



**MINNESOTA POLLUTION
CONTROL AGENCY**

Sulfate Treatment

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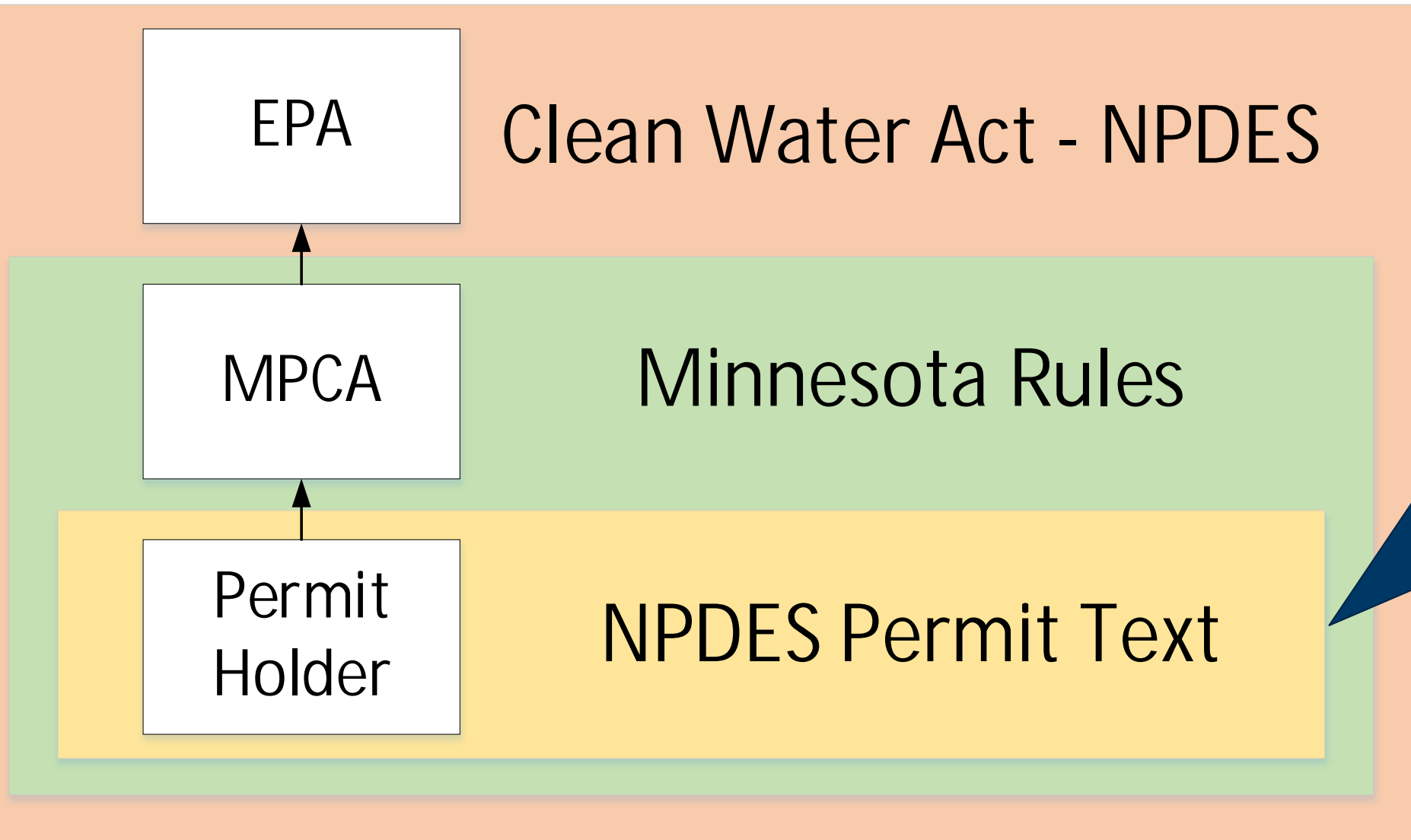
Goals of This Presentation

- **What this presentation will do:**
 - Present best available information to facilitate decision making
- **What this presentation will not do:**
 - Present value judgements about the worth of treating sulfate or changing the sulfate water quality standard

Agenda

1. Wastewater Permitting 101
2. What is an effluent limit?
3. How does wastewater treatment work?
4. What makes treating sulfate unique?
5. What is the best way to treat sulfate?
6. Will the costs of treating sulfate ever go down?
7. How do we value wastewater treatment?
8. How does EPA define affordable wastewater treatment?
9. What to do in wastewater permitting when wastewater costs are unaffordable?

Wastewater Permitting Regulatory Structure

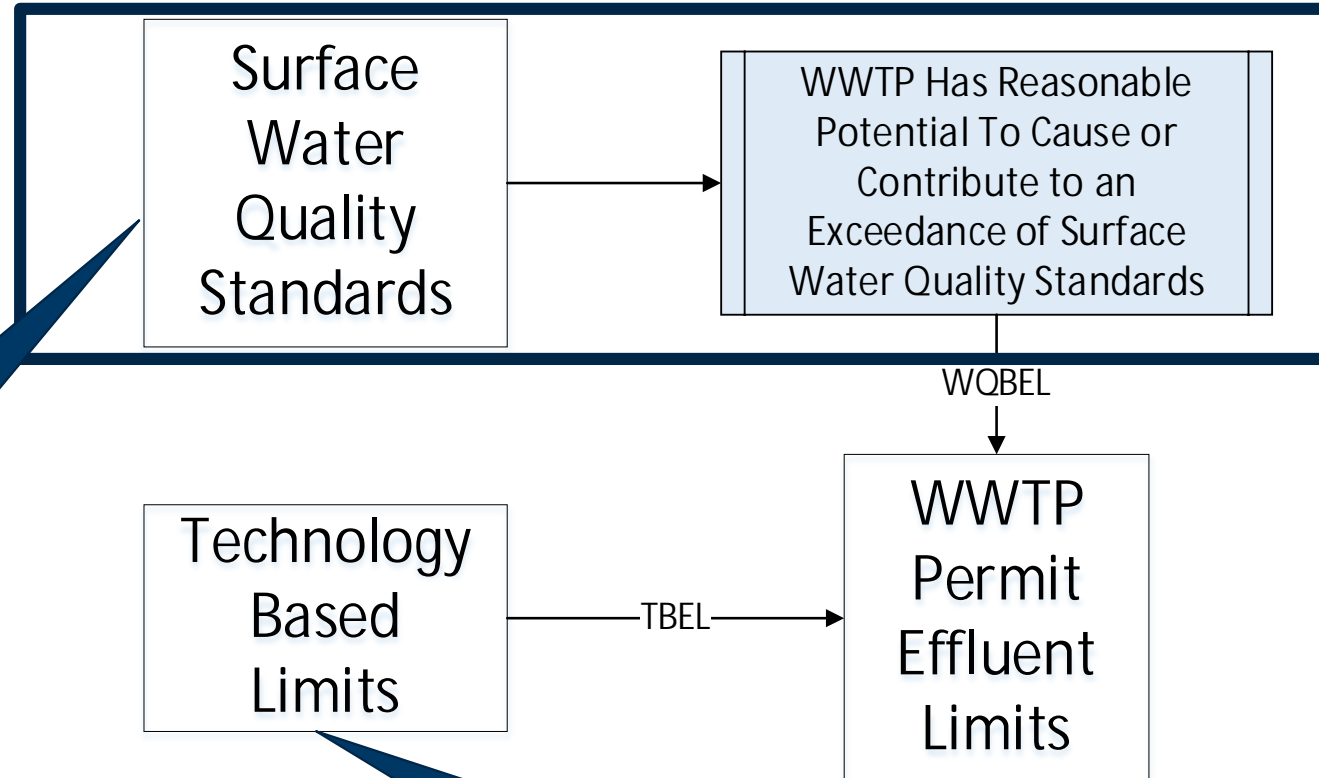


Every wastewater discharger to surface water must have a NPDES permit

What Are Effluent Limits?

- Effluent *Limit* = $f(\text{Standard})$
- Limits protect water quality standards

Based on best available science at adoption of standard into rule



Based on best available treatment in 1980's; not updated since then

What does it mean to comply with an NPDES effluent limit?

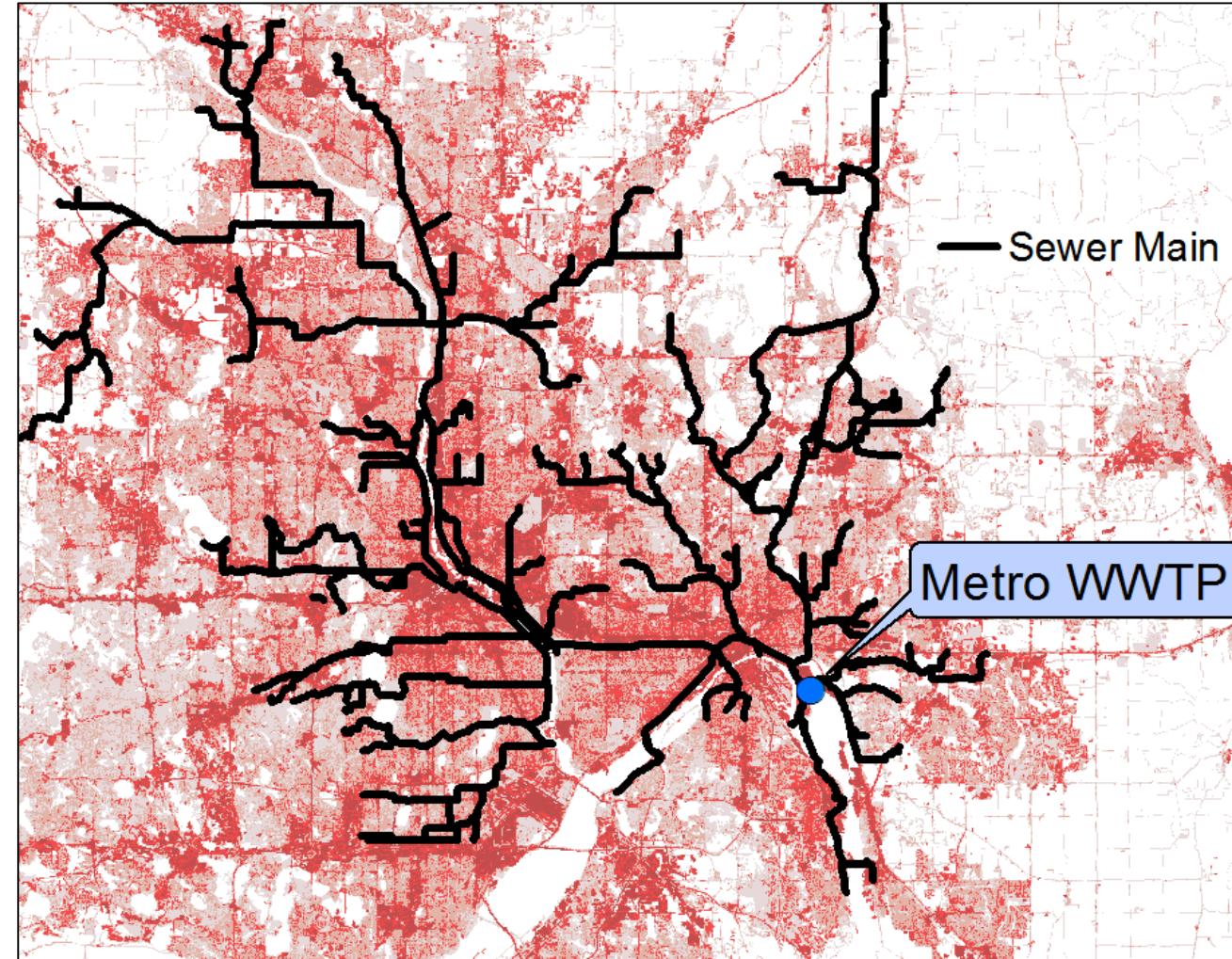
- Effluent limits must be complied with:
 - Always*
 - Design engineers and MPCA are legally responsible for design and effectiveness of wastewater treatment system to meet limits

