PNL-10158
UC-903

Summary and Evaluation of Hydraulic Property Data Available for the Hanford Site Upper Basalt Confined Aquifer System

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September 1994

Prepared for
the U.S. Department of Energy
under Contract DE-AC06-76RLO 1830

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Summary

Pacific Northwest Laboratory,[a] as part of the Hanford Site Ground-Water Surveillance Project, examines the potential for offsite migration of contamination within the upper basalt confined aquifer system. For the past 40 years, hydrologic testing of the upper basalt confined aquifer has been conducted by a number of Hanford Site programs. Hydraulic property estimates obtained from the analysis of the hydrologic test results are important for evaluating aquifer flow characteristics (i.e., ground-water flow patterns, flow velocity, transport travel time).

This report presents the first comprehensive Hanford Site-wide summary of hydraulic properties for the upper basalt confined aquifer system (i.e., the upper Saddle Mountains Basalt). In completing the summary, available hydrologic test data were reevaluated using recently developed diagnostic test analysis methods (i.e., pressure derivative analysis) to ensure that the hydrologic analysis methods used were applicable for the test data examined. A comparison of calculated transmissivity estimates indicates that, for most test results, a general correspondence within a factor of two between reanalysis and previously reported test values was obtained. For a majority of the tests, previously reported values are greater than reanalysis estimates. This overestimation is attributed to a number of factors, including, in many cases, a misapplication of nonleaky confined aquifer analysis methods in previous analysis reports to tests that exhibit leaky confined aquifer response behavior.

Results of the test analyses indicate a similar range for transmissivity values for the various hydrogeologic units making up the upper basalt confined aquifer. Approximately 90% of the calculated transmissivity values for upper basalt confined aquifer hydrogeologic units occur within the range of 10^0 to 10^2 m^2/d, with 65% of the calculated estimate values occurring between 10^1 to 10^2 m^2/d. These summary findings are consistent with the general range of values previously reported for basalt interflow contact zones and sedimentary interbeds within the Saddle Mountains Basalt.

(a) Pacific Northwest Laboratory is operated for the U.S. Department of Energy by Battelle Memorial Institute.

Acknowledgments

Several people contributed to the development of this report. In particular, important technical peer review comments were provided by P. D. Thorne. In addition, the editorial review and guidance by B. V. Johnston and S. P. Luttrell and the report preparation support provided by C. L. Wimbish and W. D. Webber are also acknowledged. Special thanks are also extended to S. P. Reidel (Westinghouse Hanford Company) and R. L. Jackson (CH2M-Hill) for their efforts in recovering hydrologic test data originally obtained by Rockwell Hanford Operations.

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1.0 Introduction

As part of the Hanford Site Ground-Water Surveillance Project, Flow System Characterization Task, Pacific Northwest Laboratory examines the potential for off-site migration of contamination within the upper basalt confined aquifer system for U.S. Department of Energy (DOE). Included as part of this activity, hydrologic field tests are conducted within selected wells completed in the upper Saddle Mountains Basalt. Analysis of the field test data provides local estimates of hydraulic properties. When combined with areal head information, ground-water travel time and flow velocity within the upper basalt confined aquifer system can be estimated.

This report presents the first comprehensive Hanford Site-wide summary of hydraulic properties for the upper basalt confined aquifer system. In completing this summary, available hydrologic test data from 35 single-well test intervals were reevaluated. This evaluation used recently developed diagnostic pressure derivative test analysis methods (Bourdet et al. 1983, 1984, 1989) and computer analysis software (Spane and Wurstner 1993) to improve the hydrologic test analyses.

The report discusses the hydrogeologic characteristics (Section 2.0) and availability of hydrologic test data (Section 3.0) for the upper basalt confined aquifer system. A detailed description of the test methods used in reanalyzing the tests is also presented in Section 4.0. Results of the test reanalyses, together with estimate comparisons, are provided in Section 5.0. A table summarizing the test reanalysis results and individual abbreviated analysis summaries for each test interval are included in the accompanying appendix.

2.0 Hydrogeologic Description

The upper basalt confined aquifer system refers collectively to pervious basalt interflow contacts and intercalated sedimentary interbeds that occur within the upper Saddle Mountains Basalt. Confinement to this aquifer system is provided by silt and clay units within the overlying suprabasalt sediments (i.e., Ringold Formation) and dense, low-permeability interior sections of the basalt flows (e.g., Elephant Mountain Member). Information presented previously by Gephart et al. (1979) and DOE (1982, 1988) indicates that confined aquifers within the Saddle Mountains Basalt commonly display a high degree of similarity with respect to hydrochemistry and hydraulic properties, with no obvious hydrostratigraphic divisions present. For the purpose of limiting the scope of this investigation, the lower boundary of the upper basalt confined aquifer system is arbitrarily placed immediately below the first laterally extensive hydrogeologic unit, which for the Hanford Site is the Rattlesnake Ridge interbed (Figure 2.1).

It should be noted that this aquifer system has been previously referred to as the upper confined aquifer. However, in limited areas of the Hanford Site, units of the lower Ringold Formation (which stratigraphically overlies the Saddle Mountains Basalt) can also be locally confined. Where this hydrologic condition occurs, the lower Ringold units have been grouped by some investigators with the underlying Saddle Mountains Basalt as part of the upper confined aquifer system. This report pertains solely to pervious hydrogeologic units within the upper Saddle Mountains Basalt that, for the purpose of avoiding confusion, are referred to collectively as the upper basalt confined aquifer system.

Within the Pasco Basin, the Rattlesnake Ridge interbed is the thickest and most widespread sedimentary unit that occurs intercalated within the upper Saddle Mountains Basalt. Stratigraphically, the interbed is assigned to the Ellensburg Formation and occurs at the boundary contact between the Elephant Mountain and Pomona Members (see Figure 2.1). The interbed varies in thickness from 0 to 33 m. Figure 2.2 is an isopach map that displays the thickness distribution for the Rattlesnake Ridge interbed within the Pasco Basin. As indicated in Figure 2.2, the interbed is absent primarily in the area to the west of the Hanford Site and within the Hanford Site in the vicinity of the Gable Mountain — Gable Butte structural area. As discussed in Spane and Raymond (1993), this absence in the area immediately north of the 200 East Area is of particular hydrogeologic importance.

Reidel and Fecht (1981) reported that areally the Rattlesnake Ridge interbed can be divided into three distinct facies based on lithology and texture:

- First Facies occurs primarily in the Cold Creek syncline area and consists of three units: 1) a lower clay or tuffaceous sandstone; 2) a middle, micaceous-arkosic and/or tuffaceous sandstone; and 3) an upper, tuffaceous siltstone or tuffaceous sandstone.

- Second Facies occurs in areas where the unit is relatively thin and consists of a single, tuffaceous sandstone to siltstone unit.

- Third Facies is limited to the northwest section of the Pasco Basin, similar in lithology and texture to first facies, but contains a conglomerate with plutonic and metamorphic clasts near its base.

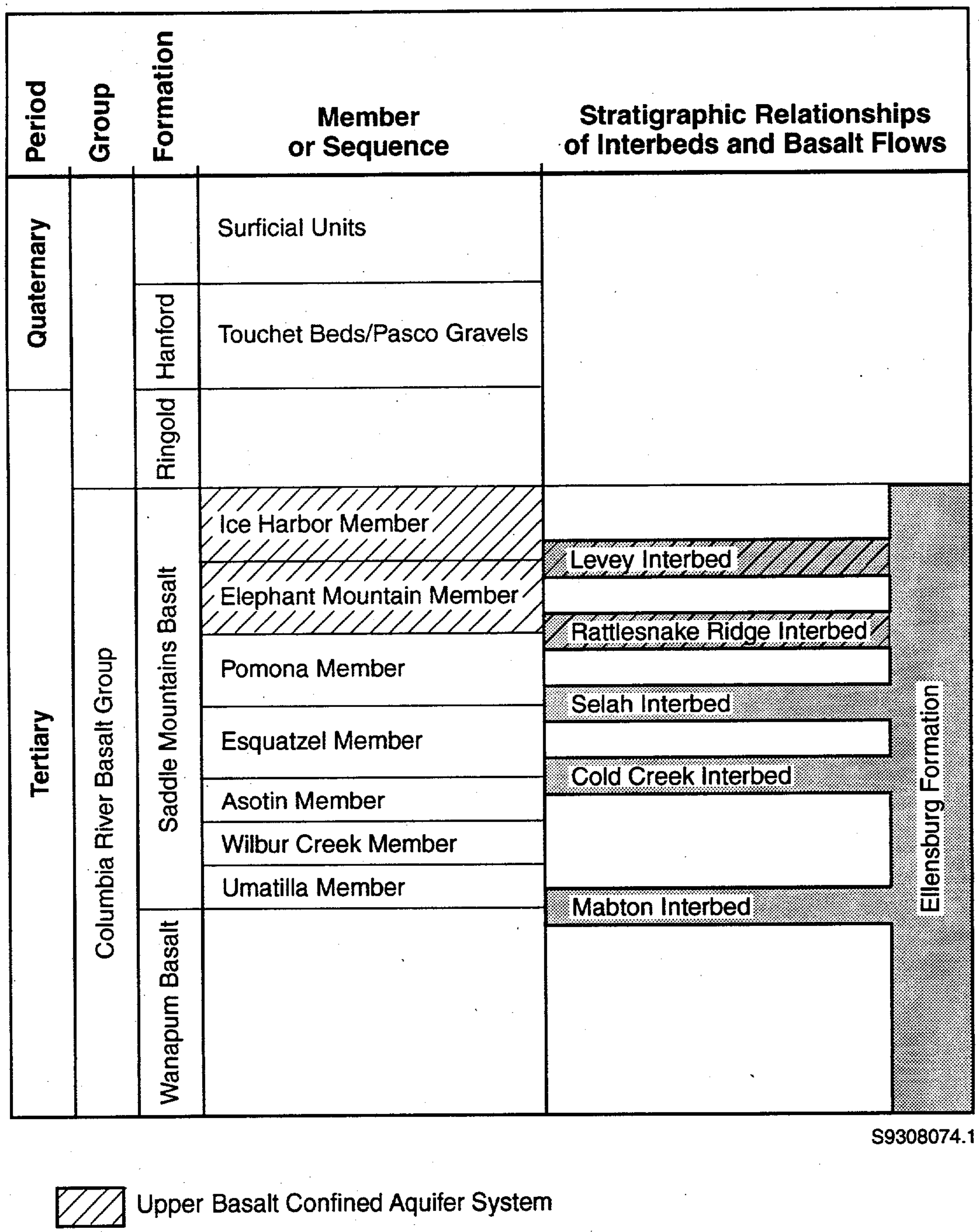

Figure 2.1. General Stratigraphic Relationships Within the Pasco Basin

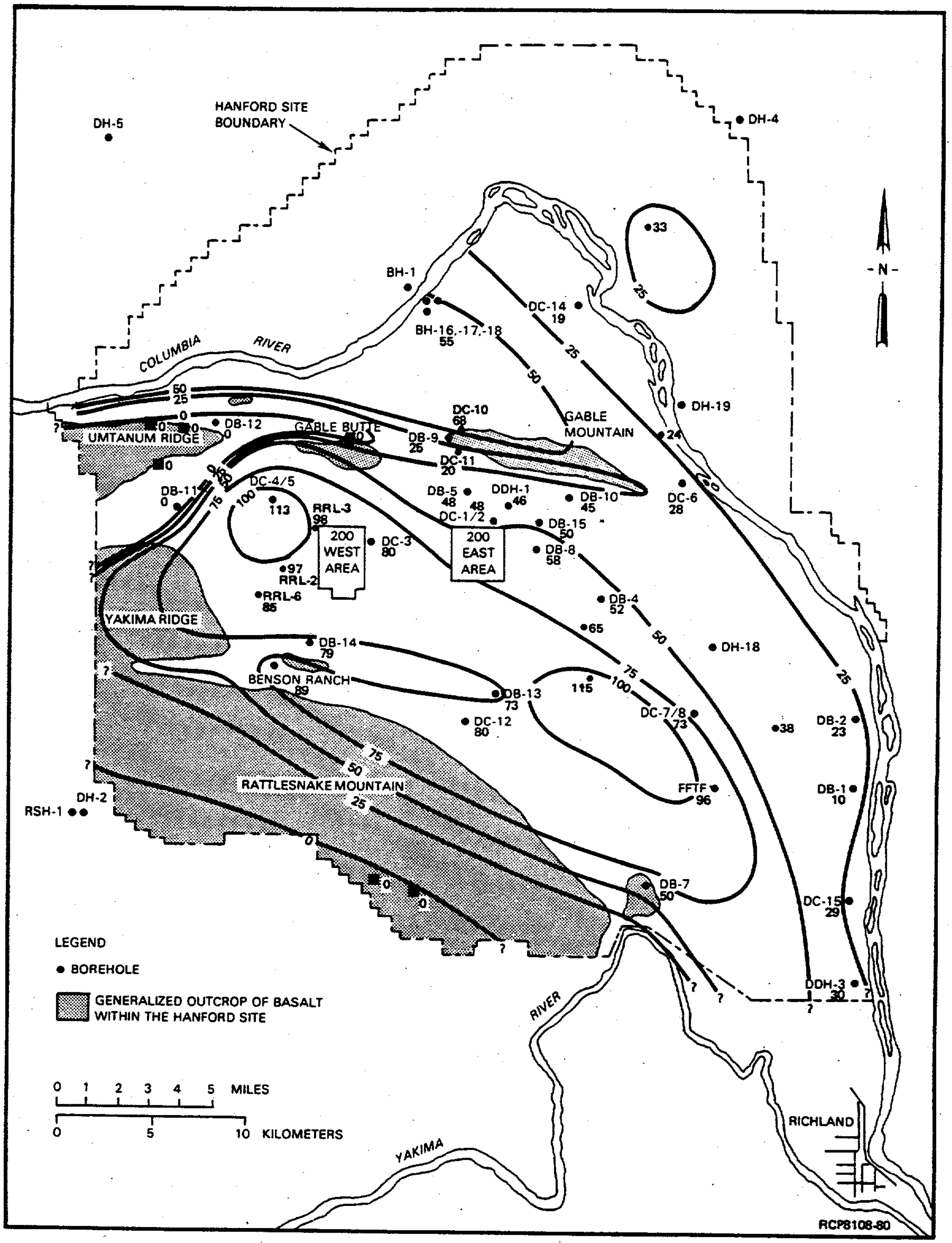

Figure 2.2. Isopach Map of the Rattlesnake Ridge Interbed on the Hanford Site (adapted from Reidel and Fecht 1981)

Permeable sandstone units within the interbed are important hydrogeologically in the lateral transmission of ground water. Because of its areal extent, hydraulic properties, and thickness, the Rattlesnake Ridge interbed represents the most important hydrogeologic unit within the upper basalt confined aquifer system for the potential offsite migration of contamination.

Other locally important hydrogeologic units within the upper basalt confined aquifer system include the overlying Levey interbed, which occurs along the southern boundary of the Hanford Site, and a pervious interflow contact between two Elephant Mountain Member flows (i.e., the Elephant Mountain and Ward Gap flows), which occurs in the eastern half of the Hanford Site. Although not as areally extensive as the underlying Rattlesnake Ridge interbed, where these units occur, their hydraulic property characteristics warrant their inclusion in the upper basalt confined aquifer system.

3.0 Data Availability

In developing this hydraulic property summary report, test data from 35 single-well test intervals were evaluated. The Rattlesnake Ridge interbed (n = 22) has the highest number of test intervals represented, while the Levey interbed (n = 2) has the fewest. A total of seven test intervals were also available for interflow contacts within the Elephant Mountain Member. Four of the test intervals have composite hydrogeologic unit completions. Hydraulic test data available for the test intervals were primarily limited to slug tests (n = 18; total tests = 36) and constant-rate discharge tests (n = 35; total tests = 43). Only 18 of the 35 test intervals have both slug and constant-rate discharge test data.

Test data evaluated in this report represent the results obtained from a variety of past and current Hanford Site programs. The following programs contributed test data reviewed in this report:

- Long-Term Transuranic Defense Waste - Offsite Migration Program (Rockwell Hanford Operations)
- Basalt Waste Isolation Project (Rockwell Hanford Operations)
- Ground-Water Surveillance Project, Hanford Site Flow System Characterization Task (Pacific Northwest Laboratory)
- Various Hanford Site CERCLA (Comprehensive Environmental Response, Compensation, and Liability Act) and RCRA (Resource Conservation and Recovery Act) operable unit investigations (Westinghouse Hanford Company).

Figure 3.1 shows the well site locations of the upper basalt confined aquifer test intervals examined as part of this report. Pertinent information concerning well completions, principal hydrogeologic units monitored, and hydraulic tests performed for the individual test well sites is provided in the appendix. Additional information concerning the test wells is also presented in Spane and Raymond (1993).

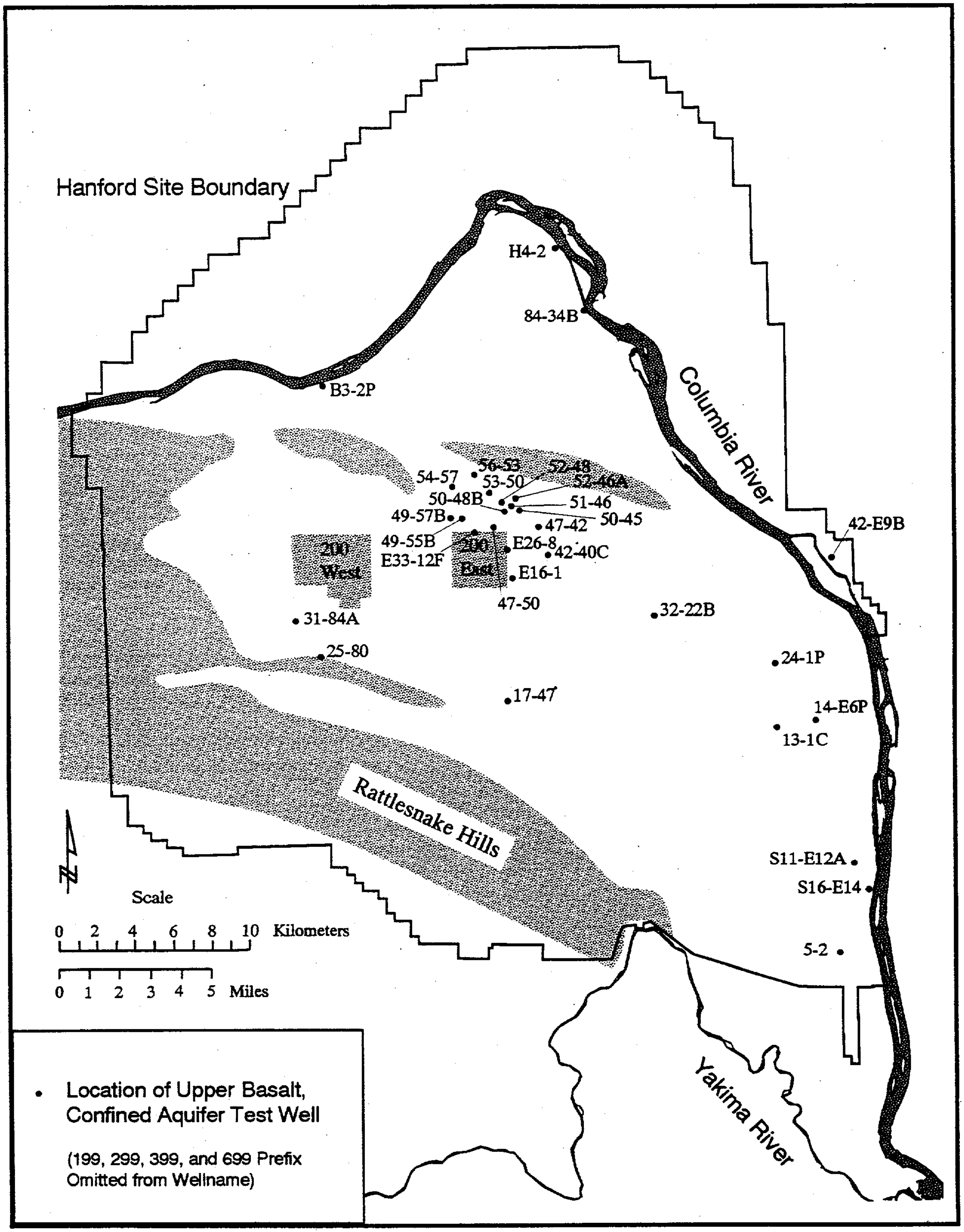

Figure 3.1. Location of Upper Basalt Confined Aquifer Test Sites

4.0 Test Analysis Method Description

In hydrologic characterization investigations, in situ hydraulic properties of subsurface units are commonly determined by analytical techniques that relate the effects of a known imposed stress to hydraulic properties (i.e., transmissivity, storativity). Standard hydrologic test methods commonly used include constant-rate discharge tests, in which ground water is removed from the test interval at a constant rate for an extended period of time, and slug tests, which are characterized by the instantaneous removal or injection of fluid. Analysis of the drawdown and recovery phases of these hydrologic tests is normally accomplished by type-curve fitting of log-log plots or straight-line analysis of semilogarithmic data plots of pressure change versus time. Recent developments in hydrologic test analysis based on the derivative of pressure with respect to the natural logarithm of time have been shown to significantly improve the diagnostic and quantitative analysis of slug and pumping tests. The improvement in test analysis is attributed to the sensitivity of pressure derivatives to various test/formation conditions. Specific applications for which derivatives are particularly useful include the following:

- determining formation response (leaky versus nonleaky) and boundary conditions (impermeable or constant head) that are evident within the test data
- assisting in the selection of the appropriate type-curve solution through combined type-curve/derivative plot matching
- determining when infinite-acting, radial flow conditions are established and, therefore, when nonleaky, confined aquifer, straight-line analysis methods are applicable
- reducing the ambiguity of type-curve selection in confined aquifer slug test analysis.

Pressure derivative analysis, used in conjunction with standard test analysis methods, is discussed in Spane (1993) and Spane and Wurstner (1993). The basis for the analytical procedures used in the test reanalyses is taken from these previous reports and is presented below.

4.1 Constant-Rate Discharge Tests

During constant-rate discharge tests (also referred to as constant-rate pumping tests), ground water is withdrawn from a well with discharge regulated and maintained at a constant rate. Water-level response within the well is monitored during the active pumping phase and during the subsequent recovery phase after termination of pumping. The analysis of drawdown and recovery water-level response within the stress well (and any nearby monitored wells) provides a means for estimating the hydraulic properties of the tested aquifer, as well as for discerning formational and nonformational flow conditions (e.g., wellbore storage, well inefficiency, presence of boundaries). Standard analytical methods that are used for constant-rate pumping tests include type-curve matching and straight-line methods.

In ground-water hydrology, type-curve matching methods (Theis 1935; Hantush 1964) are normally reserved for analyzing individual or collective observation well response. Type-curve analysis is not normally used for quantitative analysis of the pumped well because part of the drawdown or recovery water-level response within the stress well is associated with well/formation inefficiencies or damage induced by the drilling process. In the petroleum industry, the effects of well/formation inefficiencies or damage are lumped together and referred to as "skin effect." In petroleum reservoir analysis, storativity (S) is independently estimated for the test formation; transmissivity (T) and skin effect (s_k) are calculated simultaneously by matching the log-log drawdown or recovery response with appropriate type curves for various skin-effect conditions (Earlougher 1977).

For straight-line analysis methods, the rate of change of water levels within the well during drawdown and/or recovery is analyzed to estimate hydraulic properties. Because skin effects are constant with time during constant-rate tests, straight-line methods can be utilized to quantitatively analyze the water-level response in both pumped and observation wells. In ground-water hydrology, the semilogarithmic, straight-line analysis techniques commonly used are based on either the Cooper and Jacob (1946) method (for drawdown analysis) or the Theis (1935) recovery method (for recovery analysis). These methods are theoretically restricted to the analysis of test responses from wells that fully penetrate nonleaky, homogeneous, isotropic, confined aquifers.

The straight-line solutions represent an approximation of the general equation describing radial flow to a well and are valid only after a specified period of time and after infinite-acting, radial flow conditions have been established. Infinite-acting, radial flow conditions are indicated during testing when the change in pressure, at the point of observation, increases in proportion to the logarithm of time. Lohman (1972) indicates that the time (t) required for the straight-line approximation to be valid (mathematically) can be calculated from the following:

$$t \geq (r^2 S)/(4T u) \qquad (1)$$

where r is observation distance from the pumped well (L) and u equals 0.01 (dimensionless).

The recent development of pressure derivative methods (Bourdet et al. 1983, 1984, 1989; Ehlig-Economides 1988) has significantly improved the analysis of pumping tests, using type-curve or straight-line methods. The improvement in hydrologic test analysis through use of pressure derivatives is attributed to the sensitivity of the derivative response to small variations in the rate of pressure change that occurs during testing, which would otherwise be less obvious with standard pressure change versus time analysis. The sensitivity of pressure derivatives to pressure change responses facilitates their use in identifying the effects of wellbore storage and boundaries and the presence of radial flow conditions within the test data.

Figure 4.1 shows the pattern of dimensionless pressure (p_D) and the dimensionless pressure derivative $[(t_D/C_D)p_D']$ during a constant-rate test for a stress well that fully penetrates a nonleaky,

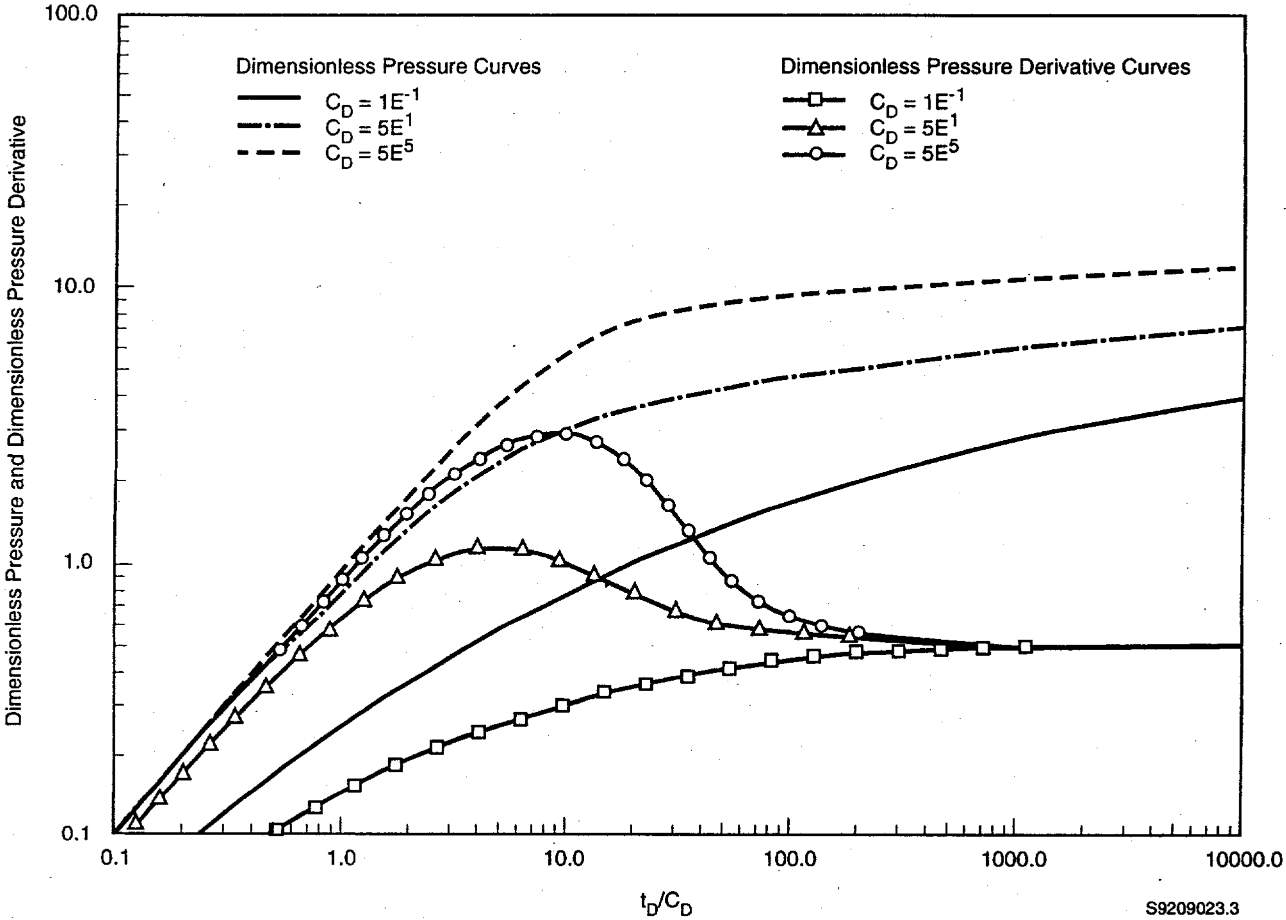

Figure 4.1. Dimensionless Pressure and Dimensionless Pressure Derivative Curves for Constant-Rate Discharge Tests in Nonleaky Confined Aquifers (adapted from Spane and Wurstner 1993)

homogeneous, isotropic, confined aquifer for various dimensionless wellbore storage conditions (i.e., $C_D > 0$). Dimensionless parameters shown in the figure are defined as

$$p_D = (2\pi\ T/Q)\blacktriangle h \qquad (2)$$

$$C_D = r_c^2/2(r_w^2\ S) \qquad (3)$$

$$t_D = (T\ t)/(r_w^2\ S) \qquad (4)$$

where Q = pumping discharge rate (L^3/T)

Δh = water-level change (L)

r_c = stress well casing radius (L)

r_w = stress well radius in test interval (L)

t = time since pumping started (T).

The p_D type curves were generated using the program TYPCURV (Novakowski 1990). The $(t_D/C_D)p_D'$ curves were produced by using the generated p_D curve data as input to the DERIV program described in Spane and Wurstner (1993). The values of C_D shown in Figure 4.1 encompass the range for storativity commonly cited for confined aquifer systems (i.e., $S = 10^{-3}$ to 10^{-5} [Heath 1983]).

As indicated in Figure 4.1, wellbore storage produces a characteristic "hump" in the pressure derivative plot, which increases in amplitude and duration as the associated dimensionless wellbore storage value, C_D, increases. A Theisian response that is characterized by no wellbore storage effects cannot be shown in the figure because $C_D = 0$. However, because of the similarity displayed by all low C_D curves (i.e., $C_D \leq 0.1$), the absence of wellbore storage effects can be approximated by the C_D curve = 0.1 shown in the figure. Infinite-acting, radial flow conditions are indicated during testing when the change in pressure at the point of observation increases in proportion to the logarithm of time. This is indicated when the pressure derivative curve becomes horizontal (i.e., when the pressure derivative becomes constant) at a p_D' value equal to 0.5. Test data displaying this derivative pattern can be analyzed using confined aquifer, semilogarithmic straight-line methods (e.g., Cooper and Jacob 1946). For most test situations, infinite-acting, radial flow conditions are established for test times with t_D/C_D values greater than approximately 60 (Earlougher 1977).

