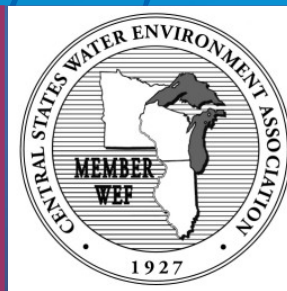


Low Level Phosphorus Removal: Case Studies from the Central States Region

Leon Downing, Ph.D., PE; Eric Lynne; Bill Marten, PE, BCCE



**Central States Water
Environment
Association**

85th Annual Meeting

May 14-18, 2012

Acknowledgements

- **Staff from the following facilities:**

- Eau Claire, WI
- Stevens Point, WI
- New Lenox, IL
- Jackson, WI
- Sheboygan, WI



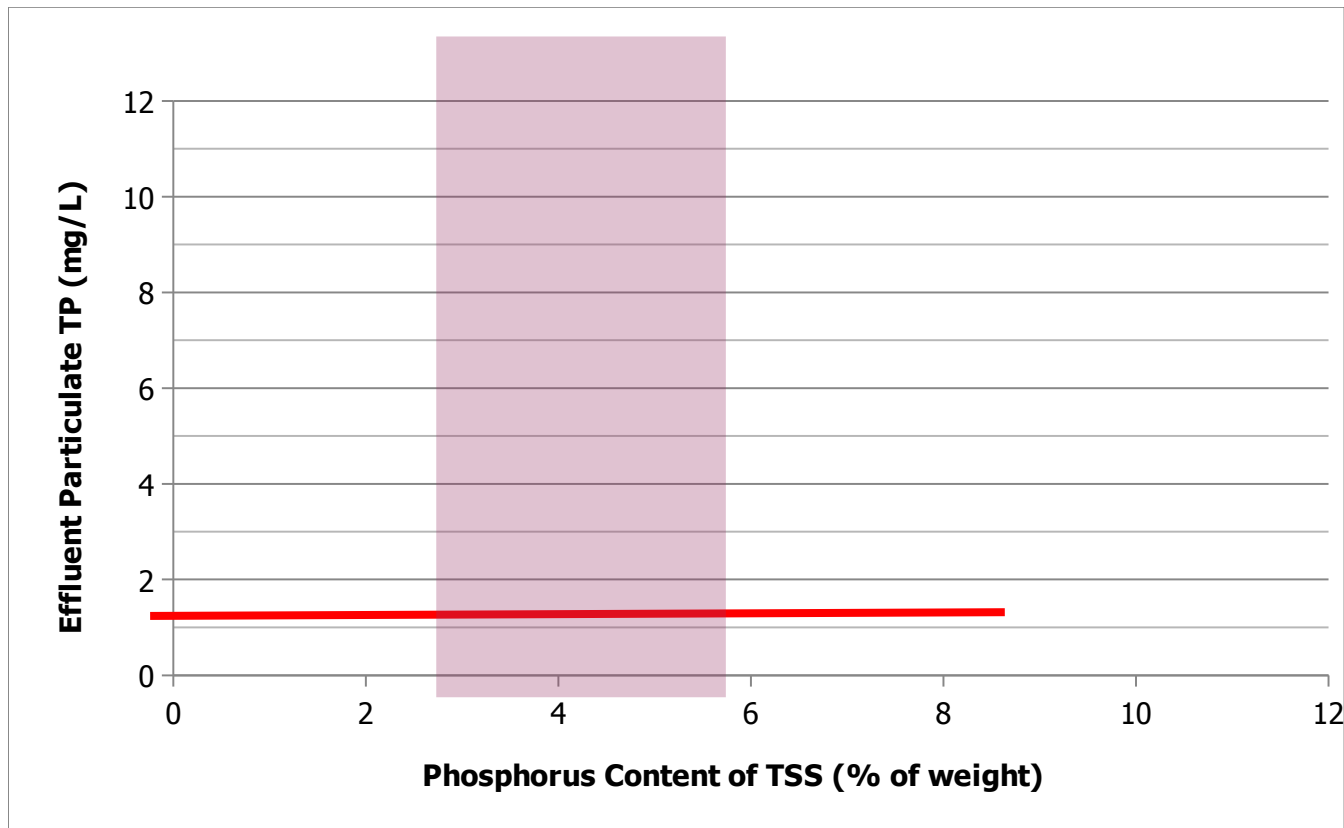
Phosphorus Removal

- **Soluble and particulate phosphorus**
 - Soluble: biological and/or chemical transformation to particulate phosphorus
 - Particulate: physical removal
- **More stringent phosphorus limitations**
 - Increased conversion of soluble phosphorus to particulate



Phosphorus Removal

- Impact on achievable effluent phosphorus



Phosphorus Removal Case Studies

- **Chemical demand to achieve low level soluble phosphorus**
- **Low level biological phosphorus removal**
- **Filtration**
- **Process troubleshooting**

