# The local/community impacts of shale gas development: What we know and don't

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RESOURCES FOR THE FUTURE

**SPECIAL SCIENTIFIC COMMITTEE ON UNCONVENTIONAL OIL & GAS DEVELOPMENT: PUBLIC WORKSHOP**
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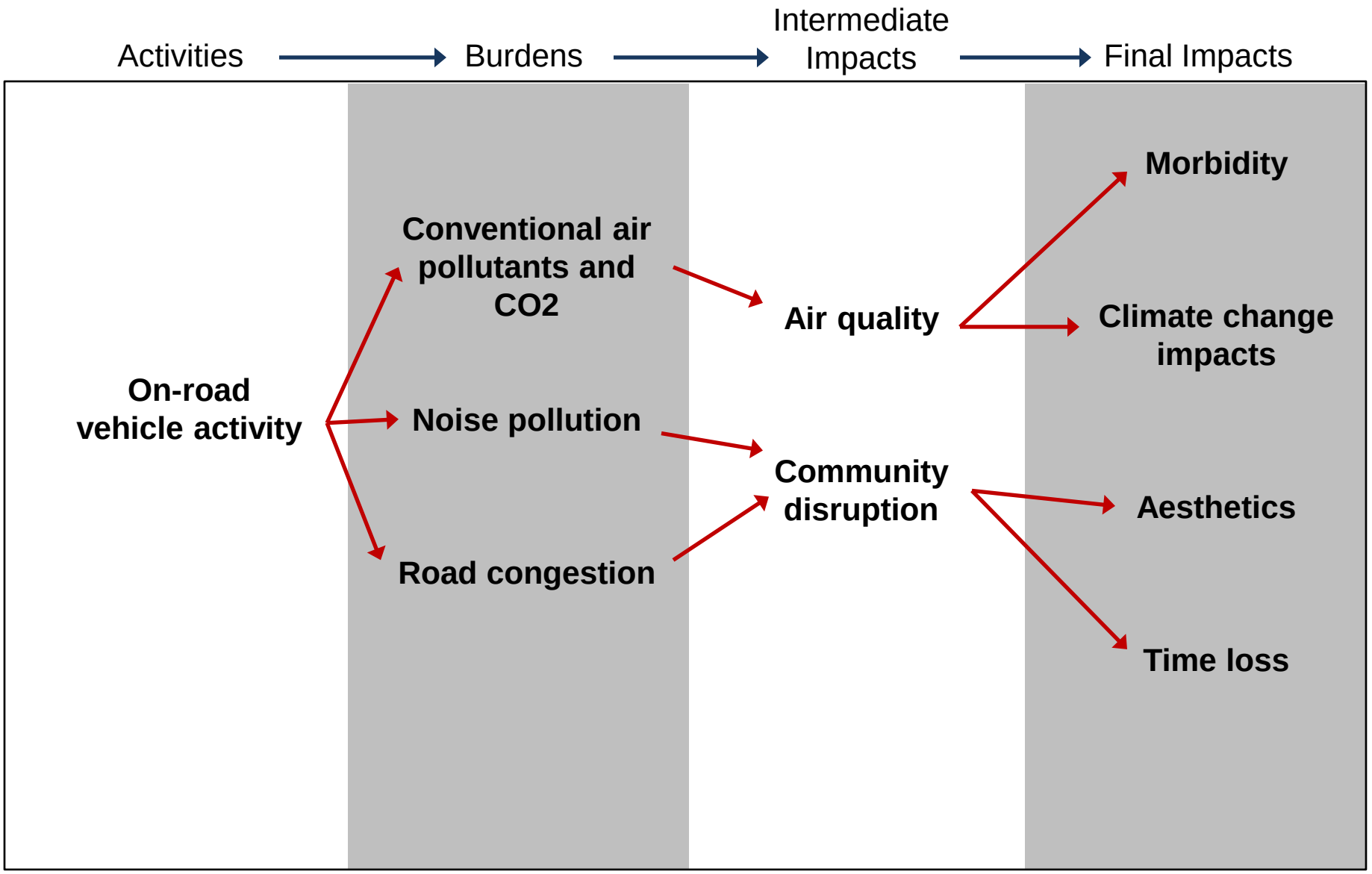
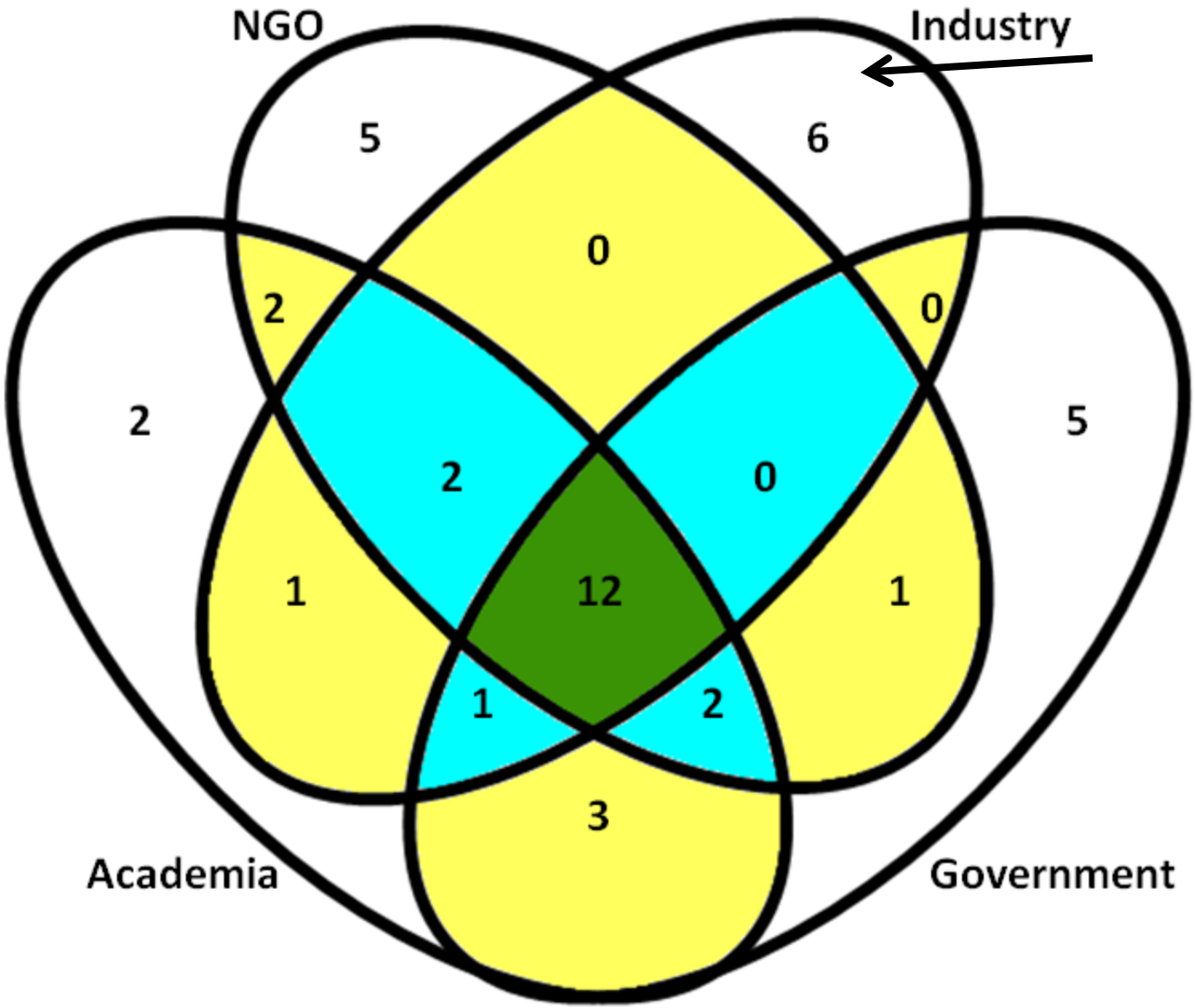
# Example of Impact Pathways