*Clean Water Act has permitting tools to handle limits that are unaffordable or difficult to comply with

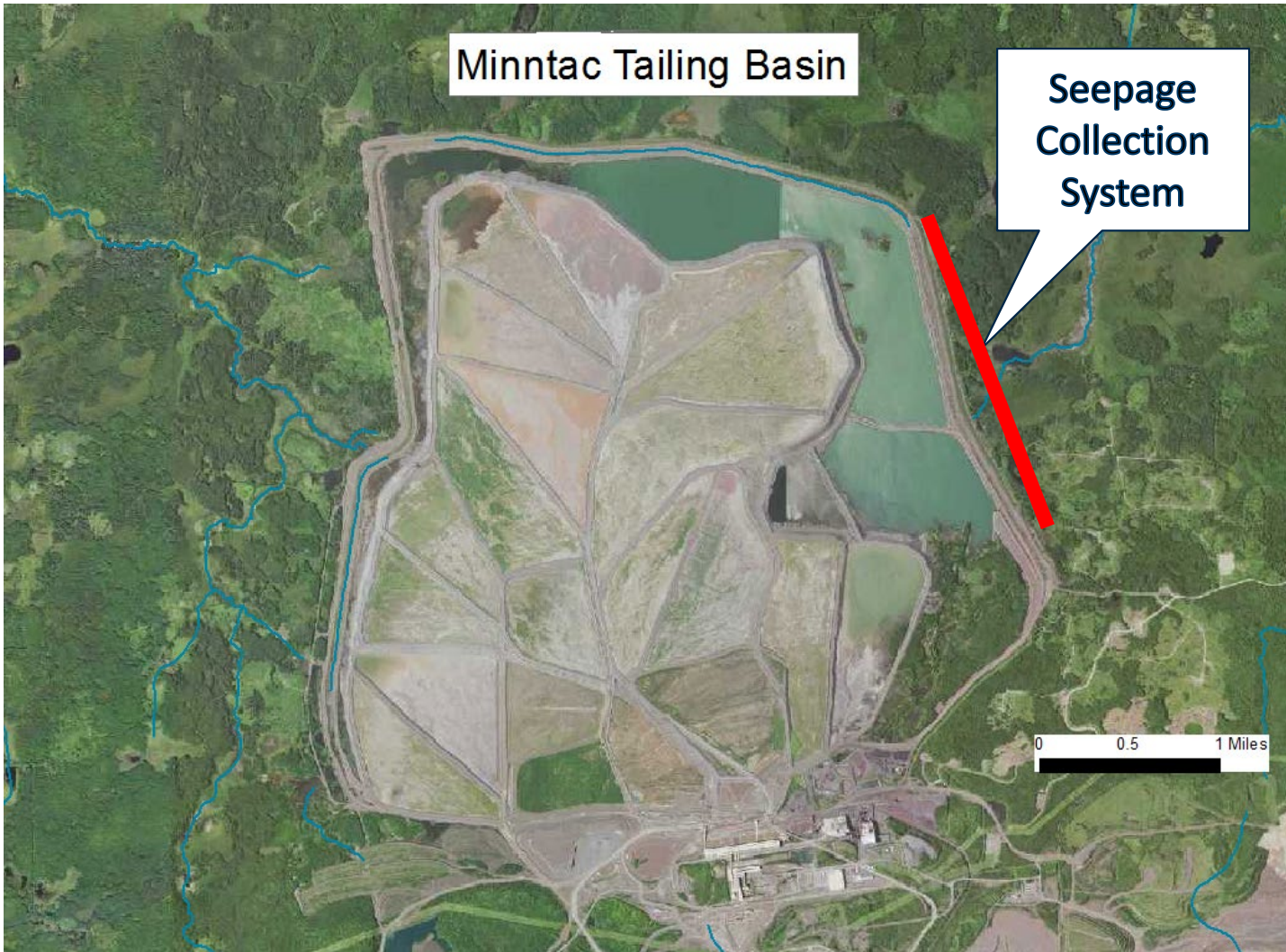


How does wastewater treatment work?

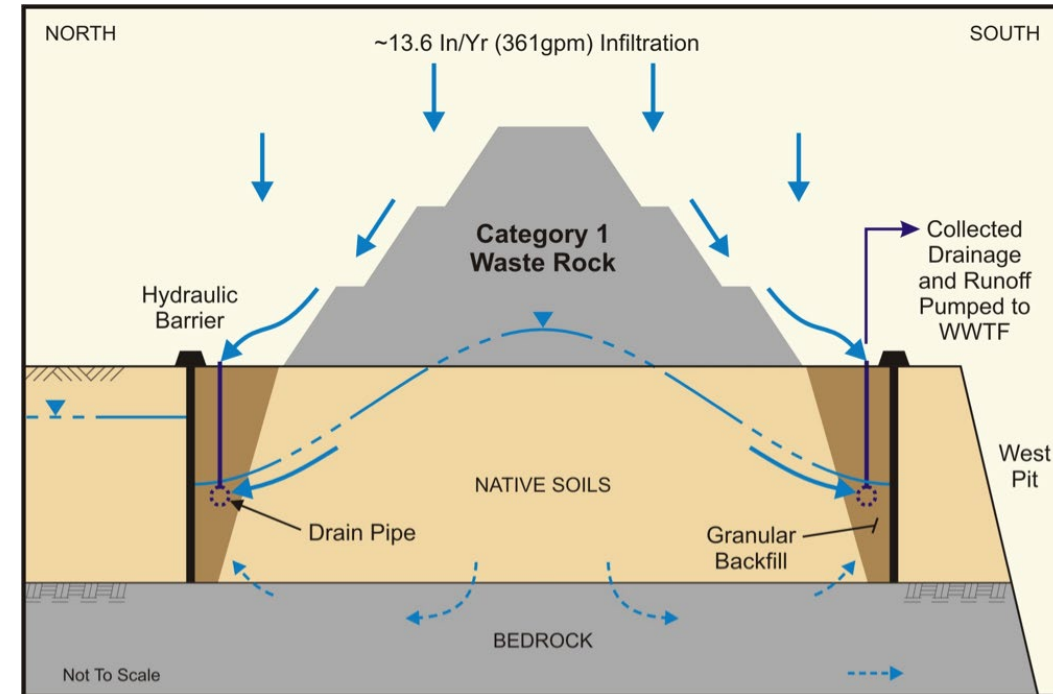
Wastewater
treatments
plants collect
and treat
wastewater



