# What have learned about using economic incentives to address the NPS problem?

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# Incentives for behavior change

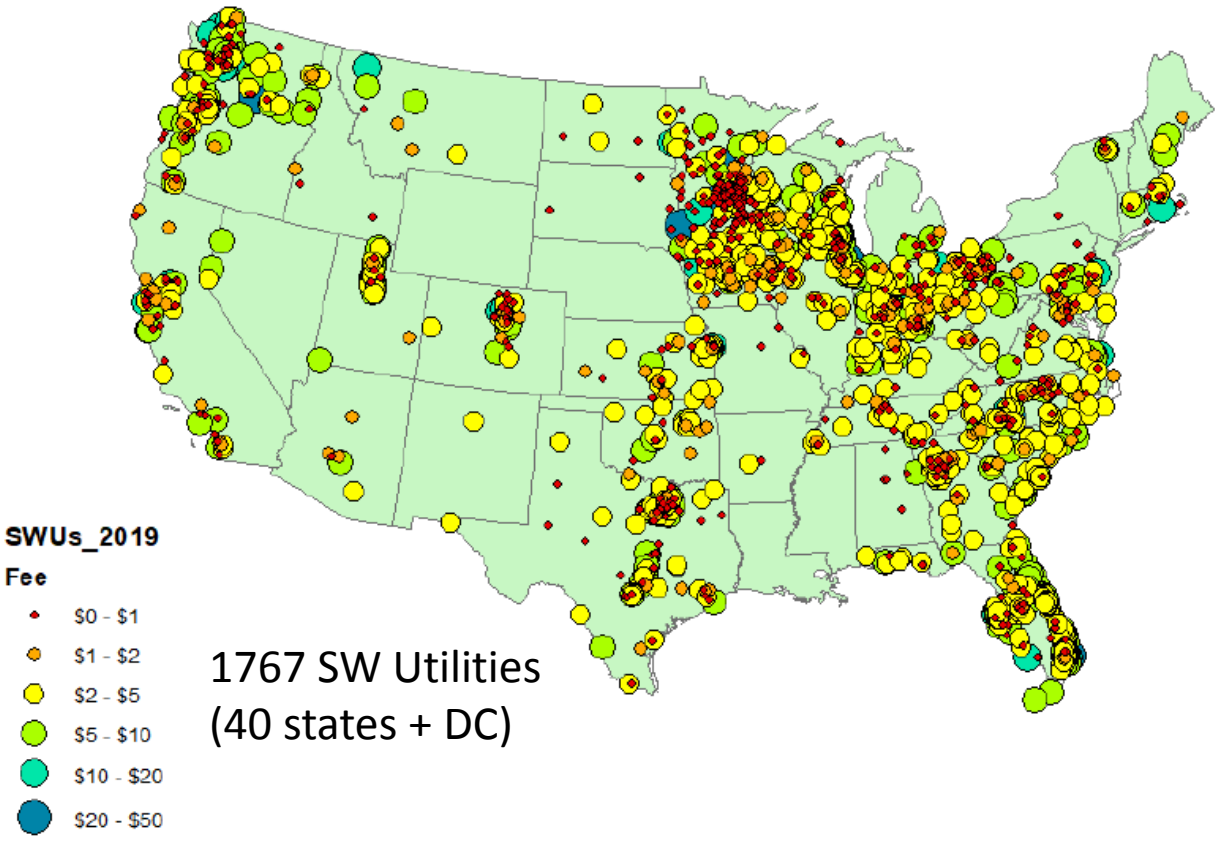
## Tools in the toolbox

1. Legal - regulatory-driven
2. Economic - market-driven
3. Social - peer-driven / individual nudges
4. Combinations of 1-3

# What has been effective in stormwater?

## Results from Tasca et al. 2017

Stormwater utility fees 2019




1767 SW Utilities
(40 states + DC)

Campbell et al. 2019

- "Charging stormwater fees is a successful mechanism to fund … environmental protection"
- Fees are intended to motivate private action
  - Property owners who install SWM may qualify for fee reductions
  - Most used practices in VA - bioretention areas, permeable pavement, infiltration trenches, and rain barrels

