

RFQ E23-2: REGIONAL GROUNDWATER MODELING TO UNDERSTAND COMMUNITY EXPOSURES ASSOCIATED WITH OIL AND GAS DEVELOPMENT

SUMMARY

The Health Effects Institute Energy (HEI Energy) seeks to fund a qualified research team to conduct regional groundwater quality modeling to help understand how documented spills associated with unconventional oil and gas development (UOGD) might affect groundwater used as a source of drinking water in the Marcellus region. This research builds on an HEI Energy-funded study that is nearing completion in southwestern Pennsylvania.

BACKGROUND

[HEI Energy](#) is an independent nonprofit organization jointly funded by the U.S. Environmental Protection Agency (EPA) and the oil and gas industry to investigate community exposures and health effects associated with UOGD. UOGD refers to the development and production of oil and natural gas as practiced starting around the beginning of the 21st century through multistage hydraulic fracturing in horizontal wells. UOGD processes occur on and off the well pad and include:

- field development: exploration, site preparation, vertical and horizontal drilling, well completion (casing and cementing, perforating, acidizing, hydraulic fracturing, flowback, and well testing) in preparation for production, and management¹ of wastes;
- production operations: extraction, gathering, processing, and field compression of gas; extraction and processing of oil and natural gas condensates; management of produced water² and wastes; and construction and operation of field production facilities; and
- post-production: well closure and land reclamation.

UOGD and Water Quality

Releases to groundwater and surface water from UOGD have garnered much public attention. A review by the U.S. EPA (2016) did not identify extensive contamination of water related to UOGD but cited instances where contamination has occurred and the knowledge gaps that remain. For example, the Pennsylvania Department of Environmental Protection [documents](#) instances when UOGD and conventional oil and gas development have impacted private water supplies. Since the U.S. EPA's review, research on how UOGD can influence water quality continues (e.g., [HEI Energy 2020](#)).

¹ Management of wastes and produced water refers to their handling from creation to disposal, including collection, storage, transport, treatment, reuse, recycling, and disposal.

² Produced water is naturally occurring water that comes out of the ground along with oil and gas. (Adapted from: American Geosciences Institute 2019). The characteristics of produced water vary and use of the term often implies an inexact or unknown composition. (Adapted from: Schlumberger 2019)

Except for permitted discharges and uses of UOGD produced water, routine UOGD operations are designed to prevent releases to groundwater or surface water. Therefore, such releases occur only under accidental conditions, making them especially challenging to study, although some researchers have done so, for example, through review of spill records or investigation of specific spill incidents (Maloney et al. 2017). Once a release to surface water is known to have occurred, researchers may be able to detect associated impacts (Cozzarelli et al. 2017). Accidental releases to the subsurface pose a much greater challenge than releases to surface water. They typically require substantial effort and resources to determine the extent and severity of impacts on groundwater quality and the conditions that influence mobility of the release in the subsurface environment. Some researchers have begun to address these challenges with various forensic methods (e.g., Chapman et al. 2012) and novel groundwater modeling (Soriano et al. 2022). More research is needed to define an efficient framework and methods that directly address the challenges in isolating UOGD impacts on water quality.

HEI Energy-Funded Community Exposure Research

In August 2020, HEI Energy issued [RFA E20-2](#), seeking studies to improve characterization of potential human exposures originating directly from onshore development of oil and natural gas from shale and other unconventional, or low permeability, resources in the United States (UOGD).

The Program's [first five studies](#) are underway to better understand community exposures to UOGD air emissions, noise, and releases to surface water and groundwater. In the two studies funded under RFA E20-2, research teams are combining existing water quality data and modeling to assess community exposures associated with UOGD releases to water. Both studies provide frameworks for identifying areas of potential water contamination, apportioning the sources of contamination, and identifying exposure pathways that connect UOGD to community water sources. The frameworks build on previously published research and could be applied in other regions, likely with modifications.

The overarching goal of the program of research and associated community engagement is to inform policy decisions by endeavoring to identify links between specific oil and gas processes and community exposures. This knowledge helps to understand how exposure varies among subpopulations (e.g., historically disadvantaged communities), understand how to mitigate any exposures that pose a health concern, and assess the efficacy of policies to mitigate exposures.