The presence of nonradial flow conditions caused by vertical flow, leaky aquifer behavior, or presence of boundaries is denoted on a pressure derivative plot by a diagnostic response pattern that deviates significantly from the horizontal radial flow-line region of the graph (i.e., $[t_D/C_D]p_D' = 0.5$). In comparison, these nonradial flow conditions are less obvious on a dimensionless pressure change plot without the derivative. Nonradial flow is suggested only by a subtle deviation from the pressure change plot. Figure 4.2 presents examples of diagnostic dimensionless pressure change and pressure derivative plots for selected heterogeneous formation test conditions. A more complete treatment of diagnostic response patterns is provided by Ehlig-Economides (1988) and Horn (1990).

Distinctive log-log derivative curves can also be developed for leaky confined aquifer response for the two cases where confining layer storage is and is not significant. For these test formation response conditions, type-curve values presented in Hantush (1964) can be used with the derivative program provided in Spane and Wurstner (1993) to generate the appropriate derivative response curve. A detailed discussion of the use of leaky confined aquifer pressure derivative analysis is provided in Spane (1993) and Spane and Wurstner (1993).

The general procedure utilized for reanalysis of available constant-rate discharge tests for wells completed in the upper basalt confined aquifer is outlined below.

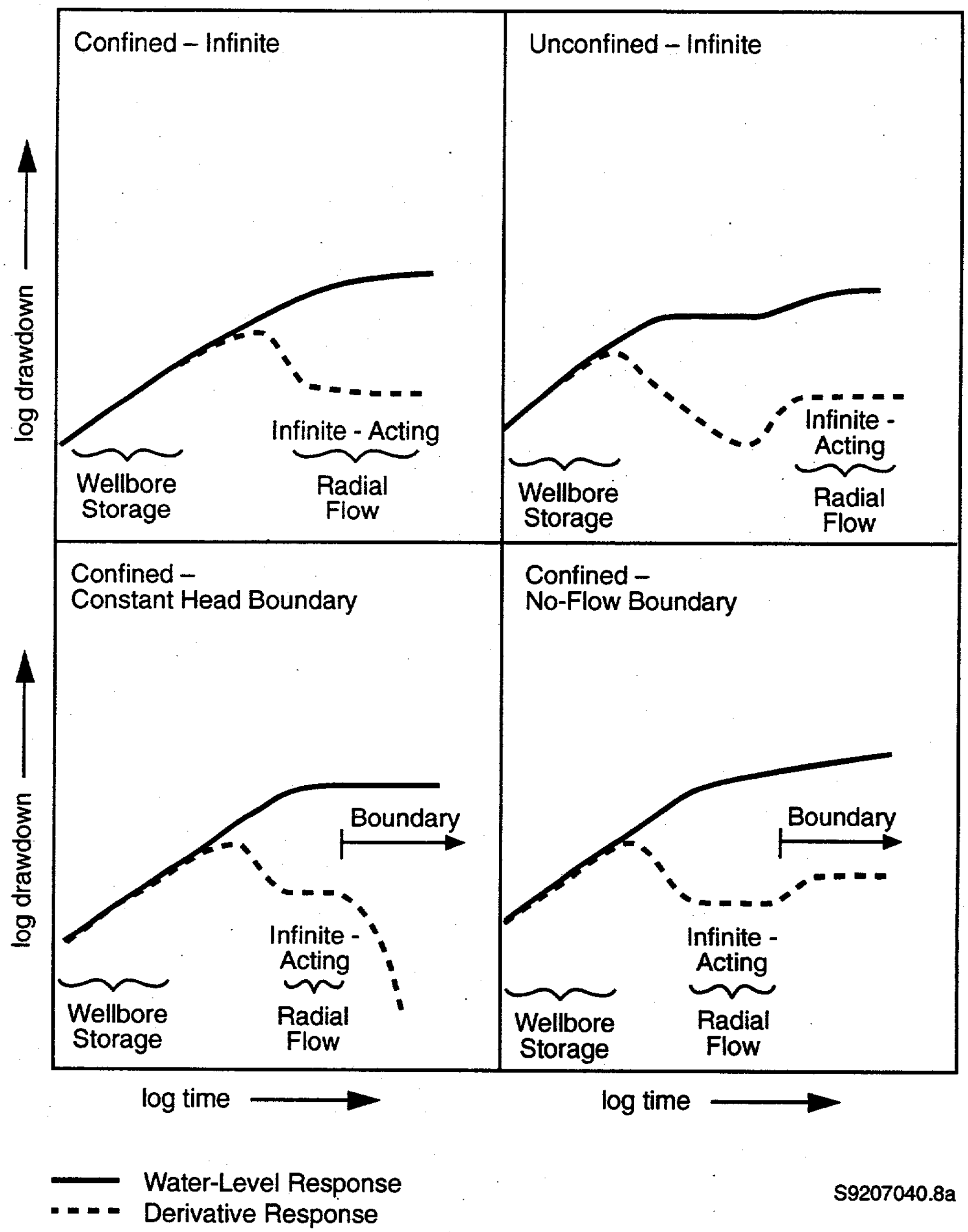

Figure 4.2. Diagnostic Log-Log Pressure and Pressure Derivative Plots for Various Hydrogeologic Formation/Boundary Conditions (adapted from Spane and Wurstner 1993)

Nonleaky Confined Aquifers

1. Construct a log-log plot of the drawdown data and data derivative versus the log of time.

2. Evaluate the drawdown data and data derivative pattern (i.e., diagnostic analysis) to ascertain the formation response model and whether radial flow conditions have been established during the test.

3. Calculate the transmissivity of the test interval based on the analysis of the indicated radial flow section of the test data (if present) using the Cooper and Jacob (1946) semilogarithmic straight-line method, provided that the data record analyzed satisfies the "u" time criteria listed in Equation (1).

4. If the semilogarithmic straight-line analysis method is not applicable, composite log-log type-curve matching of the drawdown and drawdown derivative response should be utilized to calculate transmissivity using type-curve relationships presented in Papadopulos and Cooper (1967), together with their associated derivative curve response (i.e., calculated using DERIV in Spane and Wurstner 1993). It should be noted that the type-curve analysis procedure assumes either that skin effects are equal to zero or can be independently determined.

Leaky Confined Aquifers

1. Follow the first three steps outlined for nonleaky confined aquifer conditions.

2. If radial flow conditions are not established prior to the onset of significant leakage response, composite log-log type-curve matching of the drawdown and drawdown derivative response should be utilized using type-curve relationships presented in Hantush (1964), together with their associated derivative-curve response (i.e., calculated using DERIV in Spane and Wurstner 1993). Wellbore storage effects can also be accounted for following the procedure described in Fenske (1977).

3. For leaky conditions without significant aquitard storage, the Hantush (1964) semilogarithmic straight-line method can also be used. This method, however, has only limited application for pumping well analysis because it cannot be used if significant wellbore storage effects influence the slope of the selected straight-line segment. It should be noted that the leaky type-curve analysis procedure assumes either that skin effects are equal to zero or can be independently determined.

These procedures pertain only to the analysis of drawdown data obtained during constant-rate tests. Recovery data for constant-rate tests can also be analyzed using the same procedures, provided that the recovery buildup pressure (i.e., the observed formation pressure during the recovery minus the observed formation pressure at the termination of testing) is plotted versus the equivalent time function described in Agarwal (1980). The Agarwal equivalent time function accounts for the duration of the discharge time period, thereby permitting the use of drawdown-type curves for the analysis of recovery data. The equivalent time function (t_e) is defined in Agarwal (1980) as

$$t_e = (t \times t')/(t + t') \qquad (5)$$

where t is duration of the discharge test (T), and t' is the time since discharge terminated (T). If radial flow conditions have been established during the recovery period, the straight-line analysis methods described in Theis (1935) or Agarwal (1980) can be utilized.

4.2 Slug Tests

The analytical solution for a slug test response for a fully penetrating stress well with a finite radius within a confined aquifer containing a compressible fluid was first presented by Cooper et al. (1967). Type curves were also presented that related dimensionless head response (H_D) to the dimensionless time parameter (β) for various values of the dimensionless storage parameter (α) where

$$H_D = H/H_o \tag{6}$$

$$\beta = Tt/r_c^2 \tag{7}$$

$$\alpha = r_w^2 S/r_c^2 \tag{8}$$

where H is the observed head at time t, minus pretest static head level in well (L) and H_o is the instantaneous head change applied to the well at the start of the test (L). The type curves presented by Cooper et al. (1967) can be used to match slug test response data at the stress well to solve for T and S using Equations (7) and (8), respectively.

As indicated in Figure 4.3, type-curve responses for storativity values of 10^{-2} ($\alpha \approx 10^{-2}$) and less are very similar in shape. This similarity in type-curve shape prompted Cooper et al. (1967) to conclude that

> ... because the matching of the data plot to the type curves depends on the shapes of the type curves, which differ only slightly when α differs by an order of magnitude, a determination of S by this method has questionable reliability.

The ambiguity in determining the storativity is greatly reduced, however, when the derivative of the dimensionless head is plotted. In contrast to the normal dimensionless head type curves shown in Figure 4.3, the shape and amplitude of the dimensionless head derivative curves are strongly influenced by the storativity of the aquifer. As a means of improving the selection of the correct type curve, Ostrowski and Kloska (1989) presented a slug test analysis procedure that employed the simultaneous type-curve matching of the dimensionless pressure (i.e., H/H_o) versus time and the derivative of dimensionless pressure versus time. The technique is preferable to the procedure described by Cooper et al. (1967) for dimensionless pressure versus time, in that the ambiguity in type-curve selection is significantly reduced.

Although slug test derivative type curves improve the analysis match for test intervals that are completed in homogeneous confined aquifers, they cannot be used diagnostically like pumping test derivatives to provide definitive information concerning aquifer heterogeneity, nonradial flow

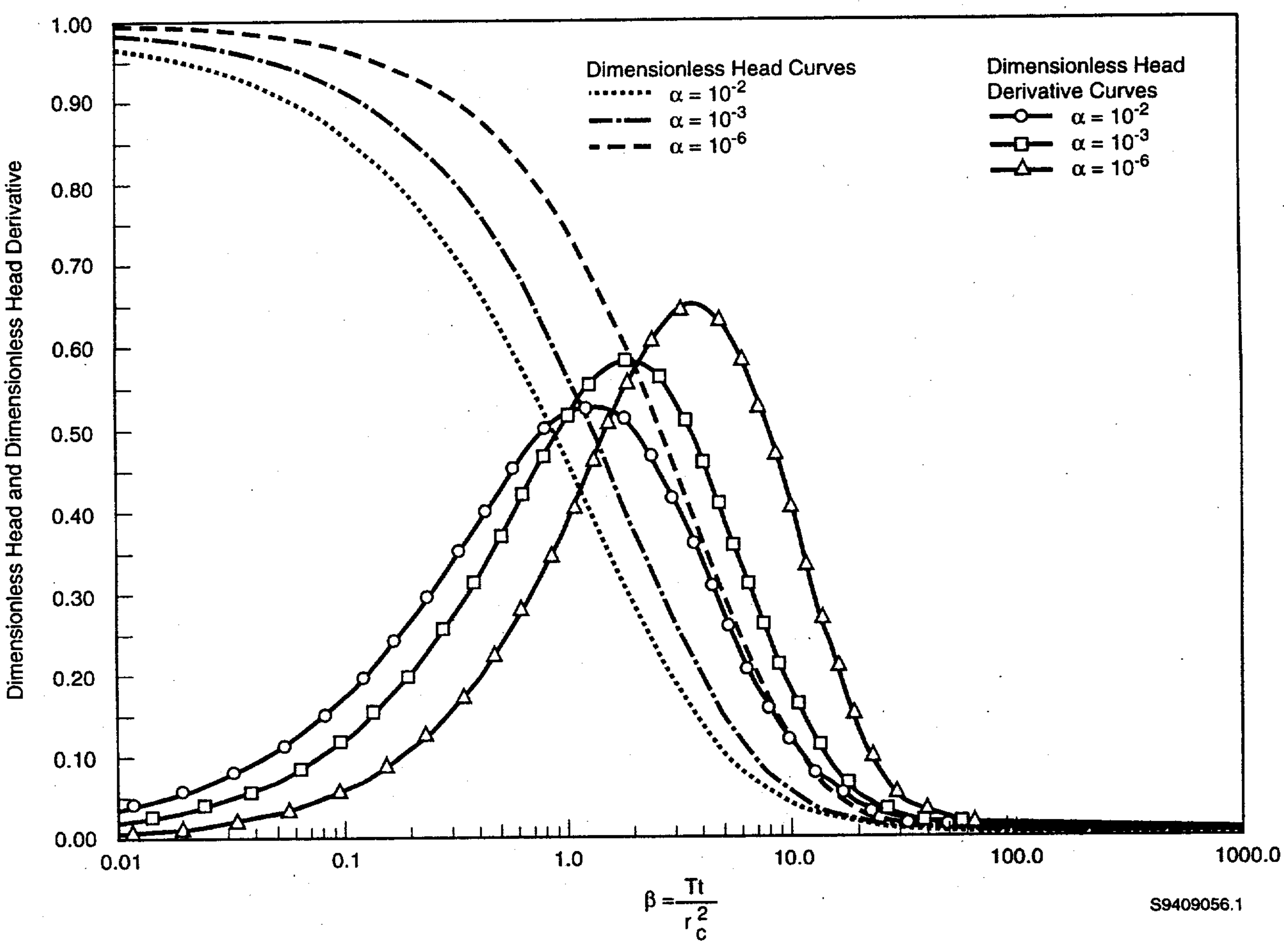

Figure 4.3. Dimensionless Head and Dimensionless Head Derivative Type Curves for Nonleaky Confined Aquifer Slug Tests (adapted from Spane and Wurstner 1993)

conditions, presence of boundaries, etc. A method is available, however, for converting slug test data to an equivalent head response that would be obtained during a constant-rate pumping test (Peres 1989; Peres et al. 1989). Once equivalent head values are obtained from the converted slug test data, equivalent head derivatives can be calculated using the procedure previously identified for constant-rate tests. The equivalent head and derivative responses can then be evaluated diagnostically to ascertain the formation response conditions existing during the test. To make the conversion process practical, a slug test data set that contains nearly complete recovery (i.e., $H/H_0 \approx 0.0$) should be available.

The general procedure utilized for reanalysis of available slug test data for wells completed in the upper basalt confined aquifer is outlined below:

1. Convert the slug test data to an equivalent constant-rate test following the procedure presented in Peres et al. (1989). Construct a log-log plot of the equivalent head and equivalent head derivative versus the log of time.

2. Evaluate the equivalent head data and equivalent head derivative pattern (i.e., diagnostic analysis) to ascertain the formation response model and whether nonradial flow conditions (e.g., leakage) have occurred during the test.

3. If nonleaky flow conditions are indicated, calculate the transmissivity of the test interval using the combined slug test type curve and derivative curve method described in Ostrowski and Kloška (1989) and Spane and Wurstner (1993).

4. If leaky flow conditions are indicated, calculate the transmissivity of the test interval using either of two methods — depending on when leakage effects become significant. For situations where leakage effects are not apparent during the first 70% of recovery (i.e., H_D = 1.0 to 0.3), use the nonleaky procedure outlined in step 3 to analyze the indicated nonleaky data section.

   For tests where leakage affects more than 30% of the slug test recovery, leaky slug test type curves and associated derivatives were developed following the procedure presented in Spane (1994). This procedure is dependent on the relationship previously established by Peres (1989) and Peres et al. (1989) between slug and constant-rate tests and the availability of leaky constant-rate test type curves. Transmissivity of the test interval is then determined using the combined slug test type-curve and derivative curve-matching procedure, as discussed in step 3 for nonleaky test conditions.

5.0 Hydraulic Test Result Summary

Hanford Site test data from 35 single-well test intervals within the upper basalt confined aquifer system were evaluated. The principal hydrogeologic unit distribution for test intervals evaluated are, from highest to least: Rattlesnake Ridge interbed (n = 22), Elephant Mountain Member interflow contacts (n = 7), and Levey interbed (n = 2). In addition, four of the test intervals have composite hydrogeologic unit completions. Hydraulic test data available for the test intervals are primarily limited to slug tests (n = 18; total tests = 36) and constant-rate discharge tests (n = 35; total tests = 42). Only 18 of the 35 test intervals have both slug and constant-rate discharge test data.

Figures 5.1 and 5.2 show the comparison between previously reported transmissivity values and reanalysis estimates for slug and constant-rate pumping tests, respectively. As shown, approximately 55% of the reanalysis slug test and 75% of the constant-rate test transmissivity values are within a factor of two of the previously reported estimates. For a majority of the hydrologic tests, previously reported transmissivity values are higher than reanalysis estimates. This overestimation is attributed to a number of factors, including, in many cases, a misapplication of nonleaky confined aquifer analysis methods in previous analysis reports to tests that exhibit leaky confined aquifer response behavior.

Figure 5.3 shows the comparison of reanalysis transmissivity values obtained for the 18 test intervals having both slug and constant-rate pumping test results. As indicated in the figure, most transmissivity estimates obtained from slug and constant-rate pumping tests have a correspondence within a factor of three. This level of correspondence is similar to previous slug test assessments reported in Papadopulos et al. (1973) and van der Kamp (1976).

Figure 5.4 shows a comparison of reanalysis transmissivity values for individual hydrogeologic units making up the upper basalt confined aquifer system. Results of the test reanalyses indicate a similar range for transmissivity values for the various hydrogeologic units. Approximately 90% of the calculated transmissivity values for upper basalt confined aquifer hydrogeologic units occur within the range of 10^0 to 10^2 m^2/d, with 65% of the calculated values occurring between 10^1 to 10^2 m^2/d. These summary findings are consistent with the general range for basalt interflow contact zones and sedimentary interbeds within the Saddle Mountains Basalt reported in Gephart et al. (1979), Strait and Mercer (1987), and DOE (1988).

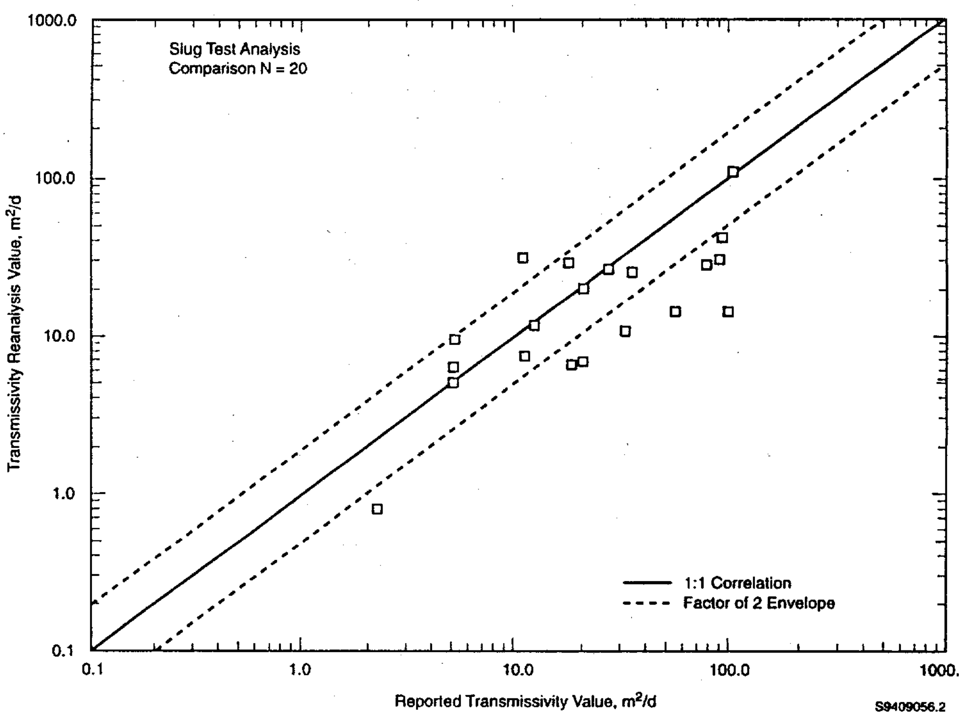

Figure 5.1. Comparison of Reanalysis and Previously Reported Slug Test Transmissivity Estimates for Upper Basalt Confined Aquifer Test Intervals

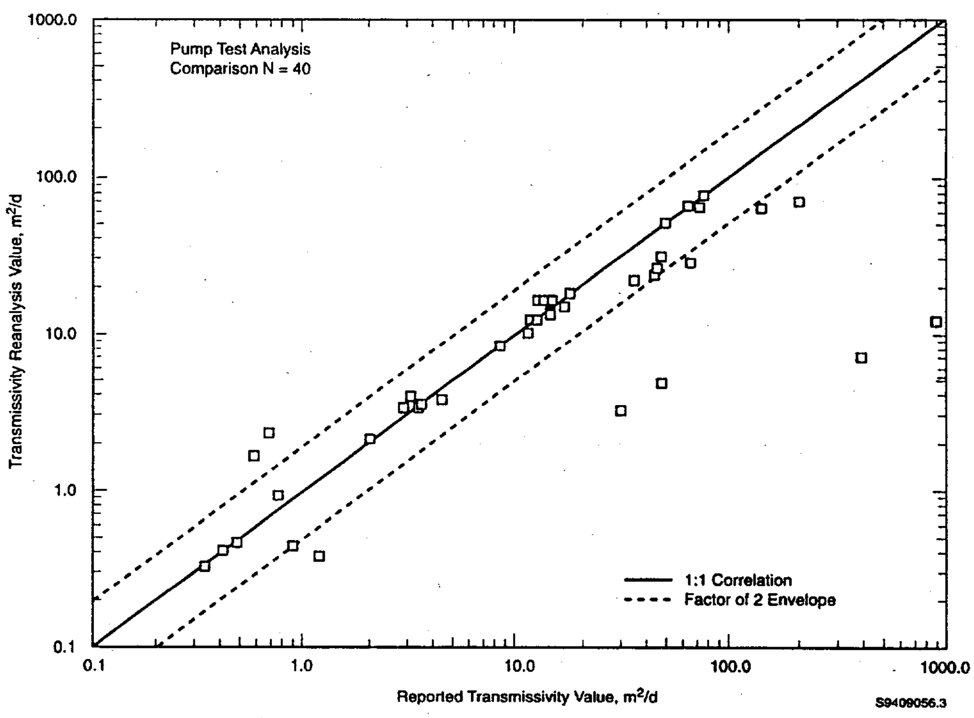

Figure 5.2. Comparison of Reanalysis and Previously Reported Constant-Rate Pumping Test Transmissivity Estimates for Upper Basalt Confined Aquifer Test Intervals

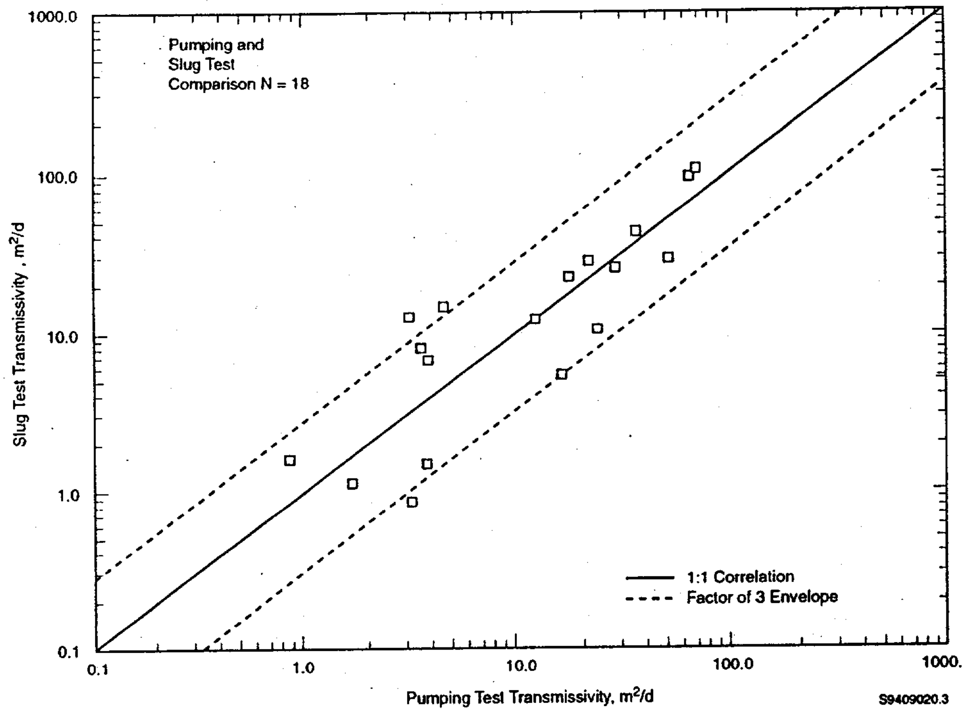

Figure 5.3. Comparison of Reanalysis Slug and Constant-Rate Pumping Test Transmissivity Estimates for Upper Basalt Confined Aquifer Test Intervals

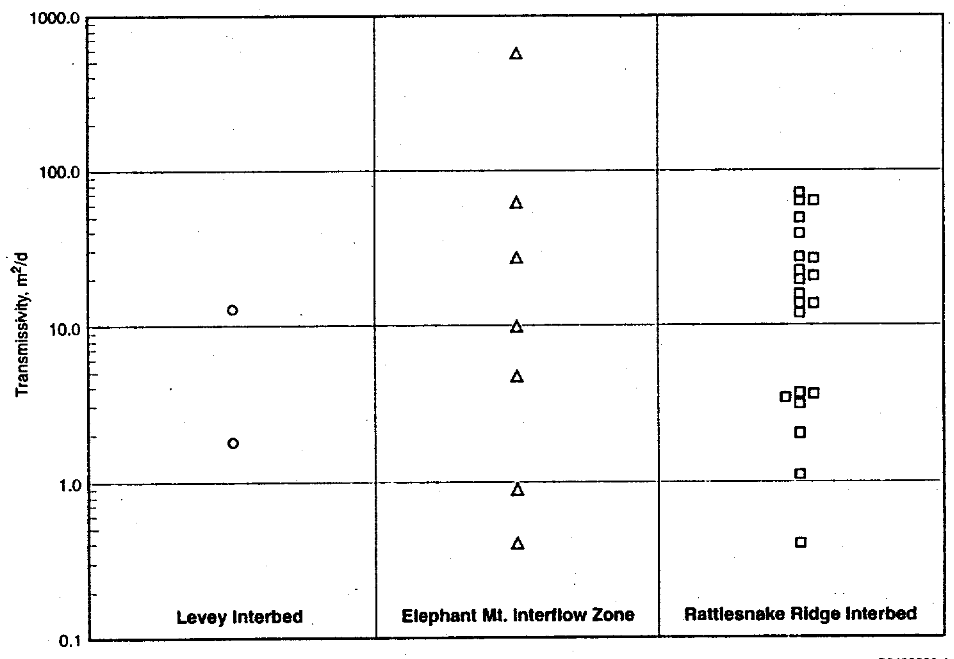

Figure 5.4. Distribution of Reanalysis Best Estimate Transmissivity Values for Individual Hydrogeologic Units Within the Upper Basalt Confined Aquifer

6.0 References

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Appendix

Test Summaries

Appendix

Test Summaries

This appendix contains a synopsis table and the abbreviated reanalysis summaries for the tests conducted within the upper basalt confined aquifer. The following wells were used in this reanalysis:

Hanford Site Well Designations

199-B3-2P	699-47-42
199-H4-2	699-47-50
299-E16-1	699-49-55B
299-E26-8	699-49-57B
299-E33-12	699-50-45
399-5-2	699-50-48
699-S16-E14	699-51-46
699-13-1C	699-52-46A
699-14-E6P	699-52-48
699-24-1P	699-53-50
699-25-80	699-54-57
699-31-84A	699-56-53
699-42-40C	699-84-34B

No reanalysis summaries are provided for test intervals in wells 699-S11-E12A, 699-17-47, 699-32-22B, and 699-42-E9B. See test summary table for comments.

Also included is a list of references and data sources for these tests.

