

# **Phosphorus Regulation: A Paper Industry Perspective**

**Wisconsin River Water Quality Symposium**

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**By**

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# Forest Products Industry & Communities

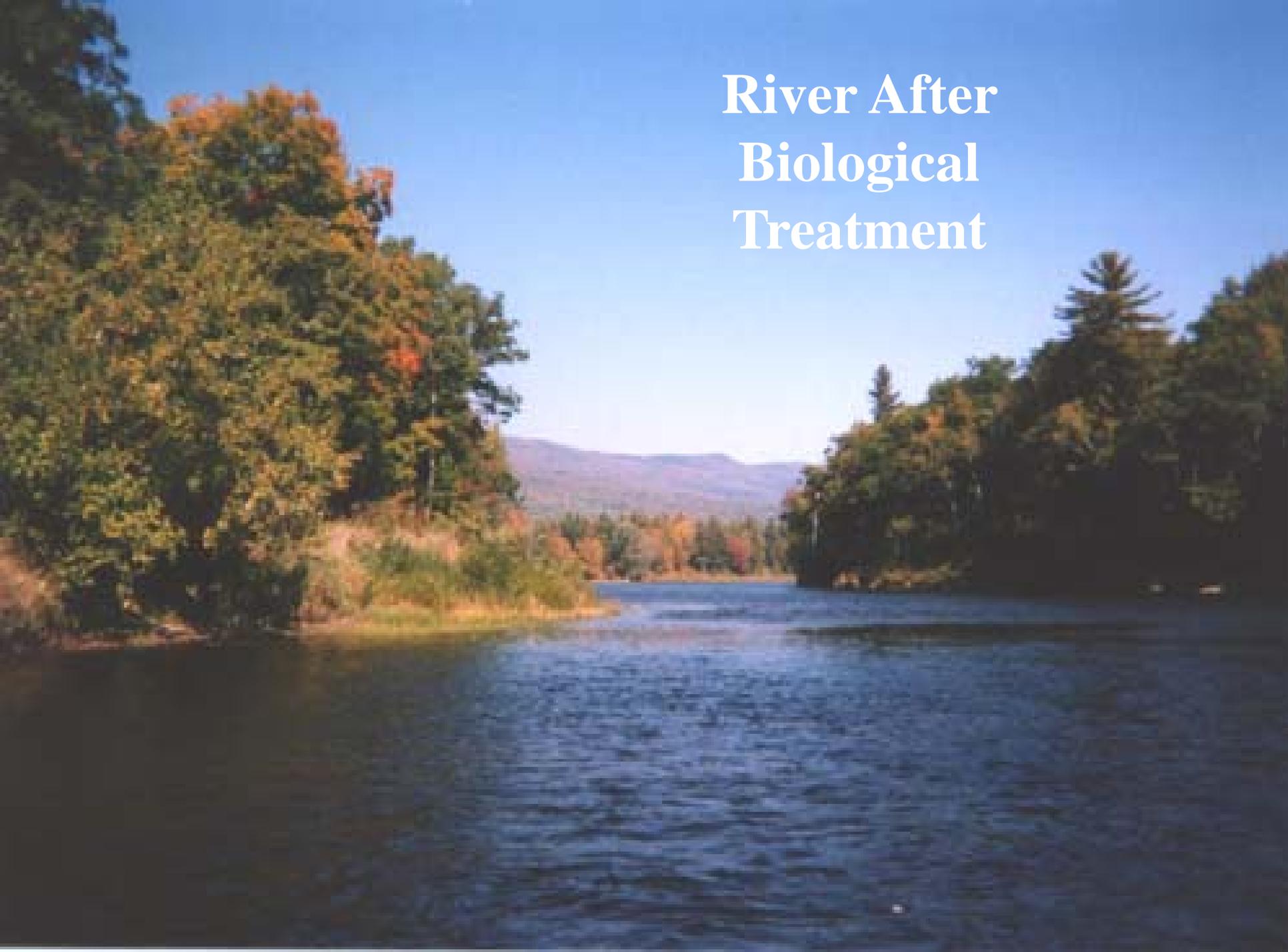
## Cities that began w/ FPI mills

- ✓ Stevens Point – 1847
- ✓ Wausau – 1852
- ✓ Grand Rapids – 1868
- ✓ Centralia – 1874
- ✓ Merrill – 1881
- ✓ Nekoosa – 1883
- ✓ Tomahawk – 1891
- ✓ Brokaw – 1906
- ✓ Port Edwards - 1908
- ✓ Mosinee – 1910
- ✓ Rothschild – 1917

