Do environmental groups mitigate spillovers of water pollution?

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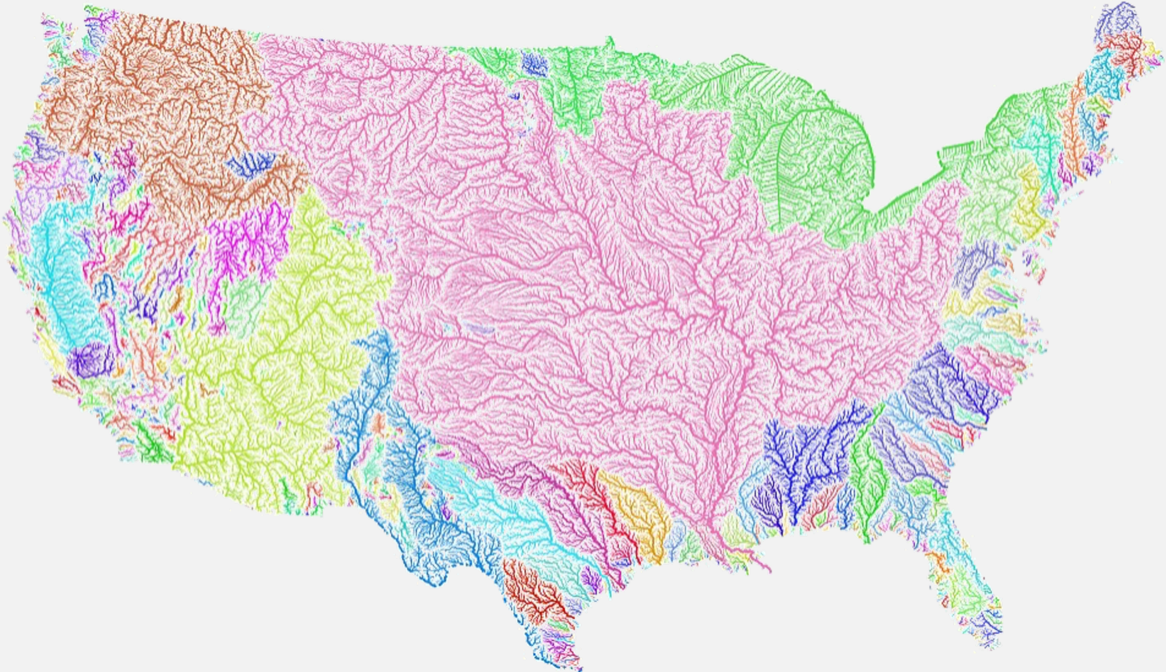