# Do SW fees motivate private landowners?

- “In practice, stormwater fees are not high enough to motivate single family households to reduce their runoff” (Tasca et al. 2017)
- Do motivate big runoff producers or those with altruistic/other motives

*“Over a 20-year period, stormwater credits cover less than 15% of the total costs to install and maintain most urban stormwater control practices”*

Gonzalez, Mosley and Stephenson (2016, VA analysis)

# Are SW programs cost-effective?

## *Results from Wainger et al. review – MD Analysis*

- Reliable revenue streams + performance incentives promote effective institutions
  - In 2 years, Clean Water Partnership (CWP), Prince George's County, restored >1,200 impervious acres and 600 acres were in construction, roughly matching goals.
- Many small projects increase transaction costs & restoration supply chains can be inadequate
- Effectiveness at reducing nutrients, toxic contaminants? Credit accuracy?

# Why do farmers adopt environmentally sustainable practices?

- Cognitive Factors
  - Knowledge
  - Perceived risk
  - Heuristics/biases
  - Financial objectives
- Dispositional Factors
  - Personality
  - Values
  - Risk tolerance
- Social factors
  - Peer group values
  - Social norms
  - Engagement strategies

(After Dessart 2019)

Bowman and Lynch 2019

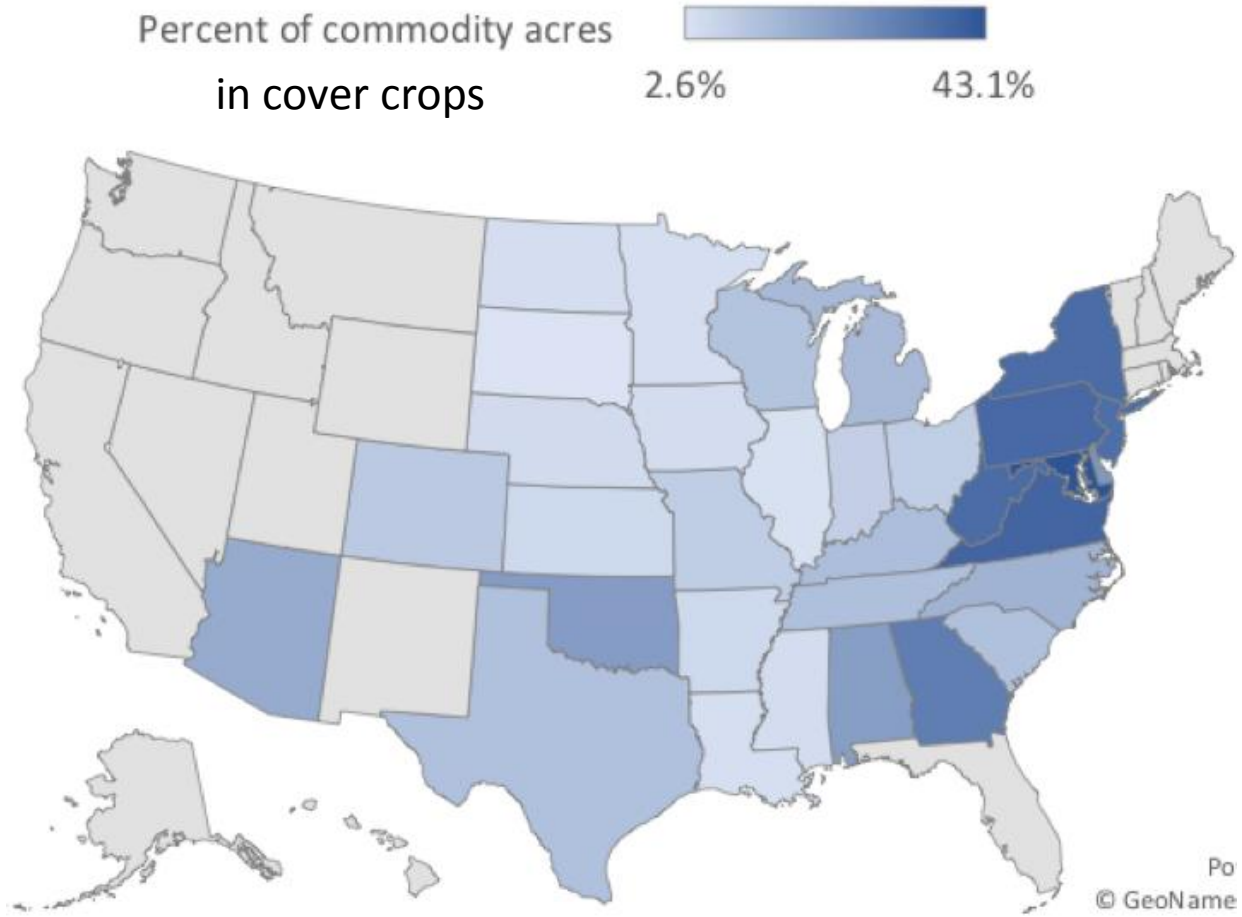
**Table 1. Top Five State Programs (in terms of acreage) Offering Financial Assistance to Farmers to Plant Cover Crops**

