



July 15, 2021

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**Re: Los Alamos National Laboratory, Work Plan for Groundwater Modeling for Contaminant Migration from Wells R-42 and R-28, NMED Response**

Dear Troy Thomson and Arturo Q. Duran,

On June 25, 2021, the New Mexico Environment Department (NMED) received the *Work Plan for Groundwater Modeling for Contaminant Migration from Wells R-42 and R-28* (Work Plan) from the U.S. Department of Energy (DOE) and N3B, hereafter referred to a "LANL." The Work Plan is submitted in response to NMED's *Notice of Non-Compliance, Los Alamos National Laboratory (LANL), Regional Aquifer Wells R-28 And R-42* (Notice) dated May 27, 2021. NMED's Notice requests that LANL submit a workplan for NMED's approval "detailing [LANL's] proposed initial modeling, both conceptual and computer simulation, of the contaminant migration."

The contaminants referred to in NMED's Notice are predominately naturally occurring iron and manganese that have been liberated from the aquifer sediments at and near the regional groundwater monitoring wells (R-42 and R-28) where a pilot-scale study was conducted in 2017 to evaluate the technical feasibility of using reactive amendments (sodium dithionite and molasses, respectively) added directly into areas within the hexavalent chromium plume as part of a potential groundwater remediation strategy resulting in reductive precipitation of Cr(III). An additional potential source of the Fe and Mn is the well screen material.

NMED's Notice further requests that "[LANL] take appropriate actions to improve all parties' understanding of the hydraulic migration, or fate and transport, of the new contaminants released from the impacted wells within the regional aquifer. NMED requests DOE first produce a groundwater hydrogeological conceptual model of that migration based on the prevailing hydraulic gradient of the regional aquifer, the current hydraulic impact of the on-going injection and extraction within the chromium plume, the influence of [LA] County production wells, e.g., PM-3 and PM-4, the current measured impact to extraction well CrEX-3, the anticipated fate and transport, i.e., either oxidation, adsorption, or precipitation of the contaminants, and other relevant [physicochemical] factors. The goal of the hydraulic groundwater hydrogeological conceptual modeling would be to estimate the locations of the [dissolved] 1.0 mg/L Fe and 0.2 mg/L Mn [NM's groundwater protection standards for the constituents] contours in three dimensions within the aquifer and to execute a computer simulation of the contaminant fate and transport in three dimensions and to identify data gaps in the existing monitoring well

network.” The Notice then requests that “DOE then take the results of the data gap analysis from the model to locate, and subsequently install, new monitoring wells, with the goal of completing the modeling of the fate and transport of the contaminants from both R-28 and R-42 in the direction of County production wells or the boundary between LANL and Pueblo del San Ildefonso.” The Notice specifically references NMED’s intent to understand possible impact to the hydrostratigraphic unit known as the Miocene riverine deposits and NMED’s intent to understand the amount of time until the extraction wells CrEX-1, CrEX-2 and CrEX-4 will be impacted by the contaminant migration based on the hydrogeologic modeling and projected extraction rates.

NMED finds the following with regard to the Work Plan:

1. The Work Plan is very general and details of model objectives, selection of input parameters, and model uncertainties need to be established and identified.
2. The Work Plan should be written for the comprehension of the general public, presumably with the appropriate technical terminology with accompanying explanations.
3. The Work Plan references the “fate and transport of iron and manganese” as the sole goal of the effort. The Work Plan should be augmented to include the Notice’s stated goals of estimating “the locations of the dissolved 1.0 mg/L Fe and 0.2 mg/L Mn contours in three dimensions within the aquifer” and “identifying data gaps in the existing monitoring well network.” Examples of data gaps should include insufficient monitoring wells in the vicinity of R-28 and R-42 and insufficient monitoring wells with screened intervals capable of determining vertical transport of elevated dissolved concentrations of Fe and Mn within the aquifer.
4. The Work Plan states that Fe and Mn are not noted in “*nearby monitoring wells*,” but fails to mention that the nearest downgradient monitoring wells are approximately 1300 feet away. The Notice specifically requests a data gap analysis be conducted as part of the Work Plan in order to evaluate siting of monitoring wells to delineate the Fe and Mn plumes around R-28 and R-42.
5. The Work Plan should reference the Notice’s specifically referenced considerations, i.e., migration based on the prevailing hydraulic gradient of the regional aquifer, the current hydraulic impact of the on-going injection and extraction within the chromium plume, the influence of County production wells, and the current measured impact to extraction well CrEX-3. The Work Plan should provide other potential sources of the elevated Mn at CrEX-3.
6. The Work Plan references elevated Mn at CrEX-3 and states that “the data remain inconclusive with regard to whether the elevated manganese at CrEX-3 is directly related to the elevated Mn at R-28. NMED considers the question of a related impact at CrEX-3 to be a fundamental goal of the Notice and that this goal should be stated in the Work Plan.
7. The Work Plan does not reference previous efforts to model contaminant fate and transport within the regional aquifer, e.g., LANL’s Groundwater Modeling Status Report dated March 2018 (2018 Report). Nor does the Work Plan mention the model being continually updated regarding the chromium plume as indicated in LANL’s comment response to a recent status report on the chromium interim measures performance, “*DOE continues to incorporate numerous data streams into the numerical modeling being conducted for the chromium plume.*” The Work Plan should be augmented to identify these efforts, to reference the general findings of those efforts and any subsequent conclusions, to reference any

