



THE
Water
Research
FOUNDATION

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REQUEST FOR PROPOSALS (RFP)

Guidelines for Optimizing Nutrient Removal Plant Performance (RFP 4973)

Due Date: Proposals must be received by 2:00 pm MT on
Thursday, September 12, 2019

WRF Project Contact: Stephanie Fevig, sfevig@waterrf.org

Project Sponsors

This project is funded by The Water Research Foundation (WRF) as part of WRF's Research Priority Program.

Project Objective

The objective of this project is to build on existing work by developing updated operational guidelines for optimizing nutrient removal plant performance. This will be accomplished through additional research or demonstration, and from documented performance for nitrogen and phosphorus removal through the use of tools such as operational best practices, online instrumentation, control capabilities, model-based controls, and smart systems.

Budget

Applicants may request up to **\$130,000** in WRF funds for this project. WRF funds requested and total project value are evaluation criteria considered in the proposal selection process.

Background and Project Rationale

One of the most pressing water quality challenges utilities face is nutrient removal. WRF's Nutrient Removal Challenge (2007-2018) conducted 44 studies on nutrient characterization and cost-effective processes to meet nutrient limits, assessed technology performance, and evaluated environmental impacts (Neethling et al., forthcoming). Research shows that efficient biological treatment, chemical addition, and solids separation are necessary to achieve secondary and tertiary nutrient levels.

Thus, operational guidelines are becoming increasingly important for performance optimization and for ensuring the stability of nutrient removal processes. This guidance is particularly important for facilities that are looking to meet very low effluent nutrient concentrations. Facilities that seek to implement advanced approaches and technologies such as short-cut nitrogen removal, sidestream treatment, carbon redirection (which can impact carbon to nitrogen and carbon to phosphorus ratios, as well as

energy recovery), advanced solids fermentation, and certain treatment processes for resource recovery purposes will also benefit from this guidance.

Due to the rapid pace of instrumentation advances, there is an opportunity to monitor critical operating parameters for optimization. Several new instrumentation technologies have been researched, but that research has not been completed to a level where these new technologies can be implemented on a full scale. Therefore, there is a need to investigate how large data sets and existing experiences with implementation and development of model predictive controls should be collected, systematized, and used to determine which adaptive control strategies can be used at specific facilities and infrastructure systems, and what the potential benefits could be.

The results of this research should be presented as a set of guidelines for both facility operators and design engineers. These guidelines will expedite the use of advanced technologies, and can help reduce energy and chemical consumption and better manage the impact of carbon diversion on resource recovery.

Research Approach

An ideal research approach will recognize the various strategies to optimize systems for nutrient removal and recovery, and explore a range of these methods. Strategies may include, but are not limited to 1) instrument-based optimization, including the most efficient location of instrumentation; 2) advanced online sensors; 3) the impact of optimizing energy recovery (i.e., carbon redirection); and 4) the use of modeling tools.

Rather than performing a pilot study, this research should analyze extensive data collected via a literature review, and conduct a suitable number of face-to-face workshops where operators share their needs, experiences, etc., with optimizing nutrient removal at their facilities. Nutrient removal experts should participate in these workshops to help the utilities, particularly small- to medium-sized facilities, learn about nutrient management opportunities and strategies. The workshops should gather information on what issues plants are facing; identify trends across facility size, regional location, and/or other specified parameters; make recommendations to help set guidelines; and identify gaps for future research.

A strong approach should clearly describe the types of facilities that will be invited to the workshops. This investigation should recognize that not all facilities are alike. A broad range of regional representation, facility sizes, and facility types in the research and at the workshops is important. Considerations may include:

- **Facility size.** Plant size and resources can impact approaches to nutrient management, as well as the selection and installation of technologies to improve nutrient removal. In addition to large-sized facilities, attention should be focused on small- to medium-sized facilities. According to the 2012 Clean Watersheds Needs Survey, almost 80% of centralized wastewater treatment and collection facilities across the United States are small- to mid-sized. Proposers should be prepared to present guidelines that apply to facilities of a wide variety of scales in urban, suburban, and rural settings.
- **Treatment types.** Proposers should determine where to focus, but must consider the broadest range of treatment facilities that could include smaller and less complex processes such as lagoons and treatment ponds, biological nutrient removal (BNR), etc., which make up more than 50% of wastewater treatment facilities currently operating in the U.S.