**River Before  
Biological  
Treatment**



# River After Biological Treatment



# Phosphorus & Mill Effluent Treatment

- **Raw mill effluent BOD range: <500 >1,200 mg/L**
- **BOD treatment: biological nutrient requirements**
  - ✓ **Nitrogen: 5 lb N per 100 lb BOD**
  - ✓ **Phosphorus: 1 lb P per 100 lb BOD**
- **Treated mill effluent >95% BOD reduction**

# Activated Sludge Treatment & Phosphorus Demand

- 1,000 lb BOD yields ~500 lb biomass & needs 5 lb P
- Ex. 65,000 lb treated BOD → 32,500 lb biomass
- 32,500 lb biomass requires 325 lb P
- Assume 240 lb/d P in raw effluent:
  - ✓ Then 325 lb demand – 240 lb input = 115 lb P deficit
  - ✓ AST mills must add P to maintain healthy biomass
  - ✓ AST-type treatment typical at many WI paper mills

# Anaerobic Treatment & Phosphorus Demand

- 1,000 lb BOD yields 100 lb biomass & needs 1 lb P
- 65,000 lb BOD → 6,500 lb biomass
- 6,500 lb biomass requires 65 lb P
- Assume 240 lb/d P in raw effluent:
  - ✓ Then 65 lb demand – 240 lb input = 175 lb P surplus
  - ✓ AnT mills must remove P to meet discharge limit
  - ✓ AnT-type treatment NOT typical at paper mills

# AST v AnT Comparison

## AST

- 65,000 lb BOD input
- 32,500 lb biomass produced
- Phos demand = 325 lb
- If mill input = 240 lb P/d
- Then supplemental P needed

## AnT

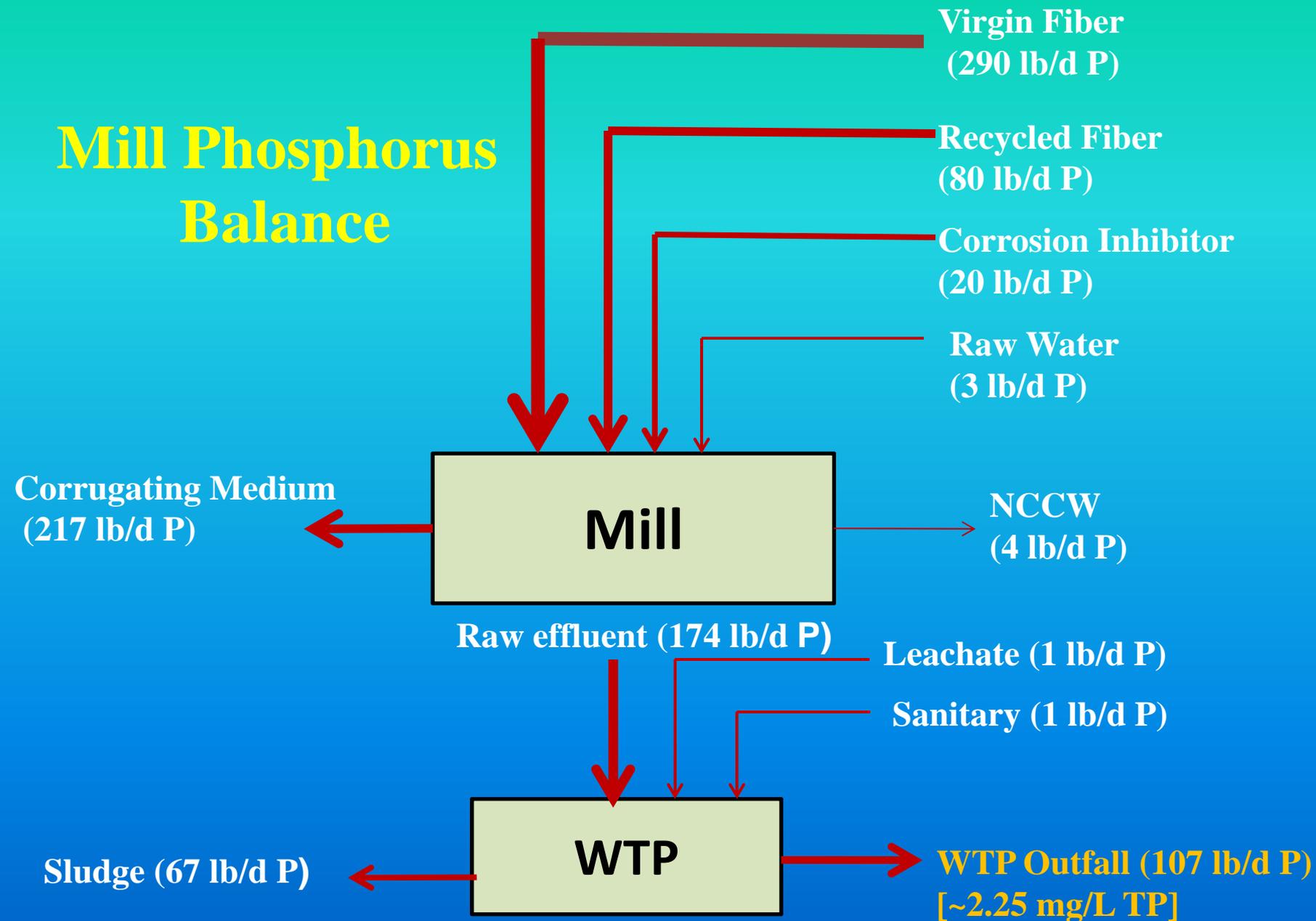
- 65,000 lb BOD input
- 6,500 lb biomass produced
- Phos demand = 65 lb P
- If mill input = 240 lb P/d
- Then surplus P