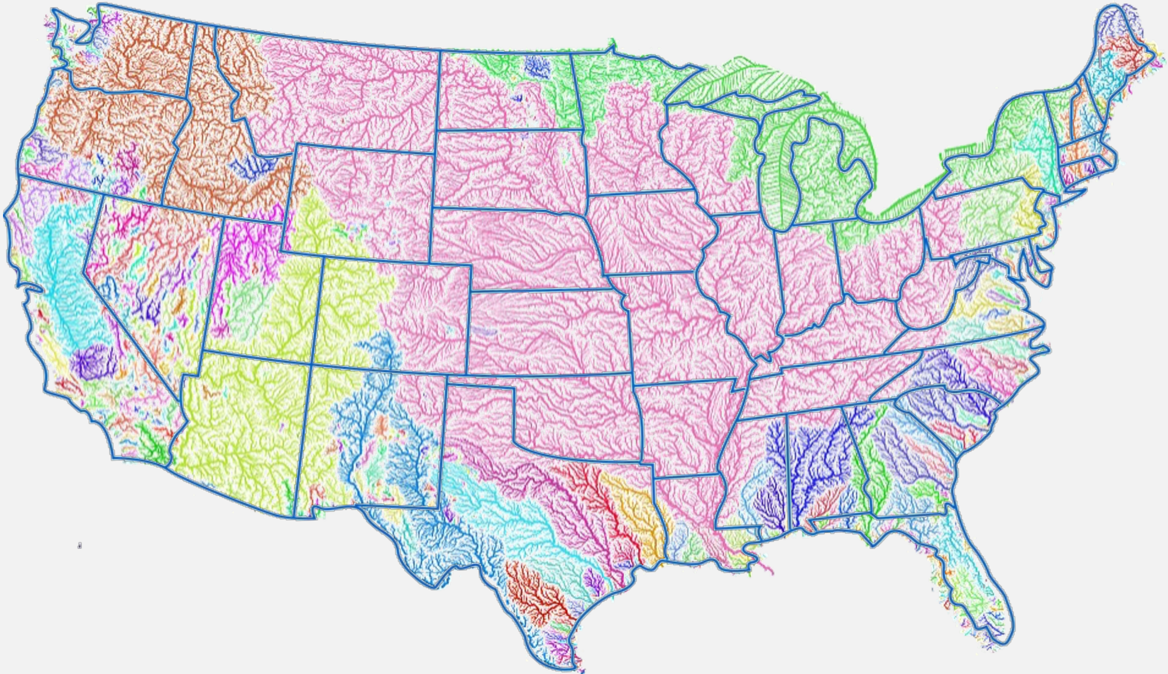

Spillovers, literally

If states can let dirty water flow into a neighboring state, they will because of decentralized oversight of Clean Water Act (CWA), most of the authorization/regulation is split into state jurisdiction

A few papers assess the discrepancy in water quality comparing states with authorization versus without

- Sigman 2002 (AER), 2005 (JEEM)
- Gunn 2022 (working paper)

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Research Aims

Using novel data and design, we

1. verify (and update) the spillover results from papers above
2. broaden previous results for *all* upstream/downstream locations
3. find that environmental groups mitigate spillovers of water pollution

TBC... determine if environmental groups encourage better Clean Water Act compliance & enforcement near state boundaries.

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TBC... determine if environmental groups encourage better Clean Water Act compliance & enforcement near state boundaries.

Model Specification

$$WQ_{it} = \nu \text{N}_t + \gamma \text{G}_{it} + \lambda \text{N}_t * \text{G}_{it} + X_{it} * \beta' + \gamma_s + \tau_t + \epsilon_{it} \qquad (1)$$

- WQ_{it} - water quality at site i in year t
- N_i - indicator of stream exit, by proximity to border
- G_{it} - number of environmental groups (or $spending) near site i in year t
- X_{it} - other county level controls: urban, population, income, and percent college, republican, white, unemployment
- γ_s - state fixed effect
- τ_t - year fixed effect
- ϵ_{it} - error term

Identification assumption: conditional on covariates, error is expected mean zero

Threat to identification: locations of WQ sites *and* enviro groups are each endogenous

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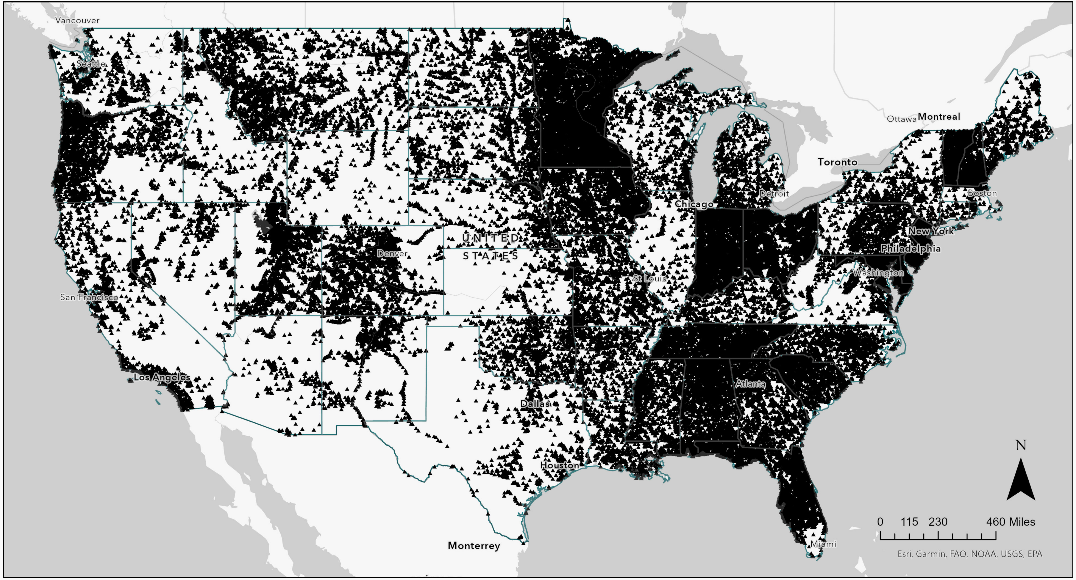
Water Quality Sites, Dissolved Oxygen