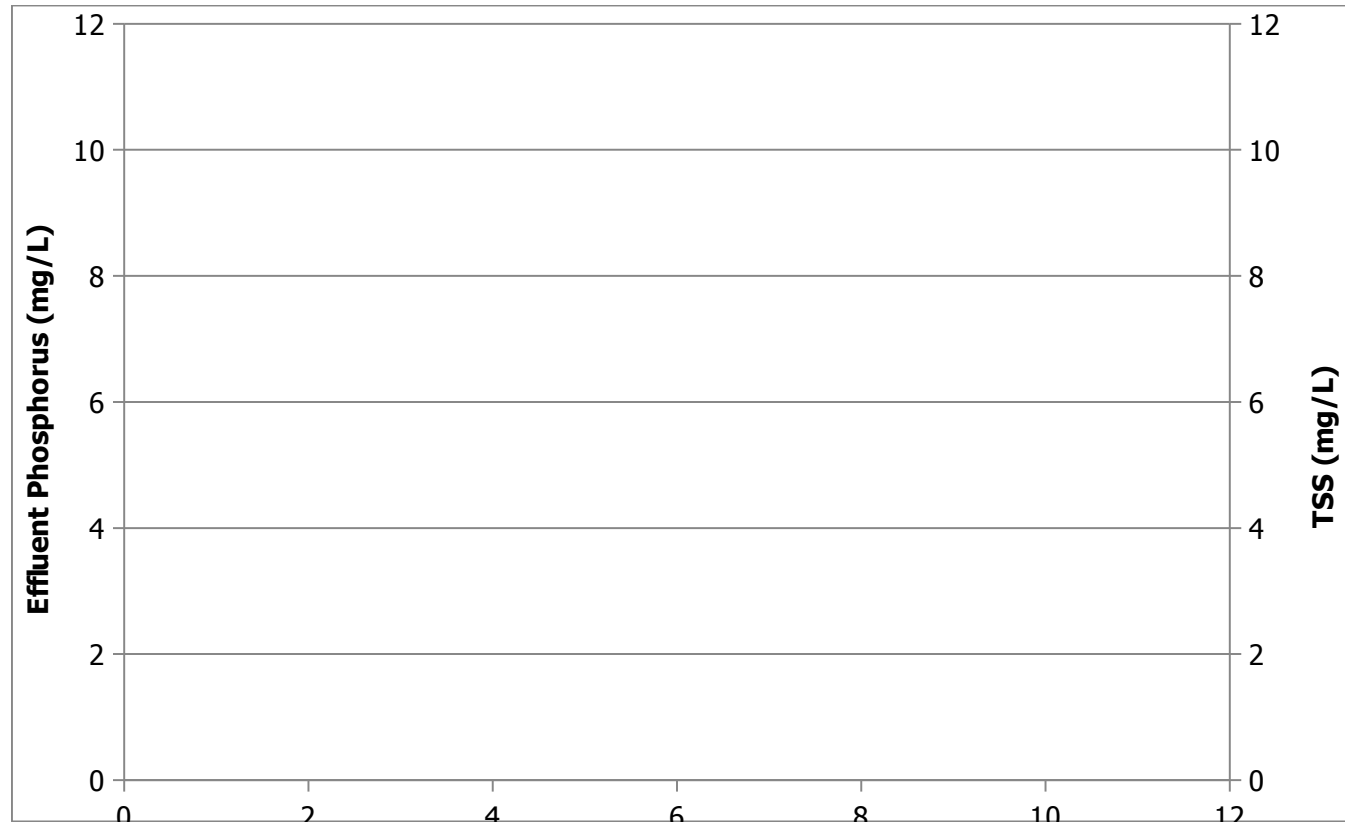


Eau Claire, WI

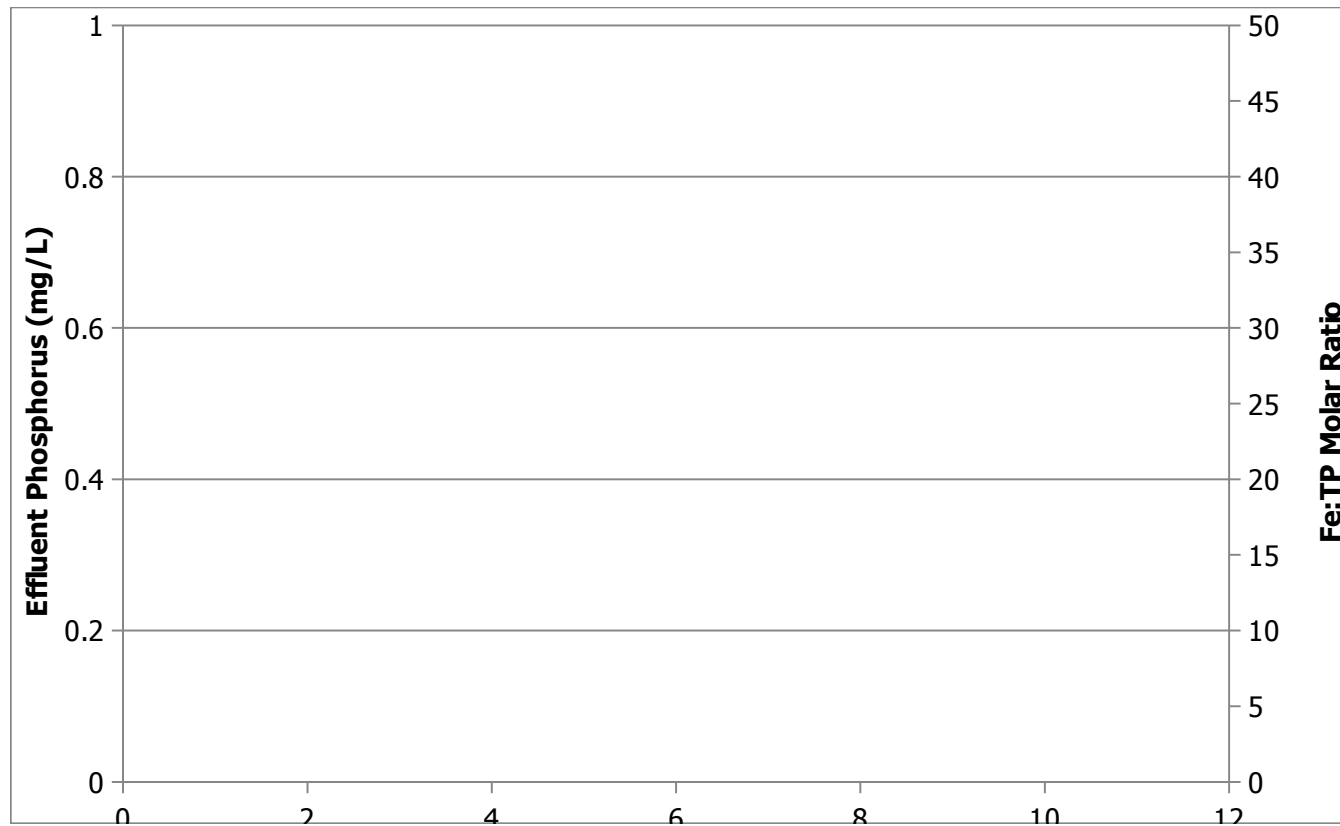


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Eau Claire, WI



