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Environmental Protection
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EPA

November 24, 1992

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Steven H. Wisness
Tri-Party Agreement Manager
U.S. Department of Energy
P.O. Box 550, A5-19
Richland, Washington 99352

Re: EPA Review Comments on the M-30-04 Document, Revision 0. Failure to Fulfill the Intent of the Milestone.

Dear Mr. Wisness:

The U.S. Environmental Protection Agency (EPA) and our contractors have reviewed the U.S. Department of Energy (DOE) document DOE/RL-92-64, Revision 0; entitled Estimating Aquifer Hydraulic Properties Using the Ferris Method, Hanford Site, Washington. This document was submitted by DOE to satisfy the M-30-04 milestone. Enclosed are our general and specific comments.

The M-30-04 milestone stated: "Submit a report (secondary document) to EPA and Ecology evaluating the interaction of the Columbia River and the unconfined aquifer for aquifer hydraulic properties". The intent (as specified in the milestone) was to determine aquifer hydraulic properties in the 100 Area.

The document does not meet the intent of the milestone, although DOE is credited with having submitted a document by the milestone date. The driver for the milestone was the need for aquifer hydraulic properties in the 100 Area. There are no conclusions developed in this document for aquifer hydraulic properties in the 100 Area.

The document has explored one method of estimating several aquifer hydraulic properties. This document was essentially a test of the Ferris method. 100 Area data is very briefly discussed to illustrate the idea of river fluctuations affecting water levels in nearby wells. Thereafter, 300 Area data is used to investigate the feasibility of applying the Ferris method. The only aquifer hydraulic properties determined in this document were for the 300 Area. The main results and conclusion of the document revolve around the utility of the Ferris method at the 300 Area.

This document provides a significant starting point from which DOE can now evaluate the aquifer hydraulic properties in the 100 Area. The general comments enclosed in this letter contain data corrections/adjustments that need to be made after which the Ferris analysis needs to be rerun and reevaluated. The document mentions that there have been previous efforts to apply the Ferris method to 100-N area data. Those efforts warrant a more extensive review in this document and may provide guidance for

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use of the Ferris method with 100 Area data. Because the river water level in the 100 Area tends to rise and fall rapidly, the less than sinusoidal pattern that results may not fit the Ferris method requirements. (The authors state that lack of 100 Area data that fit the requirements for analysis by the Ferris method was a reason for using 300 Area data.) As DOE revises this document using 100 Area data, other techniques that may prove more appropriate to available data should be considered. One potential technique EPA has previously identified to DOE as worthy of consideration is the Rowe technique. The Rowe technique was specifically created to be applicable under non-sinusoidal conditions. If alternate techniques have already been well evaluated and found inappropriate for use in the 100 Area, this needs to be detailed in the document. As 100 Area data is evaluated, it is important to keep in mind that the intent of the milestone is for aquifer hydraulic properties.

We request that the regulators be included in a scoping meeting for revision 1 of this document with DOE so that misinterpretation of the milestone does not continue. The meeting should be convened soon in order to discuss these comments and DOE comment dispositions (due to the regulators 30 days from receipt of this letter). The group's objective will be two fold: to facilitate the rewrite of the document in response to the attached comments, and determine the work needed to complete the intent of the M-30-04 milestone. With the incorporation of our comments, revision 1 will complete the milestone.

It should be kept in mind that the river-stage and water-level data loggers are a necessary part of the investigation of the various operable units and are not intended solely (or even principally) to provide data for application of the Ferris (or other aquifer-property) techniques. Therefore, the installation of pressure transducers and data loggers in the 100 Areas should not be delayed while issues concerning the application of the Ferris method are being resolved.

The EPA and DOE need the 100 Area aquifer hydraulic properties data (that was to result from the M-30-04 milestone effort) for the 100 Area groundwater operable unit risk assessments. Until the missing information is obtained, this is an unfilled data gap. If you have any questions or comments, please direct them to me at (509) 376-9884.

