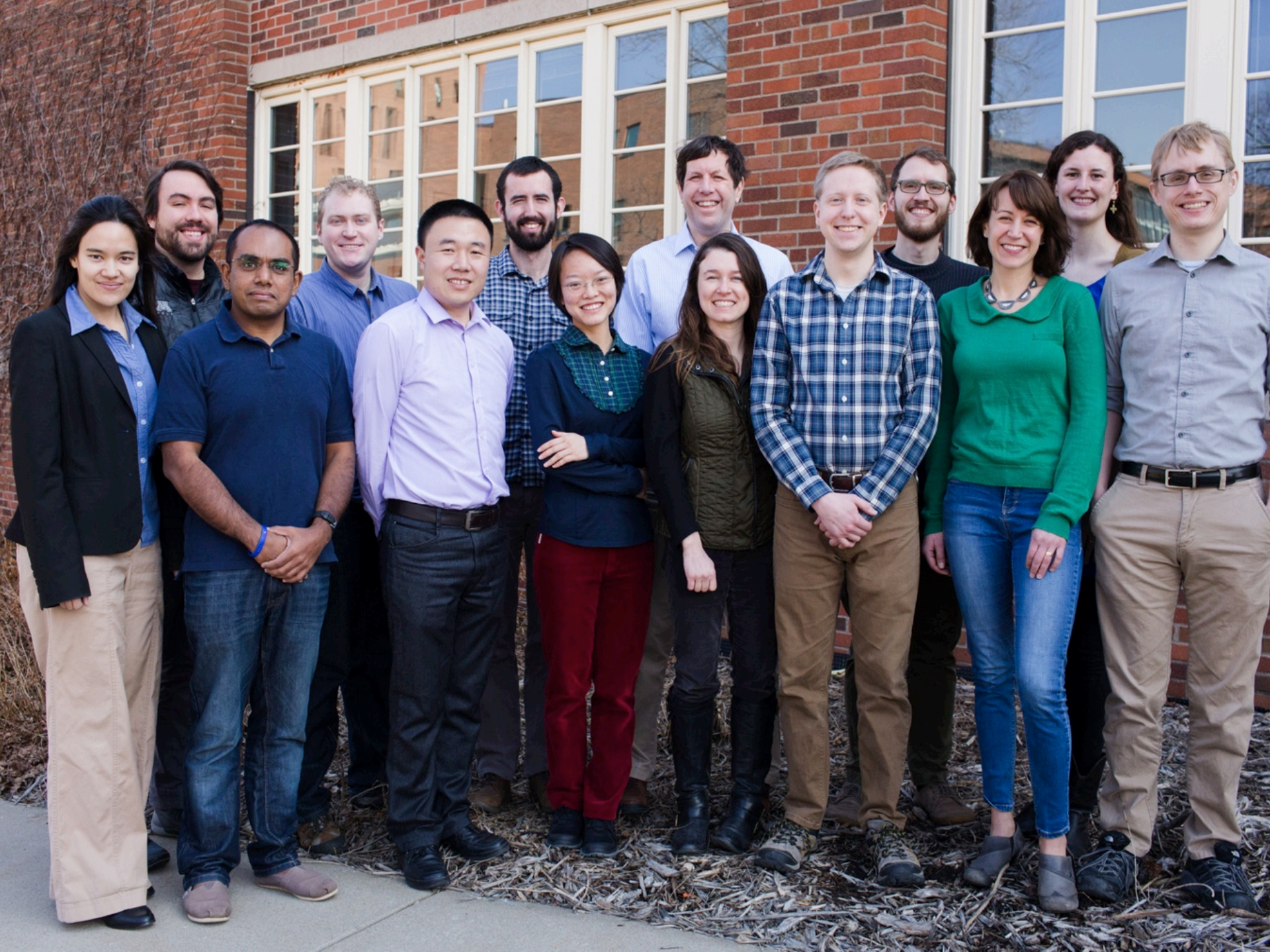
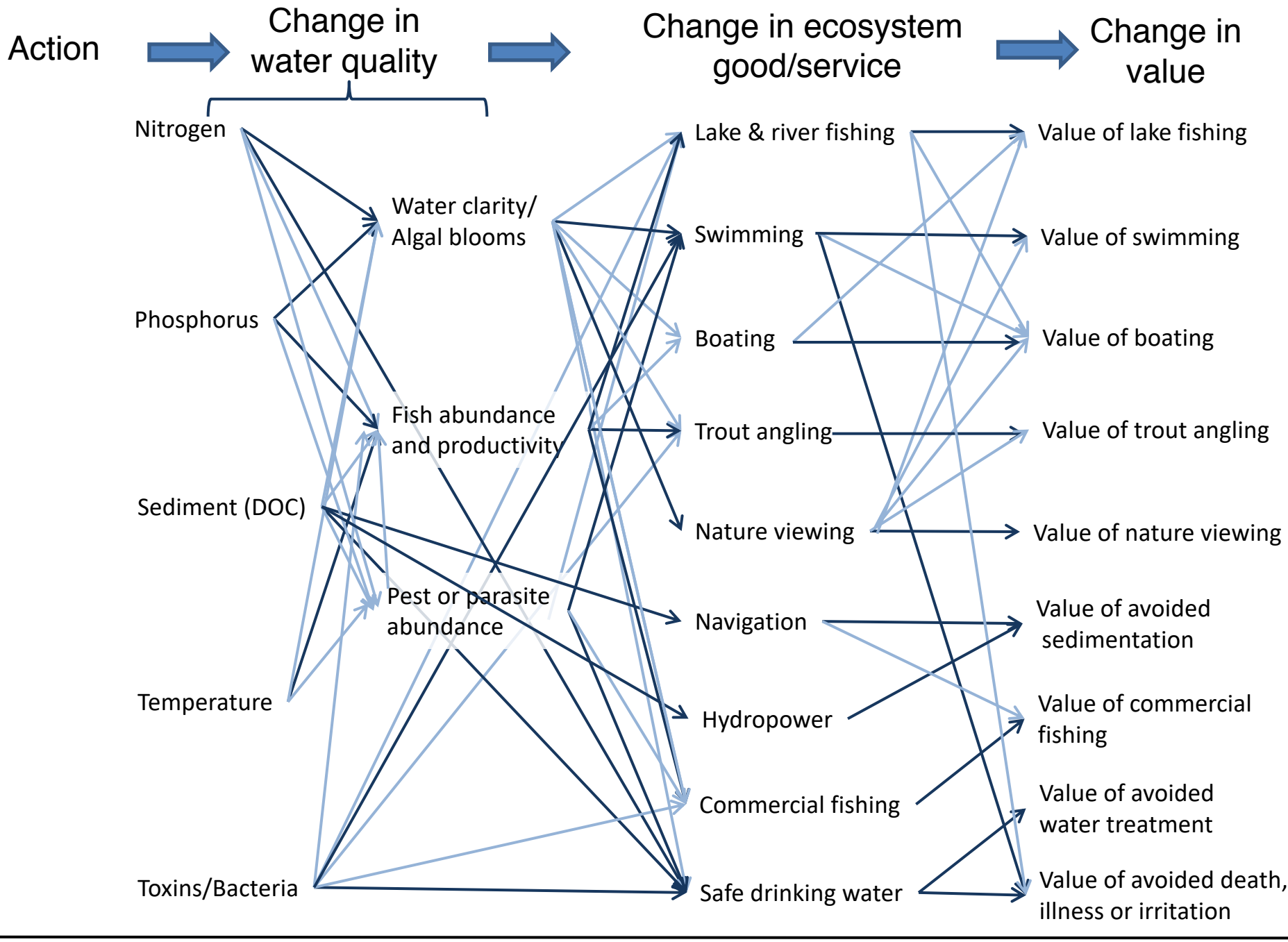


