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Forsmark site investigation

Single-hole injection tests in borehole KFM04A

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January 2005

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Abstract

This report presents injection tests performed using the pipe string system PSS3 in borehole KFM04A in Forsmark and the test results. Borehole KFM04A is the fourth deep core-drilled borehole drilled within the site investigations in the Forsmark area. It is designed as a so called telescopic borehole, with an enlarged diameter in the upper approximately 100 m, which makes it possible to install certain borehole equipment. The borehole is inclined c 60° from the horizontal plane, about 1,000 m long and cased to about 107 m borehole length. The borehole diameter is about 77 mm in the interval c 109–1,001 m.

The main aim of the injection tests in KFM04A was to characterize the hydraulic conditions in rock adjacent to the borehole on different measurement scales (100 m, 20 m and 5 m). Hydraulic parameters such as transmissivity, hydraulic conductivity, dominating flow regime and possible outer hydraulic boundaries were determined using analysis methods for stationary as well as transient conditions. In addition, a comparison with the results of previously performed difference flow logging was made.

The injection tests gave consistent results on the different measurement scales regarding transmissivity. During most of the tests, some period with pseudo-radial flow could be identified from the injection period, making a relatively straight-forward transient evaluation possible. However, the recovery periods were often strongly affected by wellbore storage, making a transient evaluation of this period more difficult.

The injection test results were generally consistent with the results from the previous difference flow logging in KFM04A. Some differences were found, however, particularly for sections of low transmissivity.

The injection tests provide a database for statistical analysis of the hydraulic conductivity distribution along the borehole on the different measurement scales. Basic statistical parameters for the tests are presented in this report.

Sammanfattning

Föreliggande rapport beskriver genomförda injektionstester med rörgångssystemet PSS3 i borrhål KFM04A i Forsmark samt resultaten från desamma. Borrhål KFM04A är det fjärde djupa kärnborrhålet i platsundersökningarna i Forsmarksområdet. Det är utfört som ett så kallat teleskopborrhål för att göra det möjligt att installera viss borrhålsutrustning i de övre, ca 100 m med större diameter än resten av borrhålet. Borrhålet är ansatt med en lutning av ca 60° från horisontalplanet, är drygt 1 000 m långt och försett med foderrör till ca 107 m. Borrhålsdiametern är ca 77 mm i intervallet 109–1 001 m.

Huvudsyftet med injektionstesterna var att karaktärisera berggrundsakvifären runt borrhålet i olika mätskalor (100 m, 20 m och 5 m) med avseende på hydrogeologiska egenskaper. Hydrauliska parametrar såsom transmissivitet, konduktivitet, dominerande flödesregim och eventuella yttre hydrauliska randvillkor bestämdes med hjälp av analysmetoder för såväl stationära som transienta förhållanden.

En jämförelse med resultaten av den tidigare utförda differensflödesloggningen i KFM04A gjordes också.

Injektionstesterna gav samstämmiga resultat för de olika mätskalorna beträffande transmissivitet. Under de flesta tester kunde en viss period med pseudo-radiellt flöde identifieras från flödesperioden, vilket möjliggjorde en standardmässig transient utvärdering. Återhämtningsperioden var däremot ofta starkt påverkad av brunnsmagasinseffekter, vilket gjorde en unik transient utvärdering av denna period svårare.

Injektionstesterna gav även samstämmiga resultat med den tidigare differensflödesloggning en i KFM04A, även om vissa avvikelser fanns för beräknade transmissiviteter i samma 5 m sektioner, i synnerhet för lågtransmissiva sektioner.

Resultaten från injektionstesterna utgör en databas för statistisk analys av den hydrauliska konduktivitetens fördelning längs borrhålet i de olika mätskalorna. Viss statistisk analys har utförts inom ramen för denna aktivitet och grundläggande statistiska parametrar presenteras i rapporten.

Contents

1 Introduction

Injection tests were carried in borehole KFM04A at Forsmark, Sweden, out during August and September 2004 by Geosigma AB. Borehole KFM04A was the fourth deep cored borehole within the on-going site investigation in the Forsmark area. The borehole is a so called telescopic borehole. This makes it possible to install certain borehole equipment in the upper c 100 m where the diameter is larger than in the rest of the borehole. The borehole is inclined c 60° from the horizontal plane, about 1,000 m long and cased to about 107 m borehole length. The borehole diameter is c 77 mm in the interval 108.69–1,001.42 m. The location of the borehole is shown in Figure 1-1.

In KFM04A, difference flow logging was previously performed during March 2004. According to the results of this investigation, 71 conductive fractures were detected and the most conductive ones were found at 112.4, 116.1, 202.8, 232.7 and 235.6 m depth (Rouhainen and Pöllänen, 2004 /1/).

This document reports the results obtained from the injection tests in borehole KFM04A. The activity is performed within the Forsmark site investigation. The work was carried out in compliance with the SKB internal controlling documents presented in Table 1-1. Data and results were delivered to the SKB site characterization database.

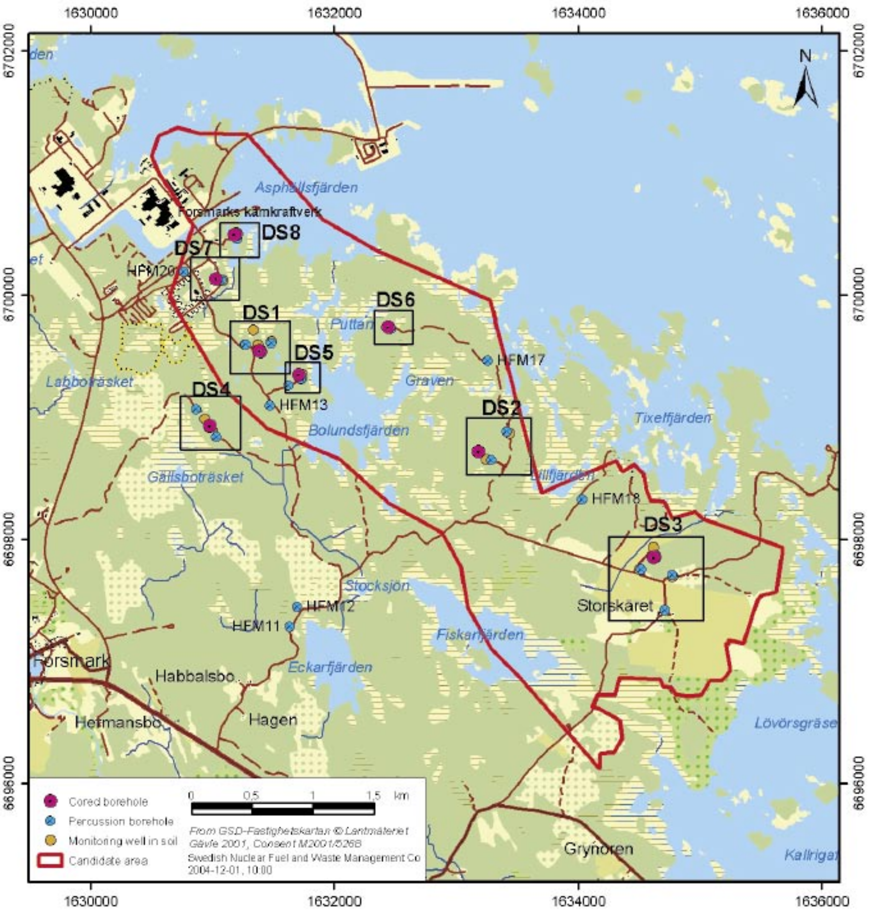

Figure 1-1. *The investigation area at Forsmark including the candidate area selected for more detailed investigations and the first eight drill sites. Borehole KFM04A is situated at drill site DS4.*

Table 1-1. SKB internal controlling documents for performance of the activity.

Activity Plan	Number	Version
Hydraulic injection tests in borehole KFM04A with PSS3	AP PF 400-04-27	1.0
Method descriptions	**Number**	**Version**
Mätsystembeskrivning (MSB) – Allmän del. Pipe String System (PSS3).	SKB MD 345.100	1.0
Mätsystembeskrivning för: Kalibrering, PSS3.	SKB MD 345.122	1.0
Mätsystembeskrivning för: Skötsel, service, serviceprotokoll, PSS3.	SKB MD 345.124	1.0
Metodbeskrivning för hydrauliska injektionstester	SKB MD 323.001	1.0
Instruktion för analys av injektions- och enhålspumptester	SKB MD 320.004	1.0
Instruktion för rengöring av borrhålsutrustning och viss markbaserad utrustning	SKB MD 600.004	1.0

2 Objectives

The main aim of the injection tests in borehole KFM04A was to characterize the hydraulic properties of the rock adjacent to the borehole on different measurement scales (100 m, 20 m and 5 m). The primary parameter to be determined was hydraulic transmissivity from which hydraulic conductivity can be derived. The results of the injection tests provide a database which can be used for statistical analyses of the hydraulic conductivity distribution along the borehole on different measurement scales. Basic statistical analyses are presented in this report.

Other hydraulic parameters of interest were flow regimes and outer hydraulic boundaries. These parameters were analysed using transient evaluation on the test responses during the flow- and recovery periods.

A comparison with the results of the previously performed difference flow logging in KFM04A was also included in the activity, as a check of the plausibility of the test results. Further, the combined analysis of the injection tests and the difference flow logging provides a more comprehensive understanding of the hydraulic conditions of borehole KFM04A.

3 Scope

3.1 Boreholes

Technical data of the tested borehole are shown in Table 3-1 and in Appendix 4. The reference point of the boreholes is defined as the centre of top of casing (ToC), given as "Elevation" in the table below. The Swedish National coordinate system (RT90) is used for the horizontal coordinates together with RHB70 for the elevation. "Northing" and "Easting" refer to the top of the boreholes.

Table 3-1. Technical data of borehole KFM04A (printout from SKB database, SICADA).

Borehole length (m):	**1,001.420**				
Drilling Period(s):	**From Date**	**To Date**	**Secup (m)**	**Seclow (m)**	**Drilling Type**
	2003-05-20	2003-06-30	0.000	106.950	Percussion drilling
	2003-08-25	2003-11-19	107.420	1,001.420	Core drilling
Starting point coordinate:	**Length (m)**	**Northing (m)**	**Easting (m)**	**Elevation**	**Coord System**
	0.000	6698921.744	1630978.964	8.771	RT90–RHB70
Angles:	**Length (m)**	**Bearing**	**Inclination (– = down)**		
	0.000	45.244	–60.081		
Borehole diameter:	**Secup (m)**	**Seclow (m)**	**Hole Diam (m)**		
	0.000	12.030	0.350		
	107.330	107.420	0.161		
	107.420	108.690	0.086		
	108.690	1,001.420	0.077		
Core diameter:	**Secup (m)**	**Seclow (m)**	**Core Diam (m)**		
	107.420	108.690	0.072		
	108.690	1,000.890	0.051		
	1,000.890	1,001.420	0.062		
Casing diameter:	**Secup (m)**	**Seclow (m)**	**Case In (m)**	**Case Out (m)**	
	0.000	12.030	0.265	0.273	
	0.000	106.910	0.200	0.208	
	106.910	106.950	0.170	0.208	

3.2 Tests performed

The injection tests in borehole KFM04A, performed according to Activity Plan AP PF 400-04-27 (SKB internal controlling document), are listed in Table 3-2. The injection tests were carried out with the Pipe String System (PSS3). The test procedure and the equipment are described in the measurement system description for PSS (SKB MD 345.100, SKB internal controlling document) and in the corresponding method descriptions for hydraulic injection tests (SKB MD 323.001, Metodbeskrivning för Hydrauliska injektionstester, SKB internal controlling document). Some of the tests were not performed as intended because the time required for achieving a constant head in the test section was judged to be too long or in other cases, equipment malfunctions caused pressure and/or flow rate disturbances, see Section 5.5. Whenever such disturbances were expected to affect data evaluation, the test was repeated. Test number (Test no in Table 3-2) refers to the number of tests performed in the actual section. For evaluation, only data from the last test in each section were used.

The upper and lower limits of the test sections used for the injection tests were as close as possible to the section limits used during the previous sequential difference flow logging in 5 m sections in KFM04A /1/. However, for the latter investigation, the steps of the measurement section in the borehole were found to be slightly larger than 5 m after the length calibration of the measurements. Therefore, the section limits used for the injection tests and sequential difference flow logging differed with a maximum of 0.8 m. In addition, some of the injection test sections were intentionally shifted from the positions used during the sequential difference flow logging in order to avoid cavities in the borehole.

Table 3-2. Single-hole injection tests performed in borehole KFM04A.

Borehole Bh ID	Test section secup	 seclow	Section length	Test type[1)] (1–6)	Test no	Test start date, time YYYYMMDD hh:mm	Test stop date, time YYYYMMDD hh:mm
KFM04A	117.00	217.00	100	3	1	20040823 09:11	20040823 10:59
KFM04A	217.00	317.00	100	3	1	20040823 13:54	20040823 15:36
KFM04A	317.00	417.00	100	3	1	20040823 17:07	20040823 18:47
KFM04A	417.00	517.00	100	3	1	20040824 08:43	20040824 10:25
KFM04A	517.00	617.00	100	3	1	20040824 13:14	20040824 14:57
KFM04A	617.00	717.00	100	3	2	20040830 17:37	20040830 19:27
KFM04A	717.00	817.00	100	3	1	20040825 12:53	20040825 14:52
KFM04A	817.00	917.00	100	3	2	20040827 13:53	20040827 15:56
KFM04A	872.00	972.00	100	3	1	20040827 09:01	20040827 11:35
KFM04A	117.00	137.00	20	3	1	20040902 11:11	20040902 13:32
KFM04A	137.00	157.00	20	3	1	20040902 14:07	20040902 16:09
KFM04A	157.00	177.00	20	3	1	20040902 18:02	20040902 19:31
KFM04A	177.00	197.00	20	3	1	20040903 08:30	20040903 09:49
KFM04A	197.00	217.00	20	3	1	20040903 10:11	20040903 11:41
KFM04A	217.00	237.00	20	3	1	20040903 13:34	20040903 14:59
KFM04A	237.00	257.00	20	3	1	20040906 09:04	20040906 10:23
KFM04A	257.00	277.00	20	3	1	20040906 10:43	20040906 12:00
KFM04A	277.00	297.00	20	3	1	20040906 12:55	20040906 14:09
KFM04A	297.00	317.00	20	3	1	20040906 14:36	20040906 15:50
KFM04A	317.00	337.00	20	3	1	20040906 17:11	20040906 18:01
KFM04A	337.00	357.00	20	3	1	20040907 08:25	20040907 09:41
KFM04A	357.00	377.00	20	3	1	20040907 10:06	20040907 11:20
KFM04A	377.00	397.00	20	3	1	20040907 12:10	20040907 13:26
KFM04A	397.00	417.00	20	3	1	20040907 14:26	20040907 15:35
KFM04A	417.00	437.00	20	3	1	20040907 15:57	20040907 17:11
KFM04A	437.00	457.00	20	3	1	20040908 08:28	20040908 09:11

Borehole Bh ID	Test section secup	 seclow	Section length	Test type[1)] (1–6)	Test no	Test start date, time YYYYMMDD hh:mm	Test stop date, time YYYYMMDD hh:mm
KFM04A	453.00	473.00	20	3	1	20040908 09:57	20040908 11:12
KFM04A	473.00	493.00	20	3	1	20040908 11:33	20040908 13:25
KFM04A	477.00	497.00	20	3	1	20040908 13:38	20040908 14:54
KFM04A	497.00	517.00	20	3	1	20040908 15:13	20040908 15:55
KFM04A	517.00	537.00	20	3	1	20040908 16:11	20040908 17:27
KFM04A	297.00	302.00	5	3	1	20040910 14:43	20040910 16:03
KFM04A	302.00	307.00	5	3	1	20040913 09:58	20040913 11:21
KFM04A	307.00	312.00	5	3	1	20040913 11:33	20040913 13:26
KFM04A	312.00	317.00	5	3	1	20040913 13:38	20040913 14:55
KFM04A	317.00	322.00	5	3	1	20040913 15:07	20040913 16:22
KFM04A	322.00	327.00	5	3	1	20040913 16:34	20040913 17:52
KFM04A	327.00	332.00	5	3	1	20040913 18:04	20040913 19:19
KFM04A	332.00	337.00	5	3	1	20040914 08:13	20040914 09:39
KFM04A	337.00	342.00	5	3	1	20040914 09:49	20040914 11:05
KFM04A	342.00	347.00	5	3	1	20040914 11:21	20040914 13:13
KFM04A	347.00	352.00	5	3	1	20040921 12:54	20040921 14:11
KFM04A	352.00	357.00	5	3	1	20040921 10:35	20040921 11:56
KFM04A	357.00	362.00	5	3	1	20040915 18:05	20040915 19:21
KFM04A	362.00	367.00	5	3	1	20040915 19:36	20040915 20:25
KFM04A	367.00	372.00	5	3	1	20040916 08:18	20040916 09:13
KFM04A	372.00	377.00	5	3	1	20040916 09:25	20040916 10:09
KFM04A	377.00	382.00	5	3	1	20040916 10:21	20040916 11:04
KFM04A	382.00	387.00	5	3	1	20040916 11:15	20040916 12:34
KFM04A	387.00	392.00	5	3	1	20040916 12:47	20040916 13:31
KFM04A	392.00	397.00	5	3	1	20040916 13:47	20040916 15:05
KFM04A	397.00	402.00	5	3	1	20040916 15:18	20040916 16:34
KFM04A	402.00	407.00	5	3	1	20040916 16:49	20040916 17:40
KFM04A	407.00	412.00	5	3	1	20040917 08:42	20040917 09:27
KFM04A	412.00	417.00	5	3	1	20040917 09:42	20040917 11:03
KFM04A	417.00	422.00	5	3	1	20040917 11:15	20040917 13:16
KFM04A	422.00	427.00	5	3	1	20040917 13:29	20040917 14:53
KFM04A	427.00	432.00	5	3	1	20040917 15:06	20040917 15:50
KFM04A	432.00	437.00	5	3	1	20040920 09:21	20040920 10:05
KFM04A	517.00	522.00	5	3	1	20040920 10:57	20040920 12:49
KFM04A	522.00	527.00	5	3	1	20040920 13:02	20040920 13:48
KFM04A	527.00	532.00	5	3	1	20040920 13:59	20040920 14:45
KFM04A	532.00	537.00	5	3	1	20040920 14:54	20040920 16:14

[1)] 3: Injection test

3.3 Equipment checks

The PSS3 equipment was fully serviced, according to SKB internal controlling documents (SKB MD 345.124, service, and SKB MD 345.122, calibration), in February 2004. Some service and calibration was also made in April 2004.

Functioning checks of the equipment were performed during the installation of the PSS equipment at the test site. In order to check the function of the pressure sensors, the air pressure was recorded and found to be as expected. While lowering, the sensors showed good agreement with the total head of water ($p/\rho g$). The temperature sensor displayed expected values in both air and water.

Simple functioning checks of down-hole sensors were conducted at every change of test section interval. Checks were also done continuously while lowering the pipe string along the borehole.

4 Description of equipment

4.1 Overview

4.1.1 Measurement container

All equipment needed to perform the injection tests is located in a steel container (Figure 4-1). The container is divided into two compartments; a data-room and workshop. The container is placed on pallets in order to obtain a suitable working level in relation to the borehole casing.

The hoisting rig is of a hydraulic chain-feed type. The jaws, holding the pipe string, are opened hydraulically and closed mechanically by springs. The rig is equipped with a load transmitter and the load limit may be adjusted. The maximum load is 22 kN.

The packers and the test valve are operated hydraulically by water filled pressure vessels. Expansion and release of packers, as well as opening and closing of the test valve, is done using magnetic valves controlled by the software in the data acquisition system.

The injection system consists of a tank, a pump and a flow meter. The injection flow rate may be manually or automatically controlled. At small flow rates, a water filled pressure vessel connected to a nitrogen gas regulator is used instead of the pump.

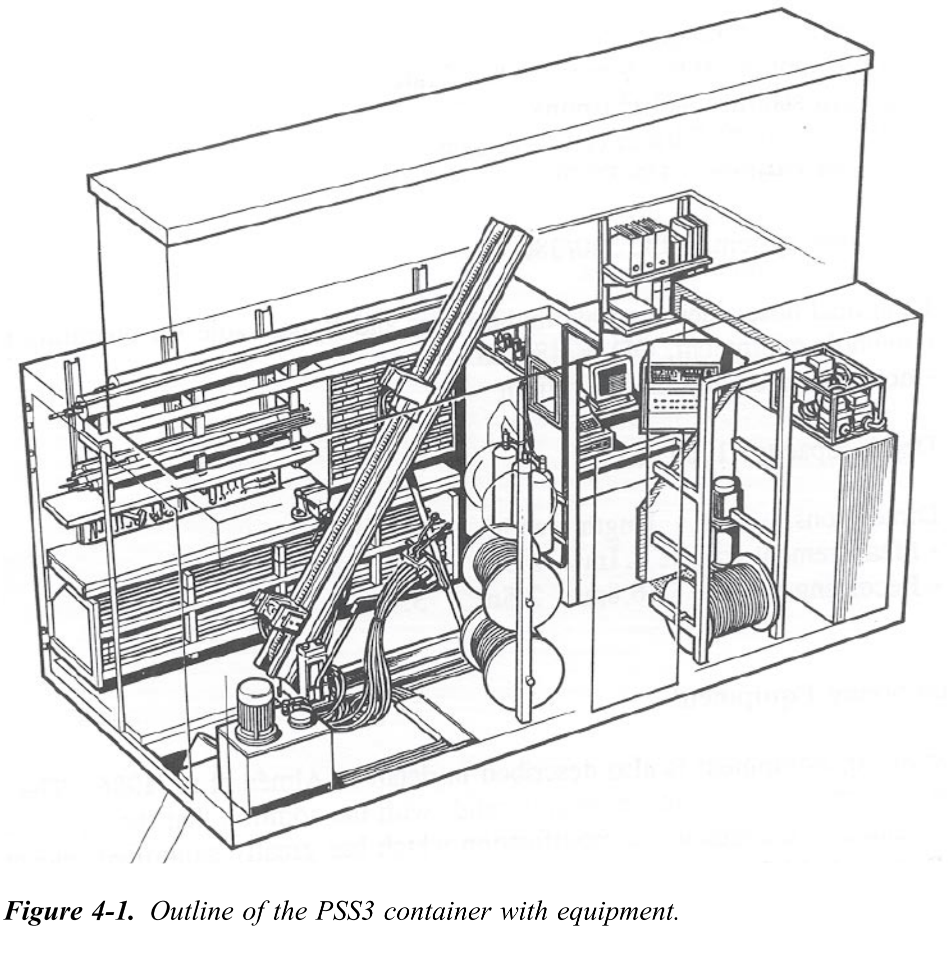

Figure 4-1. *Outline of the PSS3 container with equipment.*

4.1.2 Down-hole equipment

A schematic drawing of the down-hole equipment is shown in Figure 4-2. The pipe string consists of aluminium pipes of 3 m length, connected by stainless steel taps sealed with double o-rings. Pressure is measured above (P_a), within (P) and below (P_b) the test section, which is isolated by two packers. The groundwater temperature in the test section is also measured. The hydraulic connection between the pipe string and the test section can be closed or opened by a test valve operated by the measurement system.

At the lower end of the borehole equipment, a level indicator (caliper type) gives a signal as the reference depth marks along the borehole are passed.

The length of the test section may be varied (5, 20 or 100 m).

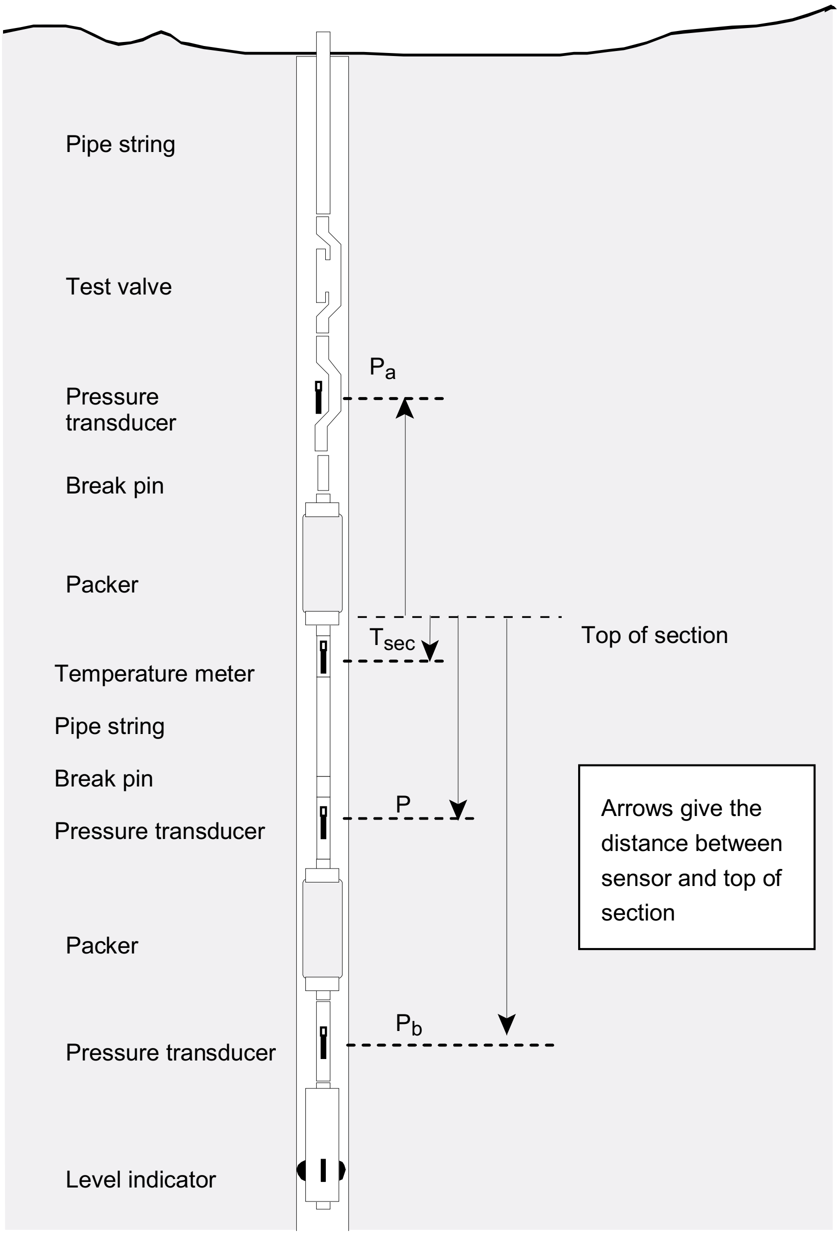

Figure 4-2. *Schematic drawing of the down-hole equipment in the PSS3 system.*

4.2 Measurement sensors

Technical data for the measurement sensors in the PSS system together with corresponding data of the system are shown in Table 4-1. The sensors are components of the PSS system. The accuracy of the PSS system may also be affected by the I/O-unit, cf Figure 4-3, and the calibration of the system.

Table 4-1. Technical data for sensors together with estimated data for the PSS system (based on current experience).

Technical specification Parameter		Unit	Sensor	PSS	Comments
Absolute pressure	Output signal	mA	4–20		
	Meas. range	MPa	0–13.5		
	Resolution	kPa	< 1.0		
	Accuracy[1)]	% F.S	0.1		
Differential pressure, 200 kPa	Accuracy	kPa		< ± 5	Estimated value
Temperature	Output signal	mA	4–20		
	Meas. range	°C	0–32		
	Resolution	°C	< 0.01		
	Accuracy	°C	± 0.1		
Flow Qbig	Output signal	mA	4–20		
	Meas. range	m^3/s	1.67×10^{-5}–1.67×10^{-3}		
	Resolution	m^3/s	6.7×10^{-8}		
	Accuracy[2)]	% O.R	0.15–3	0.2–1	The specific accuracy is depending on actual flow.
Flow Qsmall	Output signal	mA	4–20		
	Meas. range	m^3/s	1.67×10^{-8}–1.67×10^{-5}		
	Resolution	m^3/s	6.7×10^{-10}		
	Accuracy[2)]	% O.R	0.4–10	0.4–20	The specific accuracy is depending on actual flow.

[1)] 0.1% of Full Scale. Includes hysteresis, linearity and repeatability.
[2)] Maximum error in % of actual reading (% o.r.). The higher numbers correspond to the lower flow.

The sensor positions are fixed relative to the top of the test section. In Table 4-2, the position of the sensors is given with top of test section as reference (Figure 4-2).

Table 4-2. Position of sensors in the borehole and displacement volume of equipment in the test section.

Parameter	Length of test section (m) 5	20	100
Equipment displacement volume in test section [1)]	3.6	13	61
Total volume of test section [2)]	23	93	466
Position for sensor P_a, pressure above test section, (m above secup) [3)]	1.90	1.89	1.88
Position for sensor P, pressure in test section, (m above secup) [3)]	–4.12	–19.10	–99.10
Position for sensor T_{sec}, Temperature in test section, (m above secup) [3)]	–0.99	–0.99	–0.98
Position for sensor P_b, pressure below test section, (m above secup) [3)]	–6.99	–21.99	–102.00

[1)] Displacement volume in test section due to pipe string, signal cable, sensors and packer ends (in litre).
[2)] Total volume of test section (V= section length*π*d²/4).
[3)] Position of sensor relative top of test section. A negative value indicates a position below top of test section, (secup).

4.3 Data acquisition system

The data acquisition system in the PSS equipment contains a standard office PC connected to an I/O-unit (Datascan 7320). Using the Orchestrator software, pumping and injection tests are monitored and borehole sensor data are collected. In addition to the borehole parameters, packer and atmospheric pressure, container air temperature and water temperature are logged. Test evaluation may be performed on-site after a conducted test. An external display enables monitoring of test parameters.

The data acquisition system may be used to start and stop the automatic control system (computer and servo motors). These are connected as shown in Figure 4-3. The control system monitors the flow regulator and uses differential pressure across the regulating valve together with pressure in test section as input signals.

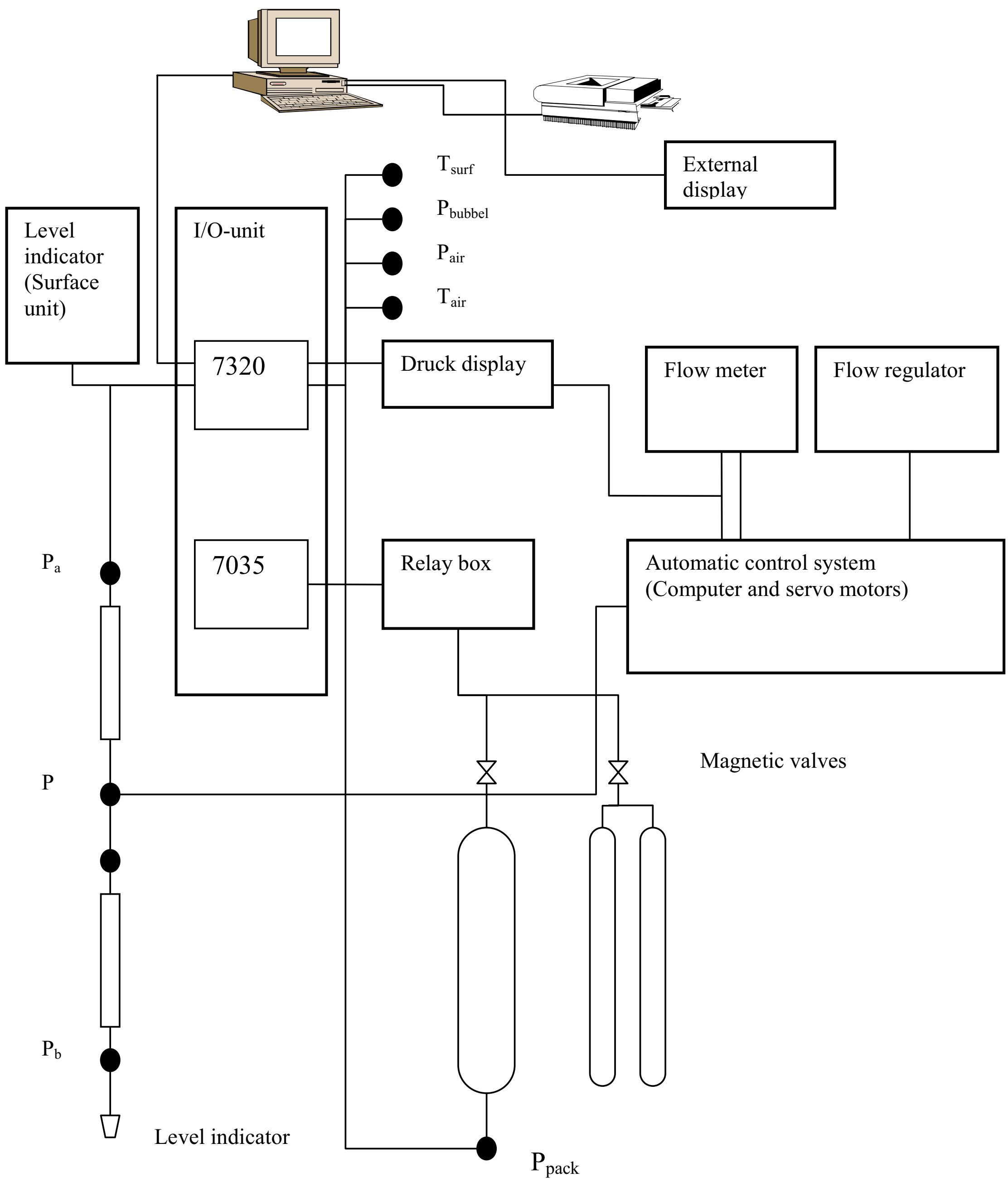

Figure 4-3. Schematic drawing of the data acquisition system and the automatic control system in PSS.

5 Execution

5.1 Preparation

5.1.1 Calibration

All sensors included in PSS are calibrated at the Geosigma engineering service station in Uppsala. Calibration is generally performed prior to each measurement campaign. Results from calibration, e.g. calibration constants, of sensors are kept in a document folder in PSS. If a sensor is replaced at the test site, calibration constants are altered as well. If a new, un-calibrated, sensor is to be used, calibration may be performed afterwards and data re-calculated.

5.1.2 Functioning checks

Equipment functioning checks were performed during the establishment of PSS at the test site. Simple function checks of down-hole sensors were done at every change of test section length, as well as while lowering the pipe string along the borehole.

5.1.3 Cleaning of equipment

Cleaning of the borehole equipment was performed according to the cleaning instruction (SKB MD 600.004, Instruktion för rengöring av borrhålsutrustning och viss markbaserad utrustning), level 1.

5.2 Test performance

5.2.1 Test principle

The injection tests in KFM04A were generally carried out while maintaining a constant head of 200 kPa (20 m) in the test section. Before start of the injection period, approximately steady-state pressure conditions prevailed in the test section. After the injection period, the pressure recovery was measured.

For injection tests with 20 m and 5 m section length, the injection phase was interrupted if the injection flow was apparently below the measurement limit. Thereafter, the recovery was measured for at least 5 minutes to verify the low conductivity of the section.

5.2.2 Test procedure

Generally, the tests were performed according to the Activity Plan AP PF 400-04-27. Exceptions to this are presented in Section 5.5.

A test cycle includes the following phases: 1) Transfer of down-hole equipment to the next section, 2) Packer inflation, 3) Pressure stabilisation, 4) Injection, 5) Pressure recovery and 6) Packer deflation.

The estimated times for the various phases are presented in Table 5-1. Regarding the packer inflation times and actual injection and recovery times, slightly different procedures were used for the tests in 100 m sections compared to the tests in 20 m and 5 m sections according to the Activity Plan. Furthermore, slightly longer test times were used for the tests in 100 m sections, cf Table 5-1.

Table 5-1. Packer inflation times, pressure stabilisation times and test times used for the injection tests in KFM04A.

Test section length (m)	Packer inflation time (min)	Time for pressure stabilisation (min)	Injection period (min)	Recovery period (min)	Total time/test (min)[1)]
100	30	15	30	30	105
20	25	5	20	20	70
5	25	5	20	20	70

[1)] Exclusive of trip times in the borehole.

5.2.3 Test strategy

Firstly, injection tests in 100 m sections were performed in the interval 117–972 m. The limits of the test sections were, as far as possible, the same as were used by the difference flow logging to facilitate comparison of the results.

Secondly, injection tests in 20 m sections were carried out in the interval 117–537 m. All 100 m sections, within this interval, were measured in five successive injection tests using a 20 m section length.

Finally, injection tests with 5 m section length were conducted in all 20 m sections with a definable flow rate in the interval 297–537 m. Four tests using a 5 m section length were performed within the 20 m intervals. The total number of injection tests was, thus, dependent on the results of the previous tests.

Since the results of the tests in 100 m sections would have a strong effect on the continued test program, it was particularly important to ensure reliable results of these tests, including sections close to the lower measurement limit.

5.3 Data handling

With the PSS system, primary data are handled using the Orchestrator software (Version 2.3.8). During a test, data are continuously logged in *.odl-files. After the test is finished, a report file (*.ht2) with space separated data is generated. The *.ht2-file (mio-format) contains logged parameters as well as test-specific information, such as calibration constants and background data. The parameters are presented as percentage of sensor measurement range and not in engineering units. The report file in ASCII-format is the raw data file delivered to the data base SICADA.

The *.ht2-files are automatically named with borehole id, top of test section as well as date and time of test start (as for example __KFM04A_0117.00_200408230911.ht2). The name differs slightly from the convention stated in Instructions for analysis of injection and single-borehole pump test, SKB MD 320.004.

Using the IPPLOT software (Version 2.0), the *.ht2-files are converted to parameter files suitable for plotting using the code SKB-plot and analysis with the AQTESOLV software.

A backup of data files was created on a regular basis by CD-storage and by sending the files to the Geosigma office in Uppsala by a file transfer protocol. A file description table is presented in Appendix 1.

5.4 Analysis and interpretation

5.4.1 General

As described in Section 5.2.1, the injection tests in KFM04A were performed as transient constant head tests followed by a pressure recovery period. From the injection period, the (reciprocal) flow rate versus time was plotted in log-log and lin-log diagrams together with the corresponding derivative. From the recovery period, the pressure and pressure change were plotted versus Agarwal equivalent time in lin-log and log-log diagrams, respectively, together with the corresponding derivatives. The routine data processing of measured data was done according to the Instruction for analysis of injection and single-hole pumping tests (SKB MD 320.004).

5.4.2 Measurement limit for flow rate and specific flow rate

The estimated standard lower measurement limit for the flow rate for injection tests with PSS is c 1 mL/min (1.7×10^{-8} m^3/s). However, if the flow rate for a test was close to, or below, the standard lower measurement limit, an estimate of a test-specific lower measurement limit of flow rate was used. This limit was based on the measurement noise level of the flow rate before and after the injection period. The decisive factor for the varying lower measurement limit is not identified, but it might be of both technical and hydraulic character. For approximately one third of the injections tests in KFM04A, the actual lower measurement limit of the flow rate was estimated and ranged from 5×10^{-9} m^3/s to 1.7×10^{-8} m^3/s.

The lower measurement limit for transmissivity is defined in terms of the specific flow rate (Q/s). The minimum specific flow rate corresponds to the estimated lower measurement limit of the flow rate divided with the actual injection pressure during the test, see Table 5-2. The intention during this test campaign was to use a standard injection pressure of 200 kPa (20 m water column). For some test sections in KFM04A, the actual injection pressure was considerably different. However, the actual injection pressure was never less than 100 kPa or more than 300 kPa. A higher injection pressure is often a result of the test section being of low hydraulic conductivity. A low injection pressure is often a result of a test section of low conductivity being exposed to a pressure increase caused by packer expansion, before the injection start. A highly conductive section may also result in a low injection pressure due to limited flow capacity of PSS. The estimated test-specific lower measurement limit for the specific flow rate in KFM04A ranged from 2.2×10^{-10} m^2/s to 4.6×10^{-10} m^2/s.

Whenever the final flow rate (Q_p) was not defined (i.e. not clearly above the measurement noise before and after the injection period), the lower measurement limit for specific flow rate was based on the estimated test-specific lower measurement limit for flow rate and a standard injection pressure of 20 m. This was done in order to avoid excessively high estimates of the specific flow rate for these low conductivity sections, which would have been the result if the actual injection pressure had been used (since the actual pressure often was significantly less than 20 m, see above).

The lower measurement limits for the flow rate correspond to different values of steady-state transmissivity, T_M, depending on the section lengths used in the factor C_M in Moye's formula, as described in the Instruction for analysis of injection and single-hole pumping tests (SKB MD 320.004), see Table 5-2.

The practical upper measurement limit for the PSS system is estimated at a flow rate of c 30 L/min (5×10^{-4} m^3/s) and an injection pressure of c 1 m. Thus, the upper measurement limit for the specific flow rate is 5×10^{-4} m^2/s. However, the practical upper measurement limit may vary, depending on e.g. depth of the test section (friction losses in the pipe string).

Table 5-2. Estimated lower measurement limit for specific flow rate and steady-state transmissivity for different injection pressures, measurement scales and estimated lower measurement limits for flow rate for the injection tests in borehole KFM04A.

r_w (m)	L_w (m)	Q-measl-L (m^3/s)	Injection pressure (kPa)	Q/s-measl-L (m^2/s)	Factor C_M in Moye's formula	T_M-measl-L (m^2/s)
0.0385	100	1.7E–08	100	1.6E–09	1.30	2.1E–09
0.0385	100	1.7E–08	200	8.2E–10	1.30	1.1E–09
0.0385	100	1.7E–08	300	5.5E–10	1.30	7.1E–10
0.0385	100	1.2E–08	100	1.1E–09	1.30	1.5E–09
0.0385	100	1.2E–08	200	5.7E–10	1.30	7.4E–10
0.0385	100	1.2E–08	300	3.8E–10	1.30	5.0E–10
0.0385	100	5.0E–09	100	4.9E–10	1.30	6.4E–10
0.0385	100	5.0E–09	200	2.5E–10	1.30	3.2E–10
0.0385	100	5.0E–09	300	1.6E–10	1.30	2.1E–10
0.0385	20	1.7E–08	100	1.6E–09	1.04	1.7E–09
0.0385	20	1.7E–08	200	8.2E–10	1.04	8.5E–10
0.0385	20	1.7E–08	300	5.5E–10	1.04	5.7E–10
0.0385	20	1.2E–08	100	1.1E–09	1.04	1.2E–09
0.0385	20	1.2E–08	200	5.7E–10	1.04	6.0E–10
0.0385	20	1.2E–08	300	3.8E–10	1.04	4.0E–10
0.0385	20	5.0E–09	100	4.9E–10	1.04	5.1E–10
0.0385	20	5.0E–09	200	2.5E–10	1.04	2.6E–10
0.0385	20	5.0E–09	300	1.6E–10	1.04	1.7E–10
0.0385	5	1.7E–08	100	1.6E–09	0.82	1.3E–09
0.0385	5	1.7E–08	200	8.2E–10	0.82	6.7E–10
0.0385	5	1.7E–08	300	5.5E–10	0.82	4.5E–10
0.0385	5	1.2E–08	100	1.1E–09	0.82	9.4E–10
0.0385	5	1.2E–08	200	5.7E–10	0.82	4.7E–10
0.0385	5	1.2E–08	300	3.8E–10	0.82	3.1E–10
0.0385	5	5.0E–09	100	4.9E–10	0.82	4.0E–10
0.0385	5	5.0E–09	200	2.5E–10	0.82	2.0E–10
0.0385	5	5.0E–09	300	1.6E–10	0.82	1.3E–10

5.4.3 Qualitative analysis

Initially, a qualitative evaluation of actual flow regimes, e.g. wellbore storage (WBS), pseudo-radial flow regime (PRF), pseudo-spherical flow regime (PSF) and pseudo-stationary flow regime (PSS), respectively, was performed. In addition, indications of outer boundary conditions during the tests were identified. The qualitative evaluation was mainly interpreted from the log-log plots of flow rate and pressure together with the corresponding derivatives. In particular, time intervals with pseudo-radial flow, reflected by a constant (horizontal) derivative in the test diagrams, were identified. Pseudo-linear flow may at the beginning of the tests be reflected by a straight line of slope 0.5 or less in the log-log diagrams, both for the measured variable (flow rate or pressure) and the derivative. A true spherical flow regime is reflected by a straight line with a slope of –0.5 for the derivative. However, other slopes may indicate transitions to pseudo-spherical or pseudo-stationary flow. The latter flow regime corresponds to almost stationary conditions with a derivative approaching zero. Due to the limited resolution of the flow meter and pressure sensor, the derivative may at some times erroneously indicate a false horizontal line by the end of periods with pseudo-stationary flow. Apparent no-flow (NFB) and constant head boundaries (CHB) or equivalent boundary conditions of fractures are reflected by an increase/decrease of the derivative. In addition, a preliminary steady-state analysis of transmissivity according to Moye's formula (denoted T_M) was made for the injection period for all tests.

$$T_M = \frac{Q_p \cdot \rho_w \cdot g}{dp_p} \cdot C_M$$

$$C_M = \frac{1 + \ln\left(\frac{L_w}{2r_w}\right)}{2\pi} \qquad (5\text{-}1)$$

Q_p = flow rate by the end of the flow period (m^3/s)
ρ_w = density of water (kg/m^3)
g = acceleration of gravity (m/s^2)
C_M = geometrical shape factor (–)
dp_p = $p_p - p_i$ (Pa)
r_w = borehole radius (m)
L_w = section length (m)

5.4.4 Quantitative analysis

From the results of the qualitative evaluation, appropriate interpretation methods for the quantitative evaluation of the tests were selected. If possible, transient analysis was made on both the injection and recovery periods of the tests. Several of the responses during the recovery period were strongly influenced by wellbore storage effects. Thus, for most tests, pseudo-radial flow was not reached during this period. On the other hand, during the injection period, a certain time interval with pseudo-radial flow could, in most tests, be identified. Consequently, standard methods for single-hole tests with wellbore storage and skin effects were used for routine evaluation of the tests.

The transient analysis was performed using a special version of the test analysis software AQTESOLV, which enables both visual and automatic type curve matching. The quantitative transient evaluation is generally carried out as an iterative process of manual type curve matching and automatic matching. For the injection phase, a model based on the Jacob and Lohman (1952) /2/ solution was used for estimating transmissivity and skin factor for an assumed value of the storativity. The model uses the effective wellbore radius concept to account for non-zero (negative) skin factors according to Hurst, Clark and Brauer (1969) /3/. The storativity was set to a fixed value of 10^{-6}, according to the instruction SKB MD 320.004.

For transient analysis of the recovery period, a model presented by Dougherty-Babu (1984) /4/ was used. In this model, a variety of transient solutions for flow in fractured porous media is available, accounting for e g wellbore storage and skin effects, double porosity etc. The solution for wellbore storage and skin effects is analogous to the corresponding solution presented in Earlougher (1977) /5/ based on the effective wellbore radius concept to account for non-zero (negative) skin factors. However, for tests in isolated test sections, wellbore storage is represented by a radius of a fictive standpipe (denoted fictive casing radius, r(c)) connected to the test section, cf Equation 5-3. This concept is equivalent to calculating the wellbore storage coefficient C from the compressibility in an isolated test section according to Equation 5-2.

The model by Dougherty-Babu (1984) was used to estimate the transmissivity and skin factor from the recovery period for an assumed value on the storativity. In addition, the wellbore storage coefficient was estimated, both from the simulated value of the fictive casing radius r(c) and from the slope of 1:1 in the log-log plots.

Some tests showed fracture responses (a slope of 0.5 in a log-log plot) and fracture models were then also used for the transient analysis. Both the models by Gringarten-Witherspoon (1972) /6/, Ozkan-Raghavan (1991a) /7/, and (1991b) /8/ for a vertical fracture and Gringarten-Ramey (1974) /9/ for a horizontal fracture were employed. In these cases, the test section length was used to convert K and S_s to T and S, respectively, after analysis by fracture models. The quotient K_x/K_y of the hydraulic conductivity in the x and the y-direction, respectively, was assumed to be 1.0 (one). Type curve matching provided values of K_x and L_f, where L_f is the theoretical fracture length.