Table A.1. Test Summary Table

Hanford Well Designation	Principal Hydro-geologic Unit	Test Interval (m)	Slug Test Type/Date	Slug Test Stress Level (m-water)	Reported Trans-missivity (m^2/d)	Reanalysis Value (m^2/d)	Constant Discharge Test Time/Date	Discharge Rate (L/min)	Reported Trans-missivity (m^2/d)	Reanalysis Value (m^2/d)	Best Estimate Trans-missivity (m^2/d)	Data Sources	Comments
199-B3-2P	Elephant Mt. Rattlesnake Ridge Interbed	199.6 - 237.1	-	-	-	-	3-hr test; 4/70	60.6	-	(tna)	-	Deju (1974); PNL Files	Hydraulic test results not analyzable; high T indicated
199-H4-2	Rattlesnake Ridge Interbed	109.7 - 118.3	(2) Withdr; 3/93	6.27 6.12	- -	1.7 1.7	2.5-hr constant drawdown test;3/93	12.5 to 6.6	-	0.85 (constant drawdown) 0.73 (recovery)	1.1	PNL Files	Best est. based on average of all tests
299-E16-1	Elephant Mt. Interflow	149.4 - 155.5	Inject;11/82 Withdr;11/82	0.74 0.83	100 52	15 15	49-hr test; 7/82	37.5	46 (drawdown) 109 (recovery)	4.5 (tna)	10	Graham et al. (1984); PNL Files	Best est. based on average of constant discharge drawdown and slug withdrawal
299-E26-8	Rattlesnake Ridge Interbed	100.6 - 121.9	Inject.;11/82 Withdr.;11/82	0.46 0.48	19 17	7 7	48-hr test; 5/82	19.2	3.0 (drawdown) 22 (recovery)	3.7 (tna)	3.7	Graham et al. (1984); PNL Files	Best est. based on constant discharge test drawdown
299-E33-12	Rattlesnake Ridge Interbed	85.3 - 126.5	Inject.;11/82 Withdr.;11/82	0.80 0.84	12 12	12 12	48-hr test;5/82	21.0	2.8 (drawdown) 4.2 (recovery)	3.2 3.6	3.6	Graham et al. (1984); PNL Files	Best est. based on constant discharge test recovery
399-5-2	Composite Upper Saddle Mts. Basalt	59.4 - 129.2	-	-	-	-	23.5-hr test; 2/70 2-hr test; 2/70	11.4 56.8	0.55 (recovery) 0.64 (recovery)	1.6 2.2	1.9	PNL Files	Best est. based on constant discharge test recovery average

Table A.1. (contd)

Hanford Well Designation	Principal Hydro-geologic Unit	Test Interval (m)	Slug Test Type/Date	Slug Test Stress Level (m-water)	Reported Trans-missivity (m^2/d)	Reanalysis Value (m^2/d)	Constant Discharge Test Time/Date	Discharge Rate (L/min)	Reported Trans-missivity (m^2/d)	Reanalysis Value (m^2/d)	Best Estimate Trans-missivity (m^2/d)	Data Sources	Comments
699-S16-E14*	Levey Interbed	83.8 - 104.5	-	-	-	-	24-hr test;1/80 24-hr air-lift test; 1/80	34.8	14 (drawdown) 14 (recovery) 11 (recovery)	16 13 9.8	13	Jackson and Spane (1982); PNL files	Best est. based on average of all tests
699-S16-E14*	Rattlesnake Ridge Interbed	127.1 - 151.2	-	-	-	-	24-hr air-lift test; 1/80 4.5-hr test; 1/80	227.1 35.6	14 (recovery) 17 (recovery)	14 14	14	Jackson and Spane (1982); PNL files	Best est. based on constant discharge test recovery
699-S11-E12A	Levey Interbed	70.1 - 79.1	(3) Withdr.; 3/80	2.91 2.12 0.35	1.2 1.2 1.2	- - -	3-hr constant drawdown test; 3/80 21-hr test;3/80	8.3 to 5.0 3.4	1.4 (drawdown) 1.8 (recovery)	- -	1.8	Spane (1981)	No test data available; analytical results are acceptable
699-13-1C	Composite Upper Saddle Mts. Basalt	154.2 - 211.8	-	-	-	-	29-hr test;7/78 25-hr test;11/78	1703 1041	409 (recovery) 900 (recovery)	7.0 (drawdown) 12 (composite)	-	PNL Files; Gephart et al. (1979)	Test analysis results highly uncertain
699-14-E6P*	Rattlesnake Ridge Interbed	146.3 - 154.5	-	-	-	-	2.3-hr test; 2/70	56.8	61 (recovery)	64	64	Deju (1974); PNL Files	Best est. based on constant discharge test recovery
699-17-47*	Elephant Mt. Interfow	113.4 - 125.3	-	-	-	-	24-hr test (?); 1978	(?)	569	-	569	Gephart et al. (1979)	No test data available; reliability of analytical results uncertain

Table A.1. (contd)

Hanford Well Designation	Principal Hydro-geologic Unit	Test Interval (m)	Slug Test Type/Date	Slug Test Stress Level (m-water)	Reported Trans-missivity (m^2/d)	Reanalysis Value (m^2/d)	Constant Discharge Test Time/Date	Discharge Rate (L/min)	Reported Trans-missivity (m^2/d)	Reanalysis Value (m^2/d)	Best Estimate Trans-missivity (m^2/d)	Data Sources	Comments
699-17-47*	Rattlesnake Ridge Interbed	140.8 - 165.8	-	-	-	-	24-hr test (?); 1978	(?)	28	-	28	Gephart et al. (1979)	No test data available; reliability of analytical results uncertain
699-24-1P	Ringold Formation/ Elephant Mt. Basalt	132.6 - 163.7	-	-	-	-	5.2-hr test;3/70	30.3	8.1 (recovery)	8.1	8.1	Deju (1974); PNL Files	Test interval includes overlying Ringold Formation
699-25-80*	Rattlesnake Ridge Interbed	64.0 - 87.8	-	-	-	-	44.8-hr test; 9/78	37.1	0.82 (drawdown) 1.1 (recovery)	0.43 0.37	0.40	Spane et al. (1980)	Best est. based on constant discharge test average
699-31-84A*	Rattlesnake Ridge Interbed	203.6 - 254.5	-	-	-	-	24-hr test; 9/81	31.5	138 (drawdown) 208 (recovery)	62 67	65	Strait and Bruce (1981); PNL Files	Best est. based on constant discharge test average
699-32-22B	Elephant Mt. Interflow	232.0 - 256.0	Inject.;5/91 Withdr.;5/91	0.45 0.39	1.4 1.4	-	10-hr test;6/91	50.7	3.2 (drawdown) 4.7 (recovery)	-	4.7	Spane (1992)	Previously reported values are acceptable
699-42-E9B	Elephant Mt. Interflow	70.7 - 86.9	Withdr;3/91	0.42	102	-	17.5-hr test;3/91	158.2	64	-	64	Spane (1992)	Previously reported values are acceptable
699-42-E9B	Elephant Mt./ Pomona Flow Contact	107.9 - 118.6	-	-	-	-	11-hr test;4/91	147.8	28 (drawdown) 34 (recovery)	-	28	Spane (1992)	Previously reported values are acceptable

Table A.1. (contd)

Hanford Well Designation	Principal Hydro-geologic Unit	Test Interval (m)	Slug Test Type/Date	Slug Test Stress Level (m-water)	Reported Trans-missivity (m^2/d)	Reanalysis Value (m^2/d)	Constant Discharge Test Time/Date	Discharge Rate (L/min)	Reported Trans-missivity (m^2/d)	Reanalysis Value (m^2/d)	Best Estimate Trans-missivity (m^2/d)	Data Sources	Comments
699-42-40C	Elephant Mt. Interflow	?	-	-	-	-	22.9-hr test; 4/82	7.1	0.7 (drawdown)	0.9	0.9	Graham et al. (1984); PNL Files	Best est. based on constant discharge test drawdown
699-42-40C	Rattlesnake Ridge Interbed	96.6 - 118.9	Inject.;10/82 Withdr.;10/82	0.39 0.49	85 87	(tna) 45	24-hr test;11/82	28.0	28 (drawdown) 16 (recovery)	40 30	40	Graham et al. (1984); PNL Files	Best est. based on constant discharge test drawdown
699-47-42*	Rattlesnake Ridge Interbed	45.7 - 67.7	-	-	-	-	12.7-hr air-lift test; 4/79 4.5-hr test; 4/79	86.7 32.3	44 (recovery) 46 (drawdown)	25 30	28	Strait and Brown (1983); PNL Files	Best est. based on average for both tests
699-47-50	Rattlesnake Ridge Interbed	79.2 - 89.9	Inject.;11/82 Withdr.;11/82	0.79 0.83	33 31	(tna) 11	12-hr test;6/80	21.5	43 (drawdown) 93 (recovery)	23 (tna)	23	Strait and Moore (1982); Graham et al. (1984)	Best est. based on constant discharge test drawdown
699-49-55B	Rattlesnake Ridge Interbed	53.3 - 68.9	Inject.;11/82 Withdr.;11/82	0.31 0.45	182 106	(tna) 110	46-hr test;5/82	115.8	70 (drawdown) 73 (recovery)	61 72	72	Graham et al. (1984); PNL Files	Best est. based on constant discharge test recovery
699-49-57B	Rattlesnake Ridge Interbed	63.7 - 68.4	-	-	-	-	3.4-hr test;1/92	44.7	14	14	14	Swanson (1992)	Best est. based on constant discharge test drawdown

Table A.1. (contd)

Hanford Well Designation	Principal Hydro-geologic Unit	Test Interval (m)	Slug Test Type/Date	Slug Test Stress Level (m-water)	Reported Trans-missivity (m^2/d)	Reanalysis Value (m^2/d)	Constant Discharge Test Time/Date	Discharge Rate (L/min)	Reported Trans-missivity (m^2/d)	Reanalysis Value (m^2/d)	Best Estimate Trans-missivity (m^2/d)	Data Sources	Comments
699-50-45	Rattlesnake Ridge Interbed	40.5 - 54.3	Inject.;11/82 Withdr.;11/82	0.80 0.81	5 5	4.8 6.0	21-hr test;5/80	32.0	12 (drawdown) 16 (recovery)	16 15	16	Strait and Moore (1982); Graham et al. (1984)	Best est. based on constant discharge test drawdown
699-50-48B	Rattlesnake Ridge Interbed	64.9 - 76.2	Inject.;11/82 Withdr.;11/82	0.77 0.84	18 11	(tna) 30	18.5-hr test;6/80	26.3	34 (drawdown) 26 (recovery)	21 (tna)	21	Strait and Moore (1982); Graham et al. (1984)	Best est. based on constant discharge test
699-51-46	Rattlesnake Ridge Interbed	36.6 - 51.2	Inject.;11/82 Withdr.;11/82	0.47 0.49	2.0 0.3	0.9 (tna)	21-hr test;5/80	10.2	30 (drawdown) 10 (recovery)	3.1 (tna)	3.1	Strait and Moore (1982); Graham et al. (1984)	Best est. based on constant discharge test drawdown
699-52-46A	Rattlesnake Ridge Interbed	53.3 - 68.6	Inject.;11/82 Withdr.;11/82	0.39 0.43	21 18	19 28	20.7-hr test;5/80	178.3	17 (drawdown) 13 (recovery)	18 16	20	Strait and Moore (1982); Graham et al. (1984)	Best est. based on average of all tests
699-52-48	Rattlesnake Ridge Interbed	45.4 - 59.4	Inject.;11/82 Withdr.;11/82	0.44 0.40	11 5.1	7.0 9.0	14-hr test;4/80	30.5	3.5 (drawdown) 3.4 (recovery)	3.5 3.3	3.4	Strait and Moore (1982); Graham et al. (1984)	Best est. based on constant discharge test results
699-53-50	Rattlesnake Ridge Interbed	44.2 - 59.1	Inject.;11/82 Withdr.;11/82	0.44 0.49	74 85	30 32	18.7-hr test;4/80	26.1	50 (drawdown) 60 (recovery)	50 (tna)	50	Strait and Moore (1982); Graham et al. (1984)	Best est. based on constant discharge test drawdown

Table A.1. (contd)

Hanford Well Designation	Principal Hydro-geologic Unit	Test Interval (m)	Slug Test Type/Date	Slug Test Stress Level (m-water)	Reported Trans-missivity (m^2/d)	Reanalysis Value (m^2/d)	Constant Discharge Test Time/Date	Discharge Rate (L/min)	Reported Trans-missivity (m^2/d)	Reanalysis Value (m^2/d)	Best Estimate Trans-missivity (m^2/d)	Data Sources	Comments
699-54-57	Rattlesnake Ridge Interbed	74.7 - 97.8	Inject.;11/82 Withdr.;11/82	0.72 0.80	19 12	(tna) 12	48-hr test;5/82	36.9	12 (drawdown) 13 (recovery)	12 12	12	Graham et al. (1984); PNL Files	Best est. based on constant discharge test average
699-56-53	Rattlesnake Ridge Interbed	61.0 - 82.3	Inject.;11/82 Withdr.;11/82	0.44 0.49	36 27	25 27	37.3-hr test;6/82	98.0	85 (drawdown) 64 (recovery)	(tna) 28	27	Graham et al. (1984); PNL Files	Best est. based on average of all test
699-84-34B*	Elephant Mt. Interflow	112.5 - 144.8	-	-	-	-	3-hr test; 1/80 5.7-hr test; 1/80	30.3 28.2	0.39 (recovery) 0.32 (drawdown) 0.52 (recovery)	0.40 0.32 0.45	0.39	Strait (1980); PNL Files	Best est. based on constant discharge test average
699-84-34B*	Rattlesnake Ridge Interbed	144.8 - 164.0	-	-	-	-	21-hr test; 1/80 3.5-hr test; 1/80	42.0 7.8	1.9 (recovery) 1.8 (drawdown) 1.5 (recovery)	2.0 (tna) (tna)	2.0	Strait (1980); PNL Files	Short duration constant discharge test not analyzable

*** Test well abandoned or recompleted in another hydrogeologic unit.**
(tna) Test not analyzable.

Well/Borehole : 199-B3-2P	Test Interval Depth : 199.6 m to 237.1 m
Hydrologic Unit : Rattlesnake Ridge Interbed	Test Date(s) : 4/7/70
Reference Document(s) : Deju (1974) - ARH-C-4; PNL Files	

Test Description:

Hydrologic testing for this well test site was limited to a recovery test following a constant-rate air-lift pumping test. The following is a brief description of the testing activities.

CRDT-DD — A constant-rate discharge air-lift test was conducted for a duration of 180 min. Discharge rates during the first 70 min of the test ranged between 53.0 and 60.6 L/min. After 70 min into the test, the discharge rate remained constant at 60.6 L/min for the remainder of the test. No pressure drawdown readings were recorded during the active air-lift pumping test phase.

CRDT-RCV — Recovery following termination of the constant-rate air-lift test was monitored routinely for 188 min. Diagnostic derivative analysis indicated that wellbore storage effects were dominant during the monitored recovery period. Because radial flow conditions were not established during the test, analysis of the recovery test data was not valid for hydraulic property determination.

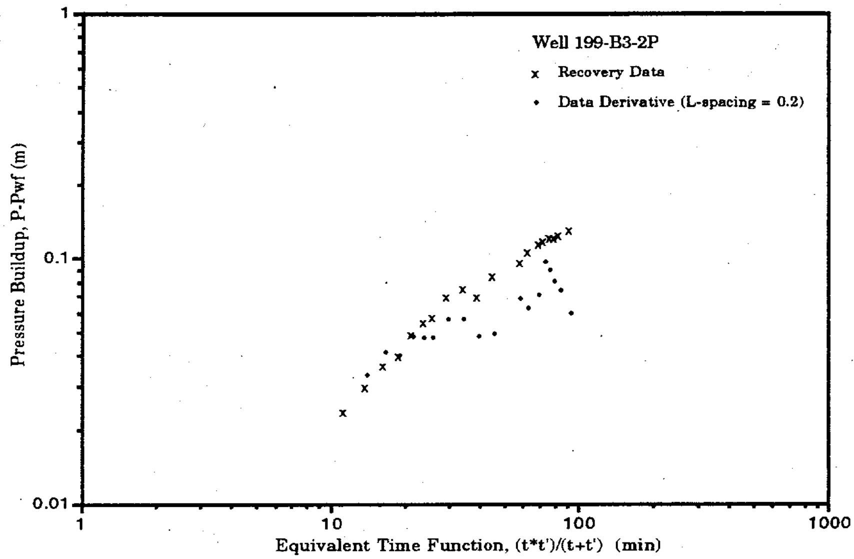
Comments:
Because of the dominant wellbore storage effects during the test, analysis of the recovery data is not possible for determination of hydraulic properties. However, as noted in Deju (1974), the transmissivity is likely high.

Test Interval Specifications:

Effective Thickness : 2.7 m   Wellbore Radius : 0.102 m   Casing Radius : 0.019 m

Test Results:

Test data are not analyzable for hydraulic property determination.



Well 199-B3-2P
x Recovery Data
• Data Derivative (L-spacing = 0.2)
Pressure Buildup, P-Pwf (m)
Equivalent Time Function, (t*t')/(t+t') (min)
1
0.1
0.01
1
10
100
1000

CRDT-RCV

Well/Borehole : 199-H4-2	Test Interval Depth : 109.7 m to 118.3 m
Hydrologic Unit : Rattlesnake Ridge Interbed	Test Date(s) : 3/18/93
Reference Document(s) : PNL Files	

Test Description:

Hydrologic tests conducted in this interval included a constant-head drawdown and recovery test and two slug withdrawal tests. Testing was conducted following well recompletion activities during March 1993. The test interval was under artesian flowing conditions, which facilitated performance of the constant-head drawdown test. The following is a brief description of the testing activities.

CHT-DD A constant-head drawdown test was conducted for a duration of 153 min. Flow rates after the first 20 sec into the test ranged between 12.5 and 6.6 L/min and averaged 6.85 L/min. Diagnostic derivative analysis indicated either leaky confined aquifer conditions or the presence of a recharge boundary occurring after approximately 8 min into the test. Straight-line analysis (Jacob and Lohman 1952) of the early-time data not exhibiting leakage effects yielded a transmissivity of 0.85 m^2/d.

CHT-RCV Recovery following termination of the constant-rate discharge test was monitored for a duration of 1152 min. Diagnostic derivative analysis of the recovery data corroborate the findings of the drawdown analysis, indicating either leaky confined aquifer conditions or occurrence of a recharge boundary. Straight-line analysis of the recovery response using a leaky confined aquifer model (Hantush and Jacob 1955 r/B solution method) gave nearly identical results as determined for the constant-drawdown analysis, T = 0.73 m^2/d.

SWT Two slug withdrawal tests were conducted by installing a 7-m-long, 0.0127-m radius standpipe on the surface wellhead. The tests were initiated by rapidly opening the surface valve and allowing the pressurized water within the well to flow into the surface standpipe. Diagnostic analysis of the slug test response indicated nonleaky conditions for the majority of the test period. Combined type-curve and derivative analysis (Ostrowski and Kloska 1989) of both tests provided identical transmissivity estimate values of 1.7 m^2/d.

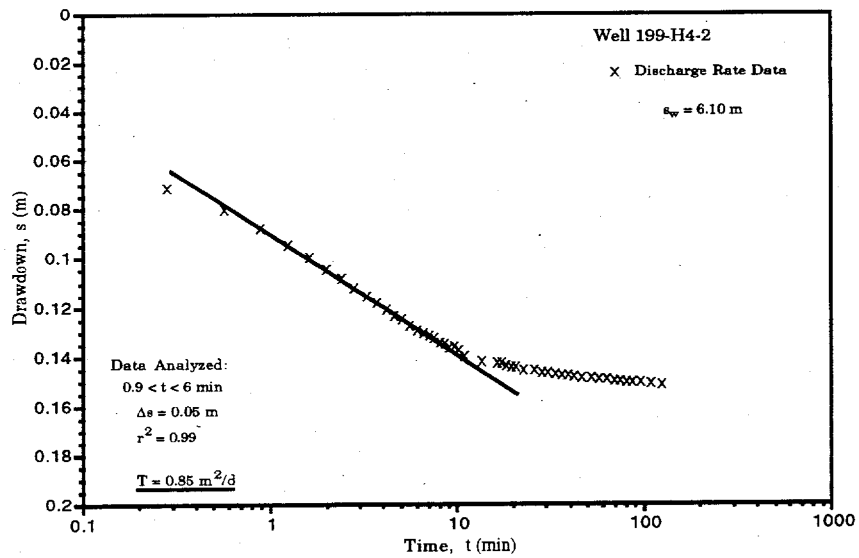
Comments:

The reported hydrologic tests were conducted following recompletion of the well during March 1993. The well was recompleted because of previous reports of possible well communication with the overlying unconfined aquifer. The best value for transmissivity of 1.1 m^2/d represents the average of the constant-head drawdown and recovery and slug withdrawal test analysis results.

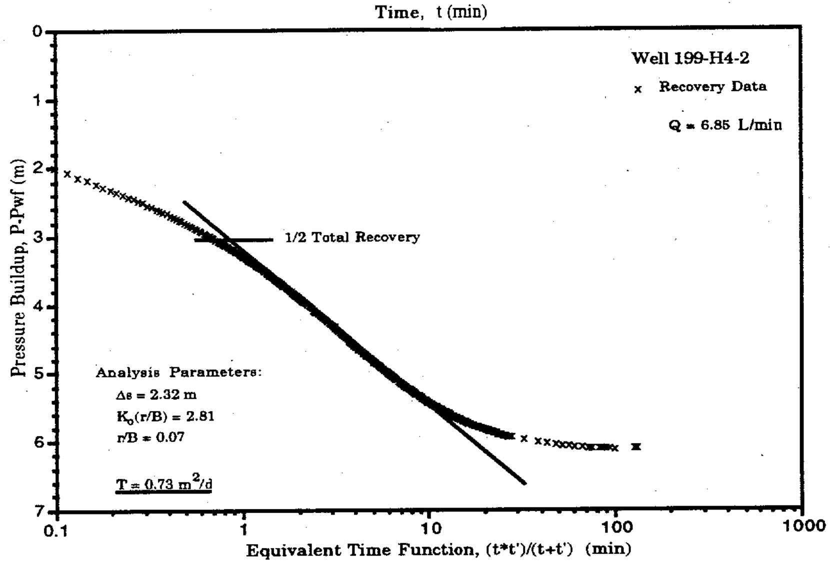
Test Interval Specifications:

Effective Thickness : 3.3 m Wellbore Radius : 0.076 m Casing Radius : 0.254 m

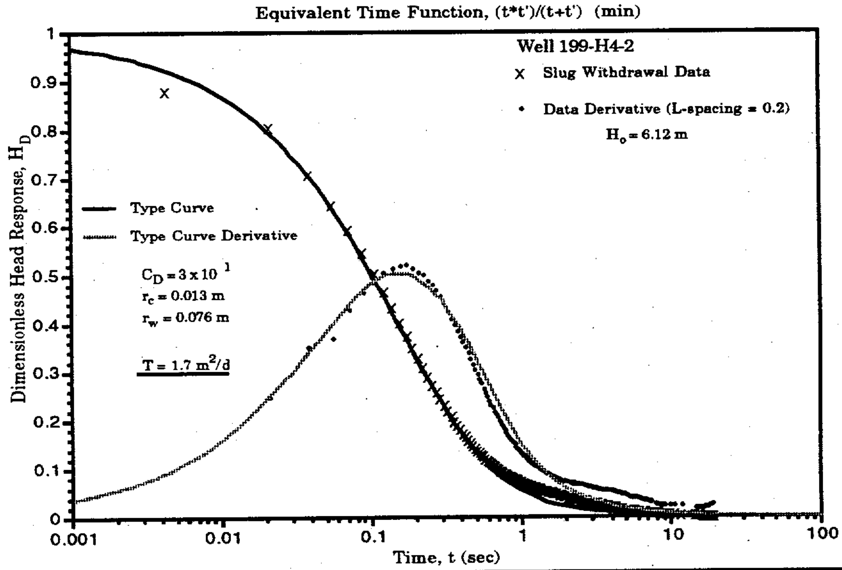
Test Results:		Reanalysis
Transmissivity		Range : 0.73 - 1.7 m^2/d Best Estimate : 1.1 m^2/d



CHT-DD



CHT-RCV



SWT

Well/Borehole : 299-E16-1	Test Interval Depth : 149.4 m to 155.5 m
Hydrologic Unit : Elephant Mt. Interflow	Test Date(s) : 7/12-13/82; 11/30/82

Reference Document(s) : Graham et al. (1984) - RHO-RE-ST-12P; PNL Files

Test Description:
Hydrologic tests conducted in this interval included a constant-rate discharge drawdown and recovery test. The following is a brief description of the testing activities.

CRDT-DD — A constant-rate discharge test was conducted for a duration of 2930 min at an average flow rate of 37.5 L/min. Diagnostic analysis indicates either leaky confined aquifer conditions or the presence of a recharge boundary occurring after approximately 30 min into the test. Reanalysis results, using a leaky confined aquifer type-curve model (Hantush and Jacob 1955 r/B solution method), indicate a transmissivity of 4.5 m^2/d.

CRDT-RCV — Recovery following termination of the constant-rate test was monitored for a duration of 196 min. Diagnostic analysis of the recovery data generally corroborates the findings of the drawdown analysis.

SIT — A slug injection test was initiated by rapidly submerging a slugging rod of known volume (0.0132 m^3) within the well column, which resulted in an observed stress level of 0.735 m. Diagnostic analysis of the slug test indicates that the presence of the slugging rod may have adversely affected the observed response.

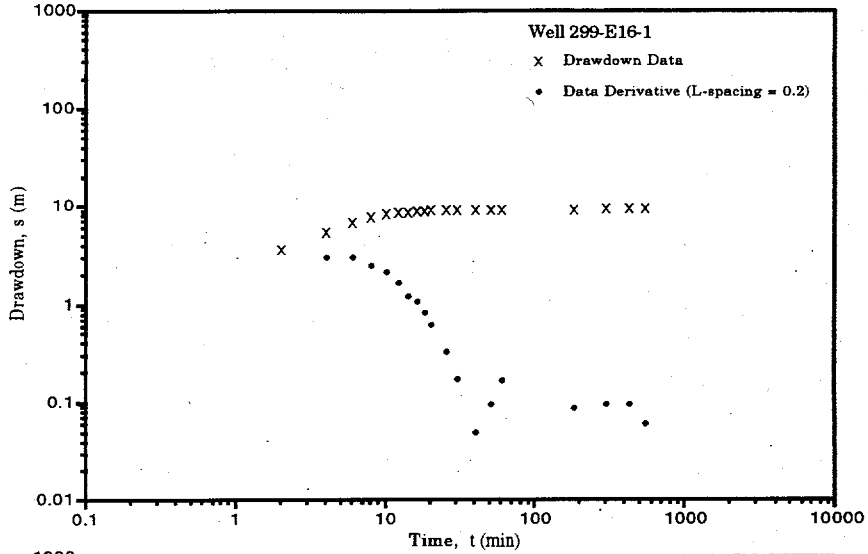
SWT — A slug withdrawal test was conducted by withdrawing a slugging rod of known volume, resulting in an observed stress level of 0.8363 m. Diagnostic analysis indicates that because of the shorter test duration, the slug test response did not exhibit effects of leakage, which were prevalent during the constant-rate test late-time data. Combined type-curve and derivative analysis (Ostrowski and Kloska 1989) of the slug test response resulted in a transmissivity estimate of 15 m^2/d.

Comments:
Reanalysis of the hydrologic test response data discussed above provides significantly lower results when compared with previously reported transmissivity values in Graham et al. (1984). The previously reported analytical results, however, were based on analysis of data (i.e., for the constant-rate test) that were affected by leakage effects previously noted. The best value for transmissivity of 10 m^2/d represents the average of the constant-rate discharge drawdown and slug withdrawal reanalysis results.

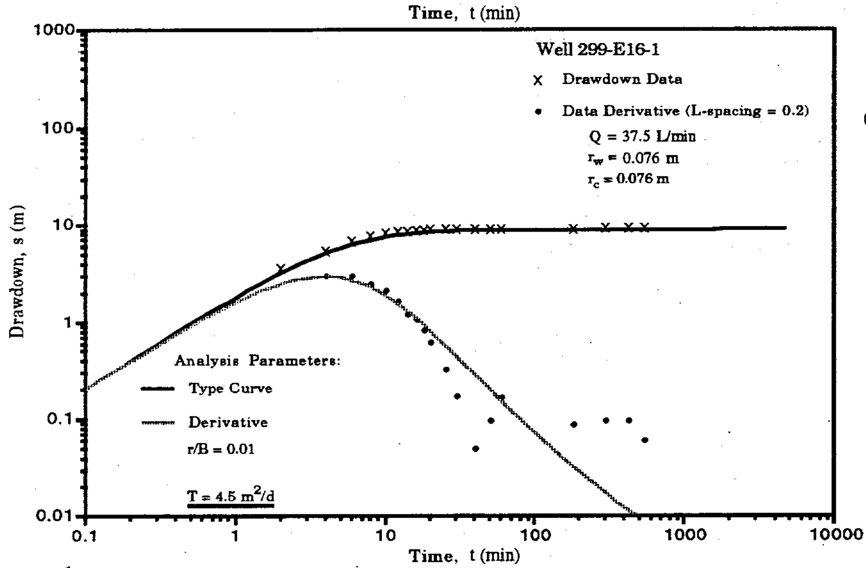
Test Interval Specifications:

Effective Thickness : 6.1 m   Wellbore Radius : 0.076 m   Casing Radius : 0.076 m

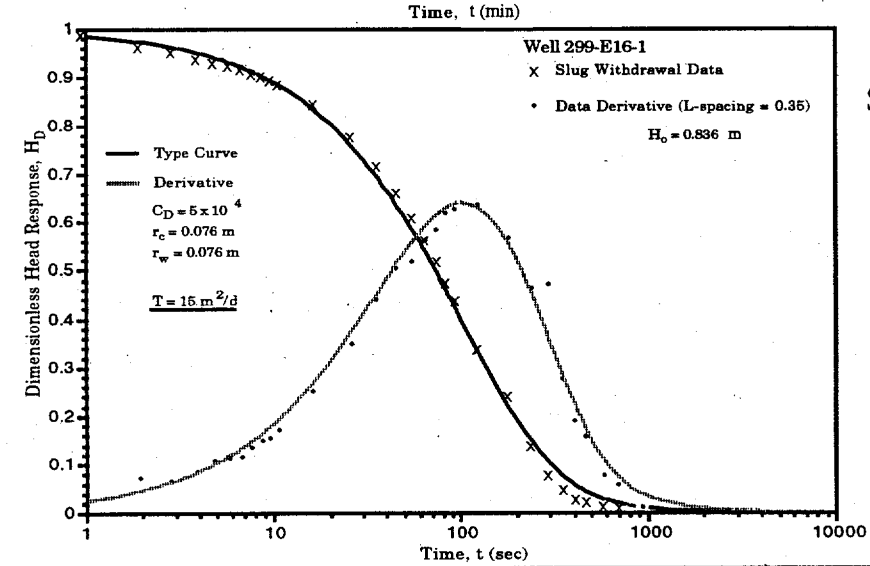
Test Results:	Previous Analysis	Reanalysis
Transmissivity	Range : 46 - 109 m^2/d (Graham et al. 1984)	Range : 4.5 - 15 m^2/d Best Estimate : 10 m^2/d



CRDT-DD



CRDT-DD



SWT

Well/Borehole : 299-E26-8	Test Interval Depth : 100.6 m to 121.9 m
Hydrologic Unit : Rattlesnake Ridge Interbed	Test Date(s) : 5/17-19/82; 11/9/82

Reference Document(s) : Graham et al. (1984) - RHO-RE-ST-12P; PNL Files

Test Description:

Hydrologic tests conducted in this interval included a constant-rate discharge drawdown and recovery test and a slug injection and withdrawal test. The following is a brief description of testing activities.

CRDT-DD A constant-rate discharge test was conducted for a duration of 48 hr at an average flow rate of 19.2 L/min. There were difficulties maintaining a constant flow rate, and test logs indicated a potential for significant barometric pressure variation. Diagnostic analysis indicates a decrease in flow rate and/or vertical leakage after 1000 min into the test. Straight-line analysis (Cooper and Jacob 1946) of drawdown data for the time period 140 to 1000 min resulted in a transmissivity estimate of 3.7 m^2/d.

CRDT-RCV Recovery response was monitored for a duration of 760 min following termination of pumping. Recovery response was affected by drainage from the pump column; data were not used in the analysis.

SIT A slug injection test was conducted by injecting a slug of known volume, resulting in a stress level (H_o) of 0.459 m. The slug test exhibited an oversteepened response, resulting from problems during injection of the slug rod.

SWT A slug withdrawal test was conducted by withdrawing a slug of known volume, resulting in a stress level (H_o) of 0.482 m. Combined type-curve and derivative analysis (Ostrowski and Kloska 1989) resulted in a transmissivity estimate of 7.0 m^2/d. The slug test derivative pattern suggests the presence of wellbore damage (skin effects).

