



**Envision** Developing next generation  
leaders in environmental science

Environment  
Centre

Lancaster  
University 

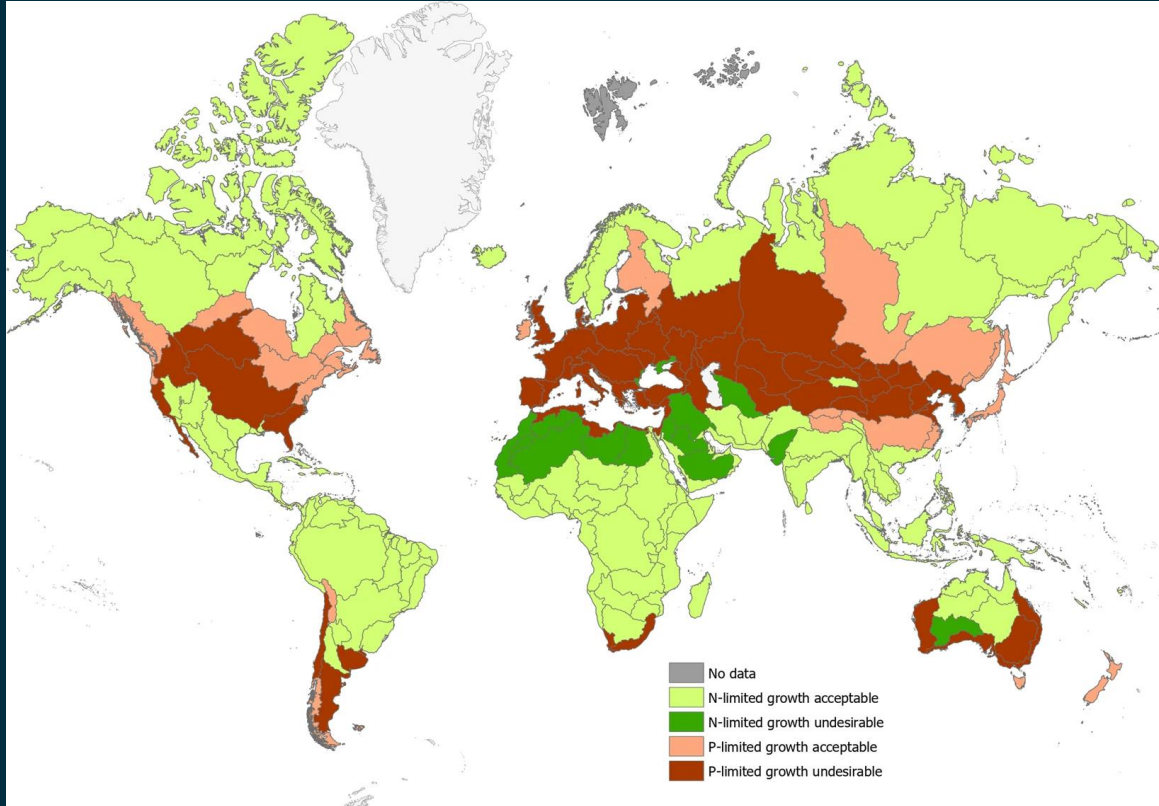
UNION  
COLLEGE  
FOUNDED 1795

LIZ FLINT, MATT ASCOTT, DAREN GOODDY, BEN SURRIDGE, MASON STAHL

# Impacts of public water supply on global nitrogen cycling



British  