OBJECTIVE OF THIS RFQ

The objective of this RFQ is to seek a well-qualified research team to conduct novel groundwater quality modeling to understand the potential for documented UOGD spills (i.e., as reported in state regulatory databases separately from spills associated with conventional oil and gas development) to adversely affect water quality in part or all of the Marcellus region that may lead to community exposures associated with the water quality impacts.

The modeling should consider the spatial extent of groundwater impacts and community exposures over various timeframes (e.g., contamination that is readily mitigated versus contamination that remains for a lengthy period either because of delayed detection or inability to mitigate effectively). The Committee seeks an understanding of the corresponding influence on community exposures in

various subpopulations, including historically disadvantaged communities. While modeling should focus on the Marcellus region, the Committee seeks a model that can be adapted for use in other major oil- and gas-producing regions of the United States.

Rationale for the RFQ

HEI Energy currently funds a [research team](#) that is using geochemical statistical modeling to isolate UOGD impacts on groundwater. The requested work represents the logical next step in understanding the importance of UOGD spills not only in this team's study location but in the broader Marcellus region. The successful applicant might choose to consult or collaborate with the team to follow up on their early findings.

Data Sources

Provide detailed justification for chemical analytes and whether you are including them to help isolate sources (e.g., UOGD versus conventional oil and gas well spills as well as other sources) of groundwater contamination, understand risks to human health, or both.

Provide information on the type of data available for use in the research, including the period, location, and frequency of measurements, and quality assurance. Useful data outside the public domain might be acceptable for use if their quality and utility for trend analyses can be independently assessed. Consider and account for any lack of comparability of data collected over time for different purposes.

Data Analyses and Modeling

Describe analyses and modeling that will be conducted to understand how UOGD might influence the quality of groundwater used by communities as sources of drinking water. The analyses and modeling must recognize and accommodate a number of factors that can contribute to the spatial and temporal variability in observed water quality. These factors include but are not limited to:

- Spill characterization. Estimates of the volume of spills and the chemical constituents released at various locations and, where possible, accounting for any mitigation.
- Presence of other sources. Many of the chemicals that might originate from UOGD operations have other anthropogenic sources (e.g., conventional oil and gas development, orphaned and abandoned wells, active coal mines or abandoned mines, and landfills) and natural sources (e.g., methane from biological sources or from depth by way of migration along natural fractures).
- Environmental conditions. The type, location, and extent of UOGD vary as a result of factors such as geology, hydrology, and meteorology. This variability, in turn, influences the potential transport of material from spills or leaks.

Data Management, Preservation, and Access

Providing access to data is an important element in ensuring scientific credibility and is particularly valuable when studies are of regulatory interest. It is the policy of HEI to ensure access is provided expeditiously to data for studies that it has funded and to provide those data in a manner that facilitates review and verification of the work while protecting confidentiality and self-

determination of any participants or communities involved in the study and respecting the intellectual interests of contributors to the original work. Please refer [here](#) for the HEI Policy on the Provision of Access to Data Underlying HEI-Funded Studies.

Successful applicants will be expected to prepare a data management plan with an explicit description of how data are owned and shared and, where data are provided by a third party, a process for other investigators to obtain and work with the data.

Quality Assurance/Quality Control

To ensure research of the highest quality, all work will be subject to Research Committee oversight and peer review by the HEI Energy Research Committee. However, quality assurance depends primarily on the investigator's own quality assurance plan throughout all phases of research. Before commencing research, investigators must prepare and obtain approval of a Quality Assurance Project Plan (QAPP) prepared in accordance with U.S. EPA guidance (see <http://www.epa.gov/quality>).

RESEARCH TEAM

The research team should possess the full range of expertise to conduct the proposed research. The Principal Investigator (PI) should be affiliated with an established research organization and be a widely recognized expert in their area(s) of expertise with a reputation for producing high-quality and objective research. The PI should be extensively published in the peer-reviewed scientific literature and have demonstrated experience successfully leading multidisciplinary teams of scientists. The full team can include the PI, their immediate team (other faculty, research scientists, post docs, students, and technicians), co-investigators, or collaborator(s) at other institutions, community members, and consultants.