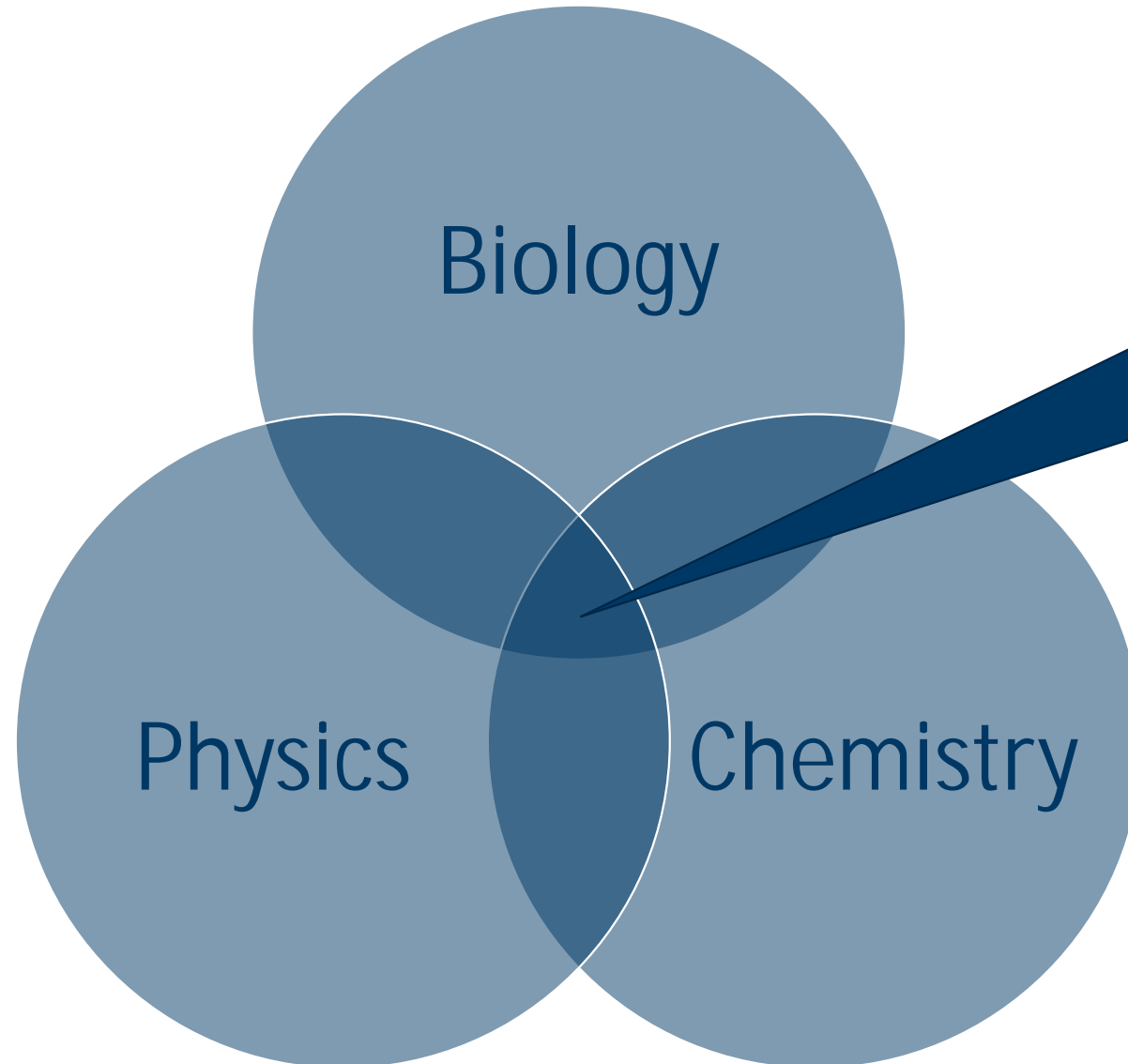
Mining Water Collection Systems



Example: Seepage Collection System Design



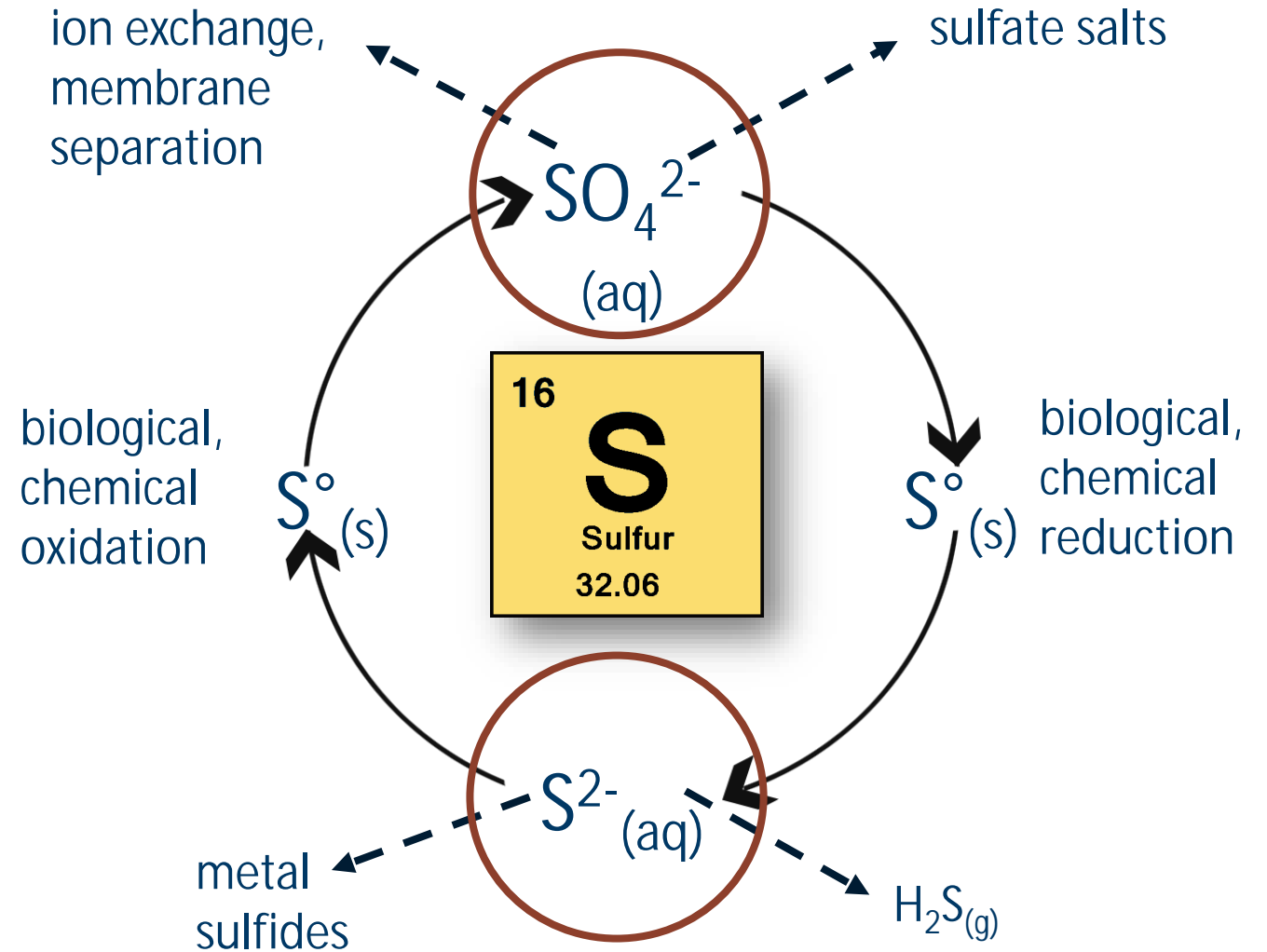
Engineers exploit basic laws of nature to design treatment systems



Basic science
needed for
treatment
plant design

What makes treating sulfate difficult biologically?

Consider treatment processes that actually remove sulfur from the system, rather than *temporarily* transforming it to a different state where it can convert back to sulfate.



What is the best way to treat sulfate?

How do we know how to treat sulfate?

1. Understanding of sulfate chemistry
2. Literature review of sulfate treatment technologies
3. Evaluation of full scale treatment systems
4. Discussion with leading researchers
5. Commissioning municipal sulfate treatment study

Analyzing Alternatives for Sulfate Treatment in Municipal Wastewater

Prepared for:
Minnesota Pollution Control Agency



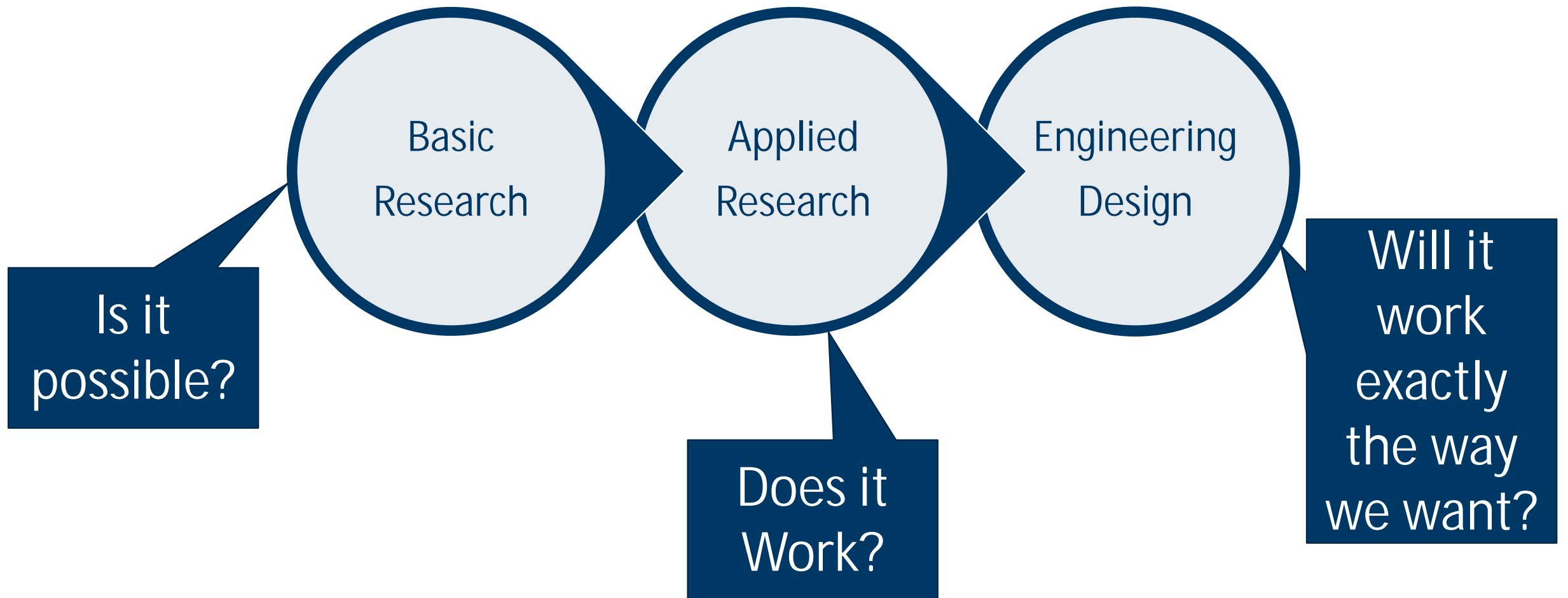
May 1, 2018

Prepared by:
Bolton & Menk, Inc. and Barr Engineering Company

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Evaluating sulfate treatment technologies



What is the best way to treat sulfate?

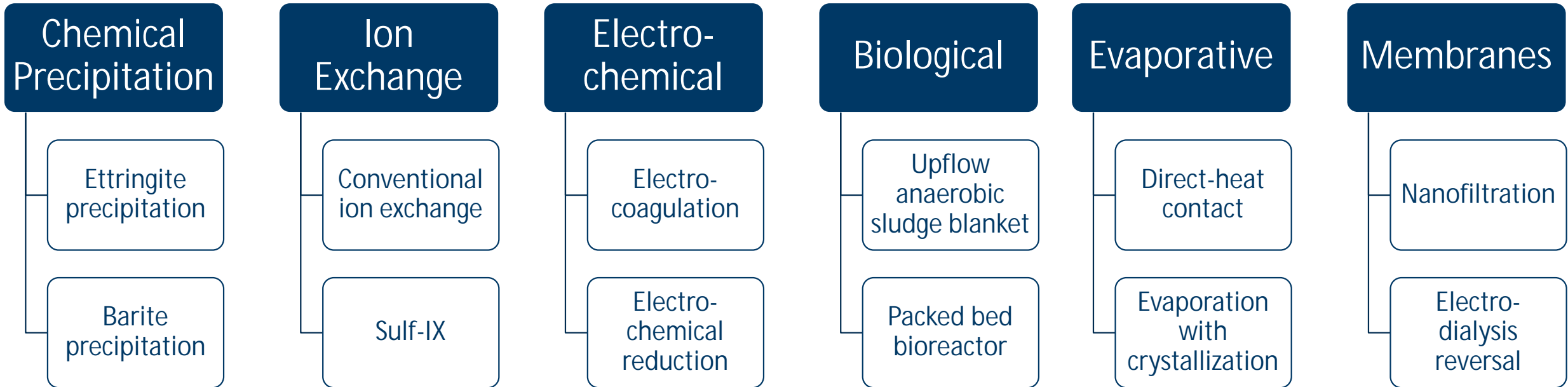
Sulfate Treatment Study

- 31 technologies evaluated
 - Effectiveness
 - Operability/maintainability
 - Relative cost
 - Degree/complexity of pre- and post-treatment requirements
 - Residuals management
- Reverse osmosis membrane treatment – highest score
- Accurate costs developed




Drinking water plant reverse osmosis membrane skid

Is reverse osmosis really the best way to treat sulfate?