# Overlap of each groups' high priority routine risk pathways



# Policy Context

- Localities have concerns
  - Front line for explosion of “industrial activity” in their often rural communities
  - Many of the impacts are obvious, but others are hidden, scary and/or hard to attribute to oil and gas activity
  - These concerns can boil over into bans and moratoria
- Key Issues (other than health and ecological effects)
  - Economic benefits/costs ←
  - Local finance ←
  - Environmental (air, water, land) ←
  - Community-related
    - Traffic accidents ←
    - Schools
    - Time lost
    - Crime
    - Noise, light, odor
    - Recreational opportunities, etc.
  - Seismic ←
  - Property Values ←
  - Public Preferences (willingness to pay) ←

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# Positive Local Economic Impacts

- Lease payments and royalties (Split estates)
- Tax revenues, fees, etc.
- Economic growth/jobs
- Boom towns
- Reduced gas and electric utility expenses

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# Dickinson, ND Financial Statistics

| | 2009 | 2013 |
|---|---|---|
| Sales Tax | $4,388,670 | $16,428,510 |
| Hospitality Tax | $554,009 | $1,060,639 |
| Occupancy Tax | $256,331 | $597,266 |
| Property Tax (Net) | $2,886,383 | $3,462,321 |
| Enterprise | $6,676,027 | $11,373,655 |
| Debt | $2,630,497 | $65,000,000 |
| City Operating Budget | $7,522,143 | $13,550,120 |
| Capital Budget | $1,677,974 | $132,000,000 |
| | | |
| *State Support* | | *$12,300,000* |

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Source: Shawn Kessel, City Administrator, 2014

# Surface Water Quality Risk Study (PNAS, 2013)

We exploit spatial and temporal variation in the proximity of shale gas wells, waste treatment facilities, and surface water quality monitors in Pennsylvania to estimate:

1. the impact of *shale gas wells* on downstream chloride and TSS concentrations; and

2. the impact of *shale gas waste treatment* and release to surface water on downstream chloride and TSS concentrations.