Linking water quality and well-being for improved assessment and valuation of ecosystem services

Bonnie L. Keeler[a,1], Stephen Polasky[a,b,c,1], Kate A. Brauman[a], Kris A. Johnson[d], Jacques C. Finlay[c], Ann O'Neill[e], Kent Kovacs[f], and Brent Dalzell[g]

Keeler et al. PNAS 2012


Action
Change in water quality
Change in ecosystem good/service
Change in value
Nitrogen
Phosphorus
Sediment (DOC)
Temperature
Toxins/Bacteria
Water clarity/ Algal blooms
Fish abundance and productivity
Pest or parasite abundance
Lake & river fishing
Swimming
Boating
Trout angling
Nature viewing
Navigation
Hydropower
Commercial fishing
Safe drinking water
Value of lake fishing
Value of swimming
Value of boating
Value of trout angling
Value of nature viewing
Value of avoided sedimentation
Value of commercial fishing
Value of avoided water treatment
Value of avoided death, illness or irritation
Primary driver
Secondary driver
Keeler et al. 12 PNAS

PROGRESS: PUTTING PEOPLE on the MAP

BIOPHYSICAL

source

transport

attenuation

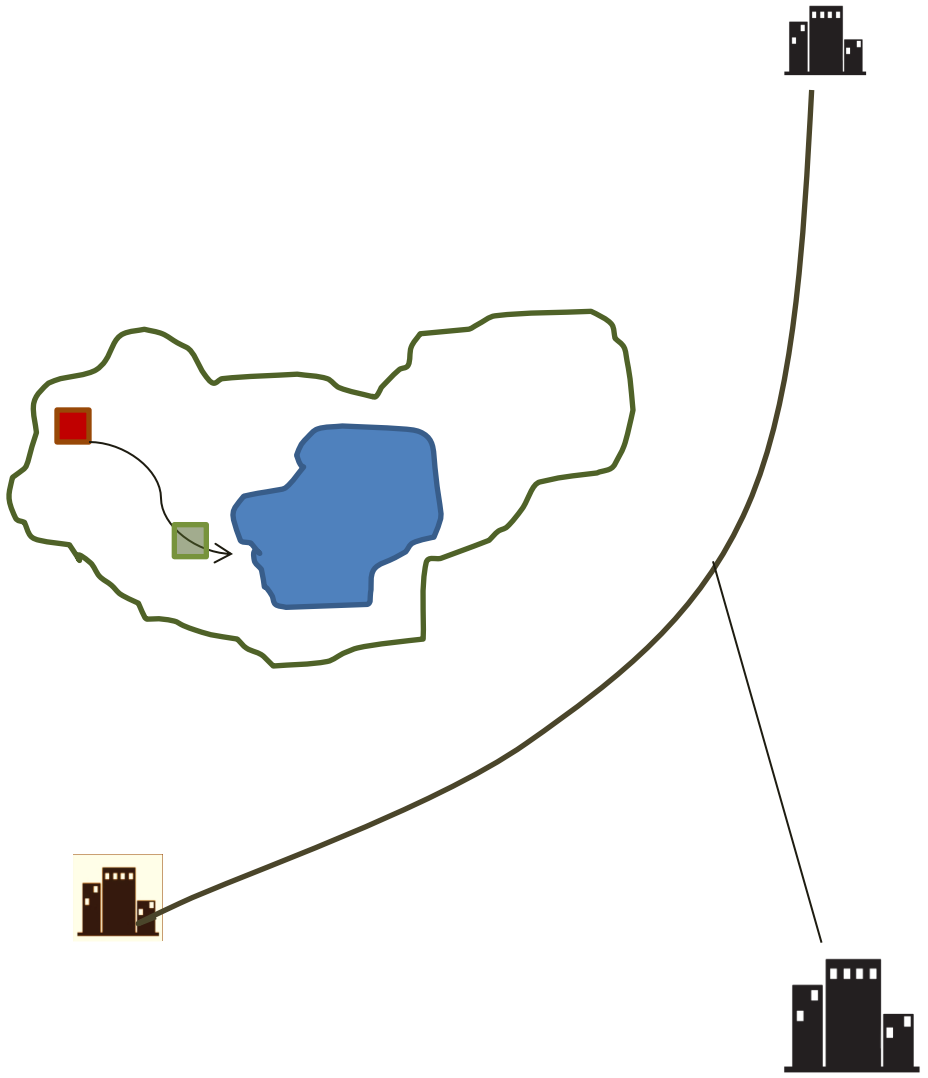
ENDPOINT

VALUE/BENEFIT

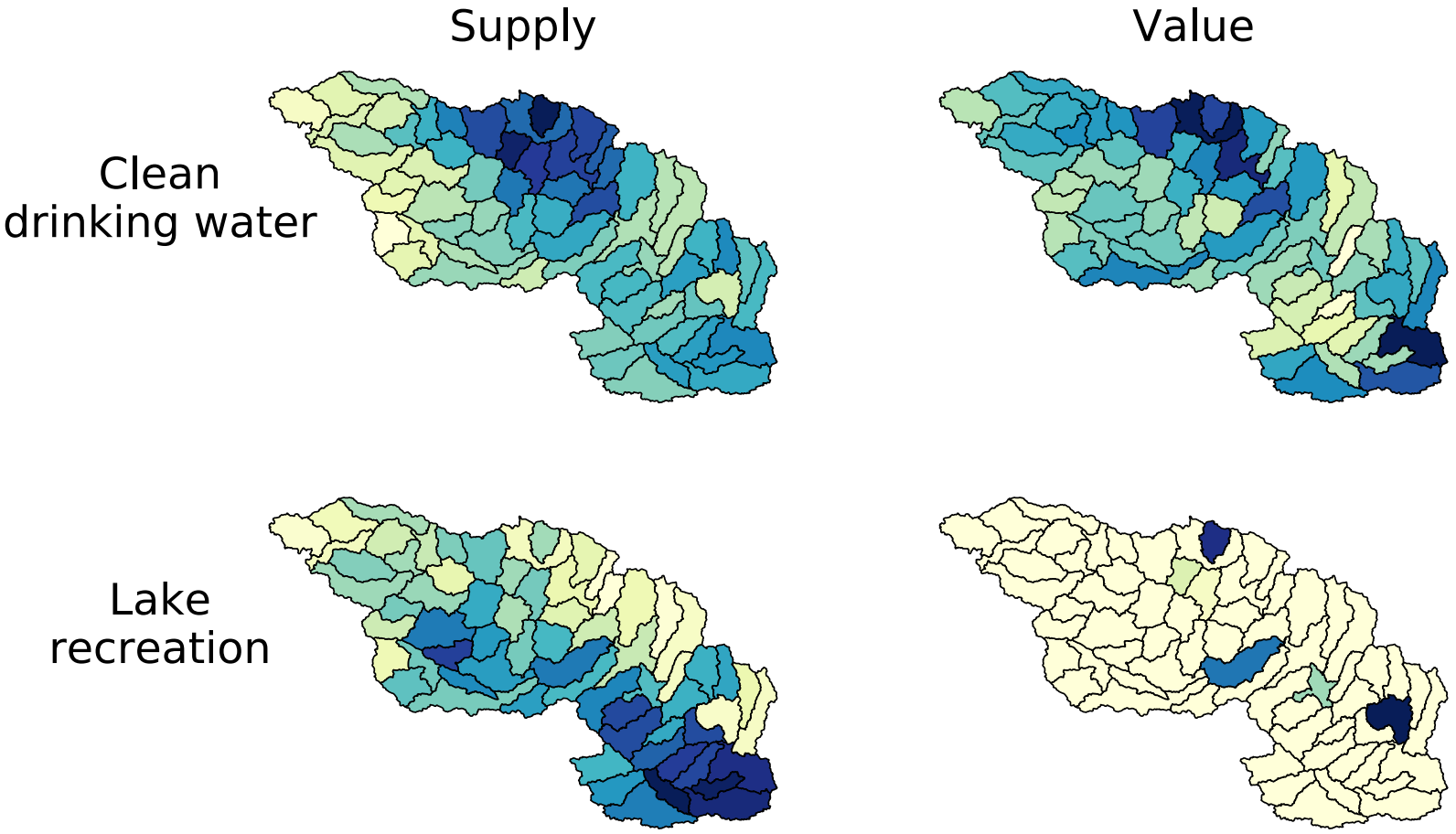
exposure

vulnerability/sensitivity

preferences/value

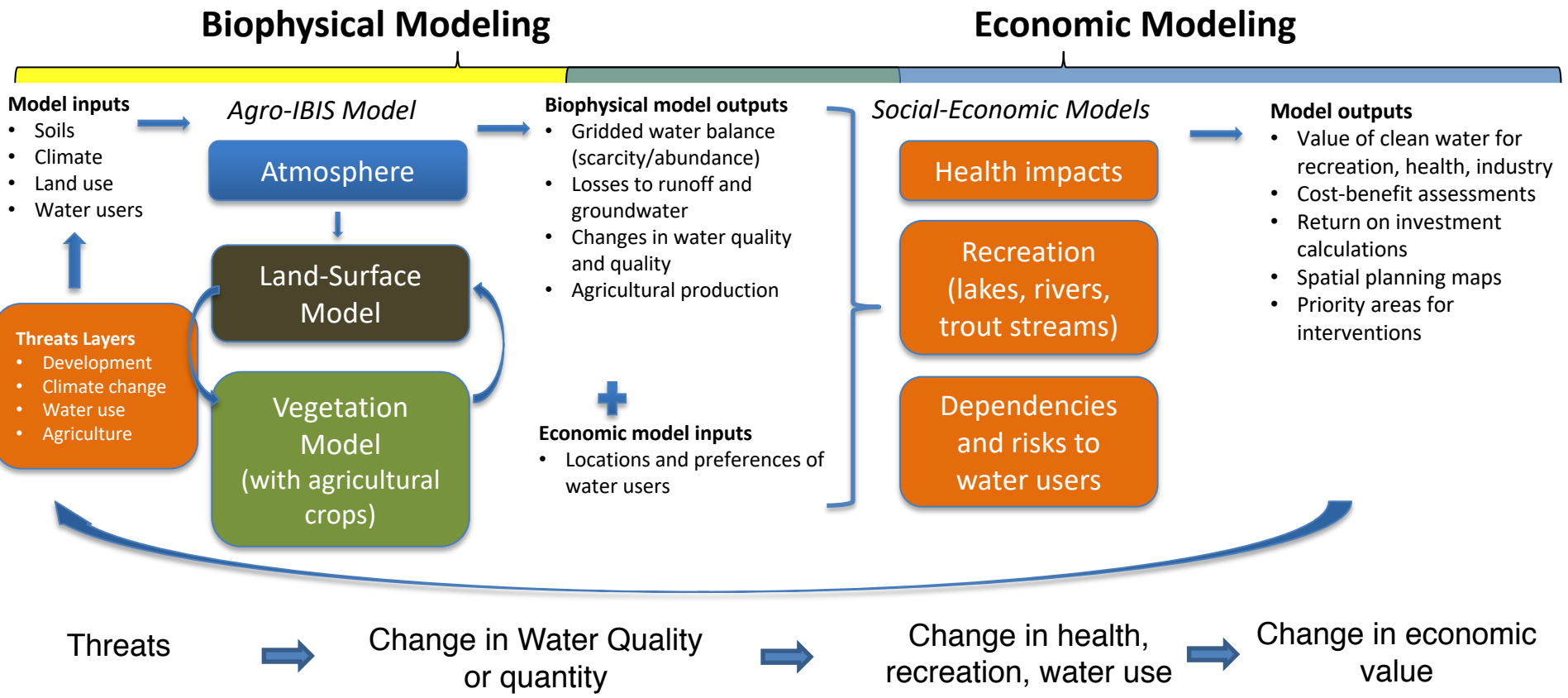