Stevens Point, WI



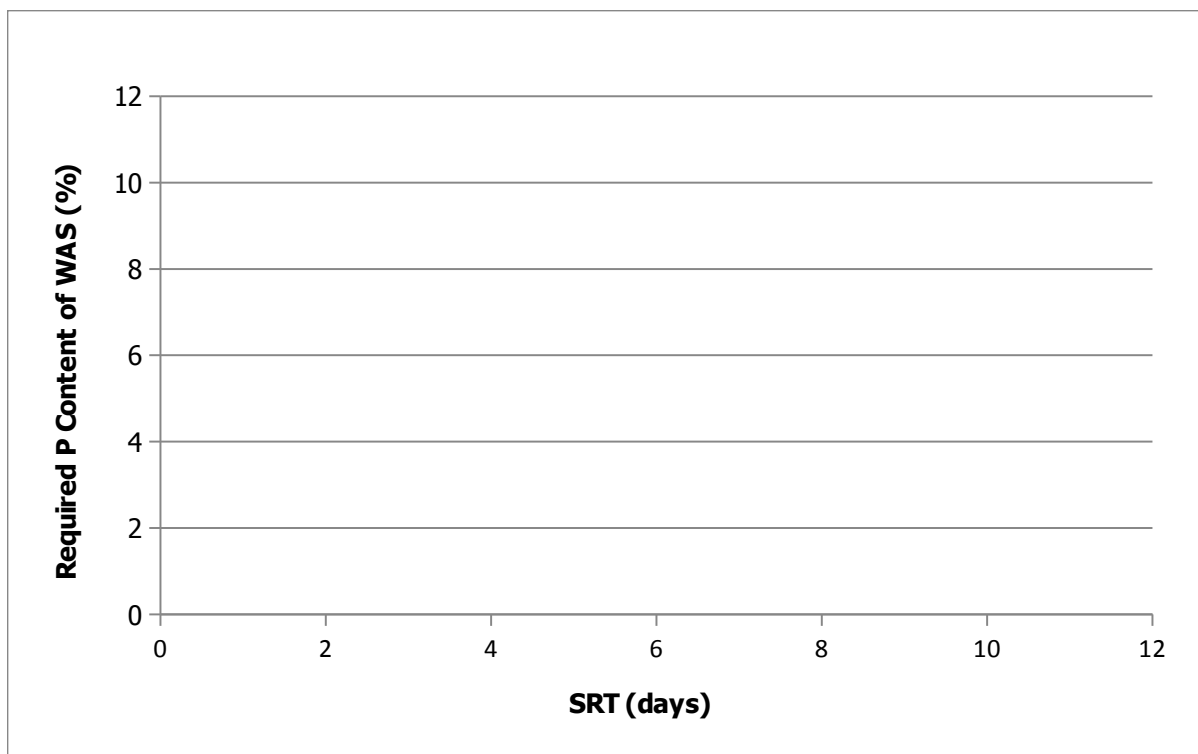
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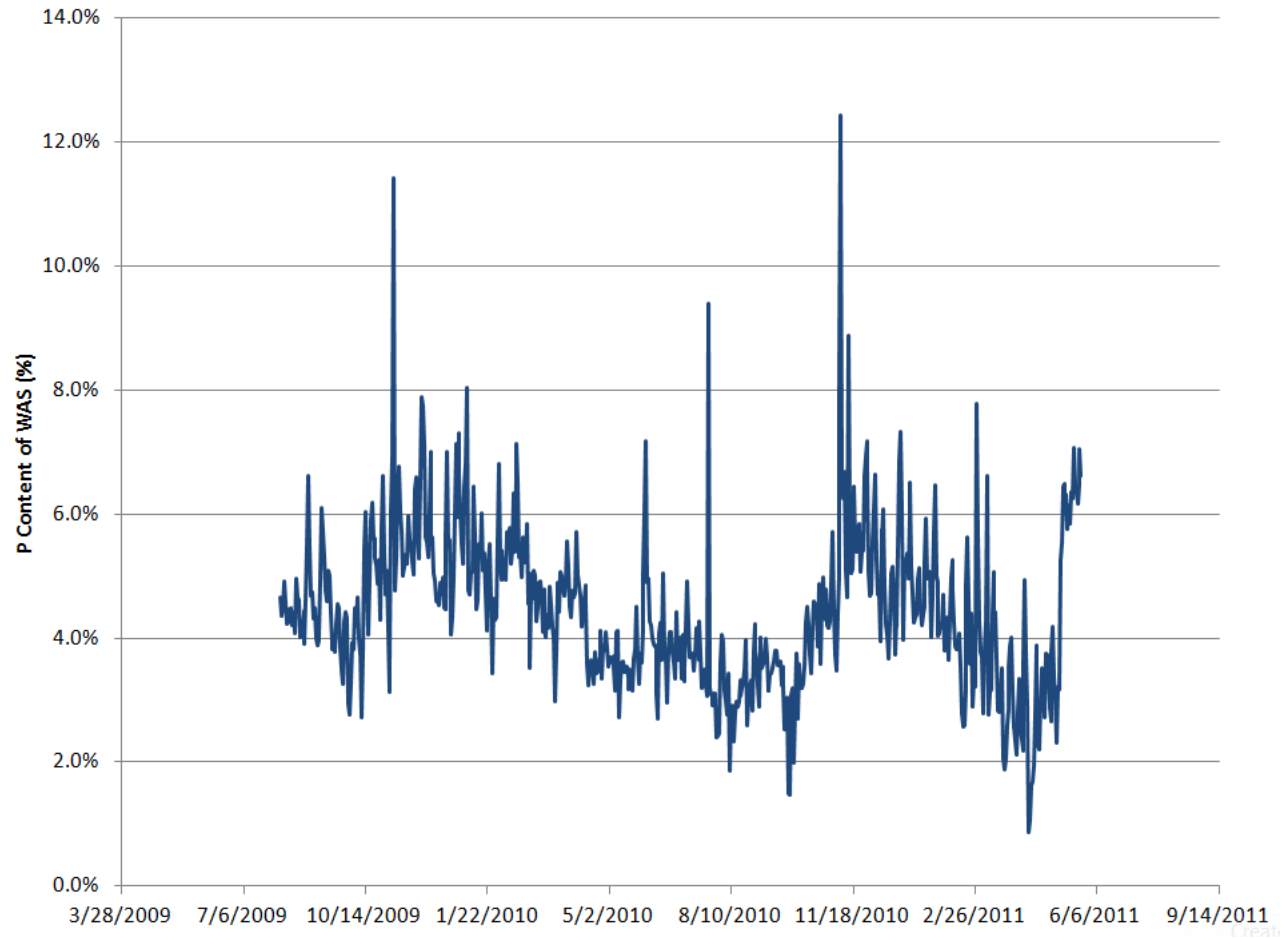


