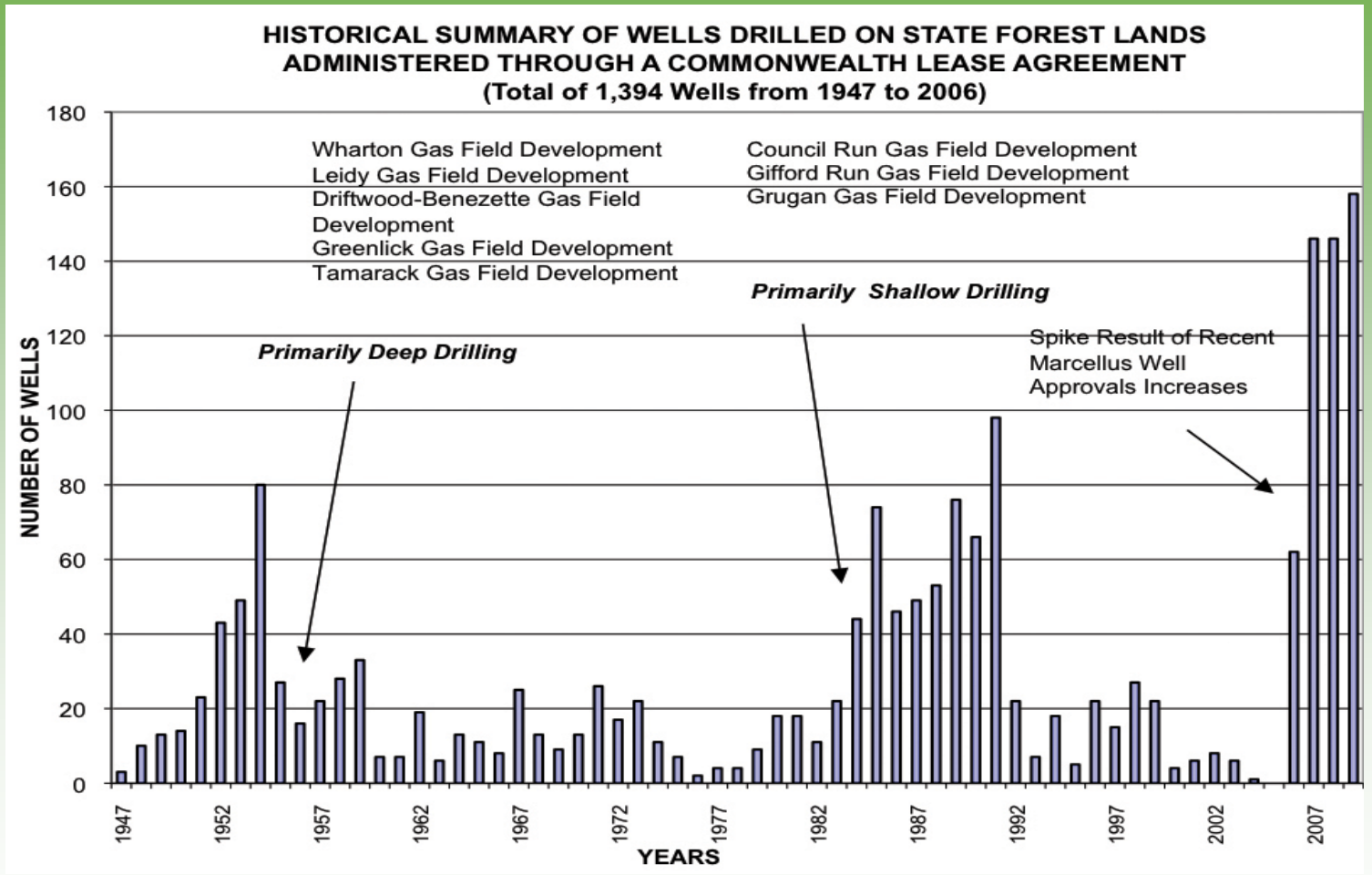
Introduction

Natural Gas Development & State Forest



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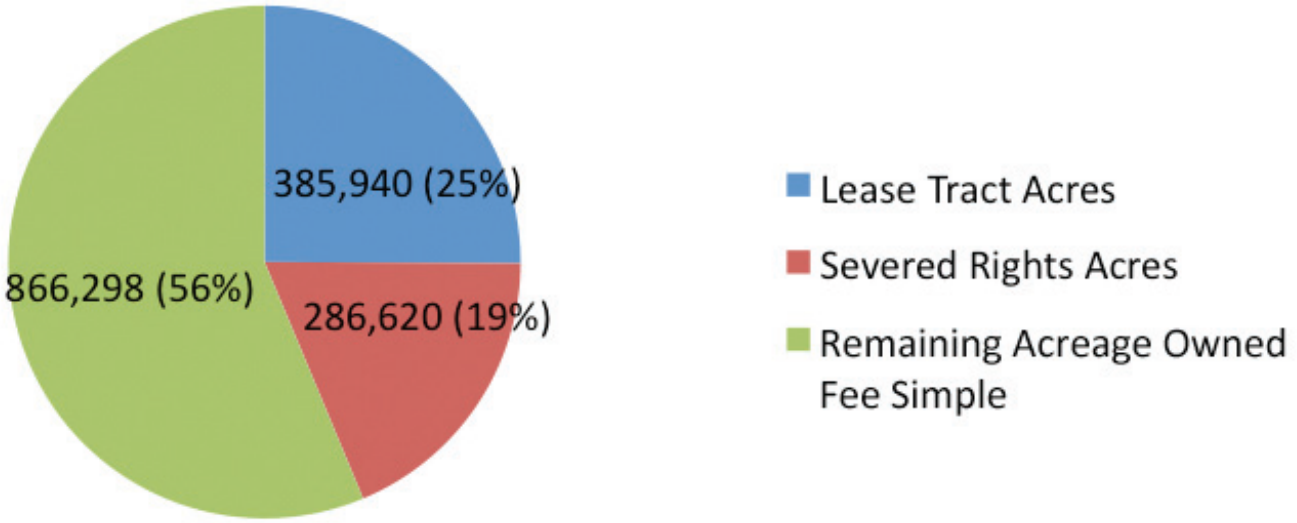
Percentage of State Forest Acreage in Marcellus Fairway by Lease/Subsurface Ownership Status

(Marcellus Fairway Acreage = 1,538,548)