previously identified data gaps, and to evaluate the relevance of those efforts to the fate and transport of dissolved Fe and Mn. The 2018 Report, figure 2.3-1 illustrates the simulation of the injection of molasses and a biological inhibitor at R-28 and shows the concentration of Cr(VI) removed as a result of remediation 10 months after injection, albeit only at the very top of the regional aquifer. The Work Plan should commit to similarly illustrating the concentrations of dissolved Fe and Mn downgradient of R-28 and R-42.

8. The Work Plan fails to address the Notice requirement to “timely report to NMED [the] results of the initial modeling ....”
9. The Work Plan describes two modeling approaches. Modeling approach 1 involves development of a three-dimensional reactive transport model, including the full effects of the hydraulic and geochemical behavior of the system through the various operational phases. Modeling approach 2 would utilize a one-dimensional geochemical transport model, with inputs such as flow direction and velocity informed by the three-dimensional model. Though the Work Plan identifies the need for “inputs such as flow direction and velocity informed by the three-dimensional model” (approach 1), the Plan recommends using approach 2 because the level of uncertainty in the geochemical processes is expected to dominate the analysis of this system, making a full three dimensional representation presented as approach 1 less useful than approach 2, which would fully evaluate the redox, solubility, and sorption processes. NMED requests LANL perform both approaches 1 and 2 and disregard the stated concern regarding “model development time.”
10. The Work Plan references an option in performing the one-dimensional transport process (approach 1) of utilizing either the Finite Element Heat and Mass (FEHM) code or the PHREEQC code. NMED request LANL utilize the PHREEQC code as the agency is considerably more familiar with the PHREEQC code and believes the code will provide more informative results. NMED requests a technical meeting with LANL before the PHREEQC simulations are conducted that focus on PHREEQC modeling with the objective of quantifying aqueous speciation, oxidation and reduction, mineral equilibrium and kinetics, adsorption for batch equilibrium and reactive transport simulations. NMED technical staff shall work closely with LANL technical staff during all aspects of conceptual model development and numerical model simulations quantifying hydraulic and geochemical processes controlling the movement, fate, and transport of dissolved Fe and Mn.
11. NMED is concerned that LANL intends for the groundwater flow direction and velocity to be “*informed by the three-dimensional model.*” NMED considers this inappropriate. The model must be calibrated to actual field hydraulic data and is not suitable to obtain these parameters through model simulations. The model must simulate observed field conditions that include, at a minimum, measured (synoptic) groundwater levels from each chromium group well and piezometer, the hydraulic gradient, and groundwater flow velocity and direction through calculations based on the measured groundwater levels from both the shallow and deeper screened intervals. LANL must derive these model calibration parameters from properly prepared potentiometric surface contour maps of the regional aquifer by triangulating the three-point problem of synoptic water levels recorded at each well at the time of injection. This will provide the basis for the three-dimensional hydrogeologic conceptual model. The model must then be calibrated to such data, at a minimum, and can also be calibrated to the concentration changes of specific contaminants.

Troy Thomson and Arturo Q. Duran  
July 15, 2021

The Permittees should provide NMED with a revised Work Plan within 30 days of this letter addressing NMED's concerns and a cover letter describing how those concerns are addressed.

Please contact me at [steve.pullen@state.nm.us](mailto:steve.pullen@state.nm.us) with any questions regarding this Response.

Sincerely,

**Steve Pullen** Digitally signed by Steve Pullen  
Date: 2021.07.15 10:43:49 -06'00'

Steve Pullen, Manager  
Ground Water Quality Bureau

Cc: (electronic distribution)

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