The different transient estimates of transmissivity, in general from the pseudo-radial flow regimes during injection and recovery period, respectively, were compared and examined. One of these was chosen as the best representative value of transient transmissivity of the formation adjacent to the test section. This value is denoted T_T. In cases with more than one pseudo-radial flow regime during the injection or recovery period, the first one is assumed as the most representative for the hydraulic conditions in the rock close to the tested section. In most cases, the transient estimates of transmissivity from the injection period were considered more representative than those from the recovery period. The recovery responses were often strongly affected by wellbore storage and generally no pseudo-radial flow regime was reached. In addition, pseudo-stationary flow sometimes occurred during the recovery period.

Finally, a representative value of transmissivity of the section, T_R, was chosen from T_T and T_M. For tests approaching a pseudo-spherical or pseudo-stationary flow by the end of the test, and no period with pseudo-radial flow could be indentified, the steady-state evaluation (T_M) was generally considered as the best estimate of transmissivity, (i.e. $T_R = T_M$). Whenever the flow rate by the end of the injection period (Q_p) was too low to be defined, and thus neither T_T nor T_M could be estimated, the most representative value of transmissivity for the test section was considered to be the estimated lower measurement limit for Q/s (i.e. T_R = Q/s-measl-L).

Estimated values of the borehole storage coefficient, C, based on actual borehole geometrical data and assumed fluid properties are shown in Table 5-3. The net water volume in the test section, V_w, has in Table 5-3 been calculated by subtracting the volume of equipment in the test section (pipes and thin hoses) from the total volume of the test section. For an isolated test section, the wellbore storage coefficient, C, may be calculated as /10/:

$$C = V_w \times c_w = L_w \times \pi \times r_w^2 \times c_w \tag{5-2}$$

V_w = water volume in test section (m^3)
r_w = nominal borehole radius (m)
L_w = section length (m)
c_w = compressibility of water (Pa^{-1})

Table 5-3. Calculated net values of the wellbore storage coefficient C for injection tests with different section length, based on the actual geometrical properties of the borehole and equipment configuration in the test section.

Borehole	r_w (m)	L_w (m)	Volume of test section (m^3)	Volume of equipment in section (m^3)	V_w (m^3)	C_{net} (m^3/Pa)
KFM04A	0.0385	100	0.466	0.061	0.405	1.9×10^{-10}
KFM04A	0.0385	20	0.093	0.013	0.081	3.7×10^{-11}
KFM04A	0.0385	5	0.023	0.004	0.020	9.1×10^{-12}

When appropriate, estimation of the actual borehole storage coefficient C in the test sections was made from the recovery period, based on the early borehole response with 1:1 slope in the log-log diagrams. The coefficient C was calculated only for tests with a well-defined line of slope 1:1 in the beginning of the recovery period. In the most conductive sections, this period occurred during very short periods at early test times. The latter values may be compared with the net values of C based on geometry (Table 5-3).

Furthermore, when using the model by Dougherty-Babu (1984), a fictive casing radius, r(c), is obtained from the parameter estimation of the recovery period. This value can then be used for calculating C as /10/:

$$C = \frac{\pi \cdot r(c)^2}{\rho \cdot g} \tag{5-3}$$

Although this calculation was not done regularly and the results are not presented in this report, the calculations corresponded in most cases well to the value of C obtained from the line of slope 1:1 in the beginning of the recovery period.

The estimated values of C from the tests may differ from the net values in Table 5-3 based on geometry. For example, the effective compressibility for an isolated test section may sometimes be higher than the water compressibility due to e.g. packer compliance, resulting in increased C-values.

For evaluation of the test data, no corrections of the measured flow rate and absolute pressure data (e.g. due to barometric pressure variations or tidal fluctuations) have been made. For short-time single-hole tests, such corrections are generally not needed, unless very small pressure changes are applied. No subtraction of the barometric pressure from the measured absolute pressure has been made, since the lengths of the test periods are short relative to the time scale for barometric pressure changes. In addition, pressure differences rather than the pressure magnitudes are used by the evaluation.

5.5 Nonconformities

The test program in KFM04A was carried out according to the Activity Plan AP PF 400-04-27 with the following exceptions:

- The test in the 892–992 m interval could not be performed due to problems lowering the test section. Instead, a test was performed in the 872–972 m interval.
- Tests with 20 m section length were not performed below 537 m even though definable flow rates were found with 100 m section length below 537 m (as decided by the activity leader).
- Tests with 5 m section length were not performed above 297 m even though definable flow rates were found with 20 m section length above that level (as decided by the activity leader).
- The temperature sensor in the injection water at the ground surface was out of order during the injection tests in KFM04A.

6 Results

6.1 Nomenclature and symbols

The nomenclature and symbols used for the results of the injection tests in KFM04A are in accordance with the Instruction for analysis of injection and single-hole pumping tests (SKB MD 320.004). Additional symbols used are explained in the text and in Appendix 5. Symbols used by the AQTESOLV software are explained in Appendix 3.

6.2 Routine evaluation of the single-hole injection tests

6.2.1 General test data

General test data with selected pressure and flow data from all tests are listed in Appendix 2.1 and 2.2, respectively.

6.2.2 Length corrections

The down-hole equipment contains a level indicator located c 3 m below the lower packer in the test section, see Figure 4-2. The level indicator transmits a signal each time a reference mark in the borehole is passed. In KFM04A, reference marks were milled into the borehole wall at every 50 m (with a few exceptions).

During the injection tests in KFM04A with the PSS, length reference marks were detected as presented in Table 6-1. As seen from Table 6-1, all length marks were detected. At each mark, the length scale for the injection tests was adjusted according to the reported length to the reference mark.

The largest difference between the reported and measured lengths at the reference marks during the injection tests was 0.29 m, at the 850 m reference mark. The difference between two consecutive measurements over a 100 m borehole interval was 0.1 m or less in all cases. A comparison of the measurements performed with different section lengths results in a maximum difference of 0.04 m.

Since the length scale was adjusted in the field every time a reference mark was passed, and since the difference between consecutive marks was small, it was not found worthwhile to make any further adjustments after the measurements, e.g. by linear interpolation between reference marks.

Table 6-1. Detected reference marks during the injection tests in KFM04A.

Borehole length (m)	Detected during the injection tests in 100 m sections	Detected during the injection tests in 20 m sections	Detected during the injection tests in 5 m sections
119	Yes	Yes	Yes
150	Yes	Yes	Yes
200	Yes	Yes	Yes
250	Yes	Yes	Yes
300	Yes	Yes	Yes
350	Yes	Yes	Yes
400	Yes	Yes	Yes
450	Yes	Yes	Yes
500	Yes	Yes	Yes
550	Yes	–	–
600	Yes	–	–
650	Yes	–	–
700	Yes	–	–
750	Yes	–	–
800	Yes	–	–
850	Yes	–	–
900	Yes	–	–
950	Yes	–	–

6.2.3 General results

A summary of the results of the routine evaluation of the injection tests in different scales in KFM04A is presented, test by test, in Table 6-2. Selected test diagrams are presented in Appendix 3. In general, one linear diagram showing the entire test sequence together with lin-log and log-log diagrams from the injection and recovery periods, respectively, are presented. The quantitative analysis was performed from such diagrams using the AQTESOLV software. From tests with a flow rate below the estimated lower measurement limit for the specific test, only the linear diagram is presented.

The dominating transient flow regimes during the injection and recovery periods, respectively, as interpreted from the qualitative test evaluation, are listed in Table 6-2 and further commented on in Section 6.2.4.

For some tests, particularly from the recovery period, a type curve fit is displayed in the diagrams in Appendix 3, despite that the parameters from the fit are judged as not representative and are thus neither included in Table 6-2 nor in the result tables for SICADA. For these tests, the type curve fit is presented only to illustrate that an assumption of pseudo-radial flow regime is not justified. Instead, some other flow regime is likely to dominate for these tests, as commented in the diagrams and in Section 6.2.4. For tests showing only wellbore storage and tests approaching a pseudo-stationary flow, no unique transient evaluation is possible. In such cases, no type curve matching was done.

In the quantitative evaluation, the steady-state transmissivity (T_M) was calculated by Moye's formula. Transient evaluation was conducted, whenever possible, both on the injection and recovery periods (T_f and T_s, respectively). However, for many low-conductivity sections, no unique transient evaluation could be made from the recovery period (only wellbore storage response). Transient evaluation was performed for all tests for which a significant flow rate, Q_p, could be identified, see Section 5.4.2.

The value judged as the most reliable from the transient evaluation of the tests was selected as T_T. The associated value for the skin factor is listed in Table 6-2. A fairly well-defined time interval with pseudo-radial flow in most cases could be identified from the injection period, and the transient analysis applied to this period is in most cases considered as the most reliable for transmissivity calculations for the injection tests in KFM04A. In addition, the transient evaluation of transmissivity from the injection period was for most of the tests also considered as the most representative estimate of transmissivity, T_R. The approximate start and stop times used for the transient evaluation are also listed in Table 6-2. For those tests where transient evaluation was not possible or not considered representative, T_M was chosen as the representative transmissivity value, T_R. If Q_p was below the actual estimated measurement limit, the representative transmissivity value, T_R, was assumed less than the estimated Q/s-measl-L, see Section 5.4.2.

The results of the routine evaluation of the injection tests in borehole KFM04A are also compiled in appropriate tables in Appendix 5 to be stored in the SICADA database.

Drilling records were checked in order to identify possible interference with test data from drilling in nearby boreholes. These records showed that drilling of HFM22 (approximately 1,500 m north of drilling site KFM04A, close to drilling site DS8, see Figure 1-1) was in progress during the field campaign in KFM04A. However, the injection tests in KFM04A are assumed to be unaffected by these activities due to the long distance between the boreholes.

In Figure 6-1, a comparison of calculated transmissivities in 5 m sections from steady-state evaluation (T_M) and transmissivity values from the transient evaluation (T_T) is shown. The agreement between the two populations is considered good. The lower measurement limit of transmissivity in 5 m sections for a flow rate of 1 mL/min and an injection pressure of 200 kPa is indicated in the figure.

The wellbore storage coefficient, C, was calculated from the straight line with a unit slope in the log-log diagrams from the recovery period, see Table 6-2. The coefficient C was only calculated for tests with a well-defined line of unit slope in the beginning of the recovery period. In the most conductive sections, this period occurred during short intervals at very early times and is not visible in the diagrams. In sections with a very low transmissivity, the estimates of C may be uncertain due to difficulties in defining an accurate time for the start of the recovery period. Furthermore, the resolution of the pressure sensors causes the recovery to be quite scattered in sections of low transmissivity. The values of C presented in Table 6-2 may be compared with the net values of C in Table 5-3 (based on geometry).

The number of tests with a well defined line of unit slope for which it was possible to calculate C was as follows: 100 m tests; 4 out of 9, 20 m tests; 7 out of 22, and 5 m tests; 12 out of 32. Table 6-2 shows that there is, in general, a good agreement between the calculated C values from the tests and those listed in Table 5-3, although the calculated values from the tests tend to be higher. When constructing 95% confidence intervals (using a t-distribution) from calculated values of C from the tests, the values of C listed in Table 5-3 are within these confidence intervals for 100 m and 20 m but slightly lower than the confidence interval for 5 m.

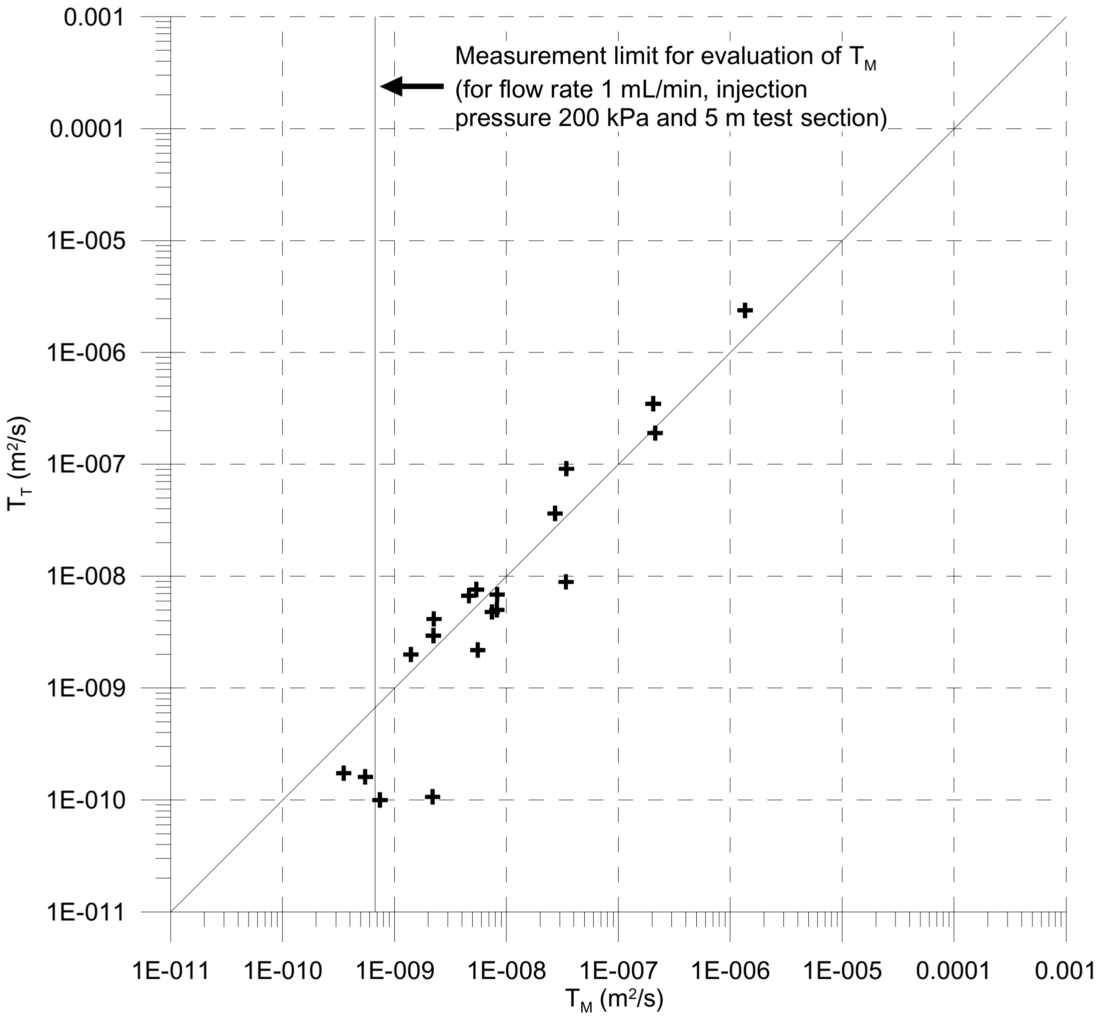

Figure 6-1. *Estimated transmissivities in 5 m sections from steady-state (T_M) and transient (T_T) evaluation.*

Table 6-2. Summary of the routine evaluation of the single-hole injection tests in borehole KFM04A.

Secup	Seclow	Test start	b	Flow regime [1]		Q/s-measl-L	Q/s	T_M	T_f	T_s	T_T	T_R [2]	ξ	dt_1	dt_2	C
(m)	(m)	YYYYMMDD hh:mm	(m)	injection	recovery	(m^2/s)	(m^2/s)	(m^2/s)	(m^2/s)	(m^2/s)	(m^2/s)	(m^2/s)	(–)	(s)	(s)	(m^3/Pa)
117.00	217.00	2004-08-23 09:11	100.00	PRF–>PSF	PSF–>PSS	9.63E–10	2.98E–05	3.87E–05	3.55E–05		3.55E–05	3.55E–05	–1.5	30	200	
217.00	317.00	2004-08-23 13:54	100.00	PRF–>PSF	PSF–>PSS	6.81E–10	2.03E–05	2.64E–05	2.82E–05		2.82E–05	2.82E–05	0.1	20	200	
317.00	417.00	2004-08-23 17:07	100.00	PRF	PRF	7.28E–10	1.72E–06	2.24E–06	2.00E–06	3.36E–06	2.00E–06	2.00E–06	–0.5	200	600	
417.00	517.00	2004-08-24 08:43	100.00	PRF	PLF/ WBS	7.67E–10	3.57E–08	4.64E–08	1.30E–08	9.45E–09	1.30E–08	1.30E–08	–3.2	600	1,800	
517.00	617.00	2004-08-24 13:14	100.00	PRF	WBS	5.71E–10	4.11E–09	5.34E–09	9.89E–10		9.89E–10	5.34E–09	–2.9	400	1,800	4.07E–10
617.00	717.00	2004-08-30 17:37	100.00	PRF	WBS	8.17E–10	4.12E–09	5.36E–09	1.04E–09	1.25E–09	1.04E–09	1.04E–09	–2.7	600	1,200	3.43E–10
717.00	817.00	2004-08-25 12:53	100.00		WBS	2.63E–10	4.74E–10	6.16E–10				6.16E–10				3.05E–10
817.00	917.00	2004-08-27 13:53	100.00			2.50E–10						2.50E–10				
872.00	972.00	2004-08-27 09:01	100.00	PRF	WBS–>	7.86E–10	3.18E–09	4.13E–09	2.24E–09	3.89E–09	2.24E–09	2.24E–09	–0.4	100	800	2.02E–10
117.00	137.00	2004-09-02 11:11	20.00	PRF	PSF	8.16E–10	1.56E–06	1.62E–06	1.85E–06	2.60E–06	1.85E–06	1.85E–06	–0.1	200	1,200	
137.00	157.00	2004-09-02 14:07	20.00	PRF	PSF–>PSS	7.90E–10	5.59E–07	5.83E–07	8.95E–07	7.05E–07	8.95E–07	8.95E–07	2.9	250	1,200	
157.00	177.00	2004-09-02 18:02	20.00	PSF	PRF–>PSF	8.04E–10	1.17E–06	1.22E–06	1.31E–07	1.10E–06	1.10E–06	1.10E–06	–0.7	15	100	
177.00	197.00	2004-09-03 08:30	20.00	PLF–>PRF	PLF–>	7.72E–10	1.11E–06	1.16E–06	3.99E–07	3.16E–07	3.99E–07	3.99E–07	–4.7	100	1,800	
197.00	217.00	2004-09-03 10:11	20.00	PRF/PSF	PSF	8.01E–10	2.06E–05	2.15E–05	4.00E–05	4.74E–05	4.00E–05	4.00E–05	3.8	100	1,000	
217.00	237.00	2004-09-03 13:34	20.00	PSF	PSF	6.93E–10	2.11E–05	2.20E–05	6.71E–05		6.71E–05	2.20E–05	8.6	100	1,000	
237.00	257.00	2004-09-06 09:04	20.00	PRF	WBS–>	7.16E–10	2.33E–09	2.44E–09	1.95E–09		1.95E–09	1.95E–09	1.1	100	1,200	5.53E–11
257.00	277.00	2004-09-06 10:43	20.00	PRF	PRF–>PSF	8.16E–10	4.87E–08	5.08E–08	4.89E–08	4.13E–08	4.89E–08	4.89E–08	0.6	200	1,200	
277.00	297.00	2004-09-06 12:55	20.00	PRF–>PSF	PRF–>PSF	8.15E–10	2.54E–07	2.65E–07	8.90E–08	1.23E–07	1.23E–07	1.23E–07	–2.7	10	200	
297.00	317.00	2004-09-06 14:36	20.00	PRF/PSF	PRF	8.16E–10	1.82E–07	1.90E–07	2.95E–07	1.86E–07	1.86E–07	1.86E–07	0.6	10	100	
317.00	337.00	2004-09-06 17:11	20.00	PRF	PSF	8.15E–10	5.07E–08	5.30E–08	7.07E–08	7.75E–08	7.07E–08	7.07E–08	2.9	100	1,200	7.04E–11
337.00	357.00	2004-09-07 08:25	20.00	PRF	PRF	8.14E–10	2.85E–07	2.97E–07	3.54E–07	3.89E–07	3.54E–07	3.54E–07	1.1	300	1,200	
357.00	377.00	2004-09-07 10:06	20.00	PRF	WBS–>PRF	7.15E–10	1.44E–06	1.51E–06	2.14E–06	3.75E–06	2.14E–06	2.14E–06	1.7	200	1,200	
377.00	397.00	2004-09-07 12:10	20.00	(PRF)	WBS	2.20E–10	7.99E–10	8.34E–10	9.92E–11		9.92E–11	8.34E–10	–2.4	200	1,200	9.26E–11

Secup	Seclow	Test start	b	Flow regime [1]		Q/s-measl-L	Q/s	T_M	T_f	T_s	T_T	T_R [2]	ξ	dt_1	dt_2	C
(m)	(m)	YYYYMMDD hh:mm	(m)	injection	recovery	(m^2/s)	(m^2/s)	(m^2/s)	(m^2/s)	(m^2/s)	(m^2/s)	(m^2/s)	(–)	(s)	(s)	(m^3/Pa)
397.00	417.00	2004-09-07 14:26	20.00	PRF	WBS–>PRF–>NFB	8.16E–10	1.08E–08	1.12E–08	7.71E–09	1.84E–08	7.71E–09	7.71E–09	–0.4	500	1,200	3.64E–11
417.00	437.00	2004-09-07 15:57	20.00	PSF/PRF	PLF	7.44E–10	3.82E–08	3.99E–08	1.39E–08		1.39E–08	1.39E–08	–3.1	500	1,200	
437.00	457.00	2004-09-08 08:28	20.00			2.50E–10						2.50E–10				
453.00	473.00	2004-09-08 09:57	20.00	(PRF)	WBS	3.65E–10	4.56E–10	4.76E–10	8.53E–11	5.46E–11	8.53E–11	4.76E–10	–1.5	100	1,200	6.79E–11
473.00	493.00	2004-09-08 11:33	20.00		WBS	2.70E–10	3.40E–10	3.55E–10				3.55E–10				1.54E–10
477.00	497.00	2004-09-08 13:38	20.00			4.50E–10						4.50E–10				
497.00	517.00	2004-09-08 15:13	20.00			4.00E–10						4.00E–10				
517.00	537.00	2004-09-08 16:11	20.00	PLF–>PSF	PLF/WBS	7.89E–10	3.00E–09	3.13E–09	1.58E–10		1.58E–10	3.13E–09	–3.7	200	500	3.23E–10
297.00	302.00	2004-09-10 14:43	5.00	PRF–>PSF	PRF–>PSF	8.16E–10	2.59E–07	2.13E–07	1.77E–07	1.90E–07	1.90E–07	1.90E–07	–1.2	10	100	
302.00	307.00	2004-09-13 09:58	5.00	PRF/PSF	WBS–>	8.40E–10	1.71E–09	1.40E–09	2.00E–09	1.88E–09	2.00E–09	2.00E–09	3.2	200	1,200	2.07E–11
307.00	312.00	2004-09-13 11:33	5.00	PRF	WBS	3.09E–10	4.28E–10	3.52E–10	1.74E–10		1.74E–10	1.74E–10	–0.1	100	1,200	1.69E–11
312.00	317.00	2004-09-13 13:38	5.00	PRF	WBS–>PSF	7.84E–10	5.62E–09	4.62E–09	6.70E–09		6.70E–09	6.70E–09	3.0	100	1,200	1.52E–11
317.00	322.00	2004-09-13 15:07	5.00	PRF–>PSF	WBS–>PSF	8.02E–10	9.98E–09	8.22E–09	5.01E–09	1.12E–08	5.01E–09	5.01E–09	–0.8	10	60	2.64E–11
322.00	327.00	2004-09-13 16:34	5.00	PRF–>PSF	PLF–>PSF	8.20E–10	6.77E–09	5.57E–09	2.19E–09	1.82E–09	2.19E–09	2.19E–09	–1.7	10	200	
327.00	332.00	2004-09-13 18:04	5.00	PRF	WBS–>PSF	7.76E–10	6.57E–09	5.41E–09	7.59E–09		7.59E–09	7.59E–09	2.4	300	1,200	1.60E–11
332.00	337.00	2004-09-14 08:13	5.00	PRF	PSF/PSS	8.21E–10	3.30E–08	2.72E–08	3.63E–08		3.63E–08	3.63E–08	1.3	400	1,200	
337.00	342.00	2004-09-14 09:49	5.00	PSF–>PRF	PRF/PSF	8.16E–10	2.49E–07	2.05E–07	3.47E–07	2.90E–07	3.47E–07	3.47E–07	2.5	400	1,200	
342.00	347.00	2004-09-14 11:21	5.00	PSF	PSF	8.21E–10	4.18E–08	3.44E–08	9.12E–08	8.69E–08	9.12E–08	3.44E–08	7.8	50	1,200	3.76E–11
347.00	352.00	2004-09-21 12:54	5.00	PRF	WBS–>PSF	7.71E–10	2.74E–09	2.26E–09	4.16E–09		4.16E–09	4.16E–09	5.2	20	1,200	1.81E–11
352.00	357.00	2004-09-21 10:35	5.00	PRF	WBS–>PSF	8.18E–10	9.08E–09	7.48E–09	4.79E–09		4.79E–09	4.79E–09	–1.3	30	1,200	1.88E–11
357.00	362.00	2004-09-15 18:05	5.00	PRF	WBS–>PRF	7.63E–10	1.65E–06	1.35E–06	2.37E–06	3.35E–06	2.37E–06	2.37E–06	1.4	300	1,200	
362.00	367.00	2004-09-15 19:36	5.00			4.00E–10						4.00E–10				
367.00	372.00	2004-09-16 08:18	5.00			4.00E–10						4.00E–10				
372.00	377.00	2004-09-16 09:25	5.00			4.00E–10						4.00E–10				

Secup	Seclow	Test start	b	Flow regime [1]		Q/s-measl-L	Q/s	T_M	T_f	T_s	T_T	T_R [2]	ξ	dt_1	dt_2	C
(m)	(m)	YYYYMMDD hh:mm	(m)	injection	recovery	(m^2/s)	(m^2/s)	(m^2/s)	(m^2/s)	(m^2/s)	(m^2/s)	(m^2/s)	(–)	(s)	(s)	(m^3/Pa)
377.00	382.00	2004-09-16 10:21	5.00			4.00E–10						4.00E–10				
382.00	387.00	2004-09-16 11:15	5.00			4.00E–10						4.00E–10				
387.00	392.00	2004-09-16 12:47	5.00			4.55E–10						4.55E–10				
392.00	397.00	2004-09-16 13:47	5.00	(PRF)	WBS	4.40E–10	9.02E–10	7.43E–10	1.00E–10	3.28E–11	1.00E–10	7.43E–10	–2.6	100	400	4.75E–11
397.00	402.00	2004-09-16 15:18	5.00	(PRF)	WBS	4.12E–10	6.68E–10	5.50E–10	1.61E–10	5.82E–11	1.61E–10	5.50E–10	–1.0	20	1,200	1.93E–11
402.00	407.00	2004-09-16 16:49	5.00			4.00E–10						4.00E–10				
407.00	412.00	2004-09-17 08:42	5.00			4.00E–10						4.00E–10				
412.00	417.00	2004-09-17 09:42	5.00	PRF	WBS–>NFB	8.20E–10	1.00E–08	8.26E–09	6.86E–09	2.15E–08	6.86E–09	6.86E–09	–0.5	200	1,200	1.60E–11
417.00	422.00	2004-09-17 11:15	5.00	PRF–>PSF	PLF	8.19E–10	4.15E–08	3.42E–08	8.91E–09		8.91E–09	8.91E–09	–3.9	200	600	
422.00	427.00	2004-09-17 13:29	5.00	PRF	WBS–>PSF	7.61E–10	2.70E–09	2.23E–09	2.95E–09		2.95E–09	2.95E–09	2.4	30	1,200	1.51E–11
427.00	432.00	2004-09-17 15:06	5.00			4.50E–10						4.50E–10				
432.00	437.00	2004-09-20 09:21	5.00			4.00E–10						4.00E–10				
517.00	522.00	2004-09-20 10:57	5.00	PLF–>PSF	PLF/WBS	7.79E–10	2.66E–09	2.19E–09	1.07E–10		1.07E–10	2.19E–09	–3.7	200	500	
522.00	527.00	2004-09-20 13:02	5.00			4.50E–10						4.50E–10				
527.00	532.00	2004-09-20 13:59	5.00			4.50E–10						4.50E–10				
532.00	537.00	2004-09-20 14:54	5.00			4.00E–10						4.00E–10				

[1] The acronyms in the column "Flow regime" are as fol
flow (PSS) and apparent no-flow boundary (NFB). The flow regime definitions are further discussed in Section 6.2.5 below.

[2] For the tests were Q_p was not detected, T_R was assumed equal to the estimated Q/s-measl-L.

6.2.4 Comments on the tests

Short comments on each test follow below. Flow regimes and hydraulic boundaries, as discussed in Section 5.4.3, are in the text referred to as:

WBS = Wellbore storage

PRF = Pseudo-radial flow regime

PLF = Pseudo-linear flow regime

PSF = Pseudo-spherical flow regime

PSS = Pseudo-stationary flow regime

NFB = No-flow boundary

117–217 m

The section is of high conductivity. Furthermore, it was not possible to obtain a constant head of 200 kPa (20 m). Final constant head was 17 m. The low flow rate during the initial phase of the flow period is a result of the system capacity being insufficient for this high conductivity. PRF is indicated in the beginning of the flow period with a transition to PSF towards the end of the injection period. The small pressure change in combination with the pressure sensor resolution causes the recovery derivative to be close to zero. The pressure in the borehole interval below the test section increased c 6 kPa during the injection period. However, since the transmissivity of section 117–217 m is of the same order of magnitude as the transmissivity below 217 m, this relatively small pressure interference should not have a major impact on the test.

217–317 m

The injection period indicates a PRF transitioning to a PSF. The recovery period was disturbed by a switch to manual regulation since the test valve did not close fast enough. A PSS was reached by the end of the recovery. No transient evaluation was performed on the recovery period. The pressure in the borehole interval above the test section increased c 2 kPa during the injection period. However, since the transmissivity of the section 217–317 m is of the same order of magnitude as the transmissivity in 117–217 m, this relatively small pressure interference should not have a major impact on the test.

317–417 m

The injection period is dominated by a PRF with a weak effect of a NFB by the end. After initial WBS, a transition to a PRF during the recovery period with a weak effect of a NFB by the end is indicated. The pressure in the borehole interval below the test section increased by c 32 kPa during the injection period. However, since the transmissivity of the section 317–417 m is significantly higher than the transmissivity below 417 m, this relatively large pressure interference should not have a major impact on the test.

417–517 m

The injection period indicates a transition to a late PRF period. The recovery period indicates a PLF, and WBS effects followed by a transition period.

517–617 m

The injection period indicates a PRF, although it is difficult to interpret due to scattered flow rate data. The recovery shows only WBS effects. No unique transient evaluation could be made for the recovery period.

617–717 m

The pressure increased by c 5 kPa during test phase 3 (test valve closed). Due to a drift in the gas pressure regulator, the pressure in the test section decreased by less than 2 kPa during the injection period. However, a PRF is indicated during the last 600 s of the injection period. WBS is indicated throughout the recovery period.

717–817 m

Q_p is considered significant even though it falls below 1 mL/min. However, no reliable transient evaluation can be made neither for the injection nor for the recovery period. The recovery period indicates only WBS effects. The pressure did not recover more than 3 m from the head change of 19 m during the injection period. Due to a drift in the gas pressure regulator, the pressure in the test section decreased by c 3 kPa during the injection period.

817–917 m

The test section has a very low transmissivity. Since the flow rate was not detectable, neither steady-state nor transient evaluation of transmissivity was possible. As a result, Q/s-measl-L was considered to be the most representative transmissivity value for this section.

872–972 m

Due to a drift in the gas pressure regulator, the pressure in the test section decreased by c 5 kPa during the injection period. However, the injection period indicates a PRF. The recovery period indicates WBS and a transition period. Due to high pressure below the test section during packer inflation, the pressure in the packers was set to 11.5 bars instead of the usual pressure exceeding 16 bars.

117–137 m

During the injection period a transition phase is indicated from c 20 s to 200 s. A PRF is implied after c 200 s throughout the injection period. During the recovery period, a PSF is indicated.

137–157 m

Abrupt change in registered flow after c 100 s of the injection period due to change of flow meter (Qbig->Qsmall), no change in actual flow. The injection period is dominated by PRF from c 250 s to the end of the period. During the recovery period, a PSF is indicated, transitioning towards PSS by the end of the period.

157–177 m

A PSF is dominating throughout the injection period. During the recovery period a short period of PRF is indicated after c 15 s to c 100 s. After 100 s to c 500 s there are strong indications of a PSF.

177–197 m

During the injection period a PLF is indicated followed by a transition to a PRF. The recovery period implies a period of PLF at the beginning of the period, followed by a transition period.

197–217 m

The injection period indicates a PRF approaching PSF. The recovery period points to a PSF. The pressure in the borehole interval below the test section increased by c 3 kPa during the injection period. However, since the transmissivity of the 197–217 m section is of the same order of magnitude as the transmissivity below 217 m, this relatively small pressure interference should not have a major impact on the test performed in the section.

217–237 m

Both the injection period and the recovery period show PSF and thus no reliable transient evaluation could be made. T_M is considered to be the most representative transmissivity value. The pressure in the borehole interval above the test section increased by c 1 kPa during the injection period. However, since the transmissivity of the section 217–237 m is of the same order of magnitude as the transmissivity above 217 m, this relatively small pressure interference should not have a major impact on the test.

237–257 m

Due to a drift in the gas pressure regulator, the pressure in the test section decreased by c 1 kPa during the injection period. Still, thIS period indicates a well-defined PRF. The recovery period is dominated by WBS and a transition period.

257–277 m

The injection period indicates a well-defined PRF. The recovery period points to a short period of PRF between 10 and 50 s, followed by a transition to a PSF.

277–297 m

The injection period indicates a PRF transitioning to a PSF. The recovery period also indicates a PRF followed by a transition towards a PSF.

297–317 m

During the injection period a PRF approaching PSF is indicated. The recovery period indicates a PRF between 10 and 100 s, followed by a transition to a PSF, or possibly PSS.

317–337 m

The injection period implies a PRF by the end of the period. The recovery indicates a PSF.

337–357 m

Both the injection and recovery periods indicate a PRF. However, the PRF during the injection period is more developed. The pressure in the section below the test section increased by by c 2 kPa during the injection period. However, since the transmissivity below 357 m is not significantly larger than the transmissivity of the section 337–357 m, this small pressure interference should not have a major impact on the test.

357–377 m

By the end of the injection period, a PRF is indicated. During the initial phase of the recovery period, effects of WBS are indicated, transitioning to a PRF by the end of the period.

377–397 m

Although the flow rate data are scattered during the injection a transition to a PRF is indicated during the period. The recovery period only points to WBS. The pressure did not recover more than 12 m from the head change of 22.78 m during the injection period which indicates a very low transmissivity in this section.

397–417 m

The flow rate data are very scattered during the injection. However, a PRF is weakly indicated between 500 and 1,200 s during the injection period. The pressure below the test section increased by c 24 kPa during the injection period. The recovery period indicates WBS transitioning to a short PRF between c 200 and 400 s. An apparent NFB is indicated at the end of the recovery period. The pressure in the borehole interval below the test section increased by c 25 kPa during the injection period. Since the transmissivity below 417 m is higher than in section 397–417 m, and the pressure interference is relatively large, the estimated transmissivity of this section may be slightly overestimated.

417–437 m

During the beginning of the injection period, a PSF seems to dominate. Towards the end of the injection period a PRF is weakly indicated. The recovery period indicates a PLF throughout the period. The pressure did not recover more than 16 m from the head change of 22.40 m applied during the injection period. The recovery response is not consistent with the response during the injection period.

437–457 m

The test section has a very low transmissivity. Since the flow rate was not detectable, neither steady-state nor transient evaluation of transmissivity was possible. Hence, in accordance with AP PF 400-04-27, the injection time was shortened. As a result, Q/s-measl-L is considered to be the most representative transmissivity value for this section. The period of measured recovery only showed a pressure increase, indicating that the section is of such a low transmissivity that packer expansion affects the pressure throughout the period.

453–473 m

Although the flow rate data are scattered during the injection, a transition to a PRF is indicated during the period. The recovery period only indicates WBS. The pressure did not recover more than 9 m from the head change of 21.92 m applied during the injection period, indicating a very low transmissivity in this section.

473–493 m

The flow rate data are scattered during the injection and no specific flow regime is indicated during the period. The recovery period only indicates WBS. The pressure did not recover more than 3.4 m from the head change of 22.22 m applied during the injection period, indicating a very low transmissivity in this section.

477–497 m

The test section has a very low transmissivity. Since the flow rate was not detectable, neither steady-state nor transient evaluation of transmissivity was possible. As a result, Q/s-measl-L was considered to be the most representative transmissivity value for this section.

497–517 m

The test section has a very low transmissivity. Since the flow rate was not detectable, neither steady-state nor transient evaluation of transmissivity was possible. Hence, in accordance with AP PF 400-04-27, the injection time was shortened. As a result, Q/s-measl-L was considered to be the most representative transmissivity value for this section.

517–537 m

Due to a drift in the gas pressure regulator, the pressure in the test section decreased by c 2 kPa during the injection period. The injection period indicates PLF or an apparent NFB in the beginning, transitioning to PSF by the end of the period. No well-defined PRF was developed. The recovery period only indicates a PLF or possibly, WBS. No reliable transient evaluation of the test is possible. Only an approximate transient evaluation was made on the injection period. Hence, T_M was considered to be the most representative transmissivity value for this section. The pressure did not recover more than 11.4 m from the head change of 21.12 m applied during the injection period.

297–302 m

Both the injection- and recovery period imply a PRF transitioning to a PSF.

302–307 m

The flow rate is scattered and the time to achieve a stable injection pressure was unusually long. However, a PRF/PSF is indicated during the injection period. During the recovery period, WBS and a transition period is indicated.

307–312 m

Despite a final flow rate below 1 mL/min, the flow rate is considered significant. Although the flow rate data are very scattered during the injection period, a PRF is indicated during the period. The recovery period indicates WBS and a transition period.

312–317 m

Due to a drift in the gas pressure regulator, the pressure in the test section decreased by c 3 kPa during the injection period. Still, a PRF is indicated from c 100 s of the injection period. The recovery period points to WBS with a transition to PSF. The apparent PRF by the end of recovery is not considered representative for the hydraulic properties of the section.

317–322 m

Due to a drift in the gas pressure regulator, the pressure in the test section decreased by c 4 kPa during the injection period. A short PRF regime is indicated in the beginning of the injection period. During the recovery period, WBS transitioning to PSF is indicated.

322–327 m

The injection period indicates a PRF between 10 and 200 s, transitioning to a PSF towards the end of the period. The recovery period indicates a PLF transitioning to a PSF by the end of the period. A fit to a single-fracture model for the first 200 s of the recovery period corresponds well to the calculated T-value from the injection period.

327–332 m

Due to a drift in the gas pressure regulator, the pressure in the test section decreased by c 3 kPa during the injection period. Still, a PRF is indicated between 300 s and 120 s of the injection period. The recovery period indicates WBS transitioning to a PSF.

332–337 m

The injection period indicates a well-defined PRF. The recovery is almost instantaneous and approaching a PSS by the end.

337–342 m

During the injection period, a transition from a PSF to a PRF by the end is indicated. During the recovery period PRF/PSF is implied. The pressure in the borehole interval below the test section increased by c 1 kPa during the injection period. However, since the transmissivity below 342 m is not significantly higher than the transmissivity of the section 337–342 m, this small pressure interference should not have a major impact on the test.

342–347 m

The flow rate data are scattered during the injection due to an unstable pressure. However, a PSF is weakly indicated during the injection period. The recovery period also indicates a PSF.

347–352 m

The flow rate data are scattered. However, a PRF is indicated during the injection period. The recovery period indicates WBS transitioning to a PSF.

352–357 m

The flow rate data are scattered. However, a PRF is assumed during the injection period. The recovery period indicates WBS transitioning to a PSF.

357–362 m

The injection period indicates a PRF after c 300 s. The recovery period points to a PRF after initial WBS, and skin effects.

362–367 m

The test section has a very low transmissivity. Since the flow rate was not detectable, neither steady-state nor transient evaluation of transmissivity was possible. Hence, in accordance with AP PF 400-04-27, the injection time was shortened. As a result, Q/s-measl-L was considered to be the most representative transmissivity value for this section.

367–372 m

The test section has a very low transmissivity. Since the flow rate was not detectable, neither steady-state nor transient evaluation of transmissivity was possible. Hence, in accordance with AP PF 400-04-27, the injection time was shortened. As a result, Q/s-measl-L was considered to be the most representative transmissivity value for this section.

372–377 m

The test section has a very low transmissivity. Since the flow rate was not detectable, neither steady-state nor transient evaluation of transmissivity was possible. Hence, in accordance with AP PF 400-04-27, the injection time was shortened. As a result, Q/s-measl-L was considered to be the most representative transmissivity value for this section. The period of measured recovery only showed a pressure increase indicating that the section is of such low transmissivity that packer expansion affects the pressure throughout the period.

377–382 m

The test section has a very low transmissivity. Since the flow rate was not detectable, neither steady-state nor transient evaluation of transmissivity was possible. Hence, in accordance with AP PF 400-04-27, the injection time was shortened. As a result, Q/s-measl-L was considered to be the most representative transmissivity value for this section. The period of measured recovery only showed a pressure increase indicating that the section is of such low transmissivity that packer expansion affects the pressure throughout the period.

382–387 m

The test section has a very low transmissivity. Since the flow rate was not detectable, neither steady-state nor transient evaluation of transmissivity was possible. Hence, in accordance with AP PF 400-04-27, the injection time was shortened. As a result, Q/s-measl-L was considered to be the most representative transmissivity value for this section. The period of measured recovery only showed a pressure increase indicating that the section is of such low transmissivity that packer expansion affects the pressure throughout the period.

387–392 m

The test section has a very low transmissivity. Since the flow rate was not detectable, neither steady-state nor transient evaluation of transmissivity was possible. Hence, in accordance with AP PF 400-04-27, the injection time was shortened. As a result, Q/s-measl-L was considered to be the most representative transmissivity value for this section. The period of measured recovery only showed a pressure increase indicating that the section is of such low transmissivity that packer expansion affects the pressure throughout the period.

392–397 m

Despite a final flow rate as low as close to 1 mL/min, the flow rate is considered significant. Although the flow rate data are scattered during the injection period, a PRF is approached during period. The recovery period only indicates WBS.

397–402 m

Despite a final flow rate close to 1 mL/min, the flow rate is considered significant. Although the flow rate data are scattered during the injection period a PRF regime is approached during period. The recovery period only indicates WBS.

402–407 m

The test section has a very low transmissivity. Since the flow rate was not detectable, neither steady-state nor transient evaluation of transmissivity was possible. Hence, in accordance with AP PF 400-04-27, the injection time was shortened. As a result, Q/s-measl-L was considered to be the most representative transmissivity value for this section.

407–412 m

The test section has a very low transmissivity. Since the flow rate was not detectable, neither steady-state nor transient evaluation of transmissivity was possible. Hence, in accordance with AP PF 400-04-27, the injection time was shortened. As a result, Q/s-measl-L was considered to be the most representative transmissivity value for this section.

412–417 m

There are indications of a PRF during the injection period from c 200 s to c 1,200 s. During the recovery period WBS is indicated during the first 10 s, followed by a transition period from 10 s to c 100 s with a very short period of apparent PRF. A transition to an apparent NFB is indicated from c 150 s to the end of the recovery period. The pressure in the borehole below the test section increased by c 25 kPa during the injection period. Since the transmissivity below 417 m is higher than in the section 412–417 m and the pressure interference is relatively large, the presented transmissivity for this section may be slightly overestimated.

417–422 m

A PRF is indicated at intermediate times of the injection period, transitioning to a PSF towards the end of the period. The recovery period only indicates a PLF. The responses during the injection and recovery periods, respectively, are not consistent. The pressure in the borehole interval below the test section increased by c 22 kPa during the injection period. However, since the transmissivity of section 417–422 m is significantly larger than the transmissivity below 422 m, this relatively large pressure interference should not have a major impact on the test performed in the section.

422–427 m

Although the flow rate data are scattered, a PRF is indicated during the injection period. The recovery period indicates WBS transitioning to a PSF.

427–432 m

The test section has a very low transmissivity. Since the flow rate was not detectable, neither steady-state nor transient evaluation of transmissivity was possible. Hence, in accordance with AP PF 400-04-27, the injection time was shortened. As a result, Q/s-measl-L was considered to be the most representative transmissivity value for this section. The period of measured recovery only showed a pressure increase indicating that the section is of such low transmissivity that packer expansion affects the pressure throughout the period.

432–437 m

The test section has a very low transmissivity. Since the flow rate was not detectable, neither steady-state nor transient evaluation of transmissivity was possible. Hence, in accordance with AP PF 400-04-27, the injection time was shortened. As a result, Q/s-measl-L was considered to be the most representative transmissivity value for this section. The period of measured recovery only showed a pressure increase indicating that the section is of such low transmissivity that packer expansion affects the pressure throughout the period.

517–522 m

The flow rate was high in the beginning of the injection period, but then decreased rapidly indicating a PLF or an apparent NFB. No well-defined PRF was developed. By the end of the injection period, a transition to a PSF is indicated. The recovery indicates a PLF.

No reliable transient evaluation of the test is possible. Only an approximate transient evaluation was made on the injection period. Hence, T_M was considered to be the most representative transmissivity value for this section. The test responses are consistent with the responses in the corresponding 20 m section at 517–537 m.

522–527 m

The test section has a very low transmissivity. Since the flow rate was not detectable, neither steady-state nor transient evaluation of transmissivity was possible. Hence, in accordance with AP PF 400-04-27, the injection time was shortened. As a result, Q/s-measl-L was considered to be the most representative transmissivity value for this section. The period of measured recovery only showed a pressure increase indicating that the section is of such low transmissivity that packer expansion affects the pressure throughout the period.

527–532 m

The test section has a very low transmissivity. Since the flow rate was not detectable, neither steady-state nor transient evaluation of transmissivity was possible. Hence, in accordance with AP PF 400-04-27, the injection time was shortened. As a result, Q/s-measl-L was considered to be the most representative transmissivity value for this section. The period of measured recovery only showed a pressure increase indicating that the section is of such low transmissivity that packer expansion affects the pressure throughout the period.

532–537 m

The test section has a low transmissivity. Since the flow rate was not detectable, neither steady-state nor transient evaluation of transmissivity was possible. As a result, Q/s-measl-L was considered to be the most representative transmissivity value for this section.

6.2.5 Flow regimes

As discussed in Section 6.2.3, several recovery periods were dominated by wellbore storage effects and no pseudo-radial flow period was reached. On the other hand, some time interval of pseudo-radial flow could in most cases be identified from the injection period. A summary of the frequency of identified flow regimes on different scales is presented in Table 6-3, which shows all identified flow regimes. I.e. if a certain flow period indicates a pseudo-radial flow regime transitioning to a pseudo-spherical flow regime, this flow period contributes to one observation of pseudo-radial and one observation of pseudo-spherical flow. The numbers within parenthesis denote the number of tests where the actual flow regime is the only one present.

It should be noted that the interpretation of flow regimes is only tentative and based on visual inspection of the data curves. The number of tests with a pseudo-linear flow regime may be underestimated for the injection period due to the fact that a certain time is required for achieving constant pressure in the beginning of the test.

Table 6-3. Interpreted flow regimes during the injection tests in KFM04A.

