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MEMORANDUM

Subject: Review of EPA report "Relation Between Nitrates in Water Wells and Potential Sources in the Lower Yakima Valley, Washington", draft, December 16, 2011

From: Stephen Kraemer, Ph.D., Research Hydrologist
Roger Burke, Ph.D., Research Chemist

To: Michael Cox
Office of Environmental Assessment, USEPA Region 10

Thank you for the opportunity to review the subject draft report on the investigation on nitrate sources to drinking water wells in the Yakima Valley. The scope and detail of the report are impressive. The writing is very good. The figures and tables adequately constructed. We will address the charge questions to the external reviewers below.

1. Are the purpose, scope, and objectives of the project clear?

Yes. The purpose of the study is to collect data to investigate the contribution of various sources from nearby land uses to the observed high nitrate in drinking water wells. The objective was to sample and analyze likely sources of nitrate (dairies, irrigated croplands, and septic systems) and private residential drinking water wells for a variety of chemicals to determine if chemicals other than nitrate can be used to link the nitrate contamination in groundwater to specific sources. The scope of the study included an area approximately 40 miles long and 10-25 miles wide.

2. Is it clear why we selected certain chemical classes (e.g., hormones) or analytical techniques (e.g., isotopic analysis) to serve as potential tracers for nitrate contamination?

Yes. The report does a good job of presenting background information.

3. Is the experimental design clear?

Yes. Although see responses (4) and (6).

4. Is the approach taken for evaluating the isotopic data reasonable given the results from the study and the literature on isotopic analysis (e.g., $\delta^{15}\text{N-NO}_3$ water well values greater than 8.4‰ characterized as dominated by animal waste; $\delta^{15}\text{N-NO}_3$ water well values less than 2.0‰ characterized as dominated by fertilizer; and $\delta^{15}\text{N-NO}_3$ water wells values between 2.0‰ and 8.4‰ being characterized as isotopically in determinant as to animal waste and/or fertilizer)?

It is reasonable to attribute N isotope values greater than 8.4 parts-per-mille to animal waste as long as the nitrate concentrations are highly elevated - which they are in all cases reported in this document as far as we can tell. Based on soil N isotope values, and the fact that denitrification also causes isotopic fractionation that causes nitrate to become more ¹⁵N-enriched, we suspect that soil cycling (e.g., Table 8, WW-02) could also produce nitrate with N isotope values greater than 8.4 parts-per-mille, albeit the nitrate concentration would probably be much less than observed for ¹⁵N-enriched samples reported in the present study.

5. Are the conclusions supported by the results?

Yes. The conclusions stay within the evidence of the investigation.

6. Are there results which could be more strongly used to link nitrate contamination to sources?

Source water delineation for the drinking water wells based on computer modeling would further refine the concept of “upgradient” and “downgradient” used in the study, similar to the work of McMahon et al. (2008). The land uses and nitrate sources could be classified within the estimated zone contributing water to the pumping wells and compared to the chemical signatures. The USGS study used MODFLOW/MODPATH for individual well analysis. A regional analytic element model, e.g., WhAEM2000, would be better suited for regional scale, multi-well capture zone delineation.

McMahon, P. B., J. K. Bohlke, L. J. Kauffman, K. L. Kipp, M. K. Landon, C. A. Crandall, K. R. Burrow, and C. J. Brown (2008), Source and transport controls on the movement of nitrate to public supply wells in selected principal aquifers of the United States, *Water Resour. Res.*, 44, W04401, doi:10.1029/2007WR006252.

7. Are the uncertainties adequately addressed and clearly articulated?

Yes. There is a whole section devoted to study limitations and uncertainties, including lack of well log information on the private wells, evidence of mixing of waters, the use of non standard research analytical methods, and limitations on information from dairy operations.