Biogas collection system





# Mill Phosphorus Balance





# Process Outfall: Variance Study

- **Source minimization: eliminated all but 1 source**
- **Bio-P removal: AnT too effective to support it**
- **Metal salt precipitation**
  - ✓ 20X MR w/  $\text{Fe}_2\text{Cl}_3$  = ~ 1.5 mg/L discharge – not reliable
  - ✓ Competing anions impede  $\text{PO}_4^{3-}$  precipitation
  - ✓ \$7.6 million capital + \$5.4 million annual O&M

# Process Outfall 12-Mo Rolling Avg



# PCA Phosphorus Permit Limit History

- 1998: Initial variance = 4.0 mg/L
- 1999 modification = 3.5 mg/L
- 2003 NPDES permit = 2.6 mg/L
- 2010 NPDES permit = 2.0 mg/L

# Industry Phosphorus Removal Options

- Pulp/paper AST phos discharges are  $< 1.0$  mg/L
- Add-on technologies needed to meet lower limits
- Potential “conventional” treatment add-ons
  - ✓ Have been used in some municipal plants
  - ✓ Biological phos removal
  - ✓ Chemical precipitation + coagulation
  - ✓ Clarification + filtration
- Adaptive management option triggered if filtration (or equivalent) required

# Exotic Methods Phosphorus Removal

- **Research-type technologies**
- **Qualifiers**
  - ✓ **Applicability is speculative**
  - ✓ **Unknown reliability**
  - ✓ **High capital and O/M costs**
- **Examples**
  - ✓ **Carbon adsorption**
  - ✓ **Membrane filtration**
  - ✓ **Ion exchange**
  - ✓ **Reverse osmosis**

## **Some of the things we fear . . .**

- **Chronic WTP upsets due to P deficiency**
- **Must operate at levels <compliance limit**
- **Sludge generation, handling & management**
- **“Investment” & downstream impairment persists**
- **Wringing results solely from point sources**



## Phos WQC: 3<sup>rd</sup> Party Observation

“In my experience, no existing pulp/paper facility in WI can currently achieve this low an effluent TSS.

To meet this effluent TSS level, a tertiary treatment process would be required, such as effluent filtration. At the high wastewater flows of most paper/pulp facilities, this cost would be prohibitive.

You are welcome to quote me. The above is just rational science and reality.”

*Dr. Michael Richard, PhD 1/9/2012*



# WI River: Rhineland to Nekoosa

- **Phosphorus Vectors**

- ✓ Pulp/paper sector 2007-2009 Avg = 166,220 lb<sup>1</sup>
- ✓ Pulp/paper sector 2011 estimate ~128,000 lb<sup>2</sup>
- ✓ Non-Point “most likely” total = 630,573 lb<sup>3</sup>