PROGRESS: PUTTING PEOPLE on the MAP



Keeler et al. in review

PROGRESS: INTEGRATED MODELING



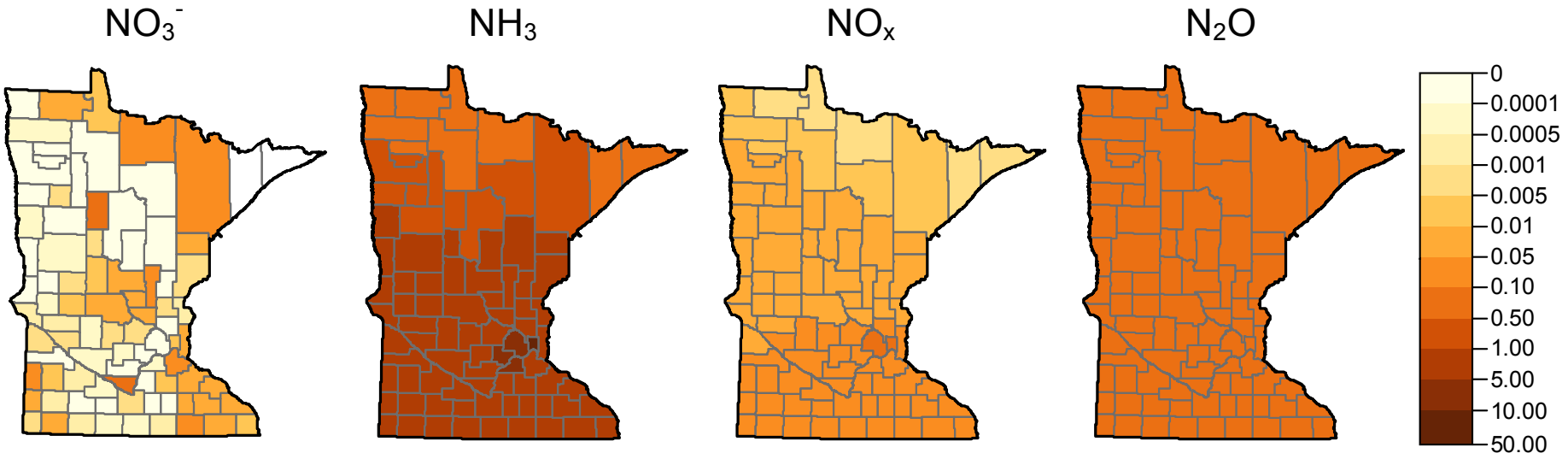
Threats → Change in Water Quality or quantity → Change in health, recreation, water use → Change in economic value

SCIENCE ADVANCES | RESEARCH ARTICLE

ENVIRONMENTAL STUDIES

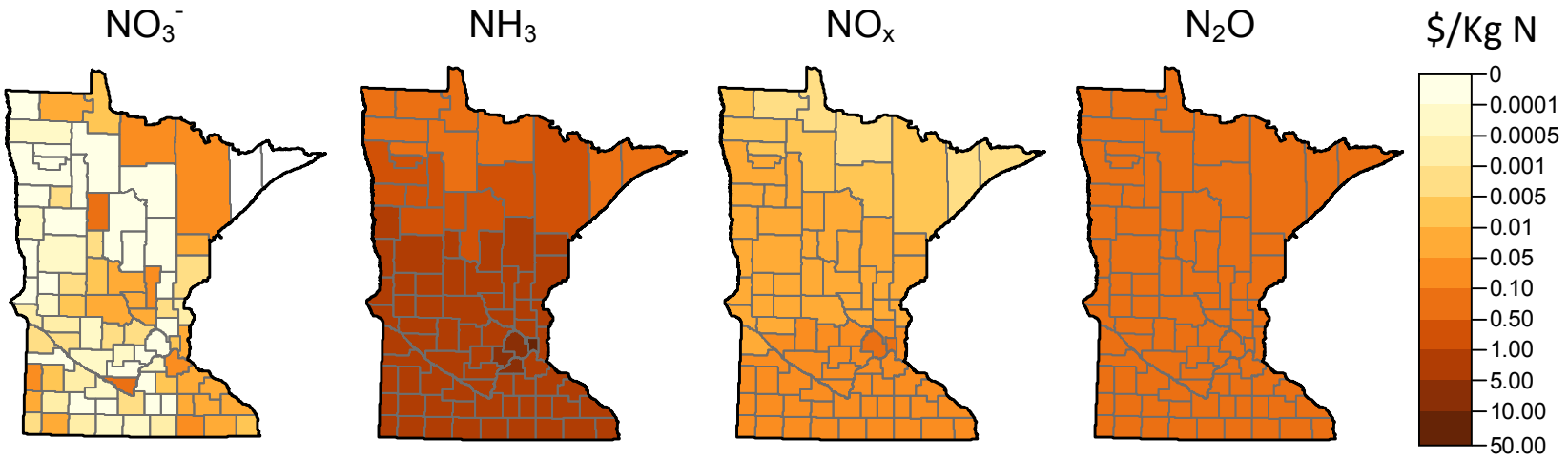
The social costs of nitrogen

Bonnie L. Keeler,[1]* Jesse D. Gourevitch,[1] Stephen Polasky,[1,2,3] Forest Isbell,[3] Chris W. Tessum,[4] Jason D. Hill,[5] Julian D. Marshall[4]



SCN = Allocation + Transport + Damages

BUT…comparing apples & oranges?