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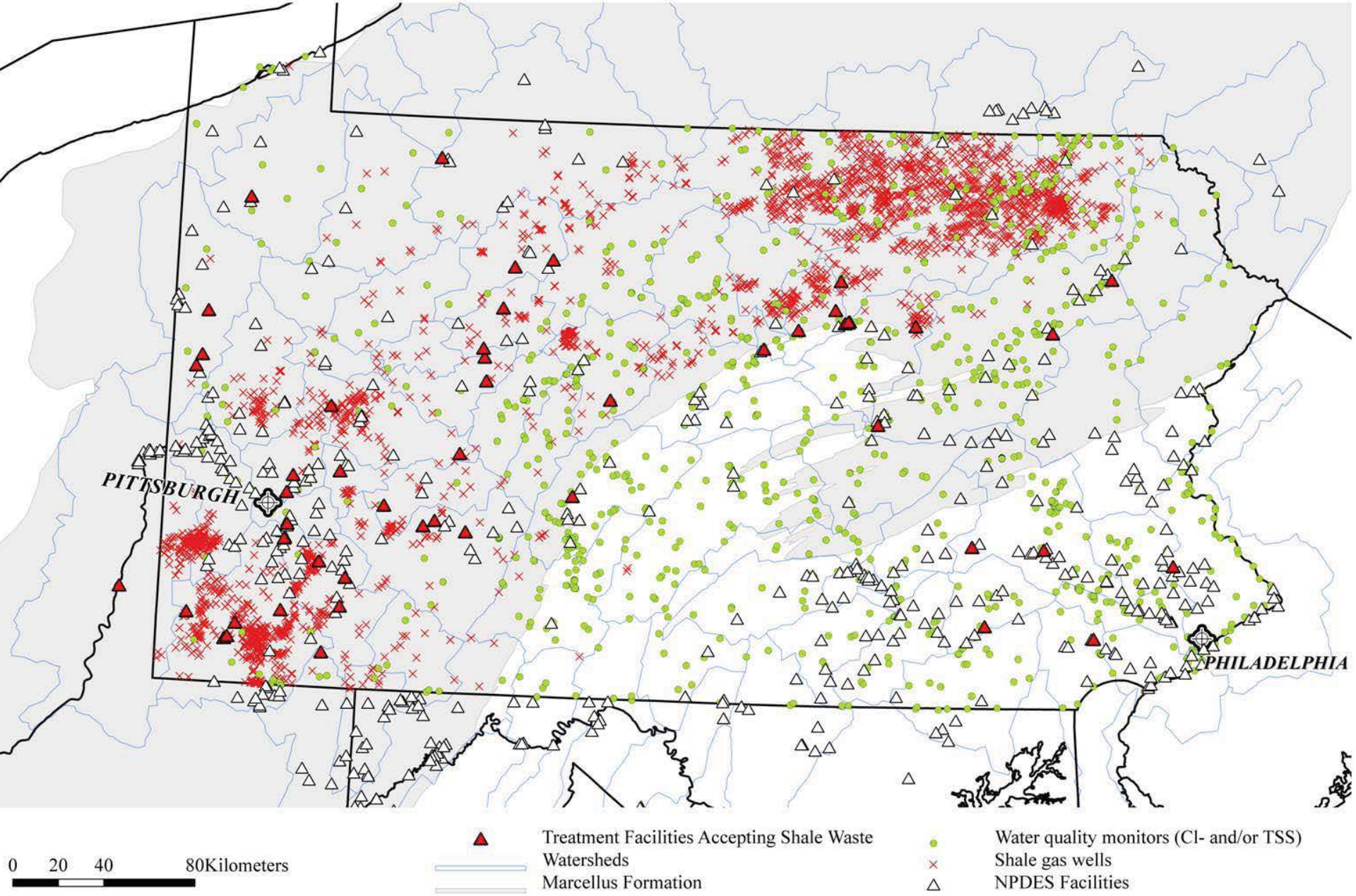
PITTSBURGH
PHILADELPHIA
0 20 40 80Kilometers
Treatment Facilities Accepting Shale Waste
Watersheds
Marcellus Formation
Water quality monitors (Cl- and/or TSS)
Shale gas wells
NPDES Facilities

# Conclusions

- No statistically significant impact of shale gas wells on downstream chloride concentrations.
  - A positive result here would have been consistent with contamination problems from spills, dumping, etc.
- Release of treated shale gas waste to surface water by permitted waste facilities appears to increase downstream chloride concentrations.
- Shale gas wells appear to increase downstream TSS concentrations.