Stevens Point, WI

- **SRT and soluble phosphorus**
 - For removal of 180 ppd of TP...

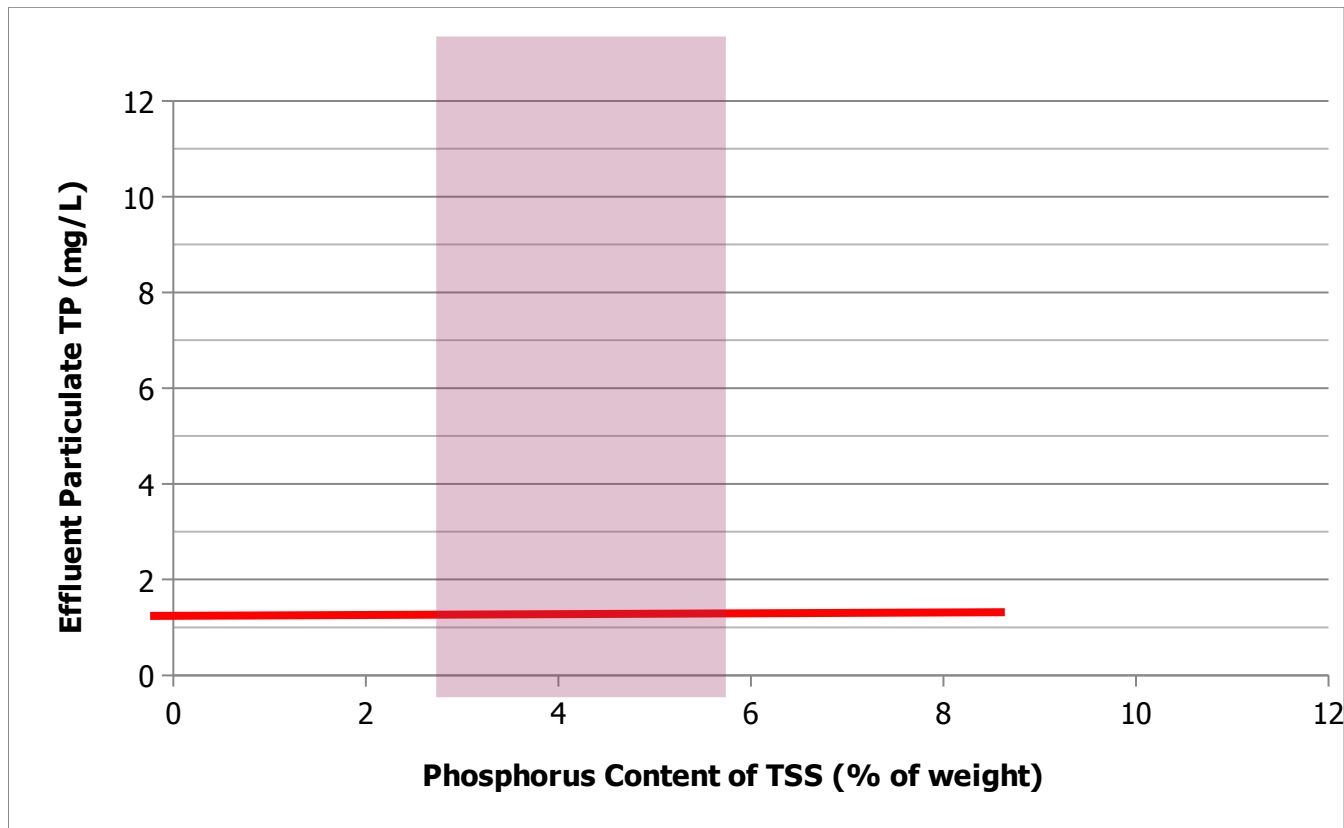


Stevens Point, WI



Phosphorus Removal

- Impact on achievable effluent phosphorus

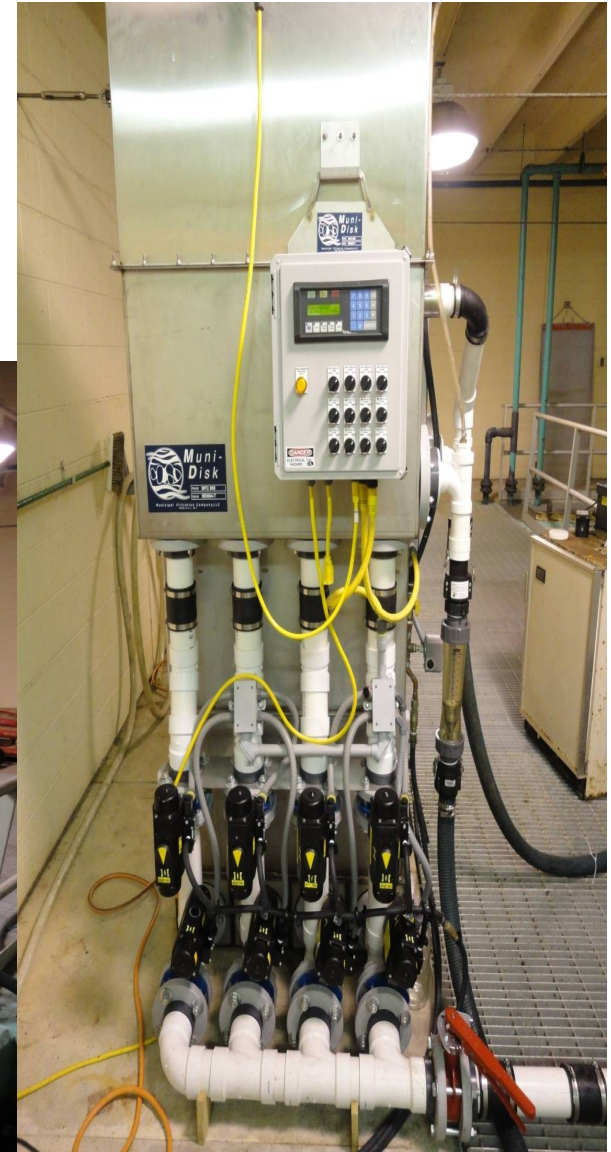
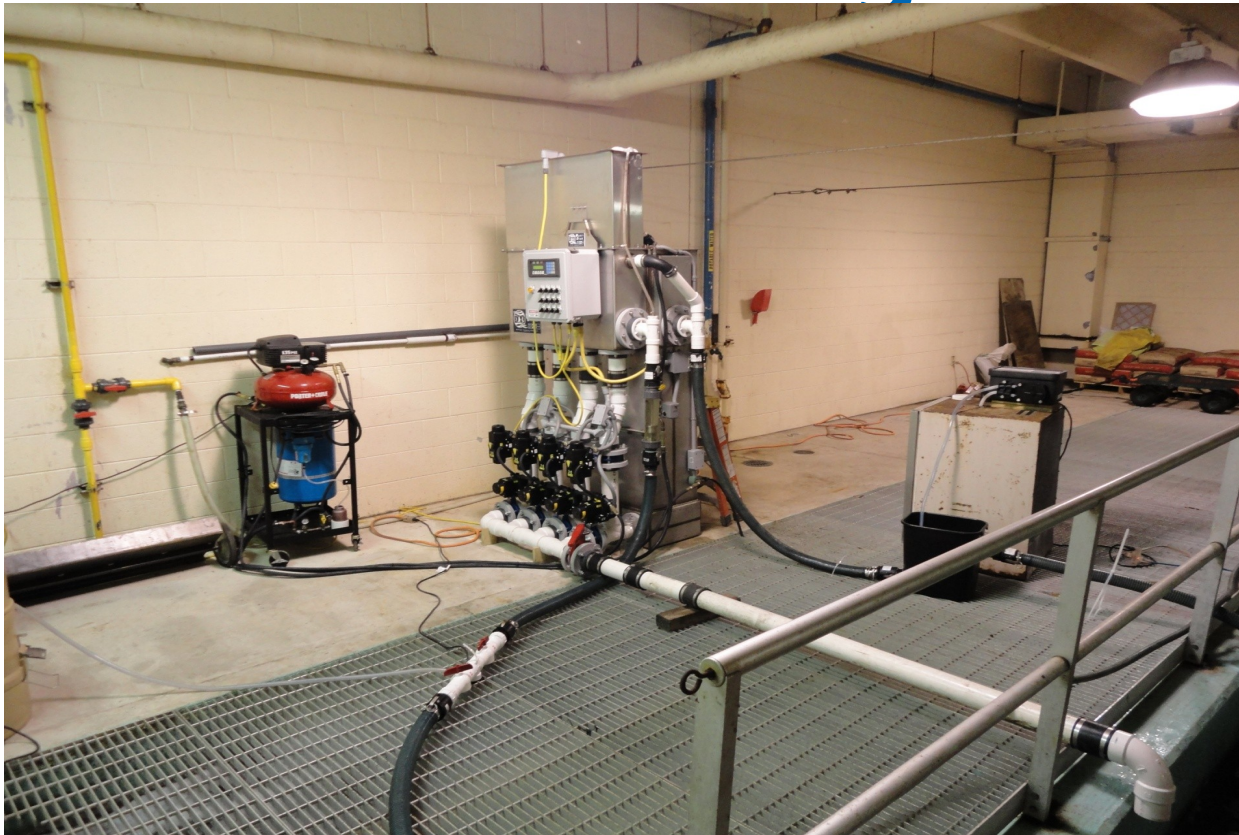


Jackson, WI

- **Nitrifying/Denitrifying Activated Sludge**
- **Chemical P (Alum) With Sand Filters**
- **Pilot Test of High Rate Cloth Filters**