Water Quality Data

The National Rivers and Streams Assessment (NRSA)

- Survey of ecological condition of the nation's rivers and streams
- Every five years: 2008–09, 2013–14, and 2018–19
- ∼2,000 sites per survey; ∼1,000 per summer field season
- *in situ* measurements of dissolved oxygen (DO), temperature, and pH; lab results for nitr, phos, tss

Pros:

- Locations selected **randomly**: probability-based sample design
- Reflect the full range flowing waters across the US

Cons:

- Infrequent panel + few sites + single summer measure = low stat power

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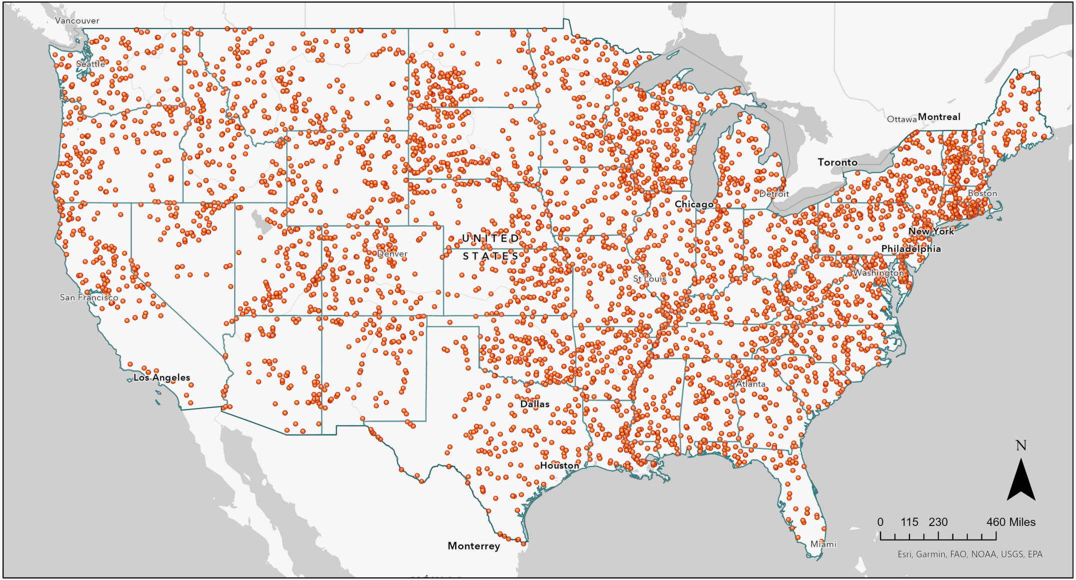
National Rivers and Streams Assessment (NRSA) Sites



Creating a Panel of Water Quality Data, 1989-2019

We download all available monitor-level measurements for dissolved oxygen (DO), temperature, nitrogen, phosphorus

From https://www.waterqualitydata.us/, in STORET managed by the US EPA and NWIS administered by the USGS:

- Water quality data collected by federal agencies, states, tribes, volunteer groups, and universities
- About 20,000 sites for every year; not randomly located

We make a proxy measure for each NRSA site for each WQ type and year:

- Use GIS to select nearby proxy sites ($<$ 5 miles away from NRSA), by year
- Calculate inverse-distance weighted mean for each NRSA location & year
- 6,700 observations in three surveys $\rightarrow$ 130,000 in three decades