What About Sulfate Minimization Plans?

- Sulfate Minimization Plans
 - A permitting tool permittees can use to reduce sulfate discharge
 - Not always tied to an effluent limit
 - MPCA has guidance developed elsewhere
- Permittee investigates sulfate sources
- Permittee evaluates sulfate reduction strategies to reduce loading

 Minnesota Pollution Control Agency
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Mercury Minimization Plan Guide
National Pollutant Discharge Elimination System (NPDES) Wastewater Program
Doc Type: Pollutant Minimization Plans

Additional Information on Page 8

Instructions: This guide was created to assist you in completing your Mercury Minimization Plan (MMP). The guide provides details on each of the five steps and suggested resources to complete the information. The attached Sector Worksheets can be used to record your plan and implementation of the activities to provide future mercury reductions. Additional information can be found on page 8.

Facility Information

Date (mm/dd/yyyy): _____
Facility name: _____ Permit No.: _____
Facility address: _____
City: _____ State: _____ Zip code: _____
Preparer name: _____ Preparer's telephone: _____

Background

Mercury is present in all municipal and many industrial wastewater discharges. Mercury is a powerful neurotoxin that affects human health and the environment. A naturally-occurring element, mercury does not breakdown into less harmful substances over time. Instead, mercury released into the environment accumulates in fish and animal tissues, a process known as bioaccumulation. Widespread mercury contamination has prompted the Minnesota Department of Health to issue fish consumption advisories throughout the state. Most of Minnesota's impaired waters are contaminated by mercury and other bio-accumulative toxins. The Minnesota Pollution Control Agency (MPCA) is carefully evaluating all mercury discharges in the state.

Provide a Facility Description Update

The MPCA has a facility description from the most recent permit application. In order to review and process your MMP to make sure that it meets permit requirements, it would be helpful to:

1. Briefly describe any changes in your facility, collection system or operation process in the last five years, including changes in industrial, commercial or institutional users or their discharges in Table A.
2. Record any place within the facility where you are monitoring for mercury and the results in Table B.

Table A – Changes in your facility

Change	Year 1	Year 2	Year 3	Year 4	Year 5
Facility					
Collection System					
Operation Process					
Changes in Industrial Users (added or removed)					
Other					

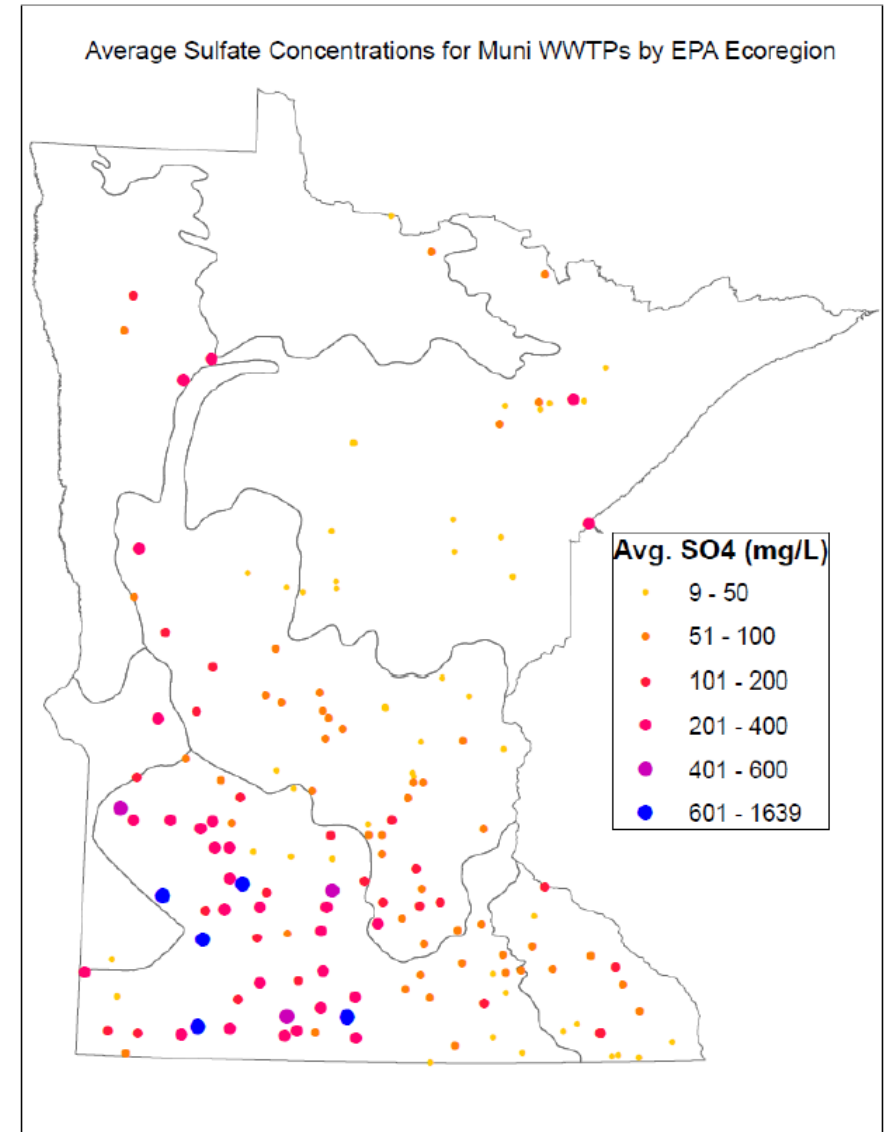
Table B – Monitoring for Mercury

Location	Results

www.pca.state.mn.us • 651-296-6300 • 800-657-3864 • TTY 651-282-5332 or 800-657-3864 • Available in alternative formats wq-wwt7-10 • 2/7/14 Page 1 of 8

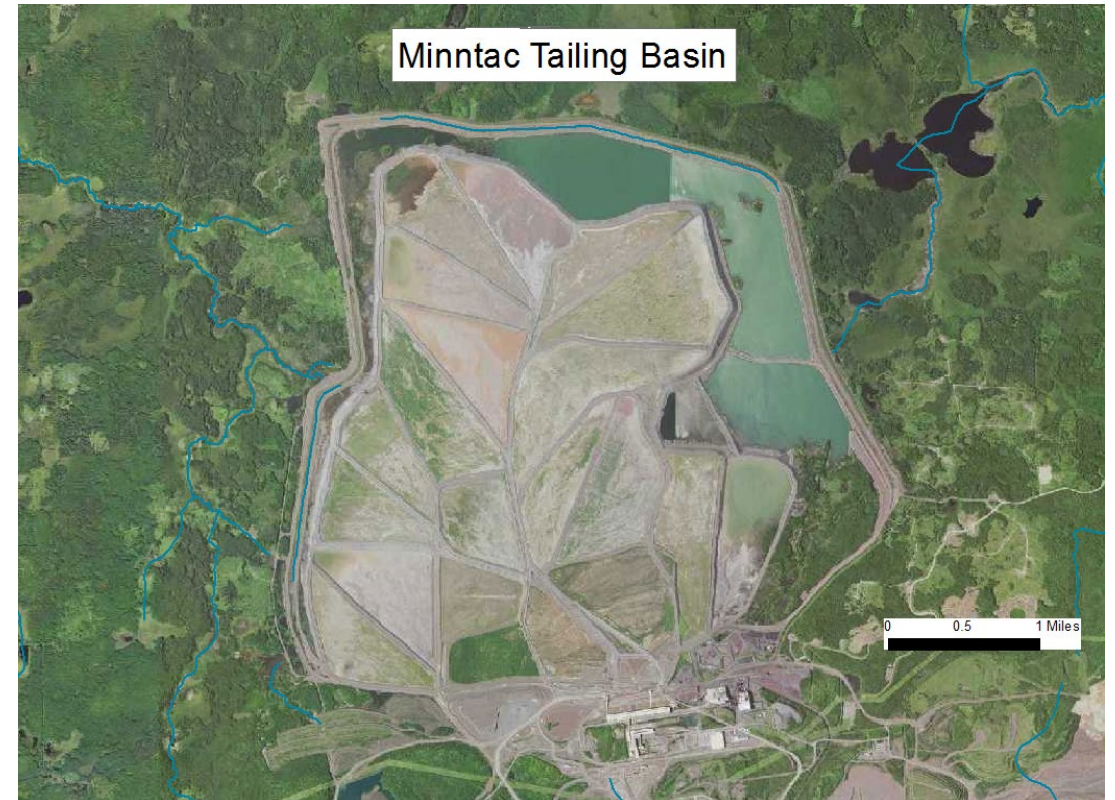
Municipal Sulfate Minimization Plans

- No municipality currently has a sulfate minimization plan
- Effluent sulfate most correlated with drinking water sulfate concentrations
- Limited potential for influent municipal sulfate reduction to the WWTP
 - Residential sulfate loading is minimal (< 50 mg/L)



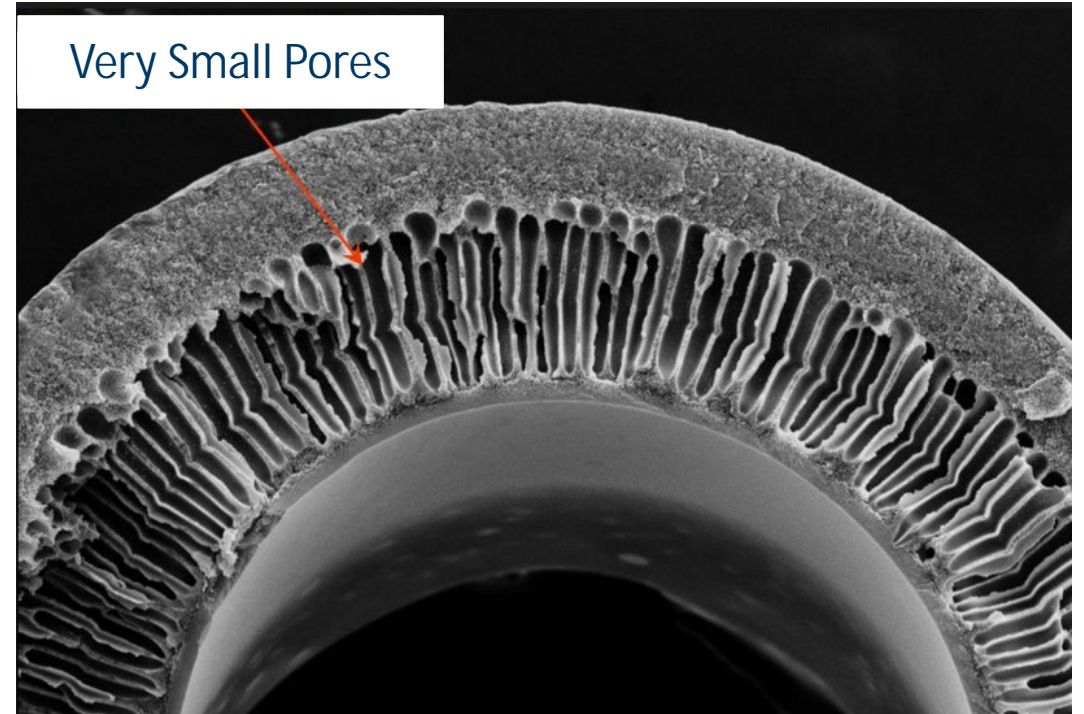
Industrial Sulfate Minimization Plans

- All taconite mines have completed “equivalent work” to a Sulfate Minimization Plan
 - Identified sources of sulfate and source reductions strategies
 - “Low hanging fruit has already been picked” with regards to minimizing sulfate loading

