

# WERF Nutrient Removal Challenge Program

JB Neethling

KWEA Nutrient Reduction  
Specialty Conference  
Topeka, KS  
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## Presentation Outline

- Overview of the WERF Nutrient Removal Challenge
- Goals
- Agenda for 2007/8
- How can you participate

# WERF Nutrient Removal Challenge Goals

- Develop and share credible scientific information about nutrients & their bioavailability to help regulators make informed decisions
- Better understand existing mechanisms of nutrient removal and best available technologies so treatment plants can become more efficient and effective, enabling them to cost-effectively meet permit limits
- Focus on nitrogen (N) and phosphorus (P)
- Wastewater treatment related issues



Funding: \$750,000 (1<sup>st</sup> & 2<sup>nd</sup> year)  
Anticipated Duration: 5 years

Anticipated Investment: ~\$2 million over 5 years

Need to Leverage with Additional Funding, Collaboration, etc.

## Nutrient Removal ET & IAT Members

### Municipal Utilities

- Sudhir Murthy, DCWASA, DC
- David Waltrip, HRSD, VA
- Heng Zhang, MWRDG Chicago, IL
- Mike McGrath, Fairfax County, VA
- Tung Nguyen, Sydney Water Corp.

### Academic

- Charles Bott, VMI

### Industrial

- Ken Wood, DuPont

### WERF Research Council Liaisons

- Glen Daigger, CH2M Hill
- Robbin Finch, City of Boise, ID

### Consulting

- James Barnard, Black & Veatch
- Joe Husband, Malcolm Pirnie
- Carl Koch, Greeley & Hansen
- Denny Parker, Brown & Caldwell
- Gary Johnson, CDM

### Regulatory

- Rao Surampalli, EPA R7
- Jim Wheeler, US EPA

### Agency Liaisons

- Matt Ries, WEF
- Other agencies – TBD

### WERF staff

- Amit Pramanik, IAT Chair

## Nutrient Removal Challenge NUTR1R06

- HDR + M&E/AECOM + CH2M-Hill + Univ. of Washington + other universities + Collaborators
- >30 Utilities and Research Organizations nationwide and abroad
- Others to be added as needed
- Selected teams already identified about \$2 to 4 million in additional funds through utilities & other research

## Key Challenge Tasks (2007 – 2011)

Promote collaborative efforts and engage stakeholders

Increase technology understanding, explore limits of technology (LOT), and reduce costs

Provide sound information to support regulators and other stakeholders

Leverage WERF research dollars to maximize program contributions and impacts

## Agenda

- Compile the Compendium (manual)
- Initiate Research Projects
- Set up Affiliates Program
- Web Portal
- Outreach

## LOT Compendium as the Guide

- Living document on Portal
- Bridge the gap from research, regulator, technology, practice
- Essential questions:
  - What do we know?
  - What don't we know?
- Documents in Q&A Format

## Tertiary Phosphorus Removal - Example Questions (Intro)

- What are the essential elements of tertiary phosphorus removal?
- What are the soluble Phosphorus Species in Wastewater?
- What are the solid Phosphorus Species in Wastewater?
- How is phosphorus species removed from wastewater by chemical treatment?
  - Non-reactive phosphorus?
  - Acid hydrolysable phosphorus?
  - Soluble organic phosphorus?

## LOT Nutrient Compendium (Manual) – Round 1

- Regulatory issues for low-level N and P
- **Dissolved Organic Nitrogen (DON)**
- **Carbon Augmentation for Nitrogen Removal**
- **Operations and Control**
- **Low P Measurement Methods**
- **Tertiary Phosphorus Removal**
- BNR processes for low nitrogen and phosphorus: Theoretical Performance and Demonstrated Performance Variability

**Completed**    Under Review

## LOT Nutrient Compendium (Manual) – Round 2

- Reliable denitrification for low effluent nitrogen concentrations
- Achieving low effluent ammonia concentrations
- Nitrification inhibition
- Sidestream treatment processes to enhance nitrification and/or nitrogen removal
- Achieving low effluent phosphorus concentration with enhanced biological phosphorus removal (EBPR)
- Design/Modeling

## Web Access

- Two Internet Spaces
- WERF Knowledge Area
- Collaboration Portal

# Public Site

- WERF Knowledge Area
  - [www.WERF.org](http://www.WERF.org)
- Public communication
- Distribute documents
- News
- Announcements



# Collaboration Portal

- Team collaboration
  - File sharing
  - Team information
  - Calendar
  - Etc.
- Affiliate access



[www.WERFNutrientChallenge.org](http://www.WERFNutrientChallenge.org)

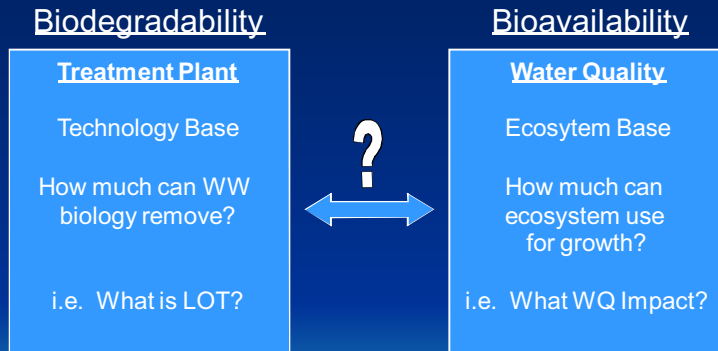
## Key Research Areas

- Dissolved Organic Nitrogen (DON)
  - Meeting with WQ and Technologist
  - “Inside the Fence” vs “Outside the Fence”
  - rDON working group
- Phosphorus
  - Analytical Method Reliability
- External Carbon for Denitrification
  - Testing Protocol
  - Methylo trophic bacterial kinetics