Geological  
Survey



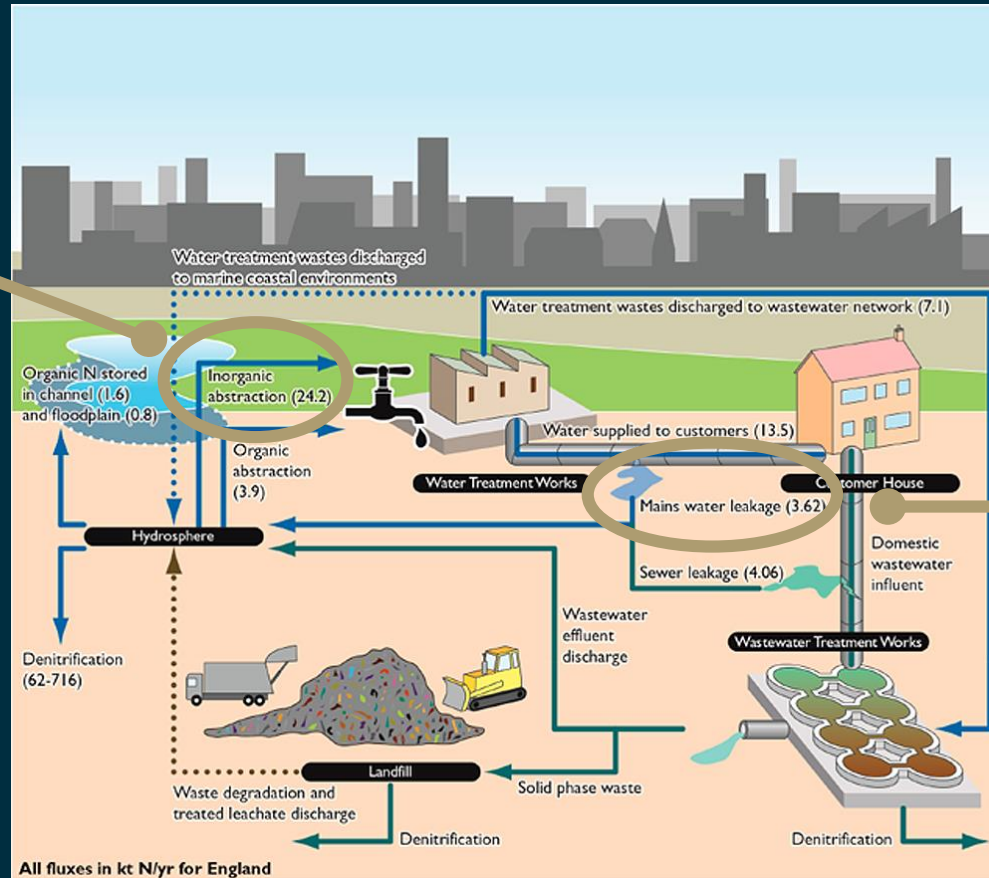
**“You can’t manage what you can’t measure”**

- Peter Drucker

Retention flux  
from  
abstraction:

24.2 kT N/yr

(3-39%  
hydrosphere  
denitrification)

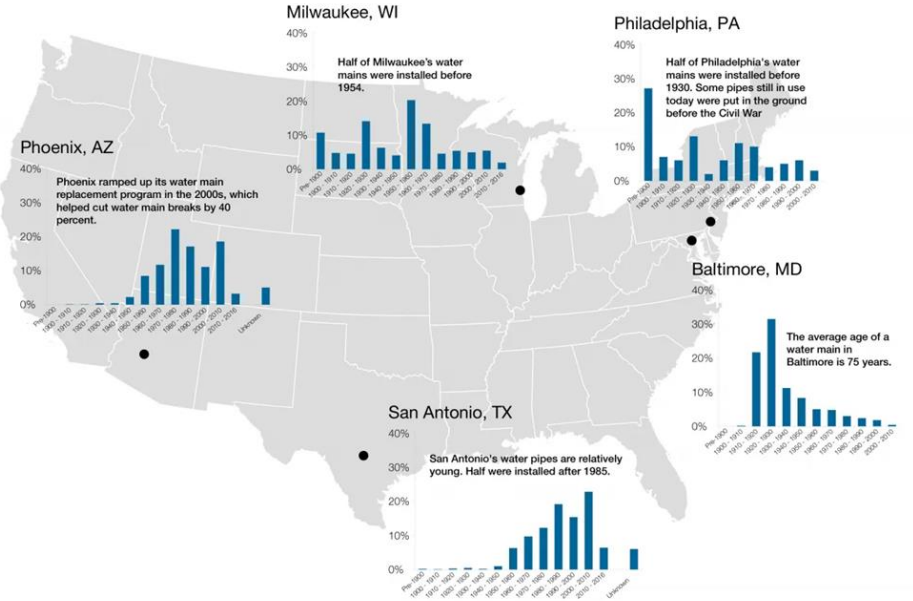
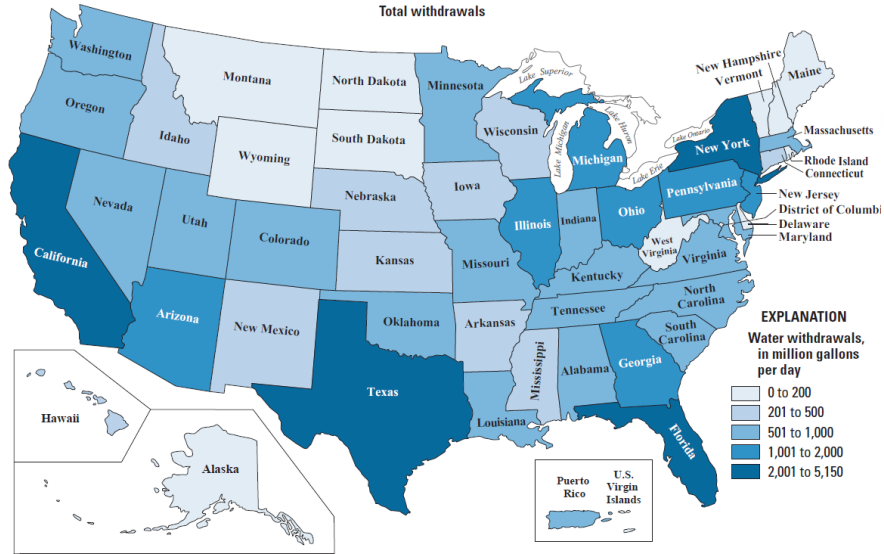