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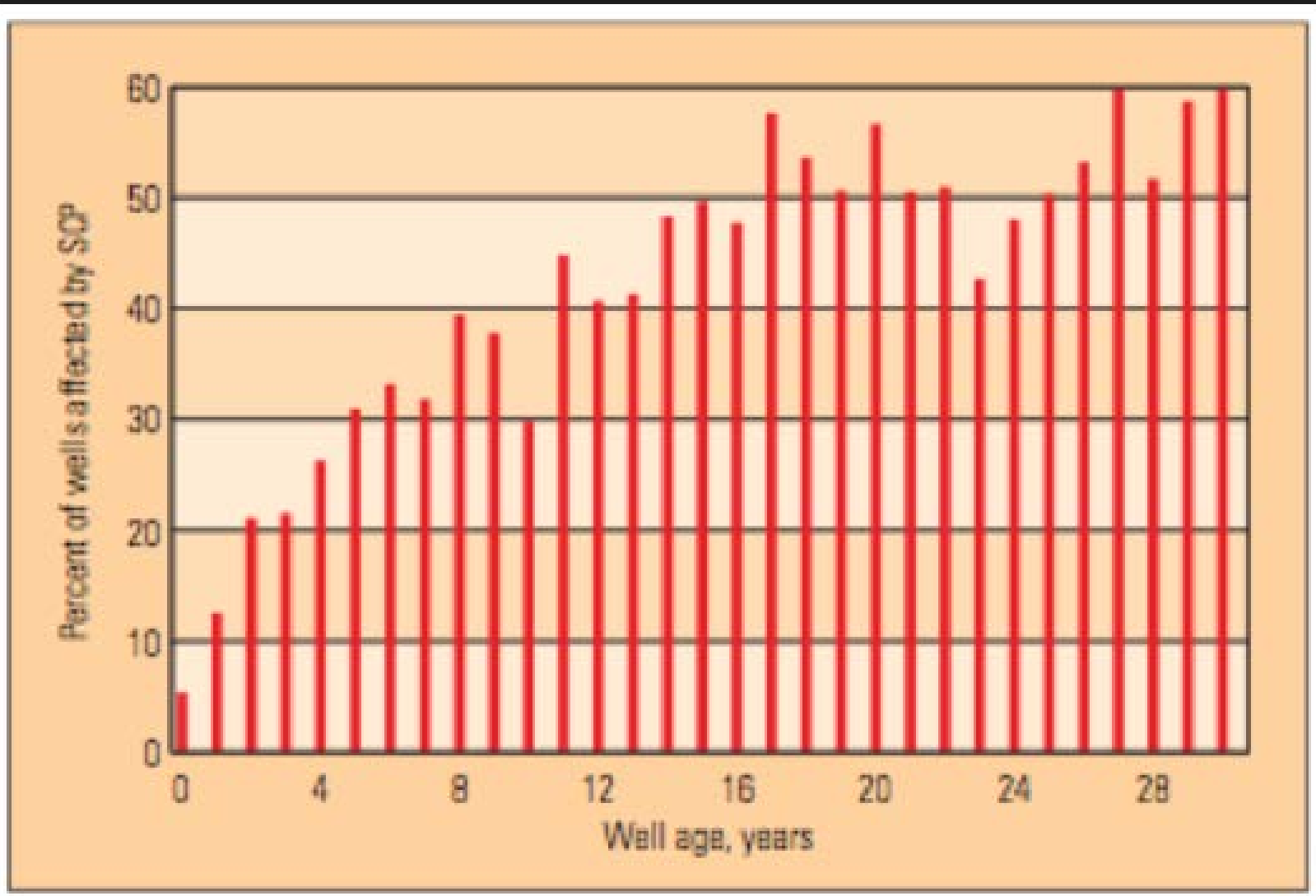
Percent of wells affected by SCP
60
50
40
30
20
10
0
0
4
8
12
16
20
24
28
Well age, years

# Compare Concentrations to Standards/Criteria

| **Primary environmental public health concerns:** | | | | |
|---|---|---|---|---|
| **Parameter** | **NOB** | **Median** | **Standard (mg/L)** | **Note** |
| Barium | 180 | 431 | 2 | EPA MCL |
| Barium | 180 | 431 | 10 | PA wastewater effluent standards monthly average |
| Bromide | 164 | 491 | 0.1 | General agreed level in fresh water sources |
| Strontium | 175 | 1080 | 4 | EPA recommended limit for finished municipal drinking water |
| Strontium | 175 | 1080 | 10 | PA wastewater effluent standards monthly average |
| Benzene | 61 | 0.03 | 0.005 | EPA MCL |
| | | | | |
| **Ecological and secondary drinking water concerns:** | | | | |
| Chlorides | 175 | 46500 | 250 | EPA SMCL, PA wastewater effluent standards |
| Magnesium | 172 | 526.5 | 0.05 | EPA SMCL |
| TDS | 175 | 82600 | 500 | EPA SMCL, PA wastewater effluent standards |
| Sulfate | 90 | 61.05 | 250 | EPA SMCL |

# Induced Seismicity

- Seismicity from fracking NOT a problem
- Deep well injection:  40,000 wells taking oil and gas liquid wastes.
- Better than pits, which leak; better than CWTs which can’t treat produced water
- DWI is #3 in anthropogenic earthquakes.
- Growth in earthquakes > 3.0 since 2009, “coincident with” oil and gas waste injections.”  In CO, TX, OH, ARK, OK.  A few “caused by.”
- Can it be managed?
- Industry cutting water flows through recycling, using less liquids