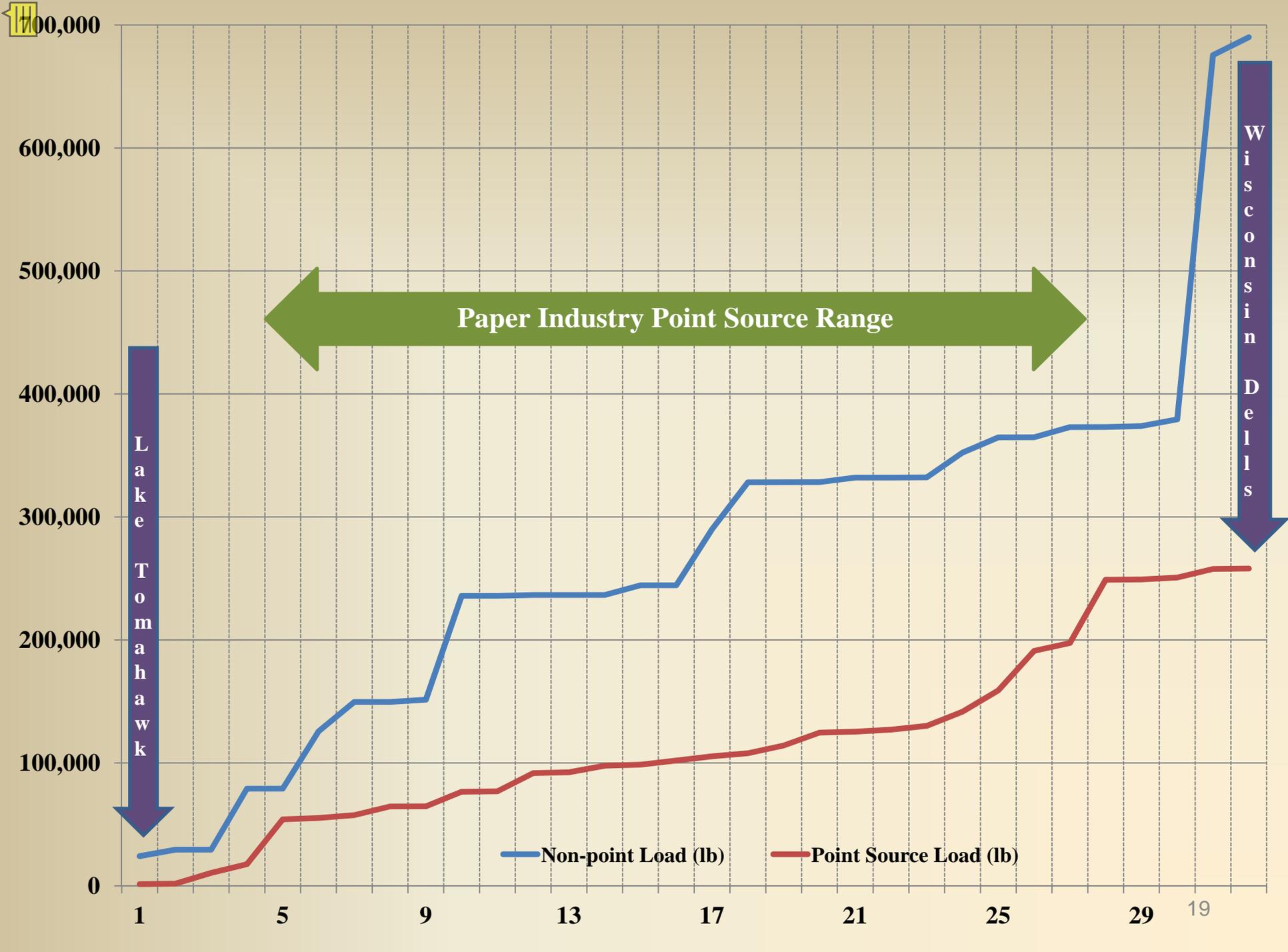
- **Implications**

- ✓ Problem w/ traditional regulatory approach
- ✓ Big tool for small problem & vice versa
- ✓ TMDL approach – not perfect, but better

<sup>1</sup> Source: DNR, 2007-2009 point source average

<sup>2</sup> Source: Ibid, minus mill closures since 2009

<sup>3</sup> Source: DNR, PRESTO long-term regression estimate at Nekoosa, WI WWTP