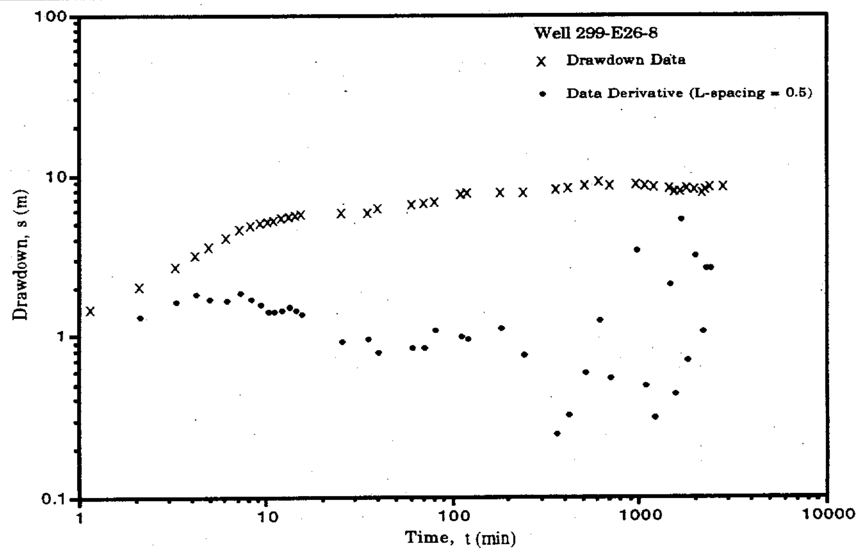
Comments:

Reanalysis of the hydrologic test response data discussed above provides comparable results with previously reported values (i.e., Graham et al. 1984). The reanalysis best estimate is based on the constant-rate discharge drawdown data. The reanalyses are considered an improvement over those cited in the reference document; the original analysis made an erroneous type-curve match for both the slug injection and slug withdrawal tests and reported results for the constant-rate discharge recovery response; recovery response was affected by drainage from the pump column

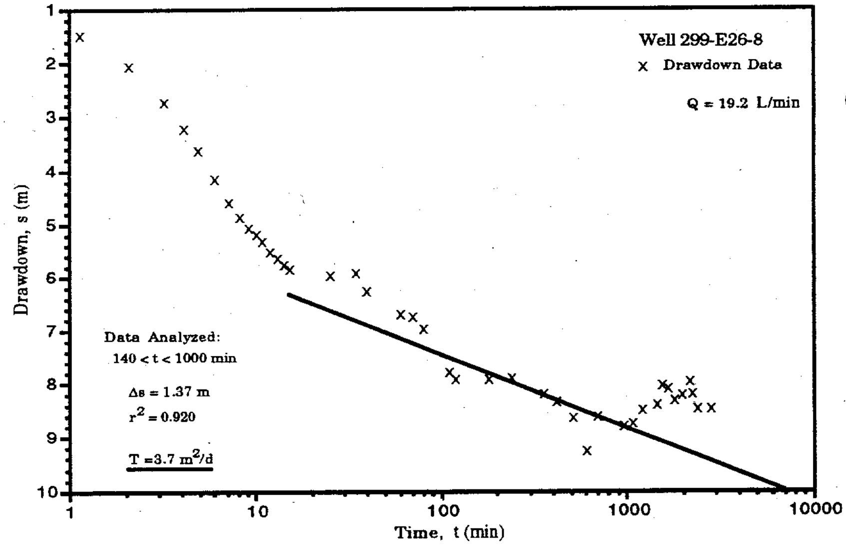
Test Interval Specifications:

Effective Thickness : 16.8 m Wellbore Radius : 0.114 m Casing Radius : 0.102 m

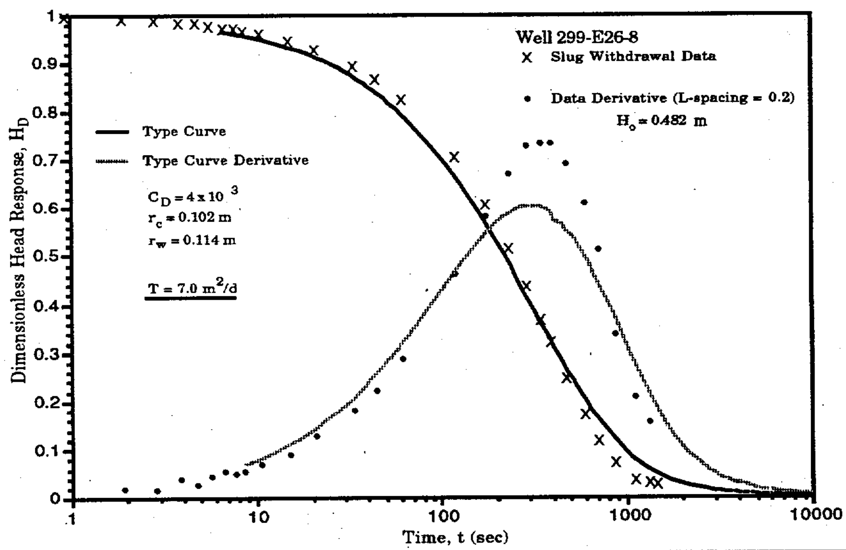
Test Results:	Previous Analysis	Reanalysis
Transmissivity	Range : 3 - 22 m^2/d (Graham et al. 1984)	Range : 3.7 - 7.0 m^2/d Best Estimate : 3.7 m^2/d



CRDT-DD



CRDT-DD



SWT

Well/Borehole : 299-E33-12	Test Interval Depth : 85.3 m to 126.5 m
Hydrologic Unit : Rattlesnake Ridge Interbed	Test Date(s) : 5/20-23/82; 11/11/82
Reference Document(s) : Graham et al. (1984) - RHO-RE-ST-12P; PNL Files	

Test Description:
Hydrologic tests conducted in this interval included a constant-rate discharge drawdown and recovery test and a slug injection and withdrawal test. The following is a brief description of testing activities.

CRDT-DD — A constant-rate discharge test was conducted for a duration of 48 hr at an average flow rate of 21.0 L/min. Diagnostic analysis indicates a decrease in flow rate and/or vertical leakage. Straight-line analysis of drawdown data for the time period 10 to 350 min yielded a transmissivity estimate of 3.2 m^2/d.

CRDT-RCV — Recovery response was monitored for a duration of 760 min following termination of pumping. Straight-line analysis (Theis 1935) of the recovery data for times greater than 35 min after termination of pumping resulted in a transmissivity estimate of 3.6 m^2/d.

SIT — A slug injection test was conducted by injecting a slug of known volume, resulting in a stress level (H_o) of 0.796 m. Combined type-curve and derivative analysis (Ostrowski and Kloska 1989) yielded a transmissivity estimate of 12 m^2/d.

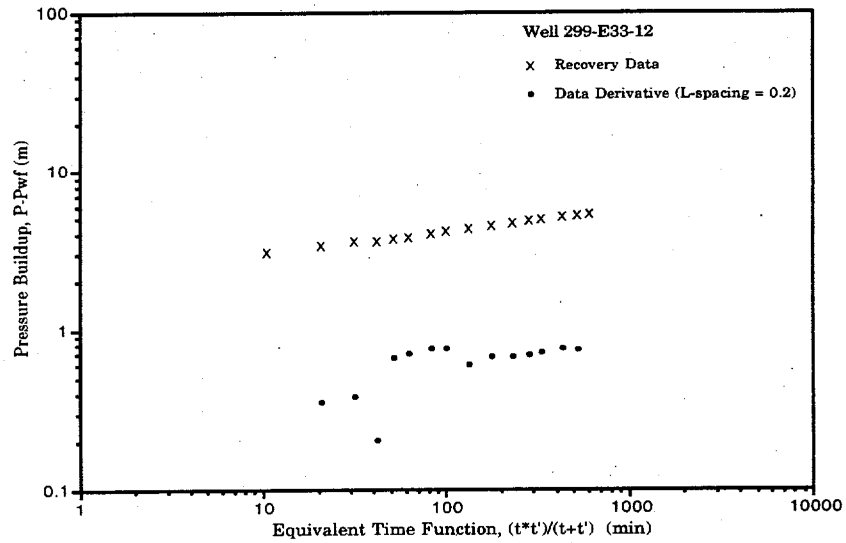
SWT — A slug withdrawal test was conducted by withdrawing a slug of known volume, resulting in an H_o of 0.838 m. Combined type-curve and derivative analysis (Ostrowski and Kloska 1989) provided a transmissivity estimate of 12 m^2/d.

Comments:
Reanalysis of the hydrologic test response data discussed above provides comparable results with previously reported values (i.e., Graham et al. 1984). The reanalysis best estimate is based on the constant-rate discharge recovery data.

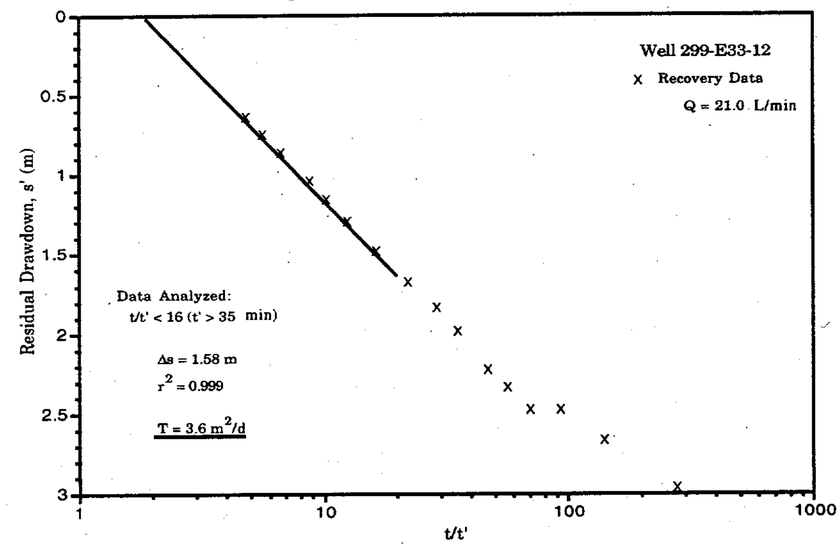
Test Interval Specifications:

Effective Thickness : 20.1 m   Wellbore Radius : 0.076 m   Casing Radius : 0.076 m

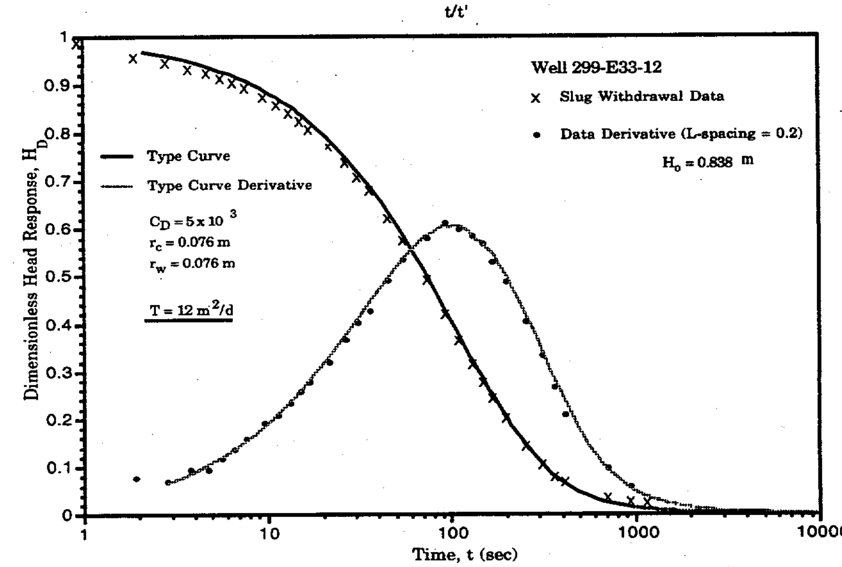
Test Results:	Previous Analysis	Reanalysis
Transmissivity	Range : 3 - 12 m^2/d (Graham et al. 1984)	Range : 3.2 - 12 m^2/d Best Estimate : 3.6 m^2/d



CRDT-RCV



CRDT-RCV



SWT

Well/Borehole : 399-5-2	Test Interval Depth : 59.4 m to 129.2 m
Hydrologic Unit : Composite Upper Saddle Mountains Basalt	Test Date(s) : 2/16-17/70; 2/19/70
Reference Document(s) : PNL Files	

Test Description:
Hydrologic tests conducted in this interval included two constant-rate discharge drawdown and recovery tests. The following is a brief description of the testing activities.

CRDT-DD1 A constant-rate discharge test was conducted for a duration of 1417 min at an average flow rate of 11.4 L/min. Diagnostic analysis indicates leaky confined aquifer conditions as well as borehole development during the test. No quantitative analysis was performed.

CRDT-RCV1 Recovery following termination of the constant-rate test was monitored for a duration of 238 min. Diagnostic analysis of the recovery data indicated leaky confined aquifer conditions. Reanalysis results, using a leaky confined aquifer type-curve model (Hantush and Jacob 1955 r/B solution method), indicate a transmissivity of 1.6 m^2/d.

CRDT-DD2 A constant-rate discharge test was conducted for a duration of 126 min at an average flow rate of 56.8 L/min. Diagnostic analysis indicates either leaky confined aquifer conditions and possible well development during the test.

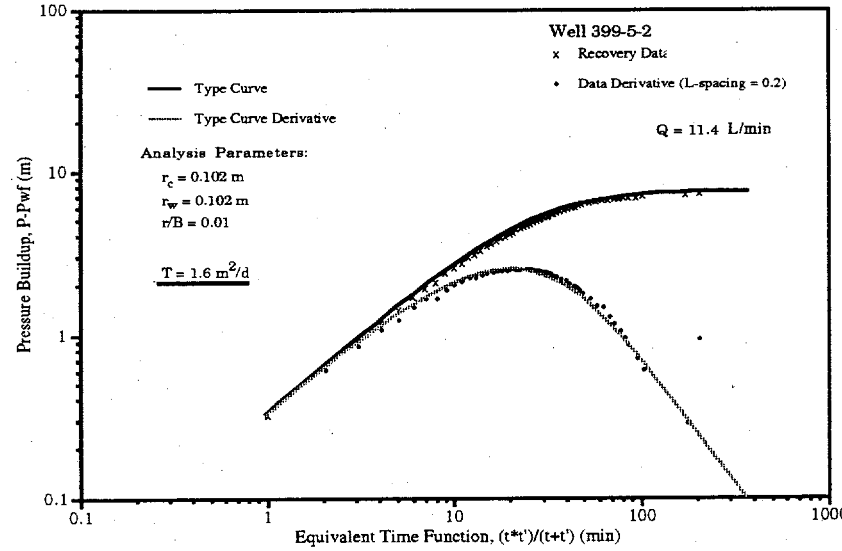
CRDT-RCV2 Recovery following termination of the constant-rate test was monitored for a duration of 217 min. Diagnostic derivative analysis of the recovery data indicated leaky confined aquifer conditions. Reanalysis results, using a leaky confined aquifer type-curve model (Hantush and Jacob 1955 r/B solution method), indicate a transmissivity of 2.2 m^2/d.

Comments:
Reanalysis of the hydrologic test response data discussed above provides slightly higher estimates for transmissivity than previously reported values in PNL files. Although similar in value, the reanalysis results are considered to be an improvement over the previously reported values because of the original analysis dependence on a nonleaky confined aquifer model for test response description. The reanalysis best estimate represents the average of test results obtained from the constant-rate discharge recovery analyses. Because of the composite test interval/well completion conditions, property estimates obtained from the test analyses cannot be assigned to a specific hydrogeologic unit within the upper basalt confined aquifer.

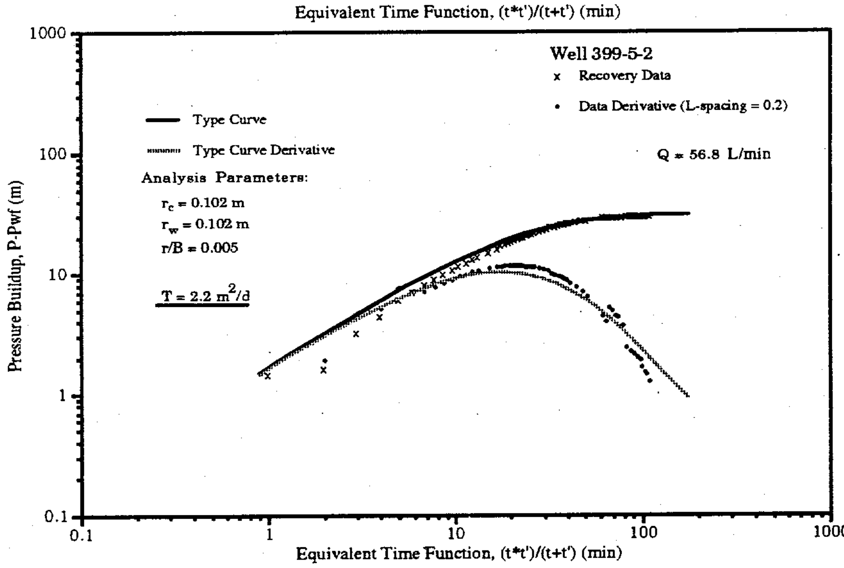
Test Interval Specifications:

Effective Thickness : 69.8 m Wellbore Radius : 0.102 m Casing Radius : 0.102 m

Test Results:	Previous Analysis	Reanalysis
Transmissivity	Range : 0.55 - 0.64 m^2/d (PNL Files)	Range : 1.6 - 2.2 m^2/d Best Estimate : 1.9 m^2/d



CRDT-RCV1



CRDT-RCV2

Well/Borehole : 699-S16-E14 (DC-15)	Test Interval Depth : 83.8 m to 104.5 m
Hydrologic Unit : Levey Interbed	Test Date(s) : 12/28/79 - 1/8/80
Reference Document(s) : Jackson and Spane (1982) in PNL Files	

Test Description:
Hydrologic tests conducted in this interval included one constant-rate discharge drawdown test and two recovery tests. The following is a brief description of the testing activities.

CRDT-DD A constant-rate discharge test was conducted with a submersible pump for a duration of 24 hr at an average flow rate of 34.8 L/min. There were difficulties maintaining a constant flow rate throughout the test. Straight-line analysis (Cooper and Jacob 1946) of drawdown data for times greater than 80 min resulted in a transmissivity estimate of 16 m^2/d.

CRDT-RCV Recovery response was monitored for a duration of 24 hr following termination of pumping. Late-time recovery data were affected by an unknown external stress. Straight-line analysis (Theis 1935) of the recovery data for times of 200 to 700 min after termination of pumping yielded a transmissivity estimate of 13 m^2/d.

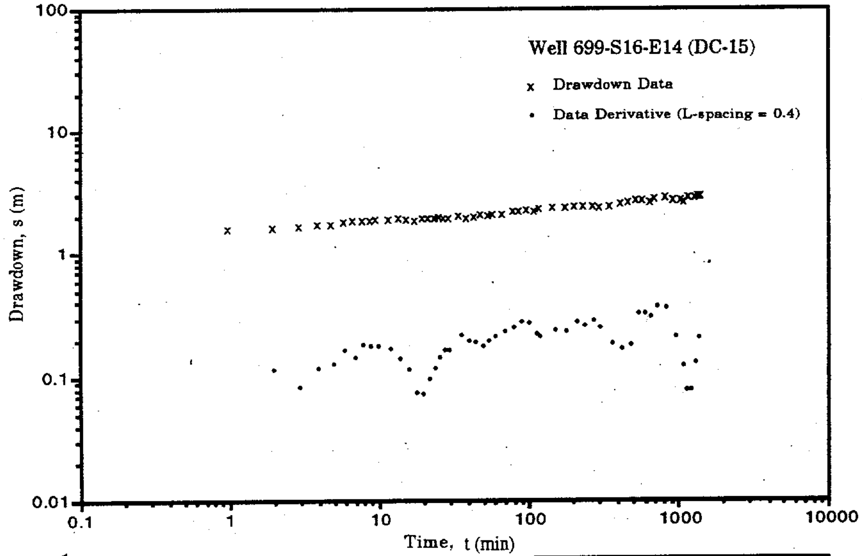
CRAT-RCV A constant-rate discharge air-lift test was conducted for a duration of 24 hr at an average flow rate of 208 L/min. Recovery response was monitored for a duration of 135 hr following termination of pumping. Straight-line analysis (Theis 1935) of the recovery data for times greater than 700 min after termination of pumping resulted in a transmissivity estimate of 9.8 m^2/d.

Comments:
Reanalysis of the hydrologic test response data discussed above provides comparable results with previously reported values (i.e., Jackson and Spane 1982 in PNL files). Analysis of the constant discharge air-lift recovery and submersible drawdown and recovery response provides comparable results; the reanalysis best estimate is based on the average estimated transmissivity.

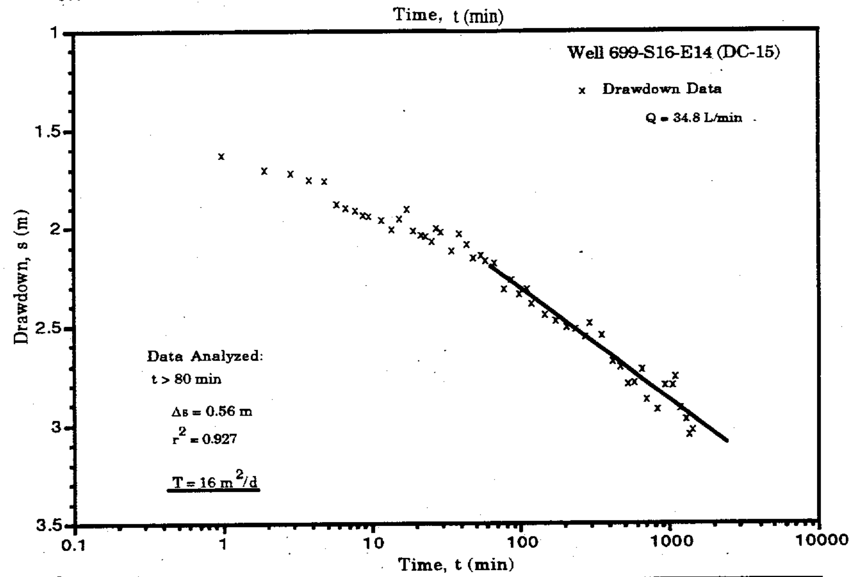
Test Interval Specifications:

Effective Thickness : 8.2 m Wellbore Radius : 0.044 m Casing Radius : 0.044 m

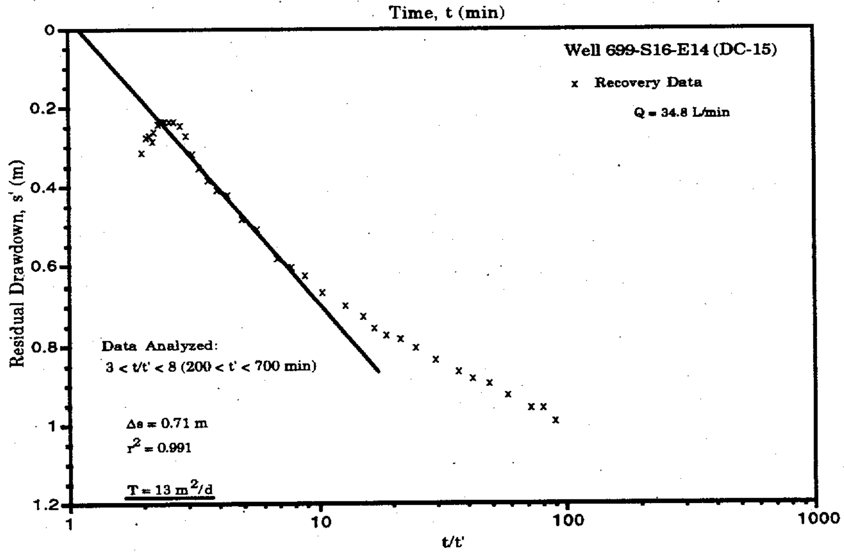
Test Results:	Previous Analysis	Reanalysis
Transmissivity	Range : 11 - 14 m^2/d (Jackson and Spane 1982 in PNL files)	Range : 9.8 - 16 m^2/d Best Estimate : 13 m^2/d



CRDT-DD



CRDT-DD



CRDT-RCV

Well/Borehole : 699-S16-E14 (DC-15)	Test Interval Depth : 127.1 m to 151.2 m
Hydrologic Unit : Rattlesnake Ridge Interbed	Test Date(s) : 1/20-22/80
Reference Document(s) : Jackson and Spane (1982) in PNL Files	

Test Description:
Hydrologic tests conducted in this interval included two constant-rate discharge recovery tests. Drawdown data were not available. Three slug injection and withdrawal tests were also conducted. Sufficient data, however, were not available for quantitative slug test analysis. The following is a brief description of the constant-rate testing activities.

CRAT-RCV A constant-rate discharge air-lift test was conducted for a duration of 24 hr at an average flow rate of 227 L/min. Recovery response was monitored for a duration of 28 hr following termination of pumping. Straight-line analysis (Theis 1935) of the recovery data for times greater than 300 min after termination of pumping resulted in a transmissivity estimate of 14 m^2/d.

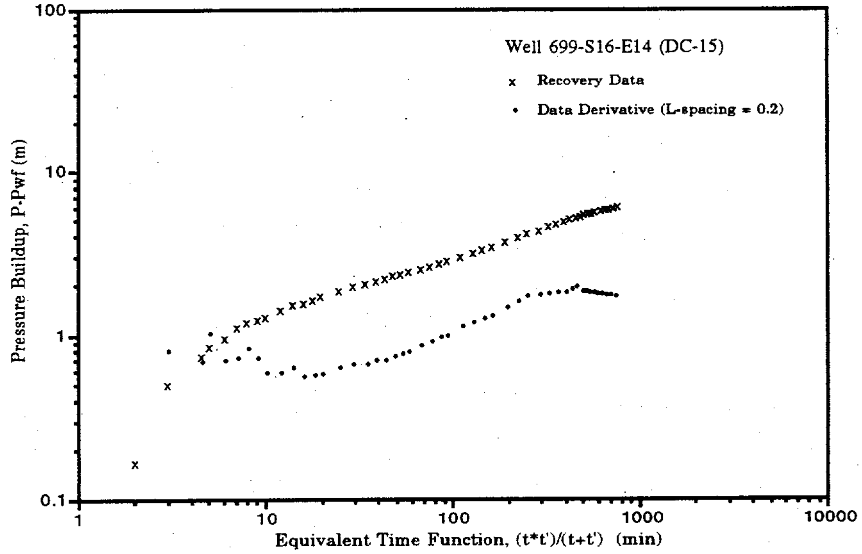
CRDT-RCV A constant-rate discharge test was conducted with a submersible pump for a duration of 4.5 hr at an average flow rate of 35.6 L/min. Recovery response was monitored for a duration of 90 min following termination of pumping. Collection of recovery data was terminated before the system had fully recovered. Straight-line analysis (Theis 1935) of the recovery data for times greater than 80 min after termination of pumping, which consisted of the last two data points, resulted in a transmissivity estimate of 14 m^2/d

Comments:
Reanalysis of the hydrologic test response data discussed above provides comparable results with previously reported values (i.e., Jackson and Spane 1982 in PNL files). Analysis of the constant-rate discharge air-lift and submersible recovery response provides comparable results; the reanalysis best estimate is based on the average estimated transmissivity.

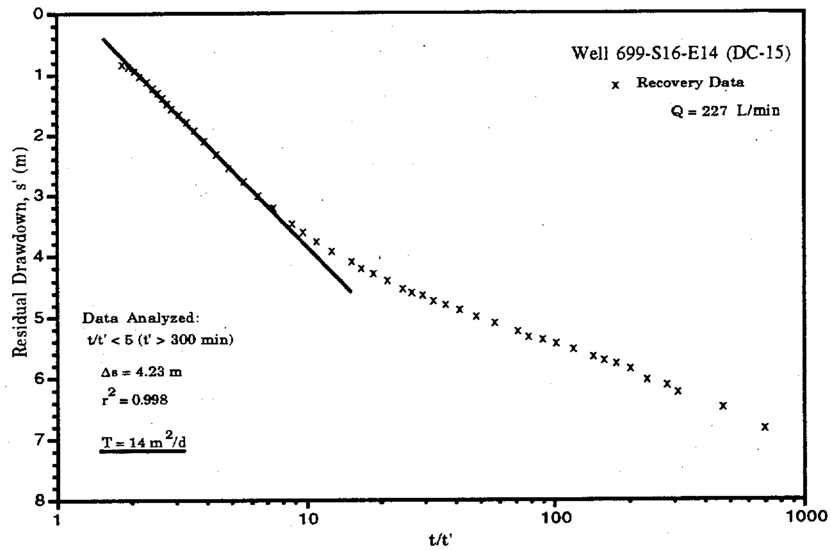
Test Interval Specifications:

Effective Thickness : 6.5 m Wellbore Radius : 0.044 m Casing Radius : 0.044 m

Test Results:	Previous Analysis	Reanalysis
Transmissivity	Range : 14 - 17 m^2/d (Jackson and Spane 1982 in PNL files)	Range : 14 m^2/d Best Estimate : 14 m^2/d



CRAT-RCV



CRAT-RCV

Well/Borehole : 699-13-1C	Test Interval Depth : 154.2 m to 211.8 m
Hydrologic Unit : Composite Upper Saddle Mountains Basalt	Test Date(s) : 7/22-23/78; 11/18-19/78

Reference Document(s) : Gephart et al. (1979) - RHO-BWI-ST-5; PNL Files

Test Description:
Hydrologic tests conducted in this interval included two constant-rate discharge drawdown and recovery tests. The following is a brief description of the testing activities.

CRDT-DD1 A constant-rate discharge test was conducted for a duration of 1740 min at an average flow rate of 1703 L/min. Diagnostic analysis indicates leaky confined aquifer conditions and possible turbulent well-loss effects during the test. Reanalysis results, using a leaky confined aquifer type-curve model (Hantush and Jacob 1955 r/B solution method), indicate a transmissivity of 7.0 m^2/d.

CRDT-RCV1 Recovery following termination of the constant-rate test was monitored routinely for a duration of 230 min. Diagnostic analysis of the recovery data indicated leaky confined aquifer conditions.

CRDT-DD2 A second constant-rate discharge test was conducted after completing the well with a well screen and sand/gravel pack. The test was conducted for a duration of 1511 min at an average flow rate of 1041 L/min. Diagnostic derivative analysis corroborate conditions exhibited for the earlier test.

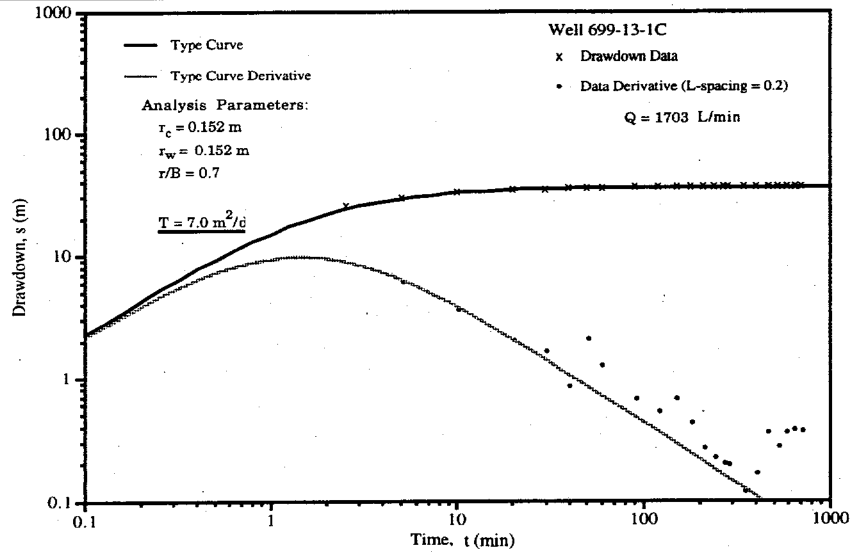
CRDT-RCV2 Recovery following termination of the constant-rate test was monitored routinely for the first 15 min and then measured three times for the next 105 min. The recovery data were combined with the drawdown data to provide a more complete response for the constant-rate test. Reanalysis results, using a leaky confined aquifer type-curve model (Hantush and Jacob 1955 r/B solution method), indicate a transmissivity of 12 m^2/d.

Comments:
Reanalysis of the hydrologic test response data discussed above provides significantly lower estimates for transmissivity than previously reported values in PNL files. There is a high level of uncertainty in the reanalysis results, however, because head-loss effects are not accounted for. Conversely, the previous analyses were based on a nonleaky confined aquifer model, which would significantly over estimate transmissivity when misapplied to leaky confined test formation conditions.