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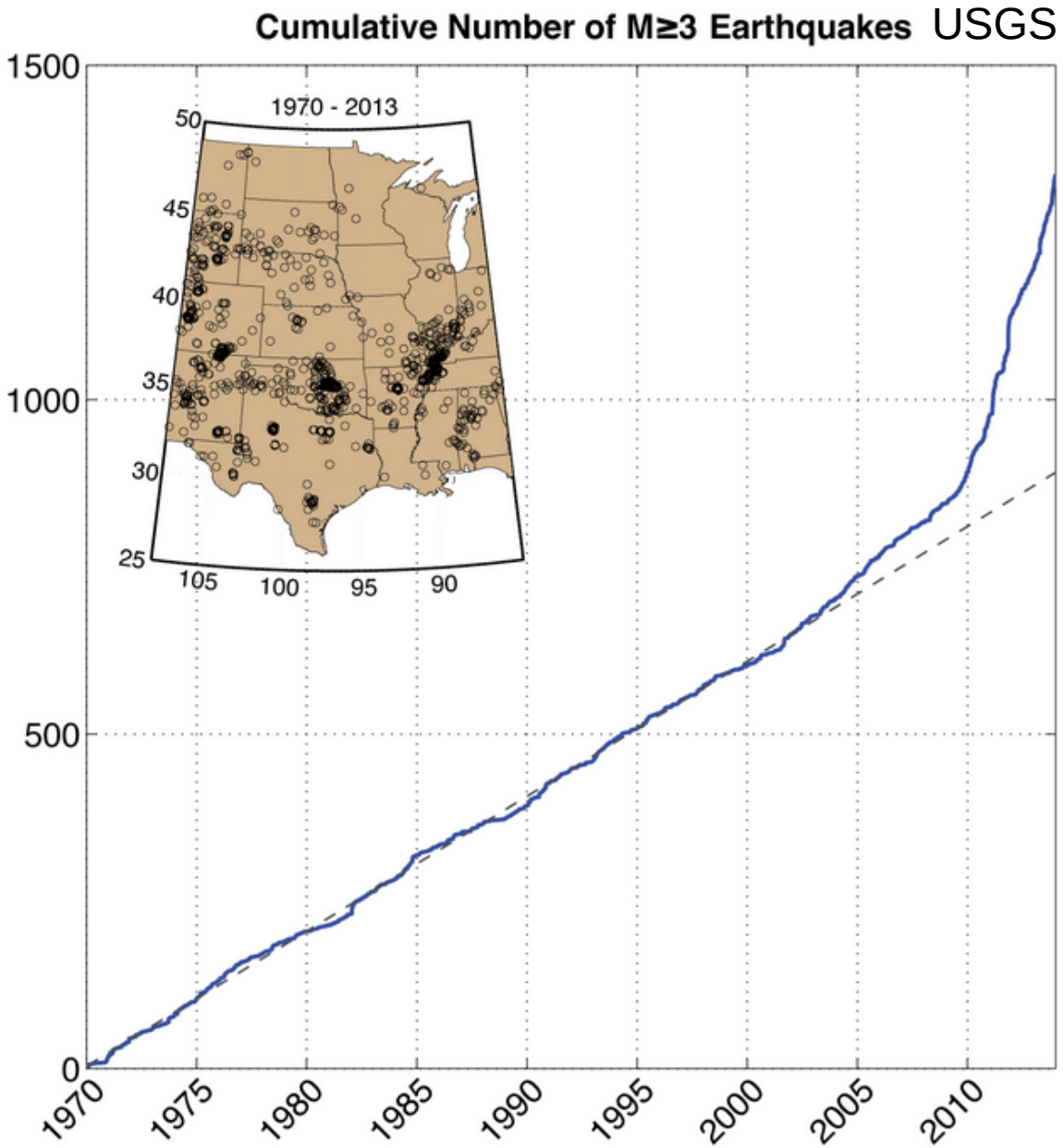


Cumulative number of earthquakes with a magnitude of 3.0 or larger in the central and eastern United States, 1970–2013. The dashed line corresponds to the long-term rate of 20.2 earthquakes per year, with an increase in the rate of earthquakes starting around 2009.