| State Program/Implementing Agency | Program Acreage | Per Acre Payment Range | Annual State Spending |
|---|---|---|---|
| Maryland Department of Agriculture Agricultural Water Quality Cost-Share Program (FY 2018) | 395,862 | $30–$75 | $18.8 million |
| Iowa Department of Agriculture and Land Stewardship | 250,000 (Average FY16-FY18) | $15–$25 (FY 2017) | $5 million (Average FY16-FY18) |
| Virginia Department of Conservation and Recreation | 200,540 (FY 2016) | $15–$33 (FY 2017) | $5,136,313 (FY 2016) |
| Missouri Department of Natural Resources (FY 2017) | 117,175 | $30–$40 | $3,800,000 |
| Delaware (individual county conservation districts) (FY 2017) | 85,438 | $30–$50 | Not a state-level program |

# What is working in agricultural sector runoff control?

## Results from Bowman & Lynch (2019) & other sources

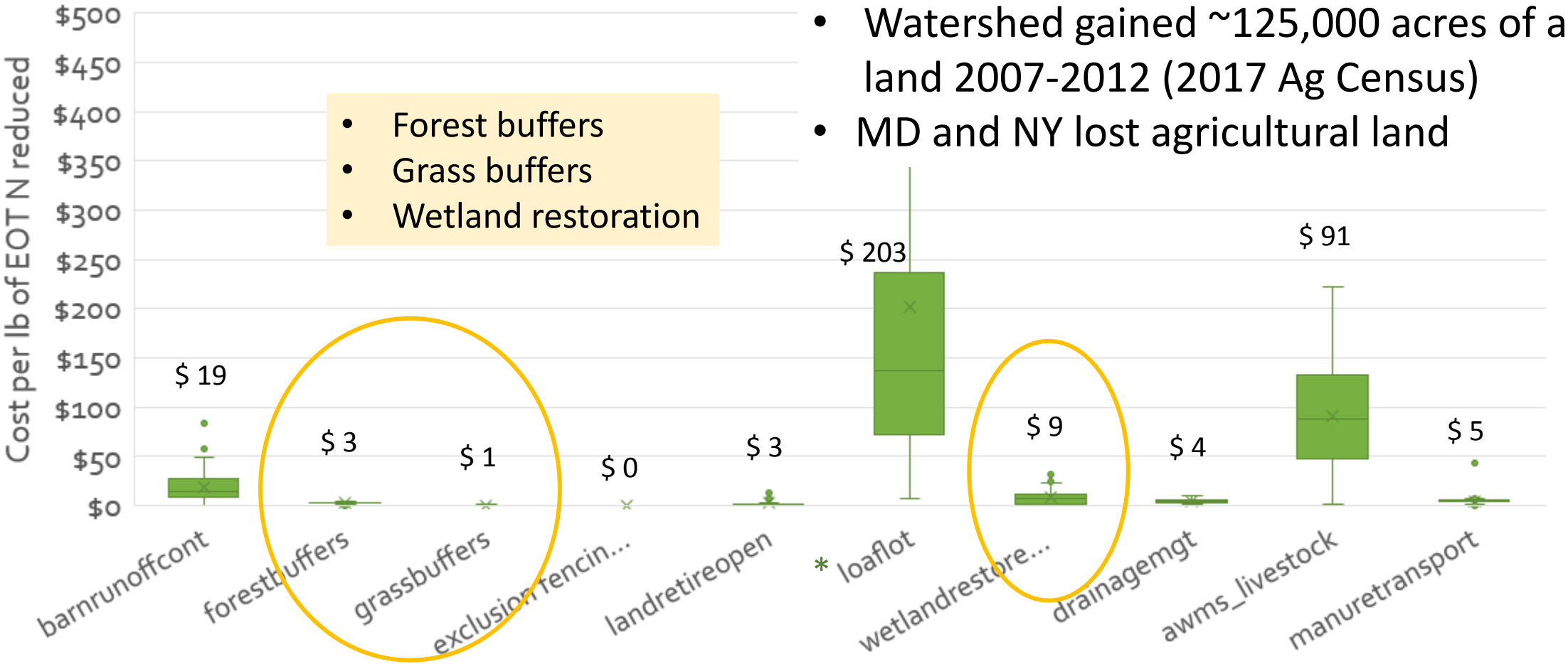
- Practices that do not take land out of production and that have soil health co-benefits have increasing adoption trends
  - Conservation till on 70 % of soybean (2012), 65 % of corn (2016) (Claassen et al. 2018)
  - 4.8% of US cropland uses cover crops (USDA, 2019); 13% PA (10th in US acreage); 43% MD; 36% VA (2017 census)
- Payment programs support adoption of soil health practices
  - Farmers often do not perceive benefits to exceed the costs
  - Soil health benefits accrue slowly but initial costs are substantial (hello discount rate!)