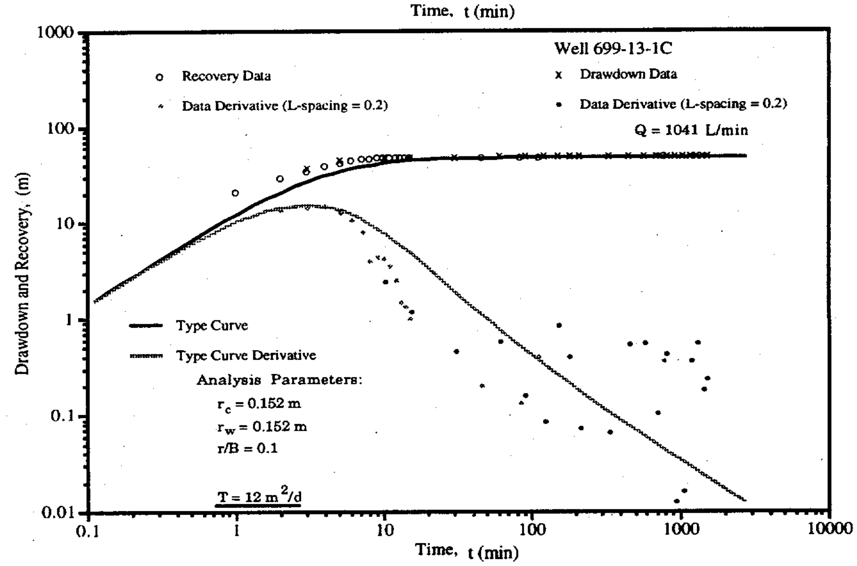
Test Interval Specifications:

Interval Length : 57.6 m   Wellbore Radius : 0.152 m   Casing Radius : 0.152 m

Test Results:	Previous Analysis	Reanalysis
Transmissivity	Range : 409 - 900 m^2/d (Gephart et al. 1979)	Range : 7.0 - 12 m^2/d Best Estimate : 9.5 m^2/d



CRDT-DD1



CRDT-DD2
-RCV2

Well/Borehole : 699-14-E6P	Test Interval Depth : 146.3 m to 154.5 m
Hydrologic Unit : Rattlesnake Ridge Interbed	Test Date(s) : 2/27/70

Reference Document(s) : Deju (1974) - ARH-C-4; PNL Files

Test Description:
Hydrologic testing for this well test site was limited to a recovery test following a constant-rate air-lift pumping test. The following is a brief description of the testing activities.

CRDT-DD A constant-rate discharge air-lift test was conducted for a duration of 136 min. Flow rates during the first 20 min of the test ranged between 75.7 and 60.6 L/min. After 20 min into the test, the flow rate decreased to 56.8 L/min and remained at this constant rate for the remainder of the test. No pressure draw-down readings were recorded during the active air-lift pumping test phase.

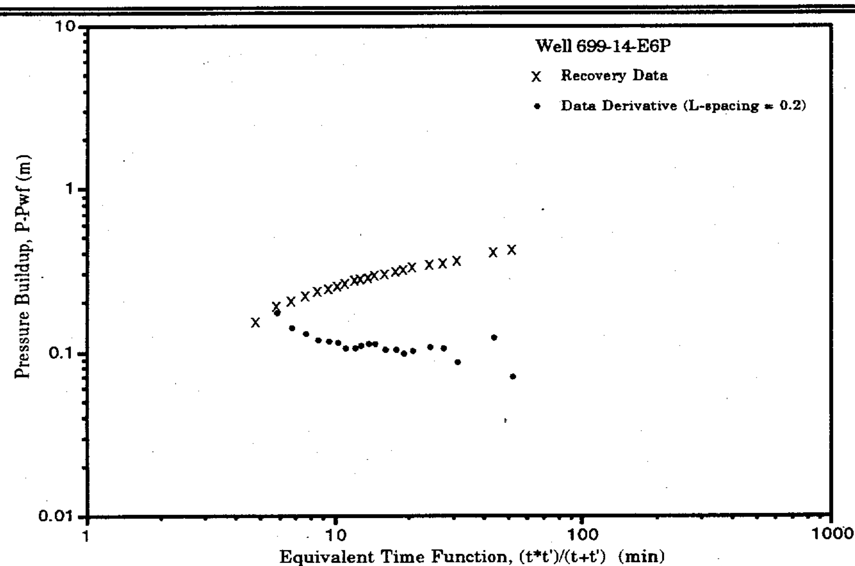
CRDT-RCV Recovery following termination of the constant-rate air-lift test was monitored routinely for 84 min. Diagnostic analysis indicates that radial flow conditions were established after approximately 12 min into the recovery period. Reanalysis results using the Theis (1935) recovery straight-line method indicates a transmissivity of 64 m^2/d.

Comments:
Reanalysis of the hydrologic test response data discussed above provides similar results with previously listed analysis values in PNL files. The reanalysis best estimate represents the result obtained from the constant-rate air-lift recovery analysis.

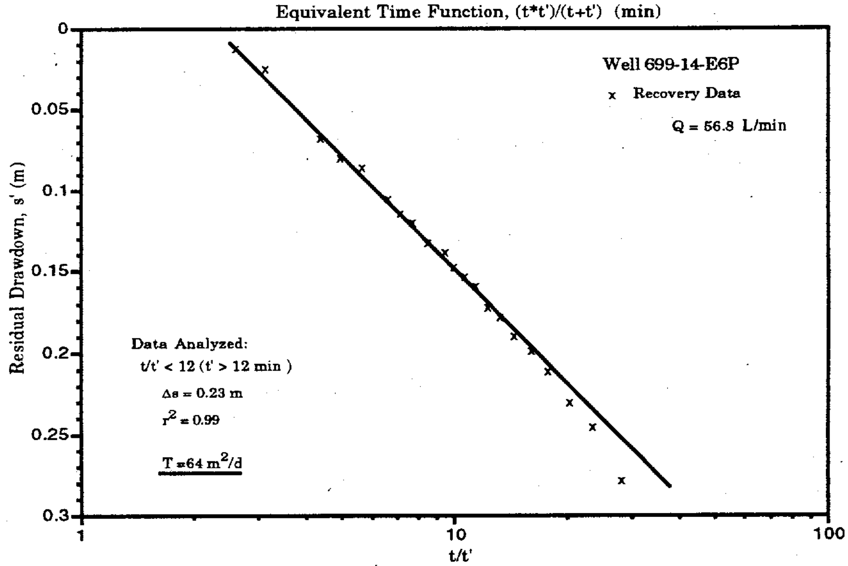
Test Interval Specifications:

Effective Thickness : 7.9 m Wellbore Radius : 0.019 m Casing Radius : 0.019 m

Test Results:	Previous Analysis	Reanalysis
Transmissivity	Range : 61 m^2/d (Deju 1974)	Range : 64 m^2/d Best Estimate : 64 m^2/d



CRDT-RCV



CRDT-RCV

Well/Borehole : 699-24-1P	Test Interval Depth : 132.6 m to 163.7 m
Hydrologic Unit : Ringold Formation and Elephant Mt. Member	Test Date(s) : 3/17-19/70
Reference Document(s) : Deju (1974) - ARH-C-4; PNL Files	

Test Description:
Hydrologic testing for this well test site was limited to a recovery test following a constant-rate air-lift pumping test. The following is a brief description of the testing activities.

CRDT-DD — A constant-rate discharge air-lift test was conducted for a duration of 313 min. Flow rates during the first 30 min of the test were reported as 26.5 L/min. In an attempt to increase discharge, the air-line conductor pipe was lowered after 30 min and flow rates increased and remained constant at 30.3 L/min for the remainder of the test. No pressure drawdown readings were recorded during the active air-lift pumping test phase.

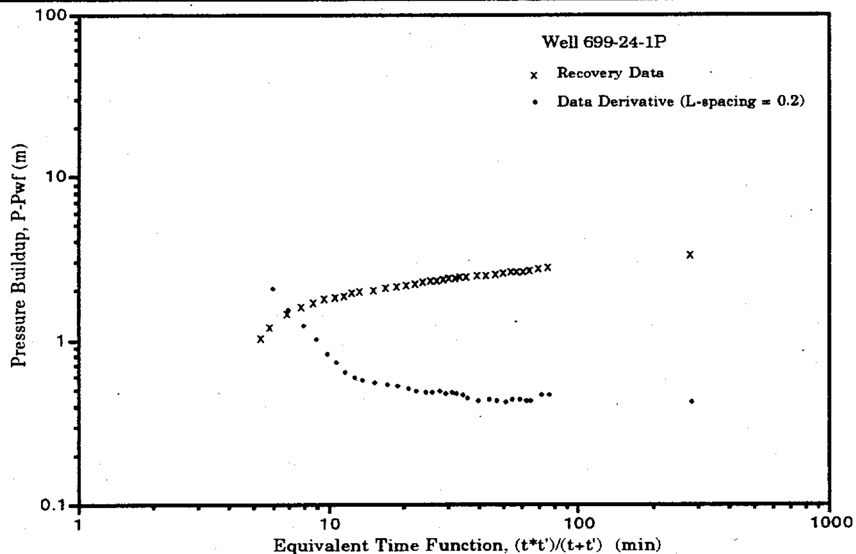
CRDT-RCV — Recovery following termination of the constant-rate air-lift test was monitored routinely for 100 min. One long-term recovery water-level measurement was recorded at a recovery test time of 2628 min following termination of air-lift pumping. Diagnostic derivative analysis indicates that radial flow conditions were established after approximately 30 min into the recovery period. Reanalysis results using the Theis (1935) recovery method and Agarwal (1980) recovery straight-line methods both indicate a transmissivity of 8.1 m^2/d.

Comments:
Reanalysis of the hydrologic test response data discussed above provides identical results with previously reported values in Deju (1974). The reanalysis best estimate represents the result obtained from the constant-rate air-lift recovery analysis. There is uncertainty as to what the hydraulic property estimate represents, however, because the test interval is completed compositively in the lower Ringold Formation and Elephant Mountain Member. Because of this uncertainty, test results will not be included in the property summary.

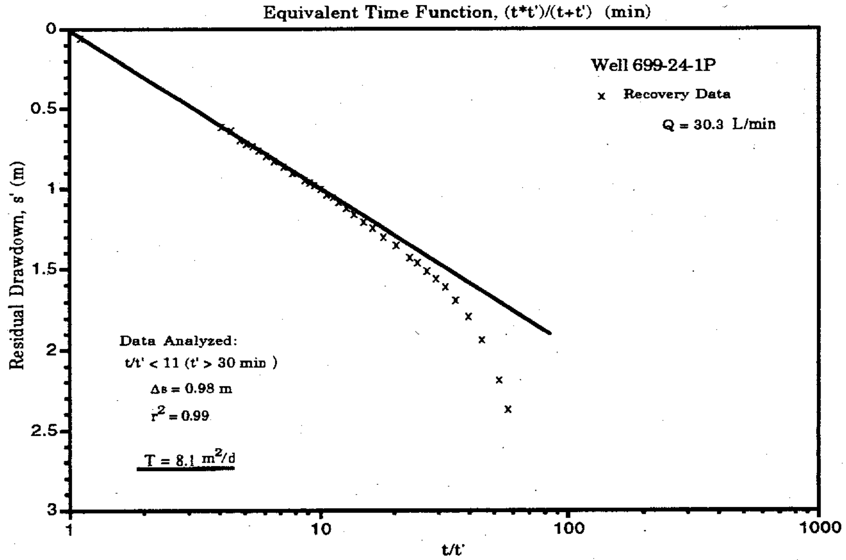
Test Interval Specifications:

Effective Thickness : 31.1 m   Wellbore Radius : 0.019 m   Casing Radius : 0.019 m

Test Results:	Previous Analysis	Reanalysis
Transmissivity	Range : 8.1 m^2/d (Deju 1974)	Range : 8.1 m^2/d Best Estimate : 8.1 m^2/d



CRDT-RCV



CRDT-RCV

Well/Borehole : 699-25-80	Test Interval Depth : 64.0 m to 87.8 m
Hydrologic Unit : Rattlesnake Ridge Interbed	Test Date(s) : 9/8-10/78
Reference Document(s) : Spane et al. (1980) - RHO-LD-67; PNL Files	

Test Description:
Hydrologic tests conducted in this interval included a constant-rate discharge drawdown and recovery test. The following is a brief description of the testing activities.

CRDT-DD — A constant-rate discharge test was conducted for a duration of 2685 min. Flow rates during the majority of the test ranged between 38.2 and 36.3 L/min, and averaged 37.1 L/min for the entire test. Flow rates during the first 10 min of the test were greater than 41.6 L/min. Diagnostic analysis indicates either leaky confined aquifer conditions or the presence of a recharge boundary occurring after approximately 250 min into the test. Reanalysis results, using a leaky confined aquifer model (Hantush and Jacob 1955 r/B solution method), indicate a transmissivity of 0.43 m^2/d.

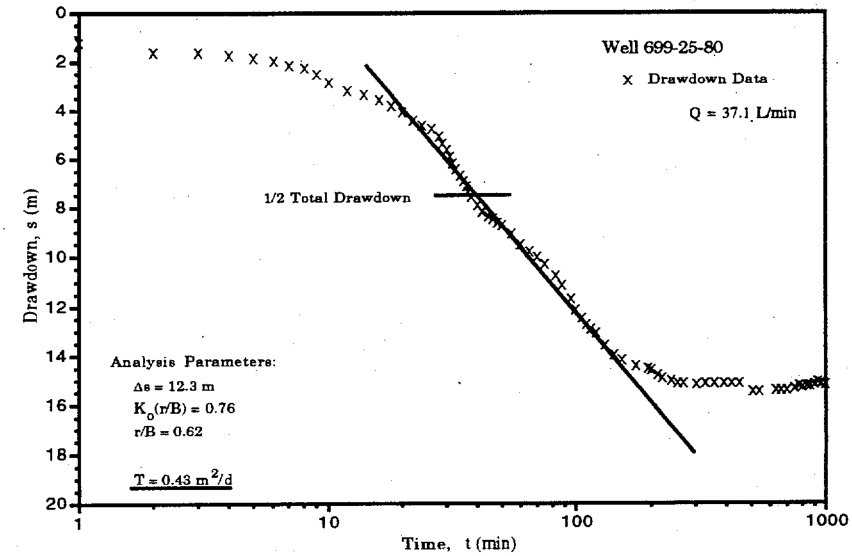
CRDT-RCV — Recovery following termination of the constant-rate test was monitored for a duration of 4605 min. Diagnostic analysis of the recovery data corroborated the findings of the drawdown analysis, indicating either leaky confined aquifer conditions or occurrence of a recharge boundary in the late-time data. Reanalysis results, using a leaky confined aquifer model (Hantush and Jacob 1955 r/B solution method) indicate a transmissivity of 0.37 m^2/d.

Comments:
Reanalysis of the hydrologic test response data discussed above provides comparable results with previously reported values in Spane et al. (1980). The reanalysis best estimate represents the average of results obtained from the constant-rate discharge drawdown and recovery analyses. Although similar in value, the reanalysis results are considered to be an improvement over the previously reported values because of the original analysis dependence on a nonleaky confined aquifer model for test response description.

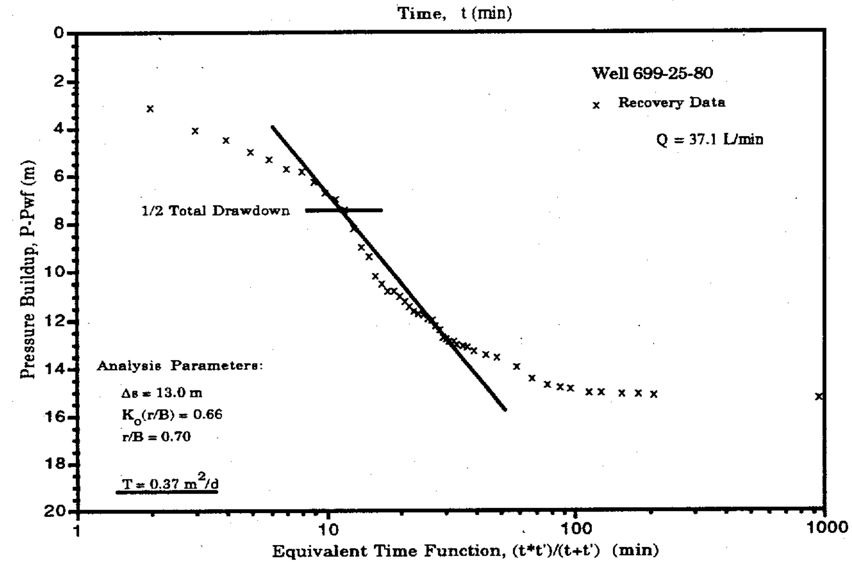
Test Interval Specifications:

Effective Thickness : 23.5 m — Wellbore Radius : 0.076 m — Casing Radius : 0.076 m

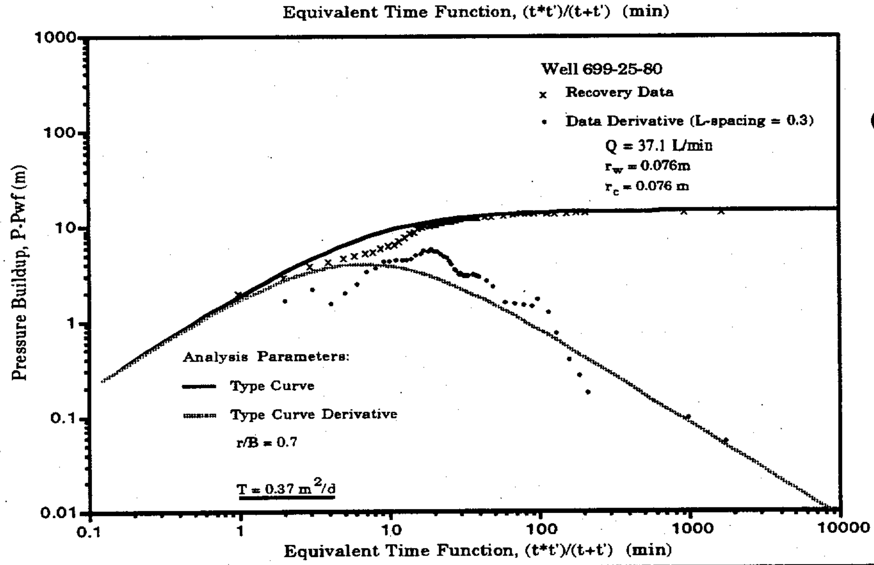
Test Results:	Previous Analysis	Reanalysis
Transmissivity	Range : 0.83 - 1.12 m^2/d (Spane et al. 1980)	Range : 0.37 - 0.43 m^2/d Best Estimate : 0.40 m^2/d



CRDT-DD



CRDT-RCV



CRDT-RCV

Well/Borehole : 699-31-84A	Test Interval Depth : 203.6 m to 254.5 m
Hydrologic Unit : Rattlesnake Ridge Interbed	Test Date(s) : 9/22-23/81

Reference Document(s) : Strait and Bruce (1981) in PNL Files

Test Description:
Hydrologic tests conducted in this interval included a constant-rate discharge drawdown and recovery test. The following is a brief description of the testing activities.

CRDT-DD A constant-rate discharge test was conducted for a duration of 1440 min. Flow rates during the test ranged between 31.2 and 31.8 L/min, and averaged 31.5 L/min for the entire test. Diagnostic analysis indicates either leaky confined aquifer conditions or packer leakage within the borehole, which becomes significant after approximately 150 min into the test. It should be noted that packer leakage was reported by Strait and Bruce (1981) for preceding tests, which necessitated packer reseating. Straight-line (Cooper and Jacob 1946) analysis results of the indicated radial flow drawdown period prior to significant leakage indicated a transmissivity of 62 m^2/d.

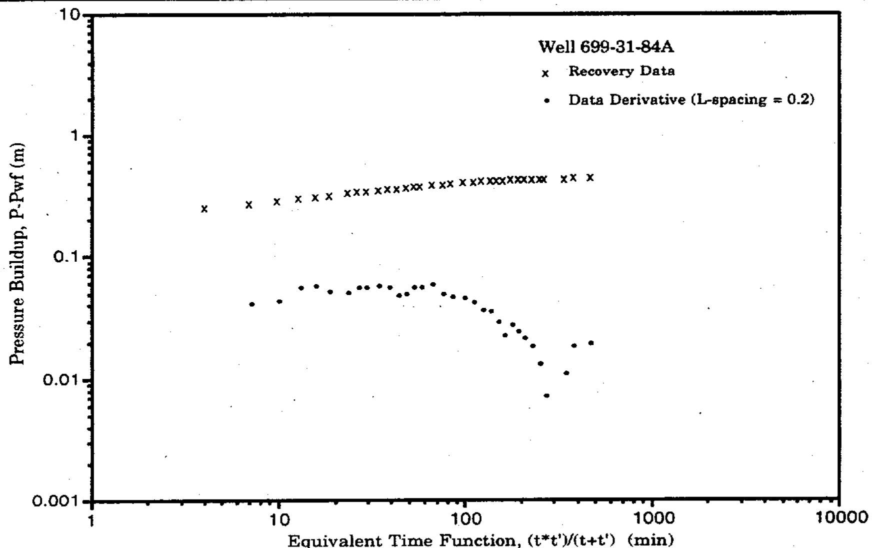
CRDT-RCV Recovery following termination of the constant-rate test was monitored for a duration of 700 min. Diagnostic analysis of the recovery data corroborated the findings of the drawdown analysis, indicating either leaky confined aquifer conditions or packer leakage in the late-time data. Reanalysis results using the Agarwal (1980) recovery method of the radial flow portion of the test data prior to significant leakage effects indicated a transmissivity of 67 m^2/d.

Comments:
Reanalysis of the hydrologic test response data discussed above provides significantly lower estimates of transmissivity in comparison to values reported (Strait and Bruce 1981 in PNL files). The previously reported analytical results, however, were based on analysis of data that were affected by leakage effects previously noted. The best estimate value of 65 m^2/d represents the average of the drawdown and recovery reanalysis results.

Test Interval Specifications:

Effective Thickness : 34.1 m Wellbore Radius : 0.067 m Casing Radius : 0.022 m

Test Results:	Previous Analysis	Reanalysis
Transmissivity	Range : 138 - 208 m^2/d (Strait and Bruce 1981 in PNL files)	Range : 62 - 67 m^2/d Best Estimate : 65 m^2/d



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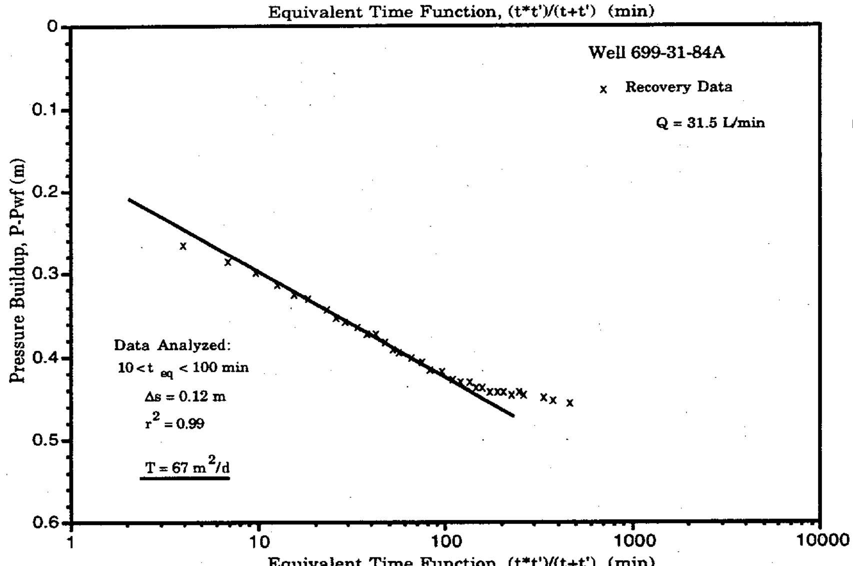
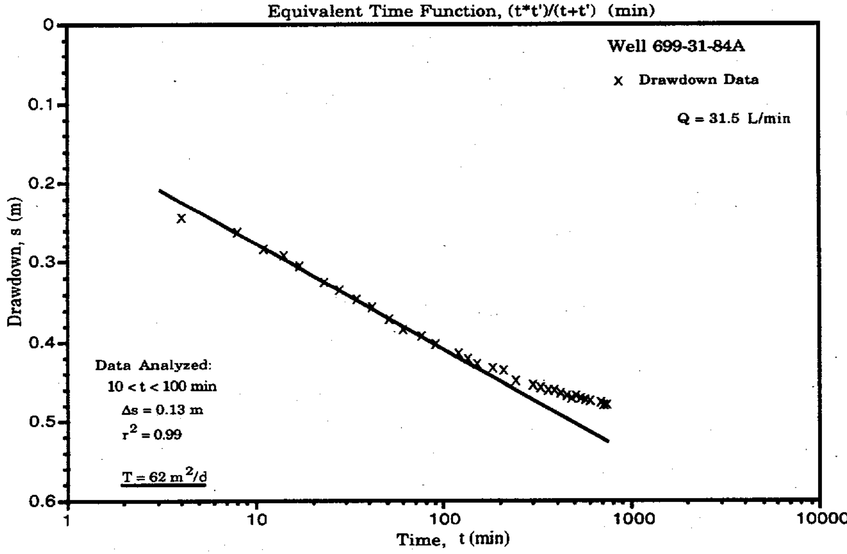


CRDT-RCV



CRDT-DD

Well/Borehole : 699-42-40C	Test Interval Depth : ?
Hydrologic Unit : Elephant Mt. Interflow	Test Date(s) : 4/15/82

Reference Document(s) : Graham et al. (1984) - RHO-RE-ST-12P; PNL Files

Test Description:

Hydrologic tests conducted in this interval included a single constant-rate discharge drawdown test. The following is a brief description of the testing activities.

CRDT-DD A constant-rate discharge test was conducted for a duration of 23 hr at an average flow rate of 7.2 L/min. Test response indicated that flow rate was unstable over the test period from 300 to 900 min; for times greater than 900 min, data indicated the flow rate was held constant. Analysis of drawdown data for times greater than 1000 min resulted in a transmissivity estimate of 0.93 m^2/d.

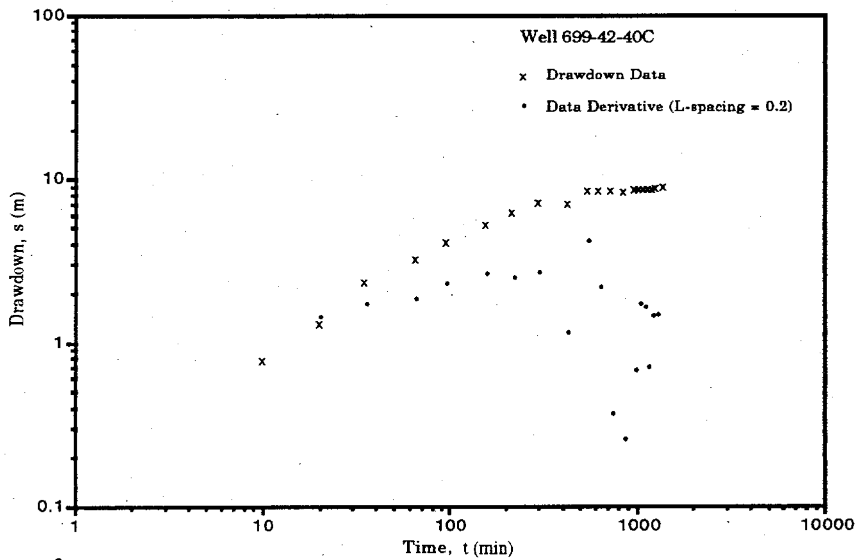
Comments:

Reanalysis of the hydrologic test response data discussed above provides comparable results with previously reported values (i.e., Graham et al. 1984). The reanalysis best estimate is based on the constant-rate discharge drawdown data.

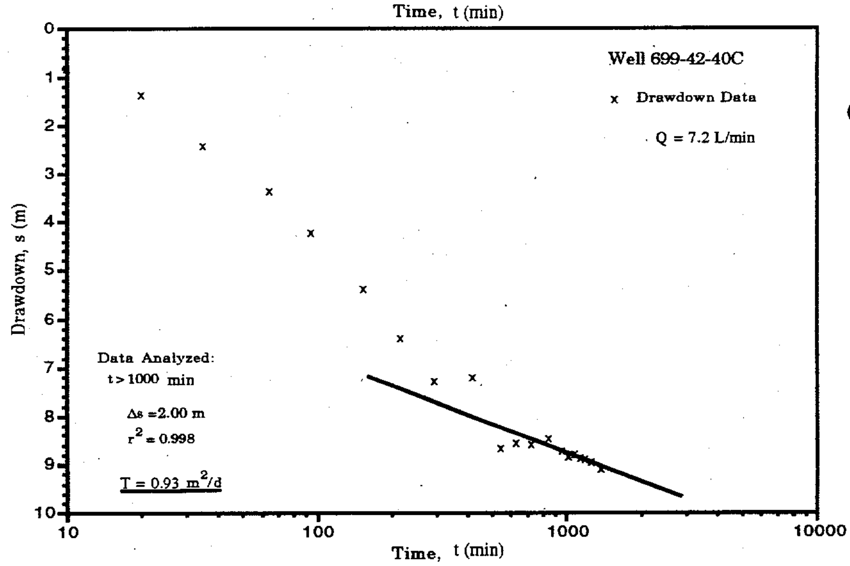
Test Interval Specifications:

Effective Thickness : 1 m Wellbore Radius : 0.102 m Casing Radius : 0.102 m

Test Results:	Previous Analysis	Reanalysis
Transmissivity	Range : 0.7 m^2/d (Graham et al. 1984)	Range : 0.93 m^2/d Best Estimate : 0.93 m^2/d



CRDT-DD



CRDT-DD

Well/Borehole : 699-42-40C	Test Interval Depth : 96.6 m to 118.9 m
Hydrologic Unit : Rattlesnake Ridge Interbed	Test Date(s) : 10/30/82; 11/18-19/82
Reference Document(s) : Graham et al. (1984) - RHO-RE-ST-12P; PNL Files	

Test Description:
Hydrologic tests conducted in this interval included a constant-rate discharge drawdown and recovery test and a slug injection and withdrawal test. The following is a brief description of the testing activities.

CRDT-DD A constant-rate discharge test was conducted for a duration of 24 hr at an average flow rate of 28.0 L/min. Diagnostic analysis indicates a possible increase in flow rate after 330 min. Straight-line analysis (Cooper and Jacob 1946) of drawdown data for the time period 50 to 330 min yielded a transmissivity estimate of 40 m^2/d.

CRDT-RCV Recovery response was monitored for a duration of 280 min following termination of pumping. Recovery response showed a dampened response to the flow rate variations experienced during the drawdown test. Analysis of the recovery data for the time period 14 to 160 min after termination of pumping resulted in a transmissivity estimate of 30 m^2/d.

SIT A slug injection test was conducted by injecting a slug of known volume, resulting in a stress level (H_o) of 0.387 m. The slug test exhibited an oversteepened response, resulting from problems during injection of the slug rod.