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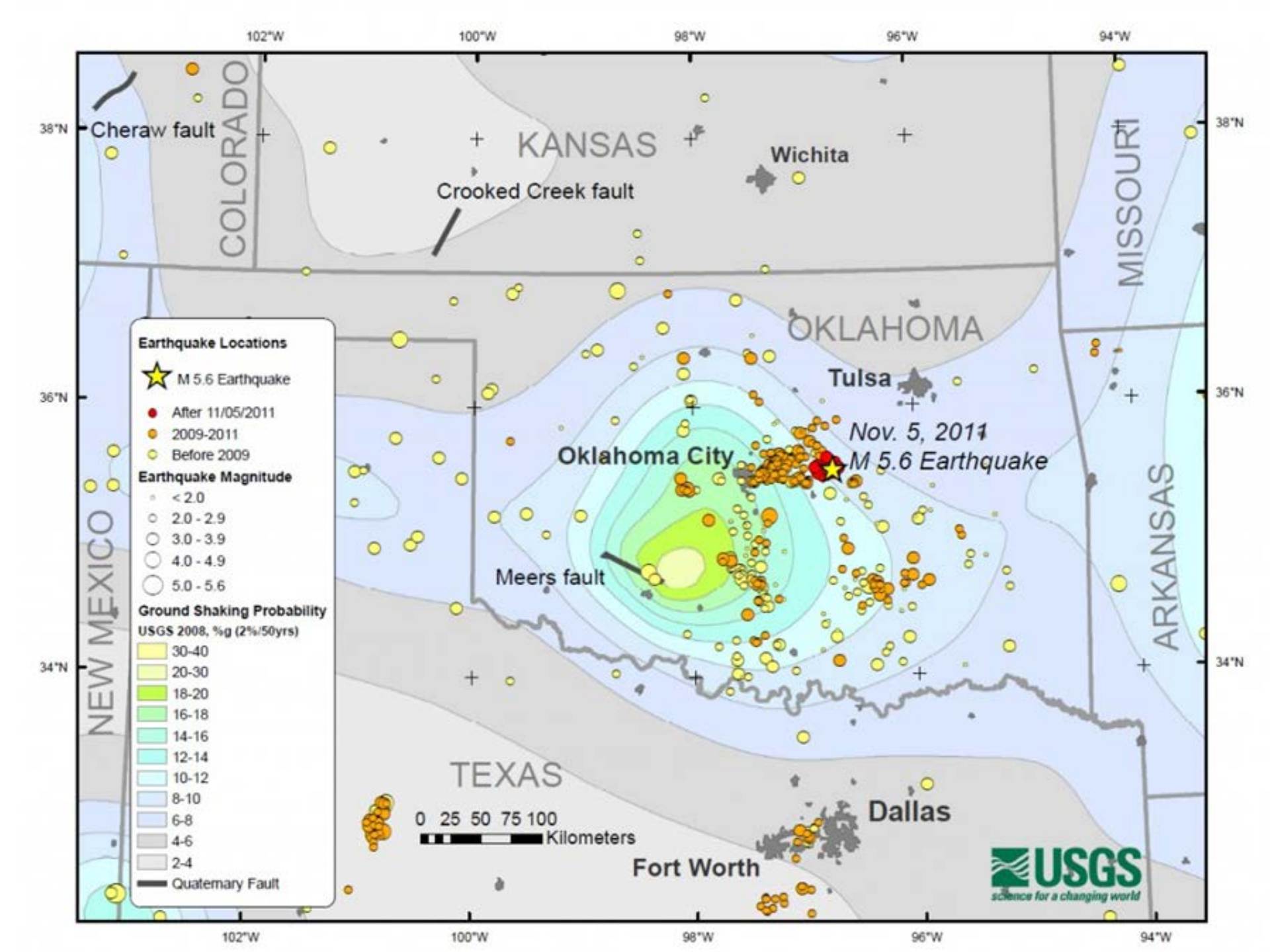
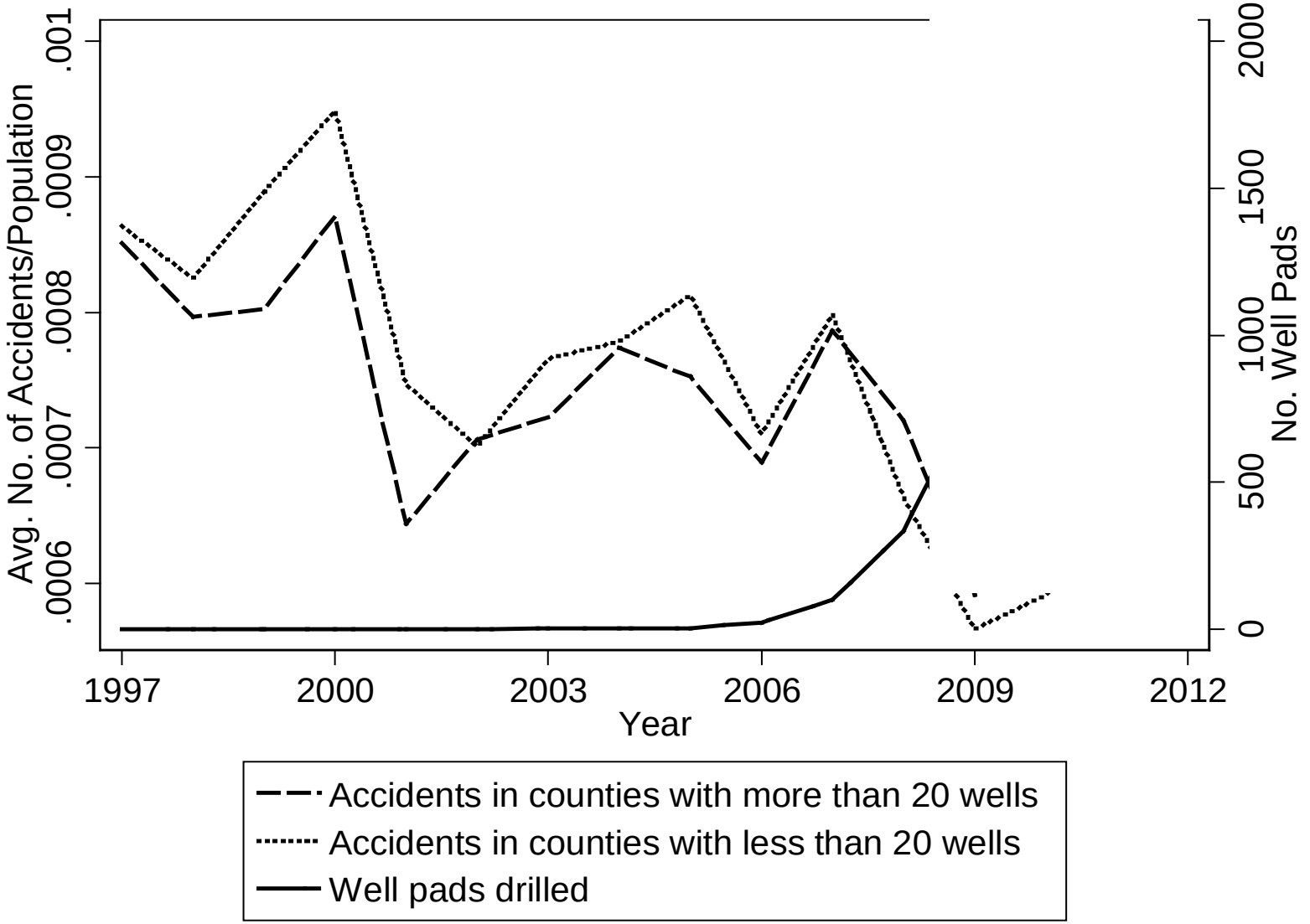

