

Potomac Aquifer Recharge Monitoring Laboratory

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Research Proposal Summary:

Risk and Performance Evaluation of Enhanced Aquifer Recharge in the Coastal Plain

Virginia Tech (VT)

Old Dominion University (ODU)

Potomac Aquifer Recharge Monitoring Laboratory (PARML)

ENHANCED AQUIFER RECHARGE PERFORMANCE AND POTENTIAL RISK IN DIFFERENT REGIONAL AND HYDROGEOLOGIC SETTINGS

U.S. Environmental Protection Agency
Office of Science Advisor, Policy and Engagement
Office of Research and Development
Science to Achieve Results (STAR) Program

Funding Opportunity Number: EPA-G2022-STAR-J1

Solicitation Opening Date: *September 16, 2022*

Solicitation Closing Date: *November 9, 2022: 11:59:59 pm Eastern Time*

RFA Motivations

- ▶ Potential risk to groundwater quality from EAR (three general types):
 1. direct contamination of groundwater by dissolved and suspended contaminants in the source of water
 2. indirect contamination through changing aquifer conditions that allow a potential contaminant to be mobilized from the subsurface (e.g., arsenic mobilization)
 3. interaction of infiltrated water with existing subsurface contaminants that could alter the spatial extent of existing contamination
- ▶ Priorities for developing new research, tools, frameworks, and models to assist planning and demonstration of EAR should be based on
 - fit for purpose approach for an existing location, and also
 - take into account current studies to include experience with existing projects and engagement with key stakeholders and water managers working on EAR.

Proposal Scope and RFA Requirements

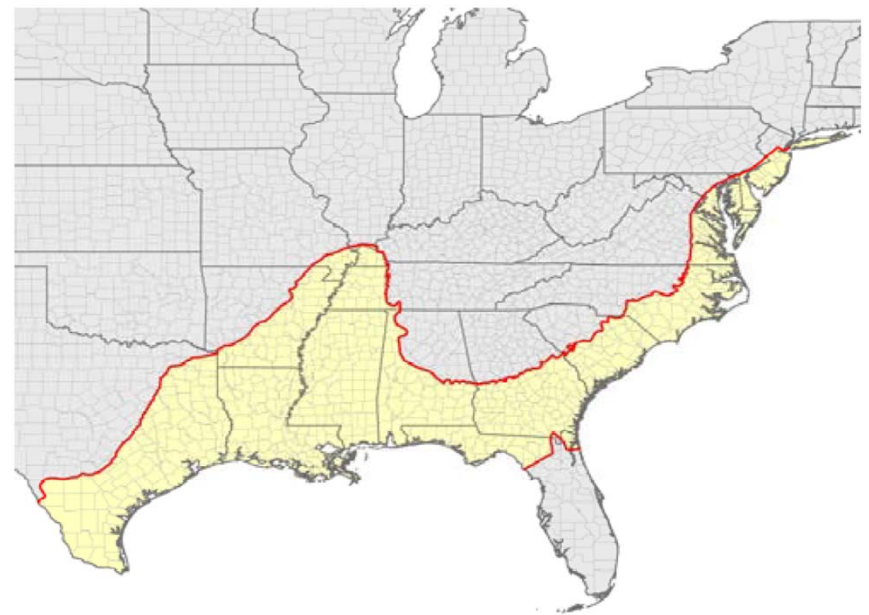
- ▶ Our proposal addressed each of the *four research areas* identified in the RFA
 1. Effect of local subsurface geology and hydrology on EAR effectiveness for enhancing water quality and ensuring a safe supply of drinking water
 2. Effect of source water (excluding oil and gas produced water) and the ability of subsurface geology to degrade or attenuate conventional and emerging contaminants (including pathogens) that might be found in different sources of water.
 3. Methods and technologies for monitoring and maintenance of EAR systems to improve and maintain performance and operational efficiency (both source water quality and quantity) and reduce potential environmental and public health risk.
 4. Computational modeling and scientific visualization.

Project Investigators

- ▶ Principal Investigator: Mark Widdowson, Virginia Tech;
- ▶ co-Principal Investigator: Gary Shafran, Old Dominion University;
- ▶ Amy Pruden, Civil & Environmental Engineering, VT
- ▶ Madeline Schreiber, Geosciences, VT
- ▶ Kang Xia, School of Plant and Environmental Sciences, VT
- ▶ Ryan Pollyea, Geosciences, VT
- ▶ Jingqui Liao, Civil & Environmental Engineering, VT