Section length (m)	Number of tests	Number of tests with definable Q_p	Injection period					Recovery period					
			PLF	PRF	PSF	PSS	NFB	WBS	PLF	PRF	PSF	PSS	NFB
5	32	19	1 (0)	17 (11)	8 (1)	0	0	13 (4)	3 (1)	3 (0)	11 (1)	1 (0)	1 (0)
20	22	19	1 (0)	15 (9)	6 (2)	0	0	7 (4)	3 (2)	8 (2)	8 (3)	1 (0)	1 (0)
100	9	8	0	7 (5)	2 (0)	0	0	5 (4)	1 (0)	1 (1)	2 (0)	2 (0)	0

Table 6-3 shows that a period of pseudo-radial flow could be identified from the injection period in c 85% of the tests with a definable final flow rate. For the recovery period, the corresponding result is only c 26%. The number of tests showing a pseudo-linear flow regime was somewhat higher for the recovery period than for the injection period of the tests. Another observation is that no pseudo-stationary flow regime could be identified during the injection period for any test, while four of the tests indicated such a flow regime during the recovery period.

For less than half of the tests, more than one flow regime could be identified. The most common transitions were from pseudo-radial to pseudo-spherical flow during the injection period and from wellbore storage to pseudo-spherical flow during the recovery period.

6.3 Transmissivity values on different scales

The transmissivity values considered the most representative, T_R, from the injection tests in the tested sections of 100 m, 20 m and 5 m length, respectively, are shown in Figure 6-2. This figure demonstrates a good agreement between results obtained from tests on different scales. A consistency check of the transmissivity values on the different scales was made by summation of calculated values from smaller scales (20 m and 5 m) and comparing with the estimated values in longer sections (100 m and 20 m).

In Table 6-4, estimated transmissivity values in 100 m and 20 m test sections according to steady-state (T_M) and most representative evaluation (T_R) are listed together with summed transmissivities in 20 m and 5 m sections over the corresponding 100 m and 20 m sections. In addition, the corresponding sum of transmissivities from the difference flow logging in 5 m sections (SUM T_D) is displayed for each section.

In Table 6-4, all transmissivity values considered the most representative (T_R) below the measurement limit (Q_p could not be defined) have been assigned the estimated lower measurement value of Q/s according to Q/s-measl-L in Section 5.4. Furthermore, in Table 6-4, all values of transmissivity from the steady-state evaluation (T_M) below the measurement limit (Q_p could not be defined) have been assigned the estimated lower measurement value (Q/s-measl-L) for the specific test. The measurement limit values are included in the summed values in Table 6-4. This leads to overestimated values of the summed transmissivities. This is particularly true for the summed transmissivities from the difference flow logging in 5 m sections, due to the increased lower measurement limit for these tests, see /1/.

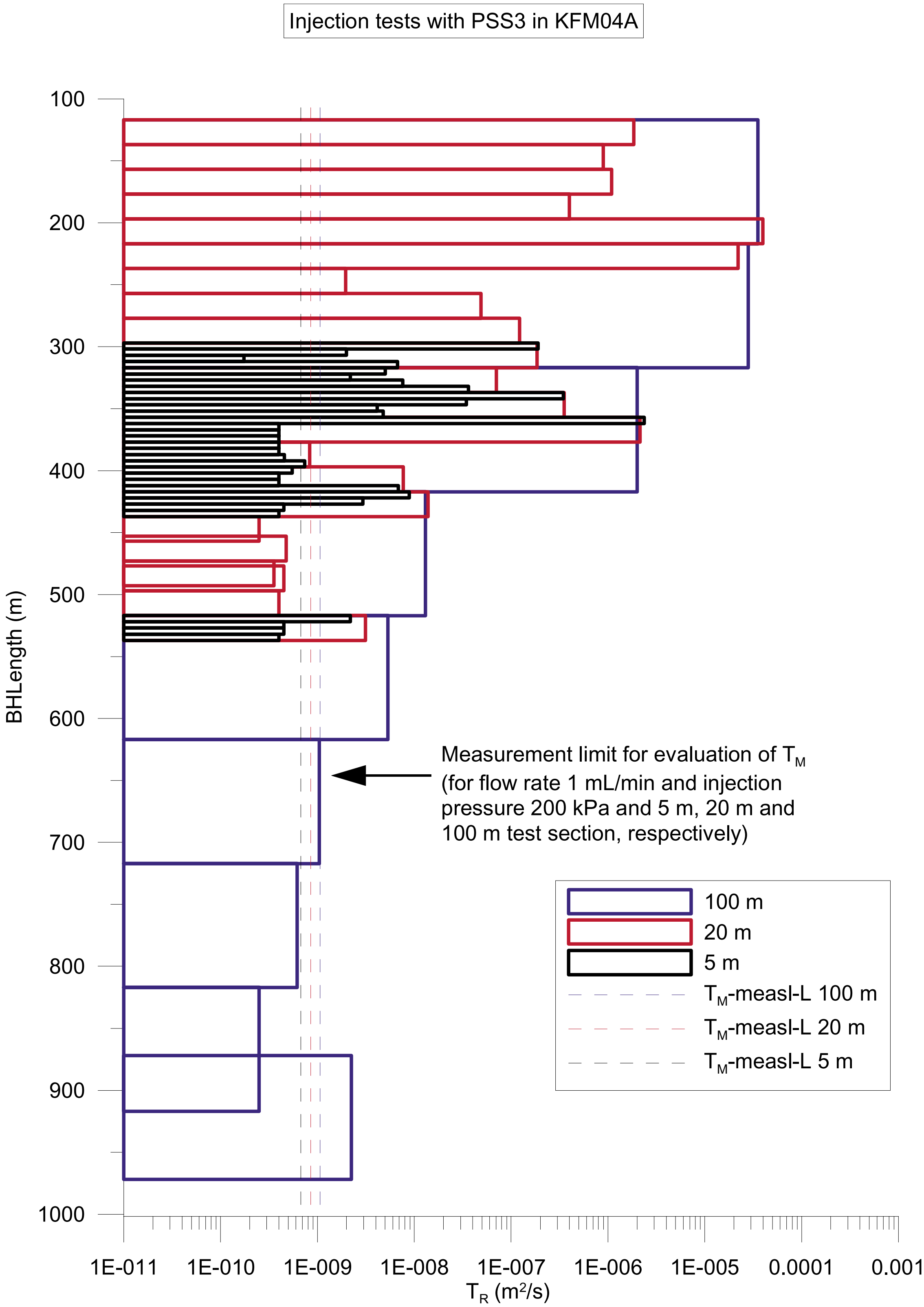

Figure 6-2. *Estimated best representative transmissivity values (T_R) for sections of 100 m, 20 m and 5 m length in borehole KFM04A. Estimated transmissivity values for the lower measurement limit from stationary evaluation (T_M-measl-L) (flow rate 1.7×10^{-8} m^3/s and injection pressure 200 kPa) for different test section lengths are also shown.*

Table 6-4. Estimated transmissivity values in 100 m and 20 m test sections together with summed up transmissivity values in 20 m and 5 m sections in the corresponding borehole intervals from the injection tests in KFM04A. In addition, the corresponding sum of transmissivity values from the difference flow logging in 5 m sections is shown.

Borehole Idcode	Secup inj.test (m)	Seclow inj.test (m)	L_w (m)	T_M inj. tests (m^2/ s)	T_R inj. tests (m^2/s)	SUM T_M (20m) inj. tests (m^2/s)	SUM T_R (20m) inj. tests (m^2/s)	SUM T_M (5m) inj. tests (m^2/s)	SUM T_R (5m) inj. tests (m^2/s)	Secup diff-flow log (m)	Seclow diff-flow log (m)	SUM–T_D (5m) diff-flow log (m^2/s)
KFM04A	117.00	217.00	100	3.87E–05	3.55E–05	2.60E–05	4.42E–05	n.m. 5 m	n.m. 5 m	116.23	216.50	4.88E–05
KFM04A	217.00	317.00	100	2.64E–05	2.82E–05	2.25E–05	2.24E–05	n.m. 5 m	n.m. 5 m	216.50	316.65	5.48E–05
KFM04A	317.00	417.00	100	2.24E–06	2.00E–06	1.87E–06	2.57E–06	1.66E–06	2.82E–06	316.65	416.72	1.46E–06
KFM04A	417.00	517.00	100	4.64E–08	1.30E–08	4.18E–08	1.58E–08	n.m. 5 m	n.m. 5 m	416.73	516.81	5.94E–08
KFM04A	517.00	617.00	100	5.34E–09	5.34E–09	n.m. 20 m	n.m. 20 m	n.m. 5 m	n.m. 5 m	516.82	616.98	4.78E–08
KFM04A	617.00	717.00	100	5.36E–09	1.04E–09	n.m. 20 m	n.m. 20 m	n.m. 5 m	n.m. 5 m	616.99	717.17	6.99E–08
KFM04A	717.00	817.00	100	6.16E–10	6.16E–10	n.m. 20 m	n.m. 20 m	n.m. 5 m	n.m. 5 m	717.18	817.22	4.95E–08
KFM04A	817.00	917.00	100		2.50E–10	n.m. 20 m	n.m. 20 m	n.m. 5 m	n.m. 5 m	817.22	917.54	4.39E–08
KFM04A	872.00	972.00	100	4.13E–09	2.24E–09	n.m. 20 m	n.m. 20 m	n.m. 5 m	n.m. 5 m	872.38	972.56	4.32E–08
KFM04A	117.00	137.00	20	1.62E–06	1.85E–06			n.m. 5 m	n.m. 5 m	116.23	136.43	1.45E–06
KFM04A	137.00	157.00	20	5.83E–07	8.95E–07			n.m. 5 m	n.m. 5 m	136.43	156.42	5.00E–07
KFM04A	157.00	177.00	20	1.22E–06	1.10E–06			n.m. 5 m	n.m. 5 m	156.42	176.44	1.86E–06
KFM04A	177.00	197.00	20	1.16E–06	3.99E–07			n.m. 5 m	n.m. 5 m	176.45	196.47	1.29E–06
KFM04A	197.00	217.00	20	2.15E–05	4.00E–05			n.m. 5 m	n.m. 5 m	196.48	216.50	4.37E–05
KFM04A	217.00	237.00	20	2.20E–05	2.20E–05			n.m. 5 m	n.m. 5 m	216.50	236.52	5.45E–05
KFM04A	237.00	257.00	20	2.44E–09	1.95E–09			n.m. 5 m	n.m. 5 m	236.52	256.53	9.12E–09
KFM04A	257.00	277.00	20	5.08E–08	4.89E–08			n.m. 5 m	n.m. 5 m	256.54	276.56	3.02E–08
KFM04A	277.00	297.00	20	2.65E–07	1.23E–07			n.m. 5 m	n.m. 5 m	276.57	296.60	5.18E–08
KFM04A	297.00	317.00	20	1.90E–07	1.86E–07			2.19E–07	1.99E–07	296.61	316.65	1.83E–07
KFM04A	317.00	337.00	20	5.30E–08	7.07E–08			4.64E–08	5.11E–08	316.65	336.66	9.11E–09
KFM04A	337.00	357.00	20	2.97E–07	3.54E–07			2.49E–07	3.90E–07	336.66	356.66	3.75E–08
KFM04A	357.00	377.00	20	1.51E–06	2.14E–06			1.36E–06	2.37E–06	356.66	376.67	1.40E–06

Borehole Idcode	Secup inj.test (m)	Seclow inj.test (m)	L_w (m)	T_M inj. tests (m^2/ s)	T_R inj. tests (m^2/s)	SUM T_M (20m) inj. tests (m^2/s)	SUM T_R (20m) inj. tests (m^2/s)	SUM T_M (5m) inj. tests (m^2/s)	SUM T_R (5m) inj. tests (m^2/s)	Secup diff-flow log (m)	Seclow diff-flow log (m)	SUM–T_D (5m) diff-flow log (m^2/s)
KFM04A	377.00	397.00	20	8.34E–10	8.34E–10			2.00E–09	2.00E–09	376.68	396.70	9.11E–09
KFM04A	397.00	417.00	20	1.12E–08	7.71E–09			9.61E–09	8.21E–09	396.70	416.72	9.14E–09
KFM04A	417.00	437.00	20	3.99E–08	1.39E–08			3.72E–08	1.27E–08	416.73	436.74	2.38E–08
KFM04A	437.00 [1)]	457.00	20		2.50E–10			n.m. 5 m	n.m. 5 m	436.75	456.76	8.97E–09
KFM04A	453.00 [1)]	473.00	20	4.76E–10	4.76E–10			n.m. 5 m	n.m. 5 m	451.76	471.78	8.91E–09
KFM04A	473.00 [1)]	493.00	20	3.55E–10	3.55E–10			n.m. 5 m	n.m. 5 m	471.78	491.79	8.90E–09
KFM04A	477.00 [1)]	497.00	20		4.50E–10			n.m. 5 m	n.m. 5 m	476.78	496.80	8.89E–09
KFM04A	497.00	517.00	20		4.00E–10			n.m. 5 m	n.m. 5 m	496.80	516.81	8.87E–09
KFM04A	517.00	537.00	20	3.13E–09	3.13E–09			3.49E–09	3.49E–09	516.82	536.83	8.12E–09
Sum of T in 297.00–437.00 m				n.m.	n.m.	2.10E–06	2.77E–06	1.92E–06	3.03E–06	296.61	436.74	1.67E–06
Sum of T in 317.00–517.00 m				2.29E–06	2.01E–06	1.91E–06	2.59E–06	n.m. 5 m	n.m. 5 m	316.65	516.81	1.52E–06

[1)] partly overlapping sections.
n.m. =not measured.

In Figure 6-3, transmissivity values considered as the most representative for 100 m and 20 m sections (T_R–100 m and T_R–20 m, respectively) are plotted versus the sum of the transmissivity values considered most representative in 5 m sections in the corresponding intervals (SUM T_R–5 m). The lower measurement limit of T_M for the different section lengths (Q_p=1 mL/min and an assumed pressure difference of 200 kPa) together with the cumulative measurement limit for the sum of 5 m sections are also shown in the figure.

Figure 6-3 indicates a good agreement between measured transmissivity values in longer sections and summed transmissivity values in corresponding 5 m sections for the injection tests. The deviation towards the lower limit is caused by the fact that values at the measurement limit (Q/s-measl-L) are accumulated in the summation process which most likely results in overestimated values of SUM T_R–5 m.

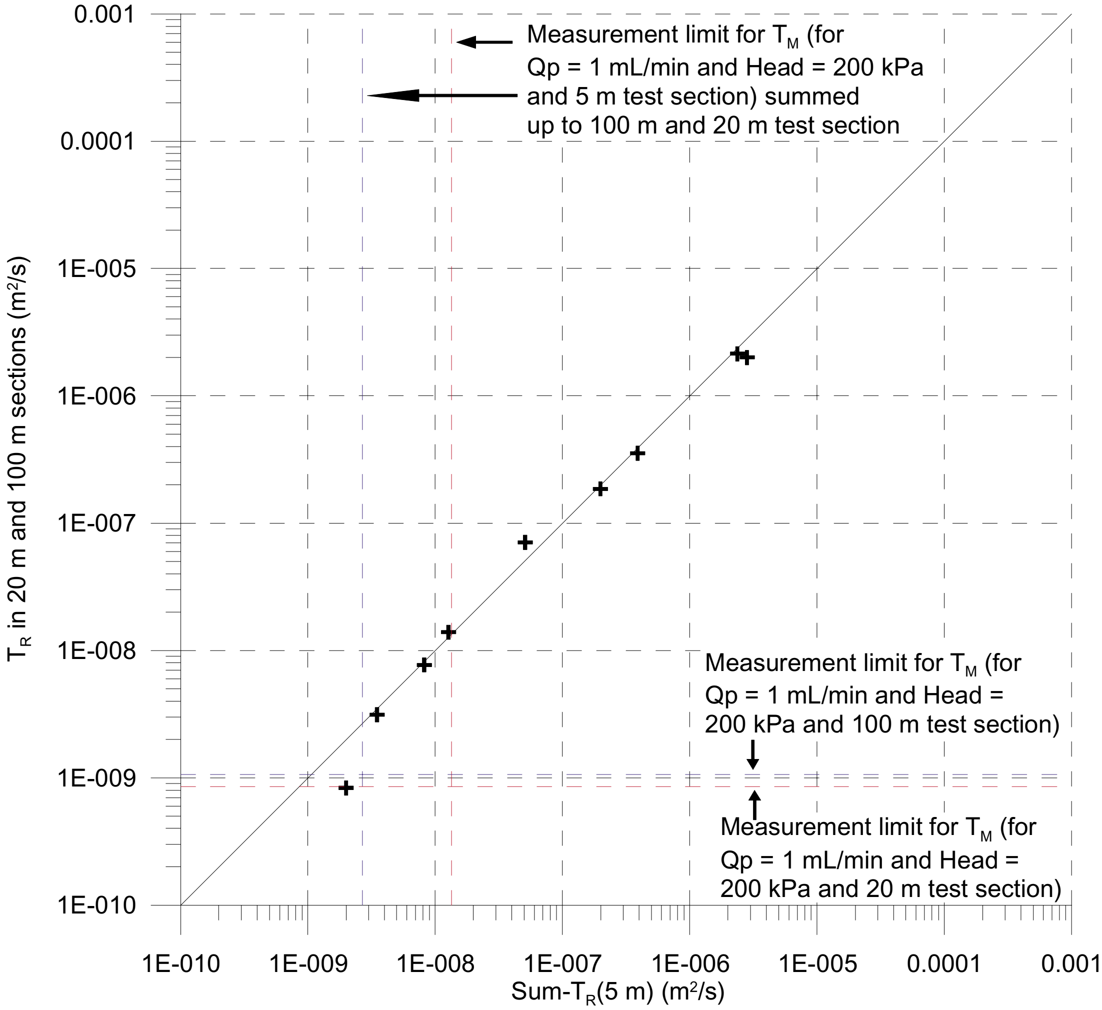

Figure 6-3. *Transmissivity values considered most representative (T_R) for 100 m and 20 m sections versus the sum of most representative transmissivity values (T_R) in 5 m sections in the corresponding borehole intervals from the injection tests in KFM04A.*

6.4 Comparison with results from the difference flow logging

In Figure 6-4, a direct comparison is made of calculated steady-state (T_M) and most representative transmissivity values (T_R) from the injection tests in 5 m sections with the calculated transmissivity values in the corresponding 5 m sections from the sequential difference flow logging (T_D) in KFM04A /1/. In Figure 6-5, T_R and T_D are plotted versus borehole length for the injections tests in 5 m sections. The presented measurement limit for the difference flow logging is the practical lower measurement limit (varying along the borehole) /1/. In the summation of the transmissivities from the 5 m sections, the estimated values for the lower (practical) measurement limits are included.

Figure 6-4 indicates a good agreement between the estimated transmissivity values from the injection tests and the difference flow logging. It should, however, be noted that the two methods differ regarding assumptions and associated uncertainties. Potential uncertainties for difference flow logging results are discussed in /11/ and for injection tests in /12/.

For the difference flow logging, the lower limit for transmissivity was in most sections of KFM04A estimated at approximately 2.2×10^{-9} m^2/s. This limit is significantly higher than the corresponding limits for the injection tests in KFM04A. This is clearly seen in Figure 6-4 as a difference between T_D, T_M and T_R, respectively, for low transmissivity values. Figure 6-4 and 6-5 further indicate that both T_M and T_R tend to be higher than T_D when T_M and T_R exceed T_D-measl-L. This is particularly true for the sections 332–337 m, 337–342 m and 342–347 m, which is clearly seen in Figure 6-5.

In Figure 6-6, a comparison is made of the estimated steady-state transmissivity values from the injection tests in 100 m and 20 m test sections with summed transmissivity values for 5 m sections from the difference flow logging (SUM T_D(5 m)) in the corresponding borehole intervals. The latter sums are shown in Table 6-4. Figure 6-6 demonstrates that the estimated transmissivity values from the injection tests in 100 m and 20 m sections are distributed over a much wider range than the sum of transmissivity values from the difference flow logging. This is partly a result of the lower measurement limit values being included in the sum for the difference flow logging. Figure 6-6 may be compared with Figure 6-3 only for the injection tests. In Figure 6-7, T_R and SUM T_D (5 m) are plotted versus the borehole length for the injection test intervals in 20 m and 100 m sections.

The results in Figure 6-6 are consistent with the results in Figure 6-4. However, the tendency in Figures 6-4 and 6-5 towards higher values of T_M and T_R than T_D is not seen in Figures 6-6 and 6-7. Still, the 20 m sections in the interval 317–347 m show significantly higher T_R than T_D as in the case of the 5 m sections in the interval 332–347 m.

For the difference flow logging, the flow period in the borehole was much longer than for the injection tests. Therefore, the difference flow logging measures interconnected, conductive fracture networks reaching further away from the borehole than the injection tests. This may be an explanation of the significantly higher T_R than T_D in some of the 5 m and 20 m sections, assuming that the fractures in these sections are of limited extent and not connected with a larger fracture network. Thus, the transmissivity of such fractures is assumed to decrease with increasing flow times. During short injection tests, such effects may not be seen.

As discussed in Section 6.2.4, there is a possibility that T_R and T_M in sections 397–417 m and 412–417 m are overestimated due to interference with the section below the test section. However, the agreement between T_D and T_R are relatively good for these sections, as seen in Figures 6-6 and 6-7. Therefore, the interference should not have a major impact on the injection tests in these sections.

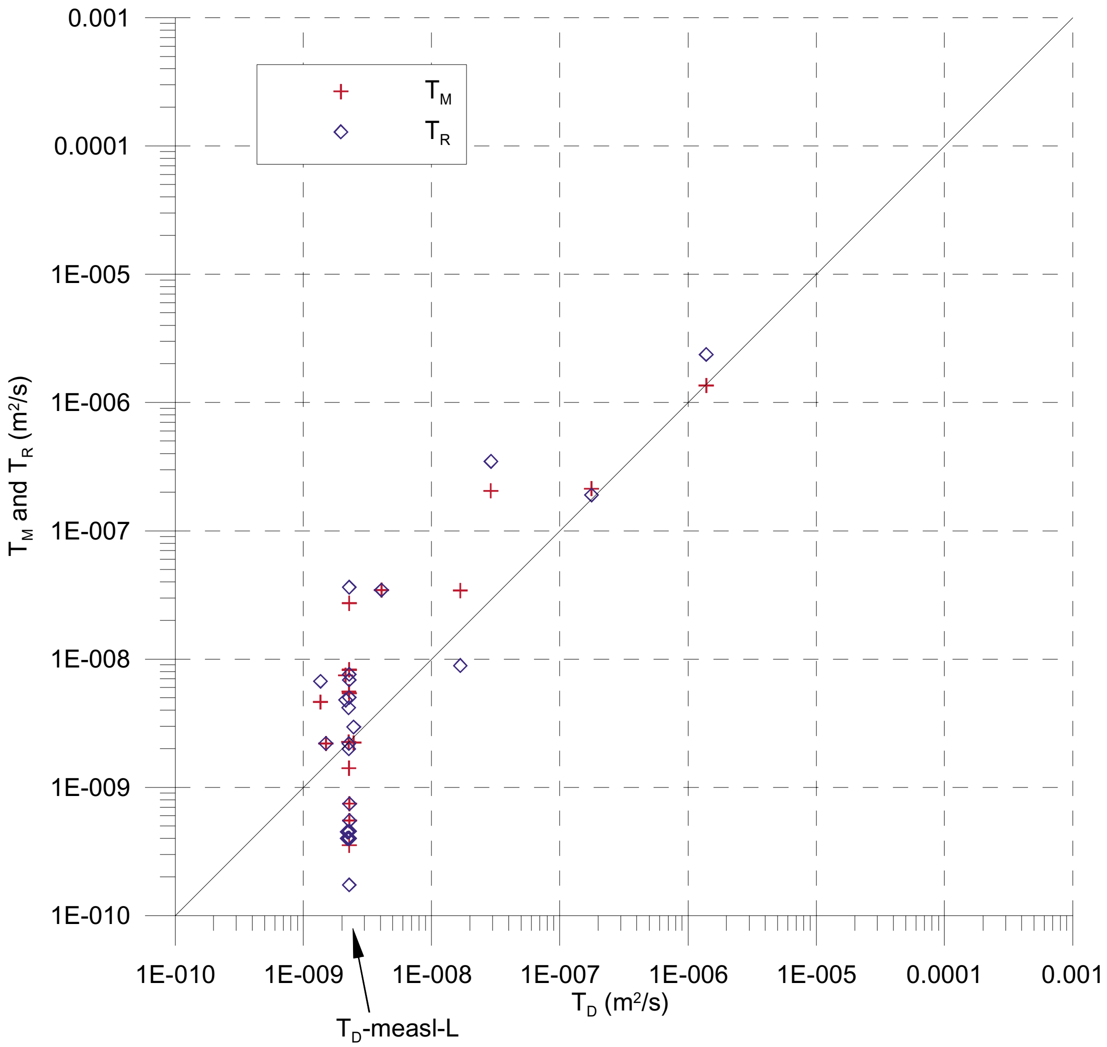

Figure 6-4. *Comparison of estimated steady-state (T_M) and most representative (T_R) transmissivity values from the injection tests in 5 m sections with estimated transmissivity values in the corresponding 5 m sections from the previous difference flow logging (T_D) in KFM04A.*

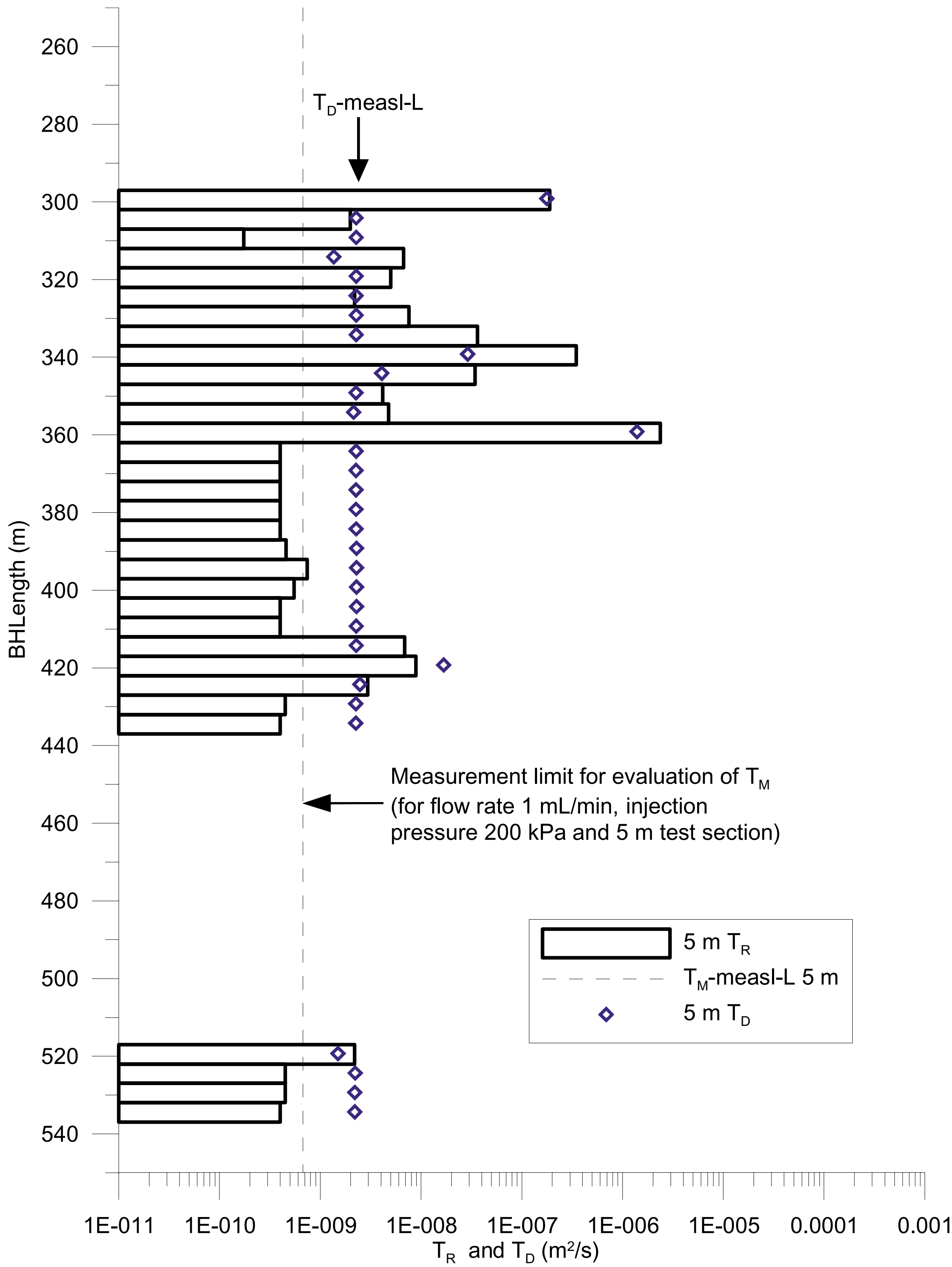

Figure 6-5. *Comparison of most representative (T_R) transmissivity values from the injection tests in 5 m sections with estimated transmissivity values in the corresponding 5 m sections from the previous difference flow logging (T_D) in KFM04A.*

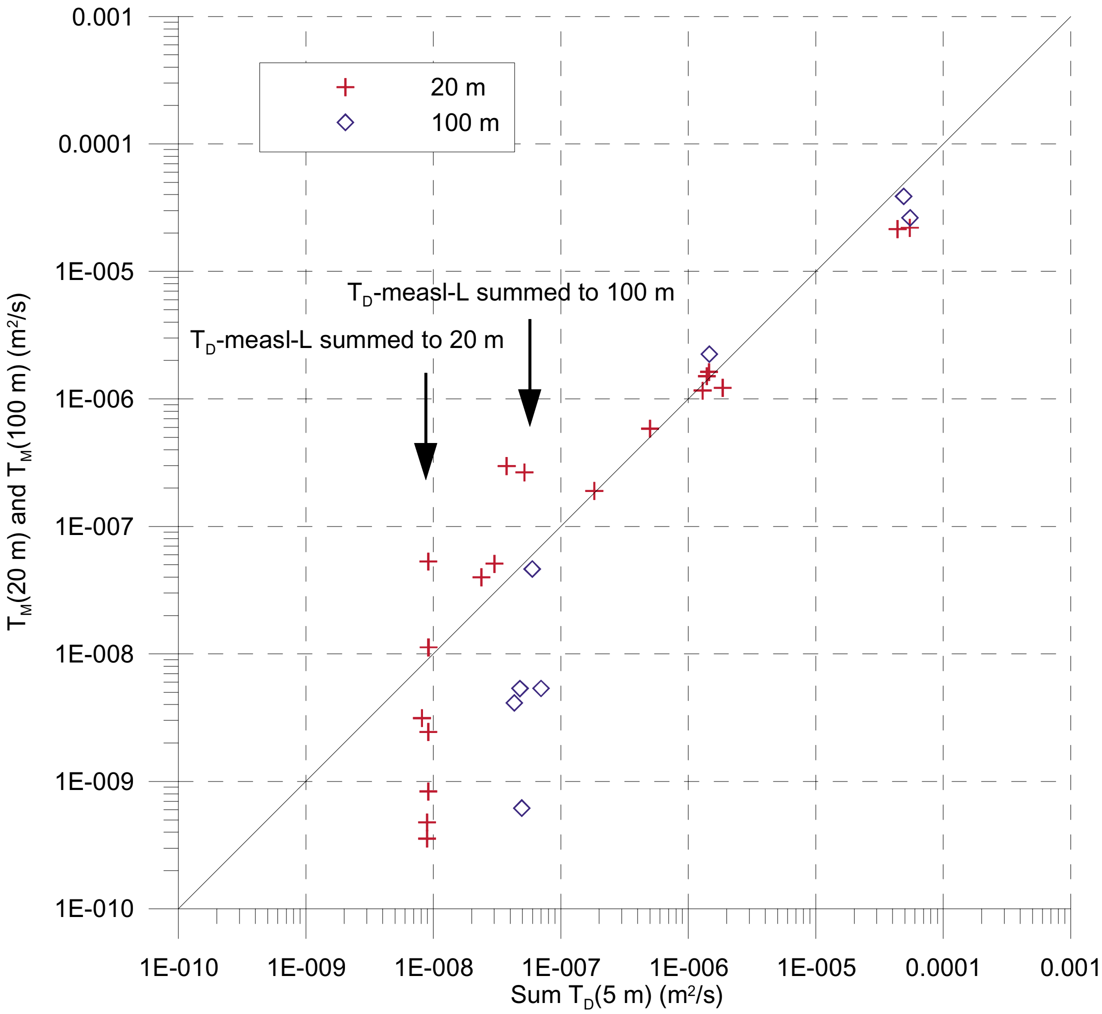

Figure 6-6. *Comparison of estimated steady-state transmissivity values from injection tests in 20 m and 100 m sections with summed transmissivity values in 5 m sections in the corresponding borehole intervals from difference flow logging in KFM04A.*

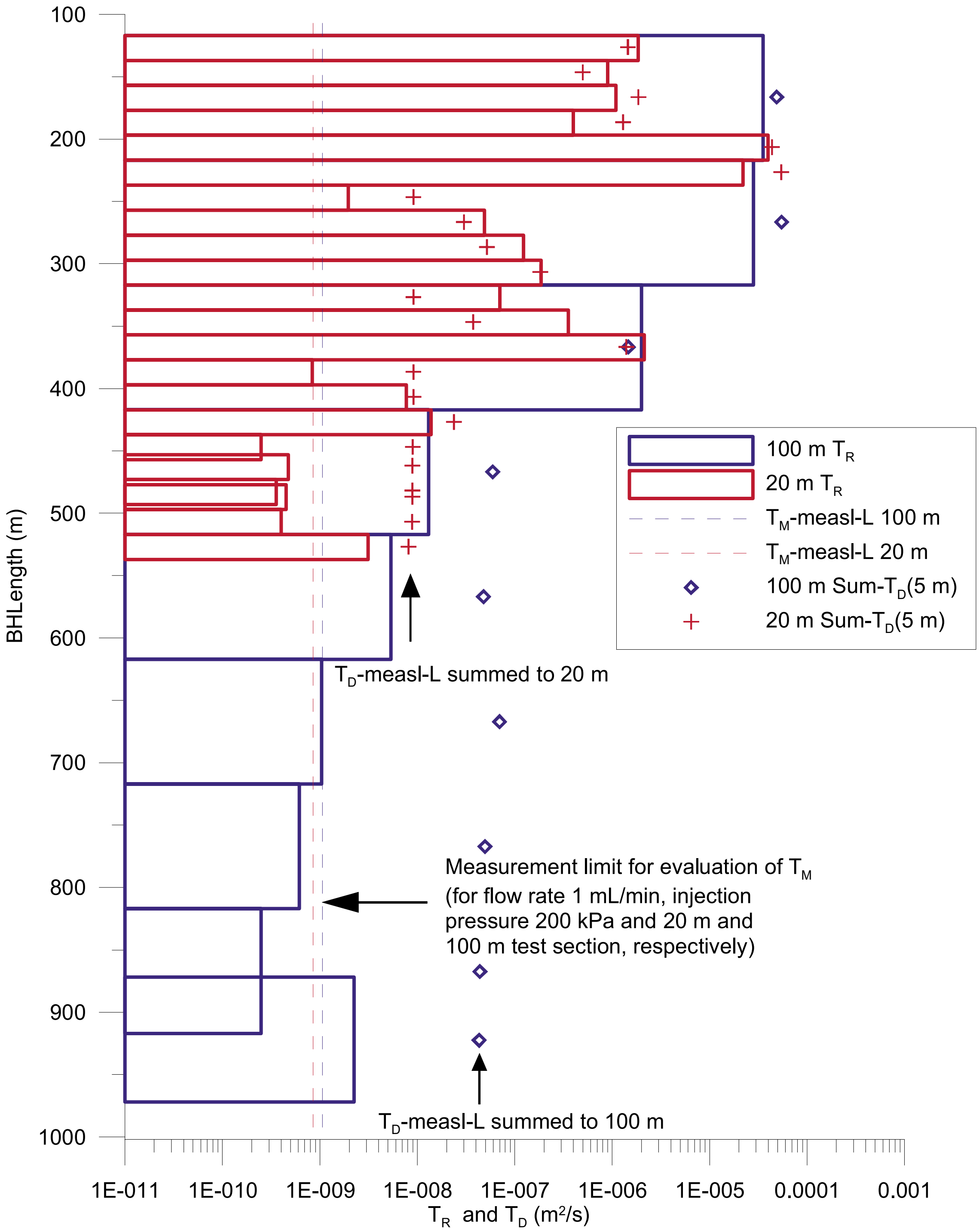

Figure 6-7. *Comparison of most representative (T_R) transmissivity values from injection tests in 20 m and 100 m sections with summed transmissivity values in 5 m sections in the corresponding borehole intervals from difference flow logging in KFM04A.*

6.5 Basic statistics of hydraulic conductivity distributions

Some basic statistical parameters were calculated for the steady-state hydraulic conductivity (K_M) distributions in different scales (100 m, 20 m and 5 m) from the injection tests in borehole KFM04A. The hydraulic conductivity is obtained by dividing the transmissivity by the section length, in this case T_M/L_w. Results from tests where Q_p was below the estimated measurement limit were not included in the statistical analyses of K_M. Therefore, the same basic statistical parameters were derived for the hydraulic conductivity considered most representative ($K_R=T_R/L_w$), including all tests. In the statistical analysis, the logarithm (base 10) of K_M and K_R was used. Selected results are shown in Table 6-5. It should be noted that the statistics for the different section lengths is based on different borehole intervals.

Table 6-5. Basic statistical parameters for steady-state hydraulic conductivity (K_M) and hydraulic conductivity considered most representative (K_R) in borehole KFM04A. L_w=section length, m=arithmetic mean, s=standard deviation.

Borehole	Parameter	Unit	L_w=100 m	L_w=100 m	L_w=20 m	L_w=20 m	L_w=20 m	L_w=5 m	L_w=5 m
KFM04A	Measured borehole interval	m	117–972 2)	317–517	117–537 3)	317–517 3)	297–437	297–537 4)	297–437
	Number of tests	–	9	2	22	11	7	32	24
	N:o of tests below E.L.M.L. 1)	–	1	0	3	3	0	13	10
	m (Log_{10} (K_M))	Log_{10} (m/s)	–9.01	–8.49	–8.34	–9.15	–8.55	–8.78	–8.75
	s (Log_{10} (K_M))	–	1.87	1.19	1.47	1.34	1.06	0.94	0.96
	m (Log_{10} (K_R))	Log_{10} (m/s)	–9.48	–10.08	–8.70	–9.61	–8.59	–9.32	–9.24
	s (Log_{10} (K_R))	–	2.03	0.27	1.63	1.37	1.14	1.00	1.03

1) Number of tests where Qp could not be defined (E.L.M.L. = estimated lower measurement limit).
2) Sections 817.00–917.00 and 872.00–972.00 partly overlapping.
3) Sections 437.00–457.00 and 453.00–473.00 partly overlapping. Sections 473.00–493.00 and 477.00–497.00 partly overlapping.
4) The interval 437.00–517.00 was not measured with 5 m section.

6.6 Comparison of results from different hydraulic tests in KFM04A

In Table 6-6, a comparison of estimated transmissivity values from different hydraulic tests in KFM04A is presented. It should be observed that the summed transmissivity values for the injection tests only include the tests actually performed for each section length. However, the most conductive sections are measured.

Table 6-6 shows that the results of the different test methods used in borehole KFM04A give consistent results. The total transmissivity of the borehole (117–972 m) is dominated by the interval 197–237 m. The transmissivity of the borehole interval 297–537 m is dominated by the section 357–362 m.

Table 6-6. Comparison of calculated transmissivity values from different hydraulic tests in borehole KFM04A (n.m. = not measured).

Hydraulic test method	Sum of T (m^2/s)	Borehole interval and length of interval (m)			
		117.00–972.00	297.00–437.00	317.00–517.00	108.61–1,001.42
Injection tests	$\sum T_M$ (100 m)	6.74E–05	n.m.	2.29E–06	
	$\sum T_R$ (100 m)	6.57E–05	n.m.	2.01E–06	
	$\sum T_M$ (20 m)	5.05E–05	2.10E–06	1.91E–06	
	$\sum T_R$ (20 m)	6.91E–05	2.77E–06	2.59E–06	
	$\sum T_M$ (5 m)	n.m.	1.92E–06	n.m.	
	$\sum T_R$ (5 m)	n.m.	3.03E–06	n.m.	
Difference flow logging	$\sum T_D$ (5 m)	1.05E–04 [1)]	1.62E–06 [2)]	1.44E–06 [3)]	1.67E–04
	$\sum T_{Df}$ (flow anomalies)	9.32E–05	1.47E–06 [2)]	1.31E–06 [3)]	1.55E–04
Pumping test in conjunction with difference flow logging	T_M				3.05E–04

n.m. = not measured.
[1)] Actual measured interval was 116.23 m to 972.56 m.
[2)] Actual measured interval was 296.61 m to 436.74 m.
[3)] Actual measured interval was 316.65 m to 516.81 m.