- **Broad range of scenarios.** Proposals should recognize and explore the various driving forces behind the optimization of nutrient removal, as well as how this may influence approaches and guidelines to optimization. Important scenarios to consider may include:
 - Timeframe for optimization: “low-hanging fruit” strategies to meet compliance;
 - Optimization of nutrient removal that sets utilities up for the future potential to incorporate nutrient recovery;
 - Balancing competing drivers and needs at a facility (e.g., nutrient removal, energy management, etc.); and
 - Other scenarios as proposing teams see fit.

To achieve the objectives, proposers are expected, at a minimum, to:

- Review and investigate existing best practices in the literature to inform the content of the workshops.
- Conduct a series of regional workshops with utility operators and industry experts to identify and vet information to be incorporated into the guidelines, and provide information sharing and training opportunities for workshop participants. The proposal must include information to demonstrate the research team has:
 - Experience with conducting and facilitating these types of workshops.
 - Appropriate knowledge and experience with the design and operation of BNR facilities.
- Identify gaps and additional research needs to accelerate the adoption technologies and practices for successful nutrient removal at facilities of varying size.
- Identify regulatory barriers and how to achieve optimized performance.
- Develop guidelines based on reviewed materials and operator experience, which could include and consider:
 - Determination of operating parameters and control setpoints for optimal performance of existing facilities under existing conditions
 - Selection of suitable online instruments, installed locations, and control logic for optimal performance
 - Selection and use of a suitable process model to optimize the facility
 - Identification of low-cost upgrades to existing facilities to improve performance

Expected Deliverables

When considering the schedule and budget, the proposers should take into account the following required deliverables:

- Quarterly progress reports
- Literature review – See “References and Resources” for suggested resources to include.
- Workshop summary report – Proposers should include a preliminary agenda and breakdown of the workshop costs in the proposal. The WRF project manager will work with the project team to organize the workshops, which can be held in conjunction with events hosted by entities such as the Water Environment Federation (WEF), WEF Member Associations, etc. Essentially, the report should be brief and cover findings, analyze common themes, highlight lessons learned, and identify future research need.
- Guidelines – This is the main project output and most important deliverable. It should include key findings from the workshop(s). Education and training for end-users is an end-goal of this project. To ensure the most efficient use of equipment and to advance nutrient removal, guidelines should be developed with a mindset of how they will ultimately be used. A good example of guidelines utilities can use can be found in Tarallo et al. (2015), which produced diagrams showing how various energy

flow configurations and scenarios can impact overall plant performance. The guidelines should have built-in flexibility to adapt and respond to changing technologies and improvements for operational efficiencies. They should also include cost estimates for proposed instrumentation and process improvements, including the appropriate level of staff training needed to effectively operate the proposed processes.

Proposers are encouraged, but not required, to consider other valuable outputs for this work. Examples of other deliverables for consideration include:

- Boilerplate training materials customizable to regions or utility size.
- Guidelines filling in gaps of WEF Manuals of Practice.
- Workshops for WEFTEC, WEF nutrients specialty conference, regional workshops, etc.

Communications Plan

Please review WRF's *Project Deliverable Guidelines* for information on preparing a communications plan. The guidelines are available at: <http://www.waterrf.org/funding/Pages/proposal-guidelines.aspx>. Conference presentations, webcasts, peer review publication submissions, and other forms of project information dissemination are typically encouraged.

Project Duration

The anticipated period of performance for this project is 12 to 18 months from contract start date.