Return flux  
from mains  
water leakage:

3.62 kT N/yr

(15% of  
abstraction)

# United States: Public Water Supply N Fluxes



# Key Research Questions

1. Is abstraction a significant retention mechanism for nitrate across the United States?
2. Are mains water leakages returning a significant amount of nitrate back to the environment?
3. How will these fluxes change in the future?

# Methodology

## Abstraction

$$\text{ABS-N} = (\text{Cr} \times \text{WD})_{\text{GW}} + (\text{Cr} \times \text{WD})_{\text{SW}}$$

- State averaged raw water nitrate concentrations (Cr)
- State PWS withdrawals (WD)

## Published comparison fluxes

- Discharge from rivers to coastal waters
- Denitrification from US waterways
- Total retention in aquatic systems

## Mains Water Leakage

$$\text{MWL-N} = \text{Ct} \times \text{LV}$$

where  $\text{LV} = \text{WD}_{\text{TOTAL}} \times f_{\text{state}}$

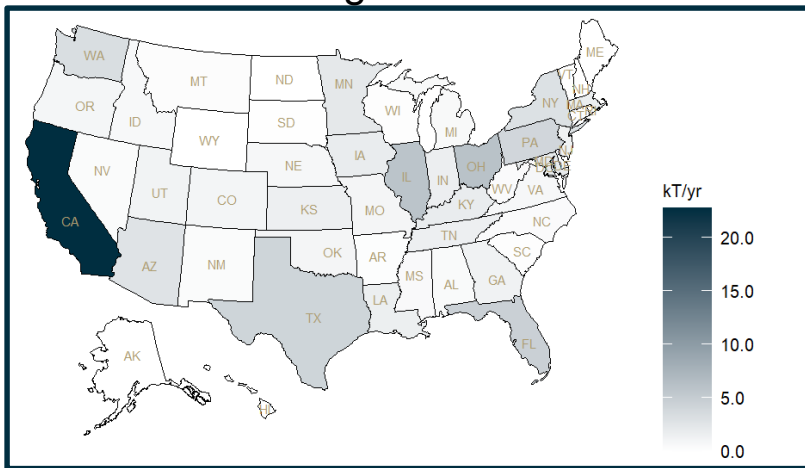
- State averaged treated water nitrate concentrations (Ct)
- State PWS withdrawals (WD)
- State fractional leakage rate ( $f_{\text{state}}$ )

## Published comparison fluxes

- Wastewater N input
- Urban N fertilizer

# Results

## Abstraction is a significant N retention flux



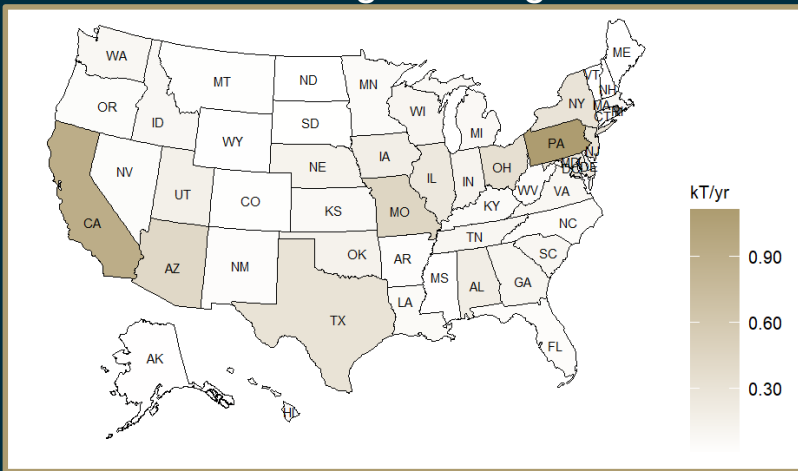
12.0% of total denitrification  
from US rivers and streams