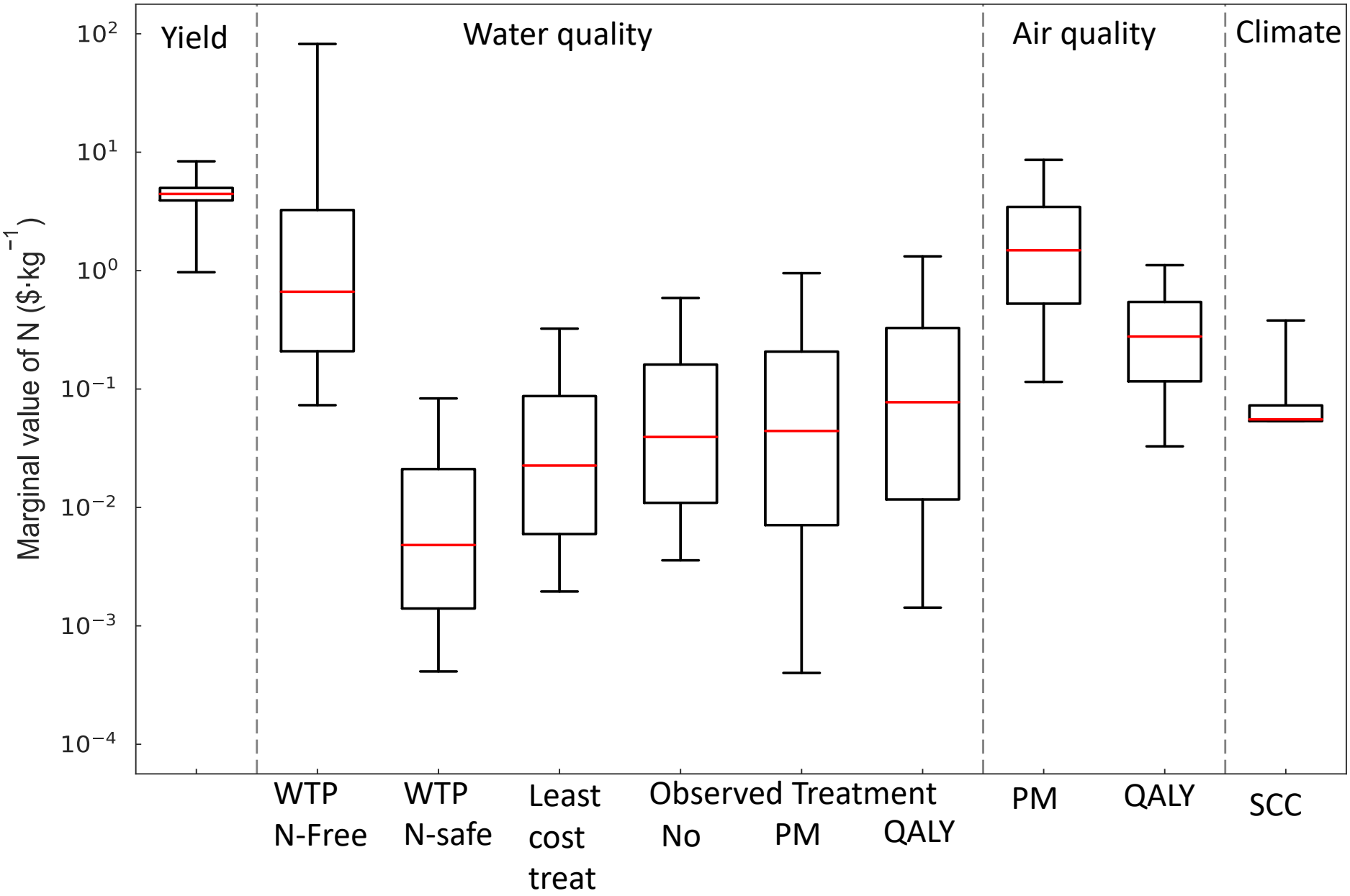
Marginal Costs

	Average Value per Kg N
NO_3	$0.01
NH_3	$2.33
NO_x	$0.05
N_2O	$0.22

Keeler et al. 2016

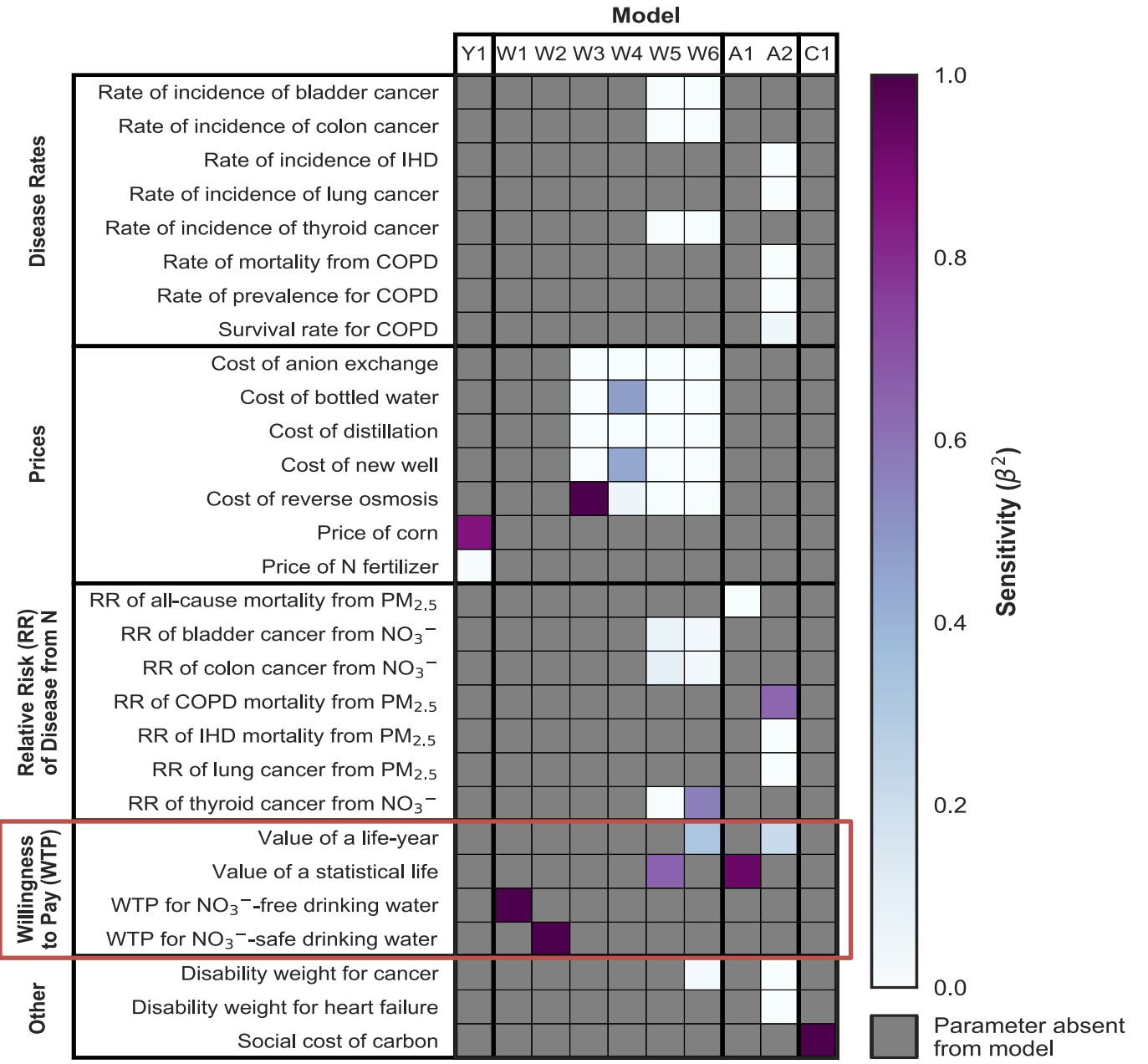
Determining socially optimal rates