

# Nutrient Removal at the Hockanum River WPCF

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**WRIGHT-PIERCE**   
Engineering a Better Environment

# Presentation overview



- Manchester WPCF history
- Project goals
- Process modifications
  - Nitrogen removal improvements
  - Phosphorus removal improvements
- Operator's perspective
  - Design phase
  - Construction phase
  - Startup and operations



# Manchester WPCF history

- Treatment dates to 1930s at HBI site
- Primary facility in 1955
  - Preliminary/primary treatment
  - Effluent disinfection
  - Anaerobic digestion
  - Sister plant at 8<sup>th</sup> Utilities District
- 1971 secondary plant
  - HBI Site
    - ◆ Kept preliminary/primary treatment
  - 8<sup>th</sup> Utilities Flow
    - ◆ Preliminary treatment at new plant
    - ◆ No primary treatment for this flow



# Manchester WPCF history

- 1991 nitrification upgrade
  - Included primary treatment
  - Eliminated remote primaries
  - Kept remote headworks & solids handling
- Added additional aeration volume
  - 16 banks total/mechanical aerators
  - two additional final settling tanks
- 2006 UV disinfection upgrade



# Project goals

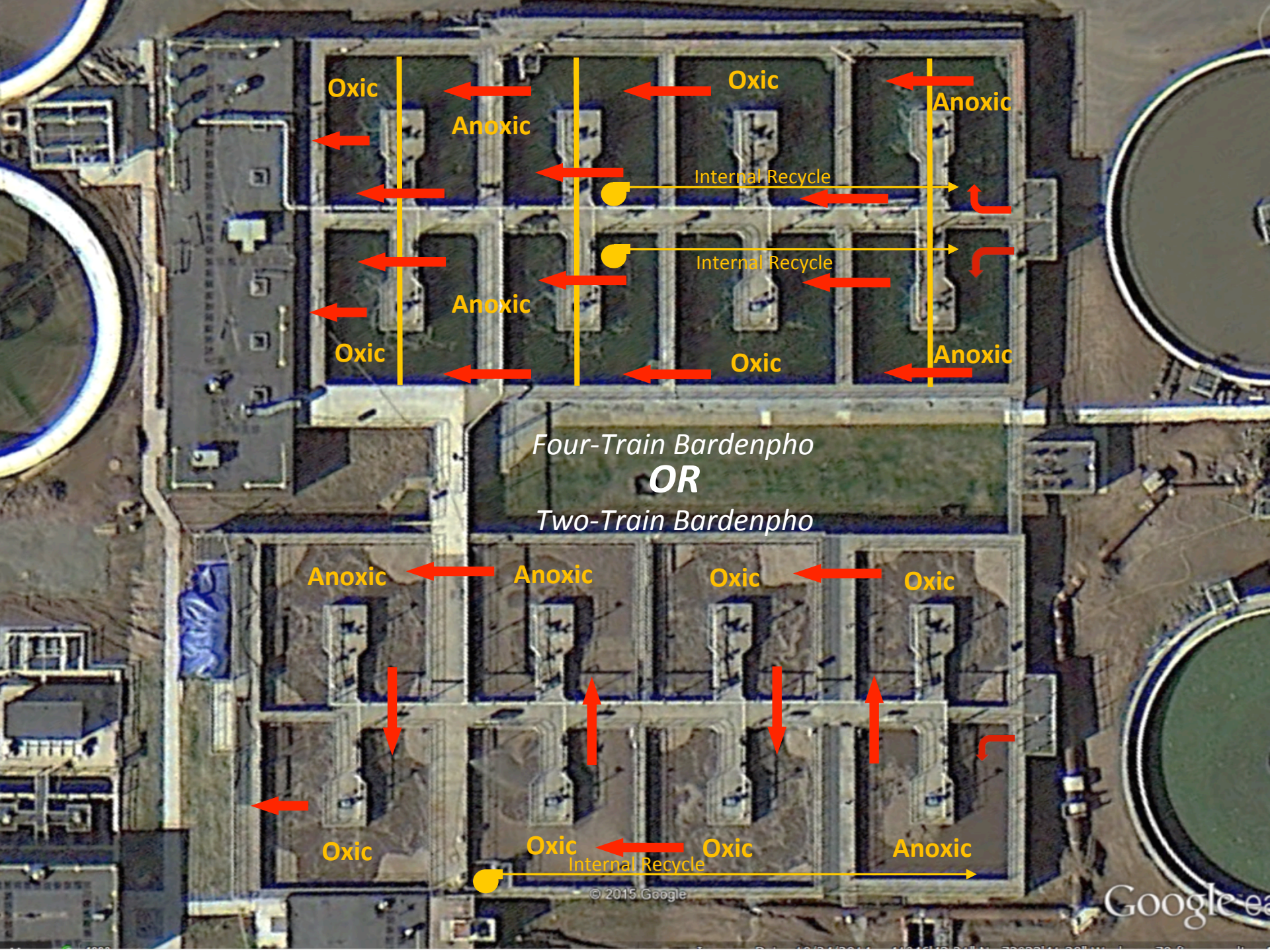
- Improve nitrogen removal
  - paying for credits (\$244,000 in 2013)
- Meet upcoming phosphorus limits
  - Seasonal limit of 0.19 mg/l at design flow
- Improve energy efficiency
  - replace two-speed mechanical aerators
  - modern SCADA & controls
- Upgrade aging equipment & systems