Sincerely,

Laurence E. Gadbois

Laurence E. Gadbois
Environmental Scientist

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Encl: Comments on "Estimating Aquifer Hydraulic Properties Using the Ferris Method, Hanford Site, Washington" (DOE/RL-92-64, Rev. 0)

cc: Eric Goller, DOE
Chuck Cline, Ecology
Steve Cross, Ecology
Dave Jansen, Ecology
Darci Teel, Ecology
Audree DeAngeles, PRC
Brian Drost, USGS
Becky Austin, WHC
Bob Peterson, WHC
Steve Weiss, WHC
Administrative Record, M-30-04

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Comments on "Estimating Aquifer Hydraulic Properties Using the Ferris Method, Hanford Site, Washington" (DOE/RL-92-64, Rev. 0)

GENERAL COMMENTS

(1) This report only partially fulfills the requirement in M-30-04;

"Submit a report (secondary document) to EPA and Ecology evaluating the interaction of the Columbia River and the unconfined aquifer for aquifer hydraulic properties" [for the 100 Aggregate Area].

This report evaluates only the Ferris method and only for data from the 300 Area. Appropriate data apparently exist in the 100 Areas (see Specific Comment on Page 9, Section 3.0, second paragraph, lines 2-4) for application of the Ferris method. Also, other techniques (e.g., Rowe 1960) exist for "non-Ferris" data in the 100 Areas.

(2) Some corrections and(or) adjustments should be made to some of the data and analyses.

- The long-term trend in river stages and water levels should be removed before the Ferris analysis is made (see Comment on Page 12, Figure 3-2).

- Well to well and well to river distances should be determined more precisely (see Comment on Page 14, Table 3-2).

- The "hour" values used for determining time lags should be more precisely determined (see Comment on Page 13, Table 3-1).

(3) More geohydrologic information (e.g., geology, well construction, water-table maps) is needed to properly evaluate the results of the application of the Ferris method (see Comment on Page 10, Section 3.3).

(4) Results and conclusions need to be reassessed after the changes in (2) and (3) above are made and the Ferris analyses are rerun.

(5) If, after corrections and reassessment, the Ferris method (or some other technique) is shown to be a useful tool in determining aquifer properties, then a section should be added to the report discussing how the existing data networks could be improved (number and placement of wells, open intervals, etc.) to obtain the best quality data for the analyses.

SPECIFIC COMMENTS

(1) <u>Comment</u> Page 1, Section 1.0, 2nd paragraph, line 2:

For greater accuracy, replace "Pump tests in monitoring wells..." with "Aquifer tests using a pumping well and observation wells..." Less desirable, but also acceptable, is "Pumping tests..." instead of "Pump tests..."

(2) <u>Comment</u> Page 2, Section 1.1, 1st paragraph, line 4:
The reference (Ecology et al. 1990) is not in Appendix E.

(3) Comment Page 3, Section 1.2, 2nd paragraph, line 3:

"...and cause daily..." should be "...that cause daily..."

(4) Comment Page 5, Section 1.3, 3rd paragraph, line 1:

"...several methods previously investigated..." should be "...several existing methods investigated..."

(5) Comment Page 8, Section 2.3:

A previous application of the Ferris technique in the 300 Area is not referenced in this report and apparently was not included in the analysis. Raymond and Brown (1963; "Groundwater Exchange with Fluctuating Rivers; General Electric report HW-SA-3198) applied the Ferris and Rowe techniques to 300-Area data. Their results indicated transmissivity values (in sq.ft/day) of: 210,000 (Rowe), 160,000 (Ferris time lag), 160,000 (Ferris amplitude), and 200,000 (pumping test).

(6) Comment Page 9, Section 3.0, 1st paragraph, lines 5 and 6:

Reference is made to "discussions" with E. P. Weeks of the USGS who has "extensive" experience with the subject (Ferris method). We spoke with Mr. Weeks, and he does not consider himself to have had "extensive" experience with the subject and does not consider the "discussions" he had regarding the subject as worthy of referencing.

(7) Comment Page 9, Section 3.0, 2nd paragraph, lines 2-4:

It is stated that no data were available for the 100 Aggregate Area that fit the requirements of the Ferris method.

- On page seven it is stated that investigators in the 100-N Area have recently applied the Ferris method; implying that data are available and that these data are suitable for the Ferris method.

- Well and river hydrographs from the 100-N Area (Gilmore et al 1990 and 1991) appear to show usable data.

- If there are no suitable data in the 100 Area for application of the Ferris technique, why wasn't some other method tested (e.g., Rowe, 1960)?

(8) Comment Page 9, Section 3.1, lines 6-9:

It is stated that river stage fluctuations were "approximated..." and lag times were derived from the "river sinusoid". This is confusing. Were the river stage measurements used directly or were they massaged in some way? All of the figures and tables which include river stage data indicate directly measured values and do not refer to any "adjustments" or other data "refinements".