7 References

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Appdendix 1. File description table

Bh id	Test section		Test type	Test no	Test start Date, time	Test stop Date, time	Data files of raw and primary data	Parameters in file	Comments
idcode	(m)	(m)	(1-6)*		YYYYMMDD hh:mm	YYYYMMDD hh:mm	__Borehole id_secup_date and time of test start		
KFM04A	117.00	217.00	3	1	20040823 09:11	20040823 10:59	___KFM04_0117.00_200408230911.ht2	P,Q,Te	
KFM04A	217.00	317.00	3	1	20040823 13:54	20040823 15:36	___KFM04_0217.00_200408231354.ht2	P,Q,Te	
KFM04A	317.00	417.00	3	1	20040823 17:07	20040823 18:47	___KFM04_0317.00_200408231707.ht2	P,Q,Te	
KFM04A	417.00	517.00	3	1	20040824 08:43	20040824 10:25	___KFM04_0417.00_200408240843.ht2	P,Q,Te	
KFM04A	517.00	617.00	3	1	20040824 13:14	20040824 14:57	___KFM04_0517.00_200408241314.ht2	P,Q,Te	
KFM04A	617.00	717.00	3	2	20040830 17:37	20040830 19:27	___KFM04_0617.00_200408301737.ht2	P,Q,Te	
KFM04A	717.00	817.00	3	1	20040825 12:53	20040825 14:52	___KFM04_0717.00_200408251253.ht2	P,Q,Te	
KFM04A	817.00	917.00	3	2	20040827 13:53	20040827 15:56	___KFM04_0817.00_200408271353.ht2	P,Q,Te	
KFM04A	872.00	972.00	3	1	20040827 09:01	20040827 11:35	___KFM04_0872.00_200408270901.ht2	P,Q,Te	
KFM04A	117.00	137.00	3	1	20040902 11:11	20040902 13:32	__KFM04A_0117.00_200409021111.ht2	P,Q,Te	
KFM04A	137.00	157.00	3	1	20040902 14:07	20040902 16:09	__KFM04A_0137.00_200409021407.ht2	P,Q,Te	
KFM04A	157.00	177.00	3	1	20040902 18:02	20040902 19:31	__KFM04A_0157.00_200409021802.ht2	P,Q,Te	
KFM04A	177.00	197.00	3	1	20040903 08:30	20040903 09:49	__KFM04A_0177.00_200409030830.ht2	P,Q,Te	
KFM04A	197.00	217.00	3	1	20040903 10:11	20040903 11:41	__KFM04A_0197.00_200409031011.ht2	P,Q,Te	
KFM04A	217.00	237.00	3	1	20040903 13:34	20040903 14:59	__KFM04A_0217.00_200409031334.ht2	P,Q,Te	
KFM04A	237.00	257.00	3	1	20040906 09:04	20040906 10:23	__KFM04A_0237.00_200409060904.ht2	P,Q,Te	
KFM04A	257.00	277.00	3	1	20040906 10:43	20040906 12:00	__KFM04A_0257.00_200409061043.ht2	P,Q,Te	
KFM04A	277.00	297.00	3	1	20040906 12:55	20040906 14:09	__KFM04A_0277.00_200409061255.ht2	P,Q,Te	
KFM04A	297.00	317.00	3	1	20040906 14:36	20040906 15:50	__KFM04A_0297.00_200409061436.ht2	P,Q,Te	
KFM04A	317.00	337.00	3	1	20040906 17:11	20040906 18:01	__KFM04A_0317.00_200409061711.ht2	P,Q,Te	
KFM04A	337.00	357.00	3	1	20040907 08:25	20040907 09:41	__KFM04A_0337.00_200409070825.ht2	P,Q,Te	
KFM04A	357.00	377.00	3	1	20040907 10:06	20040907 11:20	__KFM04A_0357.00_200409071006.ht2	P,Q,Te	
KFM04A	377.00	397.00	3	1	20040907 12:10	20040907 13:26	__KFM04A_0377.00_200409071210.ht2	P,Q,Te	
KFM04A	397.00	417.00	3	1	20040907 14:26	20040907 15:35	__KFM04A_0397.00_200409071426.ht2	P,Q,Te	
KFM04A	417.00	437.00	3	1	20040907 15:57	20040907 17:11	__KFM04A_0417.00_200409071557.ht2	P,Q,Te	
KFM04A	437.00	457.00	3	1	20040908 08:28	20040908 09:11	__KFM04A_0437.00_200409080828.ht2	P,Q,Te	
KFM04A	453.00	473.00	3	1	20040908 09:57	20040908 11:12	__KFM04A_0453.00_200409080957.ht2	P,Q,Te	
KFM04A	473.00	493.00	3	1	20040908 11:33	20040908 13:25	__KFM04A_0473.00_200409081133.ht2	P,Q,Te	
KFM04A	477.00	497.00	3	1	20040908 13:38	20040908 14:54	__KFM04A_0477.00_200409081338.ht2	P,Q,Te	
KFM04A	497.00	517.00	3	1	20040908 15:13	20040908 15:55	__KFM04A_0497.00_200409081513.ht2	P,Q,Te	
KFM04A	517.00	537.00	3	1	20040908 16:11	20040908 17:27	__KFM04A_0517.00_200409081611.ht2	P,Q,Te	
KFM04A	297.00	302.00	3	1	20040910 14:43	20040910 16:03	__KFM04A_0297.00_200409101443.ht2	P,Q,Te	
KFM04A	302.00	307.00	3	1	20040913 09:58	20040913 11:21	__KFM04A_0302.00_200409130958.ht2	P,Q,Te	
KFM04A	307.00	312.00	3	1	20040913 11:33	20040913 13:26	__KFM04A_0307.00_200409131133.ht2	P,Q,Te	

Bh id	Test section		Test type	Test no	Test start Date, time	Test stop Date, time	Data files of raw and primary data	Parameters in file	Comments
idcode	(m)	(m)	(1-6)*		YYYYMMDD hh:mm	YYYYMMDD hh:mm	__Borehole id_secup_date and time of test start		
KFM04A	312.00	317.00	3	1	20040913 13:38	20040913 14:55	__KFM04A_0312.00_200409131338.ht2	P,Q,Te	
KFM04A	317.00	322.00	3	1	20040913 15:07	20040913 16:22	__KFM04A_0317.00_200409131507.ht2	P,Q,Te	
KFM04A	322.00	327.00	3	1	20040913 16:34	20040913 17:52	__KFM04A_0322.00_200409131634.ht2	P,Q,Te	
KFM04A	327.00	332.00	3	1	20040913 18:04	20040913 19:19	__KFM04A_0327.00_200409131804.ht2	P,Q,Te	
KFM04A	332.00	337.00	3	1	20040914 08:13	20040914 09:39	__KFM04A_0332.00_200409140813.ht2	P,Q,Te	
KFM04A	337.00	342.00	3	1	20040914 09:49	20040914 11:05	__KFM04A_0337.00_200409140949.ht2	P,Q,Te	
KFM04A	342.00	347.00	3	1	20040914 11:21	20040914 13:13	__KFM04A_0342.00_200409141121.ht2	P,Q,Te	
KFM04A	347.00	352.00	3	1	20040921 12:54	20040921 14:11	__KFM04A_0347.00_200409211254.ht2	P,Q,Te	
KFM04A	352.00	357.00	3	1	20040921 10:35	20040921 11:56	__KFM04A_0352.00_200409211035.ht2	P,Q,Te	
KFM04A	357.00	362.00	3	1	20040915 18:05	20040915 19:21	__KFM04A_0357.00_200409151805.ht2	P,Q,Te	
KFM04A	362.00	367.00	3	1	20040915 19:36	20040915 20:25	__KFM04A_0362.00_200409151936.ht2	P,Q,Te	
KFM04A	367.00	372.00	3	1	20040916 08:18	20040916 09:13	__KFM04A_0367.00_200409160818.ht2	P,Q,Te	
KFM04A	372.00	377.00	3	1	20040916 09:25	20040916 10:09	__KFM04A_0372.00_200409160925.ht2	P,Q,Te	
KFM04A	377.00	382.00	3	1	20040916 10:21	20040916 11:04	__KFM04A_0377.00_200409161021.ht2	P,Q,Te	
KFM04A	382.00	387.00	3	1	20040916 11:15	20040916 12:34	__KFM04A_0382.00_200409161115.ht2	P,Q,Te	
KFM04A	387.00	392.00	3	1	20040916 12:47	20040916 13:31	__KFM04A_0387.00_200409161247.ht2	P,Q,Te	
KFM04A	392.00	397.00	3	1	20040916 13:47	20040916 15:05	__KFM04A_0392.00_200409161347.ht2	P,Q,Te	
KFM04A	397.00	402.00	3	1	20040916 15:18	20040916 16:34	__KFM04A_0397.00_200409161518.ht2	P,Q,Te	
KFM04A	402.00	407.00	3	1	20040916 16:49	20040916 17:40	__KFM04A_0402.00_200409161649.ht2	P,Q,Te	
KFM04A	407.00	412.00	3	1	20040917 08:42	20040917 09:27	__KFM04A_0407.00_200409170842.ht2	P,Q,Te	
KFM04A	412.00	417.00	3	1	20040917 09:42	20040917 11:03	__KFM04A_0412.00_200409170942.ht2	P,Q,Te	
KFM04A	417.00	422.00	3	1	20040917 11:15	20040917 13:16	__KFM04A_0417.00_200409171115.ht2	P,Q,Te	
KFM04A	422.00	427.00	3	1	20040917 13:29	20040917 14:53	__KFM04A_0422.00_200409171329.ht2	P,Q,Te	
KFM04A	427.00	432.00	3	1	20040917 15:06	20040917 15:50	__KFM04A_0427.00_200409171506.ht2	P,Q,Te	
KFM04A	432.00	437.00	3	1	20040920 09:21	20040920 10:05	__KFM04A_0432.00_200409200921.ht2	P,Q,Te	
KFM04A	517.00	522.00	3	1	20040920 10:57	20040920 12:49	__KFM04A_0517.00_200409201057.ht2	P,Q,Te	
KFM04A	522.00	527.00	3	1	20040920 13:02	20040920 13:48	__KFM04A_0522.00_200409201302.ht2	P,Q,Te	
KFM04A	527.00	532.00	3	1	20040920 13:59	20040920 14:45	__KFM04A_0527.00_200409201359.ht2	P,Q,Te	
KFM04A	532.00	537.00	3	1	20040920 14:54	20040920 16:14	__KFM04A_0532.00_200409201454.ht2	P,Q,Te	

* Test type 3 equals to injection test

Appendix 2.1. General test data

Borehole:	KFM04A
Testtype:	CHir (Constant Head injection and recovery)
Field crew:	T. Svensson, C. Hjerne, J. Jönsson, K. Gokall Norman, S. Johansen, J. Olausson
General comment:	

Test section secup	**Test section seclow**	**Test start**	**Start of flow period**	**Stop of flow period**	**Test stop**	**Total flow time t_p**	**Total recovery time t_F**
(m)	(m)	YYYYMMDD hh:mm	YYYYMMDD hh:mm:ss	YYYYMMDD hh:mm:ss	YYYYMMDD hh:mm	(min)	(min)
117.00	217.00	20040823 09:11	20040823 09:56:58	20040823 10:27:05	20040823 10:59	30	30
217.00	317.00	20040823 13:54	20040823 14:34:17	20040823 15:04:35	20040823 15:36	30	30
317.00	417.00	20040823 17:07	20040823 17:44:54	20040823 18:15:11	20040823 18:47	30	30
417.00	517.00	20040824 08:43	20040824 09:23:23	20040824 09:53:48	20040824 10:25	30	30
517.00	617.00	20040824 13:14	20040824 13:54:34	20040824 14:24:56	20040824 14:57	30	30
617.00	717.00	20040830 17:37	20040430 18:25:04	20040430 18:55:25	20040830 19:27	30	30
717.00	817.00	20040825 12:53	20040825 13:49:35	20040825 14:20:04	20040825 14:52	30	30
817.00	917.00	20040827 13:53	20040827 14:53:55	20040827 15:23:56	20040827 15:56	30	30
872.00	972.00	20040827 09:01	20040827 10:32:37	20040827 11:03:48	20040827 11:35	31	30
117.00	137.00	20040902 11:11	20040902 12:49:48	20040902 13:10:07	20040902 13:32	20	20
137.00	157.00	20040902 14:07	20040902 15:26:50	20040902 15:47:09	20040902 16:09	20	20
157.00	177.00	20040902 18:02	20040902 18:48:39	20040902 19:08:58	20040902 19:31	20	20
177.00	197.00	20040903 08:30	20040903 09:07:18	20040903 09:27:25	20040903 09:49	20	20
197.00	217.00	20040903 10:11	20040903 10:58:32	20040903 11:18:49	20040903 11:41	20	20
217.00	237.00	20040903 13:34	20040903 14:17:21	20040903 14:37:37	20040903 14:59	20	20
237.00	257.00	20040906 09:04	20040906 09:40:45	20040906 10:01:08	20040906 10:23	20	20
257.00	277.00	20040906 10:43	20040906 11:18:22	20040906 11:38:43	20040906 12:00	20	20
277.00	297.00	20040906 12:55	20040906 13:27:20	20040906 13:47:40	20040906 14:09	20	20
297.00	317.00	20040906 14:36	20040906 15:08:03	20040906 15:28:23	20040906 15:50	20	20
317.00	337.00	20040906 17:11	20040906 17:18:50	20040906 17:39:10	20040906 18:01	20	20
337.00	357.00	20040907 08:25	20040907 08:58:55	20040907 09:19:13	20040907 09:41	20	20
357.00	377.00	20040907 10:06	20040907 10:37:42	20040907 10:58:01	20040907 11:20	20	20
377.00	397.00	20040907 12:10	20040907 12:44:07	20040907 13:04:27	20040907 13:26	20	20
397.00	417.00	20040907 14:26	20040907 14:53:05	20040907 15:13:22	20040907 15:35	20	20
417.00	437.00	20040907 15:57	20040907 16:29:03	20040907 16:49:23	20040907 17:11	20	20
437.00	457.00	20040908 08:28	20040908 09:00:39	20040908 09:03:11	20040908 09:11	3	6
453.00	473.00	20040908 09:57	20040908 10:30:09	20040908 10:50:31	20040908 11:12	20	20
473.00	493.00	20040908 11:33	20040908 12:43:00	20040908 13:03:23	20040908 13:25	20	20
477.00	497.00	20040908 13:38	20040908 14:11:58	20040908 14:32:20	20040908 14:54	20	20
497.00	517.00	20040908 15:13	20040908 15:45:32	20040908 15:48:17	20040908 15:55	3	5
517.00	537.00	20040908 16:11	20040908 16:45:05	20040908 17:05:26	20040908 17:27	20	20
297.00	302.00	20040910 14:43	20040910 15:20:46	20040910 15:41:04	20040910 16:03	20	20
302.00	307.00	20040913 09:58	20040913 10:38:56	20040913 10:59:17	20040913 11:21	20	20
307.00	312.00	20040913 11:33	20040913 12:43:44	20040913 13:04:05	20040913 13:26	20	20
312.00	317.00	20040913 13:38	20040913 14:12:24	20040913 14:32:43	20040913 14:55	20	20
317.00	322.00	20040913 15:07	20040913 15:39:51	20040913 16:00:12	20040913 16:22	20	20
322.00	327.00	20040913 16:34	20040913 17:09:31	20040913 17:29:52	20040913 17:52	20	20
327.00	332.00	20040913 18:04	20040913 18:36:54	20040913 18:57:15	20040913 19:19	20	20
332.00	337.00	20040914 08:13	20040914 08:57:17	20040914 09:17:35	20040914 09:39	20	20
337.00	342.00	20040914 09:49	20040914 10:22:59	20040914 10:43:18	20040914 11:05	20	20
342.00	347.00	20040914 11:21	20040914 12:31:16	20040914 12:51:37	20040914 13:13	20	20
347.00	352.00	20040921 12:54	20040921 13:29:01	20040921 13:49:20	20040921 14:11	20	20
352.00	357.00	20040921 10:35	20040921 11:13:50	20040921 11:34:08	20040921 11:56	20	20
357.00	362.00	20040915 18:05	20040915 18:39:22	20040915 18:59:42	20040915 19:21	20	20
362.00	367.00	20040915 19:36	20040915 20:03:09	20040915 20:11:05	20040915 20:25	8	6
367.00	372.00	20040916 08:18	20040916 08:50:33	20040916 09:05:06	20040916 09:13	15	6
372.00	377.00	20040916 09:25	20040916 09:57:57	20040916 10:02:02	20040916 10:09	4	6
377.00	382.00	20040916 10:21	20040916 10:53:36	20040916 10:56:11	20040916 11:04	3	6
382.00	387.00	20040916 11:15	20040916 12:22:31	20040916 12:26:23	20040916 12:34	4	6
387.00	392.00	20040916 12:47	20040916 13:20:22	20040916 13:24:06	20040916 13:31	4	6
392.00	397.00	20040916 13:47	20040916 14:22:51	20040916 14:43:12	20040916 15:05	20	20
397.00	402.00	20040916 15:18	20040916 15:51:43	20040916 16:12:05	20040916 16:34	20	20
402.00	407.00	20040916 16:49	20040916 17:21:13	20040916 17:31:28	20040916 17:40	10	7
407.00	412.00	20040917 08:42	20040917 09:16:20	20040917 09:19:43	20040917 09:27	3	6
412.00	417.00	20040917 09:42	20040917 10:20:26	20040917 10:40:46	20040917 11:03	20	20
417.00	422.00	20040917 11:15	20040917 12:33:24	20040917 12:53:42	20040917 13:16	20	20
422.00	427.00	20040917 13:29	20040917 14:11:09	20040917 14:31:29	20040917 14:53	20	20

Test section **secup**	**Test section** **seclow**	**Test start**	**Start of flow period**	**Stop of flow period**	**Test stop**	**Total flow time** t_p	**Total recovery time** t_F
(m)	(m)	YYYYMMDD hh:mm	YYYYMMDD hh:mm:ss	YYYYMMDD hh:mm:ss	YYYYMMDD hh:mm	(min)	(min)
427.00	432.00	20040917 15:06	20040917 15:40:05	20040917 15:43:00	20040917 15:50	3	6
432.00	437.00	20040920 09:21	20040920 09:53:44	20040920 09:56:46	20040920 10:05	3	7
517.00	522.00	20040920 10:57	20040920 12:07:22	20040920 12:27:42	20040920 12:49	20	20
522.00	527.00	20040920 13:02	20040920 13:35:16	20040920 13:40:23	20040920 13:48	5	6
527.00	532.00	20040920 13:59	20040920 14:34:33	20040920 14:37:45	20040920 14:45	3	6
532.00	537.00	20040920 14:54	20040920 15:31:31	20040920 15:51:51	20040920 16:14	20	20

Appendix 2.2 Pressure and flow data.

Summary of pressure and flow data for all tests in KFM04A

Test section		Pressure			Flow		
secup	seclow	p_i	p_p	p_F	Q_p [1)]	Q_m [2)]	V_p [2)]
(m)	(m)	(kPa)	(kPa)	(kPa)	(m^3/s)	(m^3/s)	(m^3)
117.00	217.00	1095.62	1265.47	1096.03	5.16E-04	5.42E-04	9.80E-01
217.00	317.00	1952.56	2192.65	1953.12	4.96E-04	5.07E-04	9.22E-01
317.00	417.00	2789.80	3014.41	2808.56	3.94E-05	4.31E-05	7.83E-02
417.00	517.00	3600.80	3814.11	3646.34	7.76E-07	1.21E-06	2.21E-03
517.00	617.00	4395.81	4682.10	4524.95	1.20E-07	2.62E-07	4.78E-04
617.00	717.00	5170.11	5370.40	5255.10	8.41E-08	1.63E-07	2.97E-04
717.00	817.00	5921.52	6107.78	6081.30	9.00E-09	5.31E-08	9.70E-05
817.00	917.00	6654.16	6839.05	6824.69			
872.00	972.00	7013.99	7222.00	7060.35	6.73E-08	1.01E-07	1.89E-04
117.00	137.00	1080.10	1280.58	1080.65	3.18E-05	3.40E-05	4.15E-02
137.00	157.00	1255.60	1462.56	1256.15	1.18E-05	1.23E-05	1.51E-02
157.00	177.00	1428.89	1632.20	1430.00	2.42E-05	2.54E-05	3.10E-02
177.00	197.00	1604.40	1816.18	1618.20	2.40E-05	3.10E-05	3.74E-02
197.00	217.00	1778.38	1982.58	1778.80	4.28E-04	4.40E-04	5.36E-01
217.00	237.00	1951.26	2187.34	1950.99	5.07E-04	5.09E-04	6.19E-01
237.00	257.00	2122.62	2350.97	2130.91	5.43E-08	7.16E-08	8.75E-05
257.00	277.00	2294.13	2494.60	2300.34	9.95E-07	1.10E-06	1.34E-03
277.00	297.00	2463.98	2664.58	2469.22	5.19E-06	5.71E-06	6.96E-03
297.00	317.00	2634.23	2834.57	2636.44	3.71E-06	3.82E-06	4.66E-03
317.00	337.00	2803.11	3003.70	2803.66	1.04E-06	1.10E-06	1.34E-03
337.00	357.00	2971.90	3172.80	2977.51	5.83E-06	6.26E-06	7.62E-03
357.00	377.00	3139.77	3368.66	3152.46	3.37E-05	3.63E-05	4.42E-02
377.00	397.00	3313.06	3536.58	3417.92	1.82E-08	3.96E-08	4.83E-05
397.00	417.00	3480.28	3680.70	3490.77	2.20E-07	2.51E-07	3.05E-04
417.00	437.00	3638.00	3857.80	3698.83	8.55E-07	1.41E-06	1.72E-03
437.00	457.00	3809.22	3995.89	3998.51			
453.00	473.00	3935.18	4150.28	4063.08	1.00E-08	1.92E-08	2.35E-05
473.00	493.00	4094.50	4312.54	4280.52	7.56E-09	2.62E-08	3.21E-05
477.00	497.00	4129.87	4345.65	4318.06			
497.00	517.00	4290.46	4495.77	4485.84			
517.00	537.00	4445.27	4652.50	4541.58	6.33E-08	1.45E-07	1.77E-04
297.00	302.00	2632.97	2833.30	2635.74	5.28E-06	5.60E-06	6.82E-03
302.00	307.00	2674.91	2869.73	2681.53	3.39E-08	3.92E-08	4.79E-05
307.00	312.00	2716.63	2926.03	2737.83	9.13E-09	1.09E-08	1.33E-05
312.00	317.00	2757.70	2966.31	2757.70	1.19E-07	1.30E-07	1.58E-04
317.00	322.00	2802.95	3007.01	2802.40	2.08E-07	2.24E-07	2.73E-04
322.00	327.00	2852.60	3052.00	2846.00	1.38E-07	1.56E-07	1.91E-04
327.00	332.00	2884.22	3094.91	2884.09	1.41E-07	1.53E-07	1.87E-04
332.00	337.00	2926.50	3125.80	2926.58	6.71E-07	7.26E-07	8.84E-04
337.00	342.00	2969.07	3169.41	2974.59	5.08E-06	5.39E-06	6.57E-03
342.00	347.00	3012.26	3211.50	3012.67	8.49E-07	8.72E-07	1.07E-03
347.00	352.00	3055.80	3267.87	3056.35	5.92E-08	6.38E-08	7.78E-05
352.00	357.00	3097.20	3297.12	3097.20	1.85E-07	2.16E-07	2.63E-04
357.00	362.00	3140.80	3355.20	3155.15	3.59E-05	3.90E-05	4.76E-02
362.00	367.00	3229.52	3385.84	3377.56			
367.00	372.00	3261.52	3433.31	3405.71			
372.00	377.00	3317.40	3477.73	3506.71			
377.00	382.00	3381.15	3521.05	3552.51			
382.00	387.00	3380.19	3565.34	3582.31			
387.00	392.00	3454.83	3608.25	3646.89			
392.00	397.00	3444.20	3647.16	3519.95	1.87E-08	3.17E-08	3.87E-05
397.00	402.00	3520.36	3687.17	3556.38	1.14E-08	1.66E-08	2.03E-05
402.00	407.00	3581.62	3728.01	3704.84			
407.00	412.00	3629.22	3766.64	3767.75			
412.00	417.00	3605.49	3804.87	3616.53	2.04E-07	2.35E-07	2.86E-04
417.00	422.00	3644.68	3844.50	3693.24	8.45E-07	1.36E-06	1.65E-03
422.00	427.00	3682.76	3897.72	3682.21	5.92E-08	6.75E-08	8.24E-05
427.00	432.00	3839.77	3940.22	3990.71			
432.00	437.00	3819.77	3972.64	4076.26			
517.00	522.00	4451.27	4661.26	4538.75	5.70E-08	1.18E-07	1.44E-04
522.00	527.00	4527.30	4701.01	4728.04			
527.00	532.00	4573.93	4740.74	4763.36			

Test section		Pressure			Flow		
secup	seclow	p_i	p_p	p_F	Q_p [1)]	Q_m [2)]	V_p [2)]
(m)	(m)	(kPa)	(kPa)	(kPa)	(m^3/s)	(m^3/s)	(m^3)
532.00	537.00	4588.96	4779.91	4728.04			

[1)] No value indicates a flow below measurement limit (measurement limit is unique for each test but nominally 1.67 E-8 m^3/s).
[2)] No value indicates that the parameter could not be calculated due to low and uncertain flow rates during a major part of flow period

p_i	Pressure in test section before start of flow period
p_p	Pressure in test section before stop of flow period
p_F	Pressure in test section at the end of recovery period
Q_p	Flow rate just before stop of flow period
Q_m	Mean (arithmetic) flow rate during flow period
V_p	Total volume injected during the flow period

Appendix 3. Test diagrams – Injection Tests

In the following pages diagrams are presented for all test sections. A linear diagram of pressure and flow rate is presented for each test. For most tests are lin-log and log-log diagrams presented, from injection and recovery period respectively.

Nomenclature for Aqtesolv:

T	=	transmissivity (m^2/s)
S	=	storativity (-)
K_Z/K_r	=	ratio of hydraulic conductivities in the vertical and radial direction (set to 1)
Sw	=	skin factor
r(w)	=	borehole radius (m)
r(c)	=	effective casing radius (m)
C	=	well loss constant (set to 0)

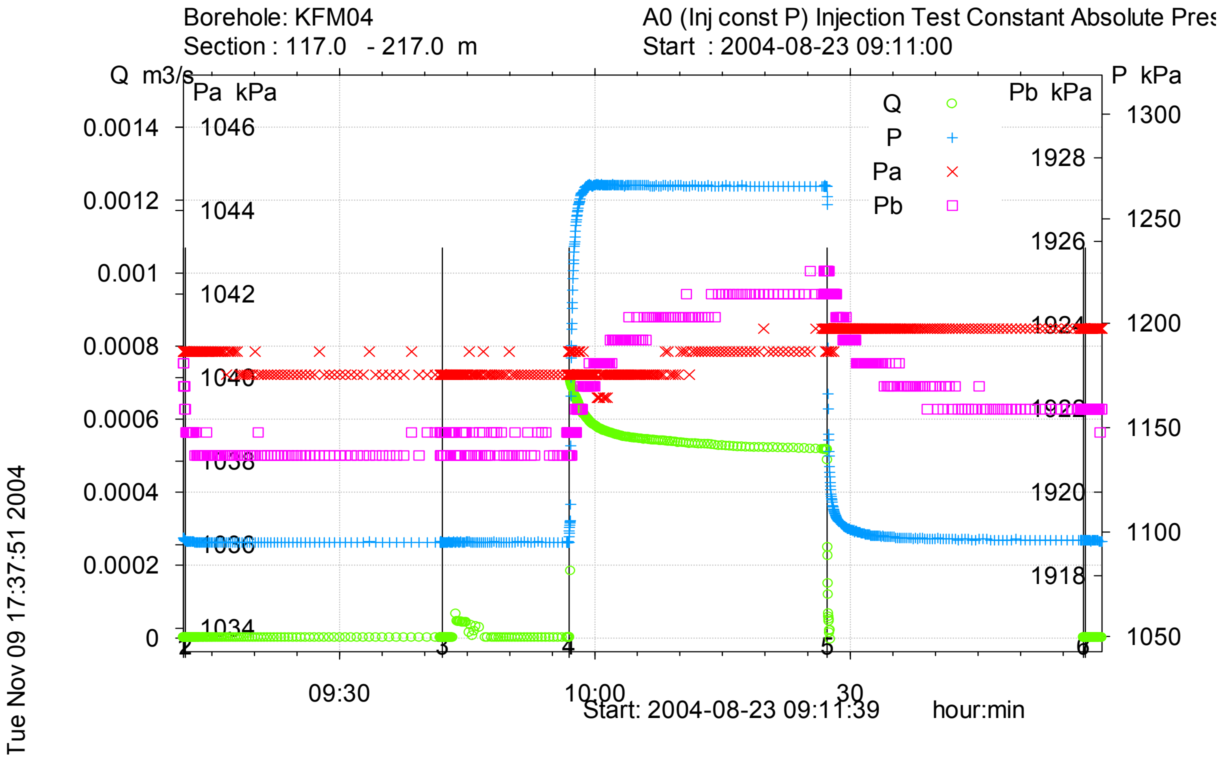


Figure A3-1. *Linear plot of flow rate (Q), pressure (P), pressure above section (Pa) and pressure below section (Pb) versus time from the injection test in section 117-217 m in borehole KFM04A.*

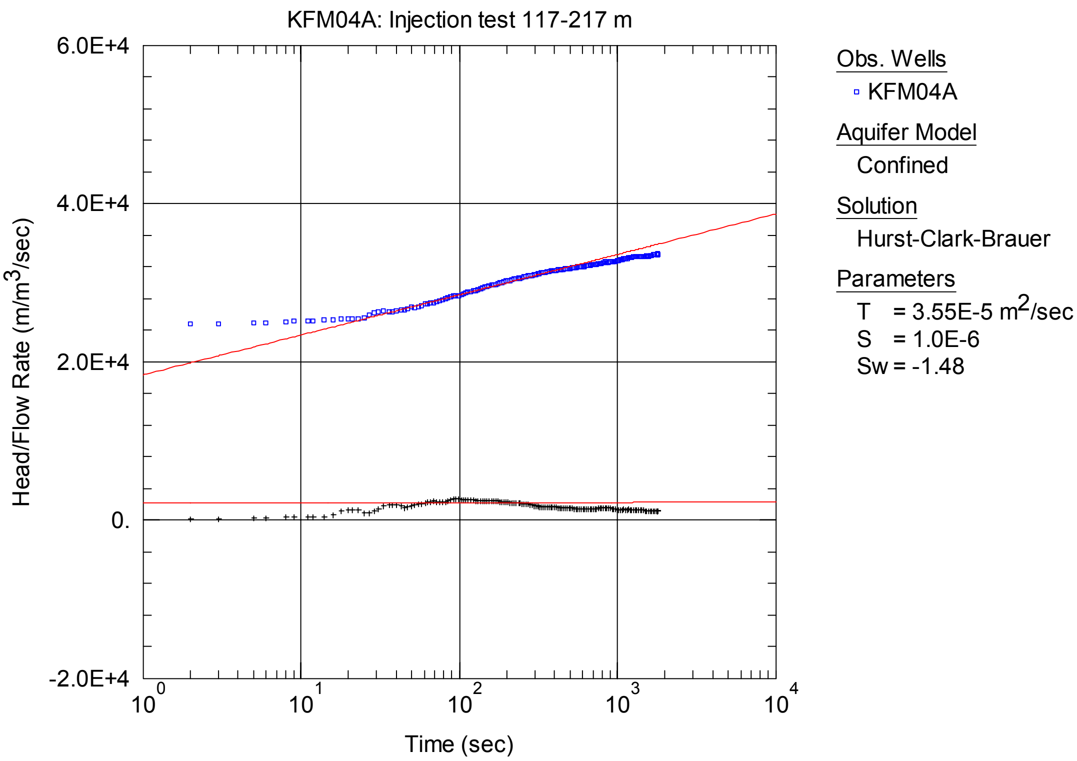


Figure A3-2. *Lin-log plot of head/flow rate (□) and derivative (+) versus time, from the injection test in section 117-217 m in KFM04A.*

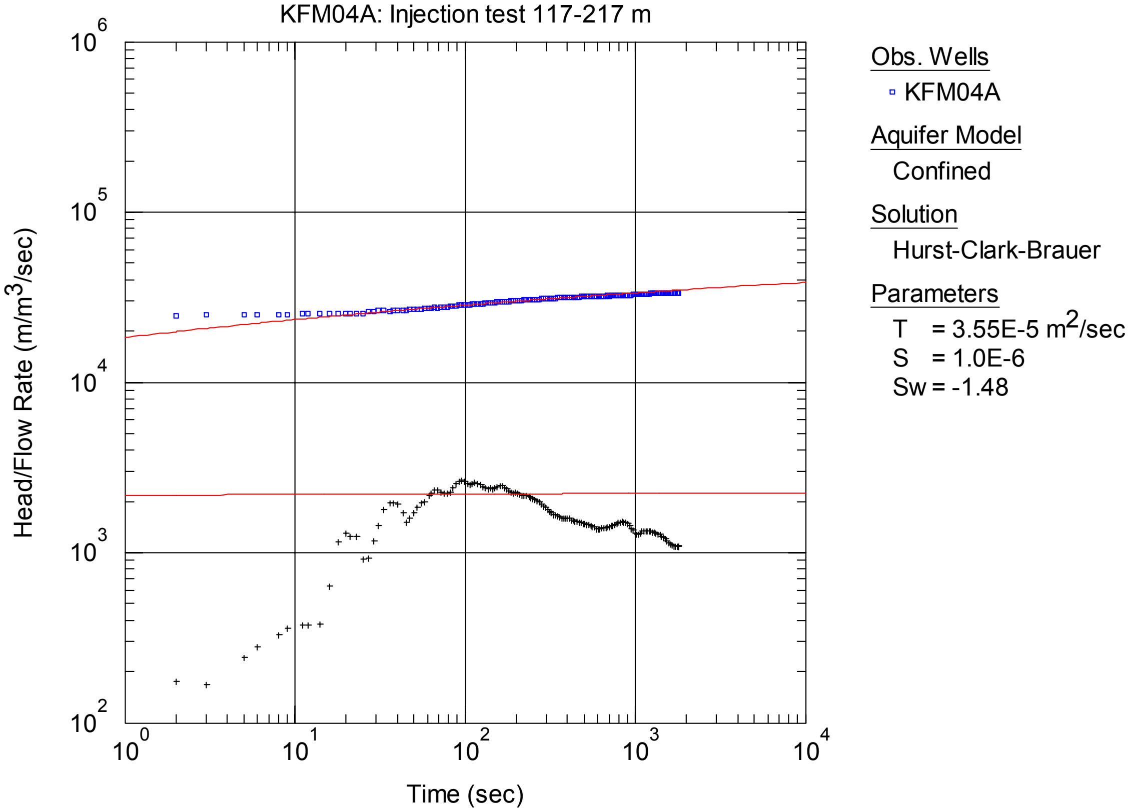


Figure A3-3. *Log-log plot of head/flow rate (□) and derivative (+) versus time, from the injection test in section 117-217 m in KFM04A.*

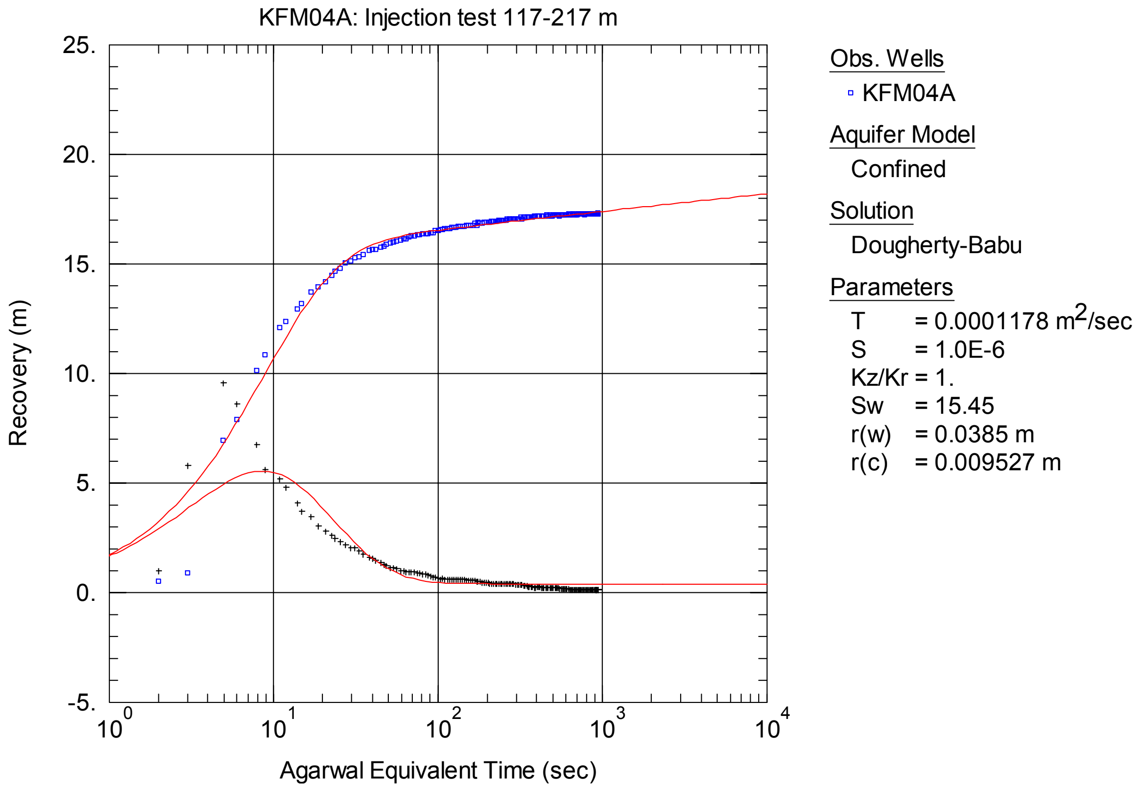


Figure A3-4. *Lin-log plot of recovery (□) and derivative (+) versus equivalent time, from the injection test in section 117-217 m in KFM04A. The type curve fit is only to show that an assumption of PRF is not valid.*

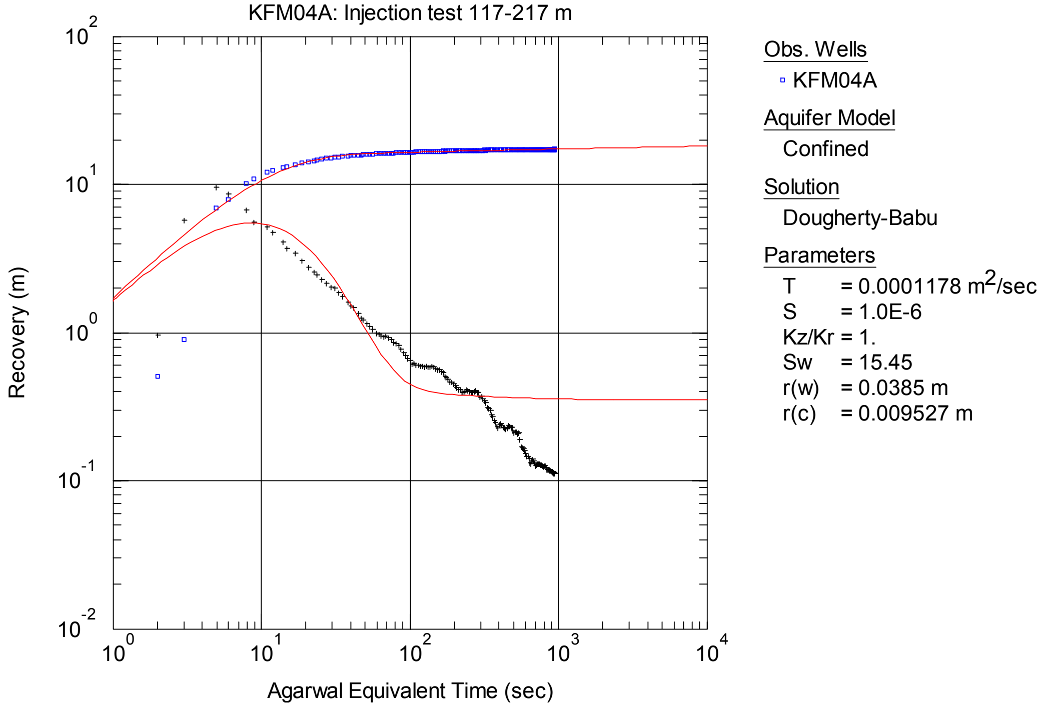


Figure A3-5. *Log-log plot of recovery (□) and derivative (+) versus equivalent time, from the injection test in section 117-217 m in KFM04A. The type curve fit is only to show that an assumption of PRF is not valid.*

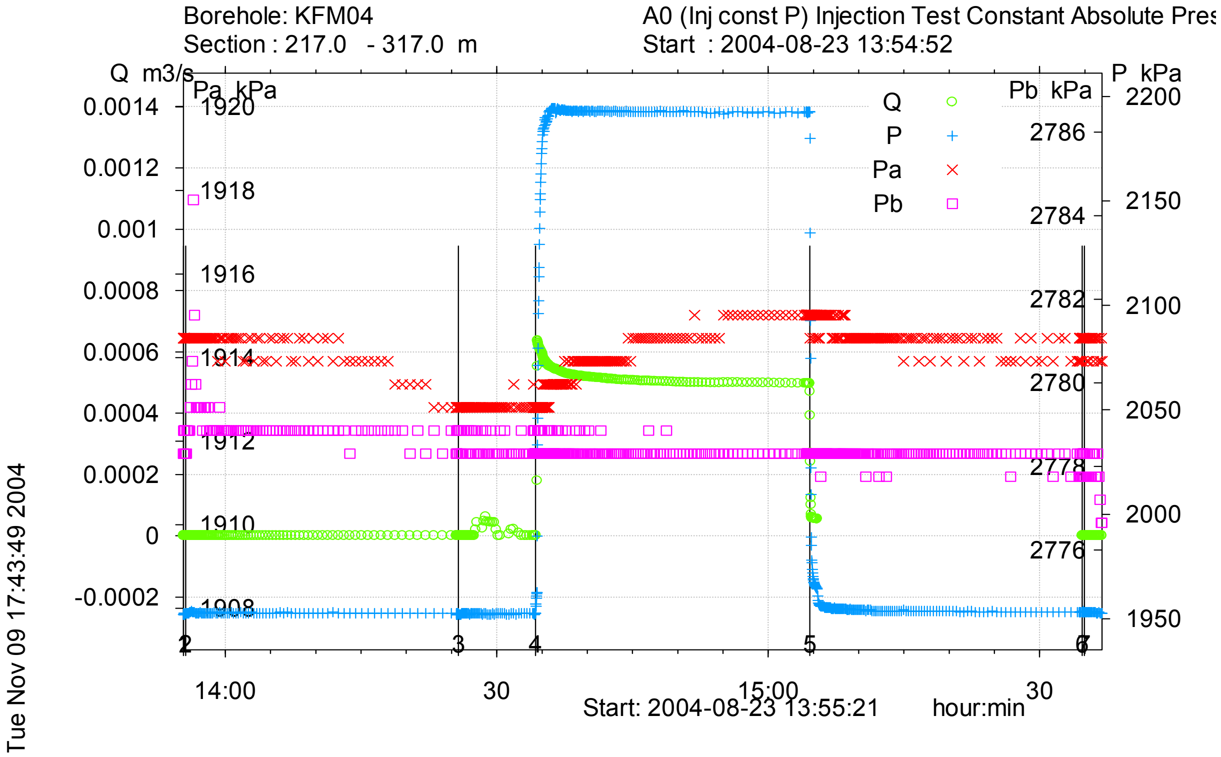


Figure A3-6. *Linear plot of flow rate (Q), pressure (P), pressure above section (Pa) and pressure below section (Pb) versus time from the injection test in section 217-317 m in borehole KFM04A.*

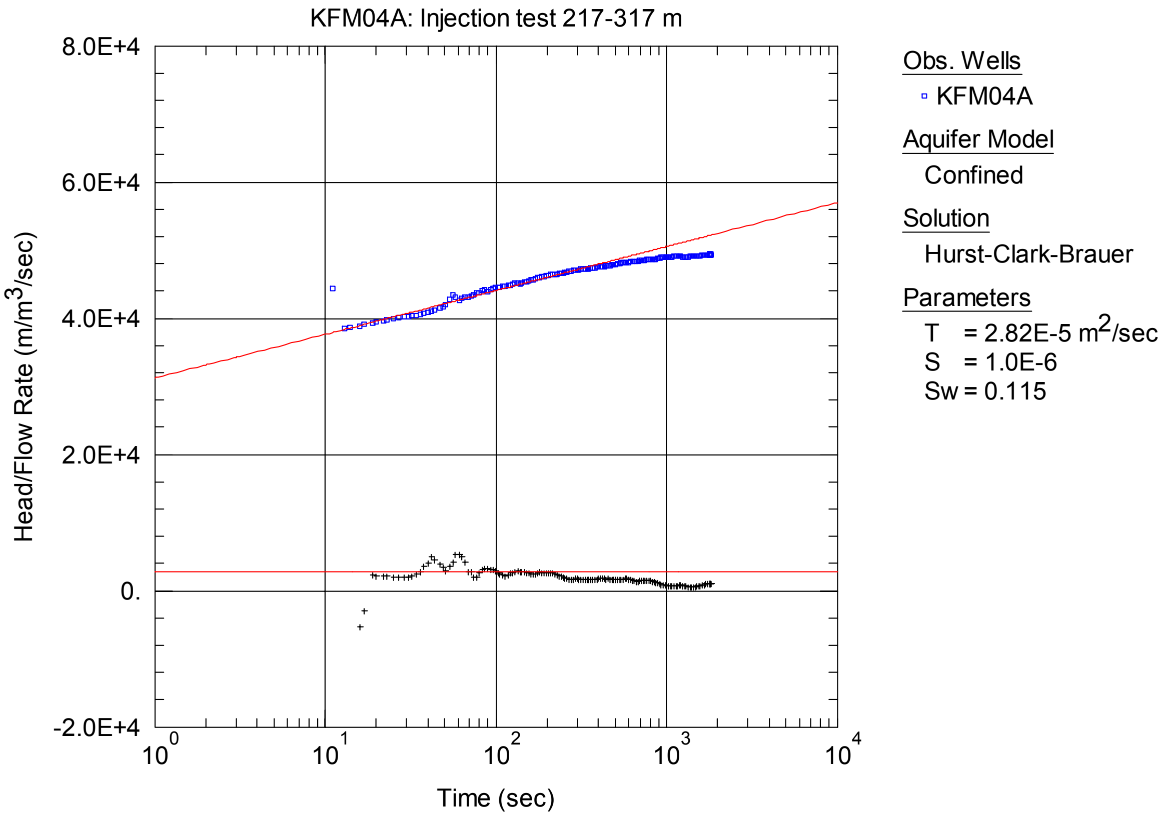


Figure A3-7. *Lin-log plot of head/flow rate (□) and derivative (+) versus time, from the injection test in section 217-317 m in KFM04A.*

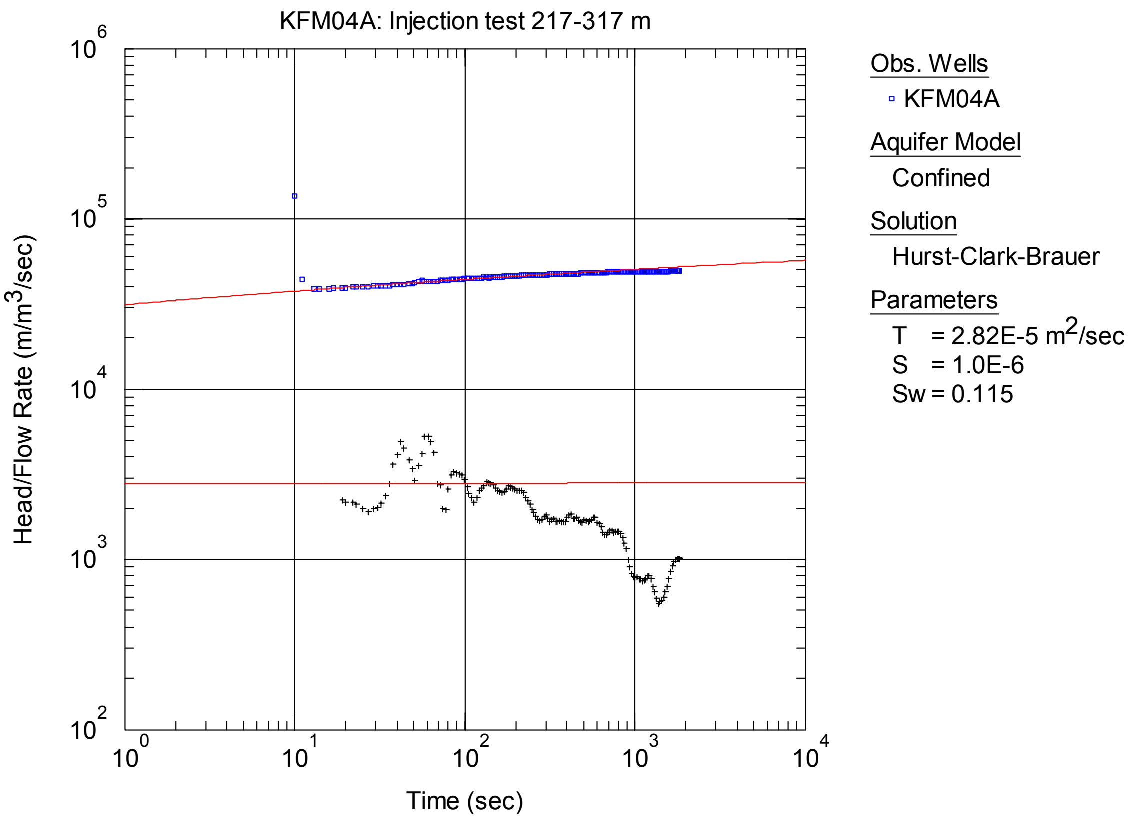


Figure A3-8. *Log-log plot of head/flow rate (□) and derivative (+) versus time, from the injection test in section 217-317 m in KFM04A.*

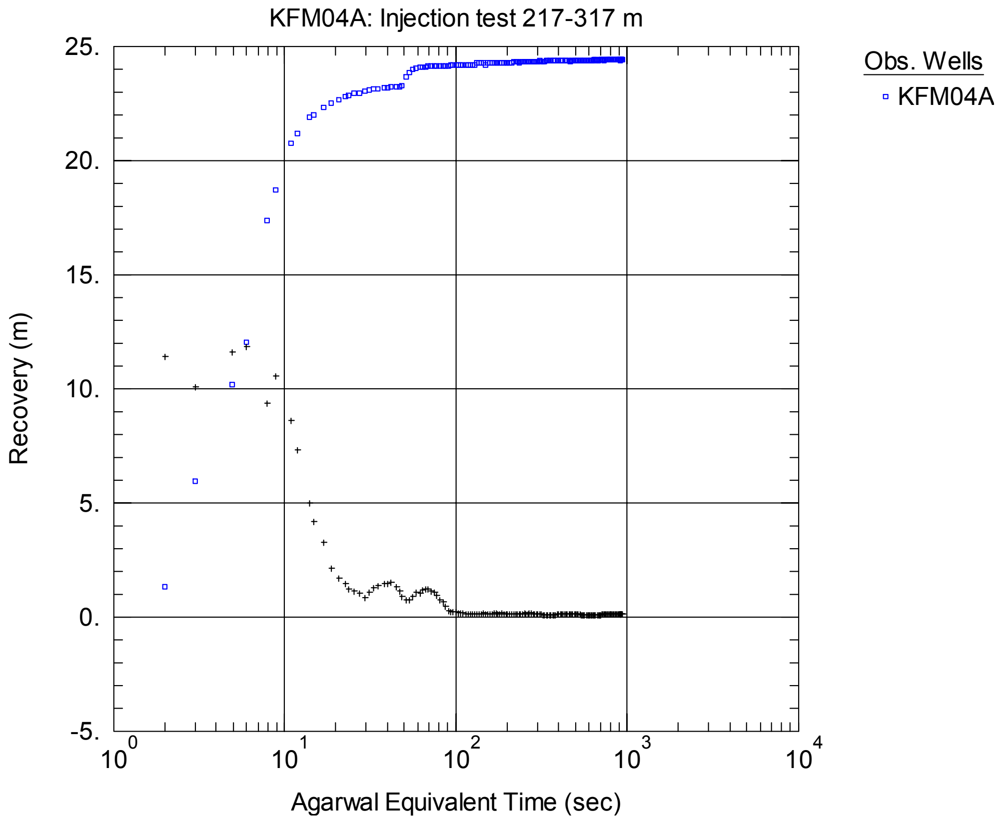


__Figure A3-9.__ Lin-log plot of recovery (□) and derivative (+) versus equivalent time, from the injection test in section 217-317 m in KFM04A.

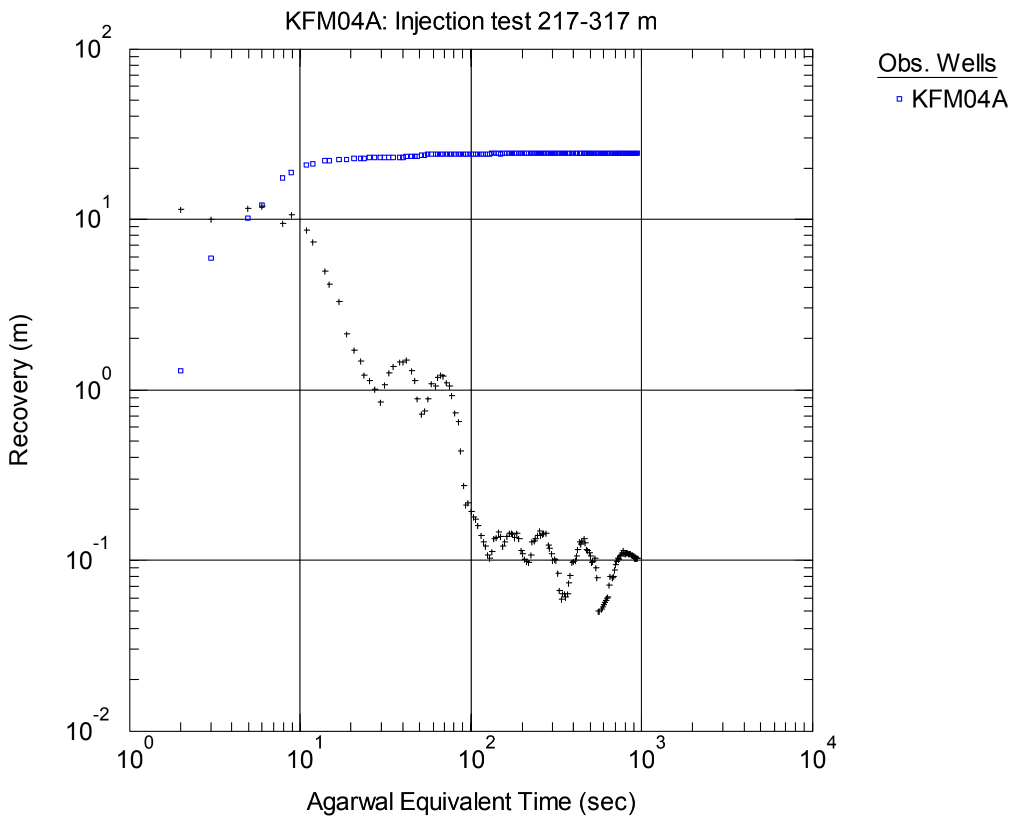


__Figure A3-10.__ Log-log plot of recovery (□) and derivative (+) versus equivalent time, from the injection test in section 217-317 m in KFM04A.