# Process modifications

- Nitrogen removal considerations
  - Anaerobic digestion impacts?
  - Eliminate primary clarifiers?
  - Supplemental carbon?
  - Include bio-P?
- Alternative configurations
  - MLE & purchase credits
  - Bardenpho
  - Four-train vs. two-train process





Oxic

Anoxic

Oxic

Anoxic

Internal Recycle

Internal Recycle

Oxic

Anoxic

Oxic

Anoxic

Four-Train Bardenpho  
**OR**  
Two-Train Bardenpho

Anoxic

Anoxic

Oxic

Oxic

Oxic

Oxic

Oxic

Anoxic

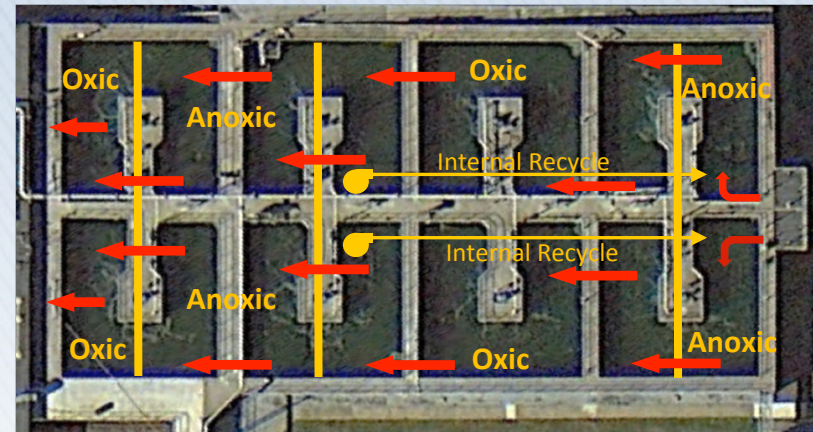
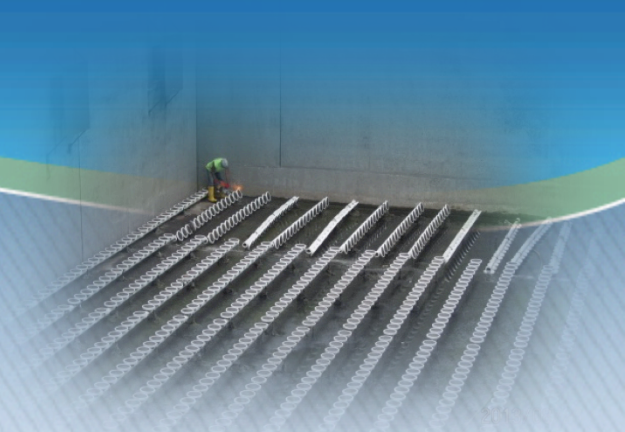
Internal Recycle