1.8% of riverine discharge to  
coastal waters

1.1% of total N retention in  
US aquatic systems

**Total:**  
87.7 kT/yr

## Mains water leakage is a significant return flux



8.2% of ABS-N

3.6% septic tank leachate N

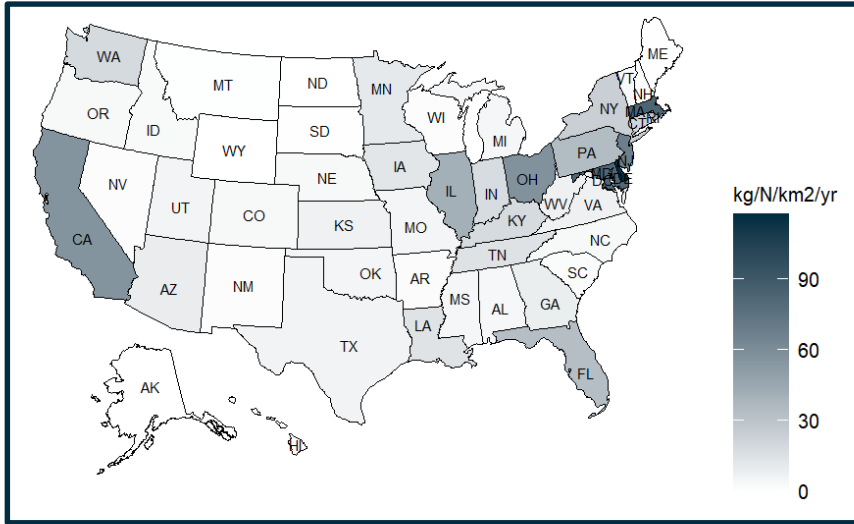
2.7% urban fertilizer

0.9% of N from wastewater

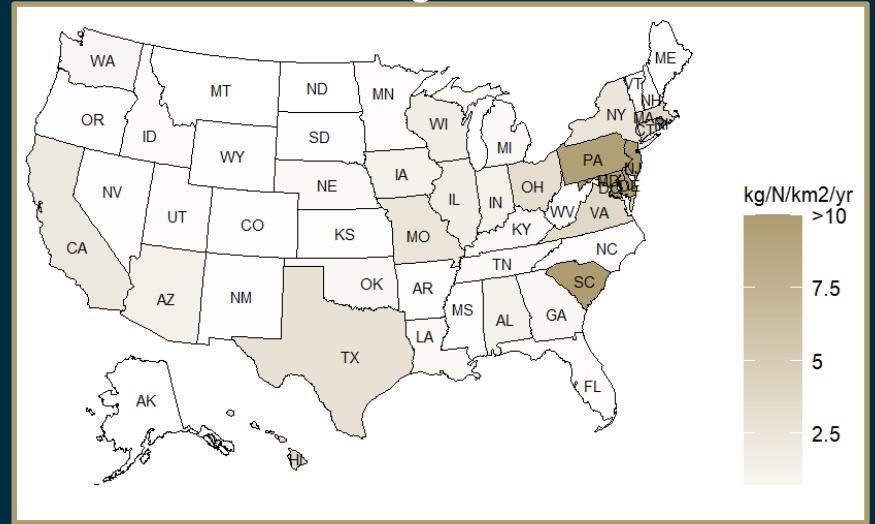
**Total:**  
7.20  
kT/yr

# Results (normalised)

## Abstraction



## Mains water leakage





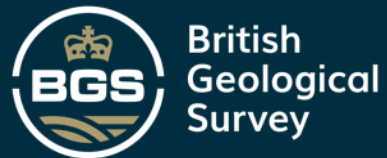
# Conclusion

- Abstraction for PWS is significant temporary N retention mechanism
- MWL is an important return flux of N to the environment
- Regional differences observed across the country, even after normalisation



# Future Work

1. Make localised PWS N flux estimates in the US (e.g. California)
2. Determine potential future significance of PWS N fluxes
3. Determine the significance of non-public supply withdrawal N fluxes in the US (e.g. self-supply, agriculture and industry)
4. Make estimates of other macronutrient fluxes associated with PWS (e.g. MWL-P)
5. Determine similar fluxes for countries at contrasting stages of development, in order to make a more global assessment



THANK YOU

I look forward to receiving any questions or comments in the breakout session later