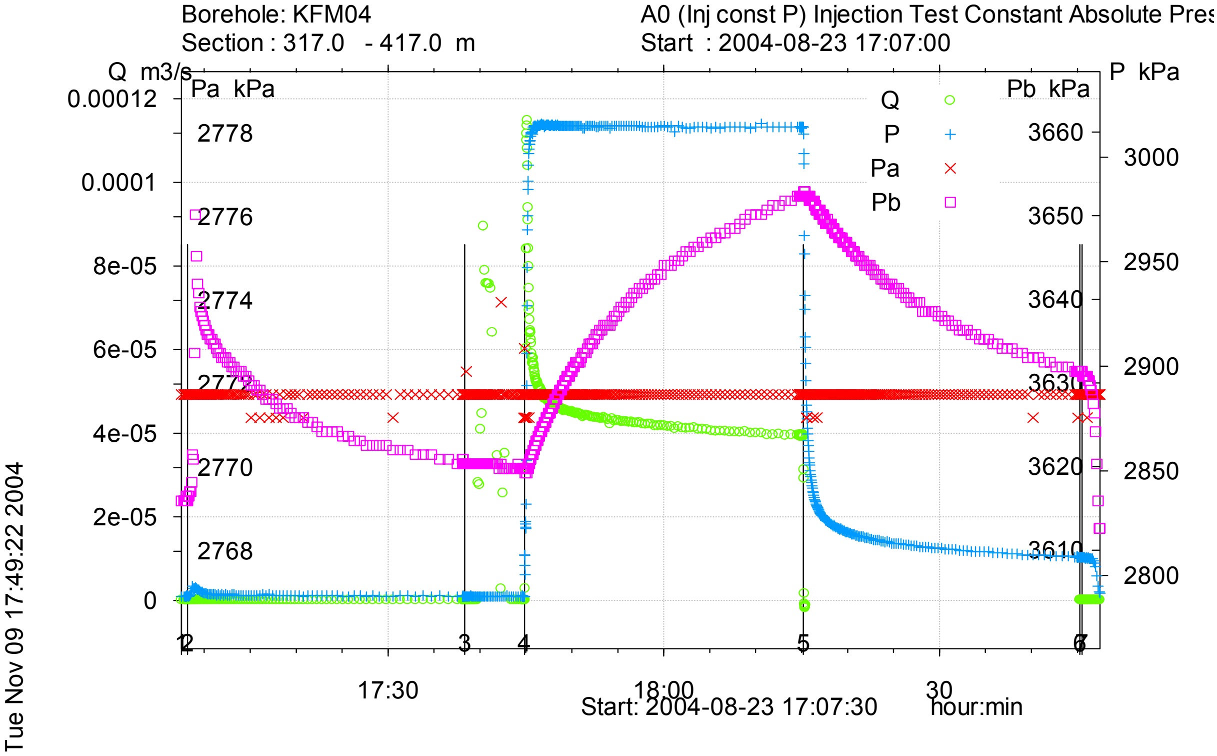


Figure A3-11. *Linear plot of flow rate (Q), pressure (P), pressure above section (Pa) and pressure below section (Pb) versus time from the injection test in section 317-417 m in borehole KFM04A.*

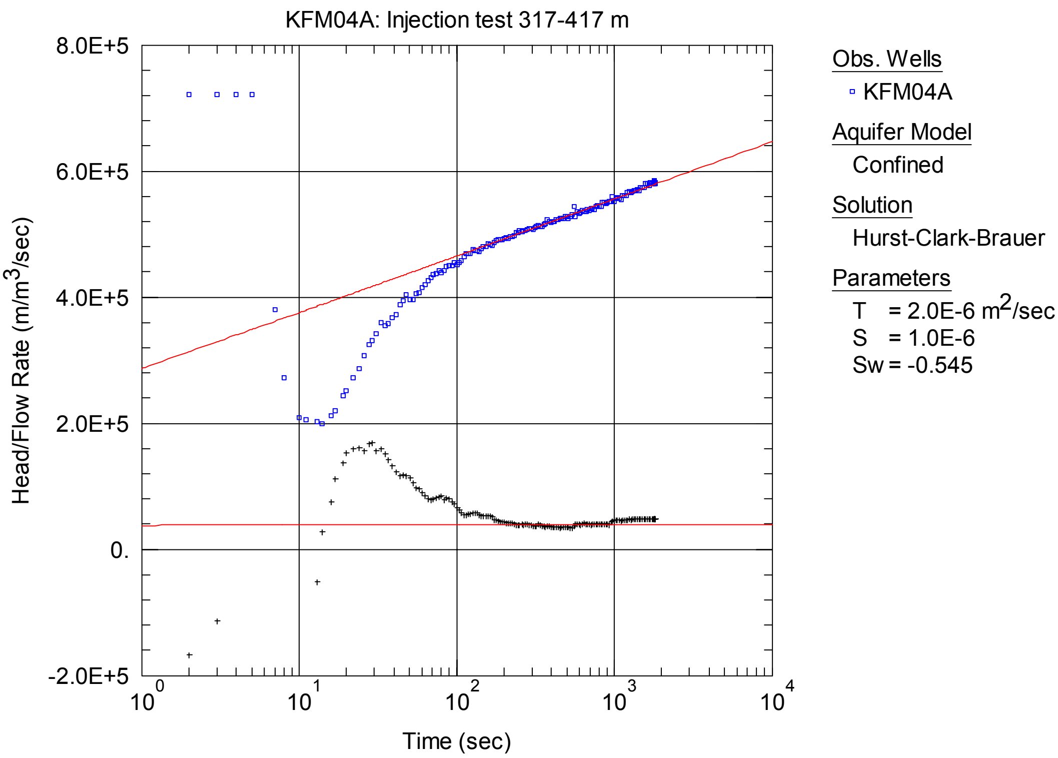


Figure A3-12. *Lin-log plot of head/flow rate (□) and derivative (+) versus time, from the injection test in section 317-417 m in KFM04A.*

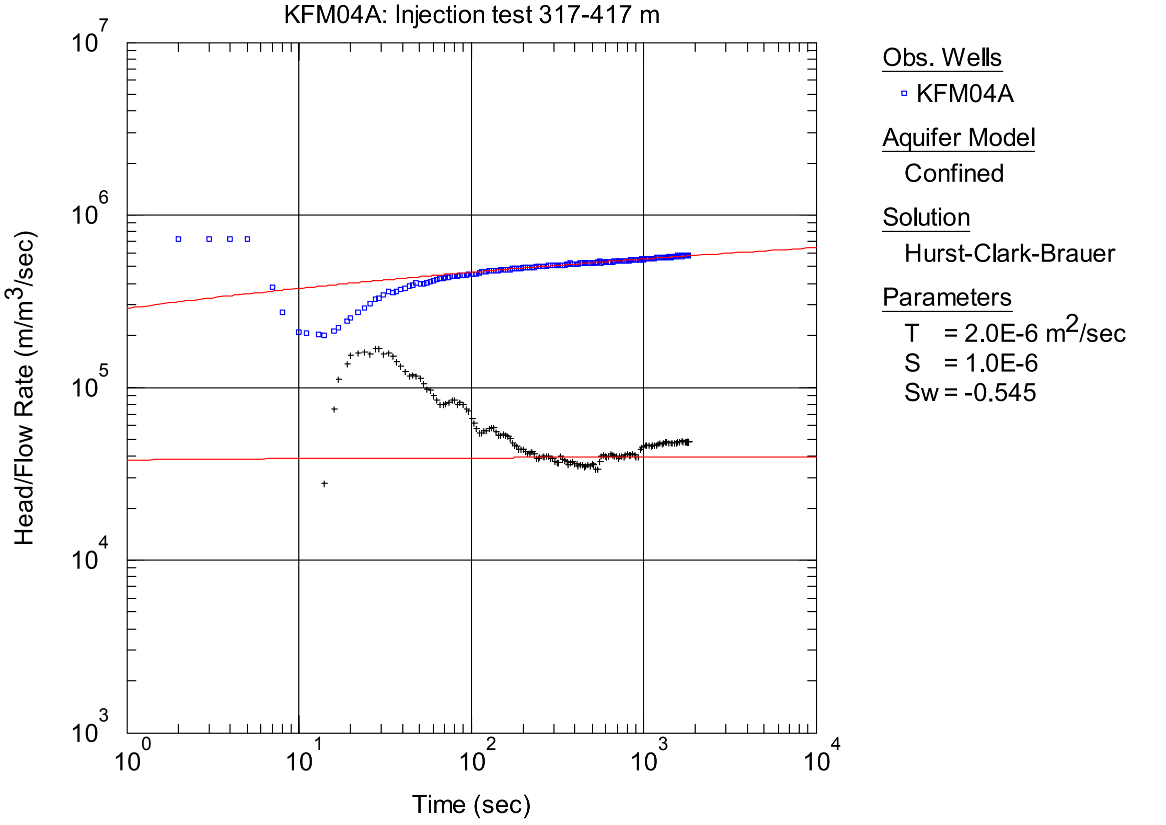


Figure A3-13. *Log-log plot of head/flow rate (□) and derivative (+) versus time, from the injection test in section 317-417 m in KFM04A.*

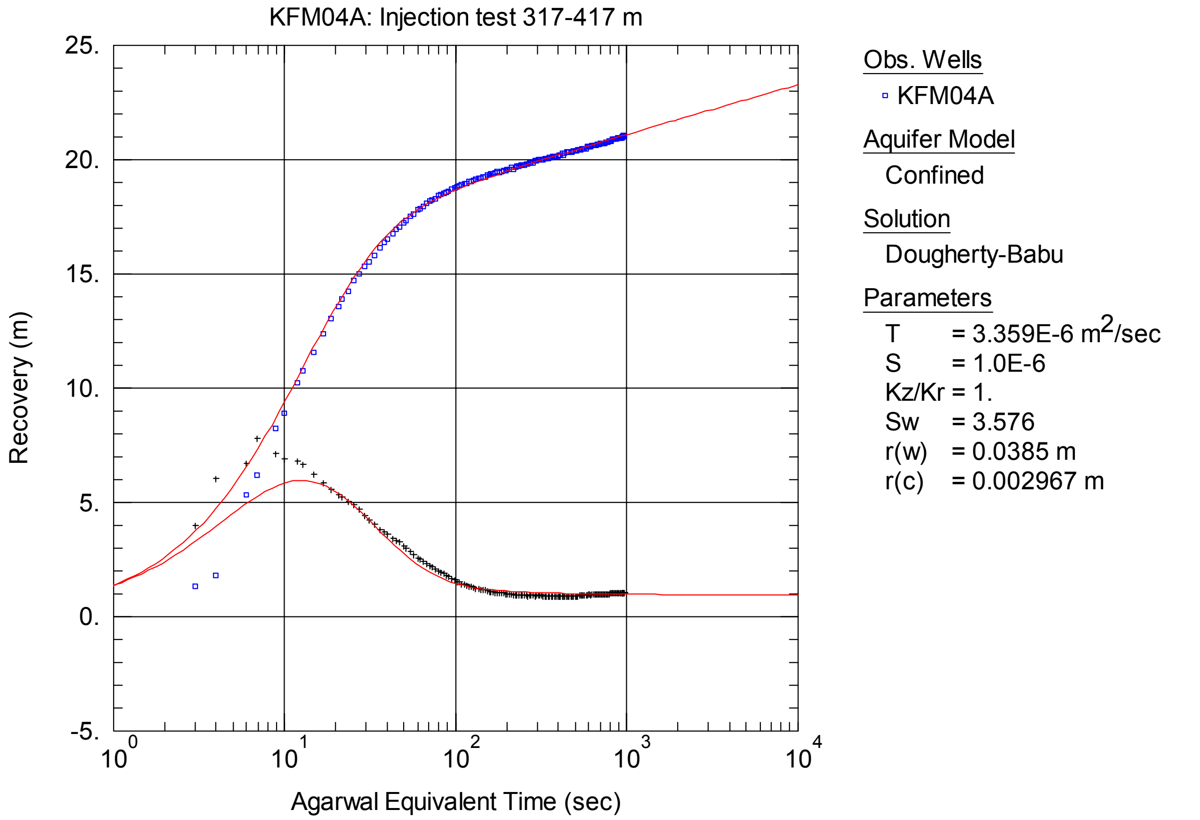


Figure A3-14. *Lin-log plot of recovery (□) and derivative (+) versus equivalent time, from the injection test in section 317-417 m in KFM04A.*

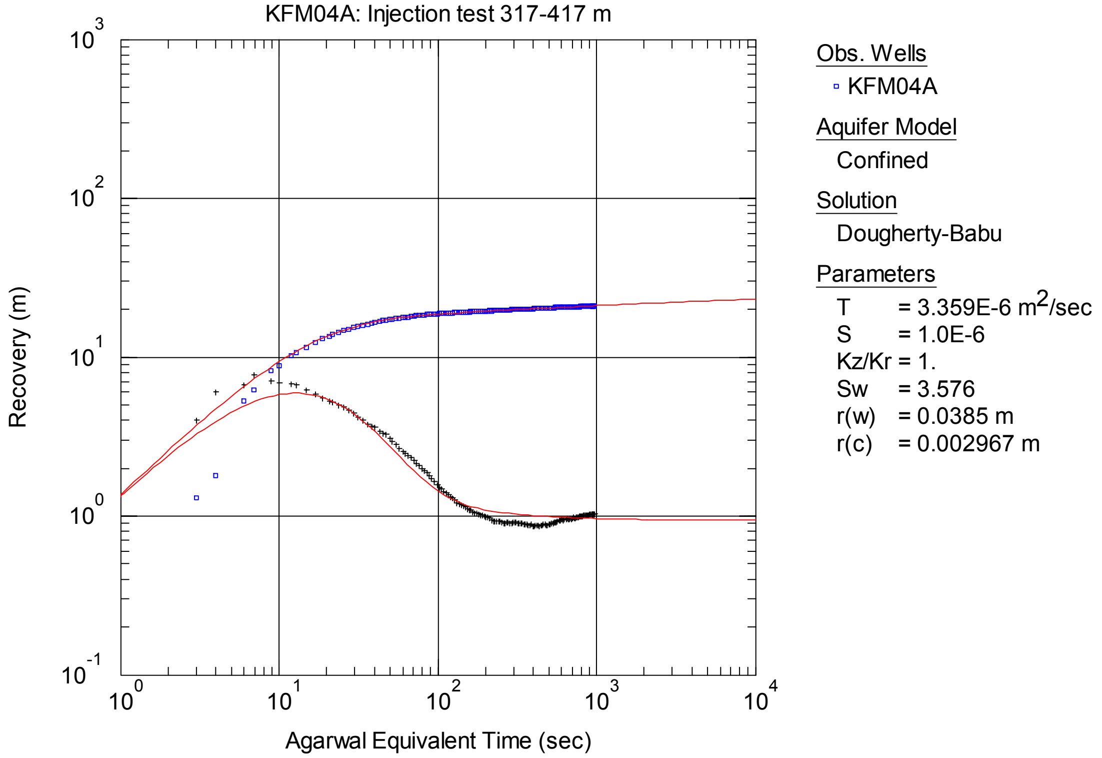


Figure A3-15. *Log-log plot of recovery (□) and derivative (+) versus equivalent time, from the injection test in section 317-417 m in KFM04A.*

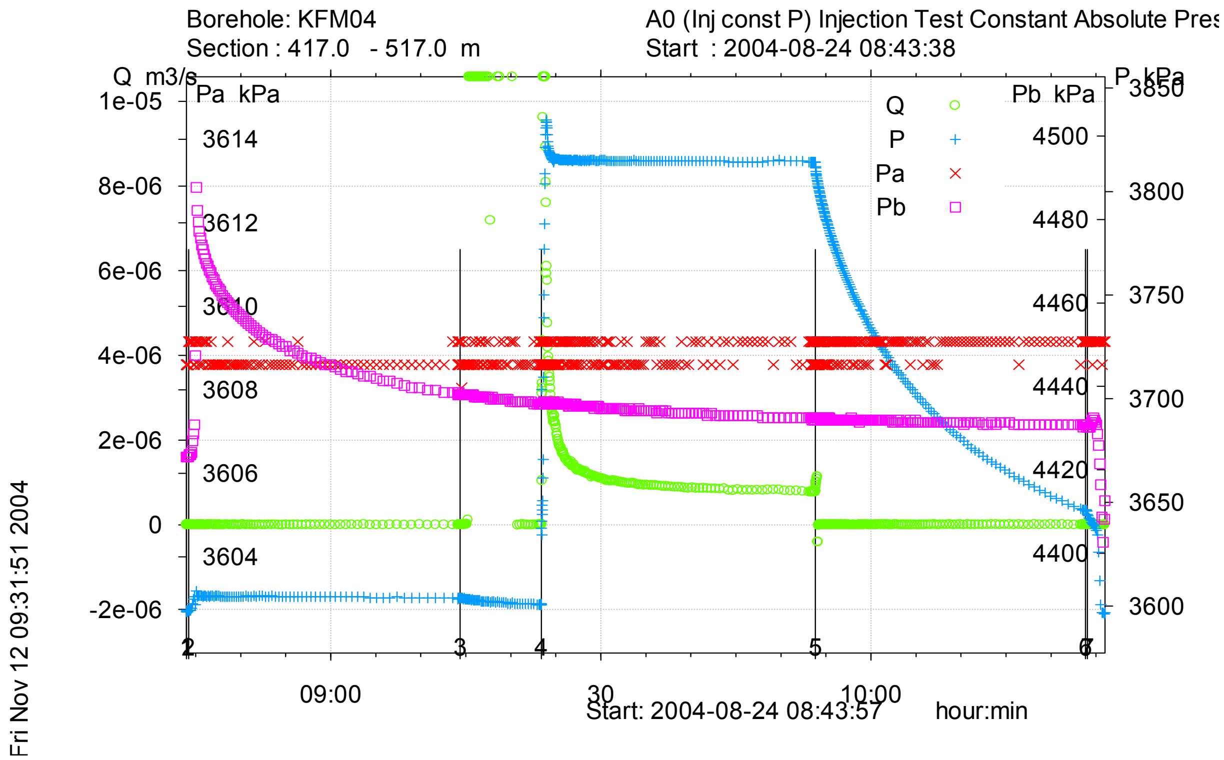


Figure A3-16. *Linear plot of flow rate (Q), pressure (P), pressure above section (Pa) and pressure below section (Pb) versus time from the injection test in section 417-517 m in borehole KFM04A.*

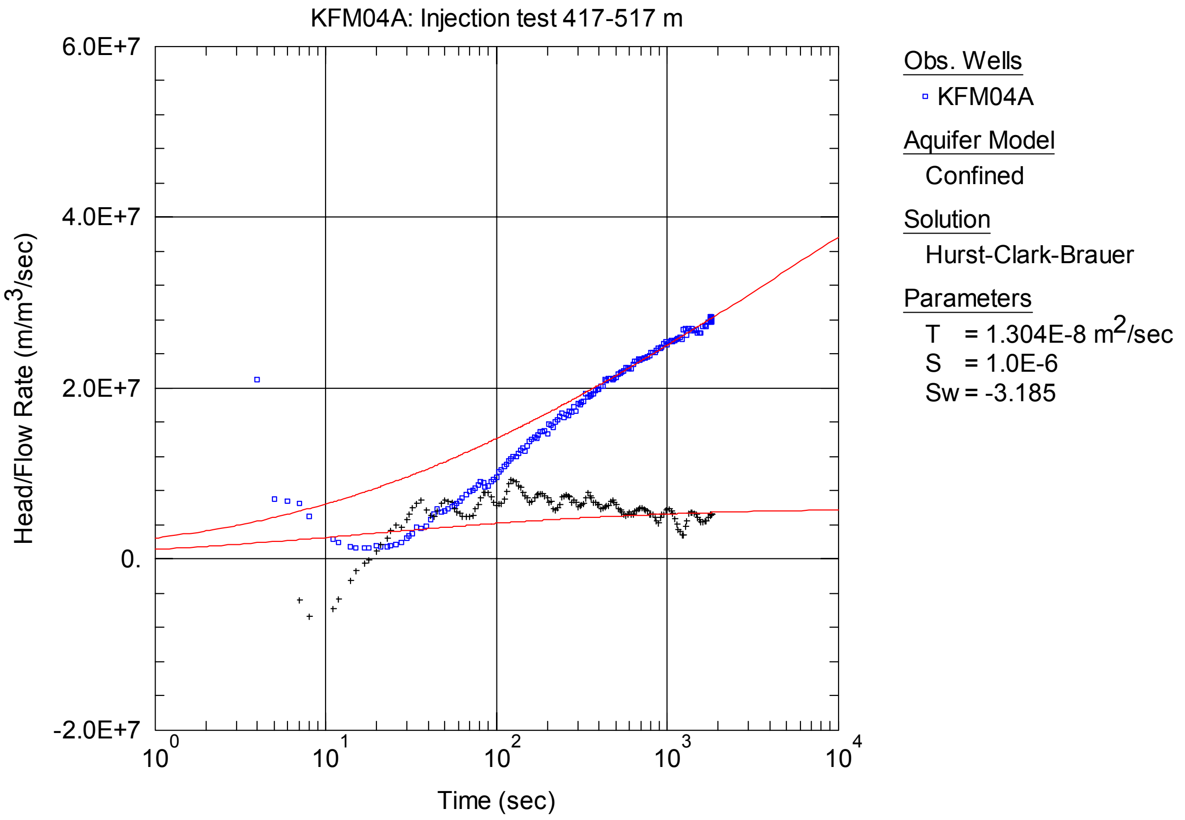


Figure A3-17. *Lin-log plot of head/flow rate (□) and derivative (+) versus time, from the injection test in section 417-517 m in KFM04A.*

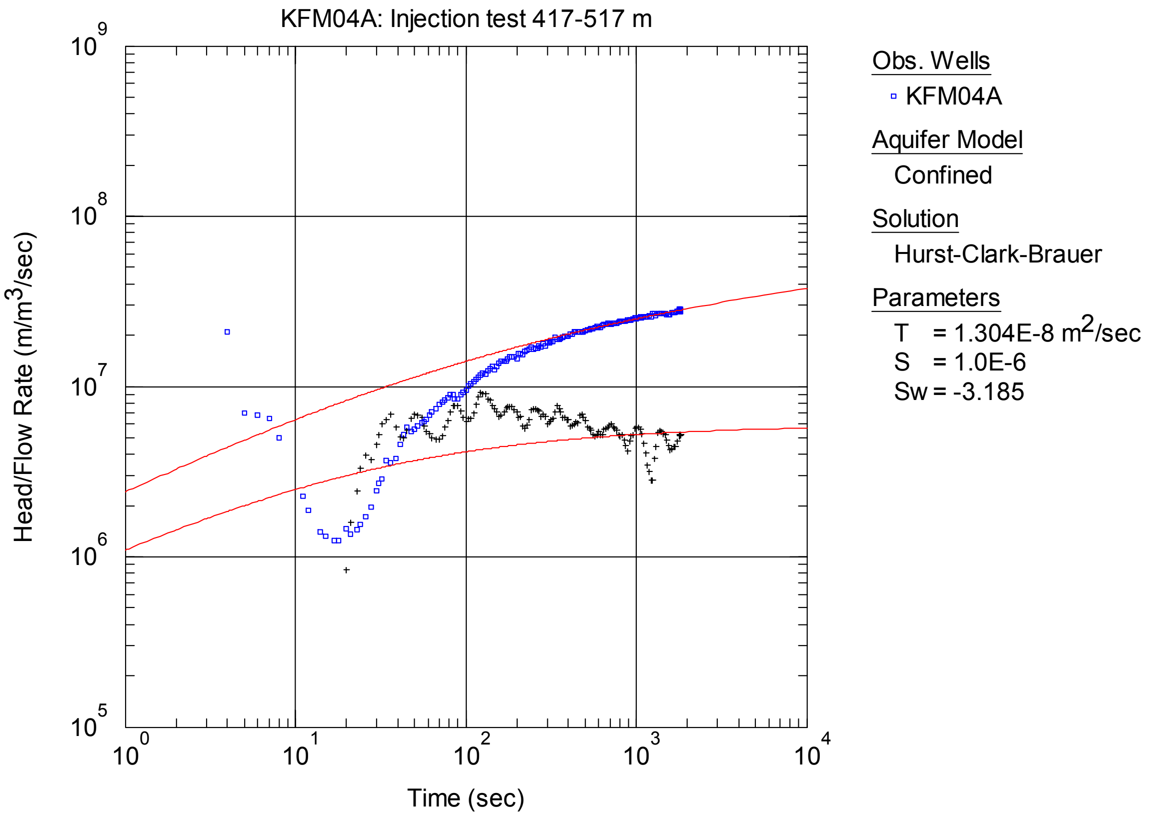


Figure A3-18. *Log-log plot of head/flow rate (□) and derivative (+) versus time, from the injection test in section 417-517 m in KFM04A.*

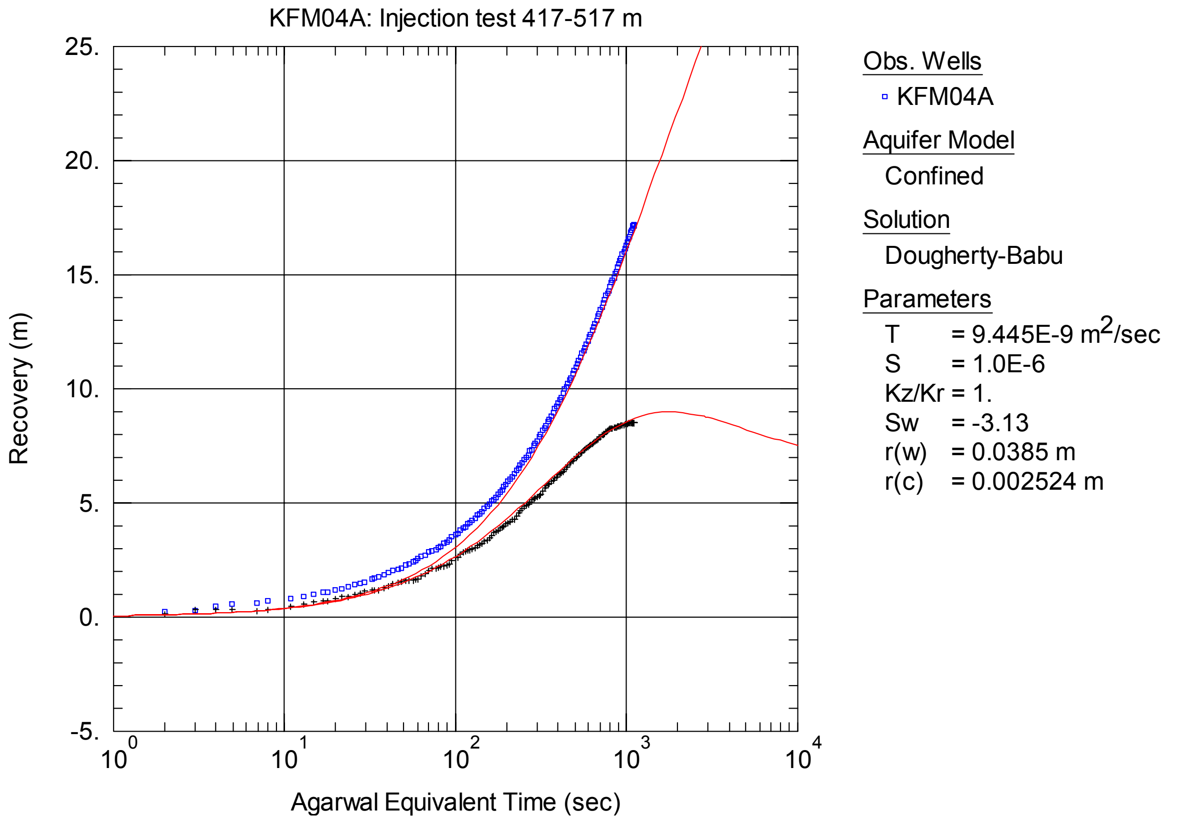


Figure A3-19. *Lin-log plot of recovery (□) and derivative (+) versus equivalent time, from the injection test in section 417-517 m in KFM04A.*

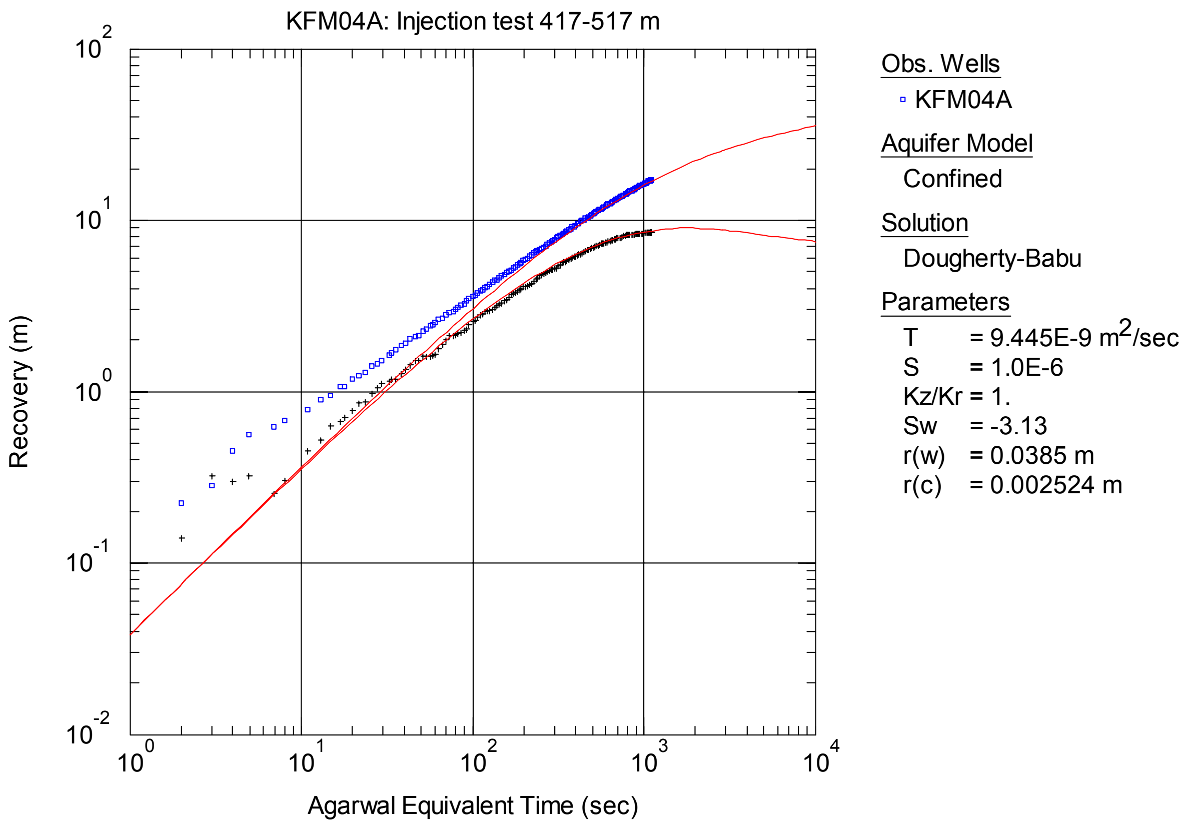


Figure A3-20. *Log-log plot of recovery (□) and derivative (+) versus equivalent time, from the injection test in section 417-517 m in KFM04A.*

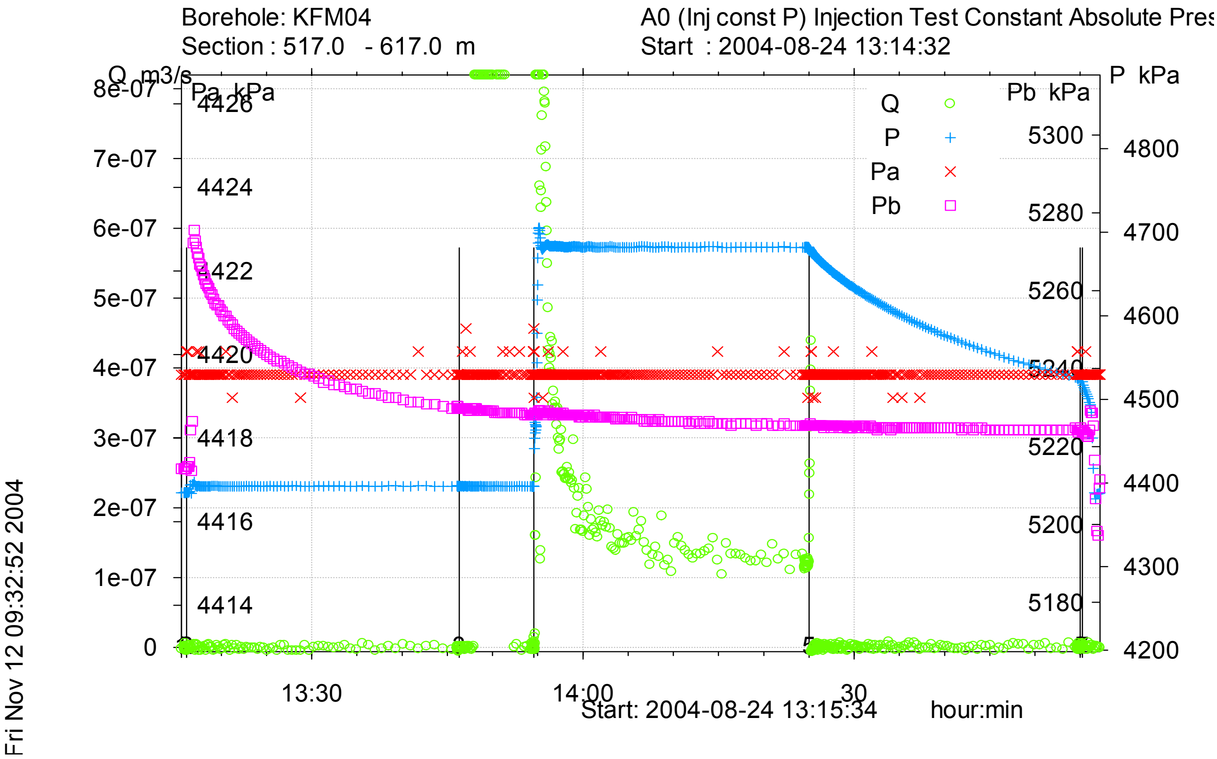


Figure A3-21. *Linear plot of flow rate (Q), pressure (P), pressure above section (Pa) and pressure below section (Pb) versus time from the injection test in section 517-617 m in borehole KFM04A.*

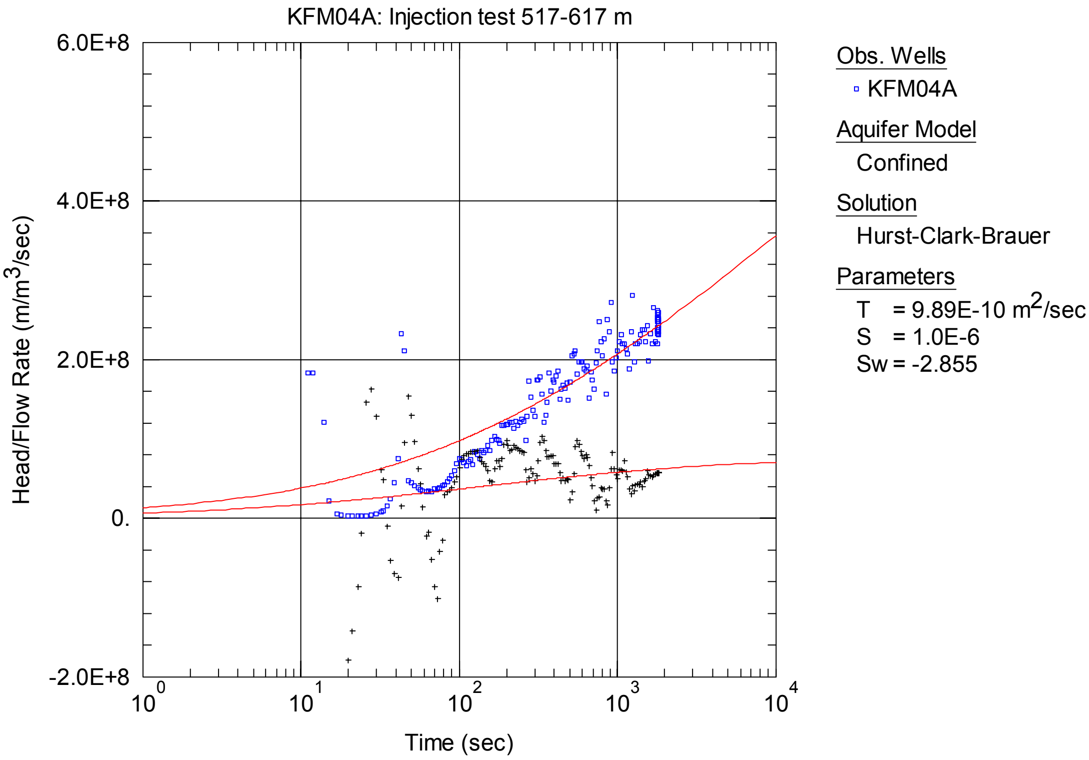


Figure A3-22. *Lin-log plot of head/flow rate (□) and derivative (+) versus time, from the injection test in section 517-617 m in KFM04A.*

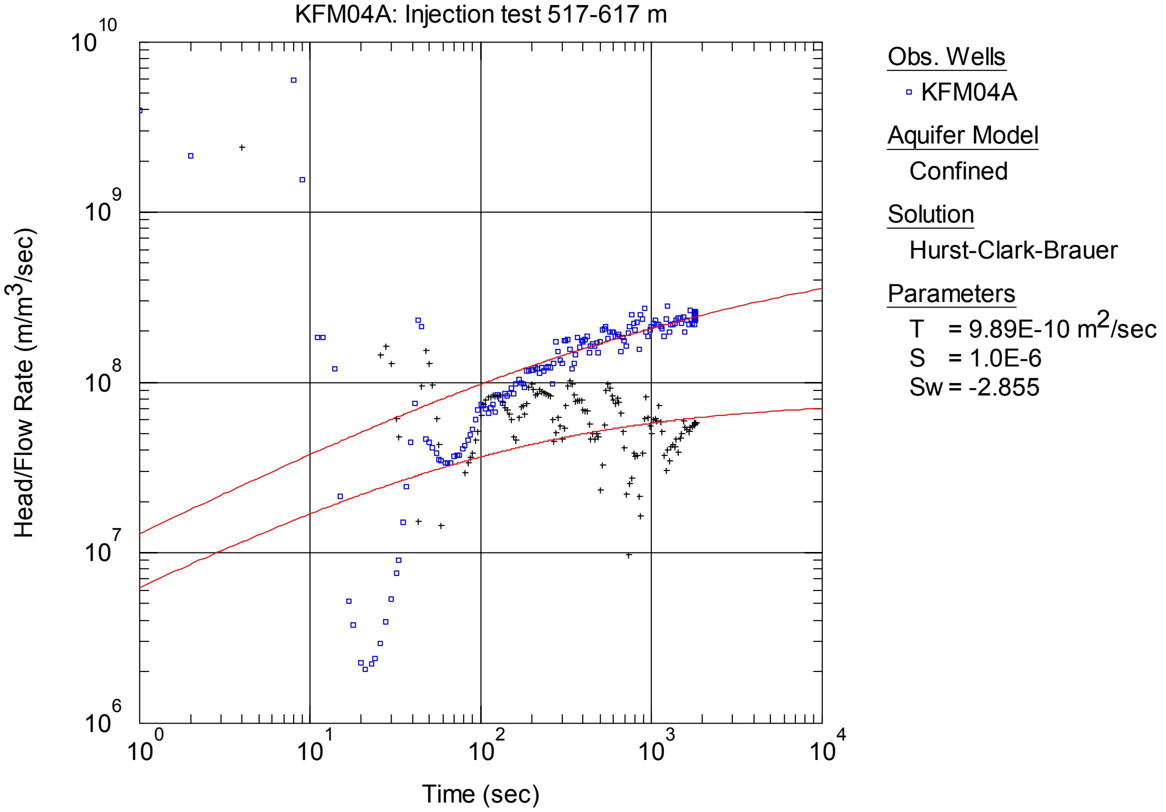


Figure A3-23. *Log-log plot of head/flow rate (□) and derivative (+) versus time, from the injection test in section 517-617 m in KFM04A.*

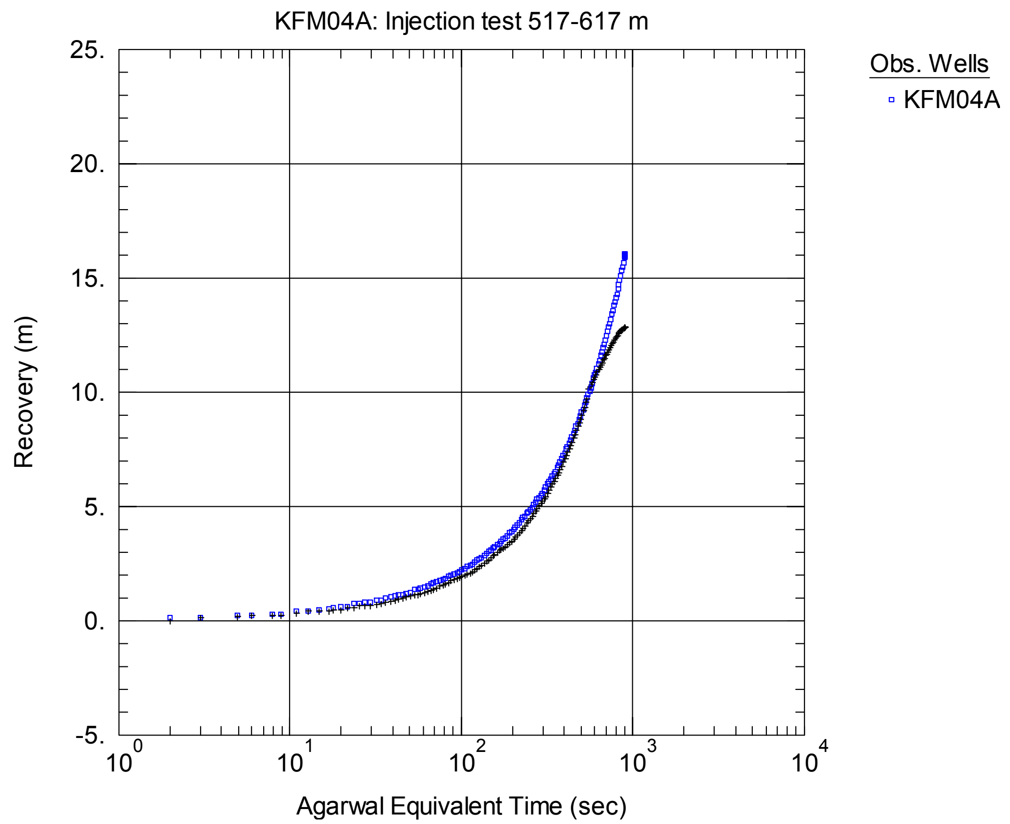


Figure A3-24. *Lin-log plot of recovery (□) and derivative (+) versus equivalent time, from the injection test in section 517-617 m in KFM04A.*

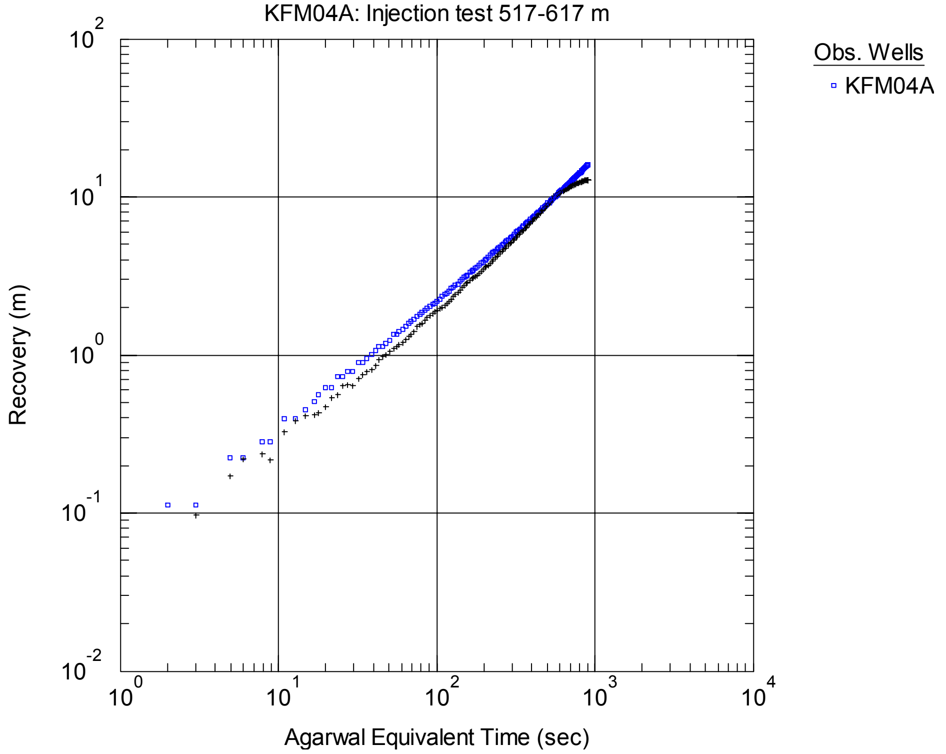


Figure A3-25. *Log-log plot of recovery (□) and derivative (+) versus equivalent time, from the injection test in section 517-617 m in KFM04A.*