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# Four-train vs. two-train

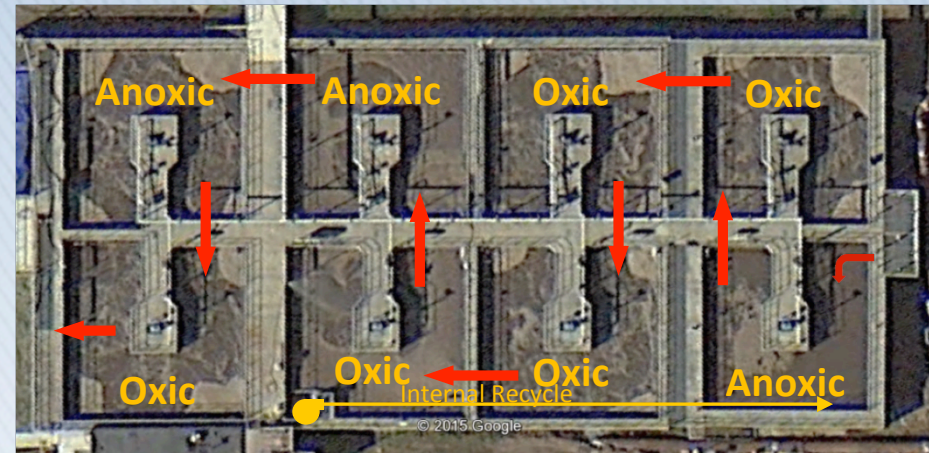
- Four-train advantages
  - Process flexibility - can take down 25% of system
- Four-train disadvantages
  - Additional baffle walls
  - Additional pumps
  - Additional mixers
  - Difficult to reuse aerator platforms
  - 8,000 fine bubble diffusers





# Four-train vs. two-train

- Two-train advantages
  - Simplified system
  - Less equipment
  - Limited structural modifications
  - Re-use existing aerator platforms
- Two-train disadvantages
  - One train = 50% of process



# Two-train process

- Utilized Hyperbolic Mixer-Aerator
  - Re-use existing platforms
  - Separate mixing and aeration
    - ◆ Operate all banks oxic or anoxic
    - ◆ Not mixing limited at end of oxic zones
  - Aerator efficiency
    - ◆ Mixers VFD Driven
    - ◆ Proportional to air flow
    - ◆ Transfer efficiency impacts