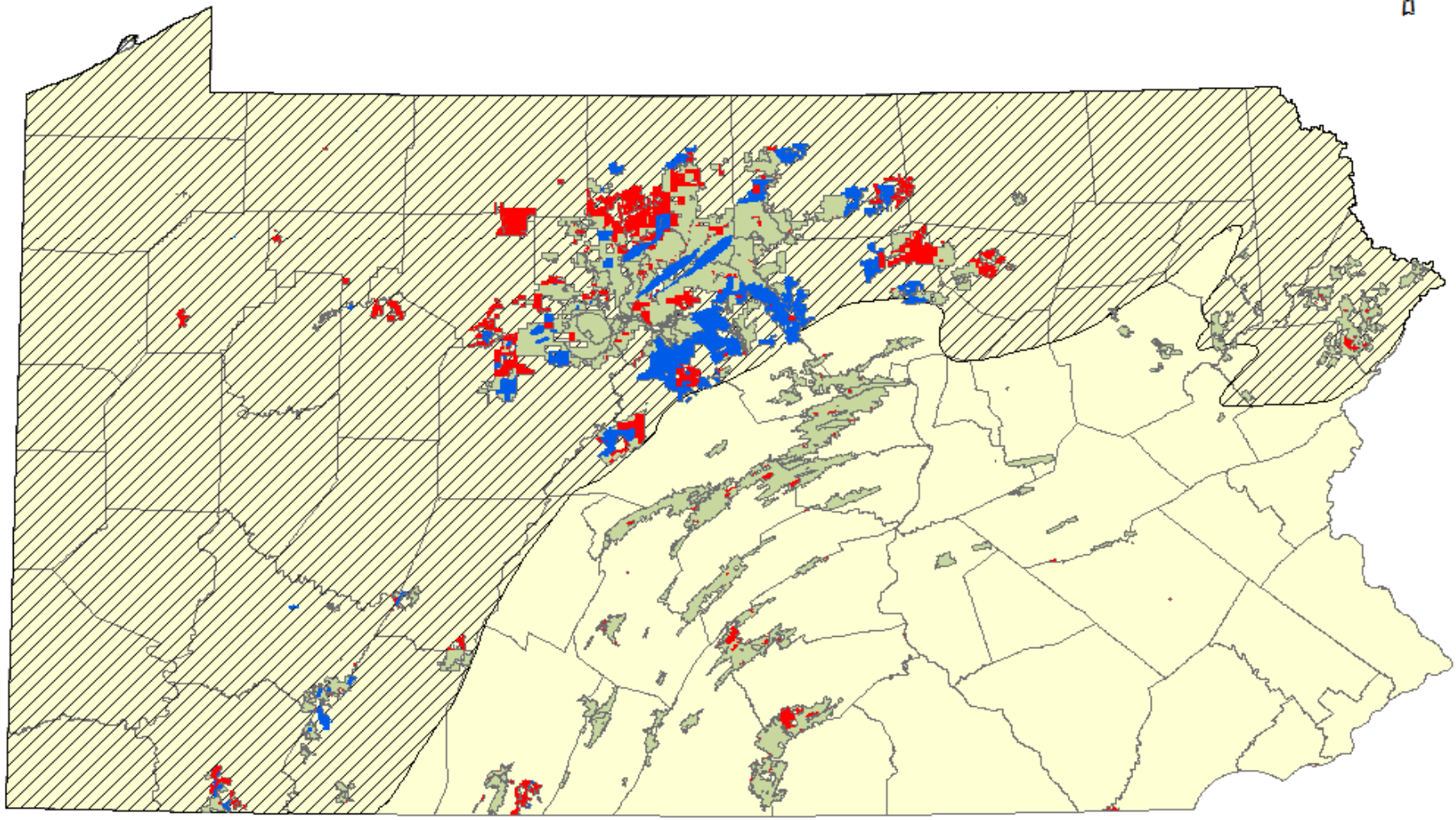
Introduction

Natural Gas Development & State Forest

Lease Event	# of Tracts	# of Acres
September 2008	18	74,023
January 2010	6	31,947
May 2010	11	32,896
Total	35	138,866

Table 1.3 State forest shale-gas leases 2008-2010.

Pennsylvania State Forest Land and The Marcellus Shale



Date: 02/27/2014

DCNR Oil & Gas Lease Agreements
Privately Owned Oil & Gas Rights
State Forest Land
Marcellus Shale Fairway

1:1,900,000

Introduction

Shale Gas Monitoring

Why monitor shale gas development?

- Good management
- New activity, potential impacts
- MSAC Recommendation:

  “DCNR should monitor and document effects, both positive and negative, of natural gas development on plants and forests, wildlife, habitat, water, soil and recreational resources.”

Introduction

Shale Gas Monitoring

Goal*:*

To develop and implement an integrated, comprehensive approach to track, detect, and report on the potential effects of oil and gas development on State Forest land and to:

- *Improve management practices*
- *Provide credible information*

Introduction

Shale Gas Monitoring

- Repeated measurements/observations to detect change/progress
- Help identify what is going well and what is not.
- Adaptive management
- Help ask the right questions
- Long term

Introduction

Shale Gas Monitoring

Monitoring Program Components:

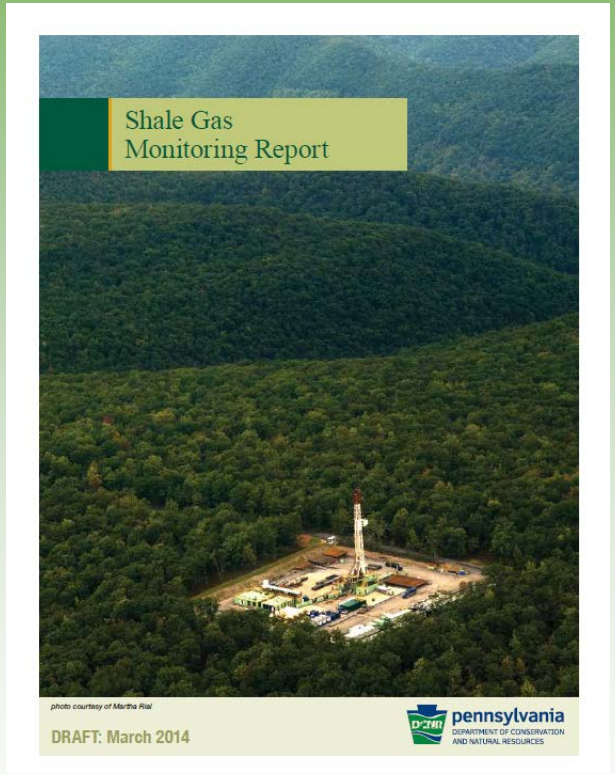
1. Dedicated and integrated monitoring team
2. Forest resource monitoring and on-the-ground management activities
3. Research and external partner collaboration

Introduction

Shale Gas Monitoring

Monitoring Report

- 15 values
- Best data and information available
- Most data 2008-2012
- Some 2013 data
- Initial report



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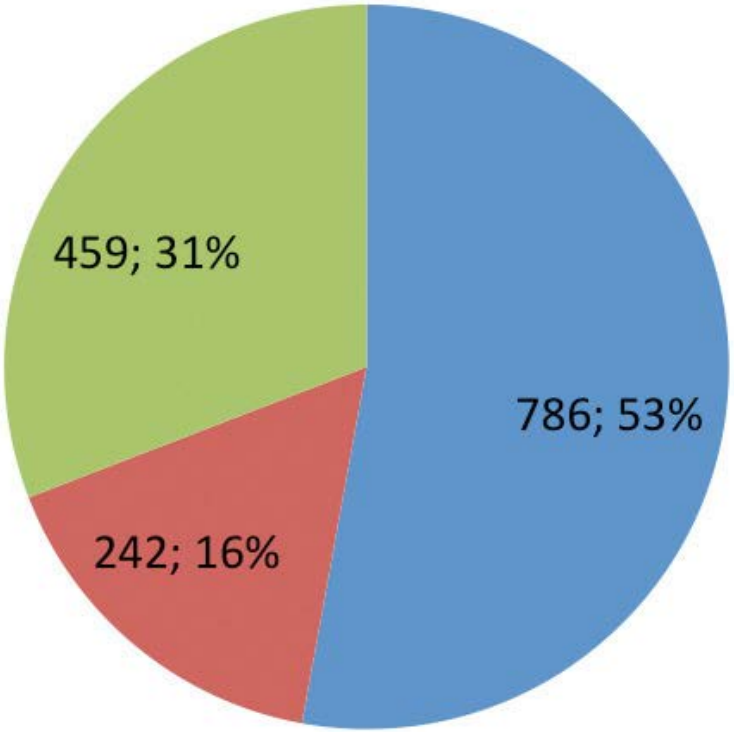
Monitoring Values

