DOCUMENT REVIEW: DRAFT FINAL PHASE II RFI/RI AQUIFER TEST REPORT 903 PAD, MOUND AND EAST TRENCHES AREAS OPERABLE UNIT 2, ROCKY FLATS PLANT

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A major goal of the Aquifer Testing program was to evaluate three different type of hydrostratigraphic environments

- Arapaho sandstone No. 1 is physically isolated from the alluvial hydrostratigraphic unit by Arapahoe claystone
  (unsaturated alluvium over saturated sandstone)
- Arapahoe sandstone No. 1 is in physical contact with the alluvial hyrdostratigraphic unit
  (saturated alluvium over saturated sandstone)
- The alluvial hydrostratigraphic unit overlies the Arapahoe claystone.
  (saturated alluvium over claystone)

The location of the subcroping Arapahoe sandstone No. 1 was determined using a geophysical model, based on shallow seismic reflection data. The model was not always correct, consequently the second hydrostratigraphic model could not be evaluated. Seismic interpretations unfortunately are model dependent and do not necessarily reflect reality. The selection of pump test sites should have been based on geologic well logs from adjacent borings and monitoring well.

GENERAL COMMENTS

1. Lithologic well logs collected during construction of the pumping and observation wells indicated that the spatial distribution of the No. 1 sandstone was incorrectly interpreted (e.g., 1991 Groundwater Protection and Monitoring Program Plan, [GPP]). The GPP presented isopach maps of sandstone No. 1 as a totally preserved meandering stream channel. Isopachs of the sandstone were described as being based upon seismic reflection and correlation of well logs. The likelihood of a continuous stream channel of sand being preserved is very low.Streams continuously cut and meander across older preserved stream sediments within the stream valley. The ultimate result of such a process is a formation comprising numerous discontinuous, anastomosing, and interfingering sand, silt, and clay units: not a continuous, "fossilized" stream bed of sandstone. Even if the entire stream bed were preserved as a continuous unit, it is highly unlikely that it would be preserved as a continuous sinuous unit of sand. Modern stream channels are commonly composed of discontinuous sand-, silt-, and clay-rich zones (i.e., Section 2.1.5, p. 2-15, of the GPP makes exactly this point).

2. It is recommended that the conductivities measured in this study for the sandstone No. 1, will not be used to model groundwater flow and contaminant transport along a homogeneous and continuous "conduit" of sandstone. The evidence for such a sandstone is at the very least subjective and data collected in this study indicate that the interpretation of the sandstone shown in Figure 2 and 3 of this report (taken the GPP) is not reliable.

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3. It is recommended that before serious transport modeling be pursued that the current hydrostratigraphic/sedimentological model of the underlying bed rock be reconsidered.

SPECIFIC COMMENTS

1. Section 1.0, p. 2, para. 2, bullet statements 1 through 3: To be consistent with the geological conceptual models shown in Figure 3, note that for test site 1 the lower sandstone is separated from the alluvium by clay stone; for test site 2 that sandstone is in physical contact with the alluvium; and for test site 3 the alluvium is in physical contact with claystone.

2. Section 4.1.1, p. 10, para. 2: Please number or label this and all other equations in the text so that the equation need only be written once. Several equations have to be repeated in the text because no numbering system exists.

3. Section 4.1.2, p. 11, para. 2: Present an equation that defines the variable u (i.e., u = $r^2S/4Tt$). Please define the variables r, S, T and t.

4. Section 4.1.2, p. 11, para. 2, s. 4: Figure 20 is a plot of W(u) versus 1/u on a semi-log plot, not W(u) vs. log(u).

5. Section 4.1.2, p. 11, para. 2, s. 5: Please define ". . .this value . . .". It is unclear what "value" is referred to here.

6. Section 4.1.2, p. 12, para. 1: The document should state which equation T was estimated from. Also, it is recommended that the equations will be numbered in the final draft).

7. Section 5.1, p. 15, para. 1, s. 1: Please describe the evidence that existed prior to this investigation that indicated that the groundwater in the sandstone was under unconfined conditions.

8. Section 5.1, p. 15, para. 1, s. 2: It is noted that ". . . in this setting, the sandstone is separated from the . . . alluvium by claystone." Please specify what evidence was used to establish that the sandstone at site 1 was isolated from the overlying alluvium, e.g., boreholes, seismic data. Drop ". . . in this setting . . ." and replace with "at Site 1."