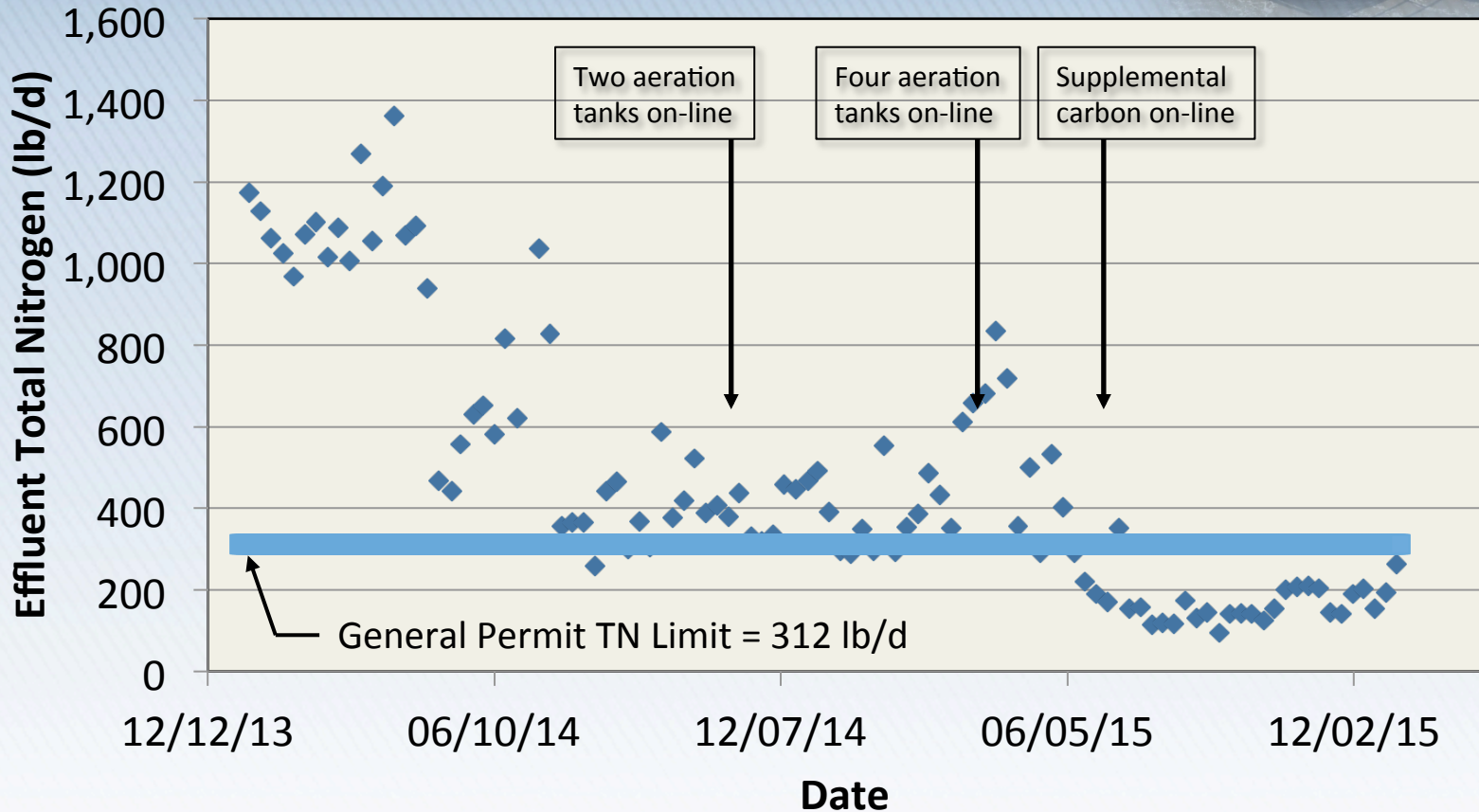


# Two-train process

- Utilized Hyperbolic Mixer-Aerator
  - Can isolate one or two banks for maintenance
    - ◆ Don't lose 50% AT volume
  - Operational flexibility
    - ◆ Bardenpho mode
    - ◆ Cyclic aeration mode
    - ◆ Nitrification mode