## RDON 2007 Workshop – Invitees

- 34 people
- Multi-faceted Group
  - University/Research
    - DON Bioavailability Research
    - DON Biodegradability (Technology-based) Research
    - Nitrogen Biogeochemical Cycling
    - Modeling
  - Industry/Utility
  - Regulatory
  - Nutrient Removal and WW Design

## RDON 2007 Workshop – WWTP ↔ Water Quality



## RDON 2007 Workshop – Outcomes

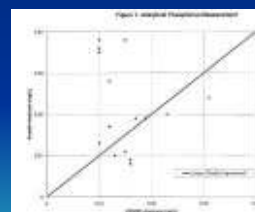
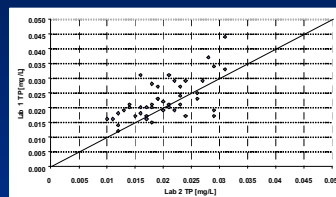
- Needs for Technology and Water Quality BOD measurements are very different!
  - Different protocols
  - Profession and regulators need to buy off on protocols
- Both methods need further development and demonstration
- Collaboration is essential. Form Task Group for this issue
- This is not a single short-term project
- Interaction between Water Quality, Regulatory, and Treatment professionals are very productive!

## RDON Efforts Under Way

- Compendium section on RDON completed
- Research: Measurement of Inert Fraction of Effluent Nitrogen
  - NH<sub>4</sub> and NO<sub>3</sub> concentrations high
- Collaboration: Survey WWTP's to set nitrogen profiles through treatment plants
  - Gdansk
  - Howard University
  - Utilities / Consultant collaborations

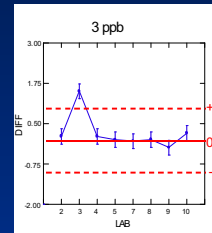
## Low Phosphorus Analytical Measurement Reliability

- Unreliable Measurements
- Test method or Analytical process
- Support
  - Spokane County
  - Coeur d'Alene
  - City of Las Vegas

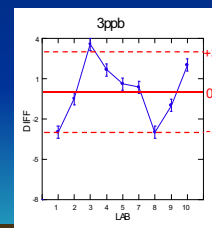


# Low Phosphorus Analytical Test

- Selected 12 commercial and municipal labs
- Synthesize 12 samples
  - Orthophosphate = 3 to 9 ug/L
  - Total Phosphorus = 3 to 18 ug/L
  - Distilled water and secondary effluent
- Analyze reliability of measurement



Ortho P



Total P

# External Carbon Protocol

- Set protocol for evaluating alternative carbon sources
- Build consistent data for paper studies and data sharing
- Current MeOH costs are huge
  - ~0.25 mil \$/yr per 10 mgd treated
- Input to Alternative Carbon Meeting
  - Chesapeake Cooperative
  - December 12-13 – Washington, DC

## Active Fraction And Biokinetics Of Methylo trophic Denitrification

- Carbon addition for low TN has significant costs
- MeOH is still most common carbon source to reach low TN limits
- Major issue is dose for short HRT anoxic zones
- Different BNR design and operating conditions may select different denitrifying methylo trophic organisms
- Need to understand populations present when obtaining biokinetic information with MeOH
- Columbia U. has C13 DNA method to identify organisms
- Use molecular tools to update models, design, operation
- Leverage ongoing work ~\$345k studies

## The Nutrient Challenge is a Different Animal

- Focus on collaborative efforts, versus single projects
- Address fundamentals, with strong results focus
- Enhance ongoing efforts by providing seed funding/extra level support
- Leverage ongoing work

## Engage Stakeholders to Participate in an Active Role

- Leverage ongoing projects
- Collaborate with those projects to increase their value to the profession
- Use the "Tom Sawyer" principle



## Why is WERF the Right Vehicle?

**WERF program provides leadership and focal point for collaborators/team members**

- Identify Collaboration

- Data analysis standards

- QA/QC

- Field studies

- Protocol development and review

- Special studies to evaluate scientific basis

**Interpret the results for significance to operator, designer, regulator, academic**

# Upcoming Opportunities

- Volunteer for Compendium
- WEFTEC Workshops
  - Saturday: W101 - Demonstrated Processes for Limit of Technology Nutrient Removal: Achievable Limits and Statistical Reliability
  - Sunday: W201 - Nutrient Removal: What the USEPA, WERF, and Others are Doing to Help Address this Challenge

## For additional information, please contact:

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[www.werf.org](http://www.werf.org)

[www.WERFNutrientChallenge.org](http://www.WERFNutrientChallenge.org)



Thank you

## RDON 2007 Workshop – Outcomes/Research Thoughts

- We need to agree on definitions for the organic nitrogen fractions!
- iDON (inert DON) appears a starting point to define unavailable DON in surface waters
- Establish/document LOT of DON (and fractions) for specific technologies
- DON represents a major fraction of effluent TN for LOT BNR systems
- Several key researchers agreed to participate in a work/task group on DON
- Key issues on measurements protocols were identified

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