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(9) Comment Page 10, Section 3.3:

To properly evaluate the application of the Ferris method to the available data, it is essential that the assumptions of the method can be examined versus the real-world situation in the 300 Area. This section should include information on geology, flow system, and well construction. Cross-sections should be included which show the best available interpretation of the geology along each of the three lines of wells to the river. Open intervals should be indicated. A map of the flow system should be included.

- A hydrofacies cross-section in Gaylord and Poeter (1991) indicates that a relatively fine-grained unit occurs in the vicinity of the 3-9 to 3-12 line, but not(?) near the other lines. This unit may cause confined or semiconfined conditions to occur near 3-9 to 3-12. There is some indication that the response (change ratio) of these wells is greater than that of the other wells, supporting the possibility of a confining effect.
- The possibility of paleochannels and relatively low permeability (over-bank Ringold deposits) zones should be investigated before data are analyzed with the Ferris method.

(10) Comment Page 12, Figure 3-2:

It is apparent from the figure, that in addition to the daily river cycle there is a longer-term trend of rising river stage and ground-water levels (about 0.5 ft/day for the river and 0.25 ft/day for the wells). This trend should be removed from the data set before stage ratios and time lags are computed. The "Change Ratios" shown in table 3-1 indicate very different values for "Rising Limbs" and "Falling Limbs". This is an artifact of the longer-term trend in river stage and ground-water levels. If the longer-term trend is removed, the rising and falling values are (and should be) almost identical. Making this adjustment does not significantly change the calculated value of diffusivity nor the y-intercept values in the regression plots. However, the longer-term trend in river stage and ground-water levels also affects the selection of lag times. Correcting for the longer-term trend (based on visual examination of the stage/water level plots)probably will not significantly affect the calculated value of diffusivity but will apparently change the y-intercept (making it closer to zero?).

(11) Comment Page 13, Table 3-1:

The "hour" values are all to the nearest hour. Presumably this is because these values are based on an hourly data set. However, many of the time lags calculated from these "hour" values are only a few hours long (and as little as a single hour long). The "rounding" of the time lag to the nearest hour could have a significant effect on the analysis. Smooth curves should be drawn through the hourly data (as was done in figure 3-2) and the maxima and minima and their associated times should be taken as accurately as possible from the curves (in less than one-hour increments).

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(12) Comment Page 14, Table 3-2:

The distances of the wells from the river (and from one another) appear to be inaccurate. Using the 1:2,000 topographic maps that have been created for the 300 Area, and drawing shortest-path lines to the river (@ 105-meter contour), results in distances that differ significantly from those in the table:

Well number	Distance from source River		
	Table 3-2	Topo. map	"error"
- 399-1-2	1,400ft	1,204ft	16%
- 399-1-7	700ft	615ft	14%
- 399-3-12	1,200ft	1,070ft	12%
- 399-3-9	200ft	182ft	10%
- 399-4-1	1,400ft	1,256ft	11%
- 399-4-9	300ft	162ft	85%
	Well 4-9		
- 399-1-2	1,100ft	1,042ft	6%
- 399-1-7	400ft	453ft	12%
- 399-3-12	900ft	908ft	0.9%
- 399-4-1	1,100ft	1,094ft	0.5%

Note: Wells are not identified by number on the 1:2,000 maps. The distances shown are based on our matching of the well locations shown on the maps with available coordinate data.

Stallman (1983) recommends a "tolerance in measurement" of 0.5% for distances (in regard to pumping tests). While this may be overly cautious, it would seem that we should be able to obtain well distances (relative to each other and to a selected river-stage elevation) that are within 1-2% accuracy.

Also, on page 10, Section 3.3, it is stated that well 4-9 is approximately 200 ft from river gage SWS-1, but the table shows a distance from the river of 300 ft.

(13) Comment Page 17, Section 3.4, 1st paragraph, lines 4 and 5:

It is stated that the regression lines should pass through zero. This is not true. They should intercept the y-axis at "the effective distance from the river's edge to the subaqueous outcrop" (Ferris, 1963). In the case of a water-table aquifer, the subaqueous outcrop extends from the river's edge along the river bottom. The "effective distance" is probably somewhere between zero (river's edge) and the maximum offshore point at which the aquifer discharges to the river. In the case of the 300 Area, this may be as much as 1000 ft offshore.