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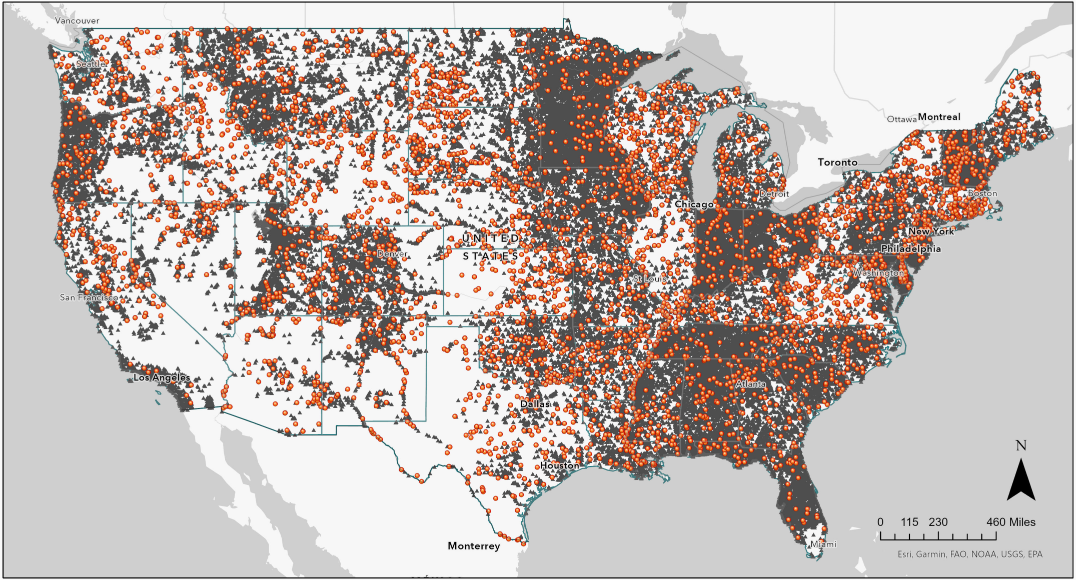
NRSA x WQ Portal



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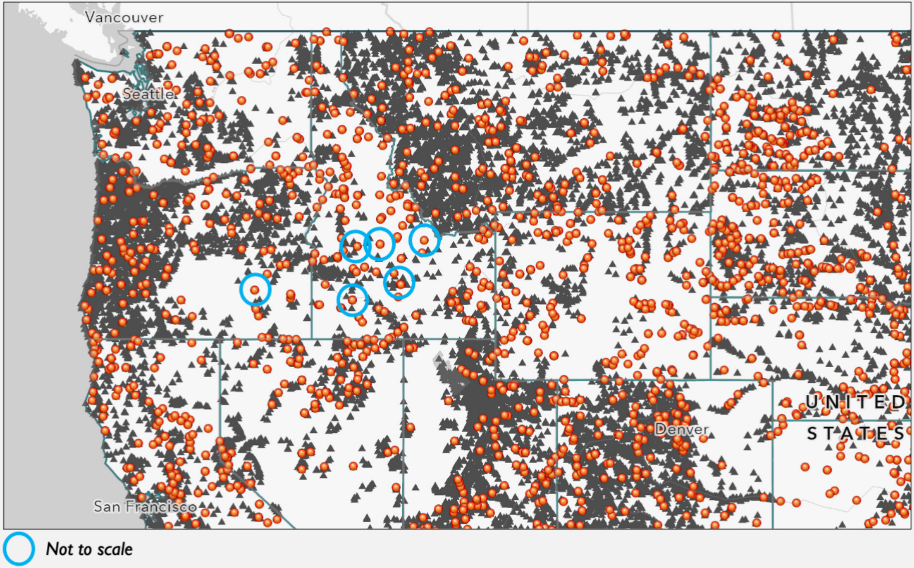
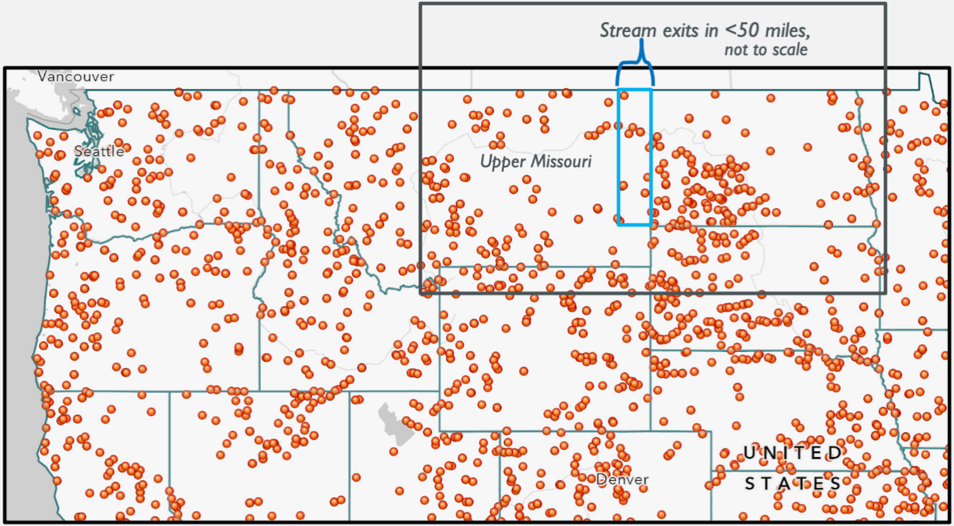