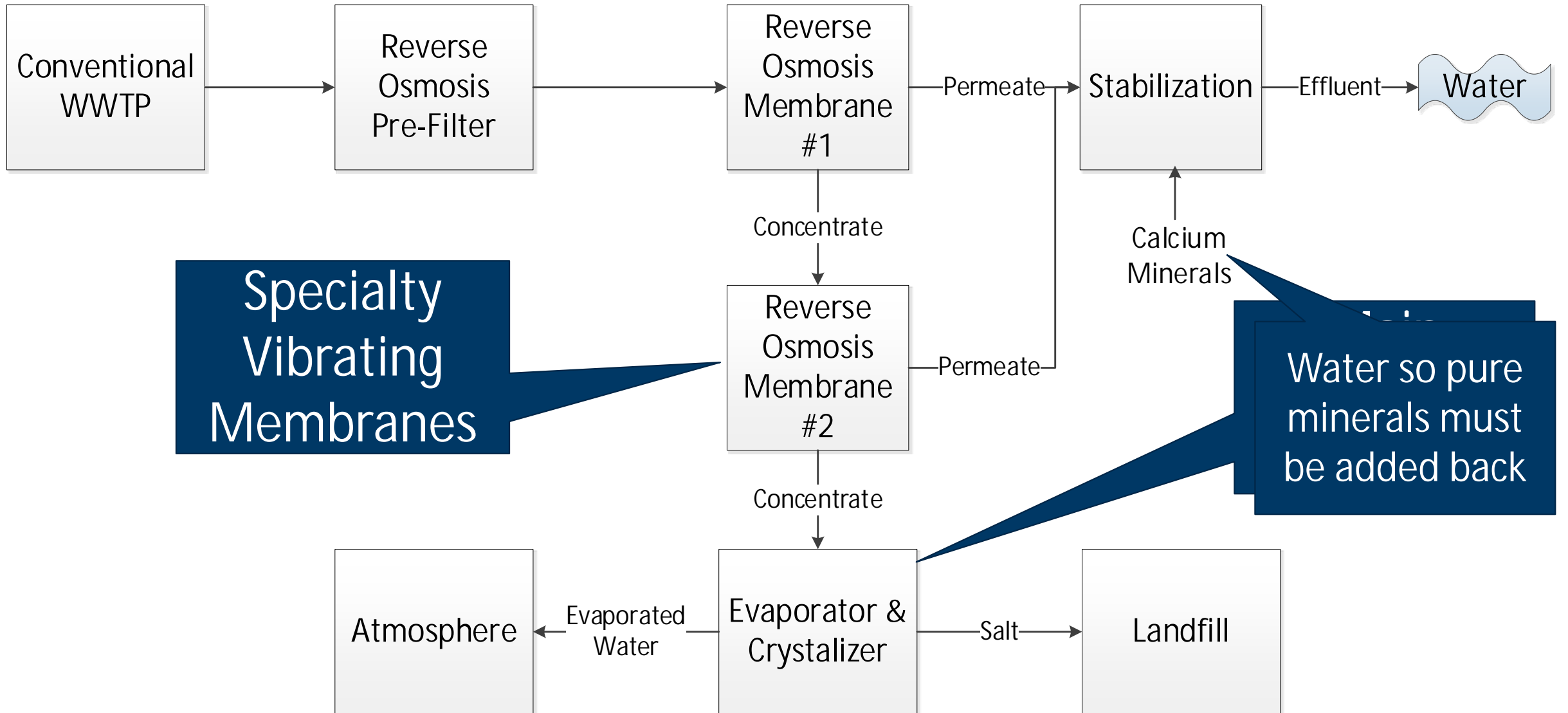


How do Reverse Osmosis (RO) membranes work?

- RO membranes have very tiny pores
- The pores are so small only small water molecules can pass through
- Larger molecules such as sulfate cannot pass through membrane
- Water that passes through membrane is salt free
- Remaining water contains all the salts that didn't pass through RO membrane



Sulfate Reverse Osmosis Membrane Treatment



Main issue: Managing RO concentrate

Managing reverse osmosis concentrate

- Equipment needed to evaporate water away from sulfate/salt is huge and expensive
- Very high capital costs and energy costs
- Equipment difficult to maintain
- Waste salt must be landfilled
- Requires new operator training and skillset



Concentrate evaporator

0.36 MGD Flow, \$12 million capital

\$3 million annual O&M

What do operators of wastewater treatment plants want?

- We want to be in compliance with our permit
- Do the best that the plant is capable of
- Nobody gets hurt

What do operators of wastewater treatment plants want?

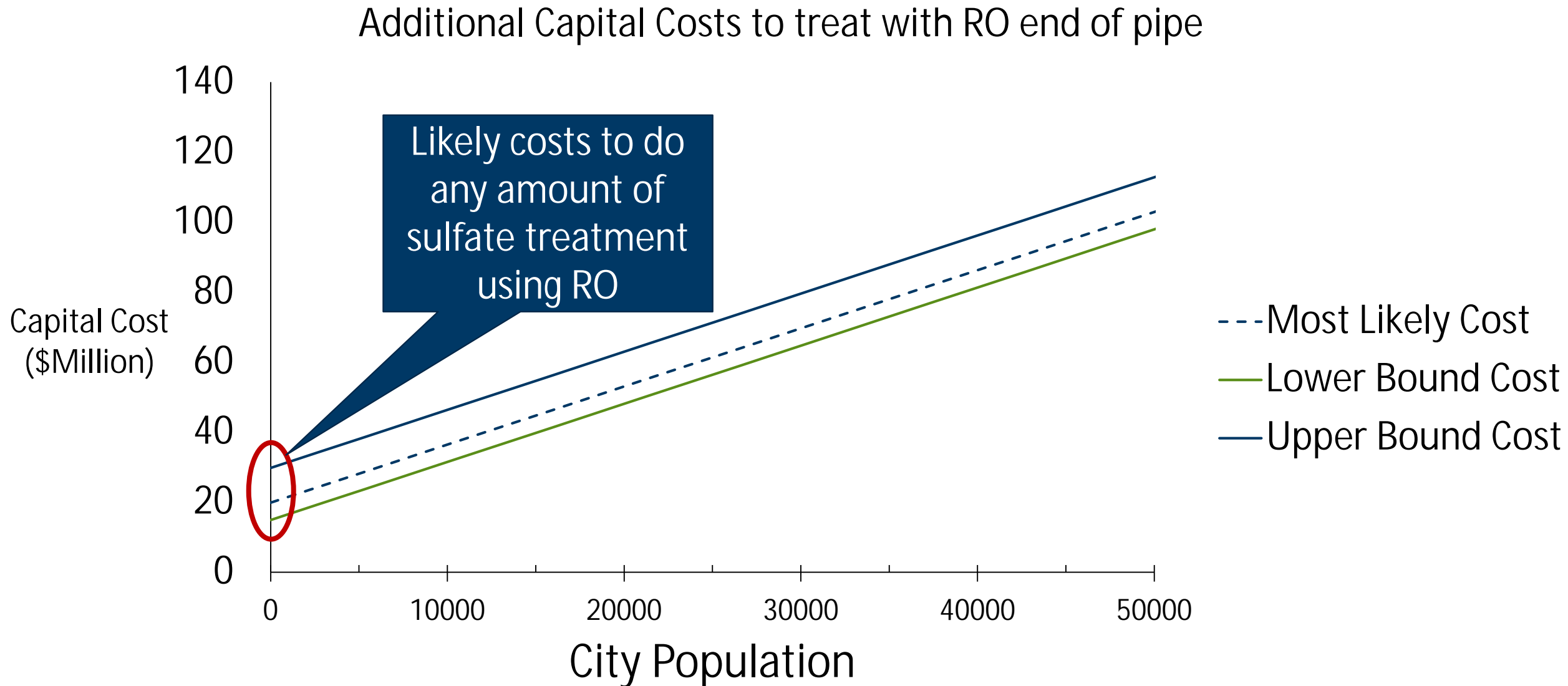
- Stable and predictable user rates
- Maintain assets
- Use less energy, chemicals
- Hire and retain good people

Talking About Wastewater Costs

- Costs of compliance are not value judgements
 - When we say sulfate treatment is “expensive”, that is relative to other wastewater treatment
 - MPCA must calculate greater need for maintaining current wastewater infrastructure funding
- State rulemaking process requires us to evaluate costs of compliance
 - But policy is often made on other grounds – not on whether benefits exceed costs
- Discussions of societal value are informed by understanding costs
 - And benefits



Sulfate Treatment Costs to < 10 mg/L Sulfate



Will the cost of sulfate treatment ever go down?

Yes!

But...