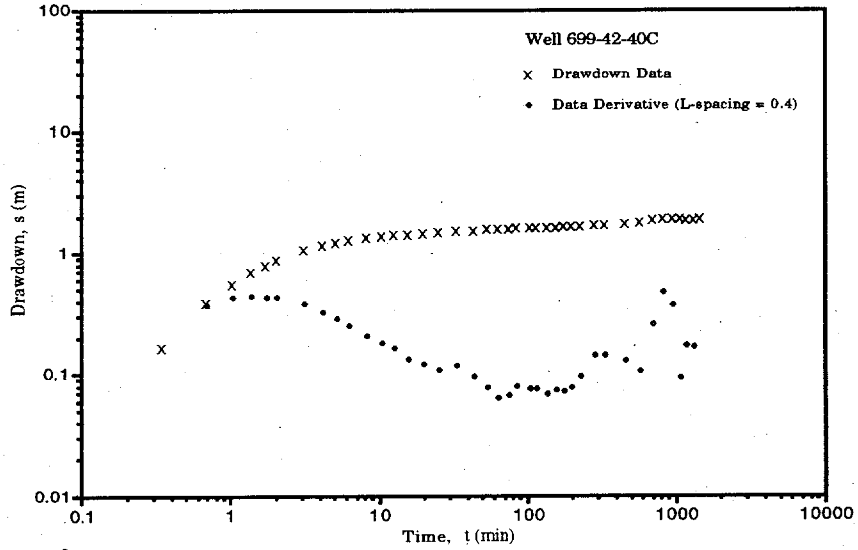
SWT A slug withdrawal test was conducted by withdrawing a slug of known volume, resulting in a stress level (H_o) of 0.486 m. Composite type-curve and derivative analysis (Ostrowski and Kloska 1989) resulted in a transmissivity estimate of 45 m^2/d.

Comments:
Reanalysis of the hydrologic test response data discussed above provides comparable results with previously reported values (i.e., Graham et al. 1984). The reanalysis best estimate is based on the constant-rate discharge drawdown data. The reanalyses are considered an improvement over those cited in the reference document; the original analysis made an erroneous type-curve match for both the slug injection and slug withdrawal tests.

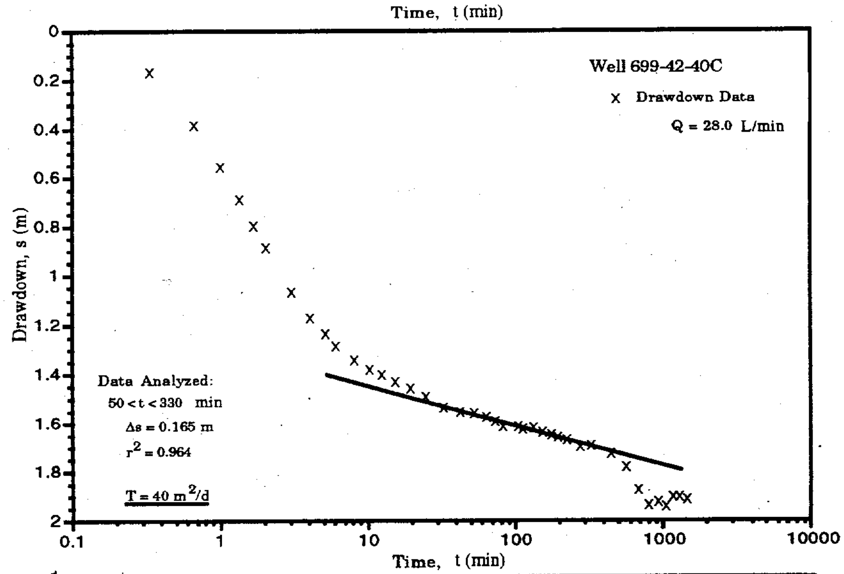
Test Interval Specifications:

Effective Thickness : 17.1 m Wellbore Radius : 0.109 m Casing Radius : 0.102 m

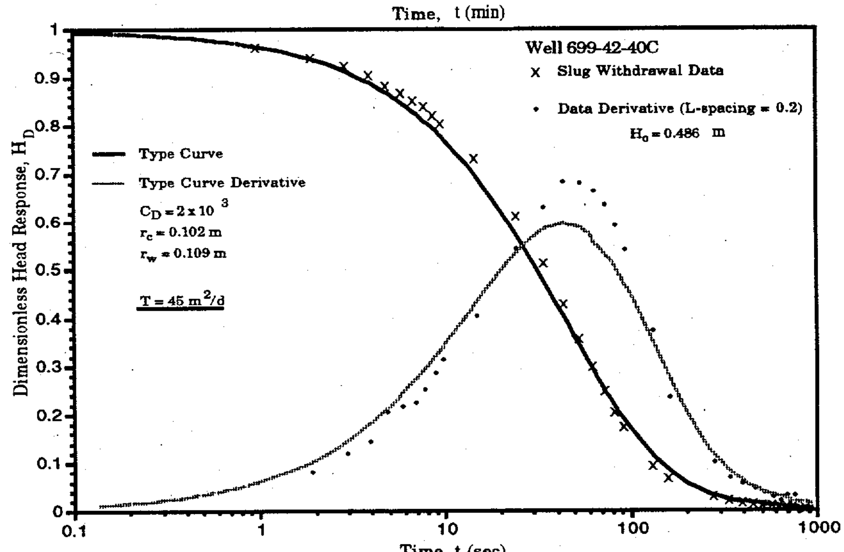
Test Results:	Previous Analysis	Reanalysis
Transmissivity	Range : 24 - 85 m^2/d (Graham et al. 1984)	Range : 30 - 45 m^2/d Best Estimate : 40 m^2/d



CRDT-DD



CRDT-DD



SWT

Well/Borehole : 699-47-42 (DB-15)	Test Interval Depth : 45.7 m to 67.7 m
Hydrologic Unit : Rattlesnake Ridge Interbed	Test Date(s) : 4/25-26/79
Reference Document(s) : Strait and Brown (1983) - SD-BWI-TI-130, Rev. 0-0; PNL Files	

Test Description:

Hydrologic tests conducted in this interval included a constant-rate discharge drawdown and recovery test. The following is a brief description of the testing activities.

CRDT-DD A constant-rate discharge test was conducted for a duration of 273 min at an average flow rate of 32.3 L/min. Diagnostic analysis indicates a possible decrease in flow rate and/or vertical leakage after 50 min. Straight-line analysis (Cooper and Jacob 1946) of drawdown data for the time period 13 to 50 min resulted in a transmissivity estimate of 30 m^2/d.

CRAT-RCV A constant-rate discharge airlift test was conducted for a duration of 760 min at an average flow rate of 86.3 L/min. Recovery response was monitored for a duration of 540 min following termination of pumping. Diagnostic analysis indicates a response to flow rate variations experienced during pumping and/or vertical leakage after 90 min. Straight-line analysis (Theis 1935) of the recovery data for times of 10 to 90 min after termination of pumping resulted in a transmissivity estimate of 25 m^2/d.

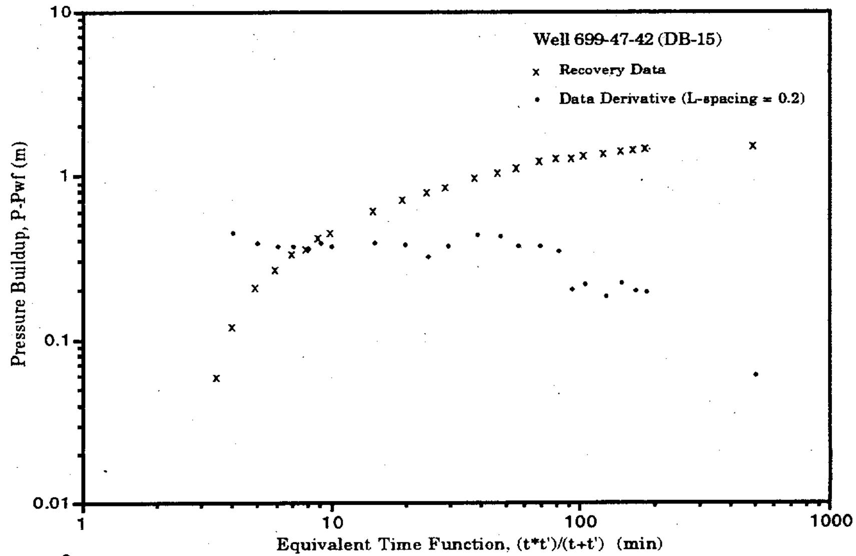
Comments:

Reanalysis of the hydrologic test response data discussed above provides comparable results with previously reported values (i.e., Strait and Brown 1983). Analysis of the constant-rate discharge drawdown and recovery response provides comparable results; the reanalysis best estimate is based on the average estimated transmissivity. The reanalyses are considered an improvement over those cited in the reference document; the original analysis, based on a nonleaky confined aquifer model, includes late-time data affected by flow rate variations and/or vertical leakage.

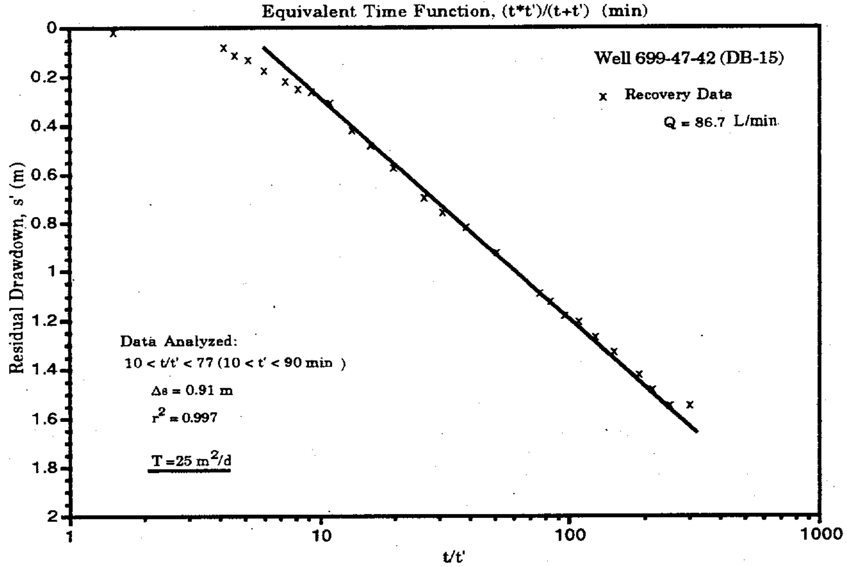
Test Interval Specifications:

Effective Thickness : 15.2 m Wellbore Radius : 0.050 m Casing Radius : 0.050 m

Test Results:	Previous Analysis	Reanalysis
Transmissivity	Range : 44 - 46 m^2/d (Strait and Brown 1983)	Range : 25 - 30 m^2/d Best Estimate : 28 m^2/d



CRAT-RCV



CRAT-RCV

Well/Borehole : 699-47-50	Test Interval Depth : 79.2 m to 89.9 m
Hydrologic Unit : Rattlesnake Ridge Interbed	Test Date(s) : 6/24-26/80; 11/12/82
Reference Document(s) : Graham et al. (1984) - RHO-RE-ST-12P Strait and Moore (1982) - RHO-ST-38; PNL Files	

Test Description:
Hydrologic tests conducted in this interval included a constant-rate discharge drawdown and recovery test and a slug injection and withdrawal test. The following is a brief description of the testing activities.

CRDT-DD A constant-rate discharge test was conducted for a duration of 700 min at an average flow rate of 21.5 L/min. Straight-line analysis (Cooper and Jacob 1946) of drawdown data for times greater than 45 min resulted in a transmissivity estimate of 23 m^2/d.

CRDT-RCV Recovery response was monitored for a duration of 200 min following termination of pumping. Recovery response was affected by drainage from the pump column; data were not used in the analysis.

SIT A slug injection test was conducted by injecting a slug of known volume, resulting in a stress level (H_o) of 0.785 m. The slug test exhibited an oversteepened response, resulting from problems during injection of the slug rod.

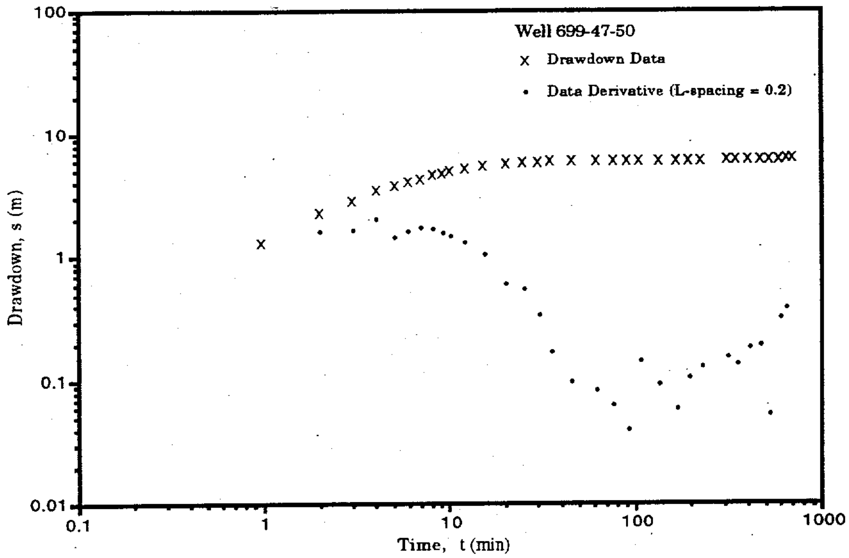
SWT A slug withdrawal test was conducted by withdrawing a slug of known volume, resulting in a stress level (H_o) of 0.834 m. Composite type-curve and derivative analysis (Ostrowski and Kloska 1989) resulted in a transmissivity estimate of 11 m^2/d.

Comments:
Reanalysis of the hydrologic test response data discussed above provides comparable results with previously reported values (i.e., Graham et al. 1984; Strait and Moore 1982). The reanalysis best estimate is based on the constant-rate discharge drawdown data. The reanalyses are considered an improvement over those cited in the reference documents; the original analysis made an erroneous type-curve match for both the slug injection and slug withdrawal tests and reported results for the constant-rate discharge recovery response.

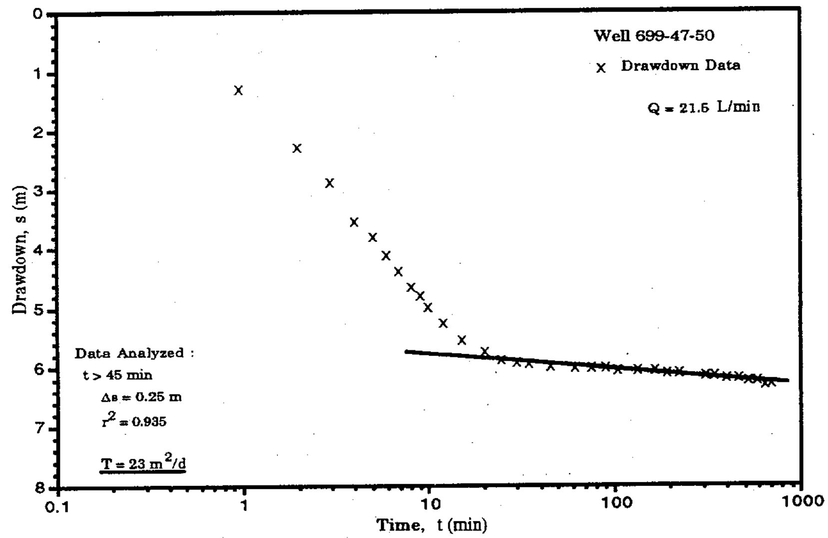
Test Interval Specifications:

Effective Thickness : 10.7 m Wellbore Radius : 0.073 m Casing Radius : 0.076 m

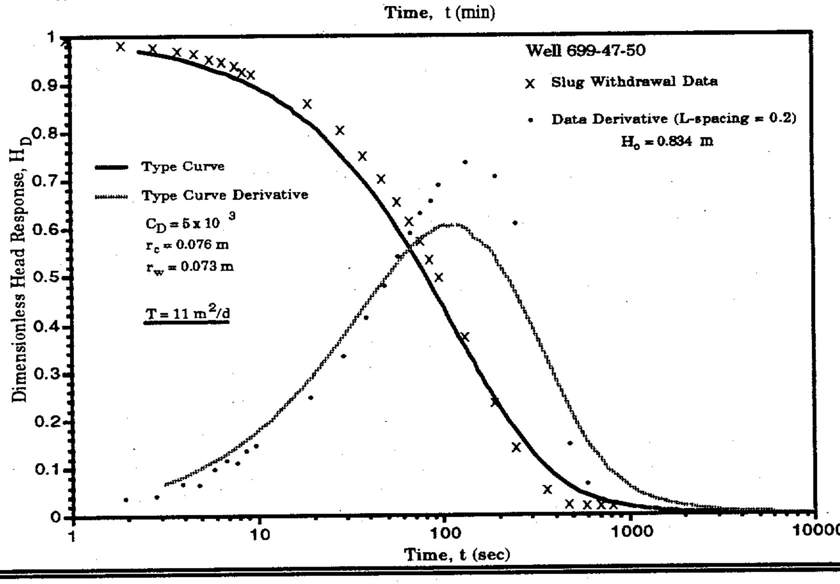
Test Results:	Previous Analysis	Reanalysis
Transmissivity	Range : 31 - 93 m^2/d (Graham et al. 1984; Strait and Moore 1982)	Range : 11 - 23 m^2/d Best Estimate : 23 m^2/d



CRDT-DD



CRDT-DD



SWT

Well/Borehole : 699-49-55B	Test Interval Depth : 53.3 m to 68.9 m
Hydrologic Unit : Rattlesnake Ridge Interbed	Test Date(s) : 5/17-19/82; 11/9/82
Reference Document(s) : Graham et al. (1984) - RHO-RE-ST-12P; PNL Files	

Test Description:
Hydrologic tests conducted in this interval included a constant-rate discharge drawdown and recovery test and a slug injection and withdrawal test. The following is a brief description of the testing activities.

CRDT-DD A constant-rate discharge test was conducted for a duration of 46 hr at an average flow rate of 116 L/min. A short-duration pump outage was experienced after approximately 1 hr. Diagnostic analysis indicates a decrease in flow rate and/or vertical leakage after 1000 min. Straight-line analysis (Cooper and Jacob 1946) of drawdown data for the time period 100 to 1000 min resulted in a transmissivity estimate of 61 m^2/d.

CRDT-RCV Recovery response was monitored for a duration of 550 min following termination of pumping. Straight-line analysis (Theis 1935) of the recovery data for times greater than 5 min after termination of pumping resulted in a transmissivity estimate of 72 m^2/d.

SIT A slug injection test was conducted by injecting a slug of known volume, resulting in a stress level (H_o) of 0.309 m. The slug test exhibited an oversteepened response, resulting from problems during injection of the slug rod.

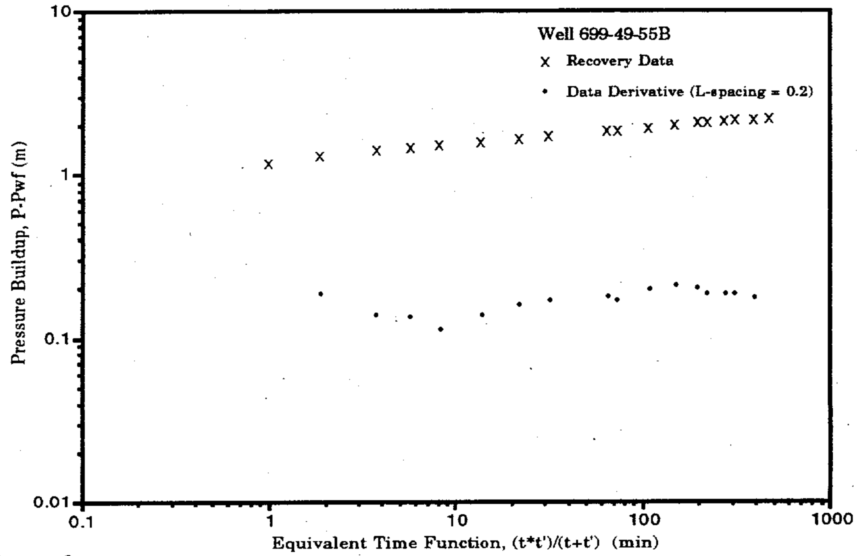
SWT A slug withdrawal test was conducted by withdrawing a slug of known volume, resulting in a stress level (H_o) of 0.445 m. Composite type-curve and derivative analysis (Ostrowski and Kloska 1989) yielded a transmissivity estimate of 110 m^2/d.

Comments:
Reanalysis of the hydrologic test response data discussed above provides comparable results with previously reported values (i.e., Graham et al. 1984). The reanalysis best estimate is based on the constant-rate discharge recovery data. The reanalyses are considered an improvement over those cited in the reference document; the original analysis made an erroneous type-curve match for the slug withdrawal test.

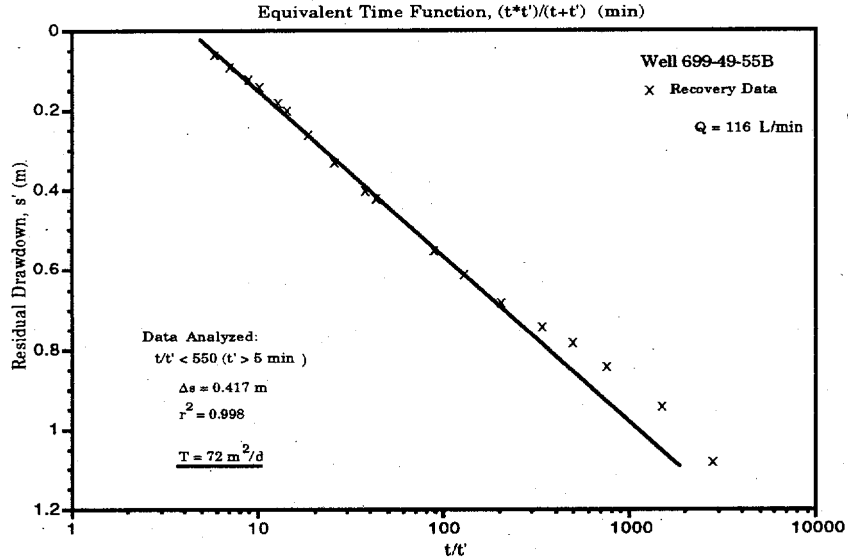
Test Interval Specifications:

Effective Thickness : 13.4 m Wellbore Radius : 0.102 m Casing Radius : 0.102 m

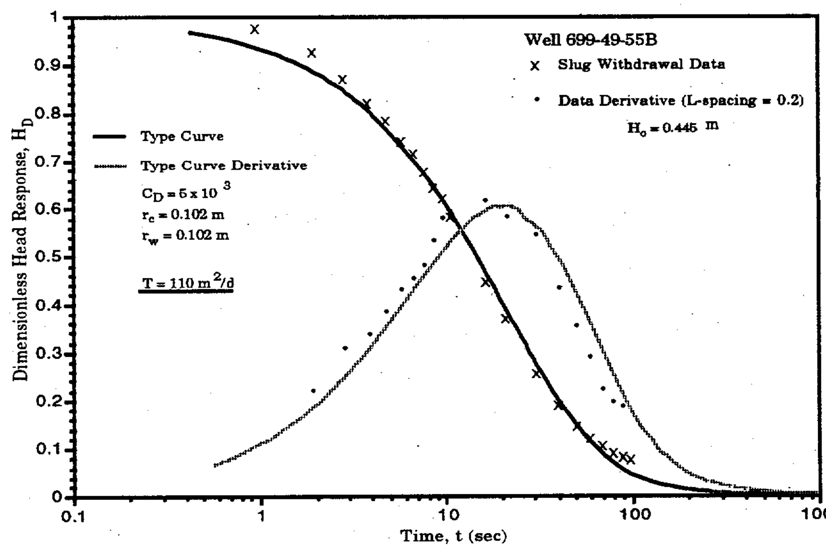
Test Results:	Previous Analysis	Reanalysis
Transmissivity	Range : 70 - 182 m^2/d (Graham et al. 1984)	Range : 61 - 110 m^2/d Best Estimate : 72 m^2/d



CRDT-RCV



CRDT-RCV



SWT

Well/Borehole : 699-49-57B	Test Interval Depth : 63.7 m to 68.4 m
Hydrologic Unit : Rattlesnake Ridge Interbed	Test Date(s) : 1/31/92
Reference Document(s) : Swanson (1992) - WHC-SD-ER-TD-001	

Test Description:
Hydrologic tests conducted in this interval included a constant-rate discharge drawdown and recovery test. The following is a brief description of the testing activities.

CRDT-DD A constant-rate discharge test was conducted for a duration of 202 min. The discharge rate is reported to have averaged 44.7 L/min for the entire test. Diagnostic analysis indicates the presence of significant wellbore storage effects during the first minutes of the test, with radial flow conditions fully established after 30 min. Straight-line analysis (Cooper and Jacob 1946) of the drawdown data during the indicated radial flow period yielded a transmissivity of 14 m^2/d.

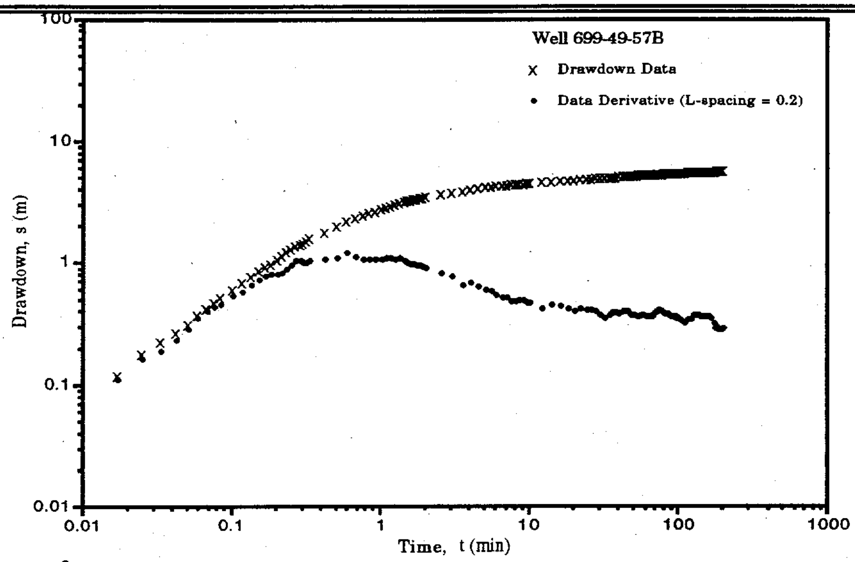
CRDT-RCV Recovery following termination of the constant-rate test was monitored for a duration of 4130 min. Lack of a valve within the pump column, however, caused water to flow back into the well on termination of the test; thereby, adversely affecting the recovery water-level response. Diagnostic derivative analysis of the recovery data also corroborated this conclusion. Because of these effects, no reliable analysis of the recovery buildup data for hydraulic property determination was possible.

Comments:
Reanalysis of the hydrologic test response data discussed above provides identical results with previously reported values in Swanson (1992). The reanalysis best estimate represents the result obtained from the constant-rate discharge drawdown analysis. It should be noted that a slug test value of 8.4 m^2/d is also reported in Swanson (1992). No test data or test analysis figure, however, are provided for test evaluation purposes. The reported unconfined aquifer analysis method used to evaluate the slug test results suggests that the analysis result may be questionable.

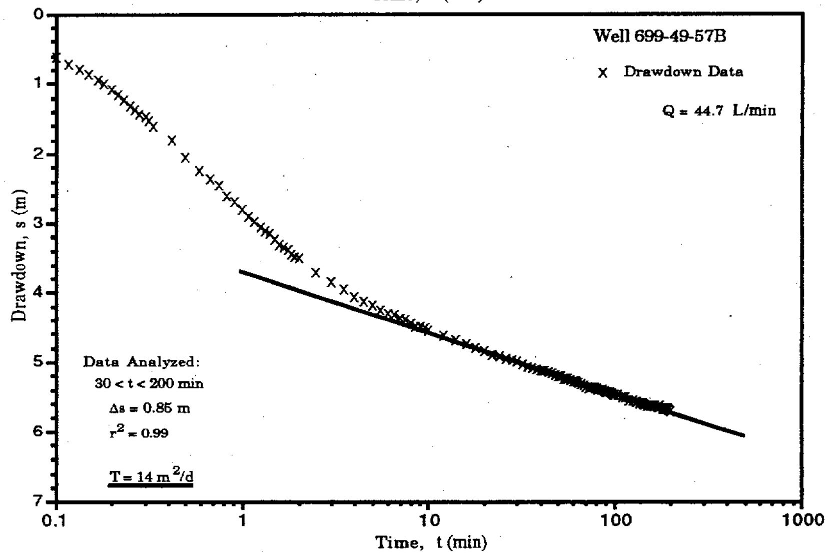
Test Interval Specifications:

Effective Thickness : 4.4 m   Wellbore Radius : 0.051 m   Casing Radius : 0.051 m

Test Results:	Previous Analysis	Reanalysis
Transmissivity	Range : 14 m^2/d (Swanson 1992)	Range : 14 m^2/d Best Estimate : 14 m^2/d



CRDT-DD



CRDT-DD

Well/Borehole : 699-50-45	Test Interval Depth : 40.5 m to 54.3 m
Hydrologic Unit : Rattlesnake Ridge Interbed	Test Date(s) : 5/28-30/80; 11/16/82

Reference Document(s) : Graham et al. (1984) - RHO-RE-ST-12P
Strait and Moore (1982) - RHO-ST-38; PNL Files

Test Description:
Hydrologic tests conducted in this interval included a constant-rate discharge drawdown and recovery test and a slug injection and withdrawal test. The following is a brief description of the testing activities.

CRDT-DD A constant-rate discharge test was conducted for a duration of 21 hr at an average flow rate of 32.0 L/min. Straight-line analysis (Cooper and Jacob 1946) of drawdown data for times greater than 100 min resulted in a transmissivity estimate of 16 m^2/d.

CRDT-RCV Recovery response was monitored for a duration of 600 min following termination of pumping. Straight-line analysis (Theis 1935) of recovery data for times greater than 50 min after termination of pumping resulted in a transmissivity estimate of 15 m^2/d.

SIT A slug injection test was conducted by injecting a slug of known volume, resulting in a stress level (H_o) of 0.799 m. Composite type-curve and derivative analysis (Ostrowski and Kloska 1989) yielded a transmissivity estimate of 4.8 m^2/d.

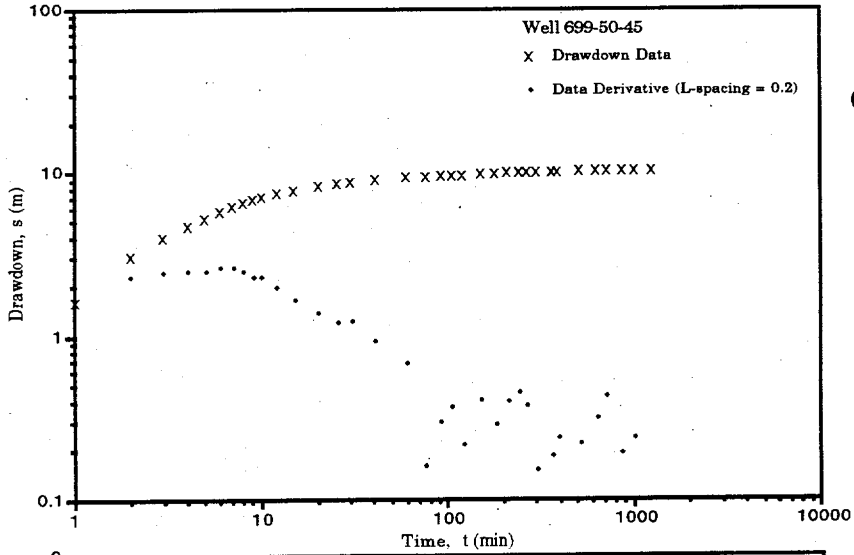
SWT A slug withdrawal test was conducted by withdrawing a slug of known volume, resulting in a stress level (H_o) of 0.812 m. Composite type-curve and derivative analysis (Ostrowski and Kloska 1989) provided a transmissivity estimate of 6.0 m2/d.