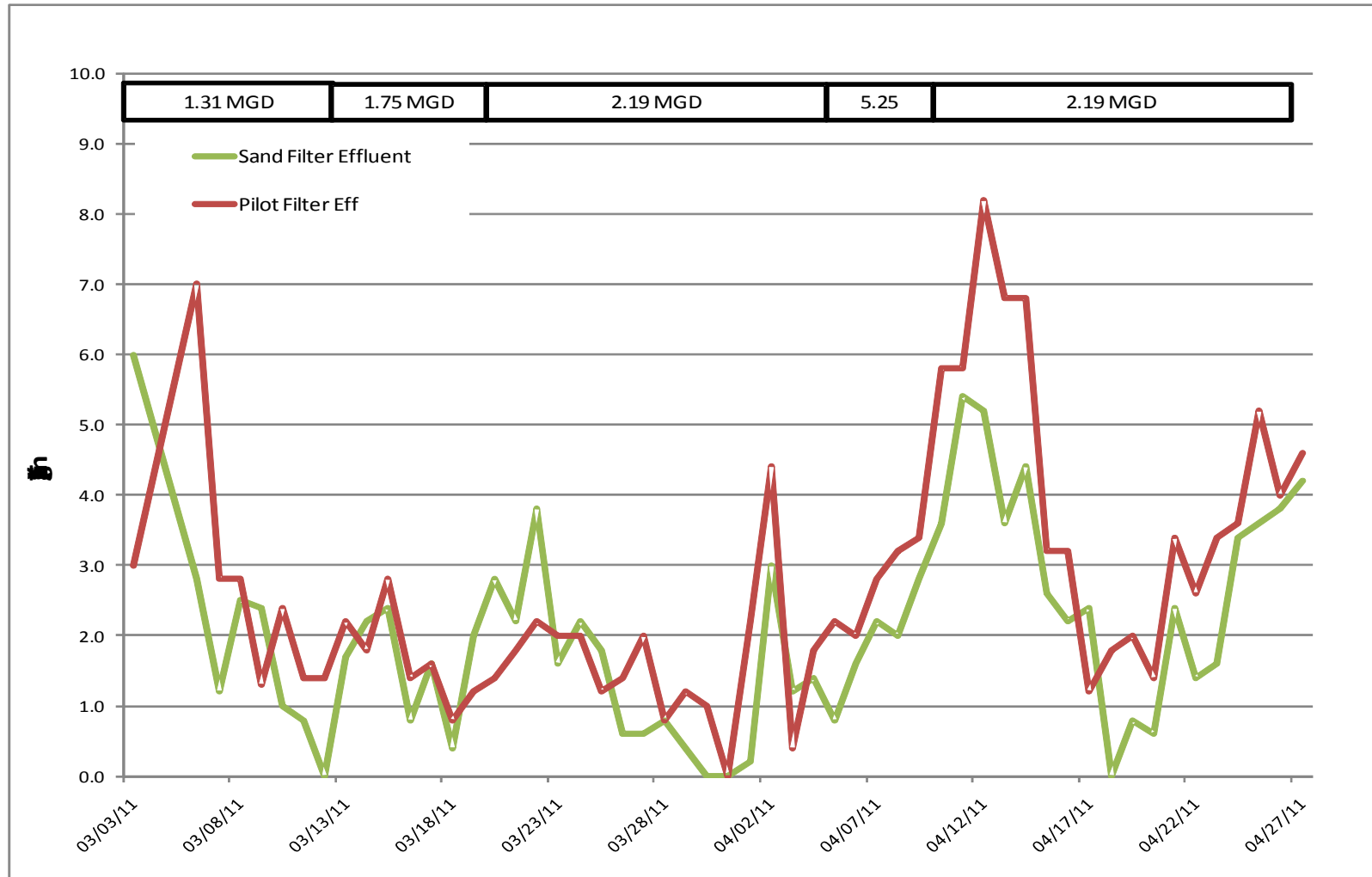


Jackson High Rate Filter Pilot Testing

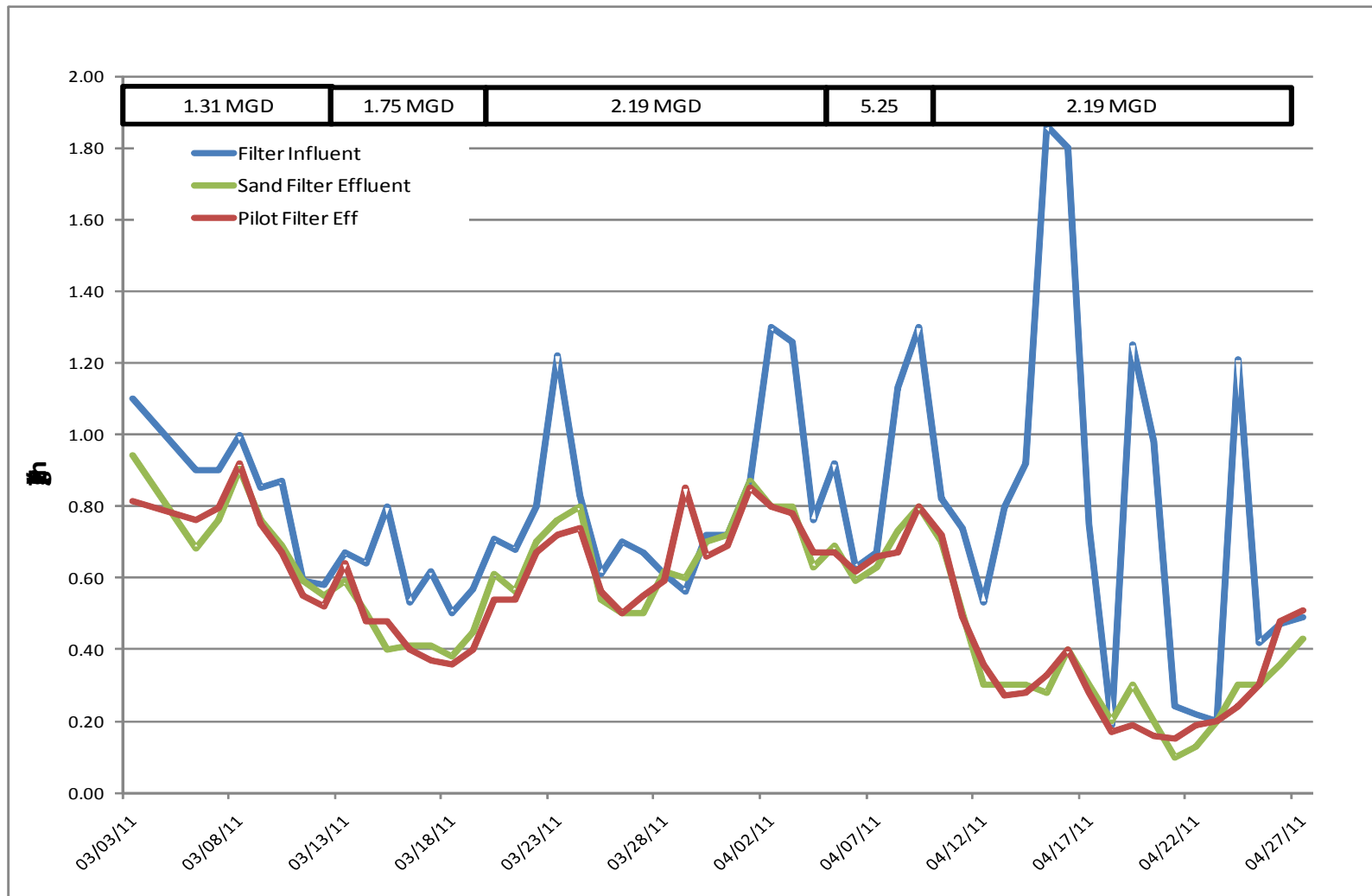


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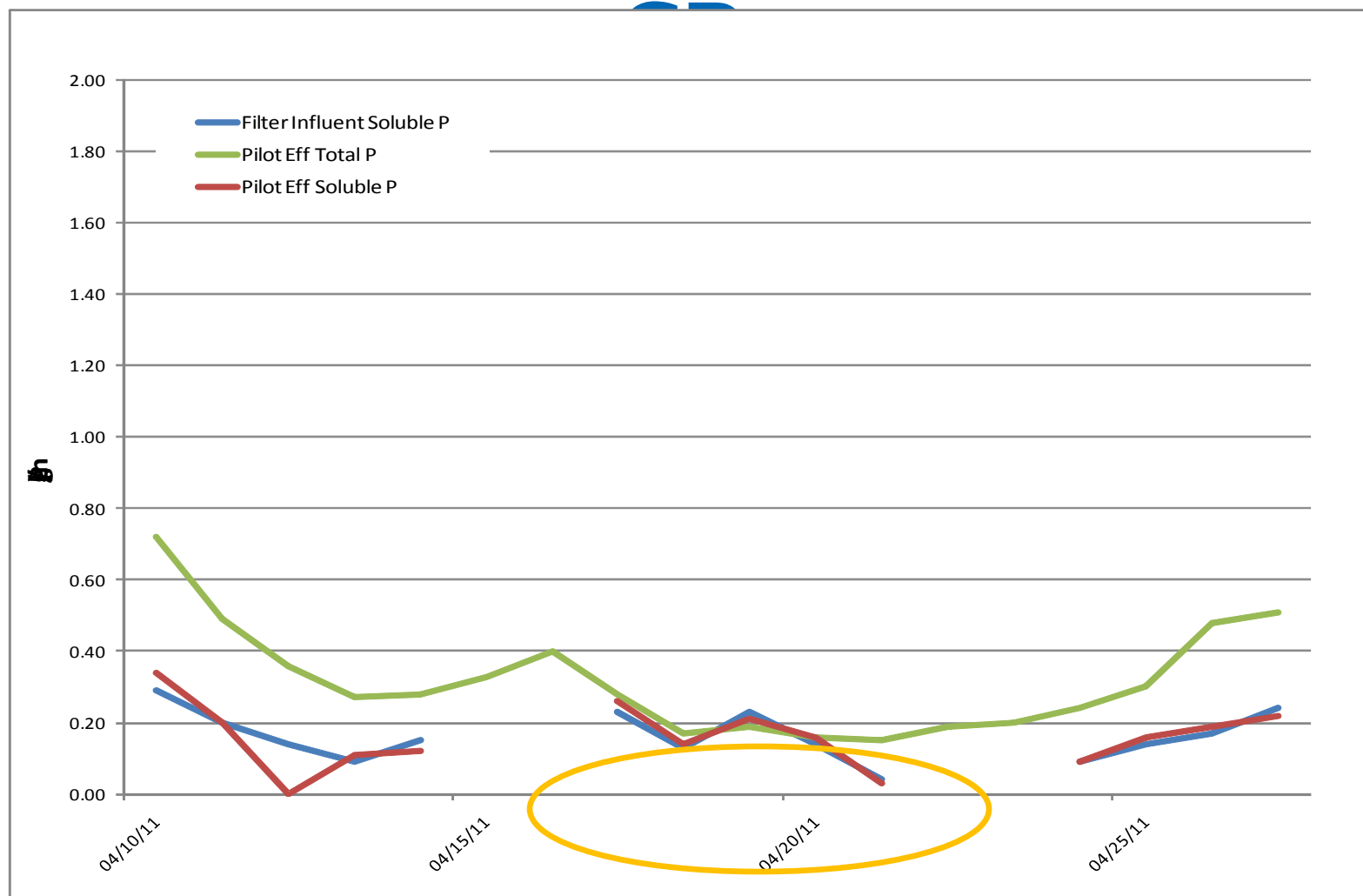
Jackson Pilot Test Results: TSS



