Questions

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

   Response: The purpose of the study is clearly stated at the beginning of the document (1st paragraph in the Introduction). The placement of the purpose at this location is vital to making the document clear to the reader. The scope of the study is also presented clearly in the first paragraph.

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?

   Response: Overall your explanation of chemical classes is clear. The list of hormones in Table 4 indicates which animals the hormones are used for. There is no mention of any being used in dairy cows. Is this correct? The first 5 listed under "Analyzed at UNL Only" do not indicate for which animals they are from. I am assuming they are associated with mammals in general.

   It would be valuable to have some information on the mobility and decay rates of the hormones and pesticides in soils. If an organic constituent is not mobile it is unlikely that they will move to ground water, thus not serve as good indicators of nitrate sources. Need to make sure the selected organic constituents have a purpose not just "this is what the lab can analyze for so we will include" justification behind selection of constituents.

3. Is the experimental design clear?

   Response: In the main text the design is clear but a few more specifics could be included. These suggestions are listed in other responses.

   Regarding Appendix C, some terms need to be better defined – qualified and out of control. When I read "qualified estimated" I think a "scientific guess". Guessing has no place in scientific investigations. I am assuming that this is not the case, so a better explanation of what "qualified estimates" are would be good. References to QA procedures from other reports are plentiful in this Appendix. Many readers will not search for these so it may be good to summarize them in this report.

   After reading Appendix C I had the impression there were a lot of issues with organic compound sample analysis that made me question the validity and need of the data.

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., δ15N-NO3 water well values greater than 8.4‰ characterized as dominated by animal waste; δ15N-NO3 water well values less than 2.0‰

characterized as dominated by fertilizer; and δ15N-NO3 water wells values between 2.0‰ and 8.4‰ being characterized as isotopically in determinant as to animal waste and/or fertilizer).

Response: I am not an expert on isotope analysis but based on what I do know, your approach seems reasonable. Listing the shortcoming of the analysis and what conclusions can be drawn was a good strategy. I would recommend placing the information found in the footnotes of Table 8 into the design section for "D. Isotopic Analysis" on page 27.

5. Are the conclusions supported by the results?

   Response: The conclusions are supported by the data.

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

7. **Response: Not that I could see.**

8. Are the uncertainties adequately addressed and clearly articulated?

9. **Response: Yes.**

Other Comments:

When giving nitrate concentrations make sure to specify wheather the concentartios are reported as NO_3 or NO_3-N (e.g. Background section, Page 5: "…0.5 mg/L and to 1.1 mg/L…")

In Figure 1, some leaching path arrows look line runoff paths.

Including Section X. Study Limitations and Uncertainties was important. Regarding the second paragraph discussion on samples from wells with high nitrate and low oxygen, denitrification will not proceed under these situation unless there is an energy source (usually organic C) for the denitrifying bacteria to use and a terminal electron acceptor (NO_3^- in this case due to lack of a better electron acceptor, O_2). These waters could have been low in organic C thus accounting for the high levels of nitrate with low oxygen in the water. Did you measure organic C content of the water? This point (requirement of an energy source) was missing in the introduction section dealing with denitrification.