1. Water
2. Plants
3. Animals
4. Invasives
5. Soil
6. Recreation
7. Infrastructure
8. Community Engagement
9. Air
10. Revenue
11. Incidents
12. Forest Landscapes
13. Forest health
14. Timber products
15. Energy

Infrastructure

- Types of shale gas infrastructure on state forest
- Characterizes extent

Total Conversion Acreage by Infrastructure Type



- Pad Acreage
- Road Acreage
- Pipeline Acreage

Total: 1,486

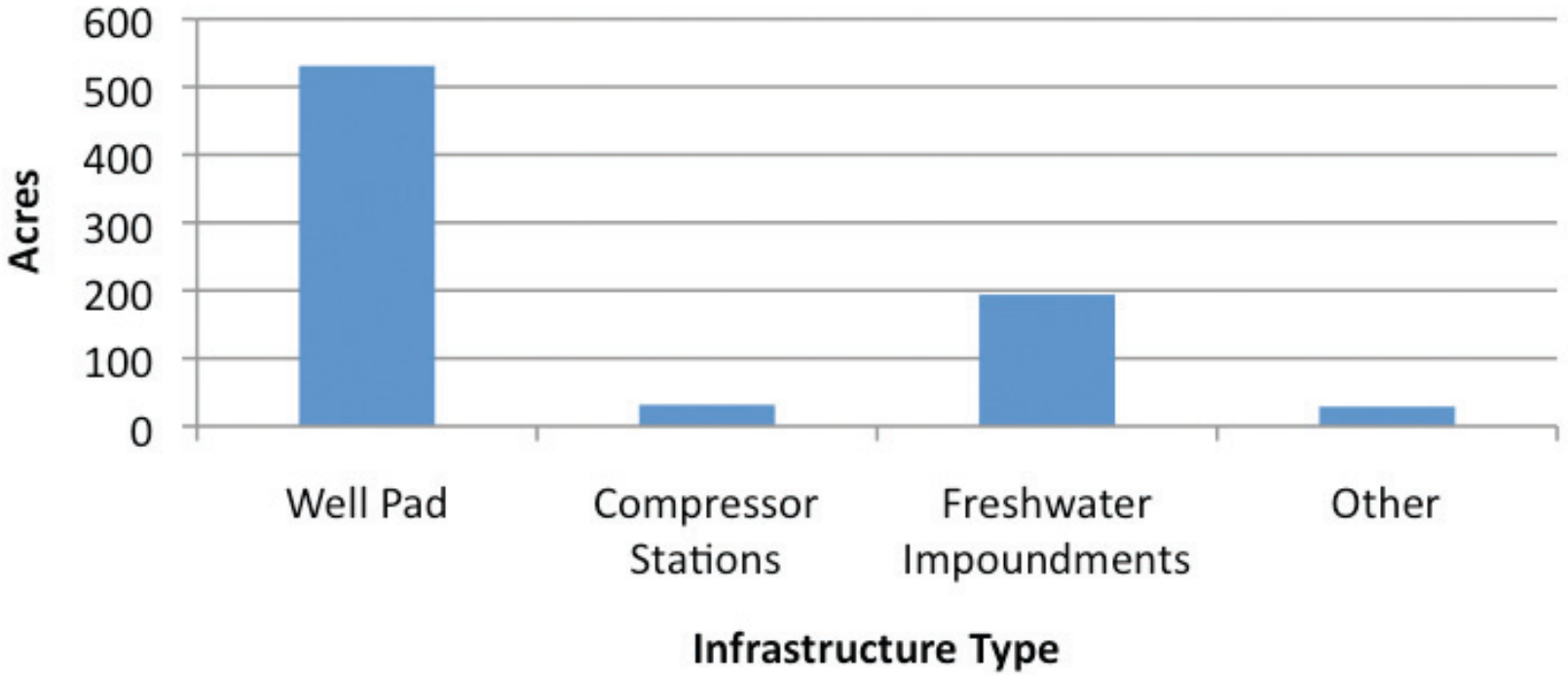
Infrastructure

Roads

State Forest District	Miles of New Road Construction	Miles of Existing Road Modified	Total
Moshannon	4.7	11.5	16.2
Sproul	4.0	39.1	43.1
Tiadaghton	13.5	44.4	57.9
Elk	0.3	0.0	0.3
Susquehannock	0.1	8.3	8.4
Tioga	6.0	15.8	21.8
Loyalsock	1.6	11.8	13.4
Total	**30.2**	**130.9**	**161.1**

Table 2.2 Miles of road construction and modification for 2008-2012 by state forest in the core gas region.

Acres of Conversion by Infrastructure Pad Type



Infrastructure

Pipelines (Miles)

State Forest District	Pipeline Corridor Type		Miles of Shale-Gas Lease ROWs Coincident with Existing ROWs	Total
	Existing	Shale-Gas Lease		
Moshannon	188.5	5.9	3.6	190.8
Sproul	207.3	14.5	7.0	214.7
Tiadaghton	25.4	52.4	7.1	70.7
Elk	110.8	2.0	0.0	112.9
Susquehannock	173.7	3.9	0.2	177.4
Tioga	44.7	18.5	2.7	60.5
Loyalsock	9.2	6.5	0.0	15.6
Total	**759.5**	**103.7**	**20.6**	**842.7**

Table 2.11 Miles of pipeline corridor by type, 2012.

Flora (Plants)

Monitoring Components

- Evaluating communities adjacent to development
- Invasive species
- Rare plant populations and wetlands near disturbance
- Baseline inventories in future development areas

Flora (Plants)