Theme: Evaluating Risk and EAR Performance in Coastal Plain Aquifers

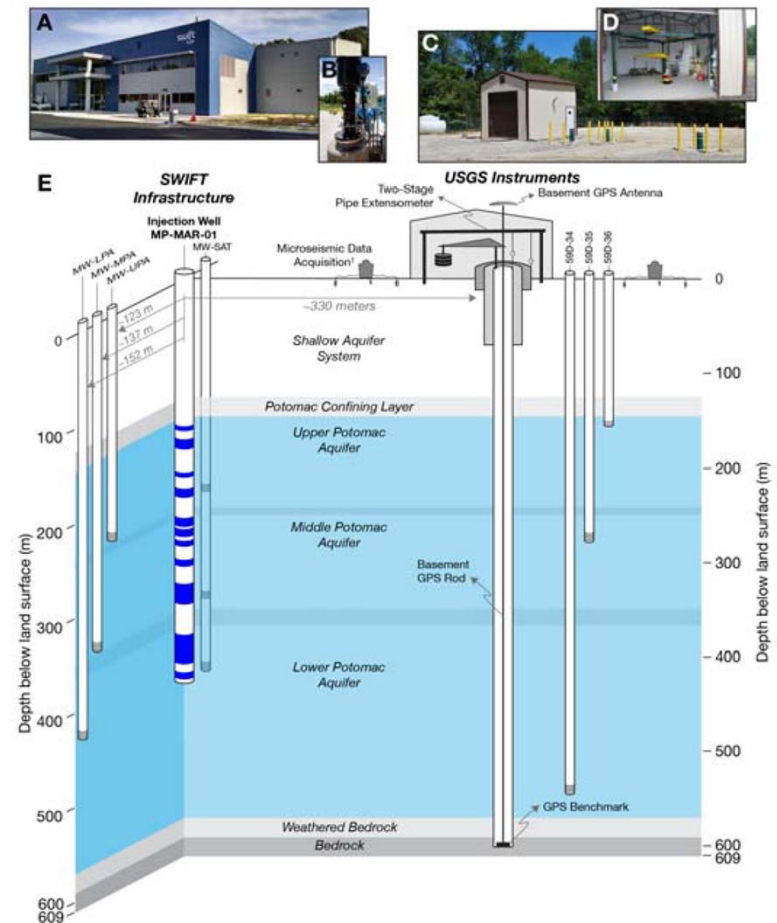
- ▶ *Main Hypothesis:* EAR can be effectively implemented in Coastal Plain aquifers with careful evaluation of risk and performance factors.
- ▶ Successful demonstration of recharge to deep confined aquifers of the Potomac Aquifer System at the SRC forms the basis of this hypothesis.
- ▶ Research at the SRC will inform an improved understanding of EAR performance and risk in Coastal Plain aquifers.



- ▶ PWS – Groundwater = 3.8 BGD
- ▶ Population served by public-supplied groundwater = 28 million

Theme: Evaluating Risk and EAR Performance in Coastal Plain Aquifers

- ▶ *Project Objective:* The overall project objective is to develop a web-based decision support tool to guide communities, agencies, and practitioners in the implementation of EAR in deep, confined aquifers.
- ▶ The tool will be designed to advance best practices and assist users in a careful evaluation of risk and performance factors to ensure EAR projects are effective, sustainable, and protective of groundwater resources.



EAR Risk and Performance Factors

- ▶ *Risk and Performance Topics Addressed:* We identified (6) risk and performance factors to be the most problematic and the greatest concern in advancing EAR to full-scale operations
 - Characterization of discrete heterogeneity: *Solute transport and groundwater quality*
 - Potential for induced seismicity
 - Mobilization of geogenic contaminants
 - Characterization of microbial response to EAR: *Attenuation in the subsurface including CECs and PFAS*
 - Recharge well injectivity: *Operational and treatment controls*
 - Computational models and visualization tools for data analysis

Table 2. Four Primary Research Activity to Address Research Objectives and EAR Risk and Performance Factors.

	Area 1: Effect of local subsurface geology and hydrology on EAR effectiveness		Area 2: Research on degradation or attenuation of conventional and emerging contaminants		Area 3: Monitoring to improve and maintain performance and operational efficiency	Area 4: Computational modeling and scientific visualization
<i>Research Activity</i>	Characterize discrete heterogeneity	Potential for Induced Seismicity	Contaminant Mobilization	Microbial Response (CECs/PFAS)	Recharge well Injectivity	Practical models for data analysis
Field-Scale Tracer Tests	●		●			●
Recharge-Pumping Tests	●	●			●	●
SAT Columns			●	●		●
Injection-Recovery Tests	●	●	●	●	●	●

Table 5. Outputs and Outcomes

Outcomes	
•	Deeper understanding of risk and performance factors associated with EAR project with particular emphasis on injection wells and confined aquifers.
•	Improved protection of groundwater resources and greater water security in the Coastal Plain.
•	Greater confidence in the use and regulatory approval of EAR projects.
Outputs	
•	Web-based decision support tool to guide communities, agencies, and practitioners in the implementation of EAR in deep, confined aquifers.
•	Peer-reviewed publications that advance the state of scientific understanding related EAR risk and performance.
•	A web-based guidance document that aids utilities and other stakeholders in best practices to address risk in EAR feasibility studies and for monitoring and modeling EAR performance.
•	A webinar targeting utilities, regulators, and researchers that discusses key findings.
•	Annual and final reports to EPA.

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► Proposal Metrics:

- \$2M total; 3 years
- Full-time GRAs (5 total)
- Award date: mid-April
- Start date: July 1