102°W
100°W
98°W
96°W
94°W
38°N
36°N
34°N
Cheraw fault
COLORADO
KANSAS
Wichita
Crooked Creek fault
MISSOURI
OKLAHOMA
Tulsa
Nov. 5, 2011
M 5.6 Earthquake
Oklahoma City
Meers fault
ARKANSAS
NEW MEXICO
TEXAS
Dallas
Fort Worth
0 25 50 75 100
Kilometers
USGS
science for a changing world
Earthquake Locations
M 5.6 Earthquake
After 11/05/2011
2009-2011
Before 2009
Earthquake Magnitude
< 2.0
2.0 - 2.9
3.0 - 3.9
4.0 - 4.9
5.0 - 5.6
Ground Shaking Probability
USGS 2008, %g (2%/50yrs)
30-40
20-30
18-20
16-18
14-16
12-14
10-12
8-10
6-8
4-6
2-4
Quaternary Fault

# Truck Traffic Accidents in Pennsylvania by Well Activity

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# Property Values and Housing

- Great aggregator of local perceived risks – with **real** effects
- Effects of proximity and intensity
- Proximity Matters
  - Within 1.5 km and on groundwater: $33,000 decrease versus homes further away and on public water
- Intensity Matters a little

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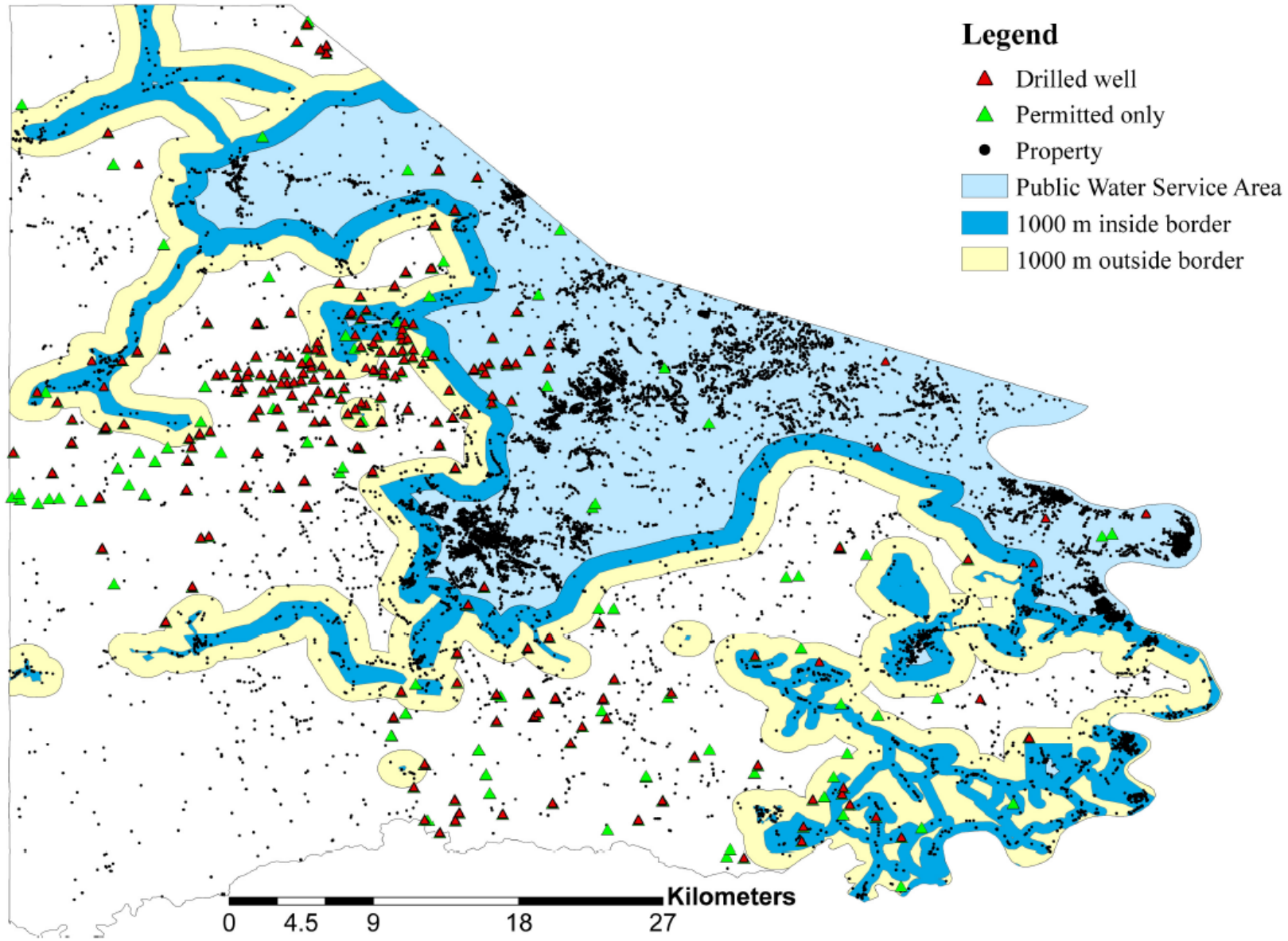
# Residential property sales in Washington County, PA