References and Resources

The following list includes examples of research reports, tools, and other resources that may be helpful to proposers. It is not intended to be comprehensive, nor a required list for consideration.

- Brown, J.; Davies, G.; Jeyanayagam, S.; Smith, R.; and Tsuchihashi, R. 2009. *Operation and Control of BNR Facilities – Compendium Document*. Project NUTR1R06g. Alexandria, Va.: Water Environment Research Foundation.
- Connor, T.; and K. Dowell. 2015. *Case Studies on Implementing Low-Cost Modifications to Improve Nutrient Reduction at Wastewater Treatment Plants*. Washington, D.C.: U.S. Environmental Protection Agency. <https://www.epa.gov/nutrient-policy-data/case-studies-implementing-low-cost-modifications-improve-nutrient-reduction>.
- Hill, R. 2010. *Optimizing Biotreatment: Integrated Process Models and Control Strategies*. Project 03-CTS-11. Alexandria, Va.: Water Environment Research Foundation.
- Neethling, J.B.; Clark, D.; Stensel, H.D.; Sandino, J.; and R. Tsuchihashi. Forthcoming. *Nutrient Removal Challenge Synthesis Report*. Project NUTR5R14g. Alexandria, Va.: The Water Research Foundation.
- Palmer, T.M.; Nutt, S.G.; and S. Kharkar. 2007. *On-Line Nitrogen Monitoring and Control Strategies*. Project 03-CTS-8. Alexandria, Va.: Water Environment Research Foundation.
- Tarallo, S.; Shaw, An.; Kohl, P.; and Eschborn, R. 2015. *A Guide to Net-Zero Energy Solutions for Water Resource Recovery Facilities*. Project ENER1C12. Alexandria, Va.: Water Environment Research Foundation.
- Tsuchihashi, R. 2015. *BNR Process Monitoring and Control with Online Nitrogen Analyzers for Nitrogen Credit Exchange Program in Connecticut*. Project No. NUTR1R06y. Alexandria, Va.: Water Environment Research Foundation.
- Water Environment Federation. 2015. *Shortcut Nitrogen Removal – Nitrite Shunt and Deammonification*. Alexandria, Va.: WEF and Water Environment Research Foundation.
- Weaver, G. 2018. "Lean, Mean Operational Excellence Machine." *WE&T*, 30 (6): 40-43.

Proposal Evaluation Criteria

The following criteria are used to evaluate proposals:

- Understanding the Problem and Responsiveness to RFP (maximum 20 points)
- Technical and Scientific Merit (maximum 30 points)
- Qualifications, Capabilities, and Management (maximum 20 points)
- Communication Plan, Deliverables, and Applicability (maximum 15 points)
- Budget and Schedule (maximum 15 points)

Proposal Preparation Instructions

Proposals submitted in response to this RFP must be prepared in accordance with the WRF document *Guidelines for Research Priority Program Proposals*. The current version of these guidelines is available at <http://www.waterrf.org/funding/Pages/proposal-guidelines.aspx>, along with *Instructions for Budget Preparation*. The guidelines contain instructions for the technical aspects, financial statements, indirect costs, and administrative requirements that the applicant must follow when preparing a proposal.

Eligibility to Submit Proposals

Proposals will be accepted from domestic or international entities, including educational institutions, research organizations, governmental agencies, and consultants or other for-profit entities.

WRF's Board of Directors has established a Timeliness Policy that addresses researcher adherence to the project schedule. The policy can be reviewed at <http://www.waterrf.org/funding/Pages/policies.aspx>. Researchers who are late on any ongoing WRF-sponsored studies without approved no-cost extensions are not eligible to be named participants in any proposals. Direct any questions about eligibility to the WRF project contact listed at the top of this RFP.