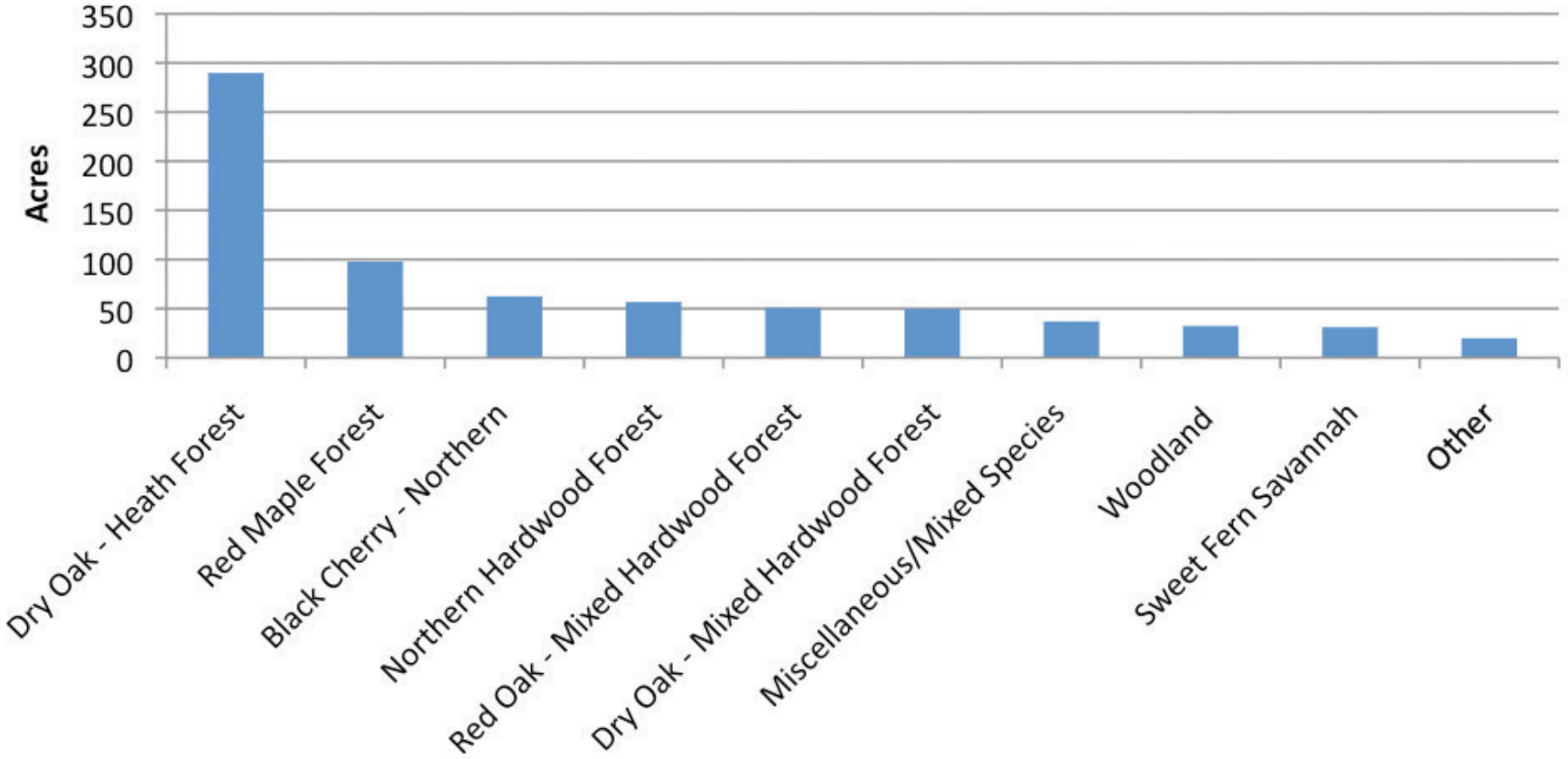
Percent cover on monitoring plots

Undisturbed – New York fern, hay-scented fern, mountain laurel

Disturbed Native – Bracken fern, wintergreen, hay-scented fern

Erosion and Sedimentation – Fescue species, orchard grass, red clover

Acres of Top 10 Community Types Converted to Marcellus Gas Infrastructure



Forest Health

- The bureau participates with the USDA Forest Service in the Forest Health Monitoring program
- Determine the status, changes, and trends in indicators of forest condition on an annual basis.
- Long-term trends

Invasive Species

- The bureau works cooperatively with the Pennsylvania Invasive Species Council, the Pennsylvania Department of Agriculture, USDA, and other state agencies and organizations to coordinate efforts regarding invasive species.

- Plants and insects and disease

Invasive Species

- 11 non-native invasive plant species were present at 14 of 18 representative pads.
- The invasive plant with the largest mean population size was Japanese stilt-grass.
- Other include crown-vetch, Canada thistle, reed canary grass.
- Knotweed and garlic mustard of concern

Invasive Species

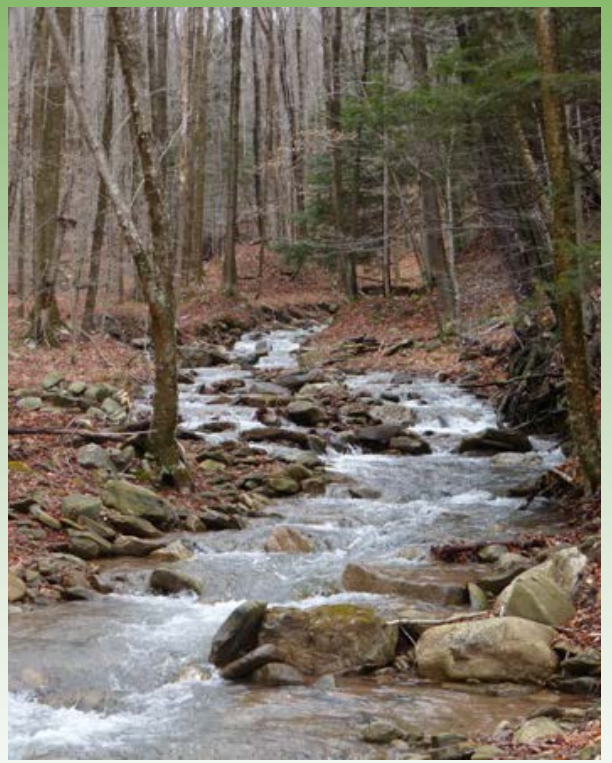
- Early Detection/Rapid Response

Water

- Important state forest value
- Public interest
- Robust program
- Numerous sampling methods
- Focus on surface water

Water

- 3,400 miles of streams in state forest shale gas region
- 70% are first-order headwater streams
- 48% High Quality (DEP Chapter 93)
- 38% Exceptional Value