# Nitrogen removal performance



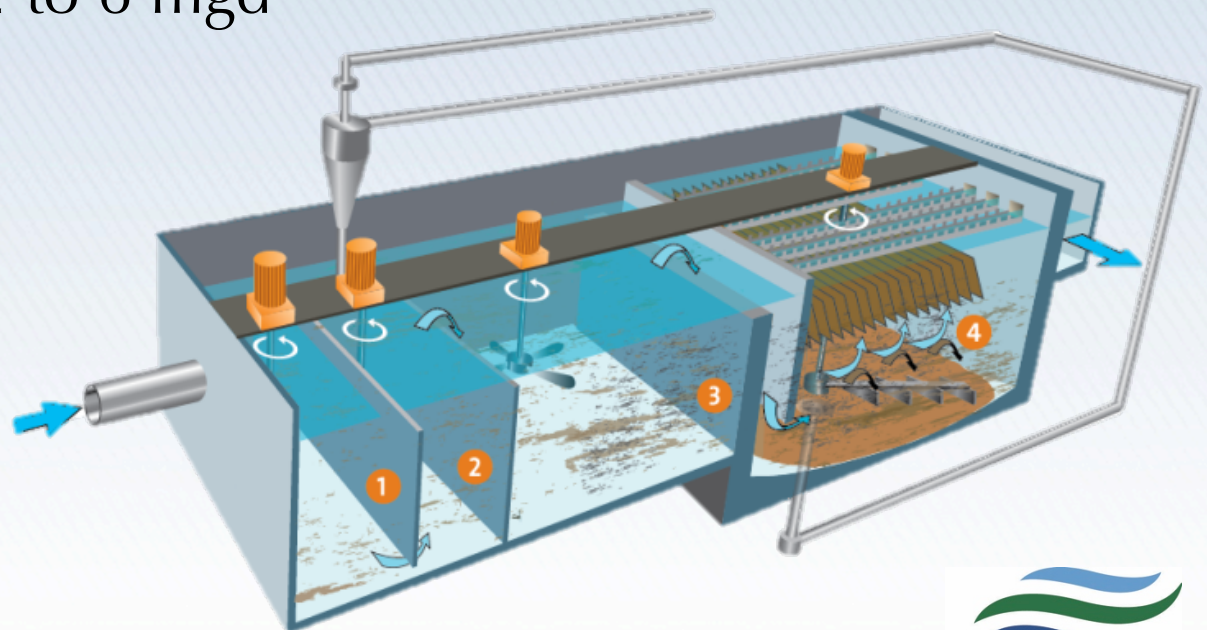
# Phosphorus Process

- Monthly limits
  - 0.39 mg/l monthly average
  - 0.78 mg/l max day
- Seasonal Load Limit
  - 13.21 lb/d average April – October
  - ~0.19 mg/L at design flow
- Tertiary Process
  - Ferric chloride due to aluminum limit

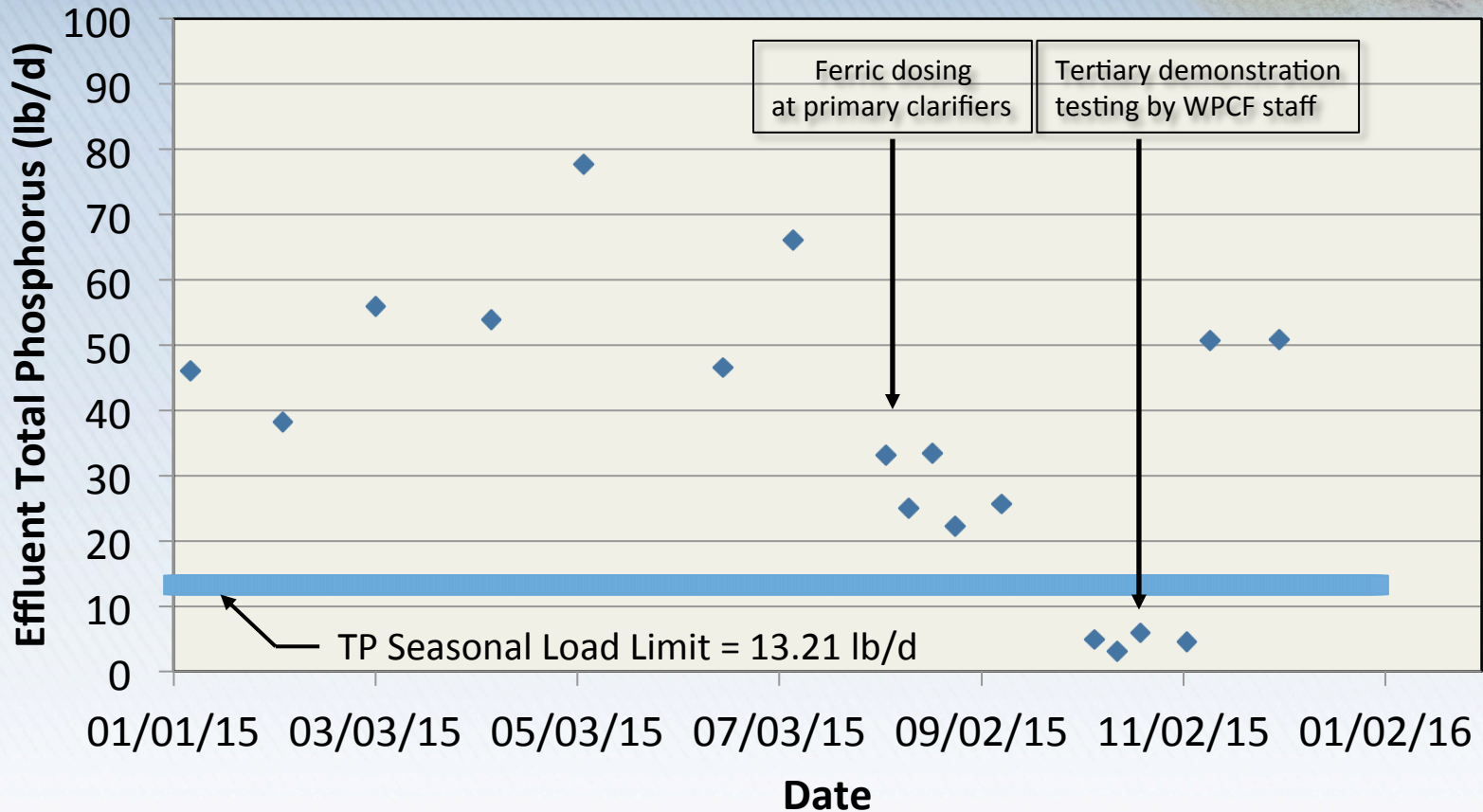


# Phosphorus Process

- Ballasted Flocculation Selected
  - Meet current and future limits
  - Handle Peak Flows
    - ◆ Spikes of 2 to 6 mgd