Comments:
Reanalysis of the hydrologic test response data discussed above provides comparable results with previously reported values (i.e., Graham et al. 1984; Strait and Moore 1982). The reanalysis best estimate is based on the constant-rate discharge drawdown data.

Test Interval Specifications:

Effective Thickness : 13.8 m Wellbore Radius : 0.064 m Casing Radius : 0.076 m

Test Results:	Previous Analysis	Reanalysis
Transmissivity	Range : 5 - 16 m^2/d (Graham et al. 1984; Strait and Moore 1982)	Range : 4.8 - 16 m^2/d Best Estimate : 16 m^2/d



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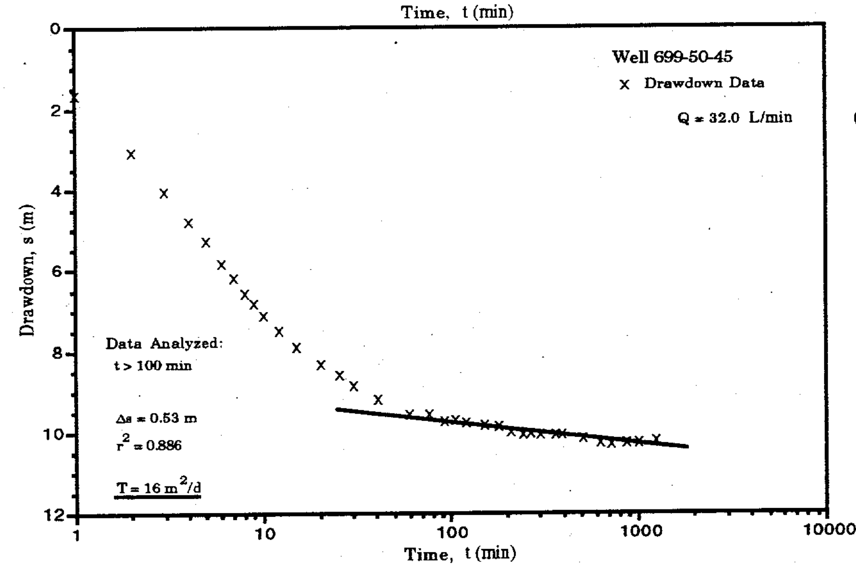
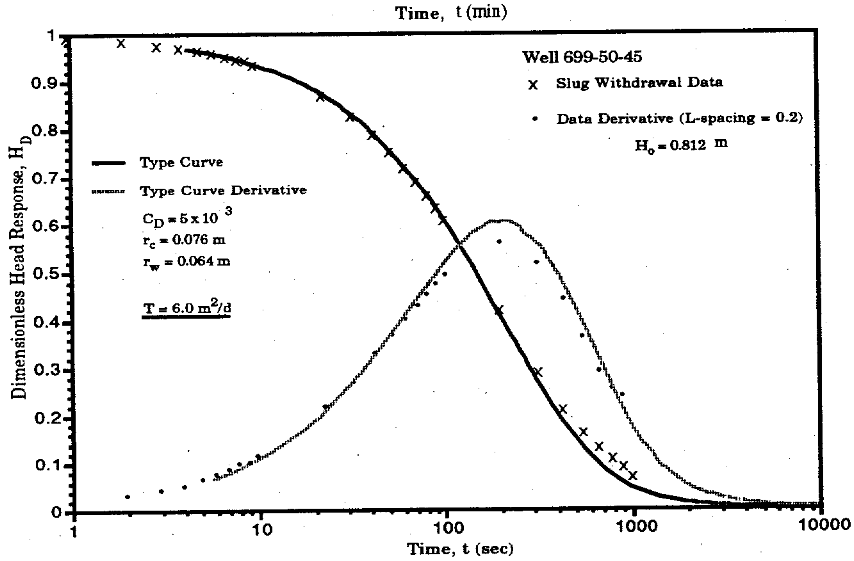


CRDT-DD



SWT

Well/Borehole : 699-50-48B	Test Interval Depth : 64.9 m to 76.2 m
Hydrologic Unit : Rattlesnake Ridge Interbed	Test Date(s) : 6/9-10/80; 11/16/82

Reference Document(s) : Graham et al. (1984) - RHO-RE-ST-12P
Strait and Moore (1982) - RHO-ST-38; PNL Files

Test Description:

Hydrologic tests conducted in this interval included a constant-rate discharge drawdown and recovery test and a slug injection and withdrawal test. The following is a brief description of the testing activities.

CRDT-DD A constant-rate discharge test was conducted for a duration of 18.5 hr at an average flow rate of 26.3 L/min. Straight-line analysis (Cooper and Jacob 1946) of drawdown data for times greater than 50 min resulted in a transmissivity estimate of 21 m^2/d.

CRDT-RCV Recovery response was monitored for a duration of 140 min following termination of pumping. Recovery response was apparently affected by drainage from the pump column; data were not used in the analysis.

SIT A slug injection test was conducted by injecting a slug of known volume, resulting in a stress level (H_o) of 0.774 m. The slug test exhibited an oversteepened response, resulting from problems during injection of the slug rod.

SWT A slug withdrawal test was conducted by withdrawing a slug of known volume, resulting in a stress level (H_o) of 0.844 m. The slug test derivative pattern suggests the presence of significant wellbore damage (skin effects). In an attempt to account for skin effects, composite type-curve and derivative analysis (Ostrowski and Kloska 1989) of the slug test response using an infinitesimal skin model (Novakowski 1990, $S_k = 50$) was utilized. This analysis resulted in a transmissivity estimate of 30 m^2/d.

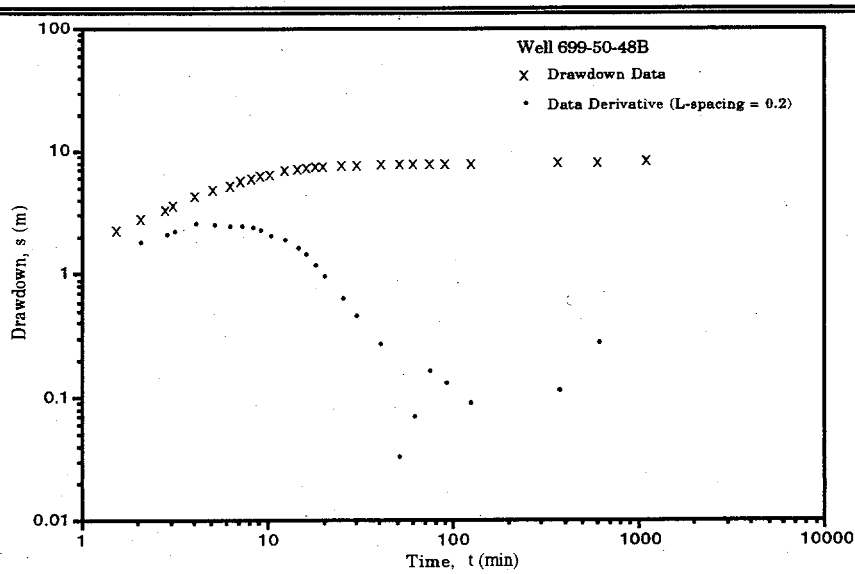
Comments:

Reanalysis of the hydrologic test response data discussed above provided comparable results with previously reported values (i.e., Graham et al. 1984; Strait and Moore 1982). The reanalysis best estimate is based on the constant-rate discharge drawdown data. The reanalyses are considered an improvement over those cited in the reference documents; the original analysis reported results for the constant-rate discharge recovery response.

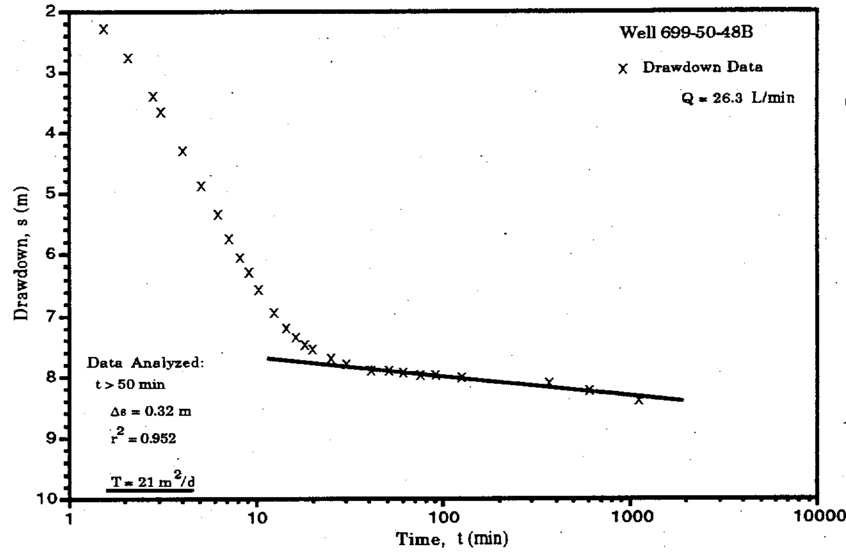
Test Interval Specifications:

Effective Thickness : 11.6 m Wellbore Radius : 0.076 m Casing Radius : 0.076 m

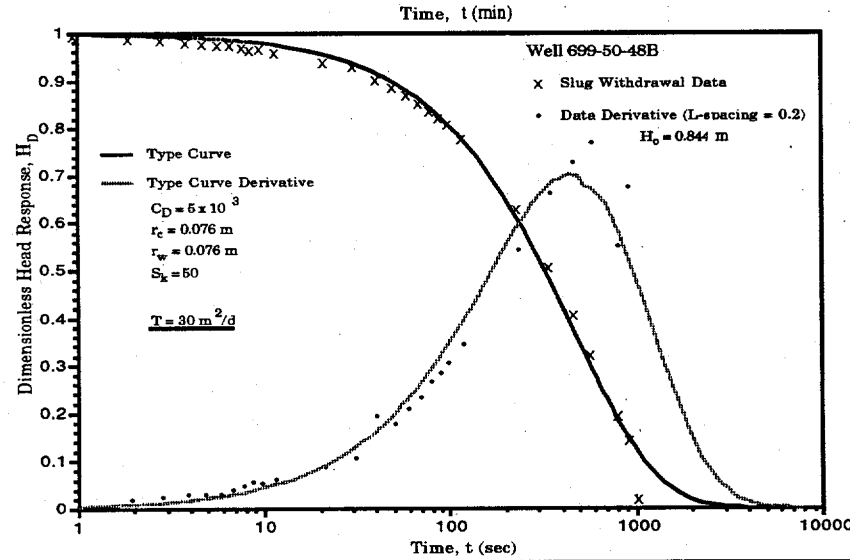
Test Results:	Previous Analysis	Reanalysis
Transmissivity	Range : 11 - 35 m^2/d (Graham et al. 1984; Strait and Moore 1982)	Range : 2.5 - 35 m^2/d Best Estimate : 21 m^2/d



CRDT-DD



CRDT-DD



SWT

Well/Borehole : 699-51-46	Test Interval Depth : 36.6 m to 51.2 m
Hydrologic Unit : Rattlesnake Ridge Interbed	Test Date(s) : 5/6-7/80; 11/16/82

Reference Document(s) : Graham et al. (1984) - RHO-RE-ST-12P
Strait and Moore (1982) - RHO-ST-38; PNL Files

Test Description:

Hydrologic tests conducted in this interval included a constant-rate discharge drawdown and recovery test and a slug injection and withdrawal test. The following is a brief description of the testing activities.

CRDT-DD — A constant-rate discharge test was conducted for a duration of 21 hr at an average flow rate of 10.2 L/min. Diagnostic analysis suggests a significant decrease in flow rate after 250 min. Straight-line analysis (Cooper and Jacob 1946) of drawdown data for the time period 100 to 250 min resulted in a transmissivity estimate of 3.1 m^2/d.

CRDT-RCV — Recovery response was monitored for a duration of 350 min following termination of pumping. Recovery response was affected by rapid drainage from the pump column; data were not used in the analysis.

SIT — A slug injection test was conducted by injecting a slug of known volume, resulting in a stress level (H_o) of 0.468 m. Data collection was terminated prior to complete formation recovery. Composite type-curve and derivative analysis (Ostrowski and Kloska 1989) of the early-time response resulted in a transmissivity estimate of 0.9 m^2/d.

SWT — A slug withdrawal test was conducted by withdrawing a slug of known volume, resulting in a stress level (H_o) of 0.488 m. Data collection was terminated prior to complete formation recovery. Because of an anomaly in the test response, assumed to result from initiating slug withdrawal before the formation had fully recovered from injection, slug withdrawal data were not analyzed.

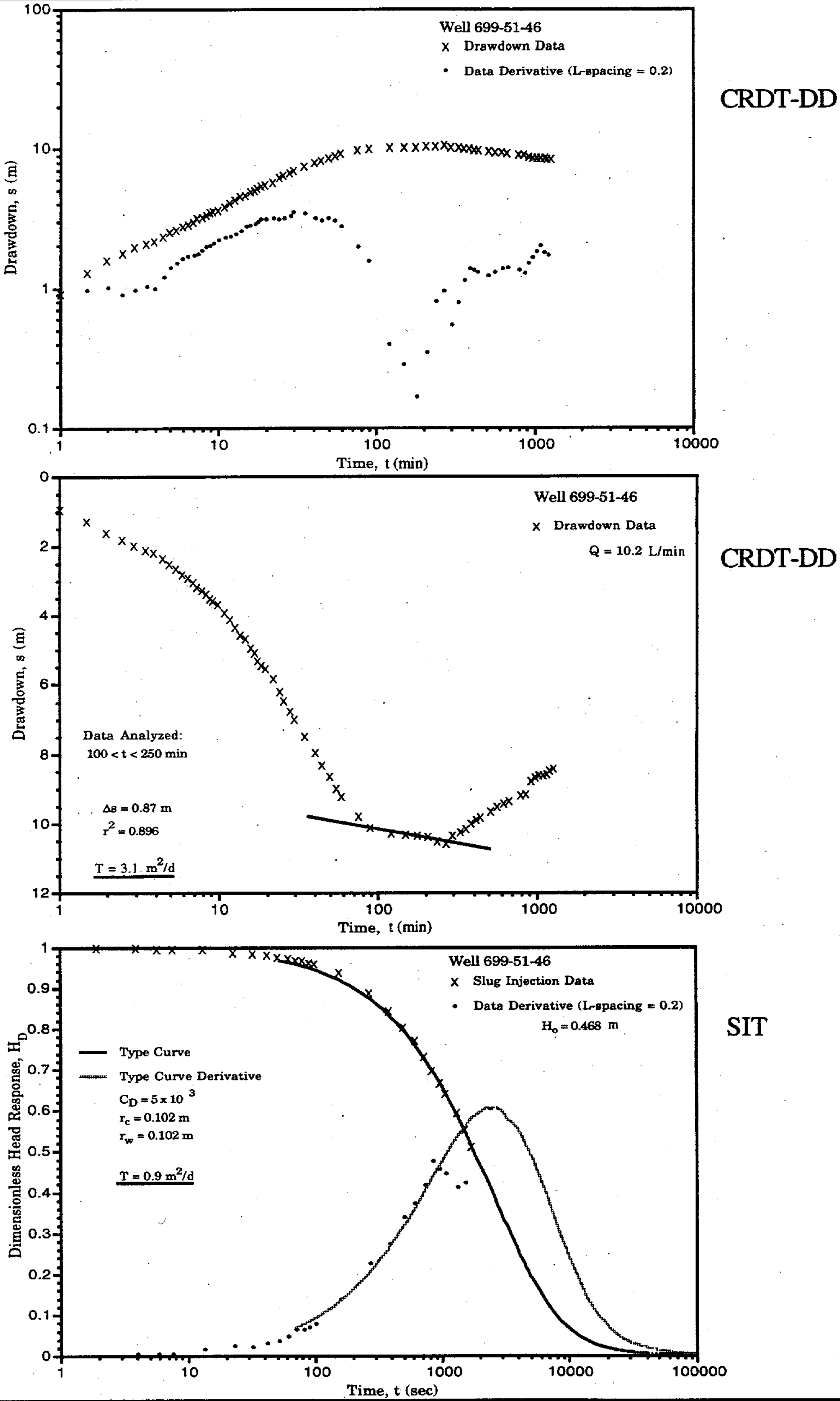
Comments:

Reanalysis of the hydrologic test response data discussed above provides comparable results with previously reported values (i.e., Graham et al. 1984; Strait and Moore 1982). The reanalysis best estimate is based on the constant-rate discharge drawdown data. The reanalyses are considered an improvement over those cited in the reference documents; the original analysis reported results for the constant-rate discharge recovery response.

Test Interval Specifications:

Effective Thickness : 13.7 m Wellbore Radius : 0.102 m Casing Radius : 0.102 m

Test Results:	Previous Analysis	Reanalysis
Transmissivity	Range : 0.3 - 10 m^2/d (Graham et al. 1984; Strait and Moore 1982)	Range : 0.9 - 3.1 m^2/d Best Estimate : 3.1 m^2/d


Well 699-51-46
X Drawdown Data
• Data Derivative (L-spacing = 0.2)
CRDT-DD
Drawdown, s (m)
Time, t (min)
Well 699-51-46
X Drawdown Data
Q = 10.2 L/min
CRDT-DD
Data Analyzed:
100 < t < 250 min
Δs = 0.87 m
r² = 0.896
T = 3.1 m²/d
Drawdown, s (m)
Time, t (min)
Well 699-51-46
X Slug Injection Data
• Data Derivative (L-spacing = 0.2)
H₀ = 0.468 m
SIT
Type Curve
Type Curve Derivative
C_D = 5 x 10 3
r_c = 0.102 m
r_w = 0.102 m
T = 0.9 m²/d
Dimensionless Head Response, H_D
Time, t (sec)

Well/Borehole : 699-52-46A	Test Interval Depth : 53.3 m to 68.6 m
Hydrologic Unit : Rattlesnake Ridge Interbed	Test Date(s) : 5/8-9/80; 11/16/82

Reference Document(s) : Graham et al. (1984) - RHO-RE-ST-12P
Strait and Moore (1982) - RHO-ST-38; PNL Files

Test Description:
Hydrologic tests conducted in this interval included a constant-rate discharge drawdown and recovery test and a slug injection and withdrawal test. The following is a brief description of the testing activities.

CRDT-DD — A constant-rate discharge test was conducted for a duration of 20.7 hr at an average flow rate of 178 L/min. Diagnostic analysis suggests a decrease in flow rate and/or vertical leakage after 50 min. Straight-line analysis (Cooper and Jacob 1946) of drawdown data for the time period 20 to 50 min resulted in a transmissivity estimate of 18 m^2/d.

CRDT-RCV — Recovery response was monitored for a duration of 180 min following termination of pumping. Diagnostic analysis of the recovery response showed the same late-time deflection observed during drawdown. Straight-line analysis (Theis 1935) of recovery data for times of 20 to 50 min after termination of pumping resulted in a transmissivity estimate of 16 m^2/d.

SIT — A slug injection test was conducted by injecting a slug of known volume, resulting in a stress level (H_o) of 0.391 m. Composite type-curve and derivative analysis (Ostrowski and Kloska 1989) yielded a transmissivity estimate of 19 m^2/d.

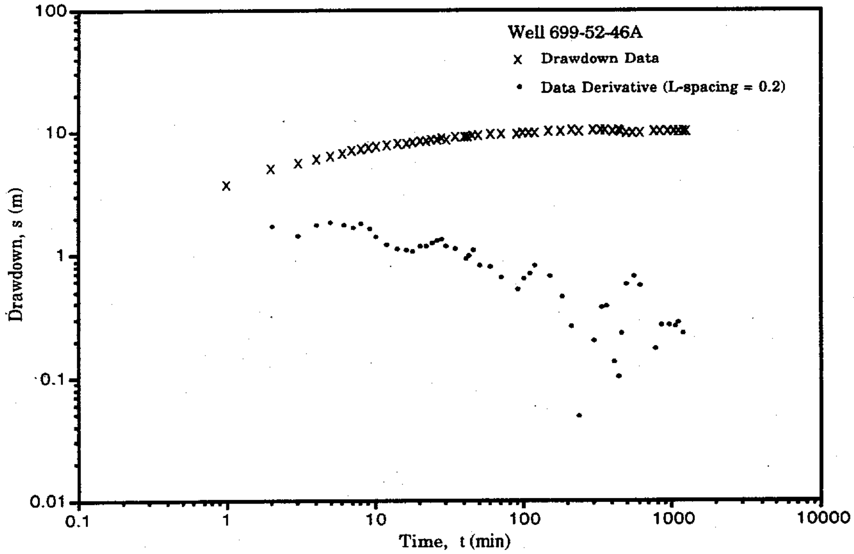
SWT — A slug withdrawal test was conducted by withdrawing a slug of known volume, resulting in a stress level (H_o) of 0.432 m. Composite type-curve and derivative analysis (Ostrowski and Kloska 1989) resulted in a transmissivity estimate of 28 m^2/d.

Comments:
Reanalysis of the hydrologic test response data discussed above provides comparable results with previously reported values (i.e., Graham et al. 1984; Strait and Moore 1982). Analysis of the constant-rate discharge and slug test response provides comparable results; the reanalysis best estimate is based on the average estimated transmissivity.

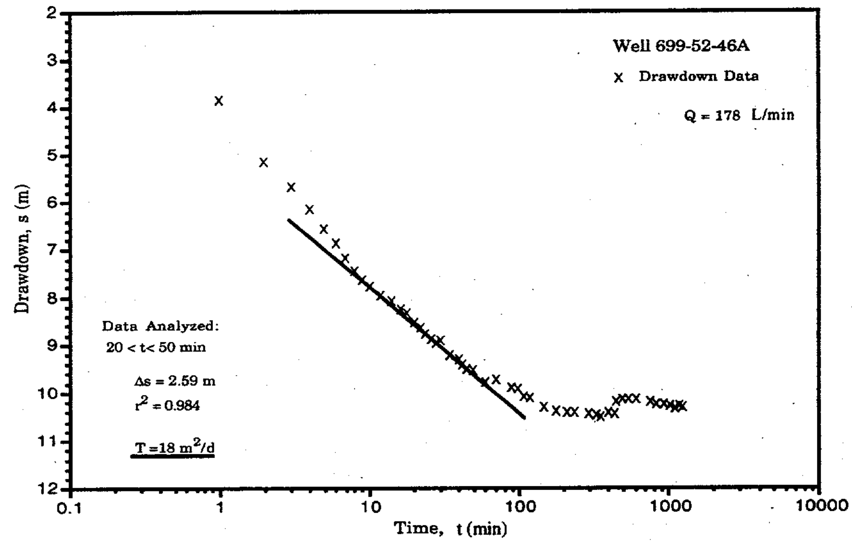
Test Interval Specifications:

Effective Thickness : 18.3 m   Wellbore Radius : 0.101 m   Casing Radius : 0.102 m

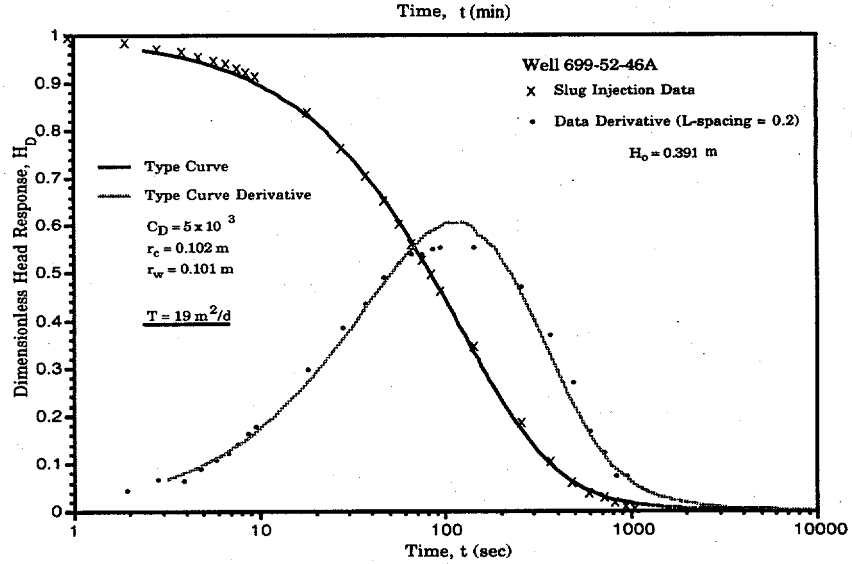
Test Results:	Previous Analysis	Reanalysis
Transmissivity	Range : 13 - 21 m^2/d (Graham et al. 1984; Strait and Moore 1982)	Range : 16 - 28 m^2/d Best Estimate : 20 m^2/d



CRDT-DD



CRDT-DD



SIT

Well/Borehole : 699-52-48	Test Interval Depth : 45.4 m to 59.4 m
Hydrologic Unit : Rattlesnake Ridge Interbed	Test Date(s) : 4/2-3/80; 11/22/82

Reference Document(s) : Graham et al. (1984) - RHO-RE-ST-12P
Strait and Moore (1982) - RHO-ST-38; PNL Files

Test Description:
Hydrologic tests conducted in this interval included a constant-rate discharge drawdown and recovery test and a slug injection and withdrawal test. The following is a brief description of the testing activities.

CRDT-DD A constant-rate discharge test was conducted for a duration of 14 hr at an average flow rate of 30.5 L/min. Diagnostic analysis suggests a decrease in flow rate after 350 min. Straight-line analysis (Cooper and Jacob 1946) of drawdown data for the time period 20 to 350 min resulted in a transmissivity estimate of 3.5 m^2/d.

CRDT-RCV Recovery response was monitored for a duration of 280 min following termination of pumping. Straight-line analysis (Theis 1935) of the recovery data for times greater than 30 min after termination of pumping resulted in a transmissivity estimate of 3.3 m^2/d.

SIT A slug injection test was conducted by injecting a slug of known volume, resulting in a stress level (H_o) of 0.440 m. Composite type-curve and derivative analysis (Ostrowski and Kloska 1989) yielded a transmissivity estimate of 7.0 m^2/d.

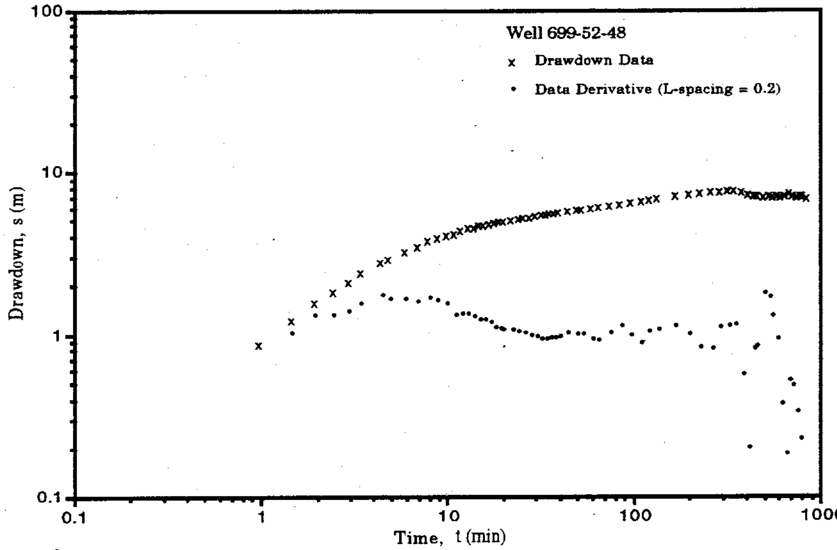
SWT A slug withdrawal test was conducted by withdrawing a slug of known volume, resulting in a stress level (H_o) of 0.403 m. Composite type-curve and derivative analysis (Ostrowski and Kloska 1989) yielded a transmissivity estimate of 9.0 m^2/d.

Comments:
Reanalysis of the hydrologic test response data discussed above provides comparable results with previously reported values (i.e., Graham et al. 1984; Strait and Moore 1982). The reanalysis best estimate is based on the constant-rate discharge drawdown and recovery response.

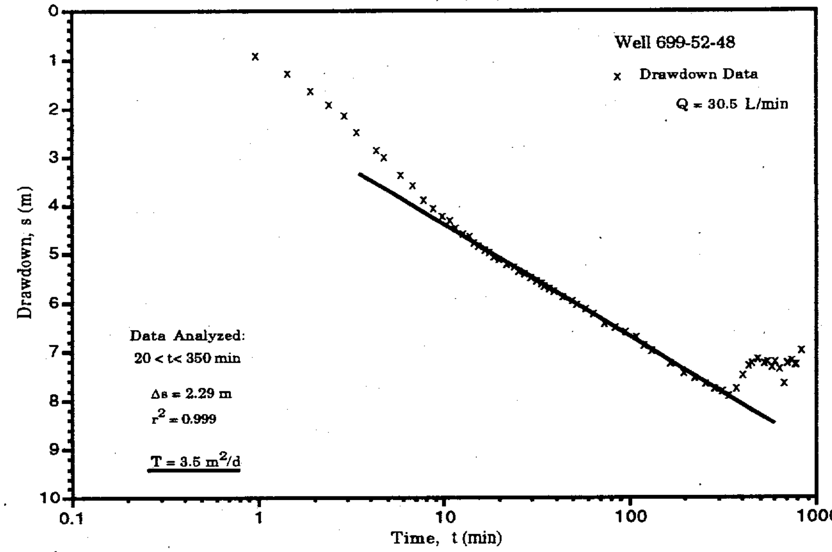
Test Interval Specifications:

Effective Thickness : 15.2 m Wellbore Radius : 0.102 m Casing Radius : 0.102 m

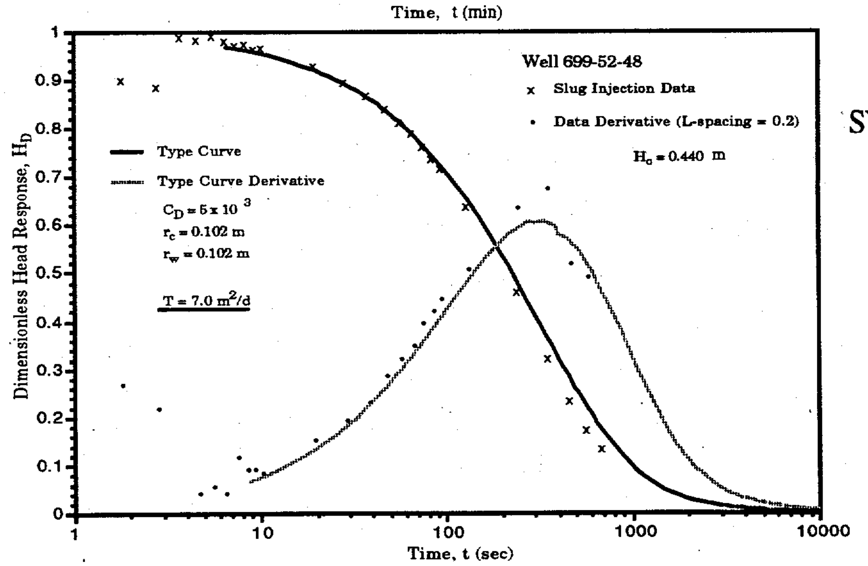
Test Results:	Previous Analysis	Reanalysis
Transmissivity	Range : 3.4 - 11 m^2/d (Graham et al. 1984; Strait and Moore 1982)	Range : 3.3 - 9.0 m^2/d Best Estimate : 3.4 m^2/d



CRDT-DD



CRDT-DD



SWT

Well/Borehole : 699-53-50	Test Interval Depth : 44.2 m to 59.1 m
Hydrologic Unit : Rattlesnake Ridge Interbed	Test Date(s) : 4/15-16/80; 11/23/82

Reference Document(s) : Graham et al. (1984) - RHO-RE-ST-12P
Strait and Moore (1982) - RHO-ST-38; PNL Files

Test Description:
Hydrologic tests conducted in this interval included a constant-rate discharge drawdown and recovery test and a slug injection and withdrawal test. The following is a brief description of the testing activities.