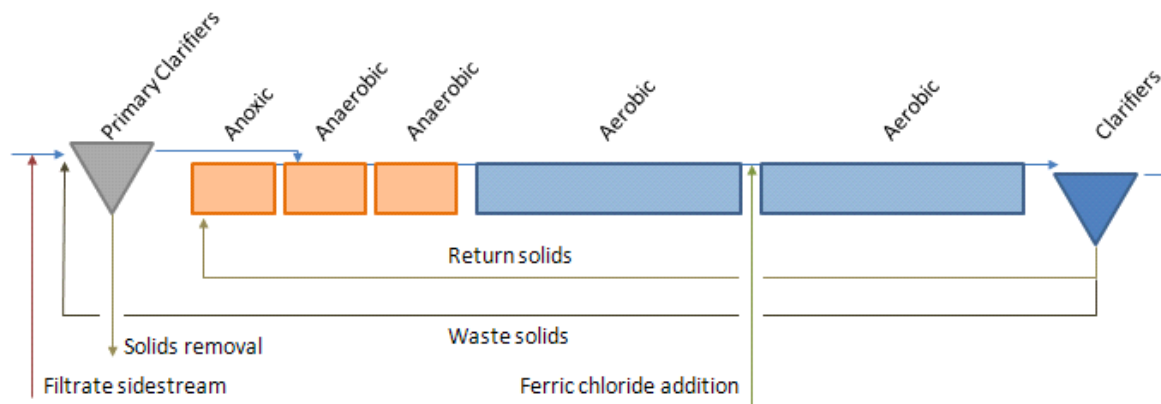
Jackson Pilot Test Results: TP



Jackson Pilot Test Results: TP & CS

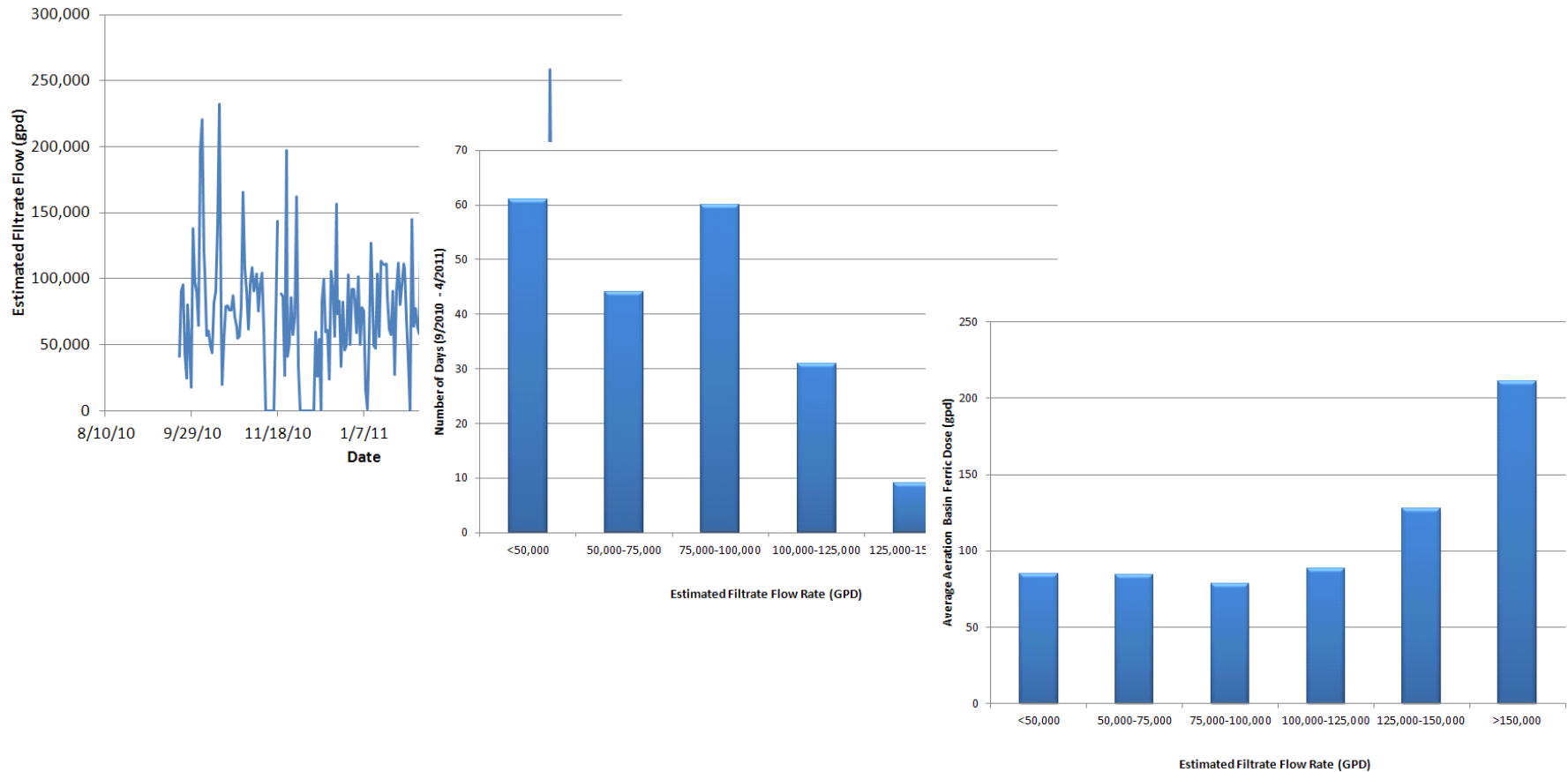


Sheboygan WWTP



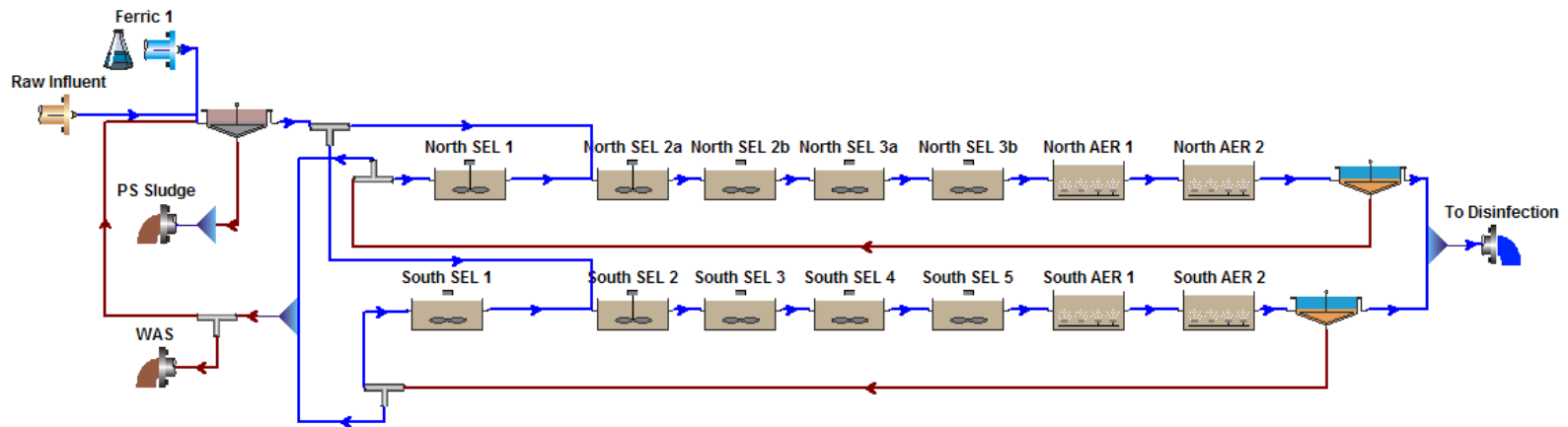
Sheboygan, WI

▪ Sidestream Impact

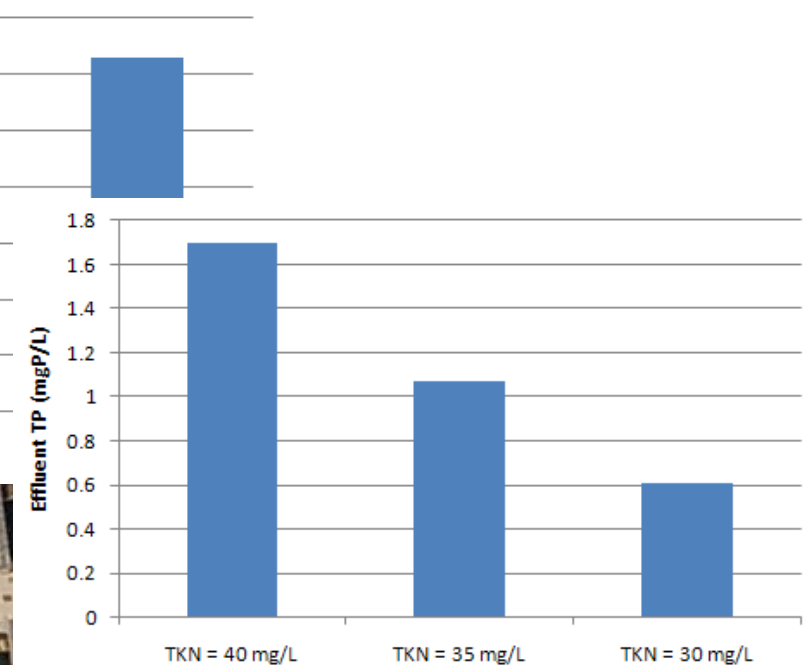
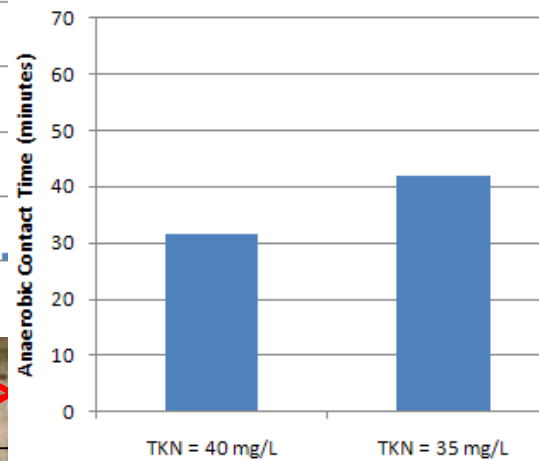