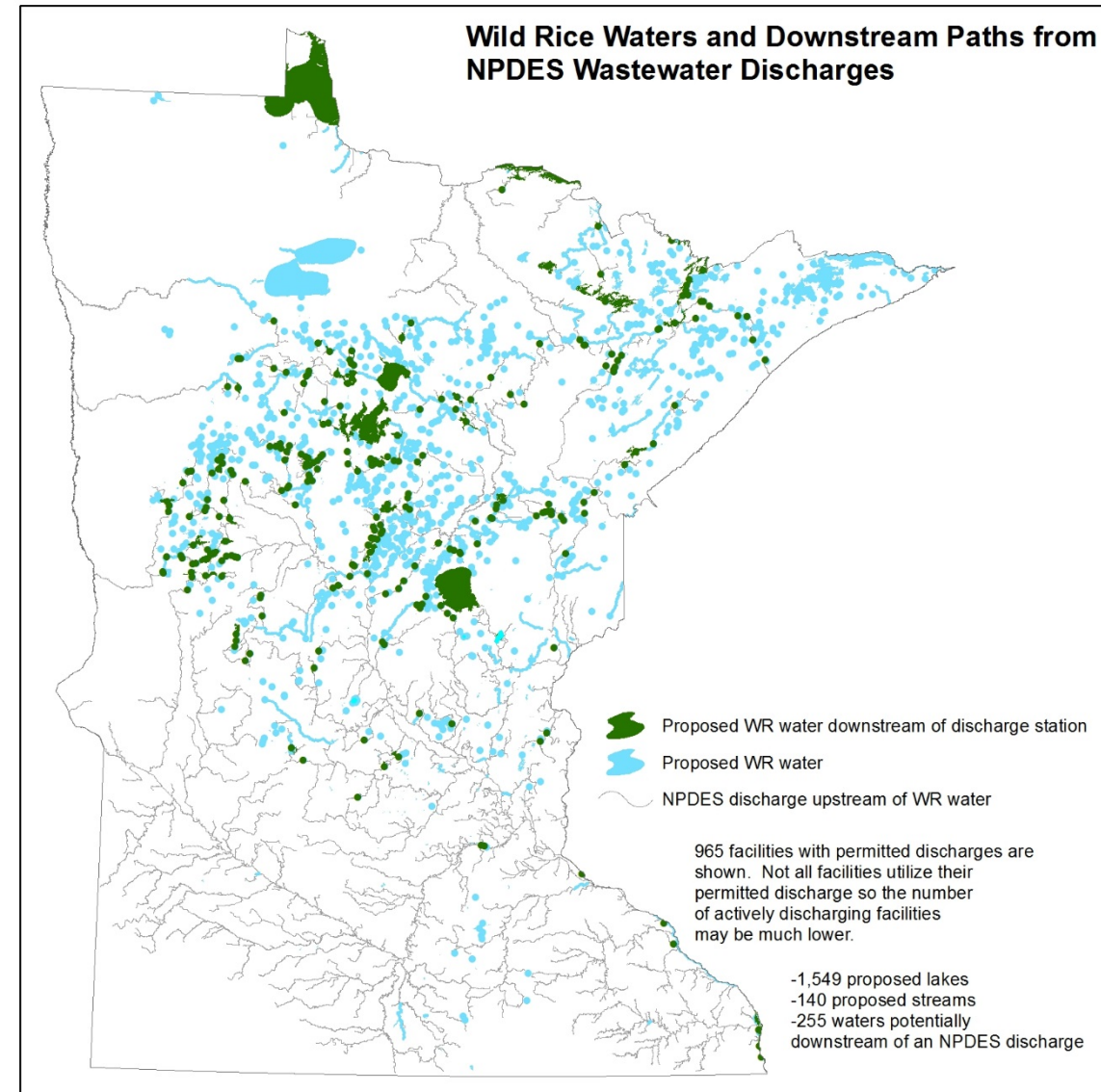
Will the cost of sulfate treatment ever go down?

Sulfate treatment constrained by laws of nature

- Separating anything from water using RO requires lots of energy and always will
- Biological sulfate treatment has future promise
 - Winter and process reliability concerns
 - Energy/carbon concerns
 - Waste product handling and disposal concerns

What exact sulfate treatment costs will permittees experience?

- How many facilities have the potential to experience sulfate treatment costs?
 - 965 facilities based on this map
- Will every facility upstream of a wild rice water receive an effluent limit?
 - Not necessarily. This can't be determined without knowing protective water quality standard for each waterbody.
- How much will sulfate treatment costs vary as a function of the effluent limit?
 - Costs scale as a function of percent sulfate treatment needed



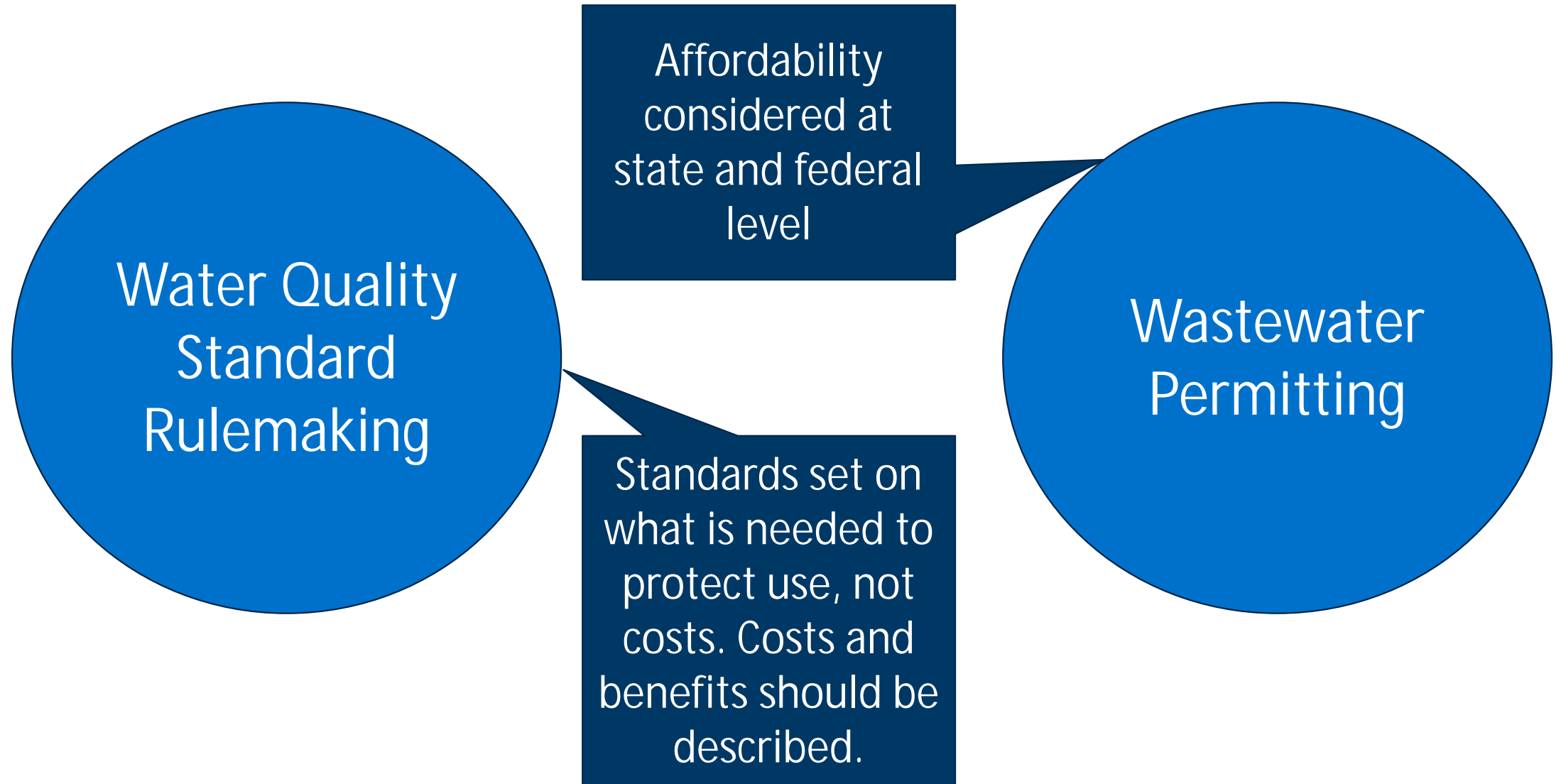


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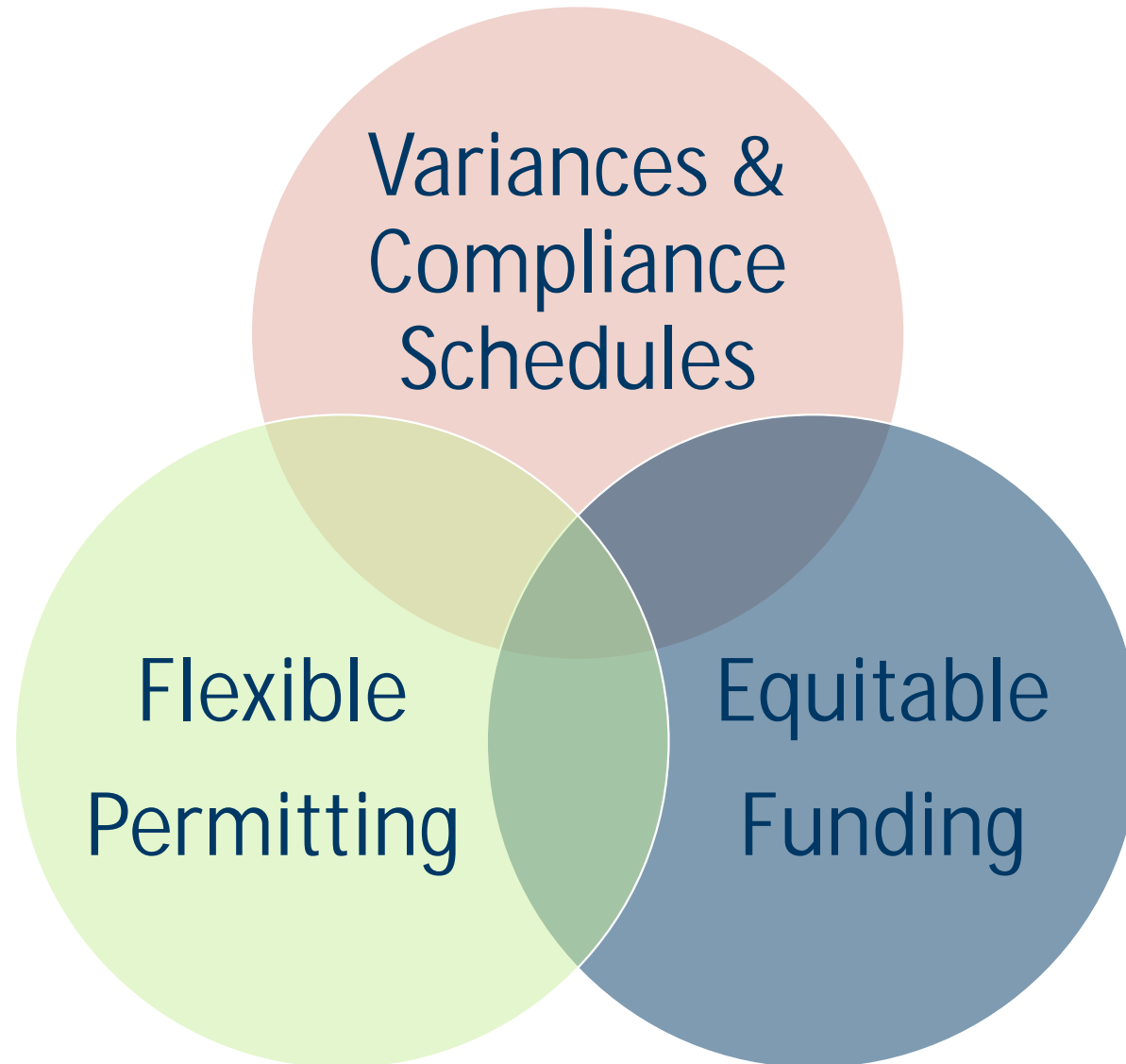
Water Quality Standard Variance

Elise Doucette

How does the Clean Water Act value water?