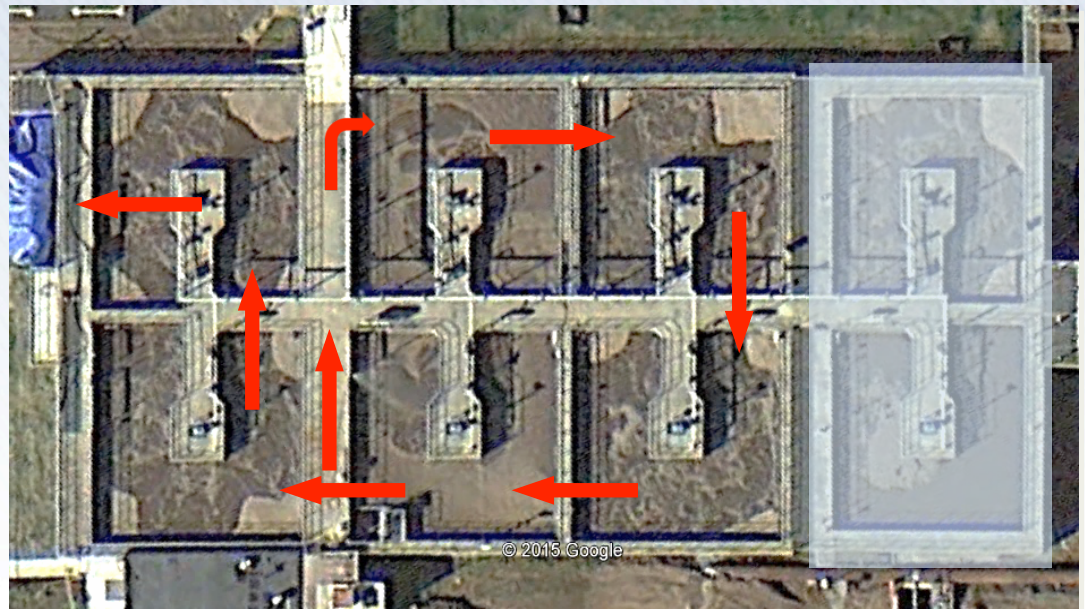


# Phosphorus removal performance



# Operator's perspective Design phase

- Long-term maintenance
  - 8,000 diffusers???
  - Tank access
- Tank configuration/reuse of existing structures





# Operator's perspective

## Design phase

- Staff goals for project
  - Eliminate different size clarifiers
    - ◆ Two shallow 80-ft, two deeper 90-ft clarifiers
    - ◆ Difficult flow split, inefficient
  - Reduce/eliminate confined space entry
  - Improve flow splitting to clarifiers
  - Improve pretreatment
    - ◆ eliminate comminutors
  - Willing to look at innovative technologies



# Operator's perspective

## Construction phase

- Maintain nitrification
  - seasonal ammonia limits
  - construction sequencing
- Coordination
  - shutdowns, switchovers, startups, bypasses, cleaning tanks
- Process impacts
  - digester cleaning impacted plant water
  - MCC Class tour – took advantage of upset



# Operator's perspective Startup & operations

- Equipment Startup
  - stay involved in startup/testing process
- Training
  - take good notes – too much to remember
  - don't train until you will utilize system
- Identify/report problems
  - Warranty only lasts so long.
- Advanced notifications for startup
  - coordinate with staff availability



# Operator's perspective

## Startup & operations

- Prepare logs/recording paperwork early
  - have ready ahead of startup, then modify
- Process optimization (tweaking)
  - anticipate multiple years to understand:
    - ◆ reaction to seasonal changes
    - ◆ impact of chemicals on other processes
    - ◆ impacts of recycle streams
- Understand who is “tweaking” and when
  - Too many hands in the pot leads to alarms



# Questions & Discussion



Thank you!