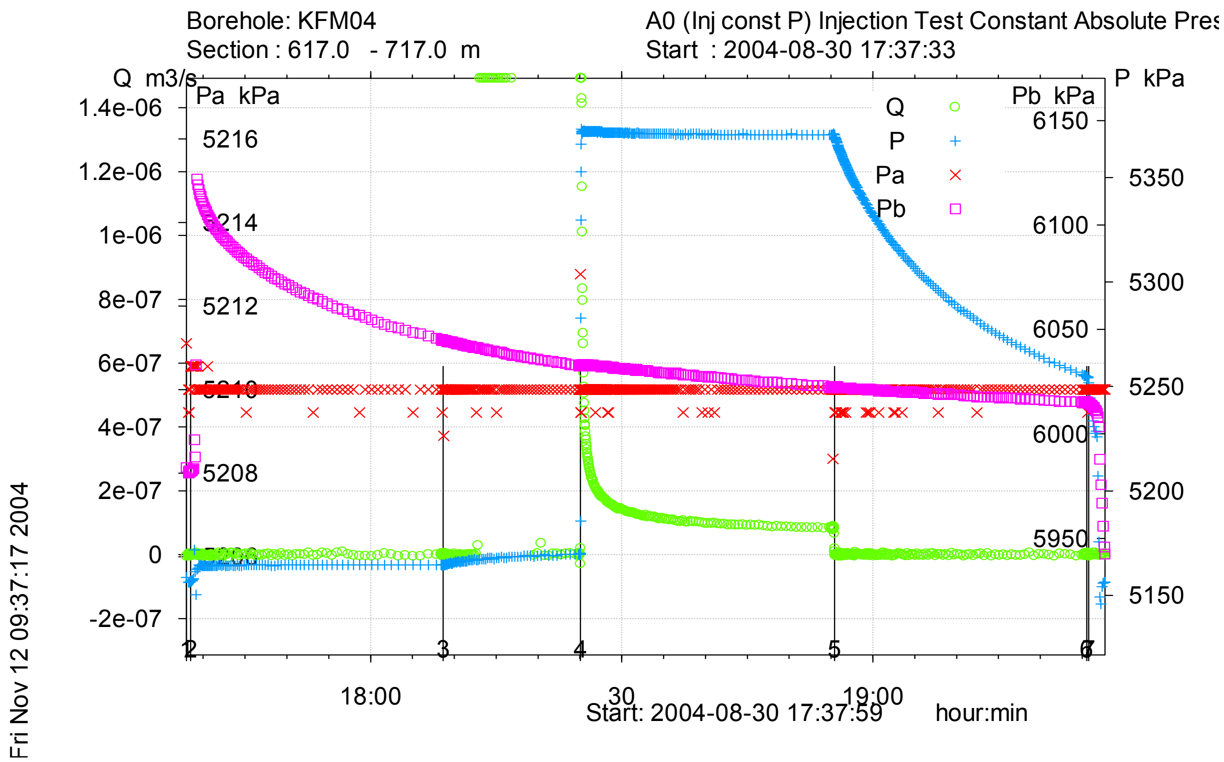


Figure A3-26. *Linear plot of flow rate (Q), pressure (P), pressure above section (Pa) and pressure below section (Pb) versus time from the injection test in section 617-717 m in borehole KFM04A.*

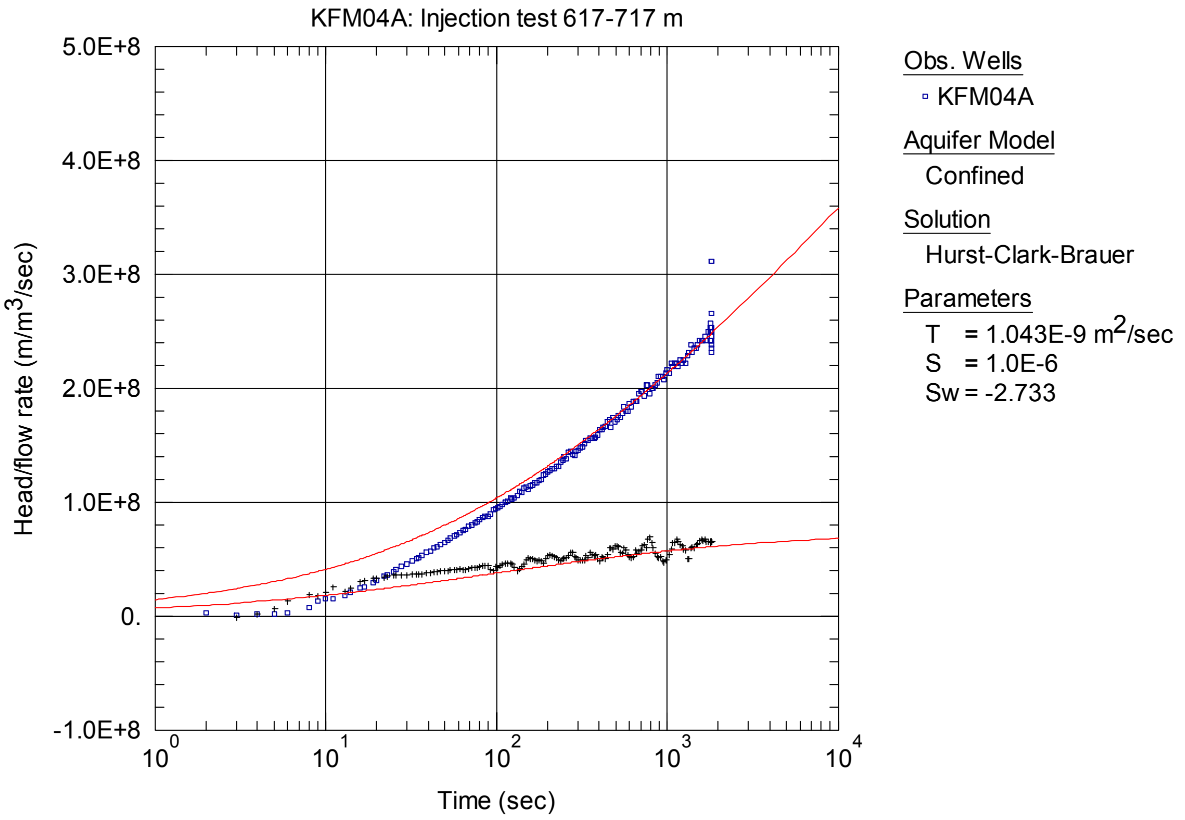


Figure A3-27. *Lin-log plot of head/flow rate (□) and derivative (+) versus time, from the injection test in section 617-717 m in KFM04A.*

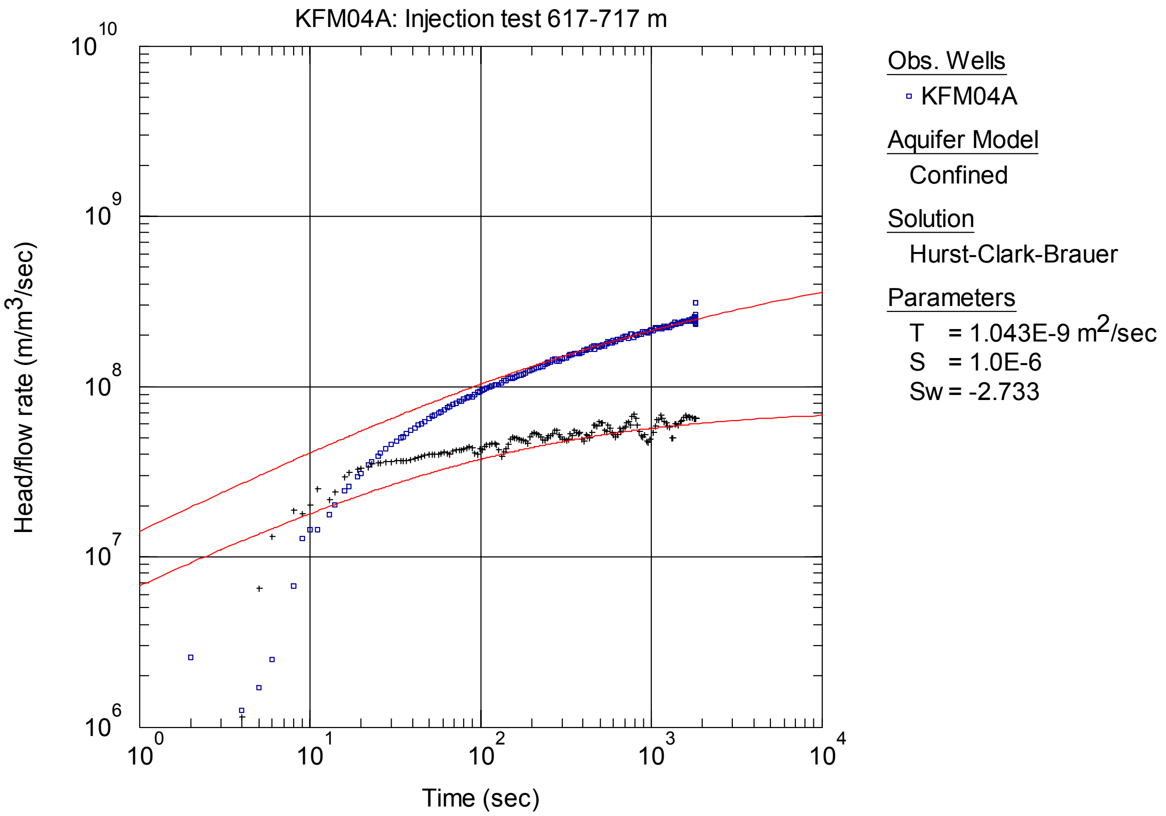


Figure A3-28. *Log-log plot of head/flow rate (□) and derivative (+) versus time, from the injection test in section 617-717 m in KFM04A.*

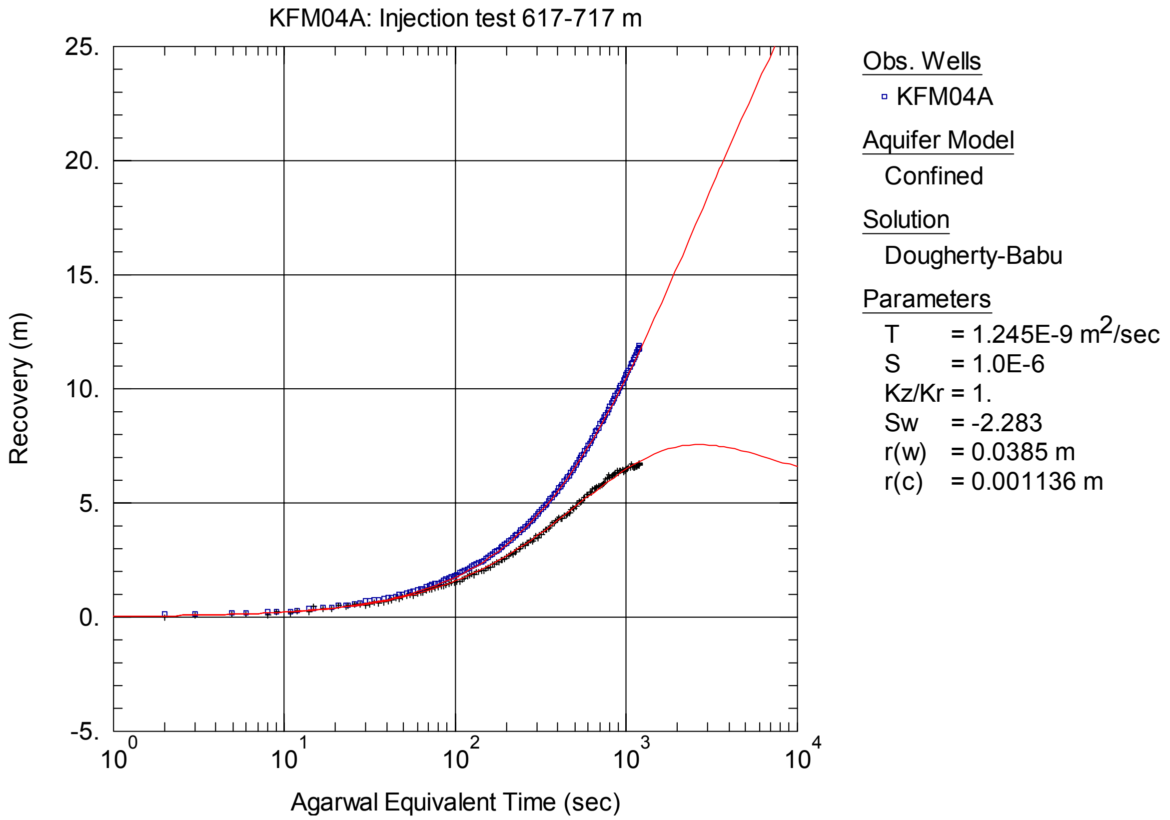


Figure A3-29. *Lin-log plot of recovery (□) and derivative (+) versus equivalent time, from the injection test in section 617-717 m in KFM04A.*

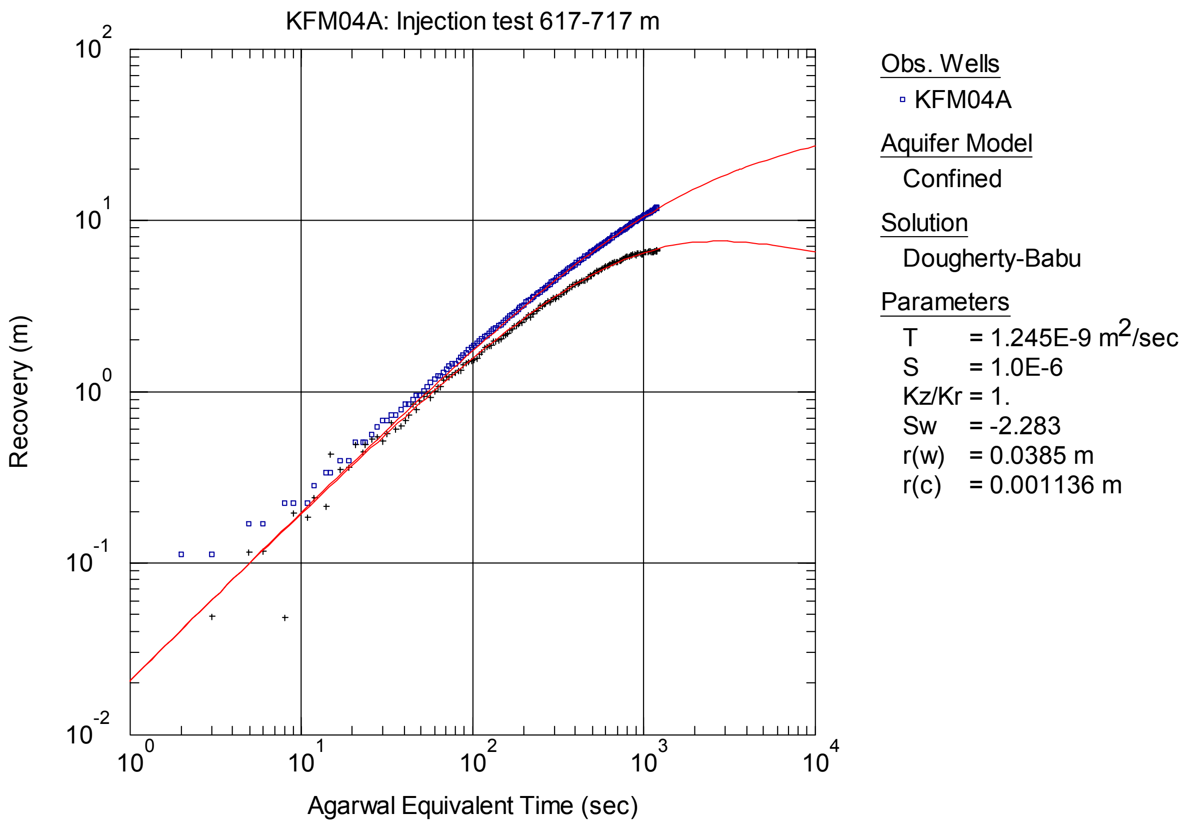


Figure A3-30. *Log-log plot of recovery (□) and derivative (+) versus equivalent time, from the injection test in section 617-717 m in KFM04A.*

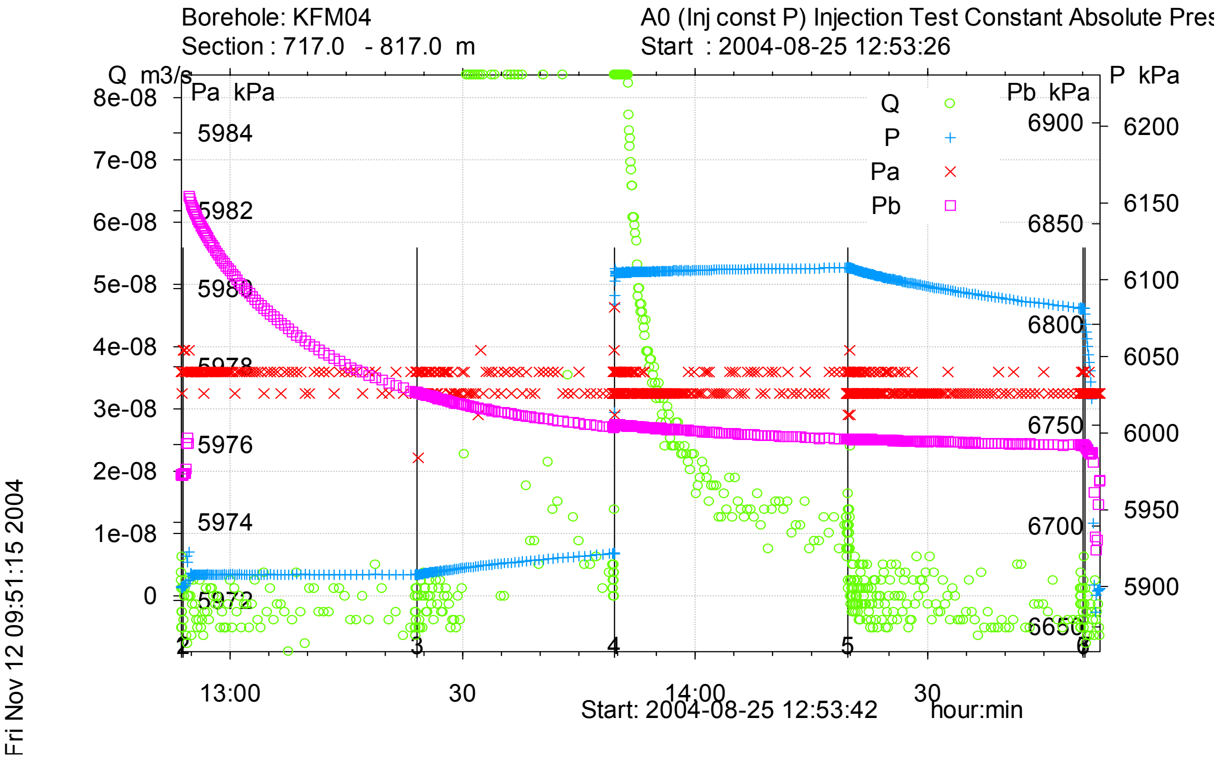


Figure A3-31. *Linear plot of flow rate (Q), pressure (P), pressure above section (Pa) and pressure below section (Pb) versus time from the injection test in section 717-817 m in borehole KFM04A.*

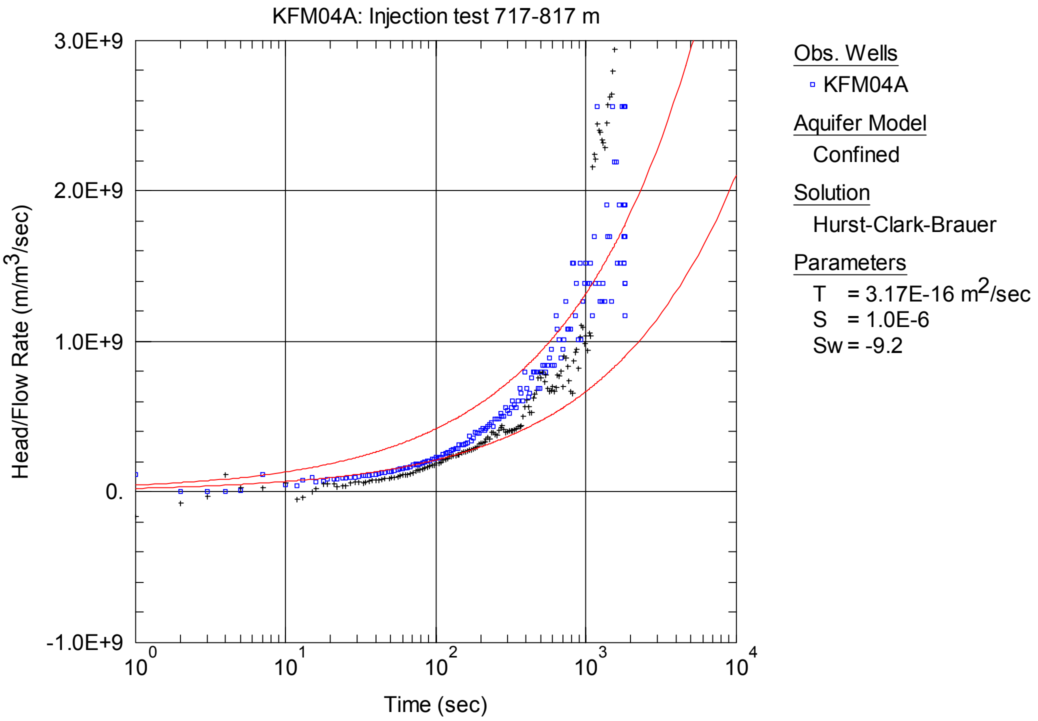


Figure A3-32. *Lin-log plot of head/flow rate (□) and derivative (+) versus time, from the injection test in section 717-817 m in KFM04A. The type curve fit is only to show that an assumption of PRF is not valid.*

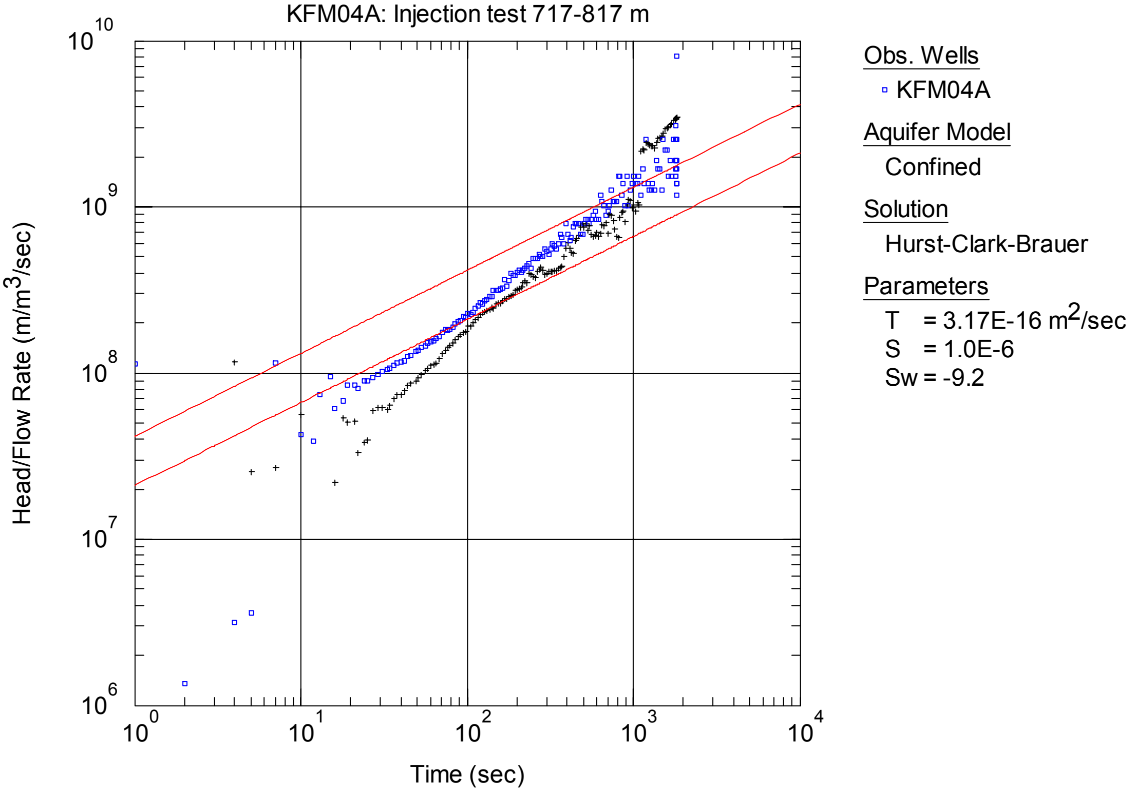


Figure A3-33. *Log-log plot of head/flow rate (□) and derivative (+) versus time, from the injection test in section 717-817 m in KFM04A. The type curve fit is only to show that an assumption of PRF is not valid.*

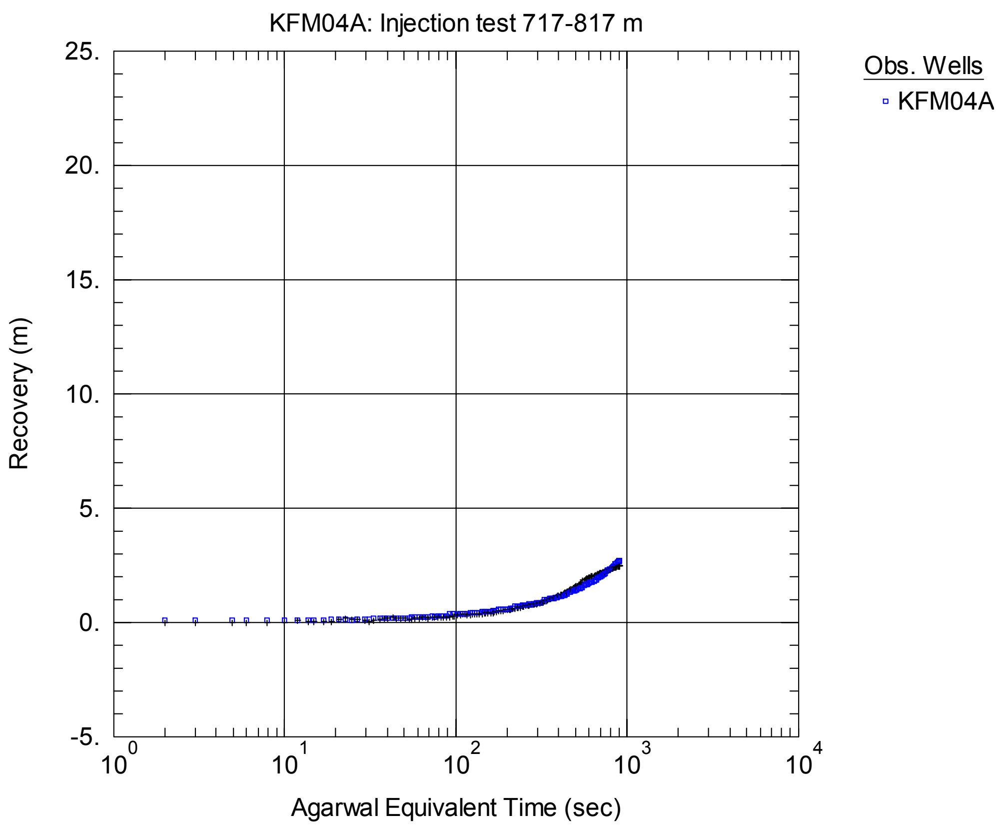


Figure A3-34. *Lin-log plot of recovery (□) and derivative (+) versus equivalent time, from the injection test in section 717-817 m in KFM04A.*

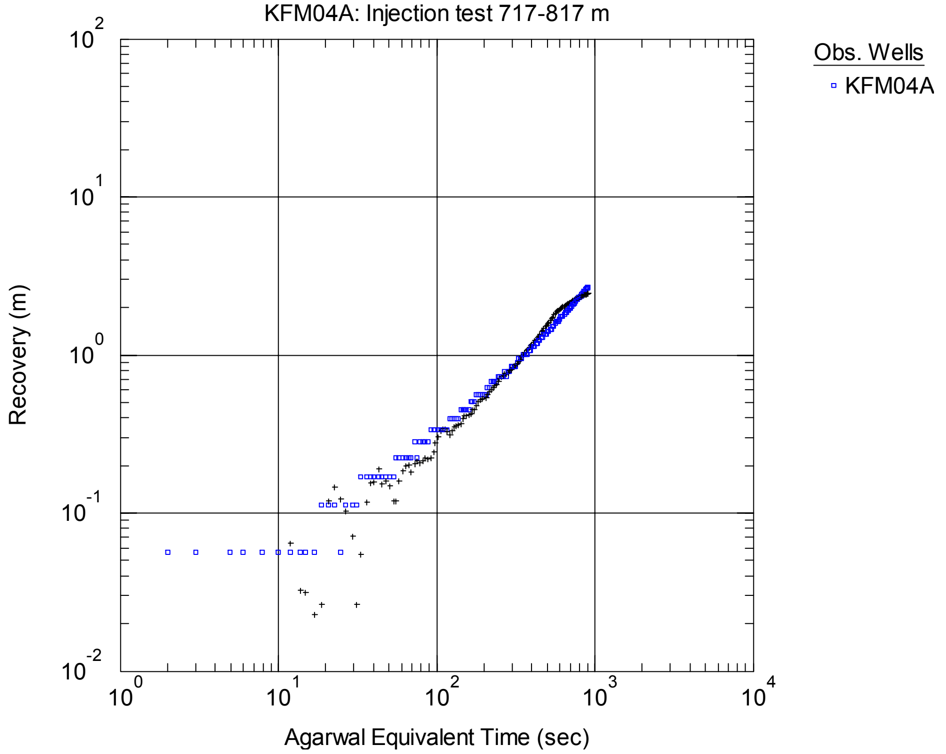


Figure A3-35. *Log-log plot of recovery (□) and derivative (+) versus equivalent time, from the injection test in section 717-817 m in KFM04A.*

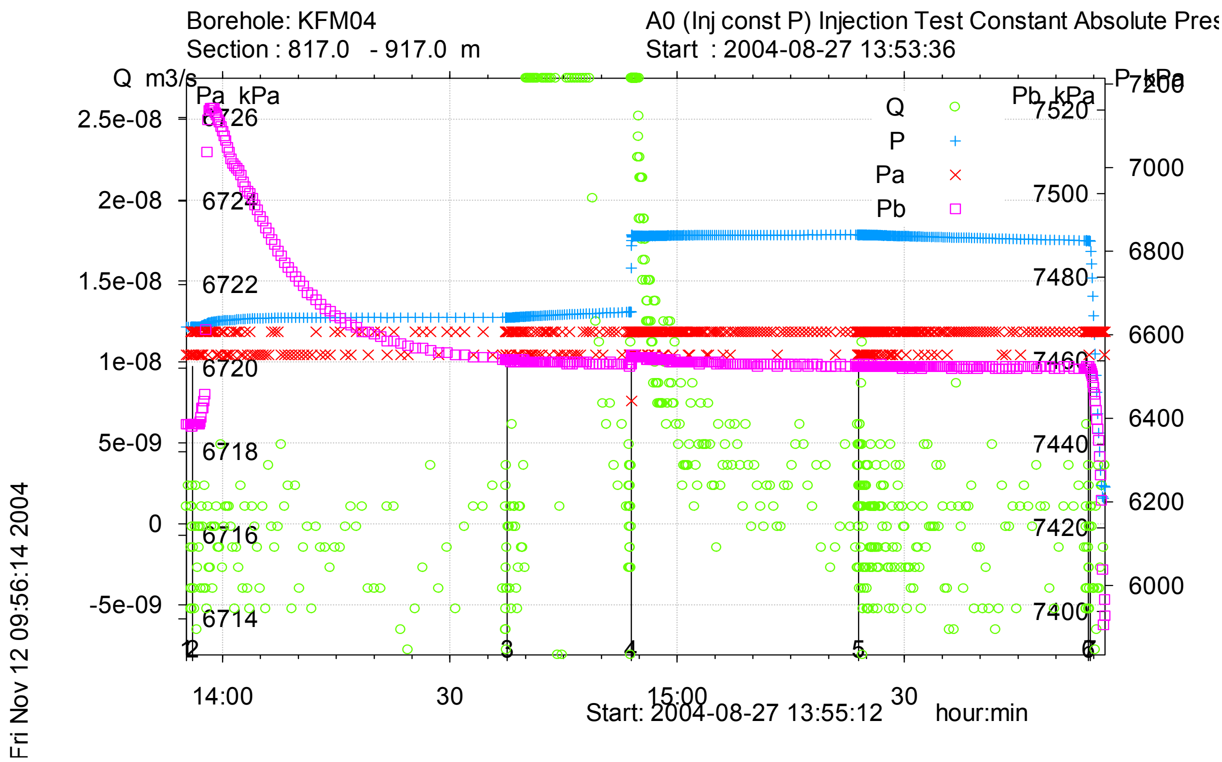


Figure A3-36. *Linear plot of flow rate (Q), pressure (P), pressure above section (Pa) and pressure below section (Pb) versus time from the injection test in section 817-917 m in borehole KFM04A.*

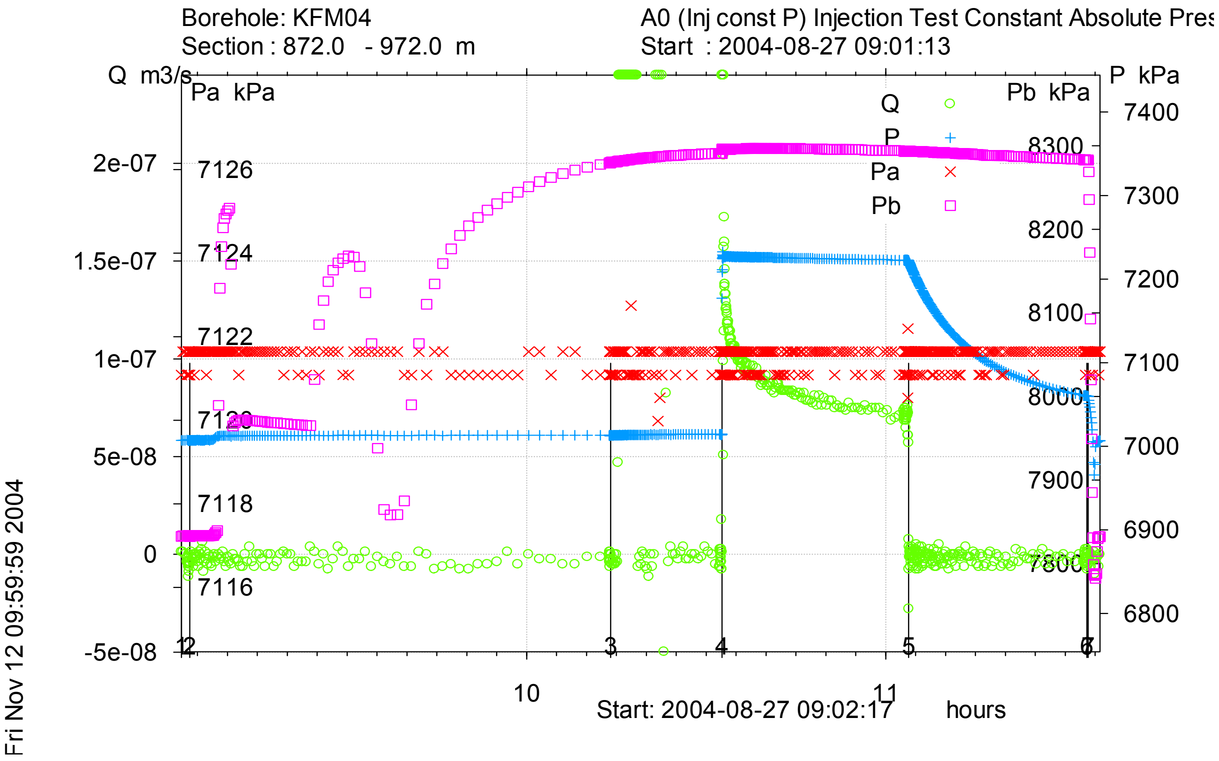


Figure A3-37. *Linear plot of flow rate (Q), pressure (P), pressure above section (Pa) and pressure below section (Pb) versus time from the injection test in section 872-972 m in borehole KFM04A.*

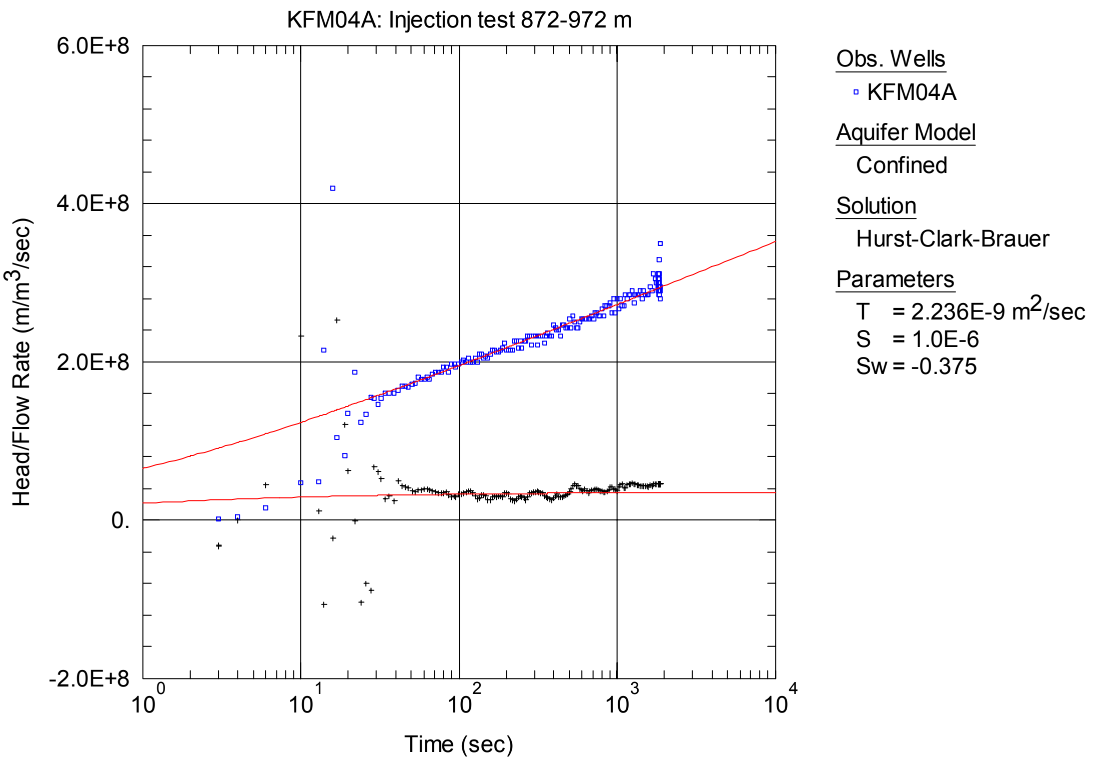


Figure A3-38. *Lin-log plot of head/flow rate (□) and derivative (+) versus time, from the injection test in section 872-972 m in KFM04A.*

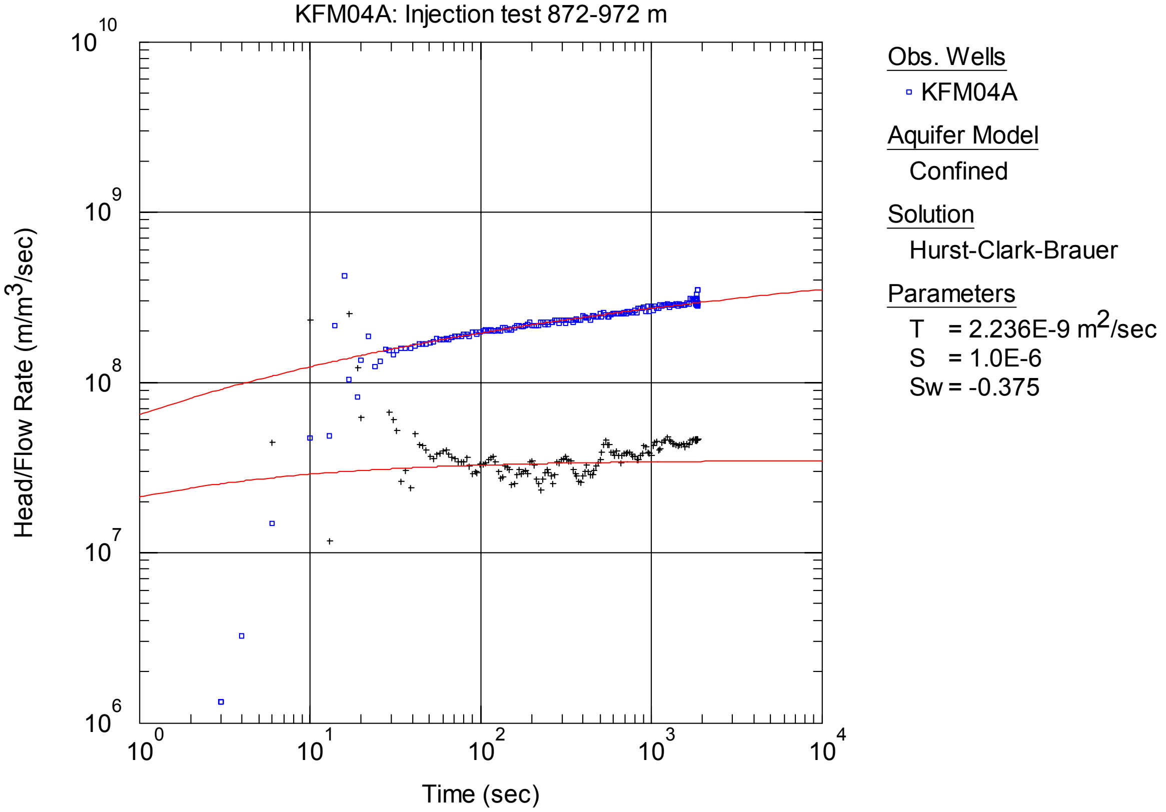


Figure A3-39. *Log-log plot of head/flow rate (□) and derivative (+) versus time, from the injection test in section 872-972 m in KFM04A.*

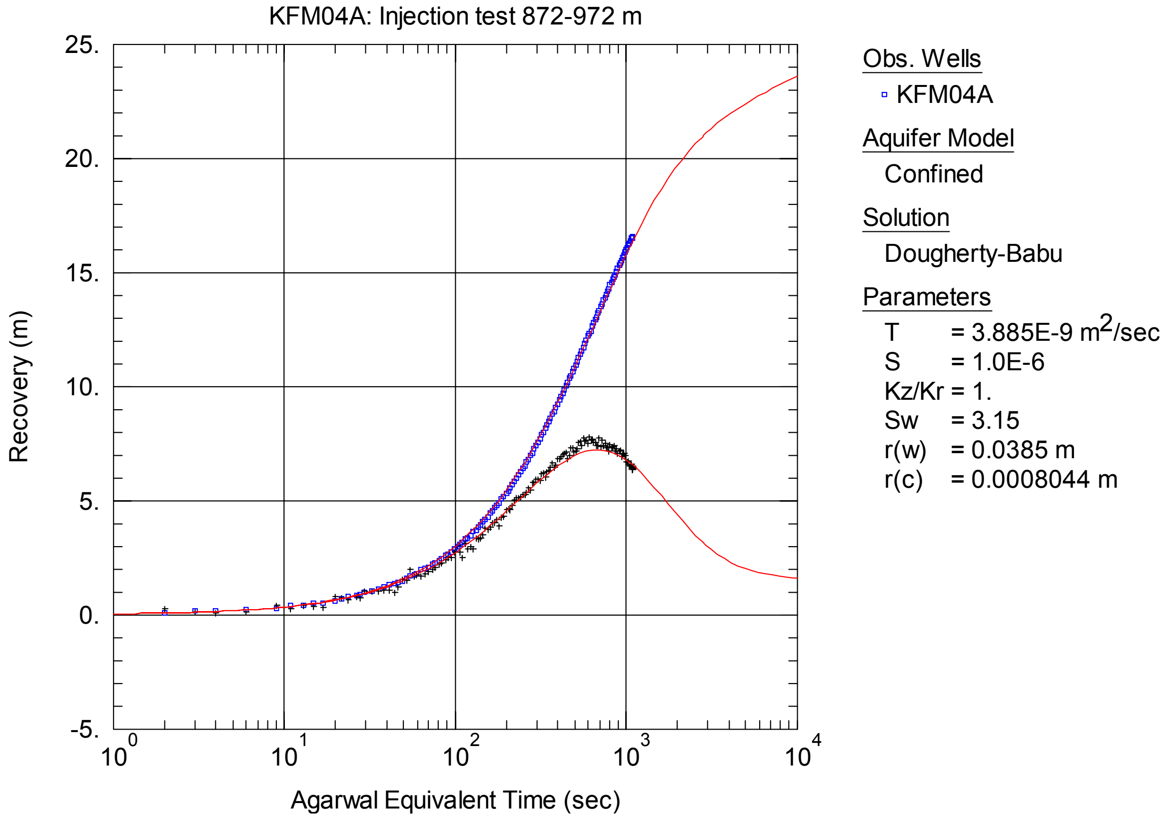


Figure A3-40. *Lin-log plot of recovery (□) and derivative (+) versus equivalent time, from the injection test in section 872-972 m in KFM04A.*

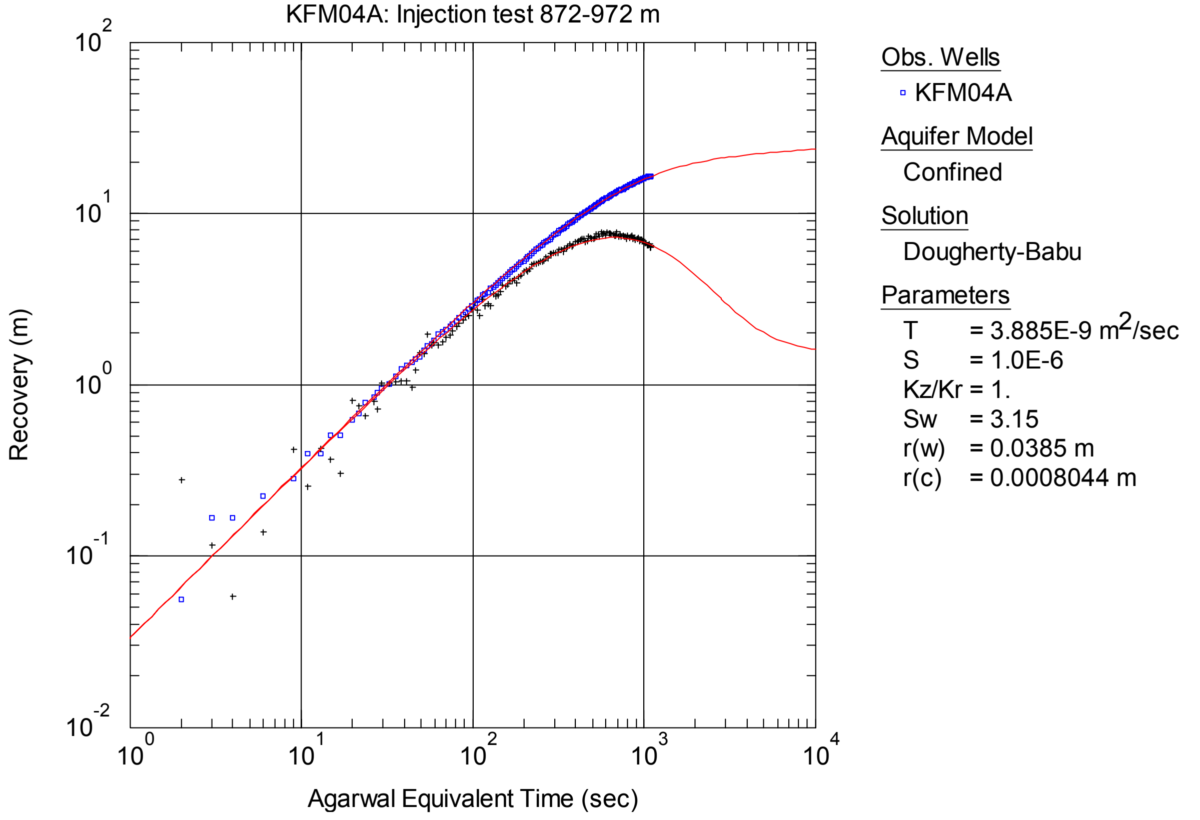


Figure A3-41. *Log-log plot of recovery (□) and derivative (+) versus equivalent time, from the injection test in section 872-972 m in KFM04A.*