What to do when wastewater compliance costs are unaffordable?



What is a variance?

CWA permitting tool that allows MPCA to address affordability and allow dischargers time to investigate compliance solutions

Variance Myth-busting

1. Not a “get out of jail free” card
2. Time limited
3. Compliance with Final limits (underlying standard) remain the goal
4. Not guaranteed, requires a justification to receive
5. Public comment and public meeting required
6. Variances make people emotional (*right* or *wrong* way of doing things)
7. EPA is a big part of the process
8. Future will be different from the past

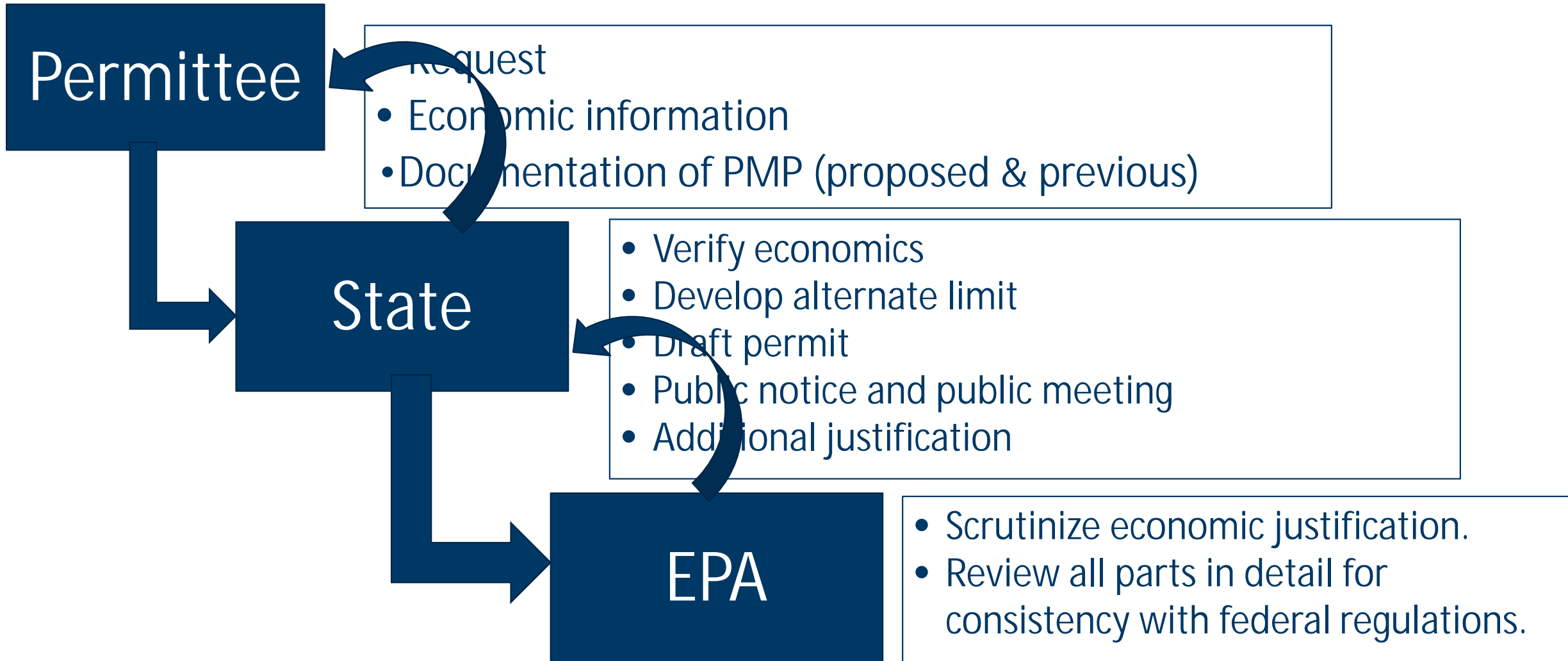
Old variance rule language

“In any case where, upon application of the responsible person or persons, the agency finds that by reason of **exceptional circumstances** the strict enforcement of any provision of these standards would cause **undue hardship**, that disposal of the sewage, industrial waste, or other waste is **necessary for the public health, safety, or welfare**; and that strict conformity with the standards would be **unreasonable, impractical, or not feasible** under the circumstances; the agency in its discretion may grant a variance therefrom upon such conditions as it may prescribe for prevention, control, or abatement of pollution in harmony with the general purposes of these classifications and standards and the intent of the applicable state and federal laws.”

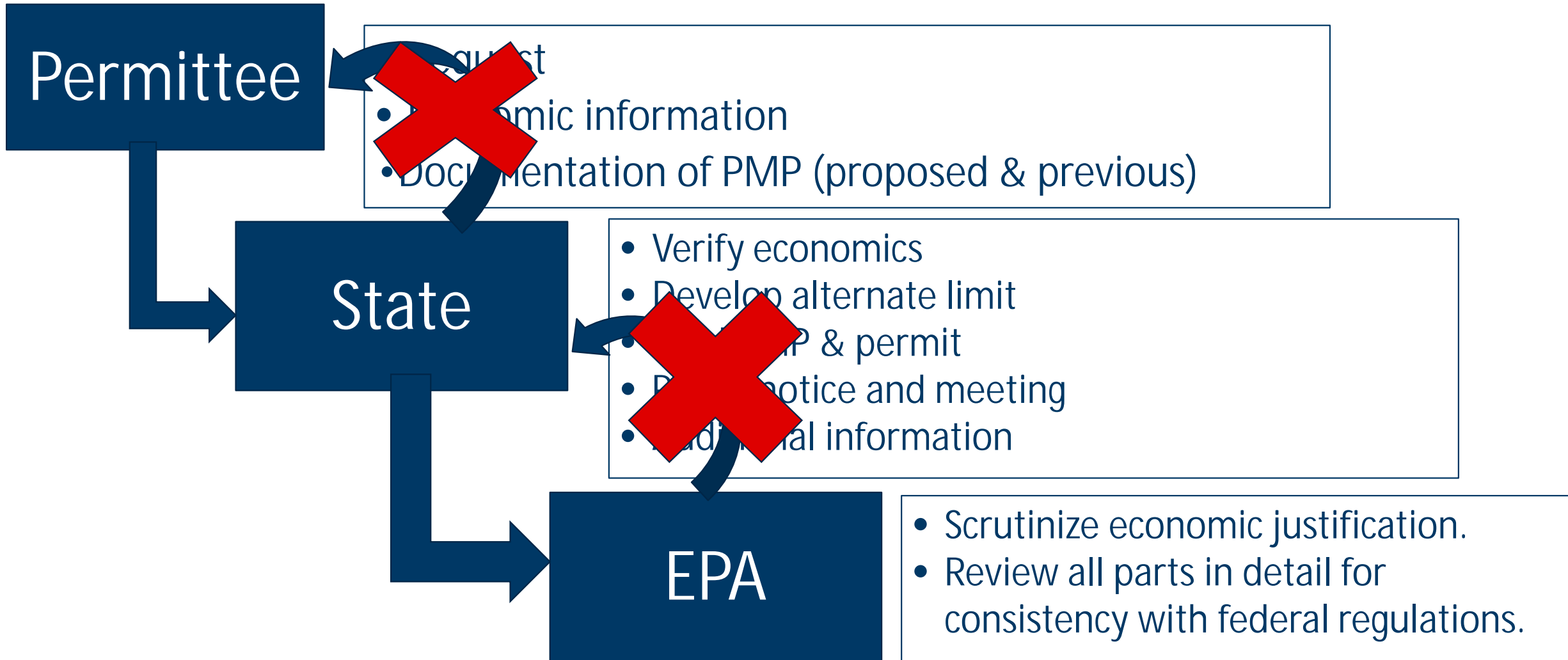
History of Variances in Rule

- 1964
 - “Variance”
- 1974
 - Changed to “variance from standard”
- 1998
 - Minn. R. 7052 GLI adopted
 - First time more definition was given
- 2008
 - Minn. R. 7053 State Discharge Restrictions; treatment requirements
- 2012
 - Process improvement
 - Began rulemaking process
- 2013
 - EPA proposed changes
- 2015
 - August – EPA promulgated rules
 - (July - Citizen’s Board disbanded)
- End of 2016
 - Minnesota adopts new procedural rules
 - Approved by EPA March 2017
- 2017
 - Conducted chloride work group
 - Created variance forms, “eligibility tool”
- 2018
 - Work continues...

Variance process



Streamlined Variance process



What are some issues with variances?

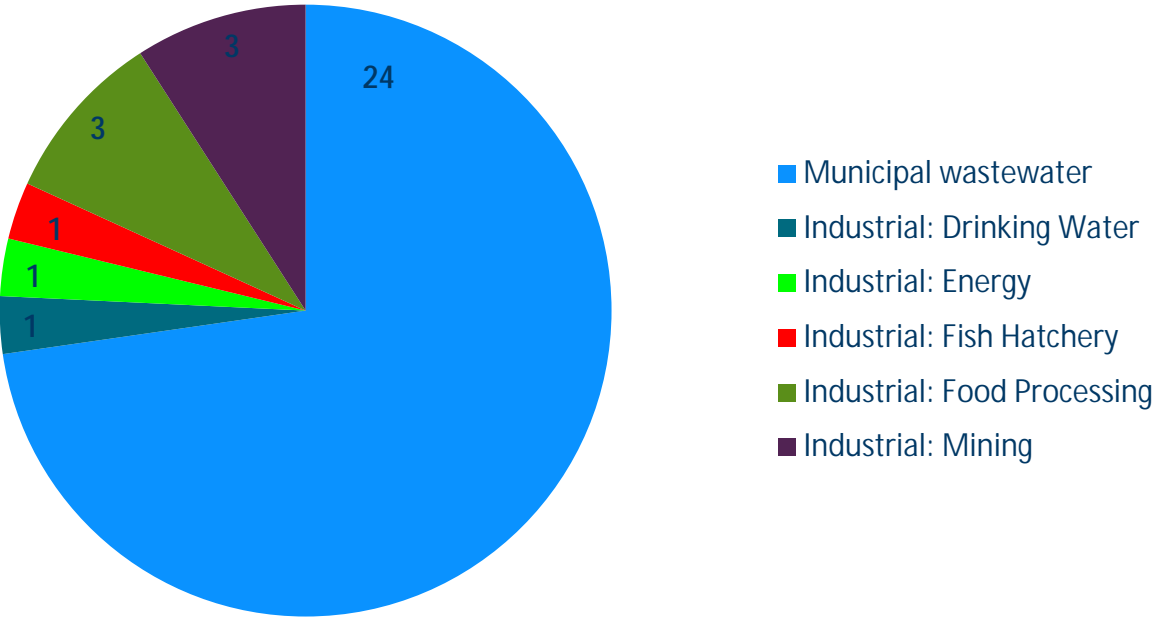
- Arduous Process – From a Scientific, Accounting and Administrative perspective
 - (see Process handouts)
- Expensive
 - (\$48,900 spent on Consultant for an Hg Variance)
- Protracted
 - (see Timeline handouts)
- Burdensome Once Granted
 - (see Burden handouts)