Empirical Strategy



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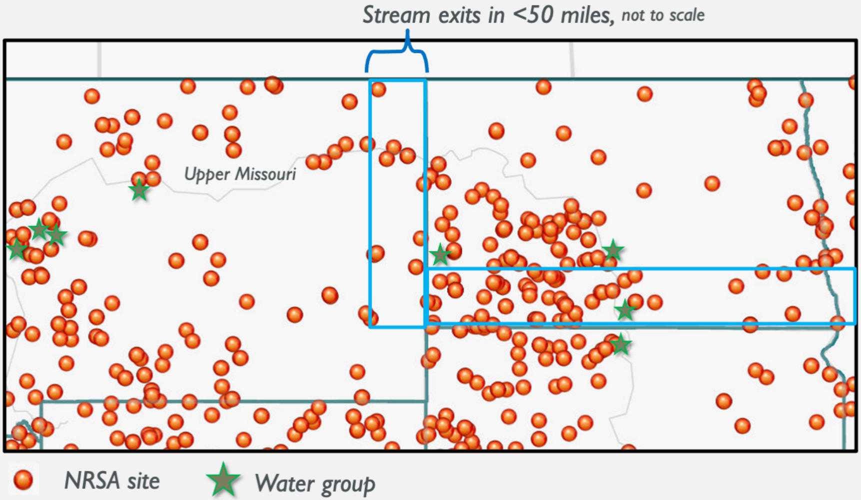

DO – 50 MILES TO EXIT – OLS

Dep Var.: DO – Summer (mg/L)				
Stream Exits	-0.049*** (0.009)	-0.090*** (0.013)	-0.056*** (0.010)	-0.047*** (0.010)
Stream Exits * Number of Groups		0.006*** (0.002)		
Stream Exits * Total Expenditures ($10,000s)			1.32E-04*** (2.5E-05)	
Stream Exits * Mean Expenditures ($10,000s)				9.02E-04*** (1.3E-04)
Year FE	Y	Y	Y	Y
State FE	Y	Y	Y	Y
Obs.	129,164	129,164	129,164	129,164

Robust Std. Errors in Parenthesis

Model Specification with Instrumental Variable

Water groups are **not** randomly located (tend to be where water quality is worse)

$$WQ_{it} = \nu \mathrm{N}_t + \gamma \mathrm{G}_{it}(\alpha_1 \mathrm{IV1}_{it}) + \lambda \mathrm{N}_t * \mathrm{G}_{it}(\alpha_2 \mathrm{IV2}_{it}) + X_{it}\beta' + \gamma_s + \tau_t + \epsilon_{it} \quad (2)$$

- WQ_{it} - water quality at site i in year t
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Following our previous work:

- $IV1_{it}$ - the price of giving to non-profits, as determined by $1 - taxrate$

Significant predictor: Highly causal to non-profit activities

Exclusion restriction/plausibly exogenous: Orthogonal to water quality

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DO – 50 MILES TO EXIT – IV FIRST STAGE

Dep Var.:	**Stream Exits * Number Groups**	**Stream Exits * Total Expenditures**	**Stream Exits * Mean Expenditures**
Stream Exits * Price of Giving	-11.838*** (0.203)	-424.577*** (12.040)	-22.678*** (1.923)
Price of Giving	5.664*** (0.201)	194.893*** (9.613)	6.103*** (1.342)
Cragg-Donald Wald F Stat. *p* – Value	2,963.85 (0.000)	840.019 (0.000)	80.390 (0.000)

Robust Std. Errors in Parenthesis

DO – 50 MILES TO EXIT – IV SECOND STAGE

Stream Exits	-0.049*** (0.009)	-0.240*** (0.036)	-0.223*** (0.033)	-0.617*** (0.112)
Stream Exits * Number of Groups		0.043*** (0.008)		
Stream Exits * Total Expenditures ($10,000s)			0.001*** (2.2E-04)	
Stream Exits * Mean Expenditures ($10,000s)				0.022*** (0.004)
Year FE	Y	Y	Y	Y
State FE	Y	Y	Y	Y
Obs.	129,164	129,164	129,164	129,164

Robust Std. Errors in Parenthesis

How big ares these changes?