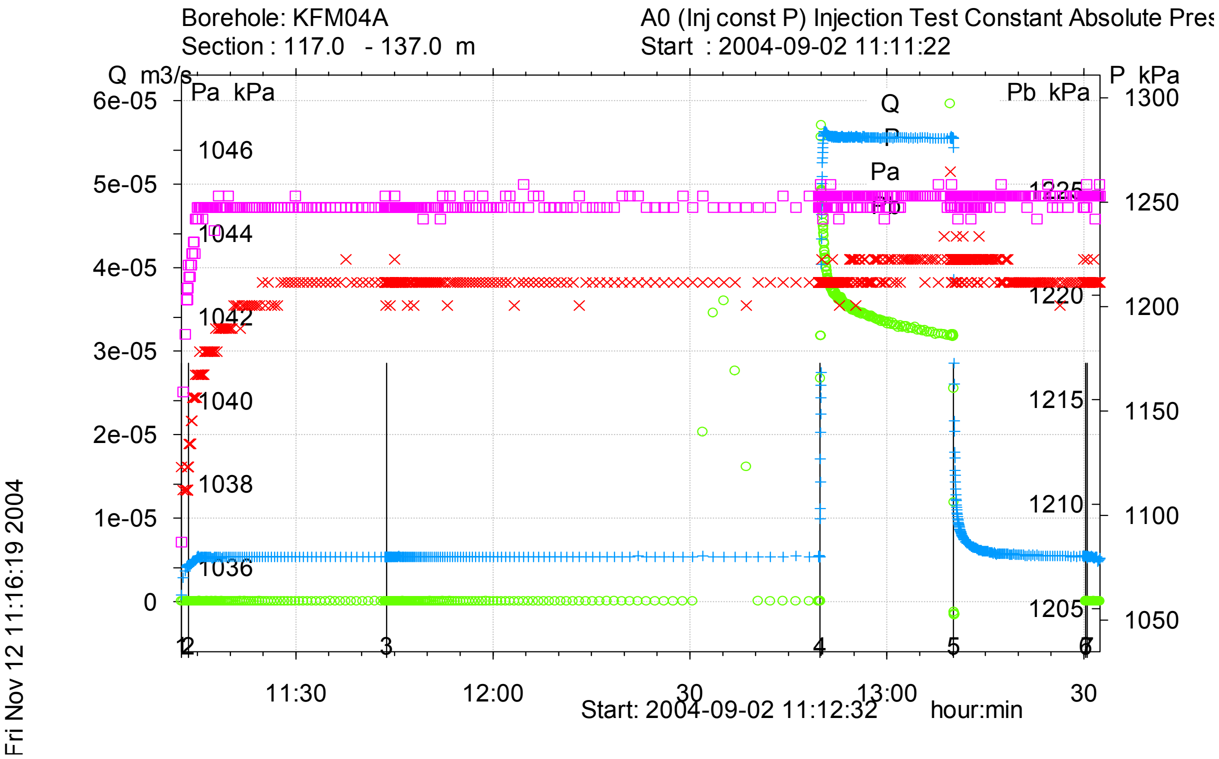


Figure A3-42. *Linear plot of flow rate (Q), pressure (P), pressure above section (Pa) and pressure below section (Pb) versus time from the injection test in section 117-137 m in borehole KFM04A.*

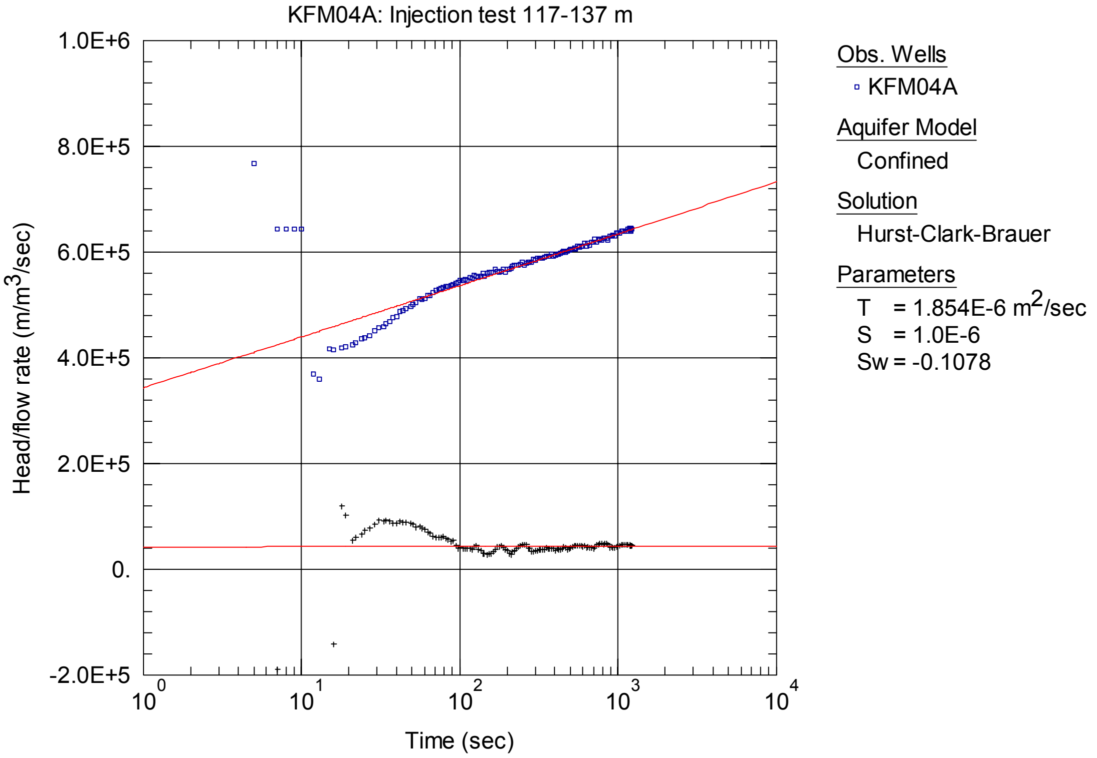


Figure A3-43. *Lin-log plot of head/flow rate (□) and derivative (+) versus time, from the injection test in section 117-137 m in KFM04A.*

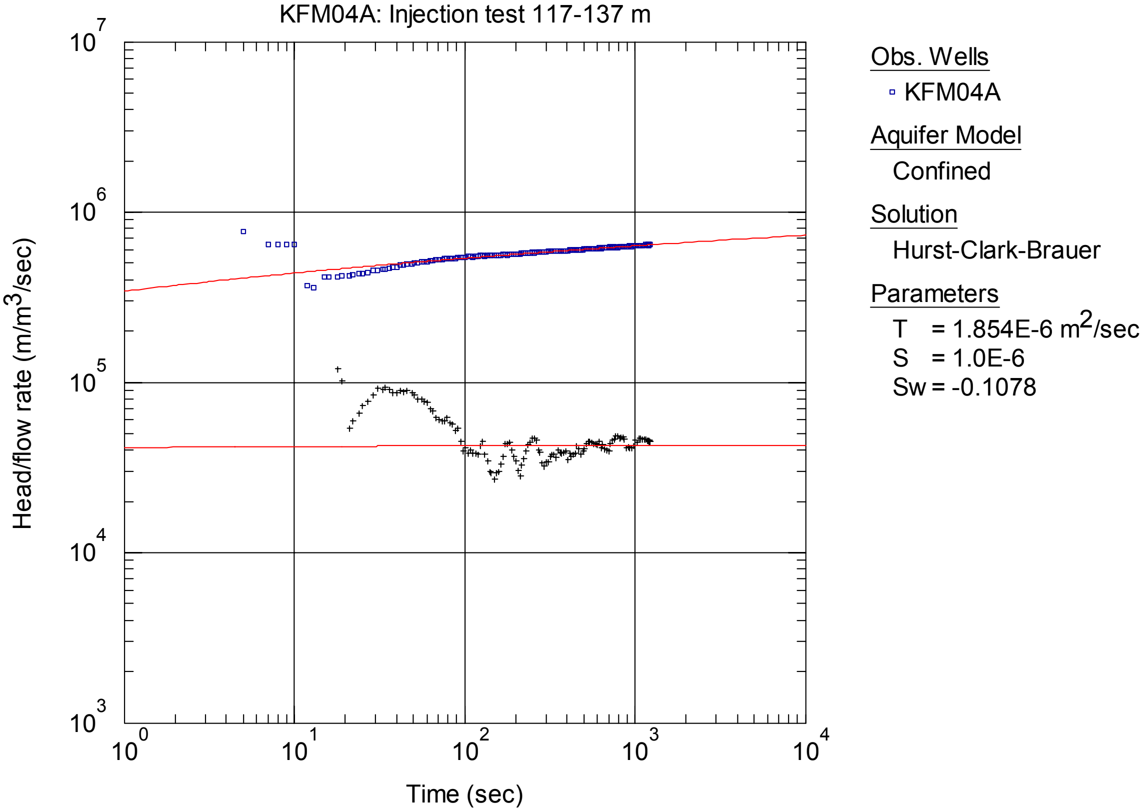


Figure A3-44. *Log-log plot of head/flow rate (□) and derivative (+) versus time, from the injection test in section 117-137 m in KFM04A.*

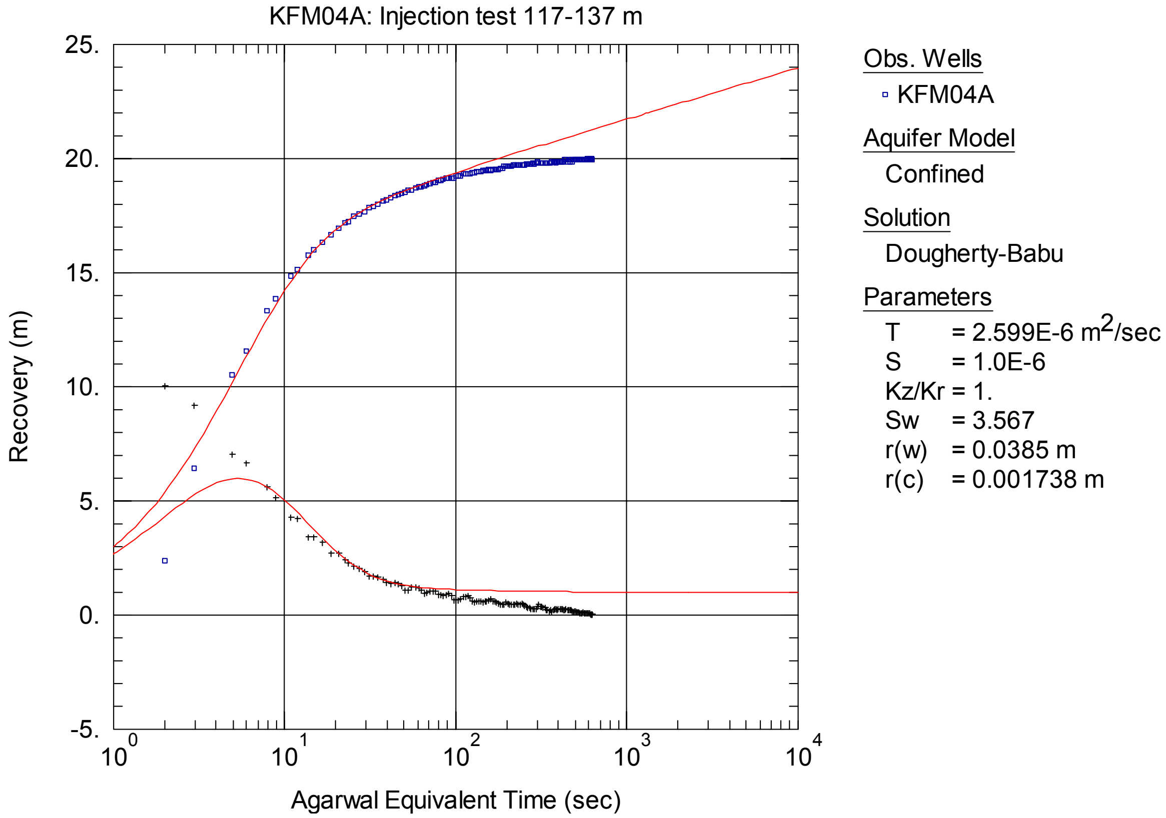


Figure A3-45. *Lin-log plot of recovery (□) and derivative (+) versus equivalent time, from the injection test in section 117-137 m in KFM04A.*

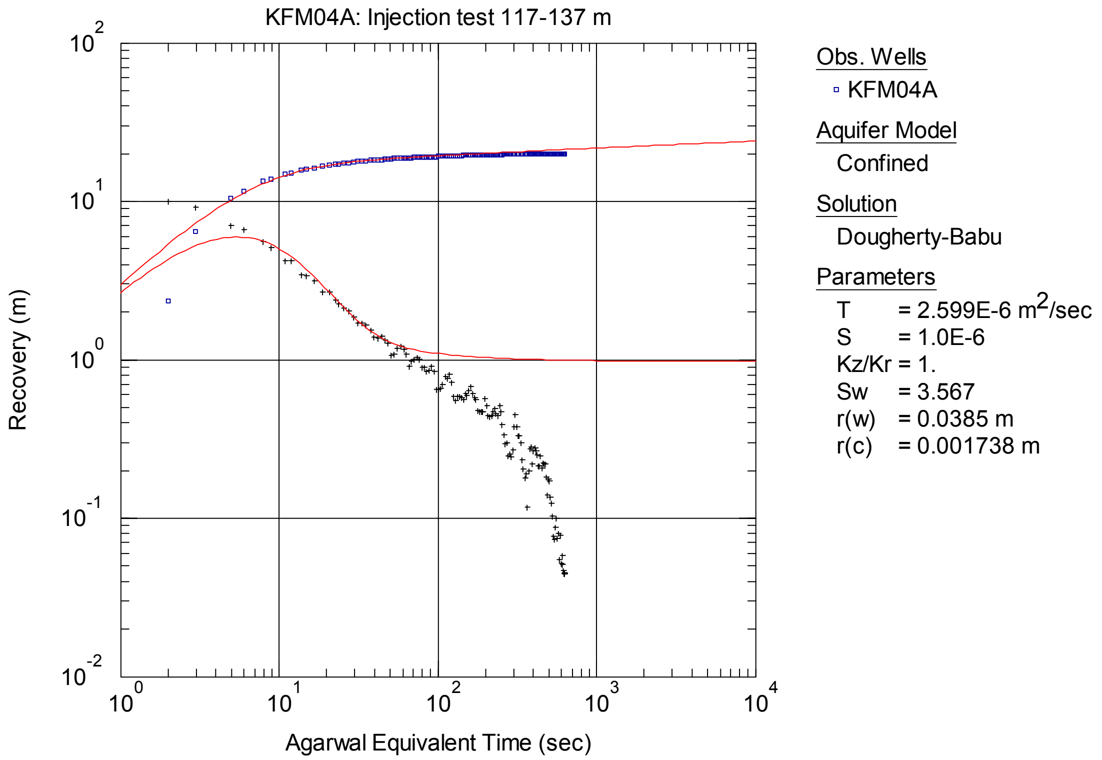


Figure A3-46. *Log-log plot of recovery (□) and derivative (+) versus equivalent time, from the injection test in section 117-137 m in KFM04A.*

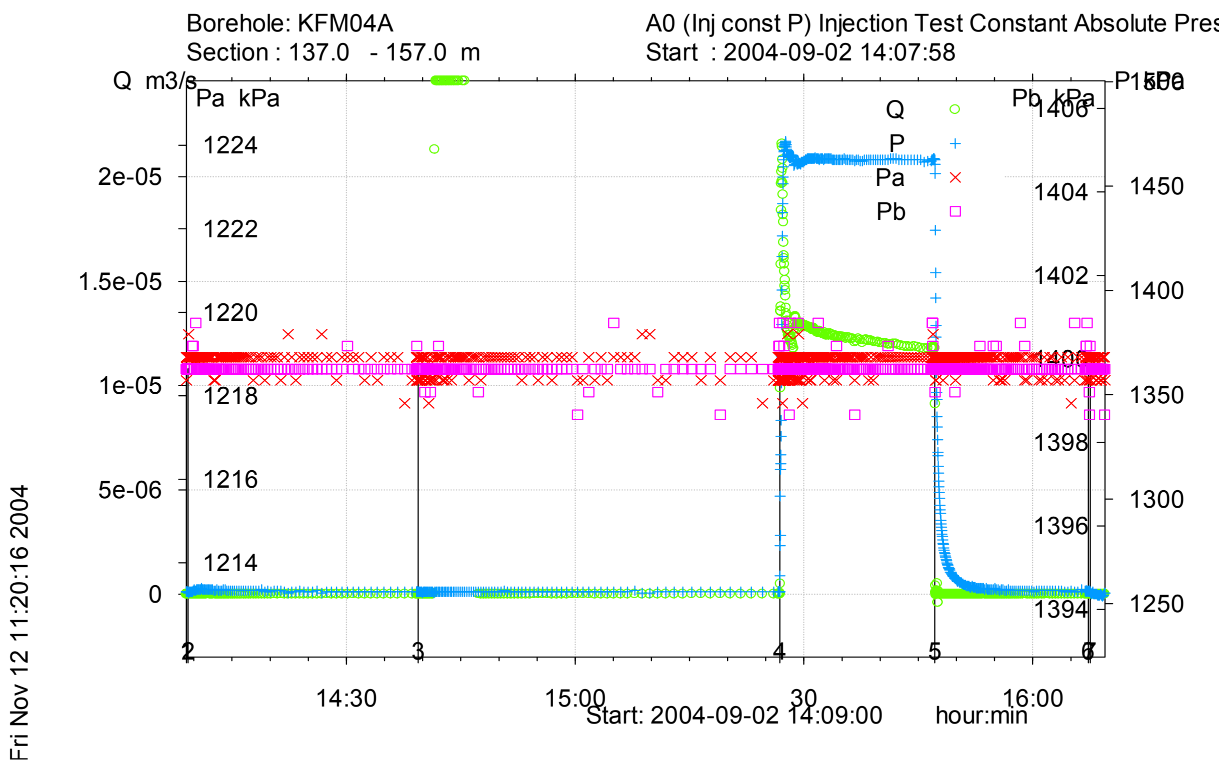


Figure A3-47. *Linear plot of flow rate (Q), pressure (P), pressure above section (Pa) and pressure below section (Pb) versus time from the injection test in section 137-157 m in borehole KFM04A.*

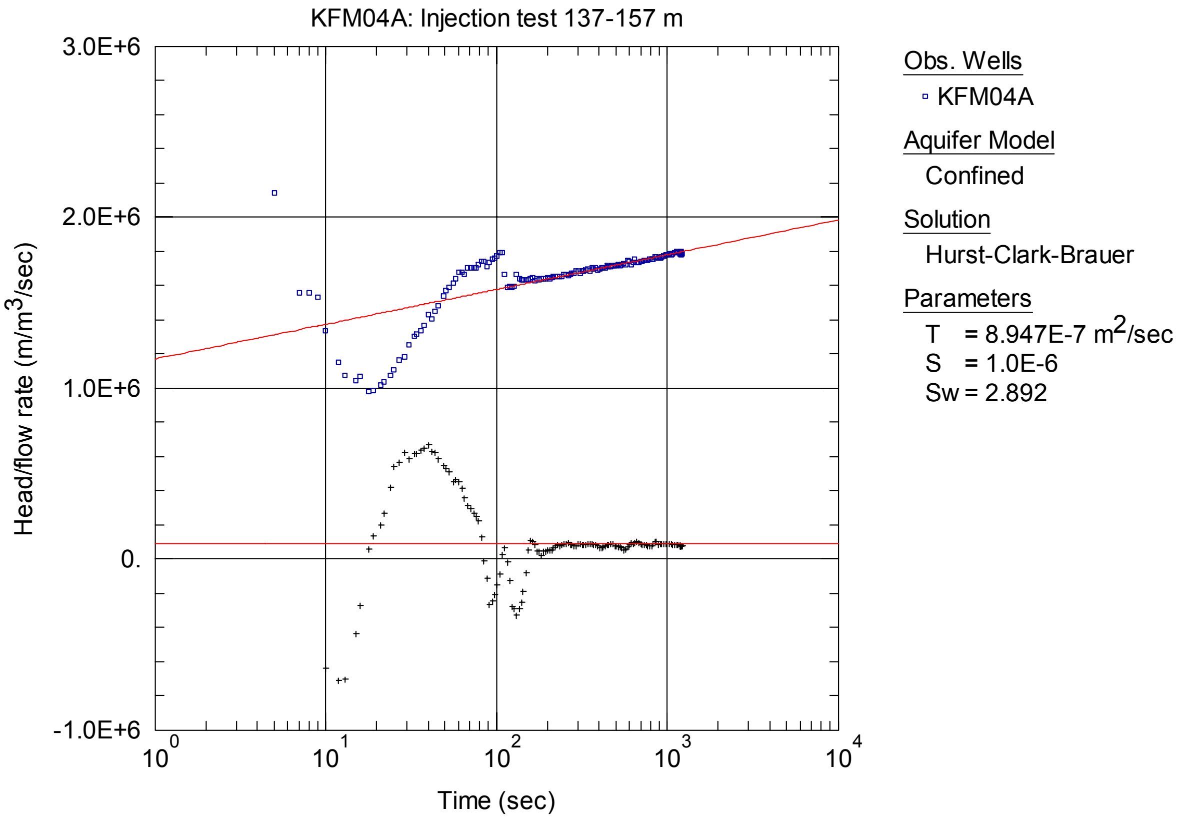


Figure A3-48. *Lin-log plot of head/flow rate (□) and derivative (+) versus time, from the injection test in section 137-157 m in KFM04A.*

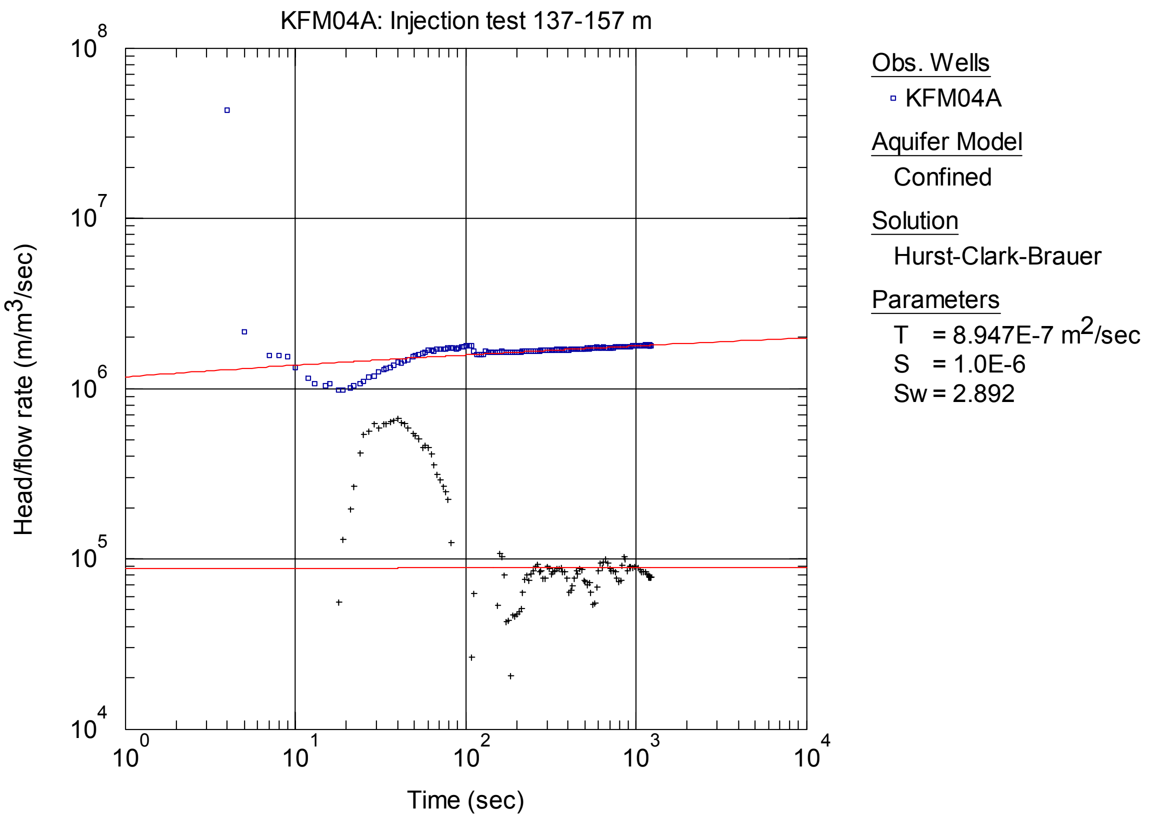


Figure A3-49. *Log-log plot of head/flow rate (□) and derivative (+) versus time, from the injection test in section 137-157 m in KFM04A.*

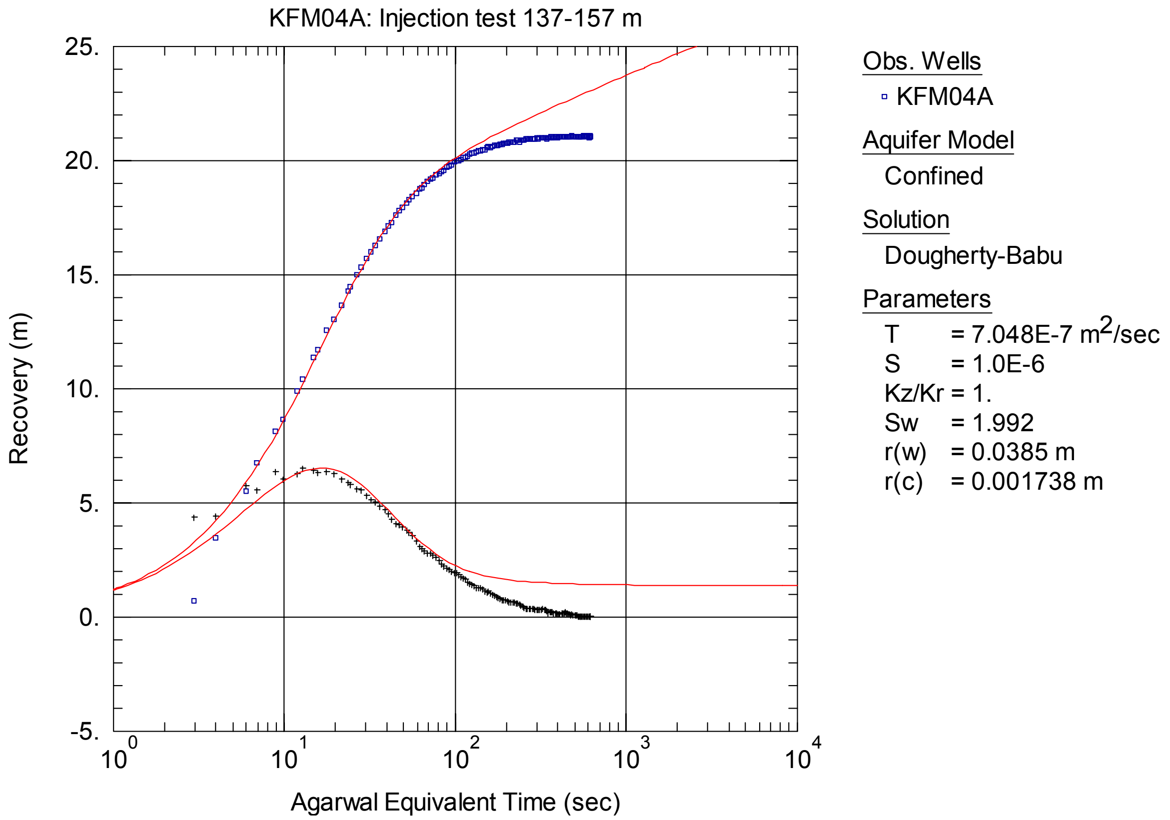


Figure A3-50. *Lin-log plot of recovery (□) and derivative (+) versus equivalent time, from the injection test in section 137-157 m in KFM04A.*

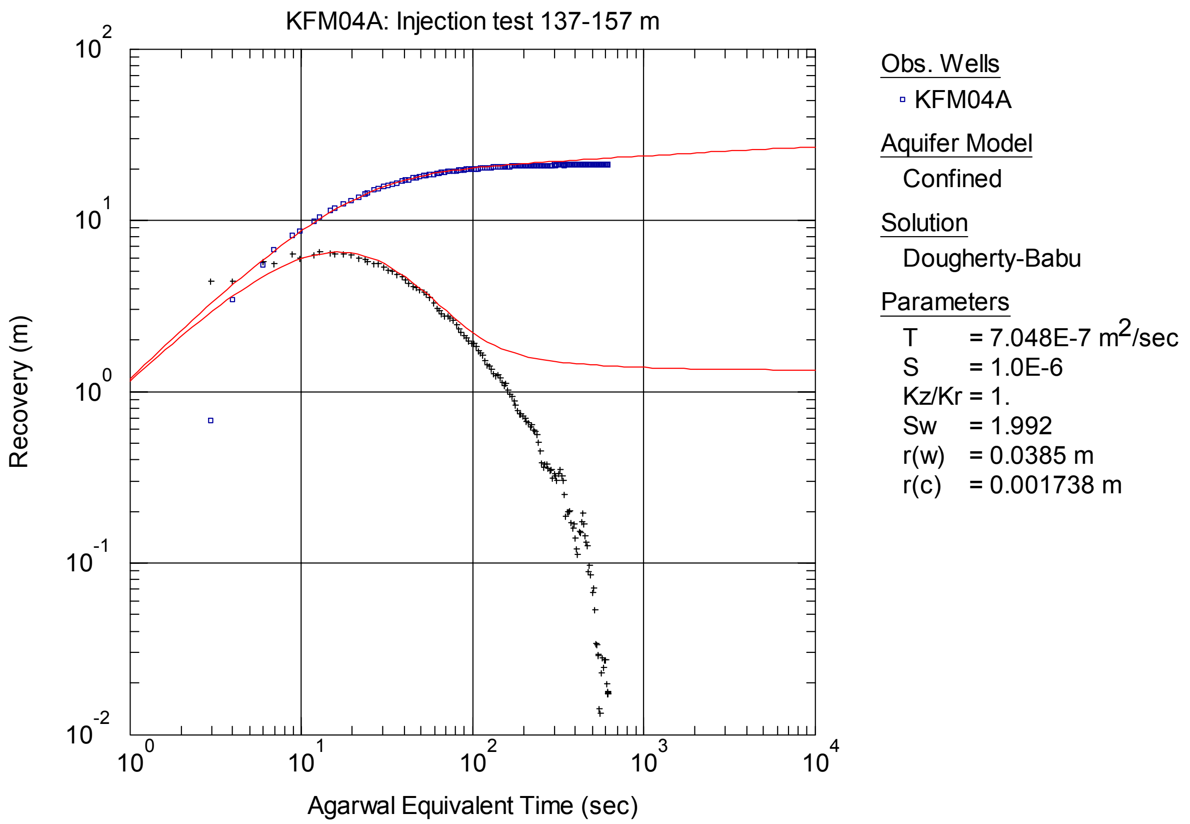


Figure A3-51. *Log-log plot of recovery (□) and derivative (+) versus equivalent time, from the injection test in section 137-157 m in KFM04A.*

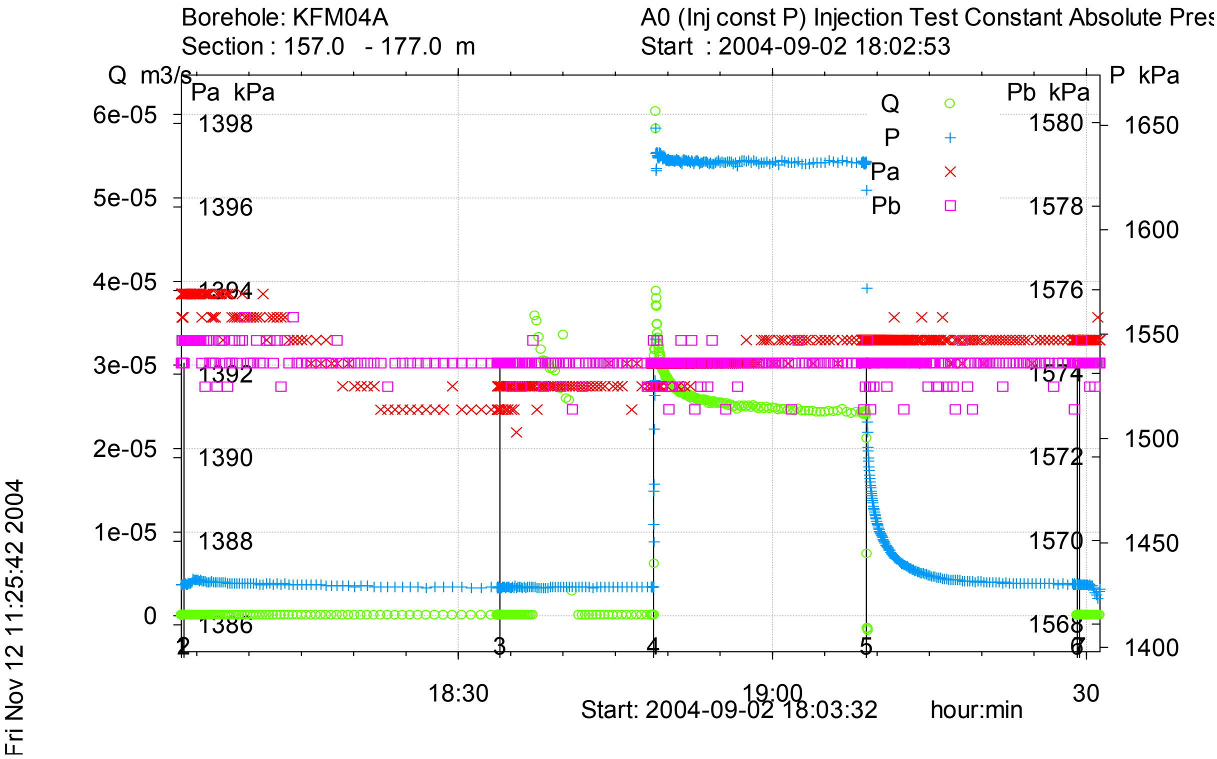


Figure A3-52. *Linear plot of flow rate (Q), pressure (P), pressure above section (Pa) and pressure below section (Pb) versus time from the injection test in section 157-177 m in borehole KFM04A.*

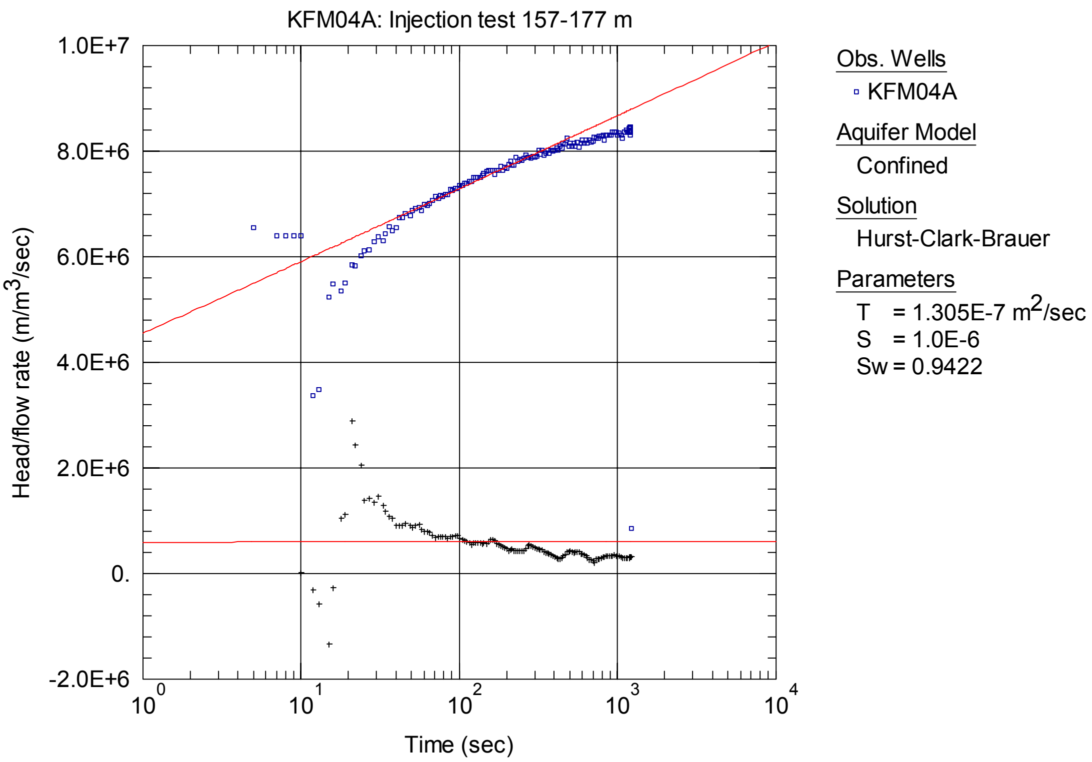


Figure A3-53. *Lin-log plot of head/flow rate (□) and derivative (+) versus time, from the injection test in section 157-177 m in KFM04A.*

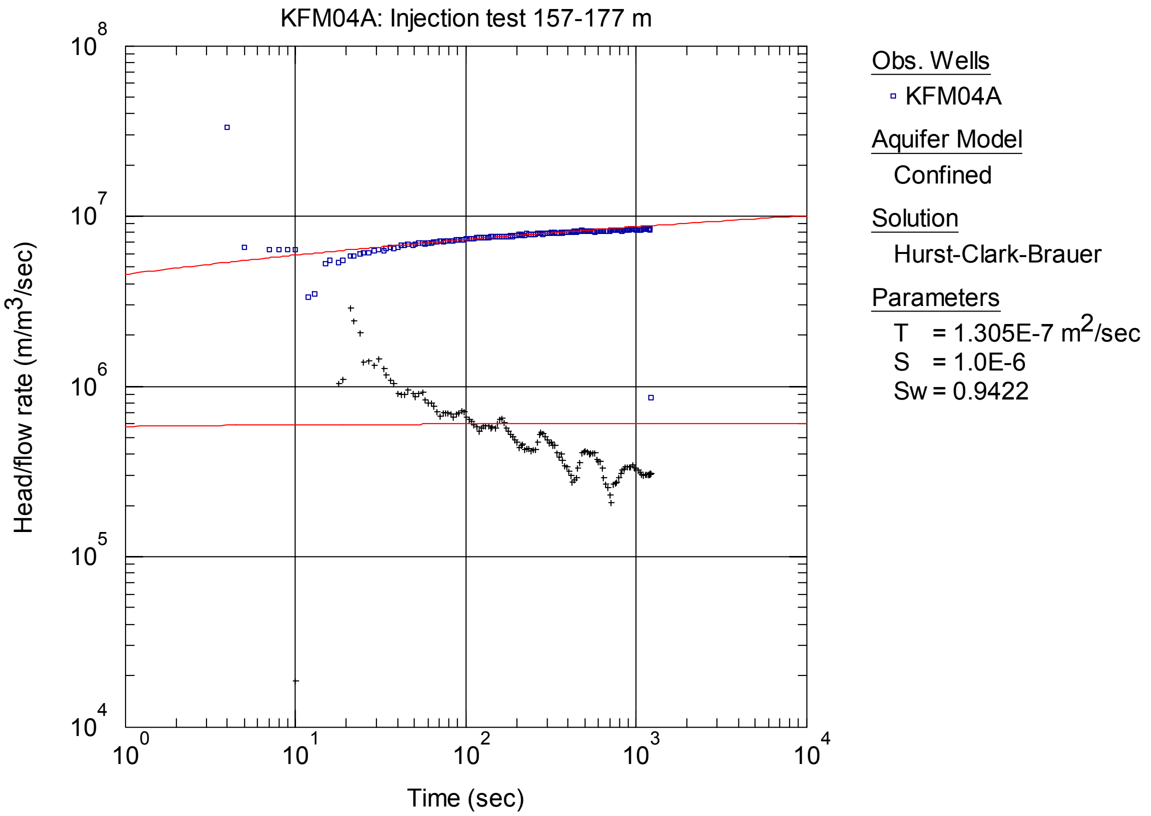


Figure A3-54. *Log-log plot of head/flow rate (□) and derivative (+) versus time, from the injection test in section 157-177 m in KFM04A.*

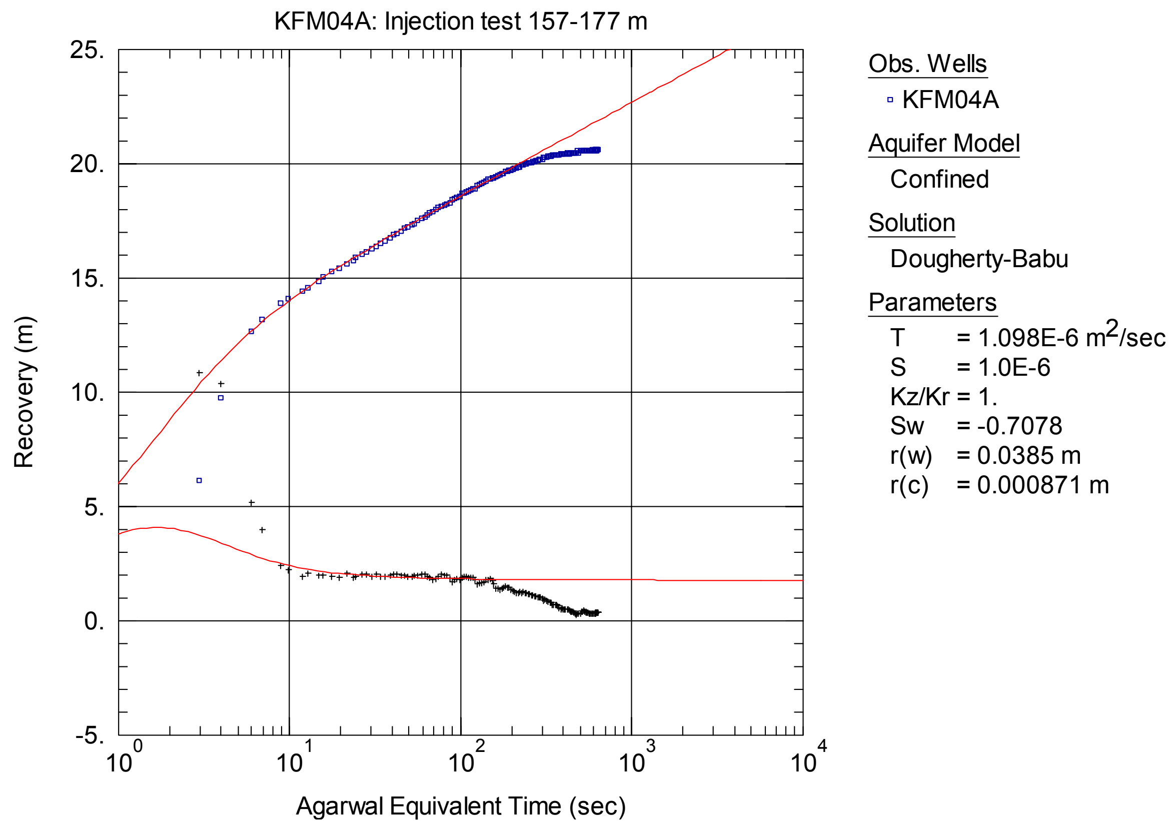


Figure A3-55. *Lin-log plot of recovery (□) and derivative (+) versus equivalent time, from the injection test in section 157-177 m in KFM04A.*

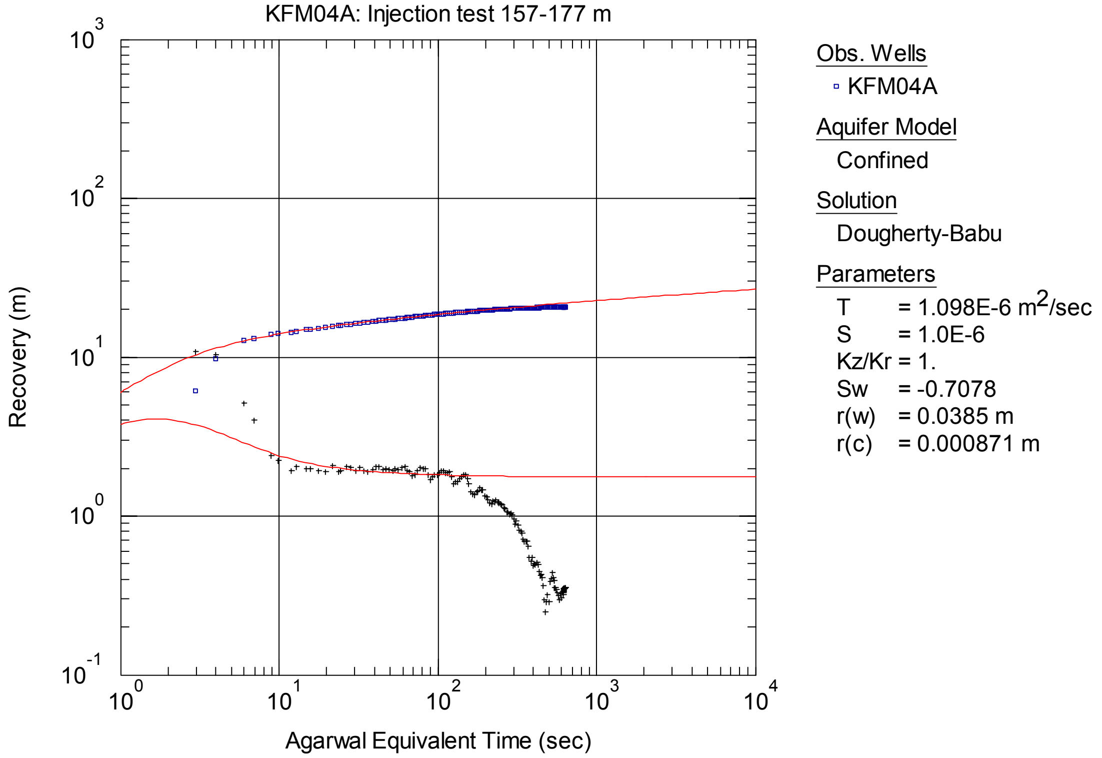


Figure A3-56. *Log-log plot of recovery (□) and derivative (+) versus equivalent time, from the injection test in section 157-177 m in KFM04A.*

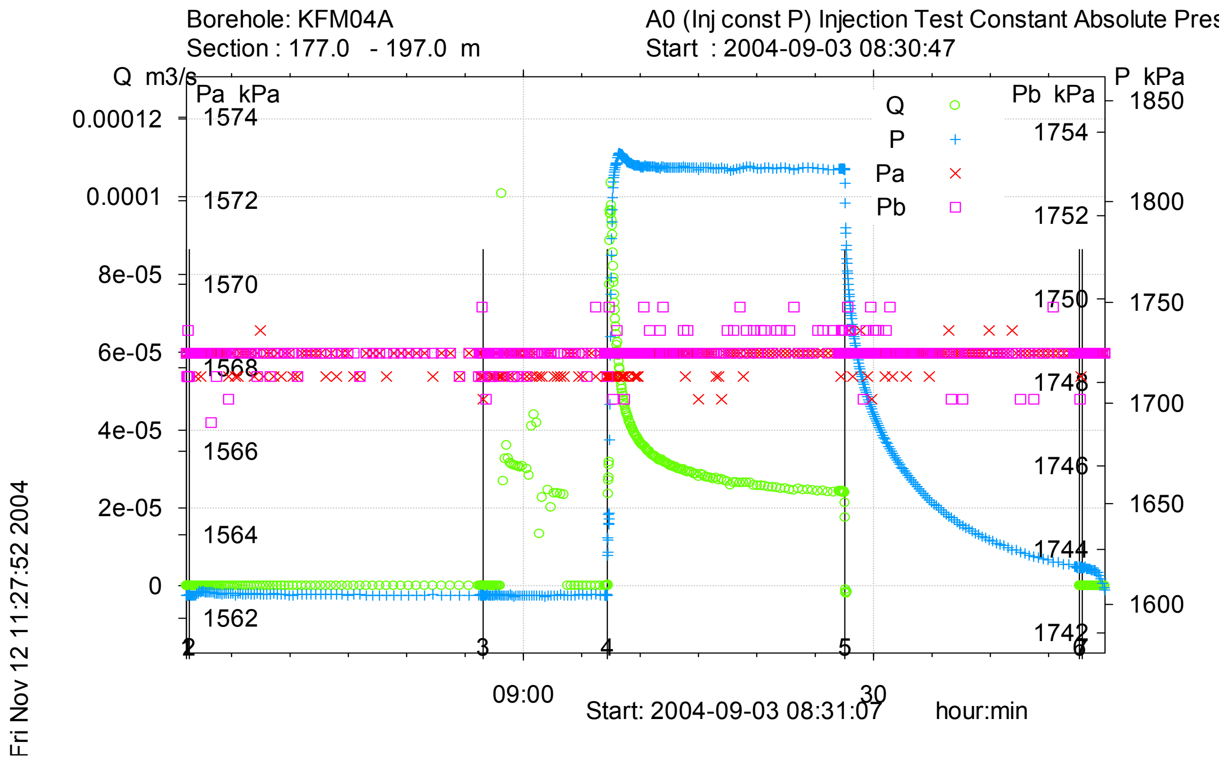


Figure A3-57. *Linear plot of flow rate (Q), pressure (P), pressure above section (Pa) and pressure below section (Pb) versus time from the injection test in section 177-197 m in borehole KFM04A.*