HEI strongly encourages applicants to diversify their research teams by including individuals from groups that are underrepresented in environmental exposure and health research and, to the extent appropriate given the study locations, be attuned to and knowledgeable about the communities in which the studies are taking place. For this purpose, HEI has adopted the National Institutes of Health (NIH) definition of underrepresented populations in the U.S. Biomedical, Clinical, Behavioral and Social Sciences Research Enterprise.³

³ NIH's definition of underrepresented populations includes individuals from racial and ethnic groups underrepresented in health-related sciences on a national basis, individuals with disabilities who are defined as those with a physical or mental impairment that substantially limits one or more major life activities, and individuals from disadvantaged backgrounds, recognizing that women from these three backgrounds face particular challenges at the graduate level and beyond in scientific fields (Source: <https://grants.nih.gov/grants/guide/notice-files/NOT-OD-20-031.html>).

STUDY DURATION AND BUDGET GUIDELINES

Between \$250,000-\$500,000 will be available for this RFQ to fund up to two studies (maximum study budget \$250,000). Studies are estimated to begin in January 2024 and be completed within one year (i.e., by January 2025).

APPLICATION COMPONENTS

The application should consist of the following components:

1. Cover page ([Form F-1](#))
2. Statement of Qualifications (6-page maximum; *no specific form required*) consisting of:
 - a. Description of the anticipated study location, any data to be analyzed, a description of their quality and accessibility, and how you plan to secure the data. If the study requires access to a physical site or data managed by other groups, the team should demonstrate access, for example, by including letters of support from site owners or data managers in the proposal. The study team should have access to or be able to purchase or rent facilities, equipment, instrumentation, or cloud computing services needed to support the proposed research and have prior experience with preparing and implementing quality assurance plans.
 - b. Brief narrative of the modeling and any other analyses that will be conducted, along with associated quality assurance/quality control procedures, to understand the potential impact of UOGD spills on water quality and community exposures across various human subpopulations, including historically disadvantaged communities.
 - c. Organizational chart that clearly identifies each team member, their affiliation and role in the research, and lines of communication among team members and how they lead to the PI who oversees the research and coordinates its successful completion. Note any potential conflicts of interest.
 - d. Milestone chart depicting the timeline for completing the research.
3. Description of the facilities, including data security procedures, available at the applicant institution. ([Form F-9](#)).
4. A budget justification for the study. The assumed start date should be January 31, 2024. Budget forms ([Forms F4a and F5a - and 4b and 5b if applicable](#)) should be used. Time and travel expenses should be budgeted for the likelihood of one in-person meeting with the Committee during the study.
5. Biographical sketches of the key personnel involved ([Form F-10](#)).

HOW TO APPLY

The application should be submitted in electronic form by email in PDF format by **November 14, 2023**, to Janet McGovern at jmcgovern@healtheffects.org. Applications should not exceed a file size of 20 MB. Once the application has been submitted, please send a second email to jmcgovern@healtheffects.org without any attachments to notify HEI Energy that your application has been submitted. HEI Energy will acknowledge receipt of the application.

The required application forms [are compiled here](#). No specific form is required for the Statement of Qualifications. For questions about the RFQ please contact Dr. Donna Vorhees (dvorhees@healtheffects.org).

For details about HEI Energy research and applying for funding, please consult the [HEI Energy Policies and Guidelines](#) page, and documents on the HEI Energy [Research and Review Process](#) and [Investigator Commitments](#).

REVIEW OF APPLICATIONS

The HEI Research Committee will review the applications based on the quality of the narrative; relevance to the objectives of the RFQ; experience, competence, and diversity of the research team; adequacy of facilities, including access to relevant data sets; and reasonableness of the proposed costs. A response to all applicants is anticipated by **December 22, 2023**.

REFERENCES

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- Maloney KO, Baruch-Mordo S, Patterson LA, Nicot JP, Entekin SA, Fargione JE, et al. 2017. Unconventional oil and gas spills: Materials, volumes, and risks to surface waters in four states of the U.S. *Sci Total Environ* 581–582:369–377; doi:10.1016/j.scitotenv.2016.12.142.
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