2017 Census of Agriculture, Myers

# What CE practices are not in widespread use?

## Cost Effectiveness for Nitrogen (MACS Implementation costs only)




- Forest buffers
- Grass buffers
- Wetland restoration

- Watershed gained ~125,000 acres of ag land 2007-2012 (2017 Ag Census)
- MD and NY lost agricultural land

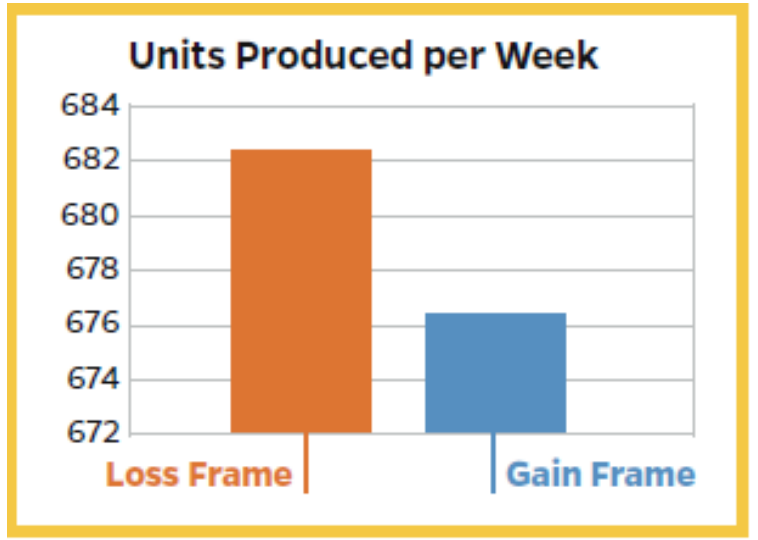
Price, Hollady and Wainger (2019)