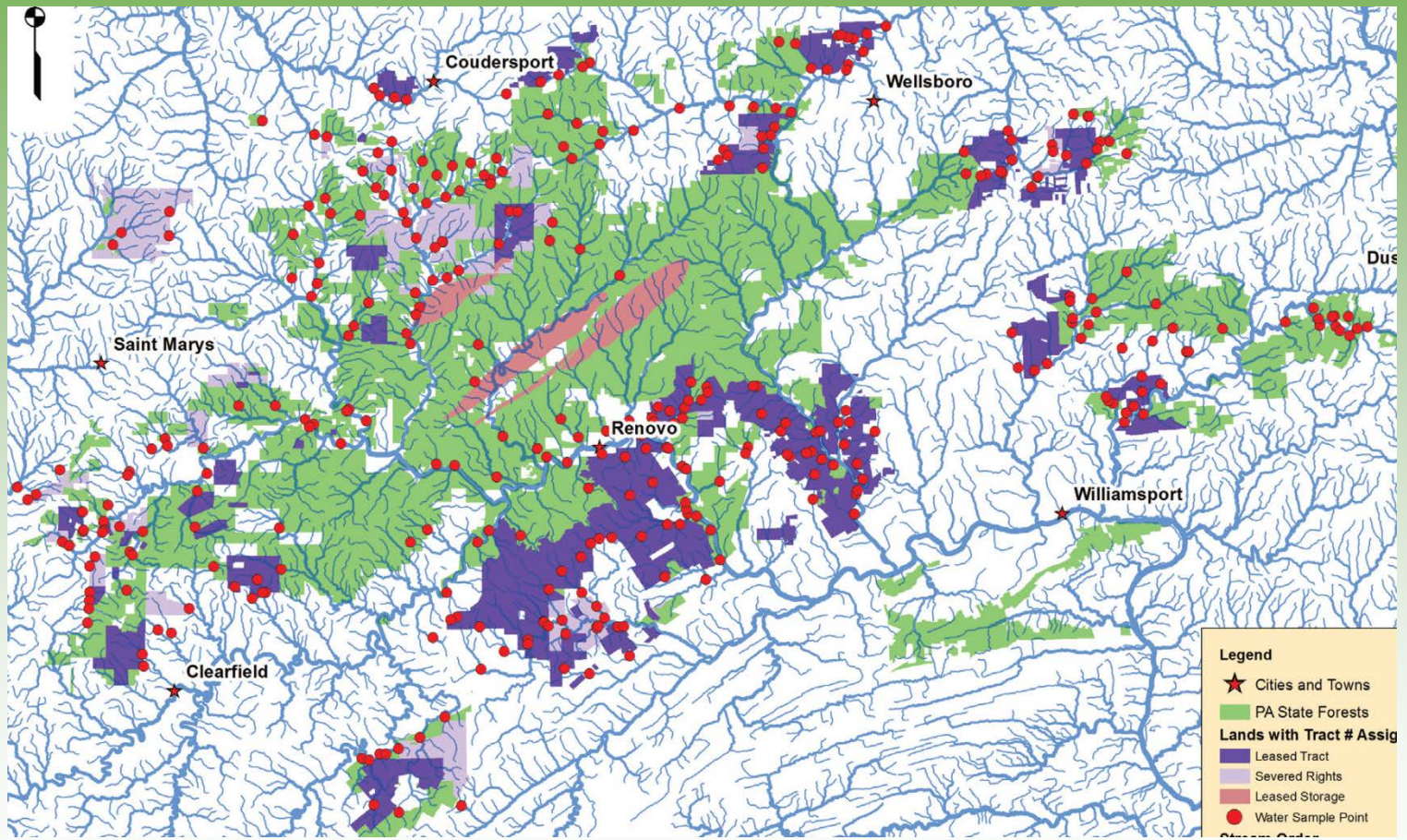
Water

Widespread Field Chemistry Sampling

- 345 sampling points
- Monitors contamination
- Baseline data
- 1 to 2 measurements per year
- Broad geographic scope

Water

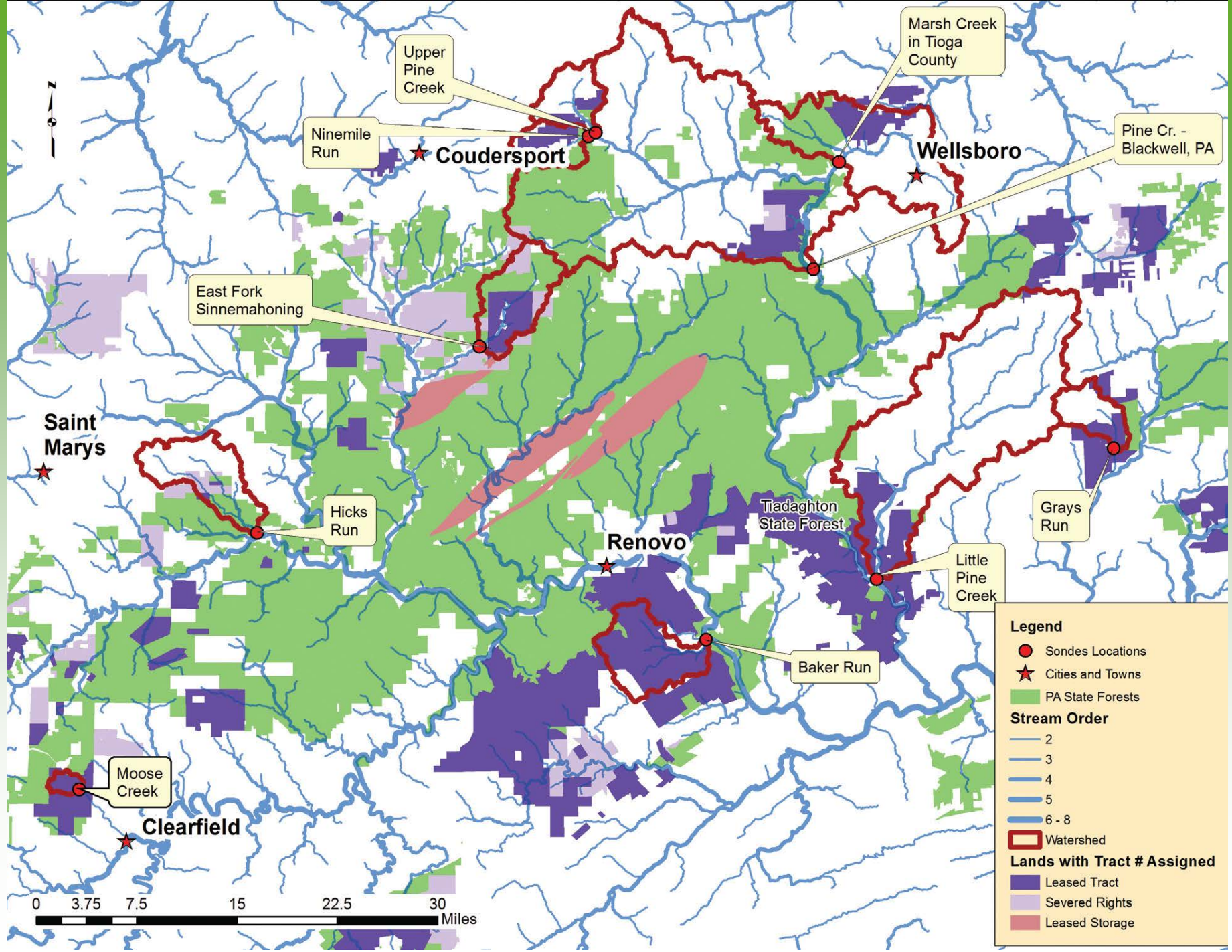
Widespread Field Chemistry Sampling Points



Water

SRBC Remote Water Quality Monitoring Network

- 59 sites within the basin
- DCNR in 2010 provided funding for 10 continuous sondes in strategic locations
- Measures temp, specific conductance, pH, turbidity, dissolved oxygen
- Real time data/ 5 minute intervals/transmitted every 4 hours/ emails to staff


Upper Pine Creek
Ninemile Run
Coudersport
Marsh Creek in Tioga County
Wellsboro
Pine Cr. - Blackwell, PA
East Fork Sinnemahoning
Saint Marys
Hicks Run
Tiadaghton State Forest
Renovo
Grays Run
Little Pine Creek
Baker Run
Moose Creek
Clearfield
0 3.75 7.5 15 22.5 30
Miles
Legend
Sondes Locations
Cities and Towns
PA State Forests
Stream Order
2
3
4
5
6 - 8
Watershed
Lands with Tract # Assigned
Leased Tract
Severed Rights
Leased Storage

Water

- Initial water monitoring results have not identified any significant impacts due to shale gas development.
- This is based on one round of field chemistry sampling and over a year of operation for 10 continuous monitoring devices in key watersheds.
- At this early stage, the data collected is primarily for establishing baseline conditions.