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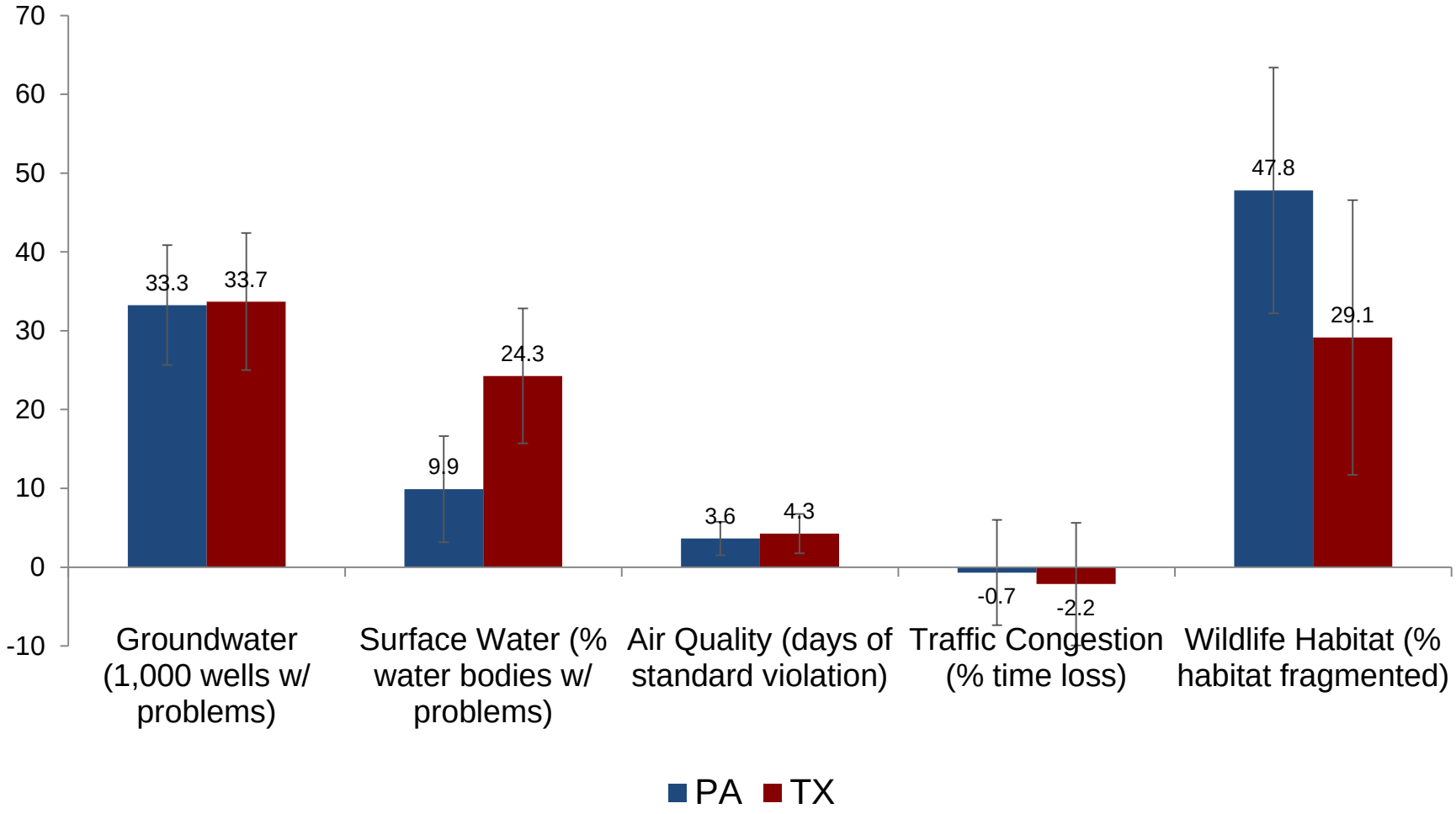


**Figure 2. Estimated WTP ($ household$^{-1}$ year$^{-1}$), on average, for the reduction of risks associated with shale gas development**

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# Research Priorities for the Future

- Boom town impacts, particularly on low income
- Mental health stress
- Groundwater data
- Produced water info more important than fracking fluids disclosure
- Waste treatment plant emissions
- Solid waste risks and RCRA
- Traffic-related

Lesser problems:

- Water quantity in PA
- Air quality (but non-attainment issues in West)

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Thank you!

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