of nitrogen fertilizer application

Jesse D. Gourevitch[a,b,*], Bonnie L. Keeler[c], Taylor H. Ricketts[a,b]



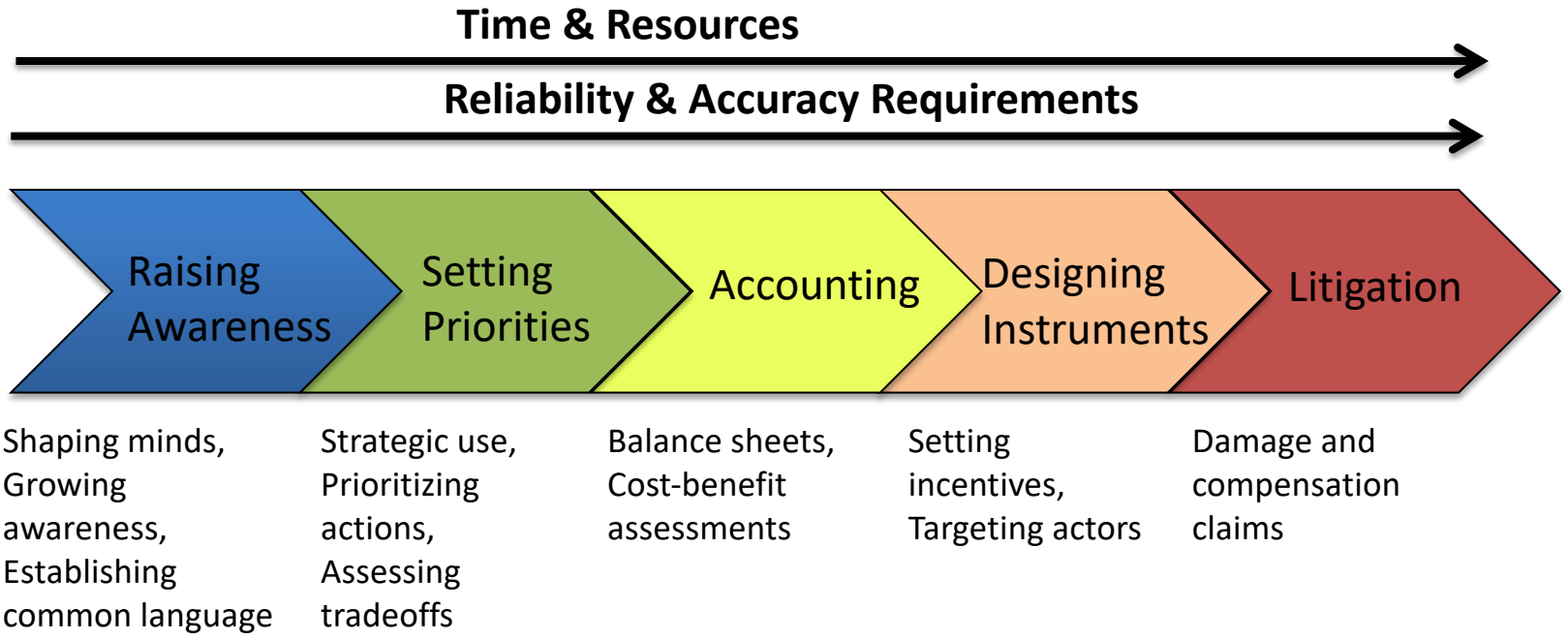
Determining socially optimal rates of nitrogen fertilizer application