Water

Other Sampling Methods

Pebble Counts:
Measures sedimentation impact

Grab Sampling:
Detect spill events/specific contaminants

Continuous Monitoring Devices HOBOs:
Temperature and conductivity

Pipeline crossings:
Streambank, sedimentation, temperature

Soil

- Collaborate with DEP
- Field inspections
- Monitoring infrastructure locations

Soil

- 70-85% of pads, roads and pipelines constructed on well-drained or excessively well drained soil
- Medium or very low surface run-off index

Soil

Well pad construction:

Future monitoring on well pad construction on physical and chemical soil properties.

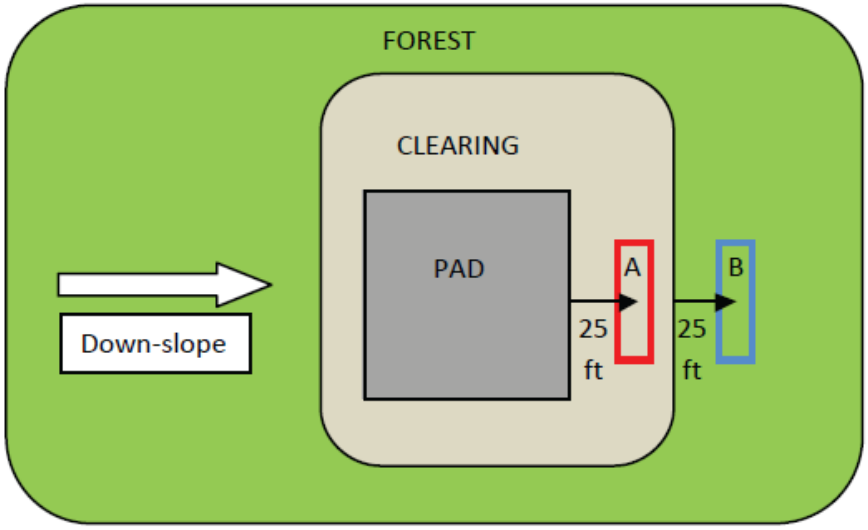


Figure 7.3 Diagram of sample plots for soil sampling around pads.

Air

Air

- DEP study in southwestern PA
- Compressor stations and processing facility
- Long-term impacts of emissions

Air

- Short-term study in Ramsey Village along Pine Creek
- Did not detect air pollutants above rural background conditions

Incidents

- Joint effort – DCNR and DEP
- Field inspections

Incidents

Year	# of Incidents Reported	DEP NOV Issued
2008	1	1
2009	33	33
2010	121	114
2011	111	102
2012	58	58
TOTALS	**324**	**308**

Table 9.1 Summary of incidents reported by DEP on state forest land by year.

Wildlife

- Habitat based
- Long term
- Research

Wildlife

- Expecting change
- Different for different species
- More edge and early successional forests
- Long-term

Recreation

- Important value
- The way most people use forest
- Opportunities
- Experiences

Recreation

Hiking Trails

-No national hiking trails impacted

- 3 designated state forest hiking trails impacted
- 1 scenic vista

Recreation

Snowmobile Trails

Statewide, since 2006:

5 percent increase (145) miles in trails

-203 mile decrease in joint-use-trails

-348 increase in designated trails

-Shale gas specific closures

Recreation

- Roads
- Scenic driving
- Heavier use/closures
- Upgrades/access
- Wild character

Recreation

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Recreation

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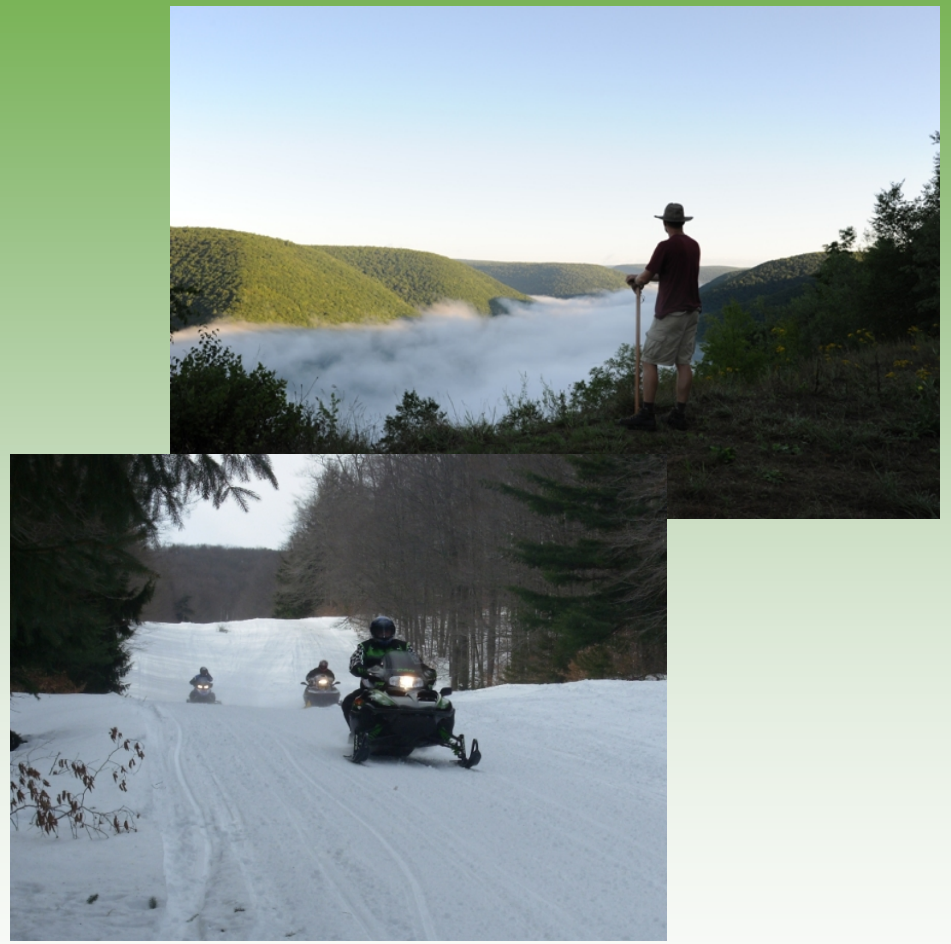
Recreation

- Recreation Opportunity Spectrum
- Recreational experiences and opportunities
- Spectrum from “Primitive” to “Developed”
- Dynamic



Recreation

District	Primitive	Semi-Primitive Non-Motorized	Semi-Primitive	Semi-Developed & Developed
Moshannon	0	-1,164	356	808
Sproul	0	-770	51	719
Tiadaghton	0	-3,259	-72	3,332
Elk	0	0	0	0
Susquehannock	-19	-9	-18	46
Tioga	0	-3,207	-391	3,597
Loyalsock	0	0	-838	838
Total	**-19**	-8,409	-913	9,341

Table 11.1 Net ROS Acreage Change (Pre-Shale-Gas vs. 2012).