Translate each coefficient into

- Amount of spillover, relative to mean DO
- Mitigation by groups, on average and for the marginal group, as a percent of the spillover effect above

MAGNITUDES – 50 MILES TO EXIT

Model:	Number of Groups	Total Expenditures	Mean Expenditures
OLS			
Spillover (% increase in DO) As % of annual DO Change	0.6% 7.7%	0.7% 8.8%	0.6% 7.4%
Group Mitigation – Average Group Mitigation – Marginal	34.1% 6.4%	39.7% 0.24%	52.2% 1.9%
IV			
Spillover (% increase in DO) As % of annual DO Change	2.9% 37.8%	3.2% 35.1%	8.1% 97.3%
Group Mitigation – Average Group Mitigation – Marginal	95.3% 17.88%	90.6% 0.5%	96.1% 3.6%

Take-Aways

- DO is significantly worse if the stream is exiting the state
- Water groups mitigate this issue
- Implies that these groups can straddle state jurisdictions and reduce the spillover

Further work

- Other WQ measures
- Effects on enforcement and compliance
- Anything else?

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- Anything else?

Thank You!

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DO – 10 MILES TO EXIT – OLS

Dep Var.: DO – Summer (mg/L)				
Stream Exits	-0.032*** (0.011)	-0.084*** (0.018)	-0.053*** (0.014)	-0.039*** (0.014)
Stream Exits * Number of Groups		0.010*** (0.003)		
Stream Exits * Total Expenditures ($10,000s)			2.15E-04*** (4.02E-05)	
Stream Exits * Mean Expenditures ($10,000s)				1.12E-03*** (2.2E-04)
Year FE	Y	Y	Y	Y
State FE	Y	Y	Y	Y
Obs.	129,164	129,164	129,164	129,164

Robust Std. Errors in Parenthesis

DO – 10 MILES TO EXIT – IV FIRST STAGE

Dep Var.:	**Stream Exits * Number Groups**	**Stream Exits * Total Expenditures**	**Stream Exits * Mean Expenditures**
Stream Exits * Price of Giving	-10.633*** (0.385)	-326.466*** (23.680)	-5.783 (3.709)
Price of Giving	1.129*** (0.084)	28.565*** (4.663)	-2.895*** (0.848)
Cragg-Donald Wald F Stat. *p* – Value	2,953.21 (0.000)	692.00 (0.000)	14.68 (0.000)

Robust Std. Errors in Parenthesis

DO – 10 MILES TO EXIT – IV SECOND STAGE

Stream Exits	-0.032*** (0.011)	-0.241*** (0.060)	-0.265*** (0.068)	-1.482** (0.678)
Stream Exits * Number of Groups		0.043*** (0.012)		
Stream Exits * Total Expenditures ($10,000s)			0.001*** (4.0E-04)	
Stream Exits * Mean Expenditures ($10,000s)				0.052** (0.025)
Year FE	Y	Y	Y	Y
State FE	Y	Y	Y	Y
Obs.	129,164	129,164	129,164	129,164

Robust Std. Errors in Parenthesis

MAGNITUDES – 10 MILES TO EXIT

Model:	Number of Groups	Total Expenditures	Mean Expenditures
OLS			
Spillover (% increase in DO)	1.1%	0.7%	0.5%
As % of annual DO Change	13.2%	8.8%	6.1%
Group Mitigation – Average	62.7%	70.8%	81.9%
Group Mitigation – Marginal	12.2%	0.4%	2.9%
IV			
Spillover (% increase in DO)	3.2%	3.5%	19.4%
As % of annual DO Change	37.9%	41.6%	231%
Group Mitigation – Average	91.9%	94.4%	100%
Group Mitigation – Marginal	17.91%	0.5%	3.6%