* Outliers removed

Oswnofence removed - $1,392/lb

# Can enrollment in voluntary programs be increased with behavioral approaches?

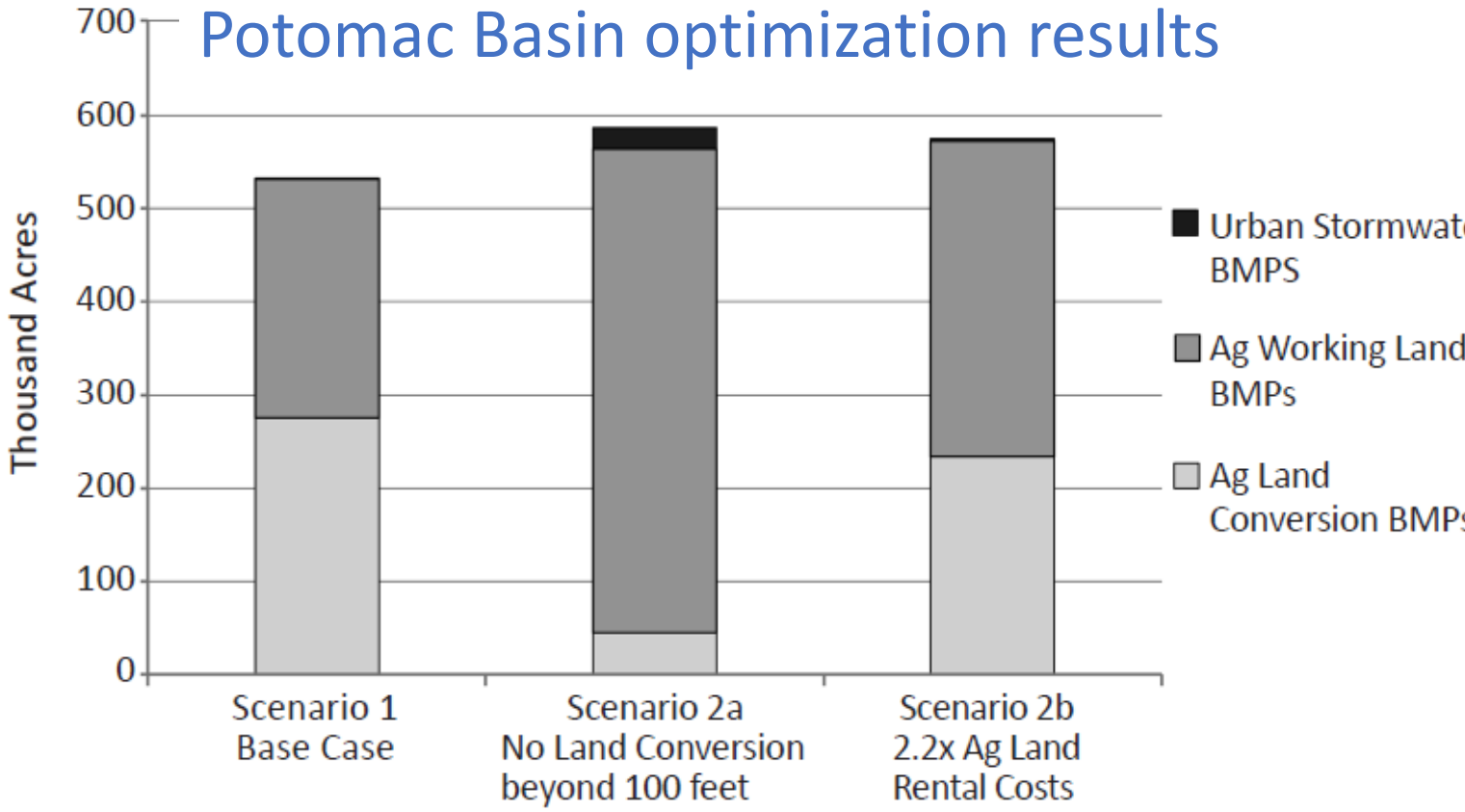
- People are not well-described as purely rational agents
- Goals can be promoted through "libertarian paternalism"
  - E.g. - Informing participants that "80% of farmers continued sustainable practices after contract ended", doubled the odds that farmers continued practices
- Behavioral approaches can modestly increase effectiveness of existing agricultural programs
  - 1-30% increase in participation reported in literature




Same incentive, different framing (Ferraro & Messer 2017)

# What if all feasible and cost-effective ag practices were used? Would it be enough?

- If we assume all agricultural management practices credits are accurate
- ~50:50 ratio of working land BMPs + converted ag land is the most cost-effective solution
- Or, maximize working land options and add SW projects (costs rise rapidly)




Wainger et al. 2013

# Can we meet the TMDL after layering on climate change?

- Amount of stormwater BMP implementation needed to ensure performance under climate change is likely to exceed the available land base (Fischbach et al. 2015)
- Using a regional watershed strategy involves coordinating regulation, planning & financial incentives