CRDT-DD — A constant-rate discharge test was conducted for a duration of 18.7 hr at an average flow rate of 26.1 L/min. Straight-line analysis (Cooper and Jacob 1946) of drawdown data for times greater than 40 min resulted in a transmissivity estimate of 50 m^2/d.

CRDT-RCV — Recovery response was monitored for a duration of 720 min following termination of pumping. Recovery response was affected by rapid drainage from the pump column; data were not used in the analysis.

SIT — A slug injection test was conducted by injecting a slug of known volume, resulting in a stress level (H_o) of 0.442 m. The slug test exhibited an oversteepened response, resulting from problems during injection of the slug rod. Composite type-curve and derivative analysis (Ostrowski and Kloska 1989) of late-time data resulted in a transmissivity estimate of 30 m^2/d.

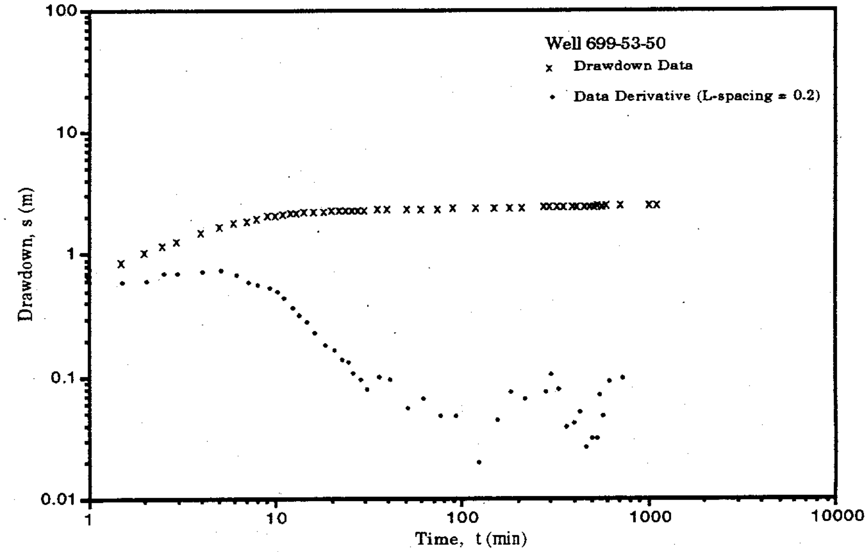
SWT — A slug withdrawal test was conducted by withdrawing a slug of known volume, resulting in a stress level (H_o) of 0.485 m. The slug test exhibited an oversteepened response, resulting from problems during withdrawal of the slug rod. Composite type-curve and derivative analysis (Ostrowski and Kloska 1989) of late-time data resulted in a transmissivity estimate of 32 m^2/d.

Comments:
Reanalysis of the hydrologic test response data discussed above provides comparable results with previously reported values (i.e., Graham et al. 1984; Strait and Moore 1982). The reanalysis best estimate is based on the constant-rate discharge drawdown data. The reanalyses are considered an improvement over those cited in the reference document; the original analysis reported results for the constant-rate discharge recovery response.

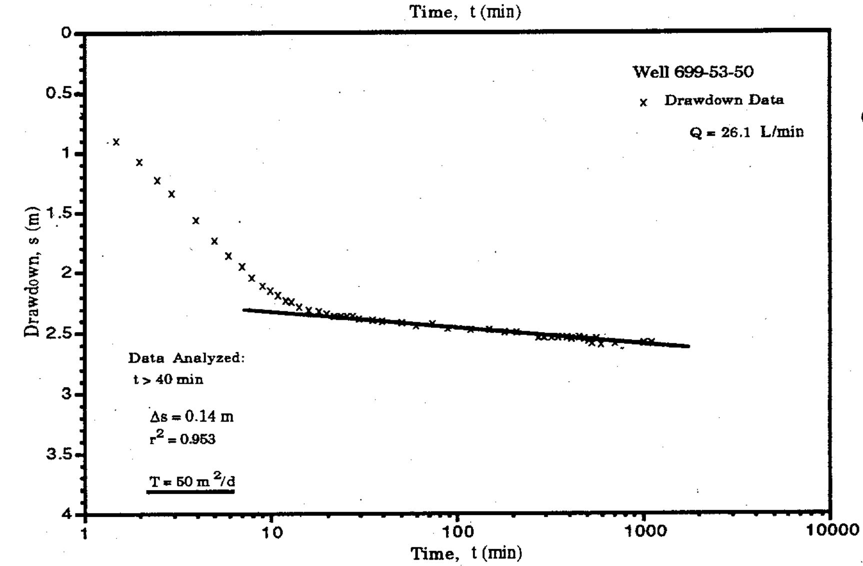
Test Interval Specifications:

Effective Thickness : 15.2 m   Wellbore Radius : 0.102 m   Casing Radius : 0.102 m

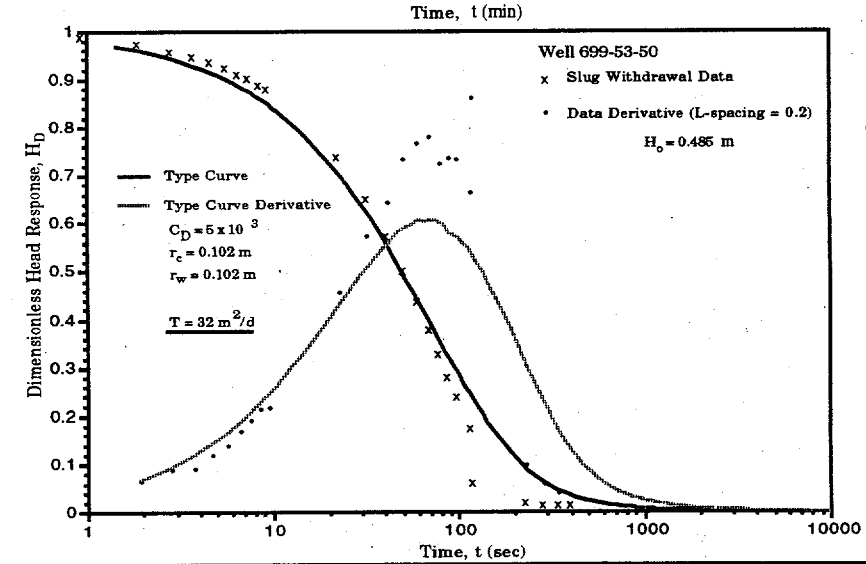
Test Results:	Previous Analysis	Reanalysis
Transmissivity	Range : 50 - 85 m^2/d (Graham et al. 1984; Strait and Moore 1982)	Range : 30 - 50 m^2/d Best Estimate : 50 m^2/d



CRDT-DD



CRDT-DD



SWT

Well/Borehole : 699-54-57	Test Interval Depth : 74.7 m to 97.8 m
Hydrologic Unit : Rattlesnake Ridge Interbed	Test Date(s) : 5/17-18/82; 11/11/82
Reference Document(s) : Graham et al. (1984) - RHO-RE-ST-12P; PNL Files	

Test Description:
Hydrologic tests conducted in this interval included a constant-rate discharge drawdown and recovery test and a slug injection and withdrawal test. The following is a brief description of the testing activities.

CRDT-DD — A constant-rate discharge test was conducted for a duration of 19 hr at an average flow rate of 36.9 L/min. There were difficulties maintaining a constant flow rate throughout the test. Straight-line analysis (Cooper and Jacob 1946) of drawdown data for times greater than 20 min resulted in a transmissivity estimate of 12 m^2/d.

CRDT-RCV — Recovery response was monitored for a duration of 275 min following termination of pumping. Straight-line analysis (Theis 1935) of the recovery data for times greater than 20 min after termination of pumping resulted in a transmissivity estimate of 12 m^2/d.

SIT — A slug injection test was conducted by injecting a slug of known volume, resulting in a stress level (H_o) of 0.718 m. The slug test exhibited an oversteepened response, resulting from problems during injection of the slug rod.

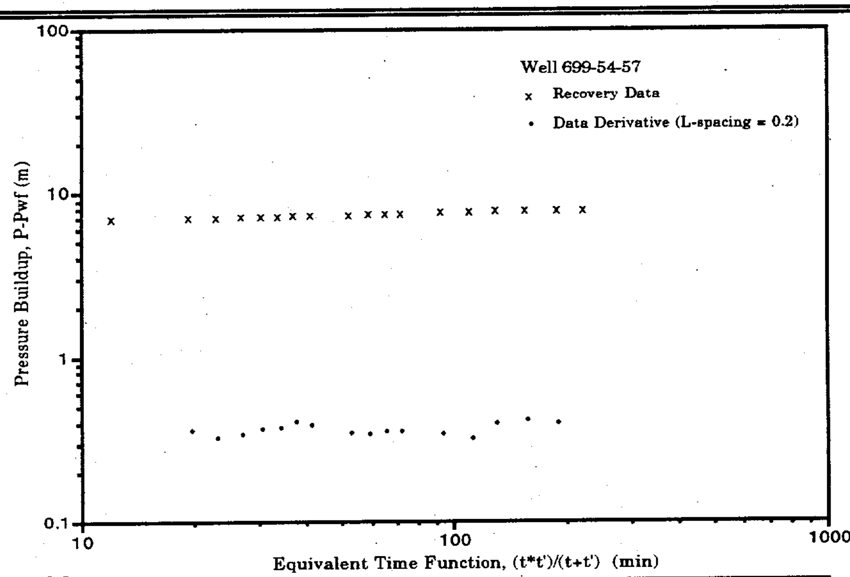
SWT — A slug withdrawal test was conducted by withdrawing a slug of known volume, resulting in a stress level (H_o) of 0.800 m. Composite type-curve and derivative analysis (Ostrowski and Kloska 1989) yielded a transmissivity estimate of 12 m^2/d.

Comments:
Reanalysis of the hydrologic test response data discussed above provides comparable results with previously reported values (i.e., Graham et al. 1984). Analysis of the constant discharge and slug test response provides comparable results; the reanalysis best estimate is based on the average estimated transmissivity.

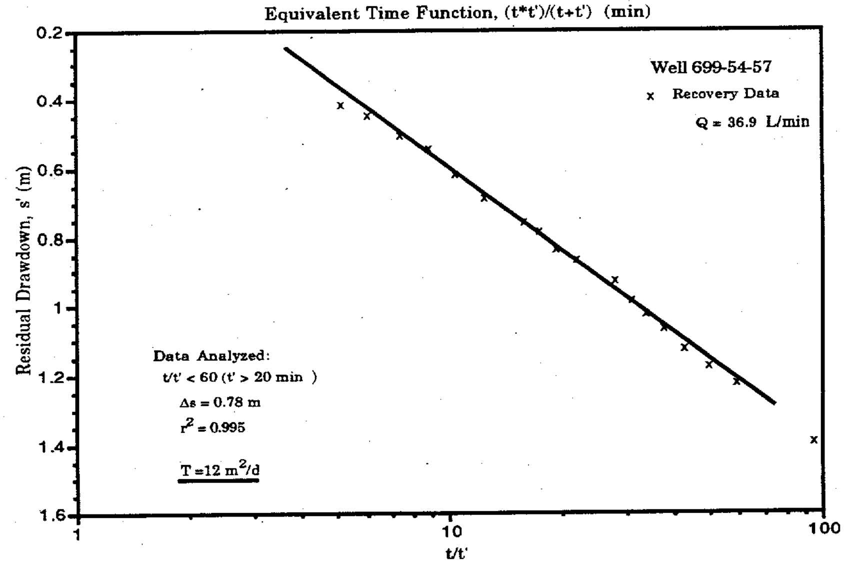
Test Interval Specifications:

Effective Thickness : 16.6 m Wellbore Radius : 0.076 m Casing Radius : 0.076 m

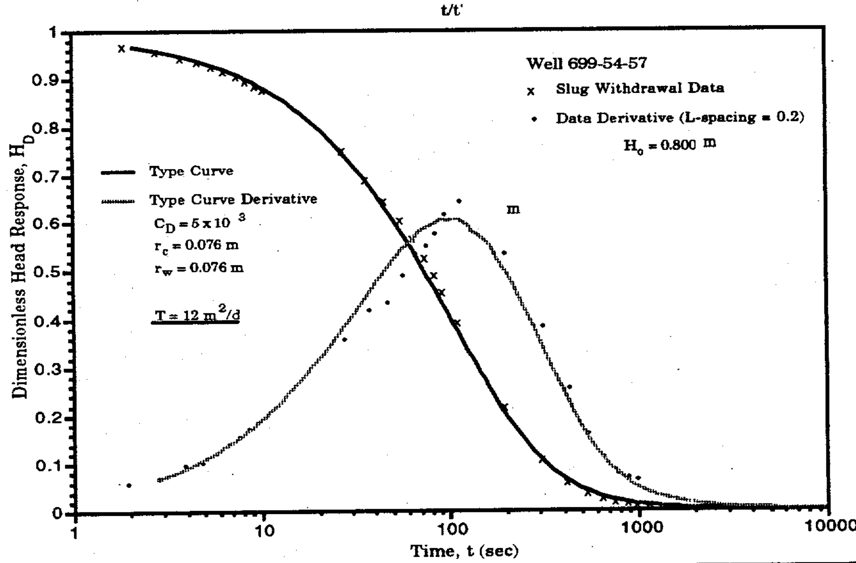
Test Results:	Previous Analysis	Reanalysis
Transmissivity	Range : 12 - 19 m^2/d (Graham et al. 1984)	Range : 12 m^2/d Best Estimate : 12 m^2/d



CRDT-RCV



CRDT-RCV



SWT

Well/Borehole : 699-56-53	Test Interval Depth : 61.0 m to 82.3 m
Hydrologic Unit : Rattlesnake Ridge Interbed	Test Date(s) : 6/2-4/82; 11/22/82
Reference Document(s) : Graham et al. (1984) - RHO-RE-ST-12P; PNL Files	

Test Description:
Hydrologic tests conducted in this interval included a constant-rate discharge drawdown and recovery test and a slug injection and withdrawal test. The following is a brief description of the testing activities.

CRDT-DD A constant-rate discharge test was conducted for a duration of 37.3 hr at an average flow rate of 98.0 L/min. Because the drawdown response was so strongly affected by pumping-rate variations throughout the test, drawdown data were not used in the analysis.

CRDT-RCV Recovery response was monitored for a duration of 800 min following termination of pumping. Diagnostic analysis indicates a response to flow-rate variations experienced during pumping and/or vertical leakage after 20 min. Straight-line analysis (Theis 1935) of the recovery data for times of 8 to 20 min after termination of pumping resulted in a transmissivity estimate of 28 m^2/d.

SIT A slug injection test was conducted by injecting a slug of known volume, resulting in a stress level (H_o) of 0.440 m. Composite type-curve and derivative analysis (Ostrowski and Kloska 1989) yielded a transmissivity estimate of 25 m^2/d.

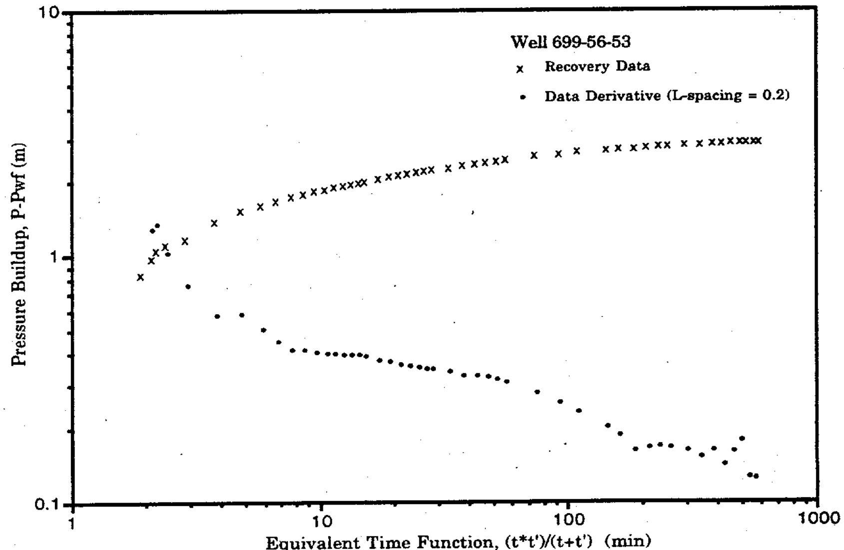
SWT A slug withdrawal test was conducted by withdrawing a slug of known volume, resulting in a stress level (H_o) of 0.487 m. Composite type-curve and derivative analysis (Ostrowski and Kloska 1989) yielded a transmissivity estimate of 27 m^2/d.

Comments:
Reanalysis of the hydrologic test response data discussed above provides comparable results with previously reported values (i.e., Graham et al. 1984). Analysis of the constant discharge recovery and slug test response provides comparable results; the reanalysis best estimate is based on the average estimated transmissivity.

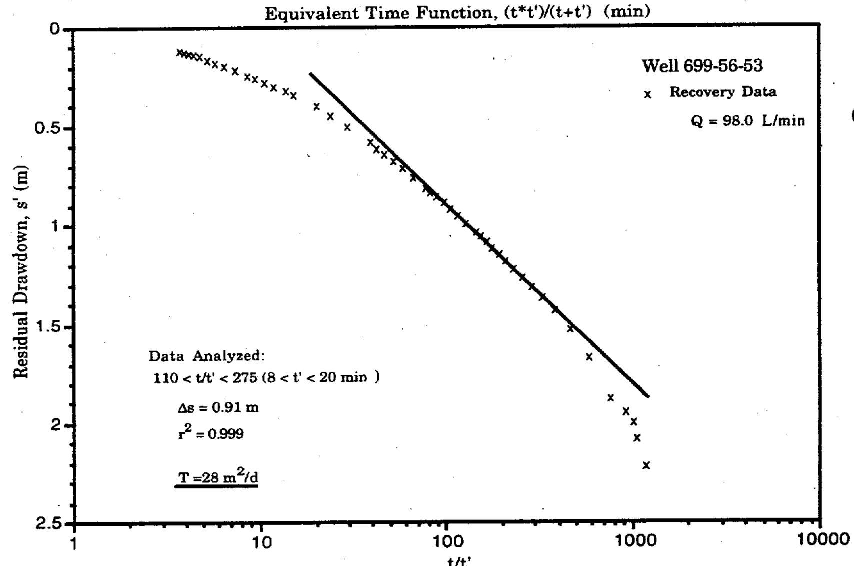
Test Interval Specifications:

Effective Thickness : 18.6 m   Wellbore Radius : 0.102 m   Casing Radius : 0.102 m

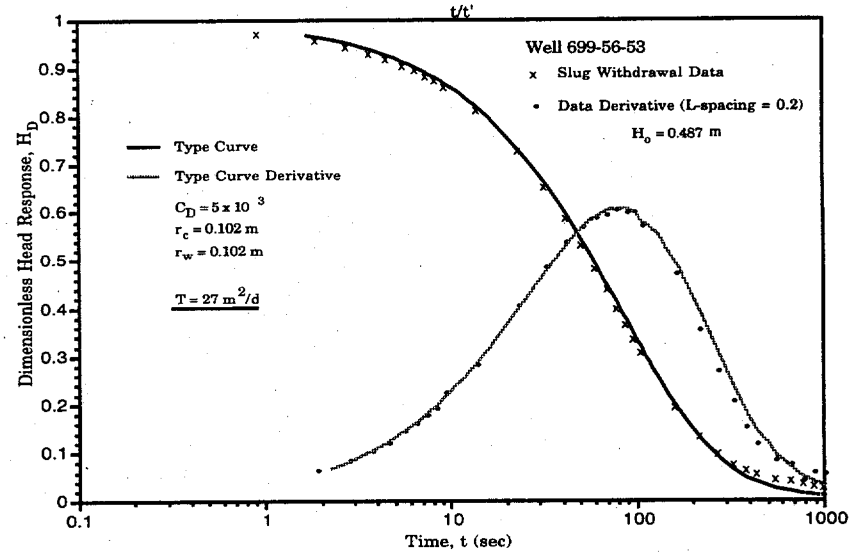
Test Results:	Previous Analysis	Reanalysis
Transmissivity	Range : 27 - 85 m^2/d (Graham et al. 1984)	Range : 25 - 28 m^2/d Best Estimate : 27 m^2/d



CRDT-RCV



CRDT-RCV



SWT

Well/Borehole : 699-84-34B	Test Interval Depth : 112.5 m to 144.8 m
Hydrologic Unit : Elephant Mt. Interflow	Test Date(s) : 1/21/80
Reference Document(s) : Strait (1980) in PNL Files	

Test Description:
Hydrologic testing for this well test site included test data collected during two short-duration constant-rate pumping tests. The following is a brief description of the testing activities.

CRDT-DD1 A constant-rate discharge air-lift test was conducted for a duration of 179 min. Average discharge during the test was 30.3 L/min. No variation in flow rate was reported. No pressure drawdown readings were recording during the active air-lift pumping test phase.

CRDT-RCV1 Recovery following termination of the constant-rate air-lift test was monitored routinely for 373 min. Diagnostic analysis indicates that radial flow conditions were established after approximately 6 min and were maintained until 60 min into the recovery period. Analysis results, using the Theis (1935) recovery straight-line method, indicated a transmissivity of 0.4 m^2/d.

CRDT-DD2 A constant-rate discharge test was conducted for 342 min. Average discharge during the test was 28.2 L/min. Straight-line analysis (Cooper and Jacob 1946) of the indicated radial flow portion of the drawdown data yielded a transmissivity estimate of 0.32 m^2/d.

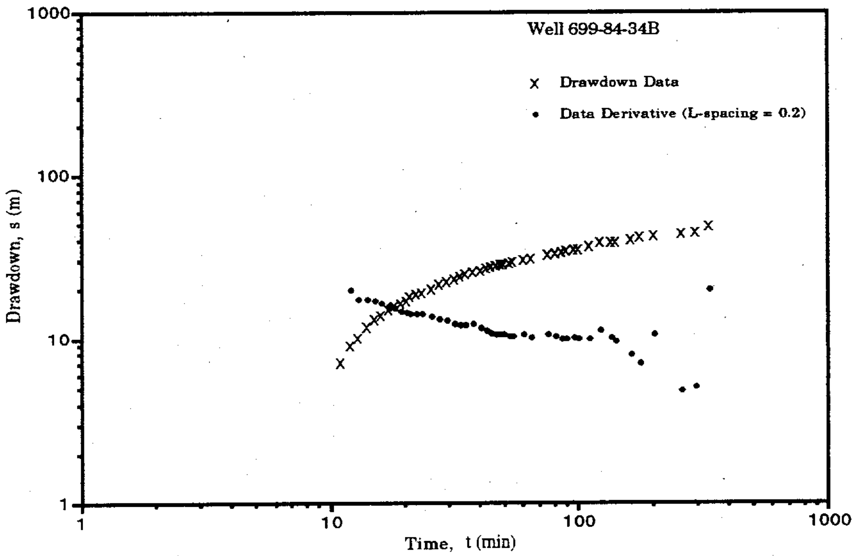
CRDT-RCV2 Recovery following termination of the constant-rate test was monitored routinely for 140 min. Analysis results using the Theis (1935) recovery straight-line method provided a transmissivity of 0.45 m^2/d.

Comments:
Reanalysis of the hydrologic test response data discussed above provides nearly identical results with previously listed analysis values in PNL files. The reanalysis best estimate represents the average result obtained from the constant-rate test recovery and drawdown analyses.

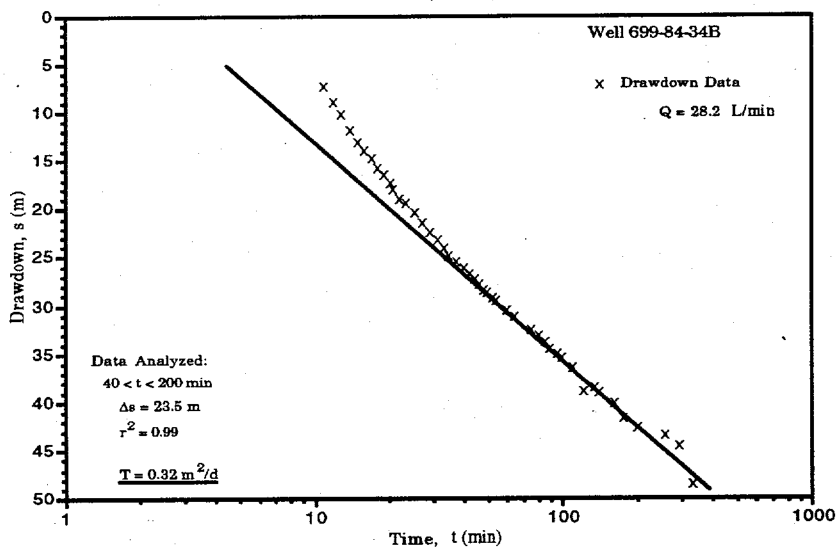
Test Interval Specifications:

Effective Thickness : 10.0 m   Wellbore Radius : 0.050 m   Casing Radius : 0.039 m

Test Results:	Previous Analysis	Reanalysis
Transmissivity	Range : 0.32 - 0.52 m^2/d Best Estimate : 0.41 m^2/d (Graham et al. 1984)	Range : 0.32 - 0.45 m^2/d Best Estimate : 0.39 m^2/d



CRDT-DD2



CRDT-DD2

Well/Borehole : 699-84-34B	Test Interval Depth : 144.8 m to 164.0 m
Hydrologic Unit : Rattlesnake Ridge Interbed	Test Date(s) : 1/15-16/80
Reference Document(s) : Strait (1980) in PNL Files	

Test Description:
Hydrologic testing for this well test site included test data collected during one long- and one short-duration constant-rate pumping test. The following is a brief description of the testing activities.

CRDT-DD1 A constant-rate discharge air-lift test was conducted for a duration of 1260 min. The discharge rate ranged between 45.8 and 39.7 L/min, and reportedly averaged 42.0 L/min for the entire test. No pressure drawdown readings were recorded during the active air-lift pumping test phase.

CRDT-RCV1 Recovery following termination of the constant-rate air-lift test was monitored routinely for 1600 min. Diagnostic analysis indicates that radial flow conditions were established after approximately 40 min and were maintained until 400 min into the recovery period. Analysis results, using the Theis (1935) recovery straight-line method, yielded a transmissivity of 2.0 m^2/d.

CRDT-DD2 A short-duration constant-discharge test was conducted for 205 min primarily to support hydrochemical sampling. The discharge rate ranged between 36.3 and 7.6 L/min, and reportedly averaged 7.8 L/min. Drawdown data were adversely affected by fluctuations in the discharge rate, which were associated with hydrochemical sampling activities. Because of these effects, no reliable analysis of the drawdown data was possible.

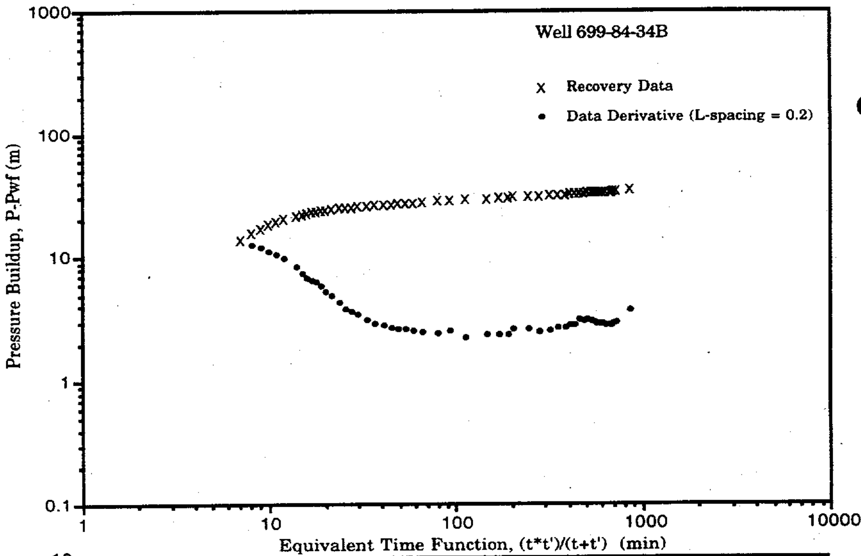
CRDT-RCV2 Because of a malfunction in the test recording system, only a few recovery water levels were obtained following termination of the short-duration constant-rate test. In addition, the submersible pump was pulled during the recovery period, causing additional adverse effects to the recovery record. Because of these factors, no reliable analysis of the available recovery data was possible.

Comments:
Reanalysis of the hydrologic test response data discussed above provides nearly identical results with previously listed analysis values in PNL files. The reanalysis best estimate represents the result obtained from the recovery following the constant-rate air-lift test.

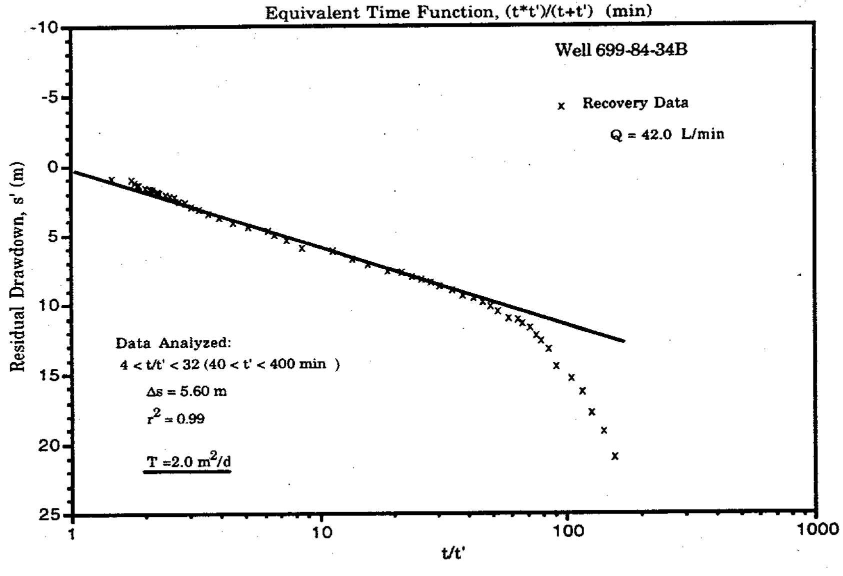
Test Interval Specifications:

Effective Thickness : 5.8 m   Wellbore Radius : 0.050 m   Casing Radius : 0.039 m

Test Results:	Previous Analysis	Reanalysis
Transmissivity	Range : 1.5 - 1.9 m^2/d Best Estimate : 1.9 m^2/d (Strait 1980 in PNL files)	Range : 2.0 m^2/d Best Estimate : 2.0 m^2/d



CRDT-RCV1



CRDT-RCV1

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