Jesse D. Gourevitch[a,b,*], Bonnie L. Keeler[c], Taylor H. Ricketts[a,b]



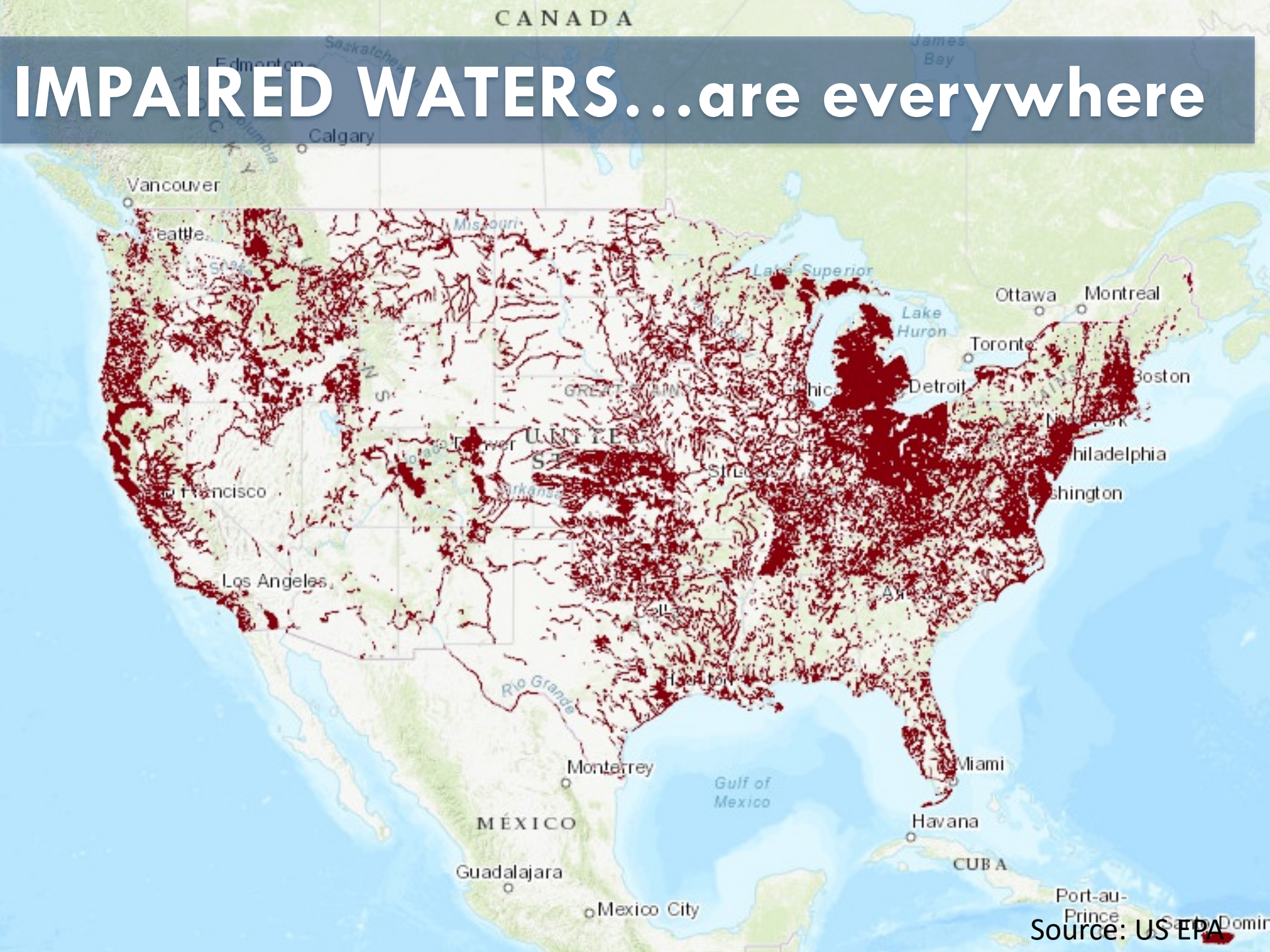
"The price you pay for precision is an inability to deal with real-world issues"

- Douglass C. North



Adapted from Gómez-Baggethun et al. Ecol Econ 2013

IMPAIRED WATERS…are everywhere



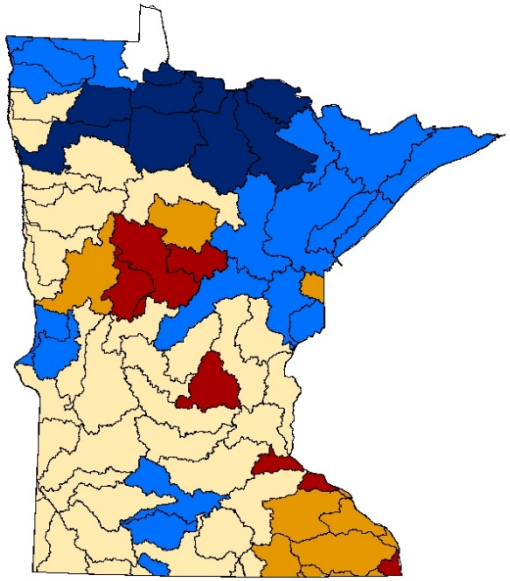
Source: US EPA

ARE WE MAKING SMART INVESTMENTS in CLEAN WATER?

CLEAN WATER LAND & LEGACY AMENDMENT

WHERE to INVEST?