# Economics of NPS - Conclusions

1. Programs with centrally administered fee-based programs have been most successful in getting SW and Ag practices in the ground
2. High potential to increase gains from existing programs, but administrators have to want to change
3. Behavioral nudges show promise for increasing CE of existing programs, but gains are often modest
4. Doing more of the same does not appear sufficient to address climate change
5. If we have overestimated effectiveness of current BMPs, we've got big challenges in meeting TMDL (land base, % farmer adoption, SW costs)

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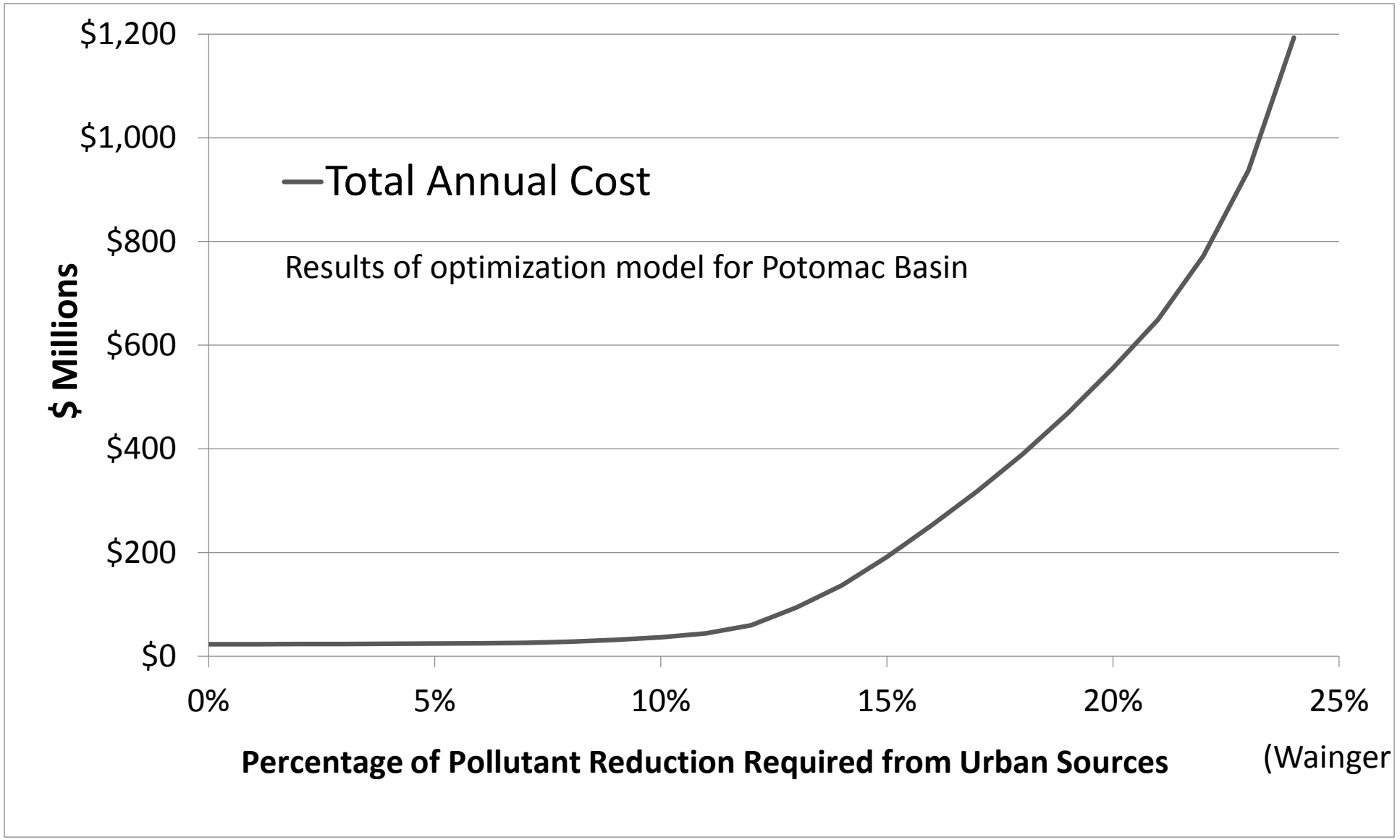
# Why we need innovation in stormwater

*Effect of increasing stormwater effort on total TMDL costs*




(Wainger et al. 2013)