Administrative, Cost, and Audit Standards

WRF's research program standards for administrative, cost, and audit compliance are based upon, and comply with, Office of Management and Budget (OMB) Uniform Grants Guidance (UGG), 2 CFR Part 200 Uniform Administrative Requirements, Cost Principles, and Audit Requirements for Federal Awards, and 48 CFR 31.2 Contracts with Commercial Organizations. These standards are referenced in WRF's *Guidelines for Research Priority Program Proposals*, and include specific guidelines outlining the requirements for indirect cost negotiation agreements, financial statements, and the Statement of Direct Labor, Fringe Benefits, and General Overhead. Inclusion of indirect costs must be substantiated by a negotiated agreement or appropriate Statement of Direct Labor, Fringe Benefits, and General Overhead. Well in advance of preparing the proposal, your research and financial staff should review the detailed instructions included in WRF's *Guidelines for Research Priority Program Proposals* and consult the *Instructions for Budget Preparation*, both available at <http://www.waterrf.org/funding/Pages/proposal-guidelines.aspx>.

Budget and Funding Information

The maximum funding available from WRF for this project is **\$130,000**. The applicant must contribute additional resources equivalent to at least 33 percent of the project award. For example, if an applicant requests \$100,000 from WRF, an additional \$33,000 or more must be contributed by the applicant. Acceptable forms of applicant contribution include cost-share, applicant in-kind, or third-party in-kind that comply with 2 CFR Part 200.306 cost sharing or matching. The applicant may elect to contribute

more than 33 percent to the project, but the maximum WRF funding available remains fixed at \$130,000. **Proposals that do not meet the minimum 33 percent of the project award will not be accepted.** Consult the *Instructions for Budget Preparation* available at <http://www.waterrf.org/funding/Pages/proposal-guidelines.aspx> for more information and definitions of terms.

Period of Performance

It is WRF's policy to negotiate a reasonable schedule for each research project. Once this schedule is established, WRF and its sub-recipients have a contractual obligation to adhere to the agreed-upon schedule. Under WRF's No-Cost Extension Policy, a project schedule cannot be extended more than nine months beyond the original contracted schedule, regardless of the number of extensions granted. The policy can be reviewed at <http://www.waterrf.org/funding/Pages/policies.aspx>.

Utility and Organization Participation

WRF encourages participation from water utilities and other organizations in WRF research. Participation can occur in a variety of ways, including direct participation, in-kind contributions, or in-kind services. To facilitate their participation, WRF has provided contact information, on the last page of this RFP, of utilities and other organizations that have indicated an interest in this research. Proposers are responsible for negotiating utility and organization participation in their particular proposals. The listed utilities and organizations are under no obligation to participate, and the proposer is not obligated to include them in their particular proposal.

Application Procedure and Deadline

Proposals are accepted exclusively online in PDF format, and they must be fully submitted before 2:00 pm Mountain Time on Thursday, September 12, 2019. All proposal documents must be compiled into two (2) PDF files consisting of your technical review documents and your financial review documents. All forms and components of the proposal are available in the *Proposal Component Packet* zip file on the proposal website at <https://proposals.waterrf.org/Pages/RFPs.aspx>. An FAQ and a tutorial are also available. A login is required to access the proposal website and download the packet. Proposers are encouraged to create logins and verify the validity and compatibility of the system well in advance in order to avoid last-minute errors or delays.

The online proposal system allows submission of your documents until the date and time stated in this RFP. To avoid the risk of the system closing before you press the submit button, do not wait until the last minute to complete your submission.

Questions to clarify the intent of this RFP and WRF's administrative, cost, and financial requirements may be addressed to the WRF project contact, Stephanie Fevig at (303) 347-6103 or sfevig@waterrf.org. Questions related to proposal submittal through the online system may be addressed to Caroline Bruck at (303) 347-6118 or cbruck@waterrf.org.

4973 Utility and Organization Participants

The following utilities have indicated interest in possible participation in this research. This information is updated within 24 business hours after a utility or an interested organization submits a volunteer form, and this RFP will be re-posted with the new information. **(Depending upon your settings, you may need to click refresh on your browser to load the latest file.)**

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