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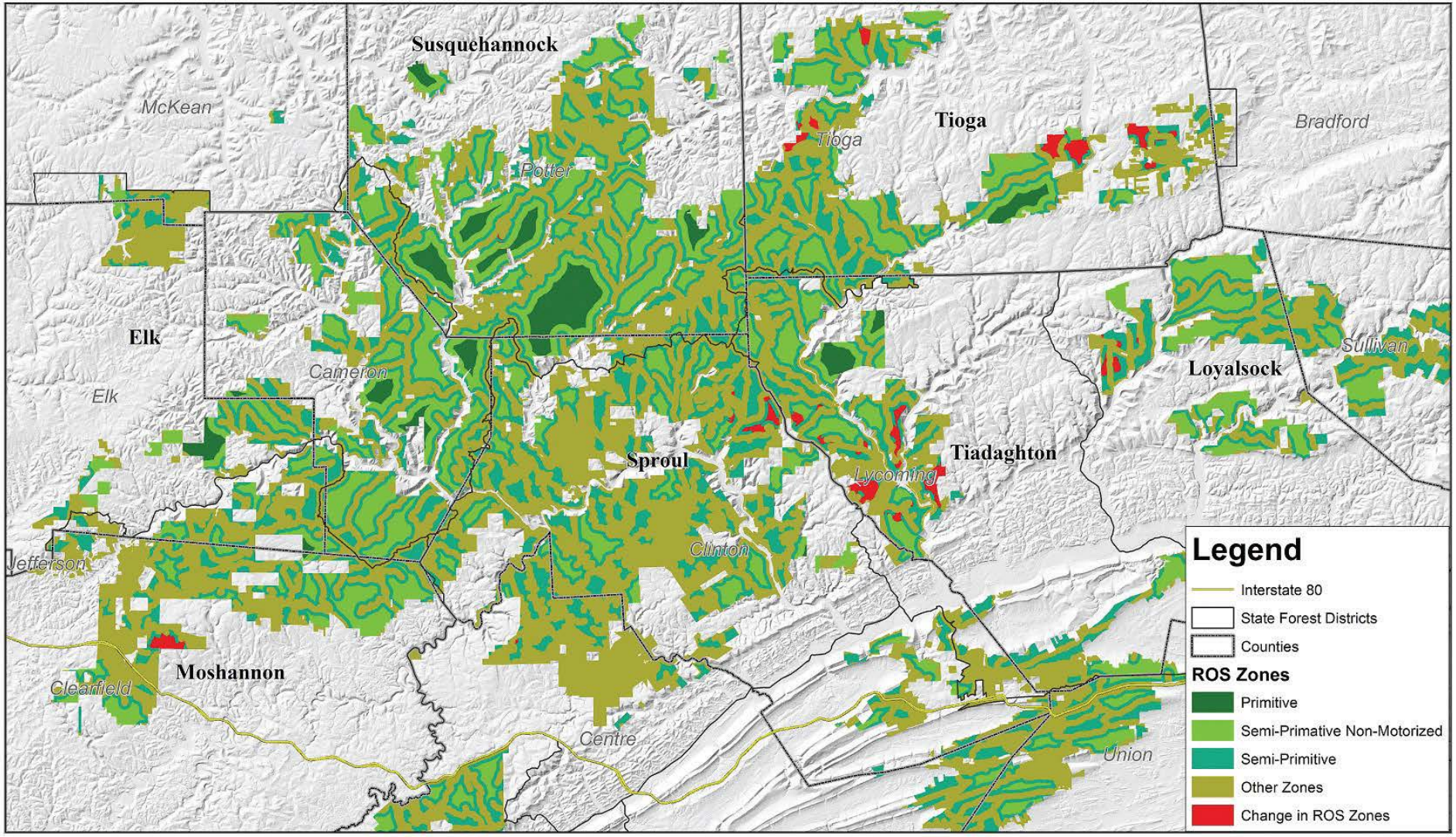
Pennsylvania Bureau of Foresty

Recreational Opportunity Spectrum - ROS
Marcellus Effects - December 2012

0 5 10 20 Miles

N



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Recreation

- Compressor Noise
- Important issue, long-term
- 6 compressors measured 56-70db
- Guideline is 55db
- Natural Gas Advisory Committee

Community Engagement

- State Forest Resource Management Plan
- Advisory Committees
- Communications and outreach
- Outreach tours (2011 – 17 tours, 391 people)

Community Engagement

- Focus Groups
- Community Leaders
  - Pine Creek Valley 2013
  - Tioga County 2014
  - Clinton County 2014
- Other groups planned

Timber

- Impacts to silvicultural operations
- Timber sale placement
- Timber revenue
- Forest products industry

Timber

- Some change in timber sale placement
- New haul road construction has decreased

Energy

Energy

State forest wells

- 568 by end of 2013
- Anticipate 3,000 to fully develop current leased acreage.

Energy

Year	Gross Mcf Gas Produced	Total Producing Wells
2008	6,694	3
2009	518,185	8
2010	20,439,524	69
2011	93,684,205	167
2012	181,817,133	283
Totals	**296,465,741**	

Table 14.3 DCNR annual lease gas production from 2008 through 2012 and number of producing wells.

Energy

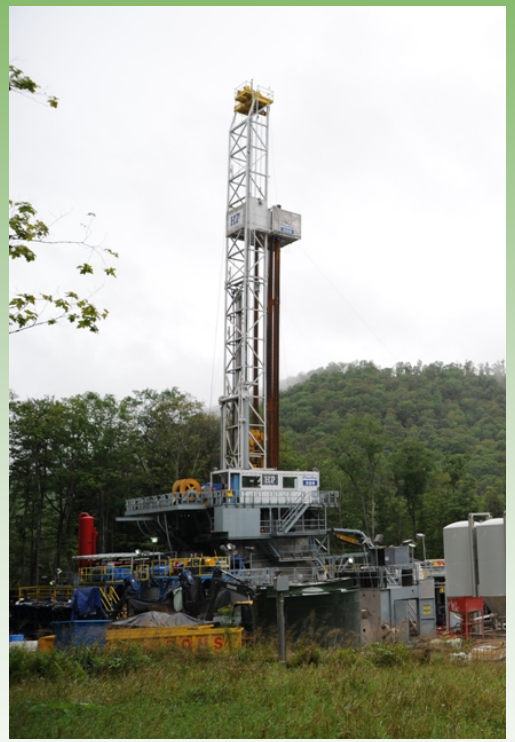
- 15 percent of all shale gas produced in PA comes from state forest.
- State forest shale gas lease tracts ~1/5 developed