(14) Comment Page 17, Section 3.4, 2nd paragraph, lines 6-8:

It is stated that although well 399-3-9 is closer to the river than well 399-4-9, the time lag in 3-9 was longer indicating a potentially anomalous connection to the river. Based on the 1:2,000 topographic maps of the 300 Area, it appears as if well 4-9 is actually closer to the river (see above comment on Table 3-2, page 14).

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(15) Comment Page 17, Section 3.4, 2nd paragraph:

Selecting a single well to use as the "reference well" for all the others assumes that the hydraulic properties of the aquifer are the same in the entire area. A better approach would have been to select several lines with three or more wells and used the closest well in each line as the "reference well" for that line.

(16) Comment Page 19, Section 3.4, 1st paragraph:

The interpretation that the y-intercept values are "too high to be considered acceptable" may not be true. This statement seems to be based on the assumption that the intercepts should be zero (see comment on Page 17, Section 3.4, 1st paragraph, lines 4 and 5).

(17) Comment Page 19, Section 3.5, 1st paragraph:

The "high y-intercept values" may not actually be too high (see comment on Page 17, Section 3.4, 1st paragraph, lines 4 and 5).

(18) Comment Page 20, Section 3.5, 1st paragraph and Table 3-7:

Add and compare values of transmissivity obtained by Raymond and Brown (1963) (see comment on Page 8, Section 2.3).

(19) Comment Page 20, Section 3.5, 3rd paragraph:

It is indicated that obtaining suitable data sets for application of the Ferris method is not guaranteed for the 100 Area. However, on Page 7 it is stated that investigators are apparently currently applying the Ferris method to 100-N Area data with some degree of success. The status of these other investigations should be detailed and a conclusion drawn as to the appropriateness of the Ferris method to the 100 Area.

(20) Comment Page 21, Section 3.5, 1st paragraph:

The problems with applying the Ferris method are discussed, but no mention is made of the specific advantages of using this method in the 100 Areas. One of the reasons for investigating the technique is that we are limited in the application of the standard aquifer testing (pumping tests, etc.) because of the possibility of inducing contaminant movement and the problem of dealing with large volumes of contaminated pumped water.

(21) Comment Page 21, Section 3.5, 1st paragraph, lines 1 and 2:

It is stated that a "substantial commitment to gathering field data" is required for application of the Ferris method. In the case of the 100 Areas, the majority of the required data (river stages and water levels) are being collected independent of the application of this technique. Therefore, the data requirements should not be a factor in considering the use of the technique.

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(22) Comment Page 21, Section 3.5, 2nd paragraph:

In addition to the indicated information to support risk assessment is the probable(?) need for ground-water flux values. If flux values are required, then ground-water hydraulic property values (obtainable by the Ferris method) will be required.

(23) Comment Page A-2, Figure A-1:

"Water Table" should be "Potentiometric Surface".

(24) Comment Page A-3, Section A.2, 2nd paragraph, line 10:

"...Muskat 1937)..." should be "...Muskat (1937)..."

(25) Comment Page B-1, line 1:

"...loggers are installed..." should be "...loggers have been installed..." or "...loggers are in place..."

(26) Comment Page C-2, Figure C-1 (a):

The title indicates May 17-21, but the figure indicates May 18-21.

(27) Comment Page C-5, Figure C-2 (a):

The title indicates May 17-21, but the figure indicates May 18-21.

(28) Comment Page C-8, Figure C-3 (a):

The title indicates May 17-21, but the figure indicates May 18-21.

(29) Comment Page C-9, Table C-5:

The table refers to wells 399-4-9 and 399-4-1, but the distances given at the bottom of the table are for wells 399-3-9 and 399-3-12.

(30) Comment Pages C-11 and C-13, Figures C-4 and C-6:

In addition to the single regression line through the entire set of data points, lines should be drawn through each set (line of two wells) of data points. Drawing a single line through all six assumes that the hydraulic properties are the same throughout the entire area. This may not be true, and some insight to this may be obtainable from separate lines.

(31) Comment Pages C-11 and C-12, Figures C-4 and C-5:

The data points used to draw the regression lines should be corrected (by removing the long-term trend, more accurately measuring distances from the wells to the river, and being more precise in obtaining lag times) and the lines redrawn.

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(32) <u>Comment</u> Page C-13, Figure C-6:

The data points used to draw the regression lines should be corrected (to more accurately reflect well distances from the river) and the lines redrawn.

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