**Problem**

**Problem Solving**

**Problem Solving Risk**



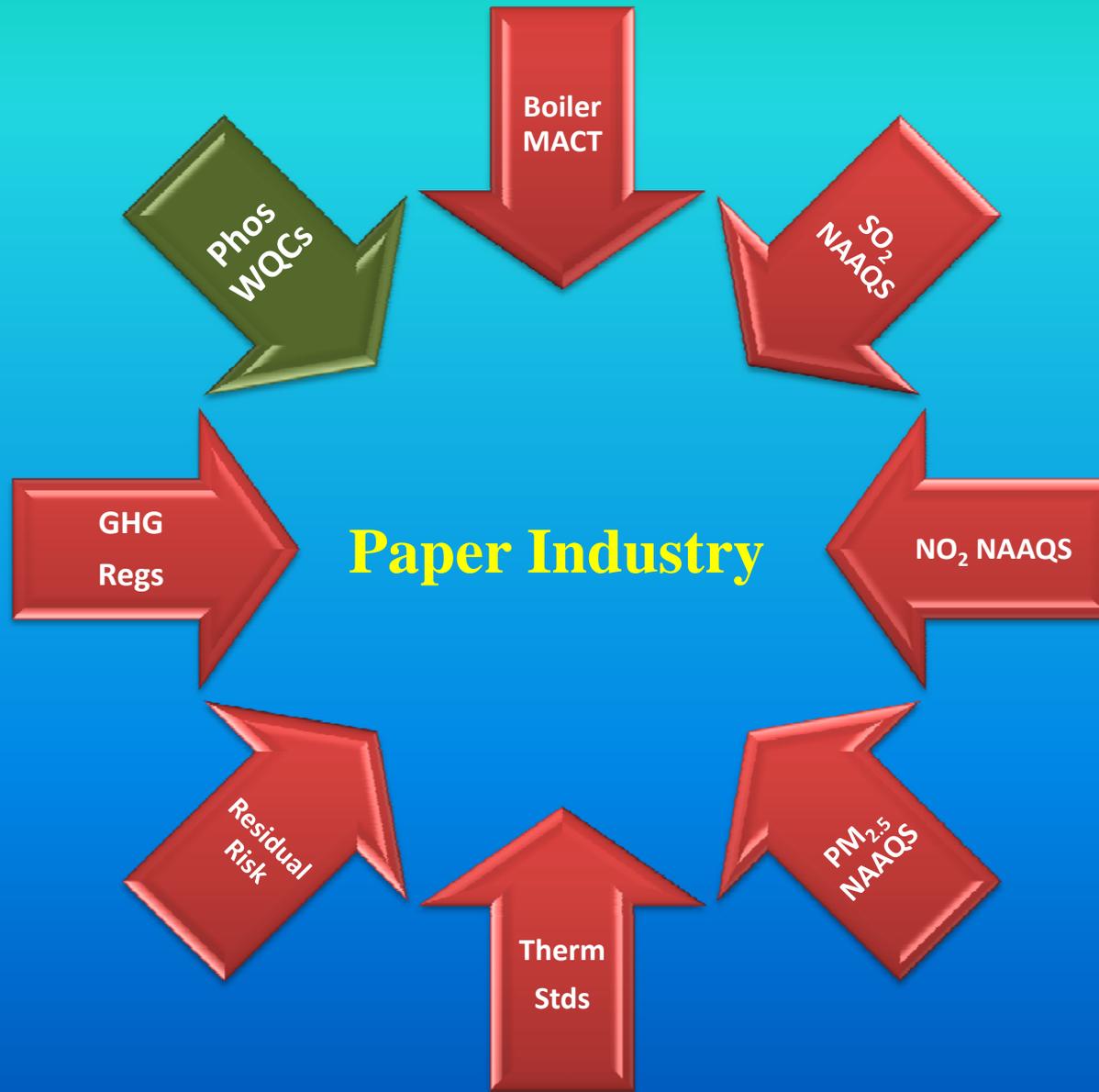
# WI River TMDL

- **Study scope: Rhinelander to Lake Wisconsin**
- **Objectives:**
  - ✓ **Improve water quality & attain standard**
  - ✓ **Determine impact of P discharge on WI River water quality**
  - ✓ **Derive Waste Load Allocations for point dischargers**
  - ✓ **Derive Load Allocations for non-point sources**
  - ✓ **Determine impact from sources upstream of impairment**
  - ✓ **Accurately link P sources to biological effects**
  - ✓ **Complete in ~ 4 years**

# TMDL Collaboration

- **Involve point/non-point sources**
- **Employ a science-based approach**
- **Technical expertise from:**
  - ✓ **WDNR**
  - ✓ **National Council for Air and Stream Improvement**
  - ✓ **Modeling Consultant(s)**