Revenue

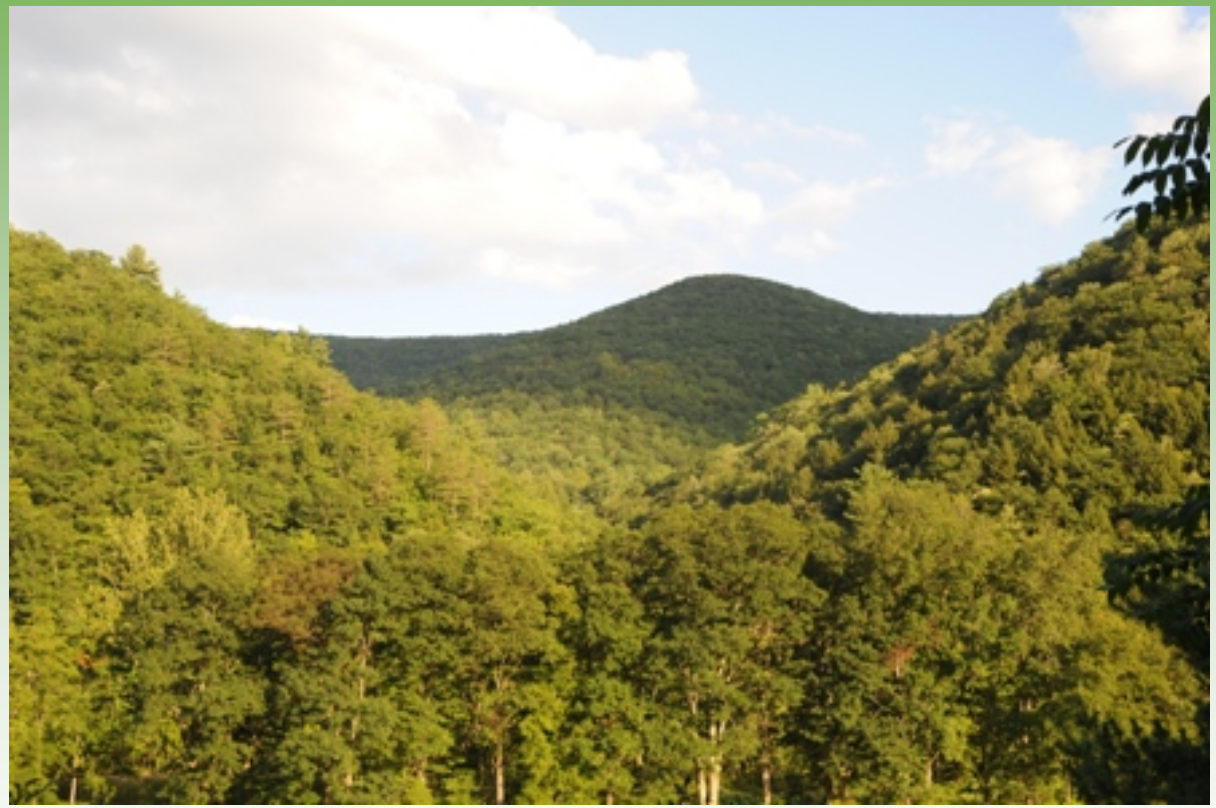
- Oil and Gas Lease Fund (recreation, conservation, flood control)
- Act 13: Marcellus Legacy Fund (environmental and conservation programs) to local communities

Revenue

- Pre-shale gas period: $154 million.
- Shale gas (2008-2012): $582 million
- Royalty income



Forest Landscapes



Forest Landscapes

- 1,486 acres converted of the 2.2 million-acre state forest system
- During the same period, 8,900 acres acquired in core gas forest districts and 33,500 statewide

Forest Landscapes

- Wild character
- How to measure?
- ROS
  - 8,409-acre decrease in semi-primitive
  - 19-acre decrease in primitive

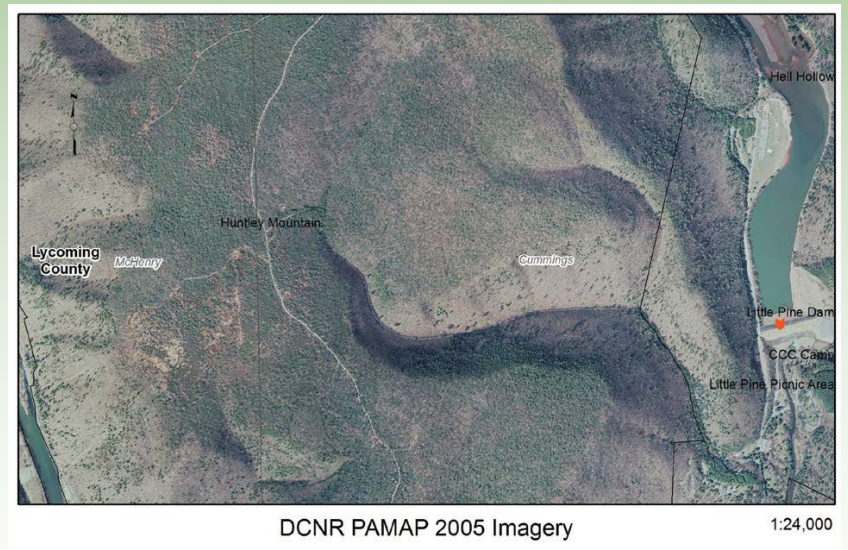
Forest Landscapes

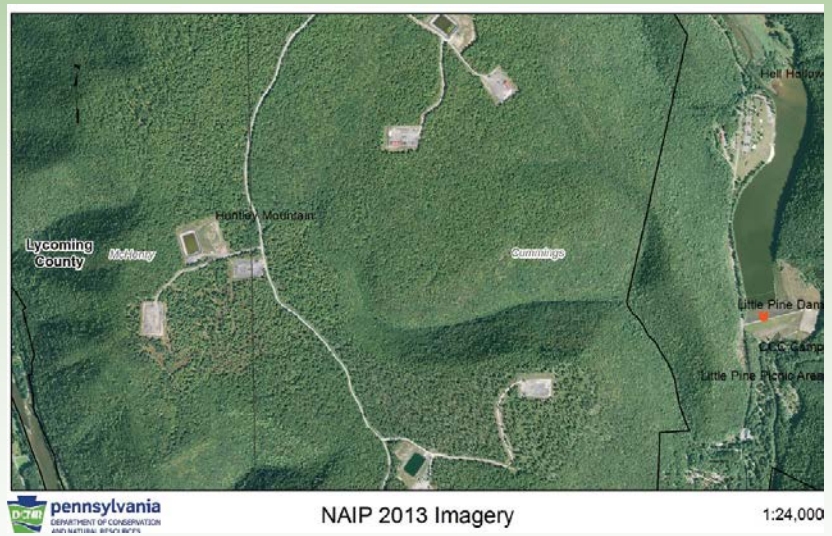
- Forest fragmentation
- Proximity to disturbance
- Indirect, cumulative impacts
- Change that is different for different species

Forest Landscapes

Edge Forest – 4,355-acre increase

Core Forest (>500 acres) – 9,241-acre decrease





Forest Landscapes

Restoration

- 10 pads interim restoration
- No pads have been fully restored

Partner Monitoring

Forest Certification

- FSC certified
- Social, environmental, economic standards
- 15 years
- Audits
- 2010 shale gas audit
- Third party monitoring

Research Partnerships

- Research part of our monitoring approach
- Specific questions with greater vigor
- Address issues with additional expertise
- Funding from O&G

Research Partnerships

Evaluating storm water and erosion and sedimentation control measures (Evans)

Quantifying soil and landform change across shale-gas infrastructure (Drohan)

Quantifying the cumulative effects of multiple disturbance regimes (Drohan)

Effects of natural gas pipelines and infrastructure on forest wildlife (Brittingham)

Assessing potential impacts of Marcellus Shale development on the timber rattlesnakes (Rocco)

Conclusion

- Initial report
- Stakeholder discussion/exchange of ideas
- Monitoring efforts will change through time
- Gaps?
- Future reporting of monitoring data?

Website & Survey

www.dcnr.state.pa.us/forestry/NaturalGas/monitoringreport/index.htm

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