9. Section 5.1 , p. 15, para. 1: There should be some defense of the "hydrologic setting" presented in Figure 3. Figure 3 contains highly generalized "cross sections" of the geology at Sites 1 through 3. There is no scale and no apparent well control to defend these "cross sections." Recommend including scales and well control locations to justify these "cross sections," or else label these as preliminary conceptual models. Please discuss the evidence that led to the conclusion the No. 1 sandstone of the Arapahoe is preserved has shown in Figure 3.

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10. Section 5.1, p. 15, para. 2, s. 2: Please provide more detail about the "preliminary analytical estimates of the expected radius of influence . . ." etc.

11. Section 5.1, p. 15, para. 3, s. 4: It is not clear that the saturated thickness of the aquifer is known. Figures 23 and 24 show the lowest layer intersected by the boreholes as claystone; however, there is no evidence that this is a continuous layer or that it is a aquiclude. Because the pumping wells were not logged or cored there is not even sufficient evidence to conclude that the claystone is continuous in the vicinity of the pump test.

12. Section 5.1, p. 17, para. 1: The depth to the Quaternary/Cretaceous (Q/Ka) unconformity shown in Figure 23 for wells 21091 and 20991 is inconsistent with the well logs shown in Appendix A; please correct this discrepancy.

13. Section 5.1, p. 17, para. 1: The date of the groundwater level measurements should be shown on Figures 23 and 24 because the measurements shown in the well logs were from previous investigations. The current measurements have not been incorporated in the well logs and this causes confusion in regards to which measurements apply for the tests. (Comment also applies to Figures 44, 45, 61.)

14. Section 6.1, p. 29, para. 1: Please provide and discuss evidence for the stratigraphic interpretation shown in Figure 3.

15. Section 6.1, p. 32, para. 2: The Cretaceous lithology immediately beneath the Q/Ka unconformity is shown as sandstone in well 21191 on Figure 43; however, the well logs in Appendix A indicate that the lithology is claystone. Please correct the figure.

16. Section 6.1, p. 32, para. 5: Well OB20291 was not logged or cored therefore, it is impossible to know where to place the unconformity. Also correct the depth shown for well 20491 shown in Figure 44. Well logs in Appendix A indicate that 20491 was terminated in alluvium and did not penetrate bedrock as shown in this figure. Please correct Figure 44.

17. Section 7.3.2, p. 54, para. 1: The fact that differing analyses of the same basic data yield similar results does not provide any evidence that the results are correct. All of the techniques approximate real conditions and may have the same sensitivities (or lack of) for the range of conditions measured in this study. It is recommended that this sentence be deleted.

18. Section 8.0, p. 56, para. 1: Please clarify what type of heterogeneities are being referred to, e.g., lithologic, hydrologic, structural. Explain in what way the results in Table 7 confirm these heterogeneities in the alluvium and bedrock. It is noted that the results of the pump test "confirm the presence of heterogeneities in both the alluvium and the bedrock."

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19. Section 8.0, p. 56, para. 2, last sentence: Well OB20191 and OB20191 are reported as two different wells. Please clarify.

20. Section 8.0, p. 56, para. 3, sentence 1: This sentence needs to be reworded. Replace "consistent with" with "indicating a lack of." The lack of water level response in the Arapahoe claystone to pumping in the alluvium, indicates a lack of hydraulic connection.

21. Section 8.0, p. 56, para. 3, sentence 2: It is correct that the claystone at Site 3 was not part of the uppermost hydrostratigraphic unit. It is incorrect to make broad generalizations about all Arapahoe claystone. Its is not even certain that there is a laterally continuous unit of claystone. It is likely that the claystone that was monitored was a laterally discontinuous lens of claystone. It should be noted that a unit of low-conductivity claystone was unaffected by a pump test in the alluvium. It is quite possible that sandstones at the same or similar physical stratigraphic levels were effected.

22. Section 8.0, p. 56, para. 4: The ranges in conductivities for alluvium from Site 2 and Site 3 overlap in values. It unclear how it can be concluded that the values "represent the textural heterogeneities of the sites." It is unclear if differences between the two sites or the difference within a site were being discussed. If the latter is true Site 3 data are within the same order of magnitude indicating no significant variation. However, Site 2 data varies over 2 orders of magnitude, which is not much considering the error in these types tests and analyses.

23. Section 8.0, p. 57, para. 2: Please note that some care should be taken in comparing results from slug test and pump test. These are two significantly different types of aquifer tests and major differences are to be expected in results.

24. Appendix A: Please include explanations for the patterns used in well logs.

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