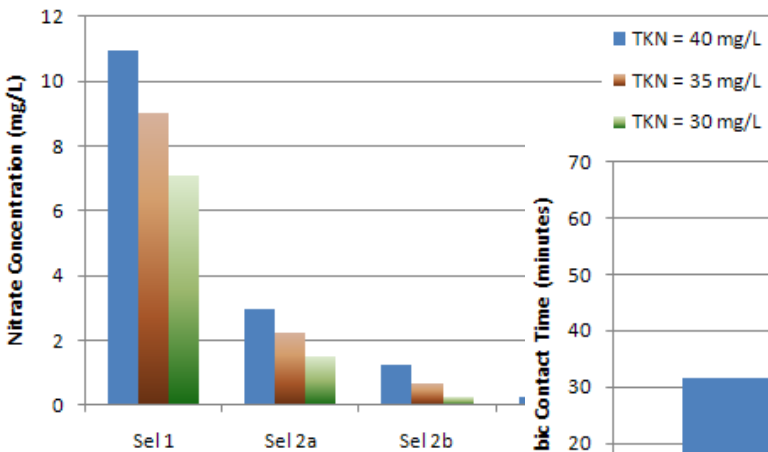


Sheboygan, WI

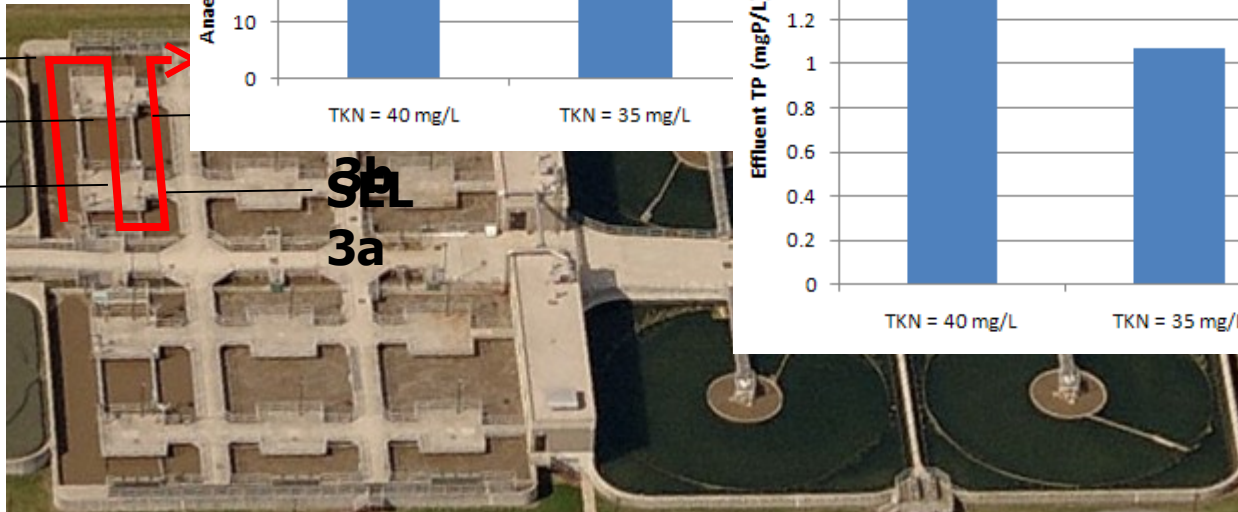
- Examine using Biowin modeling
- Sensitivity to effective influent ammonia concentration
 - Sheboygan samples influent ammonia weekly
 - Effluent permit is 23 mg/L (Lake Michigan discharge)
 - High strength sidestream is not treated or equalized