Cost of applying for a variance

- Variances are expensive
- Hard Costs: \$10,850 to apply for a variance (in rule)
 - No other Midwest state charges to apply for a variance
- Soft Costs: >\$100,000 in consulting fees
 - Complicated enough process that environmental consultants are required
 - MPCA developed streamlined variance process for chloride (>\$250,000 in MPCA staff time to develop)
 - MPCA could develop a streamlined sulfate variance process for municipalities in less than a month
 - Hard for industries

History of variances (and current variances)

Number of Facilities with Variances Granted
1971-2014*

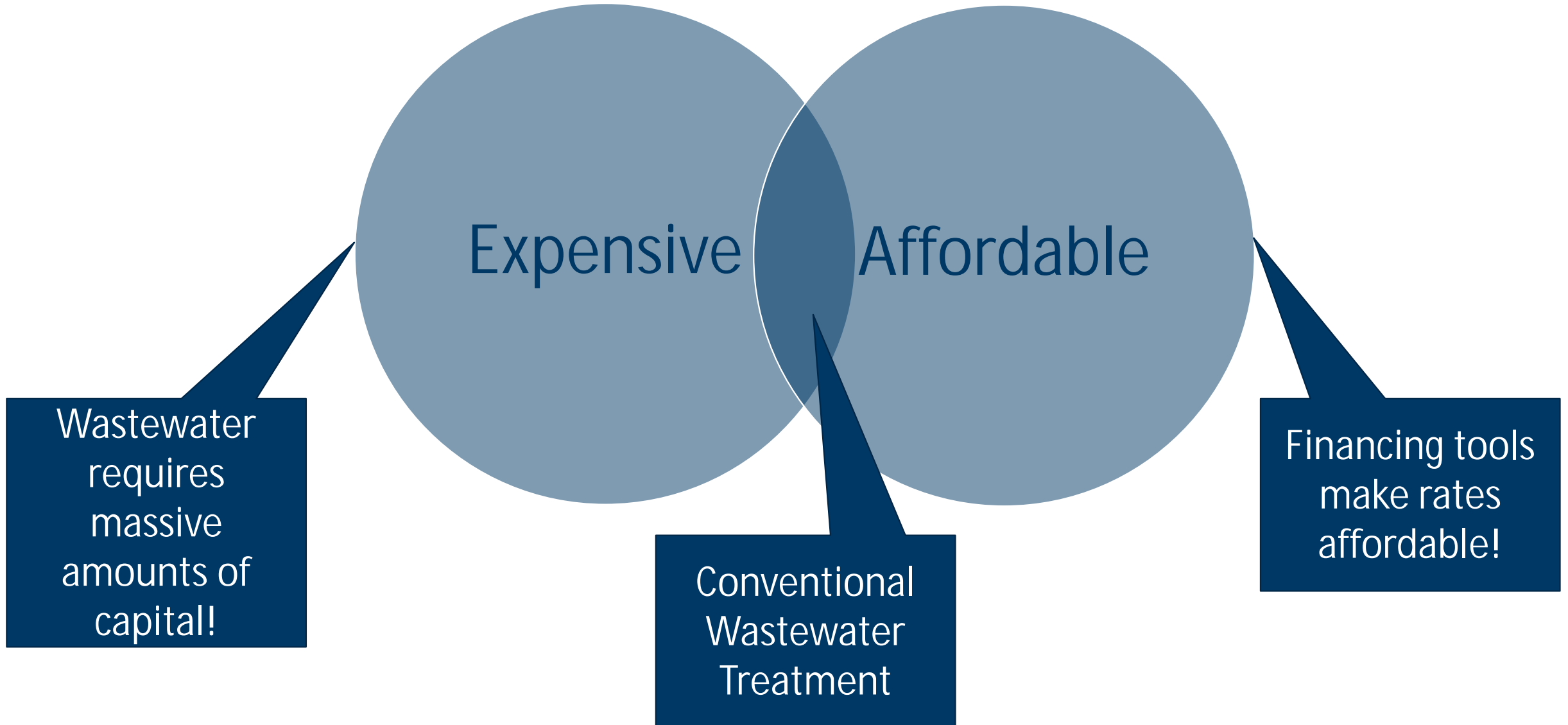


*Data are based on all variances granted, some of which later expired or were renewed.

Active Variances from Minnesota Rules Chapters 7050, 7052 and 7053 (Updated Sept. 2017)

- Cliffs Erie – Dunka Mining
- Maple Hill Estates
- United Taconite LLC-Thunderbird Mine
- Southern Minnesota Beet Sugar – Renville
- Western Lake Superior Sanitary District (WLSSD)

What does affordable wastewater mean?



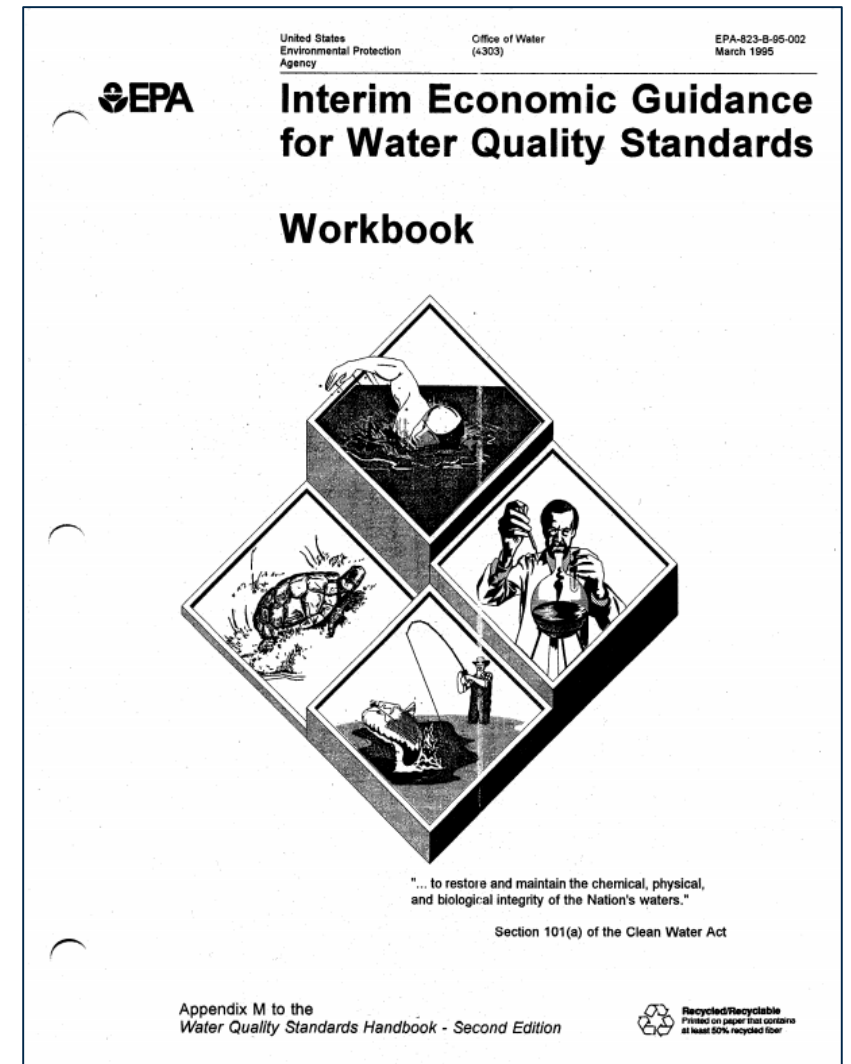
EPA Municipal Wastewater Affordability Index

Primary Affordability Measure

$$\frac{\text{Annual Wastewater Cost per Household}}{\text{Median Annual Household Income}} \leq 2\%$$

Secondary Measures

- Municipal economic health
- Widespread social and economic impacts in surrounding communities



Implications of Sulfate Treatment Costs: Municipalities

Sulfate treatment costs will be unaffordable for all municipal wastewater treatment plants.



EPA Industrial Wastewater Affordability Index

- **Primary Affordability Measure**

- Profitability with and without pollution control

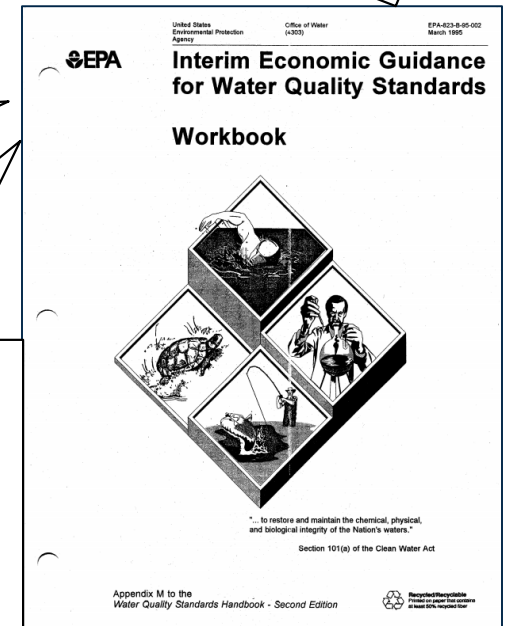
- **Secondary Affordability Considerations**

- Level of industry competition
- Possibility of plant shutdown
- Likelihood of competitors facing similar pollution control costs
- Willingness of consumers to pay more for the product
- Widespread social and economic hardship in the surrounding communities

"Arguably, as long as the applicant maintains positive earnings, it can afford to pay for the pollution control"

"The structure, size, and financial health of the parent firm should also be considered"

"If the discharger is already not profitable, it may not claim that substantial (negative) impacts would occur due to compliance with water quality standards"



Implications of Sulfate Treatment Costs: Industry

MPCA does not have the data to assess whether pollution costs will be affordable or not



- It is difficult to remove sulfate from water
- The best technology to reliably remove sulfate from water is RO
- RO is very expensive to build, maintain & operate
- RO is unaffordable for all municipal wastewater plants
- MPCA does not have the data to determine whether RO would be affordable for industry
- MPCA supports the use of variances for all dischargers that demonstrate economic hardship because of unaffordable wastewater costs

Questions?