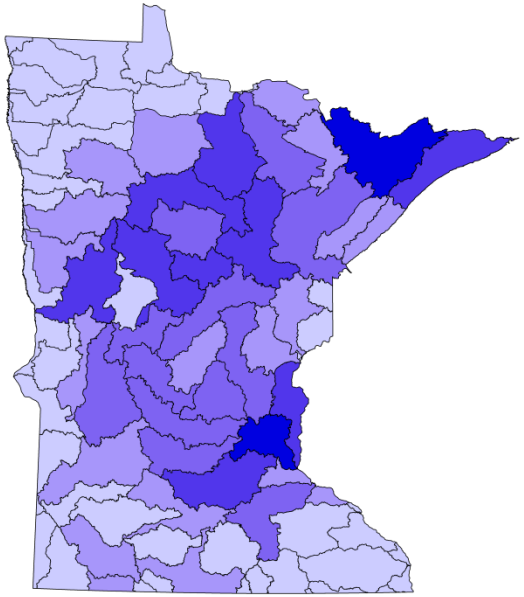
Drinking water



Level of Susceptibility to Groundwater Contamination

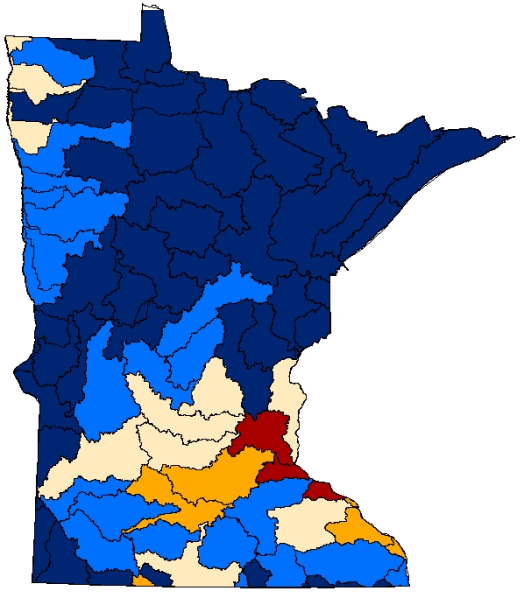
- Insufficient Data to Rank
- Lowest Susceptibility
- Low Susceptibility
- Medium Susceptibility
- High Susceptibility
- Highest Susceptibility

Recreational use value



Lake visitation by major watershed

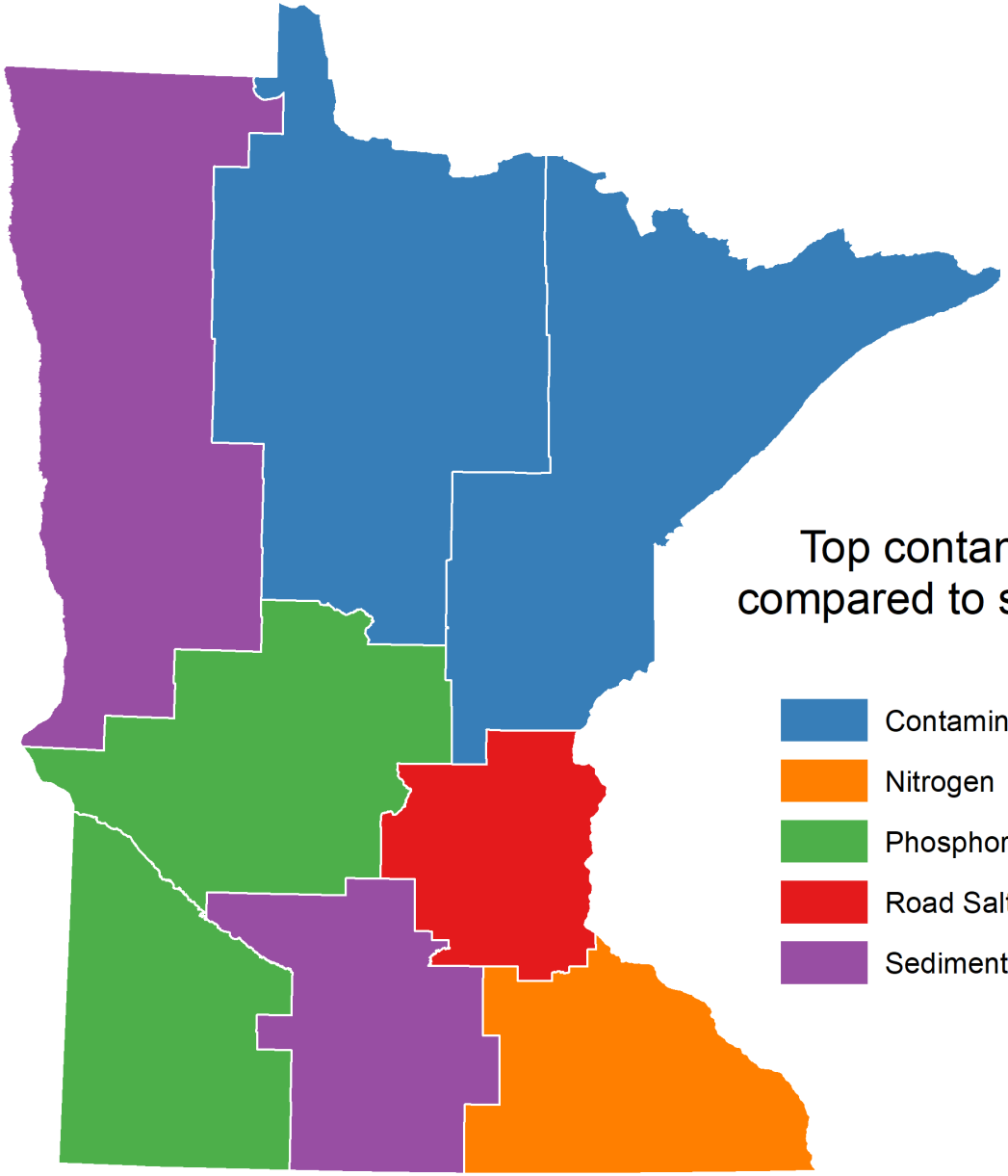
Gulf hypoxia



Level of Nutrient Delivery to Basin Outlet

- Lowest delivered load
- Low delivered load
- Medium delivered load
- High delivered load
- Highest delivered load

DEPENDS on VALUES…



25BY25

Top contaminant concern
compared to statewide average

- Contaminants of Emerging Concern
- Nitrogen
- Phosphorus
- Road Salt
- Sediment

WHOSE VALUES? WHOSE WATER?