Sheboygan, WI

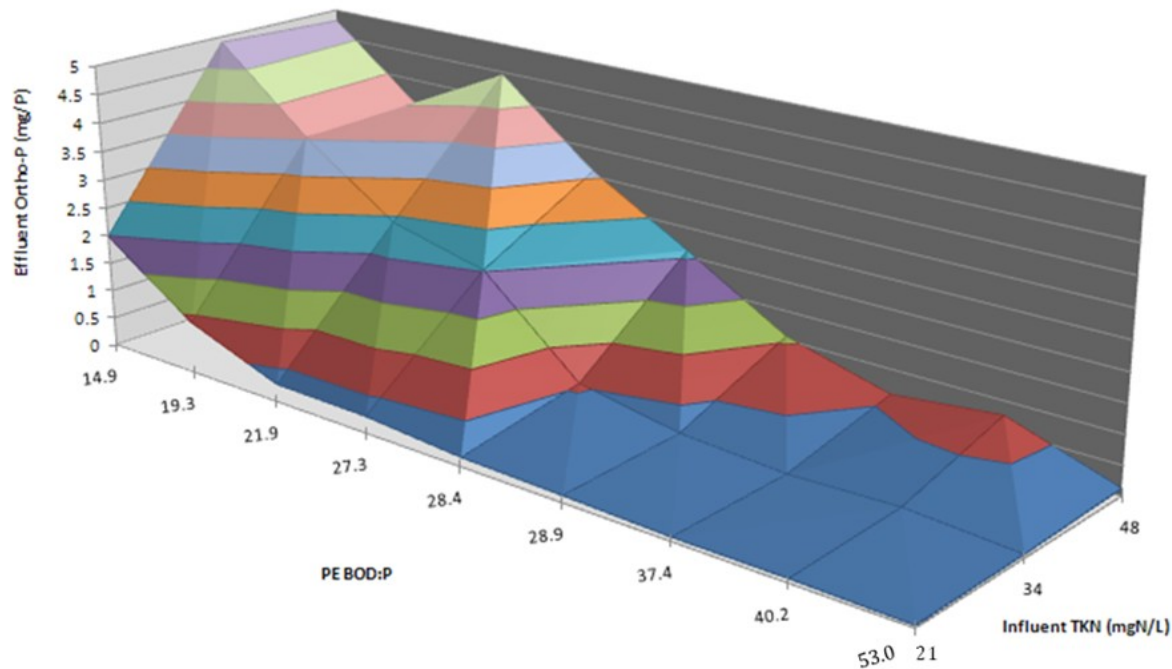


SEL 1
SEL 2a
SEL 2b



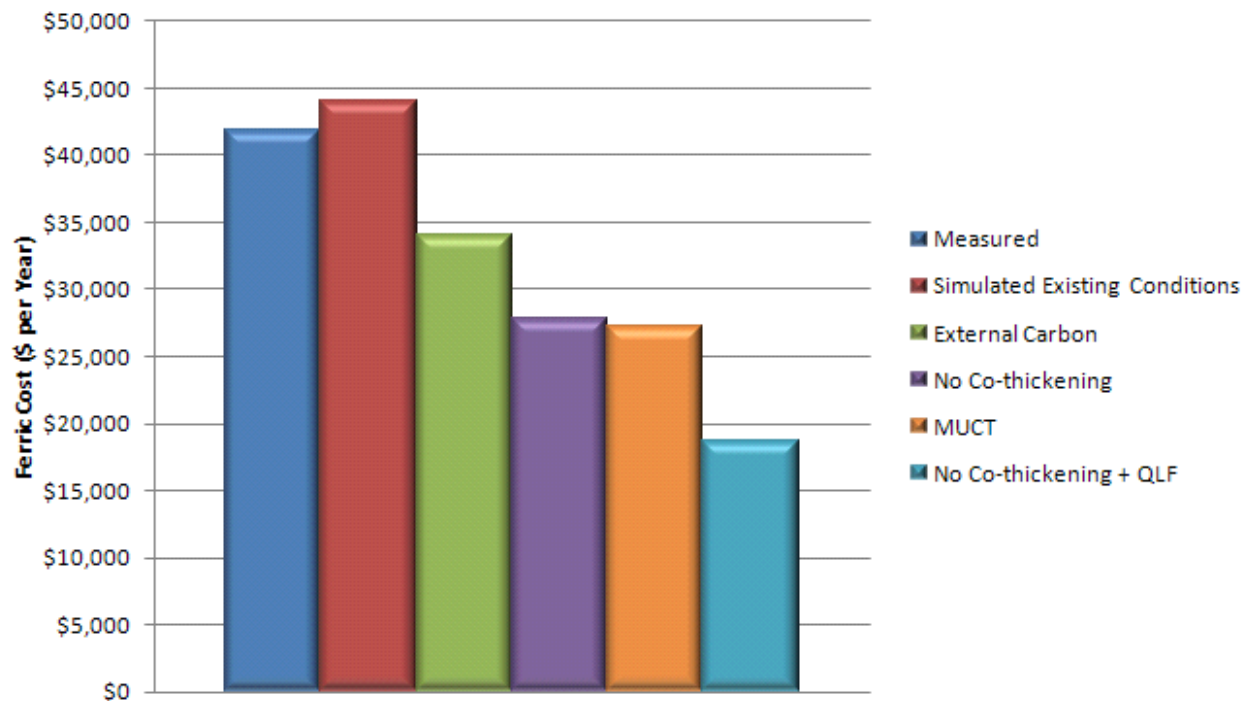
Sheboygan, WI

- **Dynamic Simulations**
 - Establish relationship of BOD, TKN, and TP



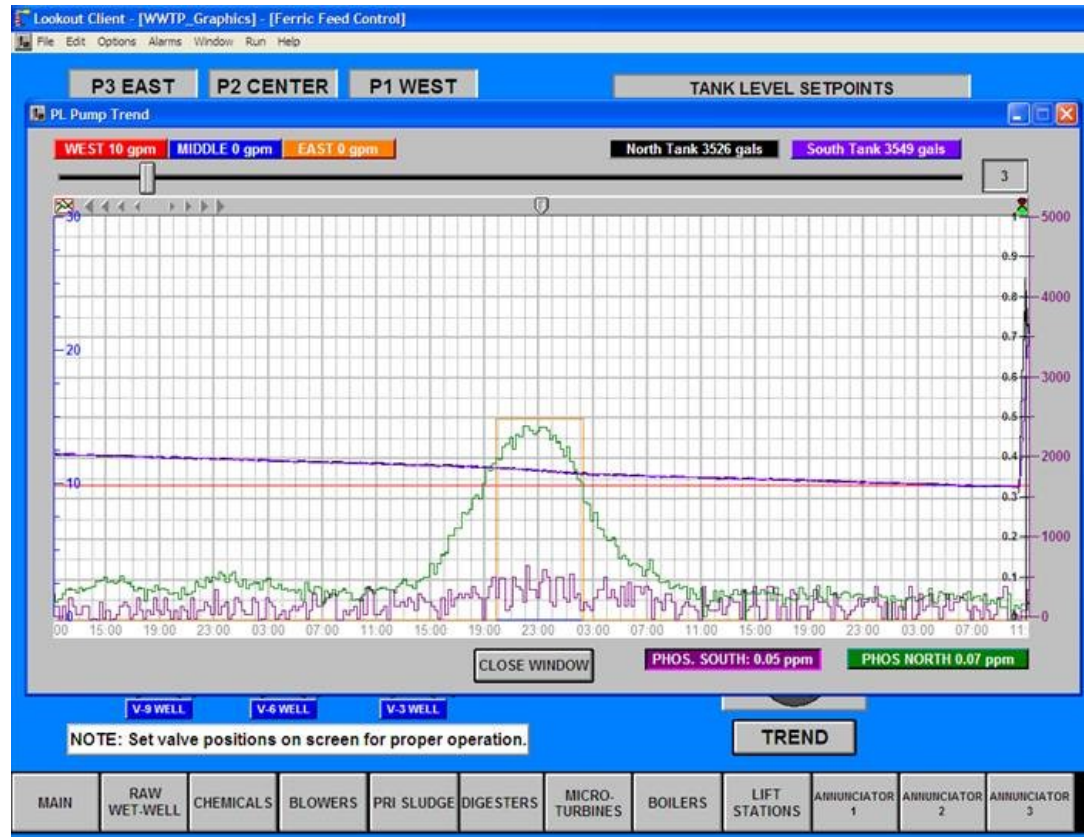
Sheboygan, WI

- Improvements evaluation with modeling



Sheboygan, WI

- External carbon?



Central States Experiences

- **Low level soluble phosphorus is achievable**
 - Process dynamics
 - Chemical requirements
 - Particulate (TSS) removal
- **Keys to success:**
 - Process operation and control
 - Understanding where the P is going
 - Highly effective P removal



Questions?

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