# Cumulative Regulatory Burden



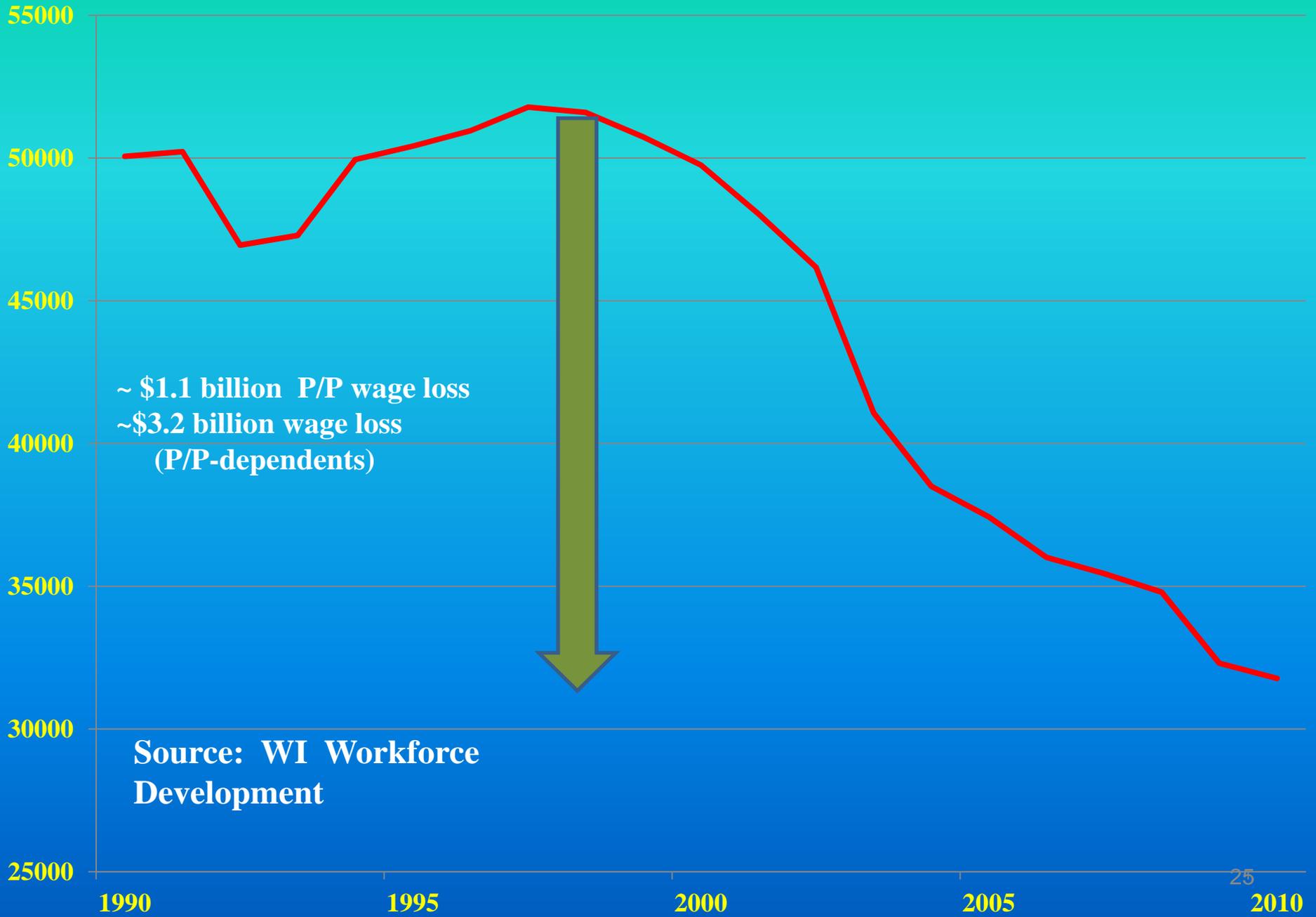


# Wisconsin River Mills

- **Wausau Papers – Rhinelander**
- **Packaging Corp of America – Tomahawk**
- **International Papers – Merrill**
- **Wausau Papers – Brokaw**
- **Domtar – Rothschild**
- **Wausau Papers – Mosinee**
- **New Page – St. Point, Biron, WI Rapids**
- **Neenah Papers - Whiting**
- **Domtar – Nekoosa, Port Edwards**



# WI Pulp/Paper Industry Employment Trend



**Questions?**