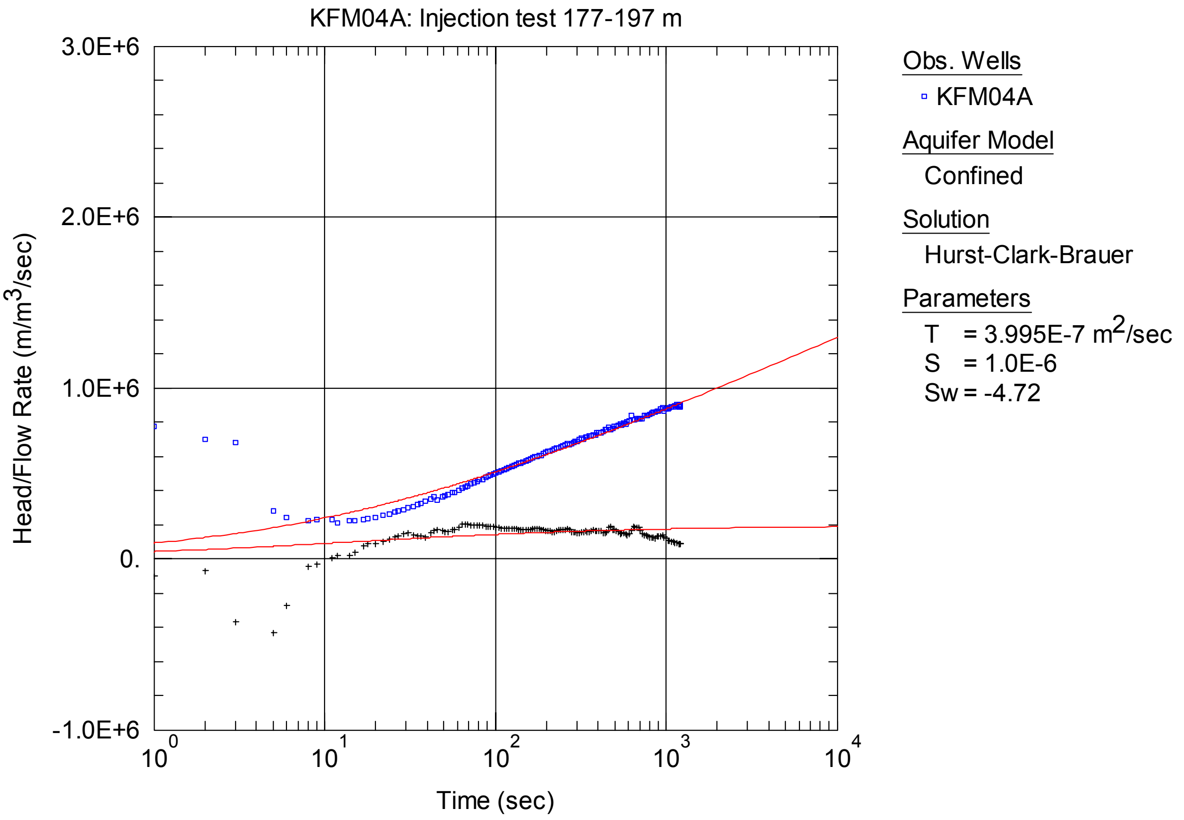


Figure A3-58. *Lin-log plot of head/flow rate (□) and derivative (+) versus time, from the injection test in section 177-197 m in KFM04A.*

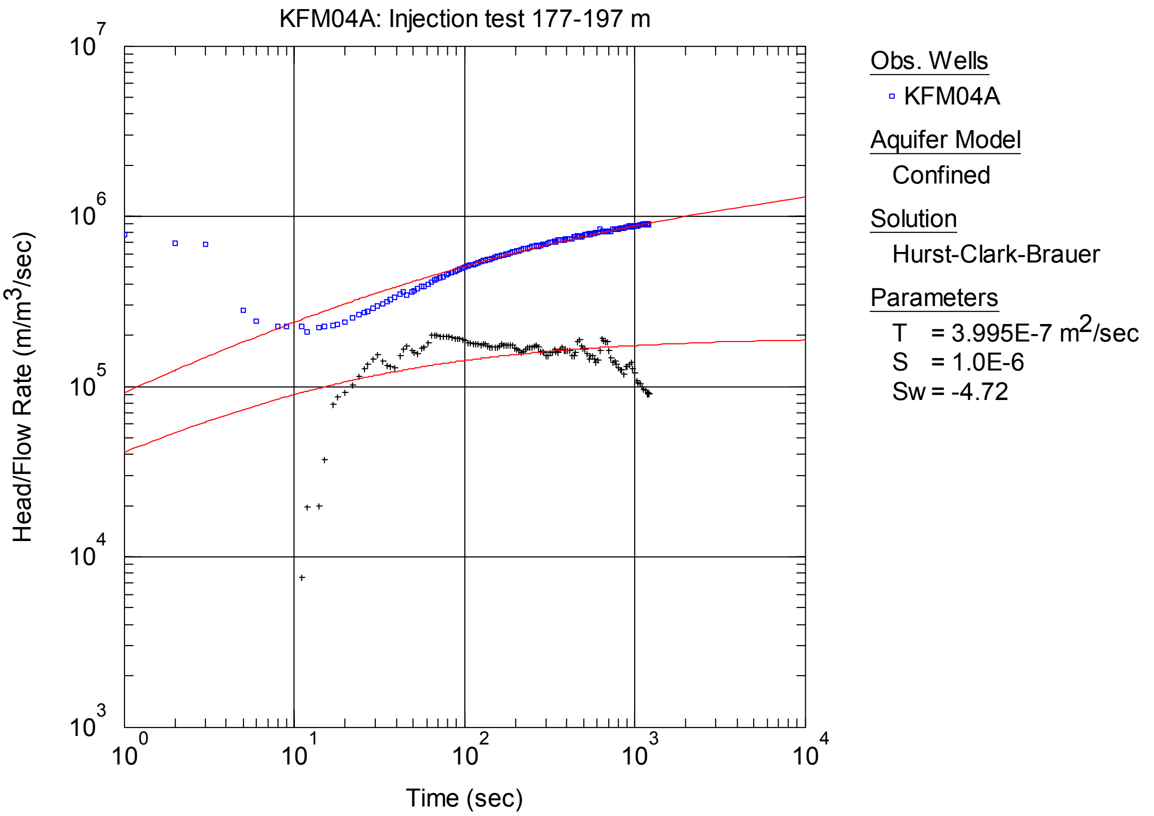


Figure A3-59. *Log-log plot of head/flow rate (□) and derivative (+) versus time, from the injection test in section 177-197 m in KFM04A.*

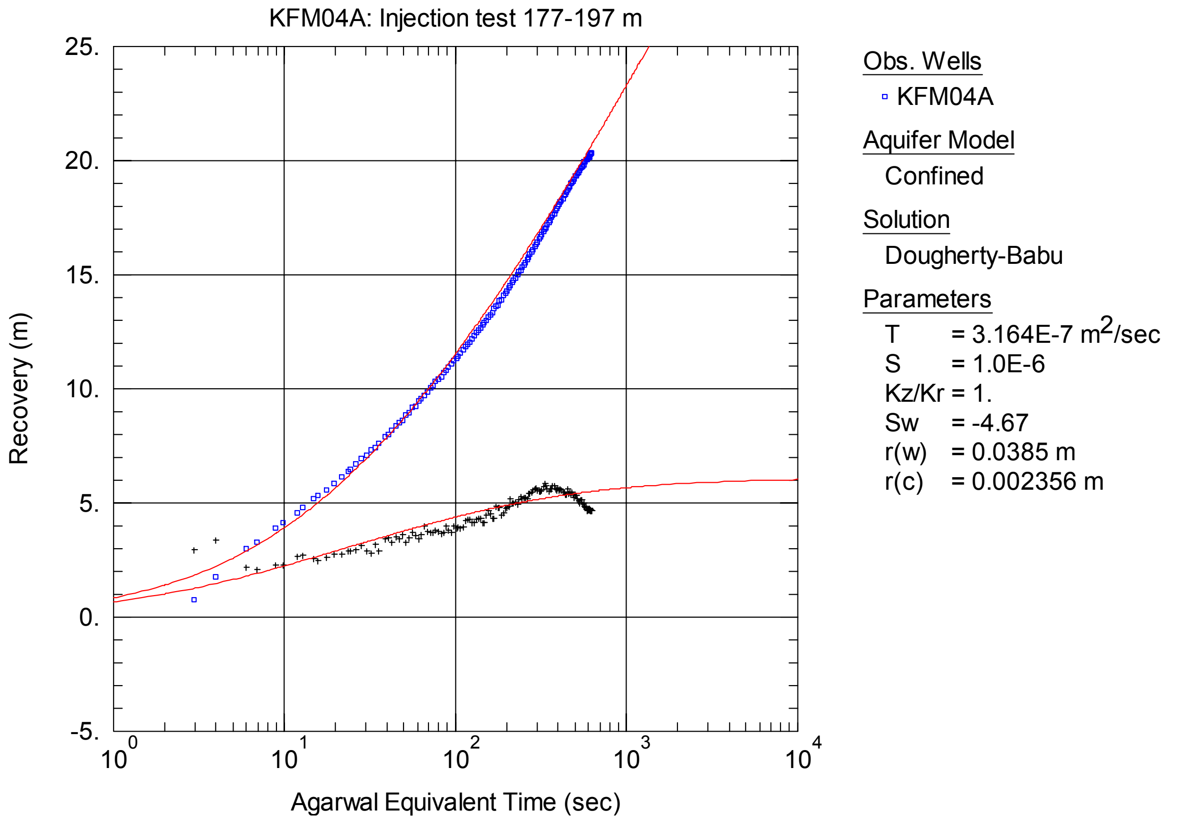


Figure A3-60. *Lin-log plot of recovery (□) and derivative (+) versus equivalent time, from the injection test in section 177-197 m in KFM04A.*

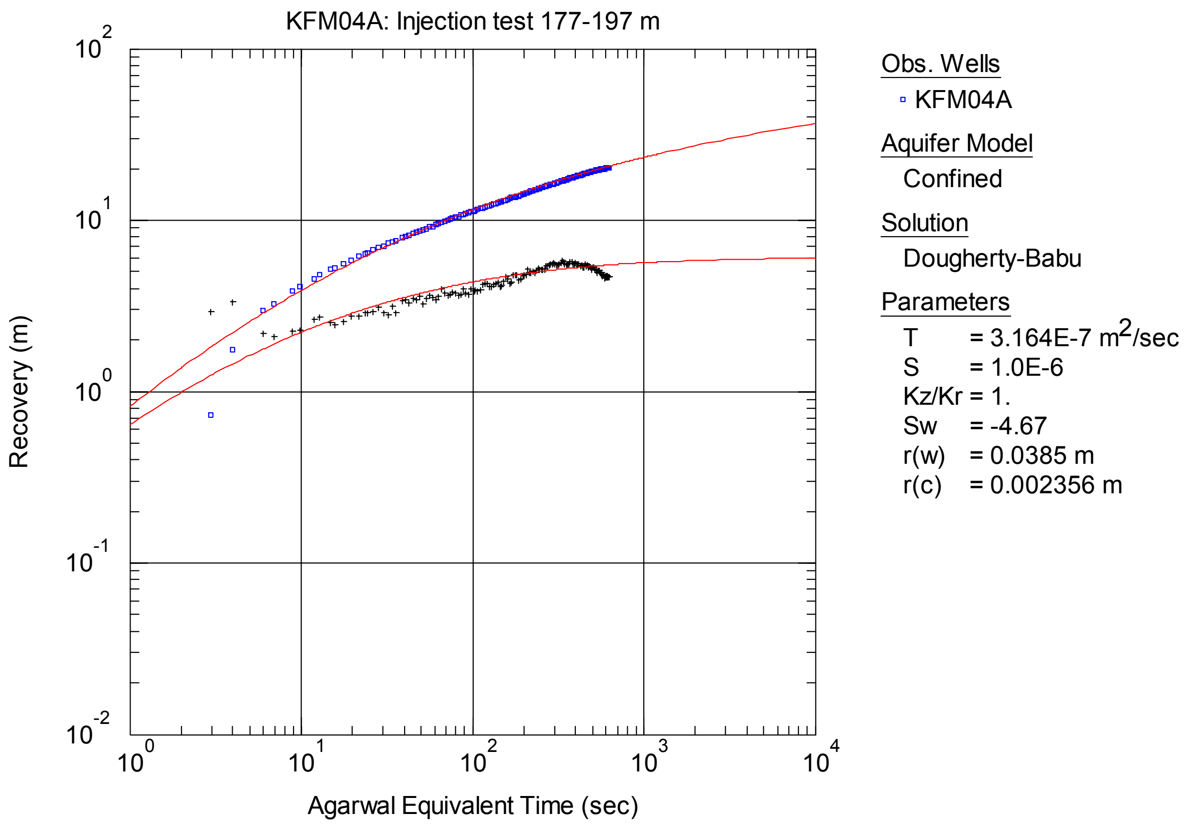


Figure A3-61. *Log-log plot of recovery (□) and derivative (+) versus equivalent time, from the injection test in section 177-197 m in KFM04A.*

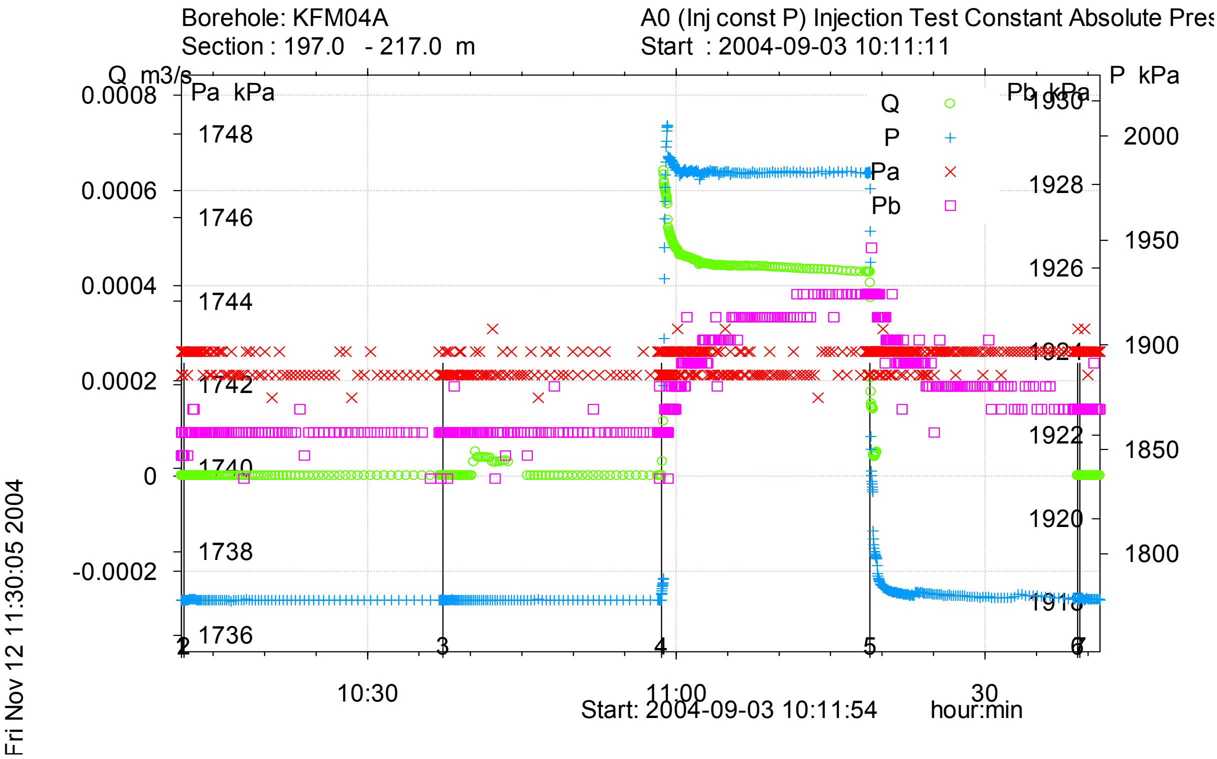


Figure A3-62. *Linear plot of flow rate (Q), pressure (P), pressure above section (Pa) and pressure below section (Pb) versus time from the injection test in section 197-217 m in borehole KFM04A.*

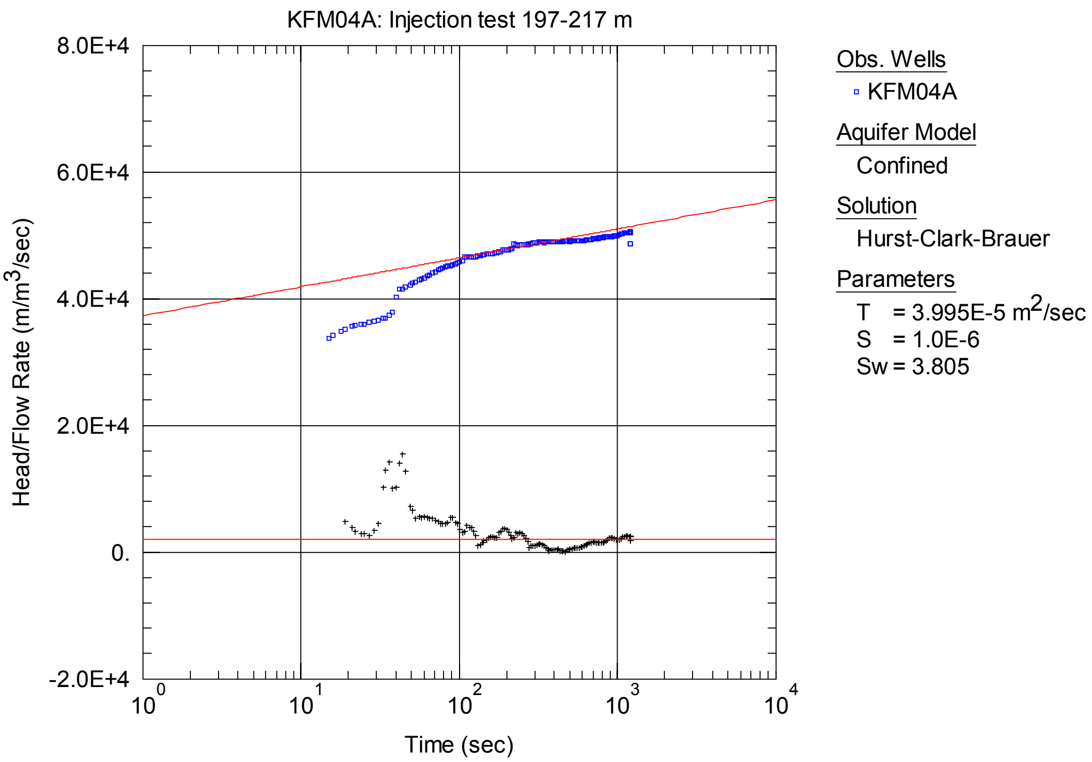


Figure A3-63. *Lin-log plot of head/flow rate (□) and derivative (+) versus time, from the injection test in section 197-217 m in KFM04A.*

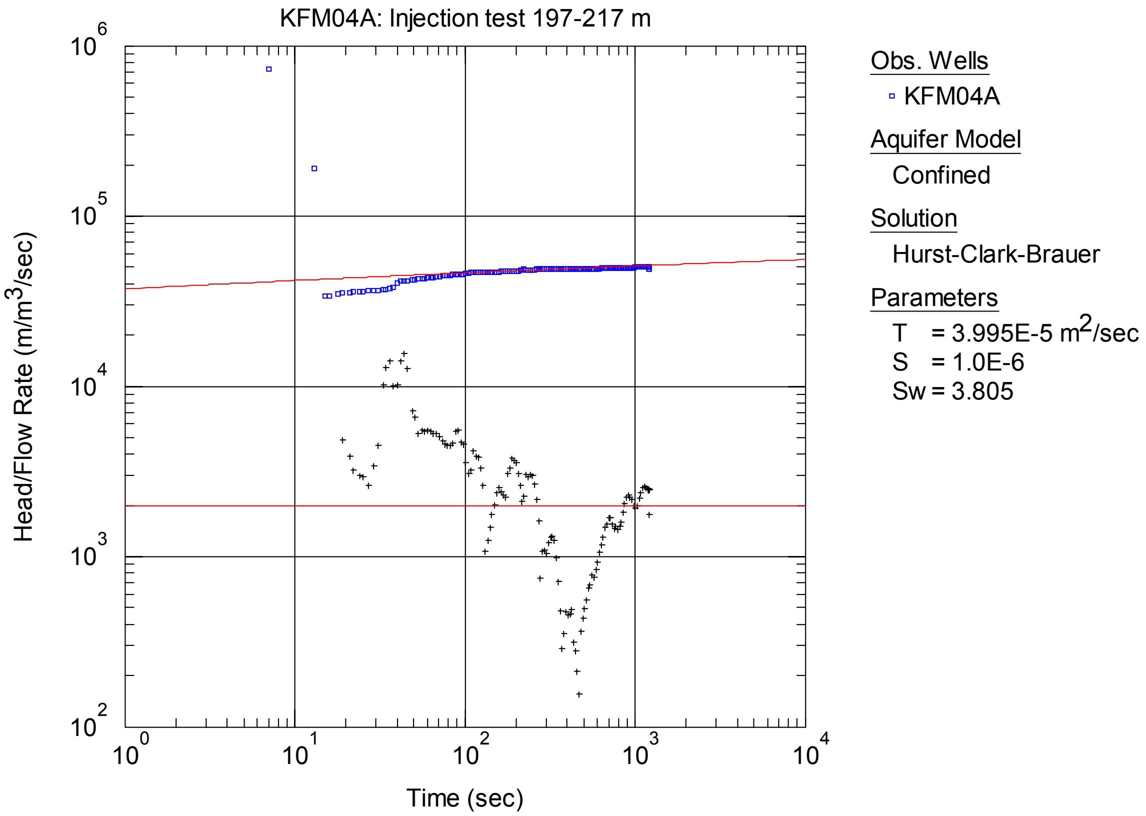


Figure A3-64. *Log-log plot of head/flow rate (□) and derivative (+) versus time, from the injection test in section 197-217 m in KFM04A.*

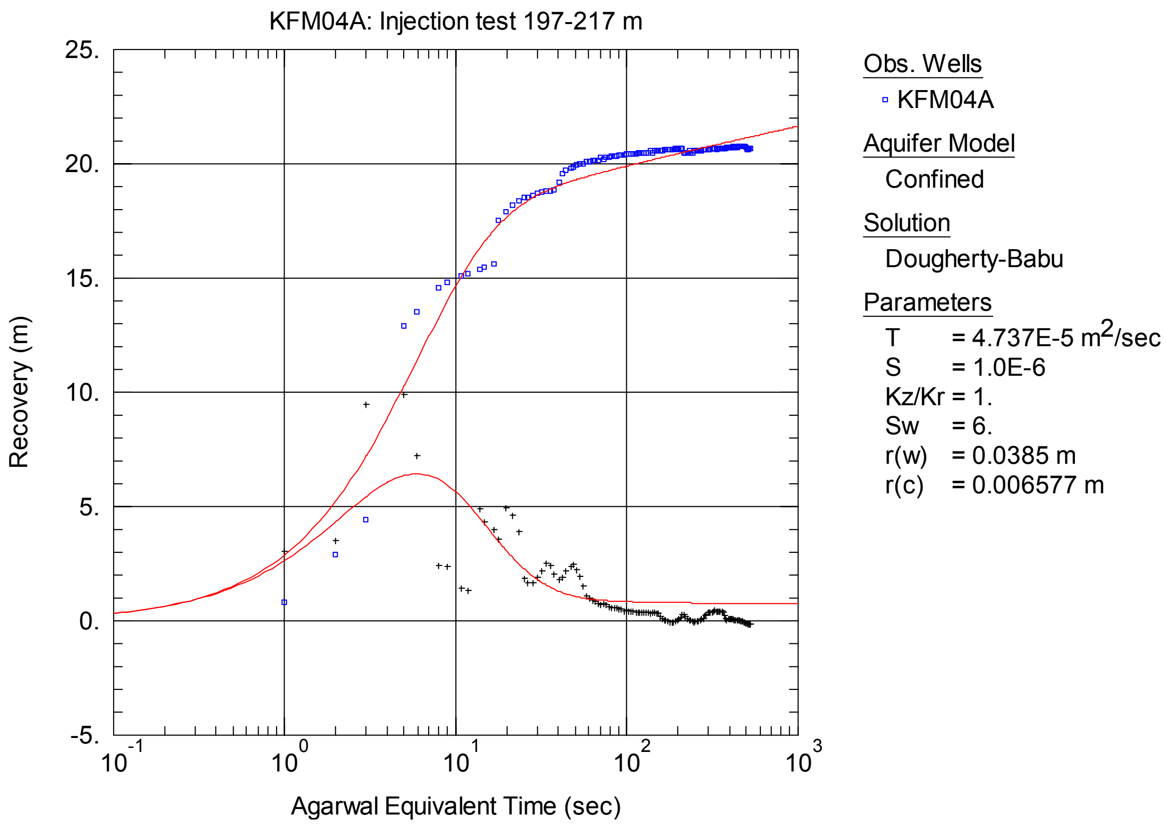


Figure A3-65. *Lin-log plot of recovery (□) and derivative (+) versus equivalent time, from the injection test in section 197-217 m in KFM04A.*

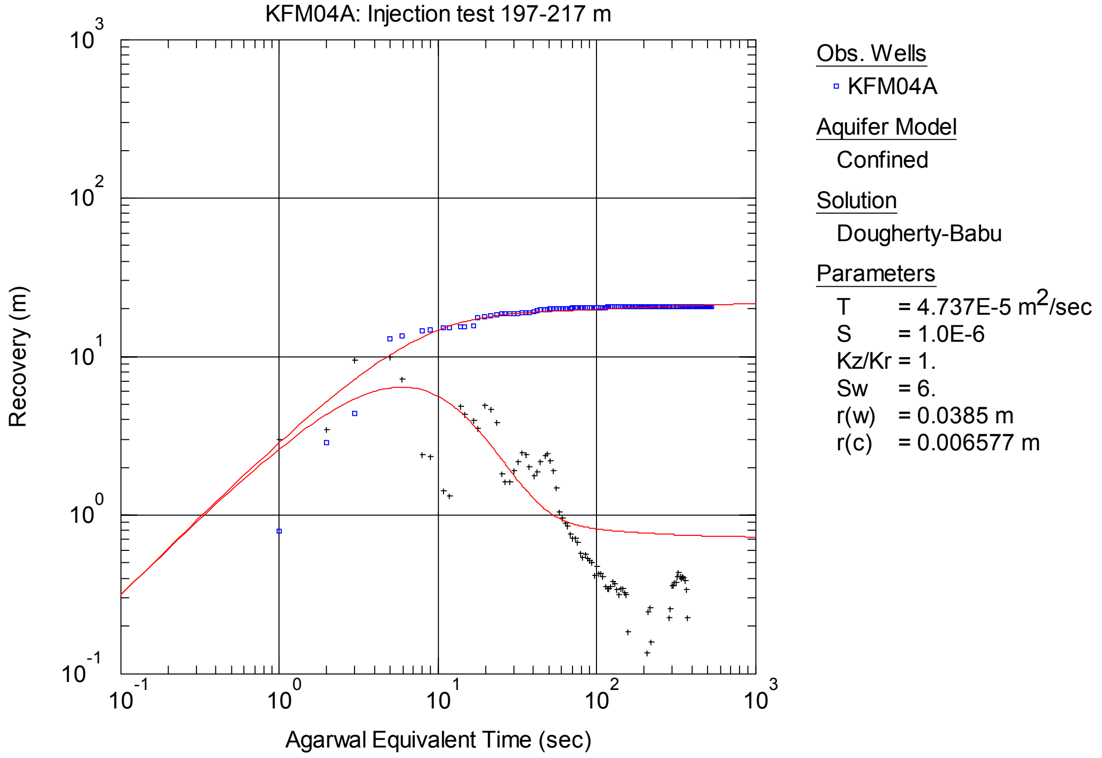


Figure A3-66. *Log-log plot of recovery (□) and derivative (+) versus equivalent time, from the injection test in section 197-217 m in KFM04A.*

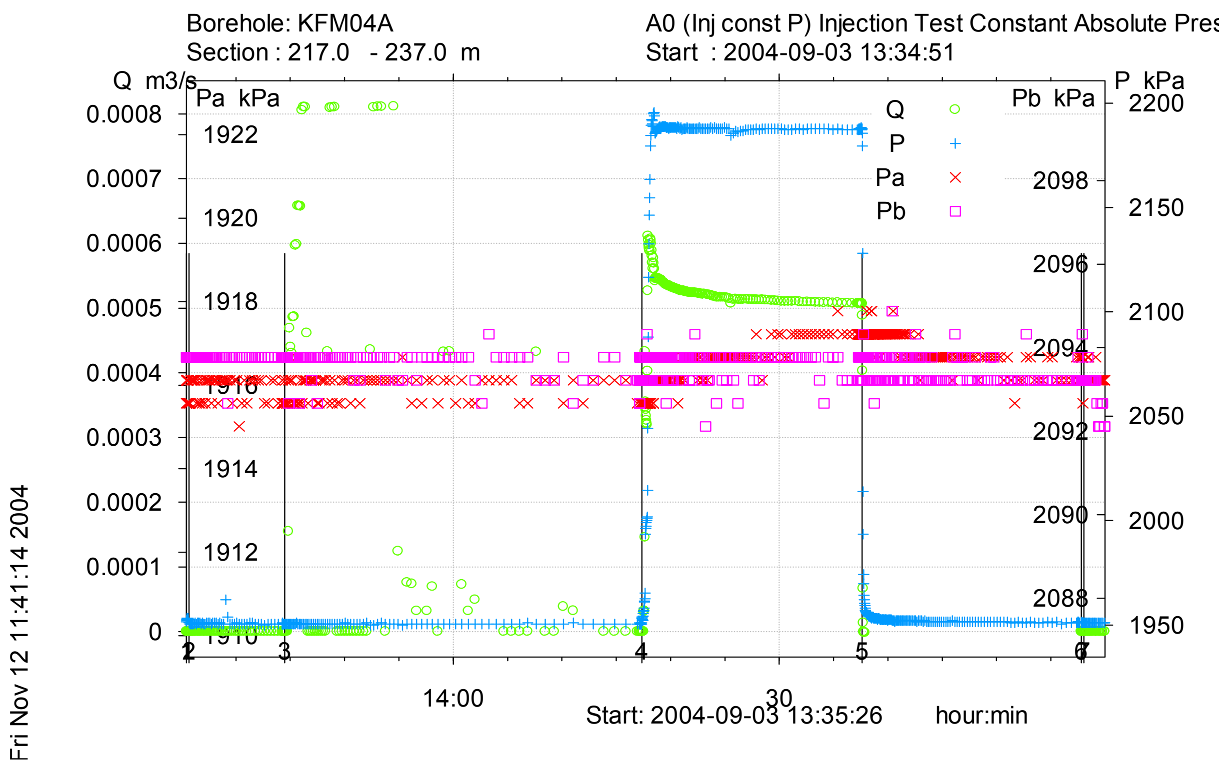


Figure A3-67. *Linear plot of flow rate (Q), pressure (P), pressure above section (Pa) and pressure below section (Pb) versus time from the injection test in section 217-237 m in borehole KFM04A.*

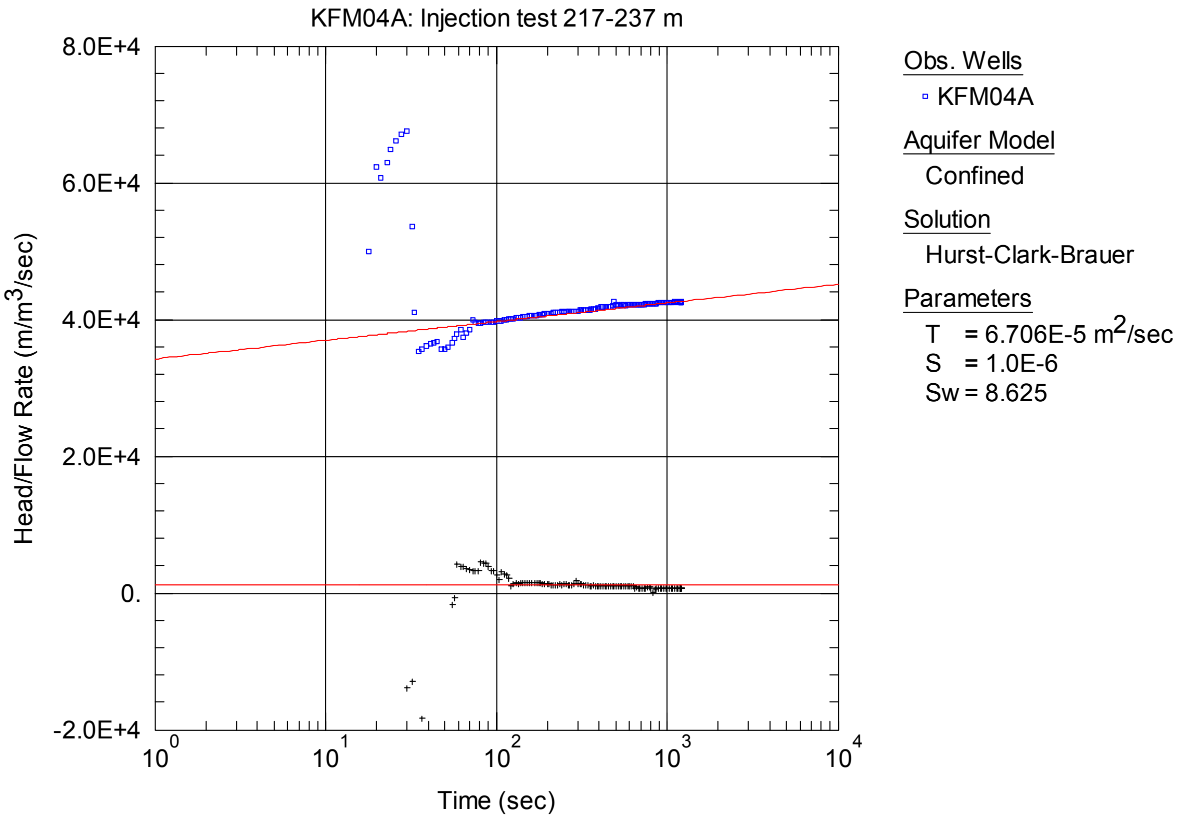


Figure A3-68. *Lin-log plot of head/flow rate (□) and derivative (+) versus time, from the injection test in section 217-237 m in KFM04A.*

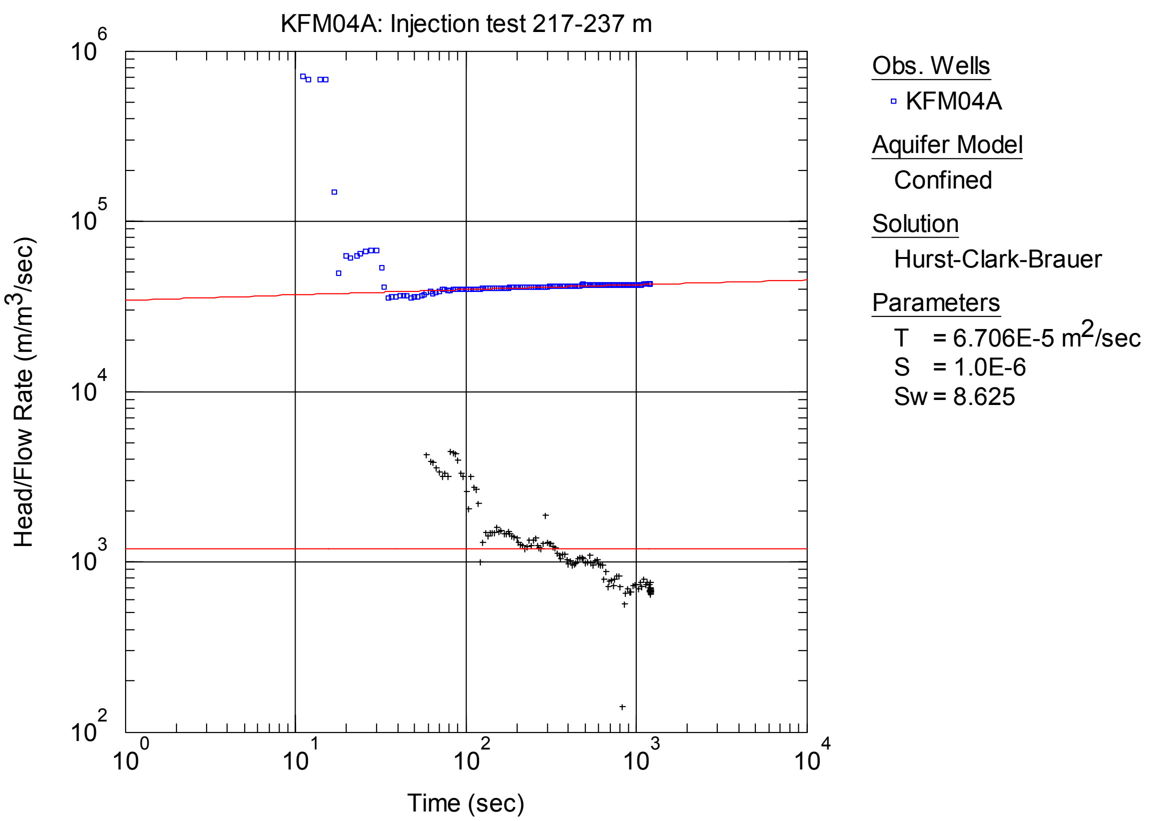


Figure A3-69. *Log-log plot of head/flow rate (□) and derivative (+) versus time, from the injection test in section 217-237 m in KFM04A.*

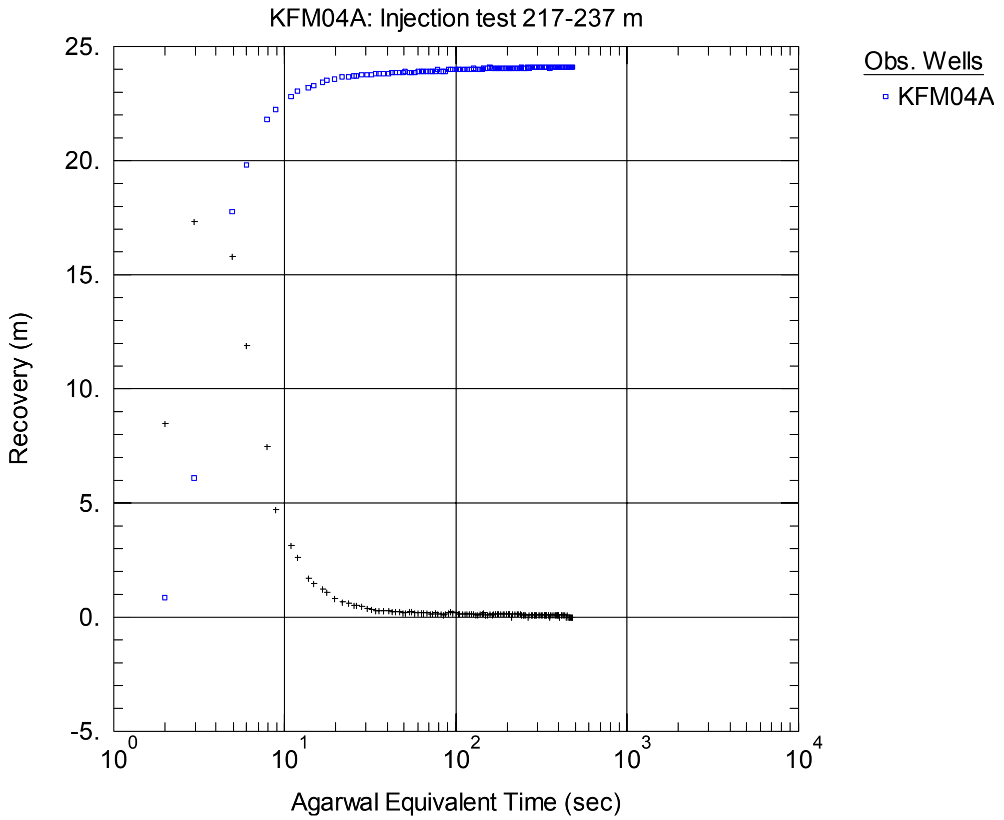


Figure A3-70. *Lin-log plot of recovery (□) and derivative (+) versus equivalent time, from the injection test in section 217-237 m in KFM04A.*

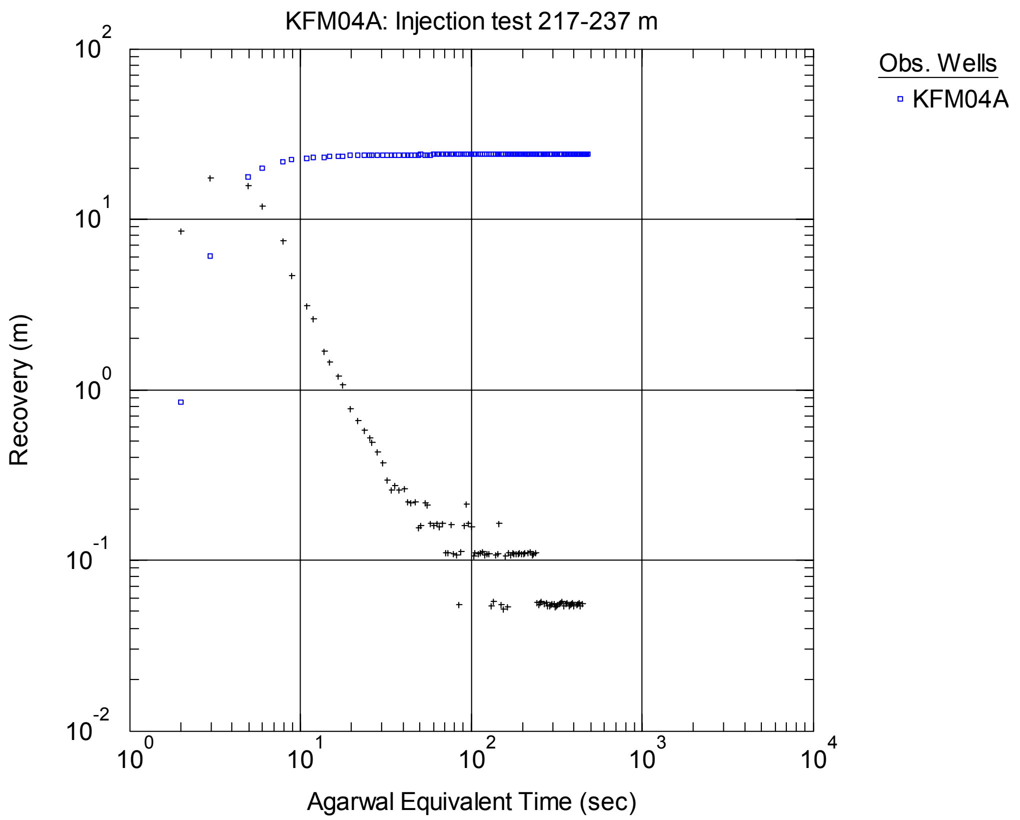


Figure A3-71. *Log-log plot of recovery (□) and derivative (+) versus equivalent time, from the injection test in section 217-237 m in KFM04A.*

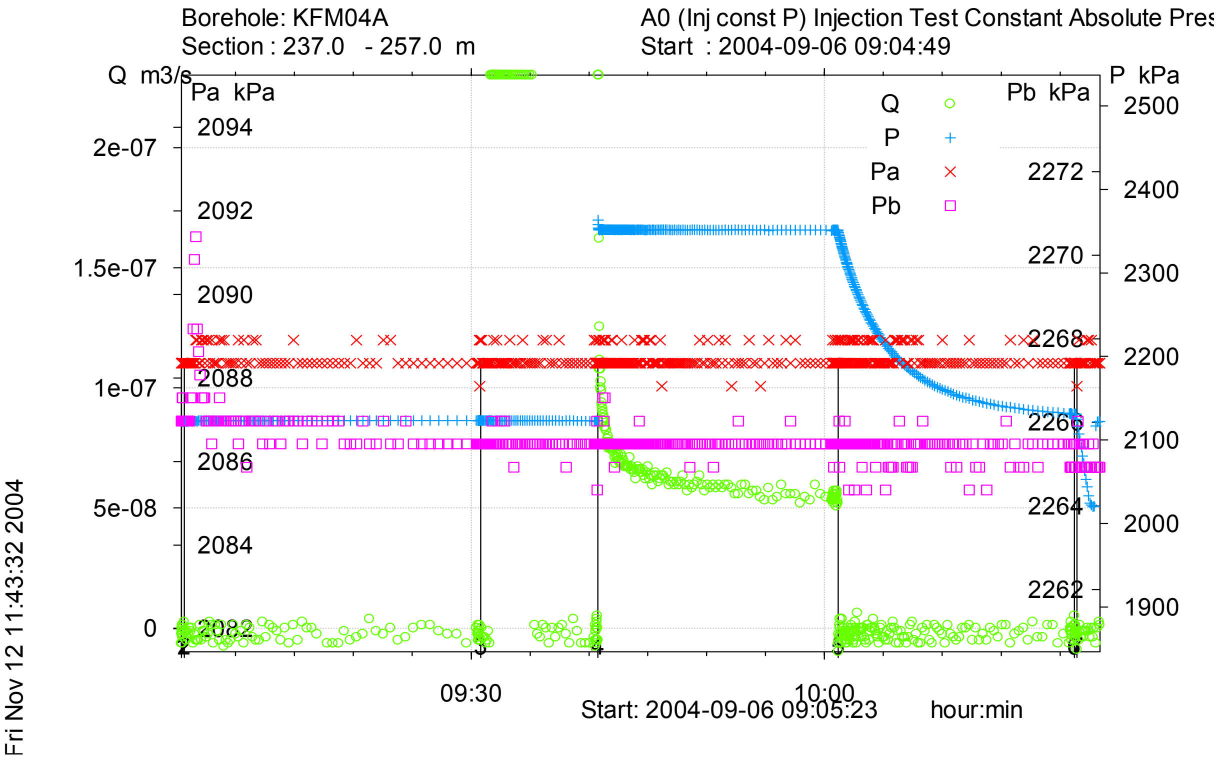


Figure A3-72. *Linear plot of flow rate (Q), pressure (P), pressure above section (Pa) and pressure below section (Pb) versus time from the injection test in section 237-257 m in borehole KFM04A.*

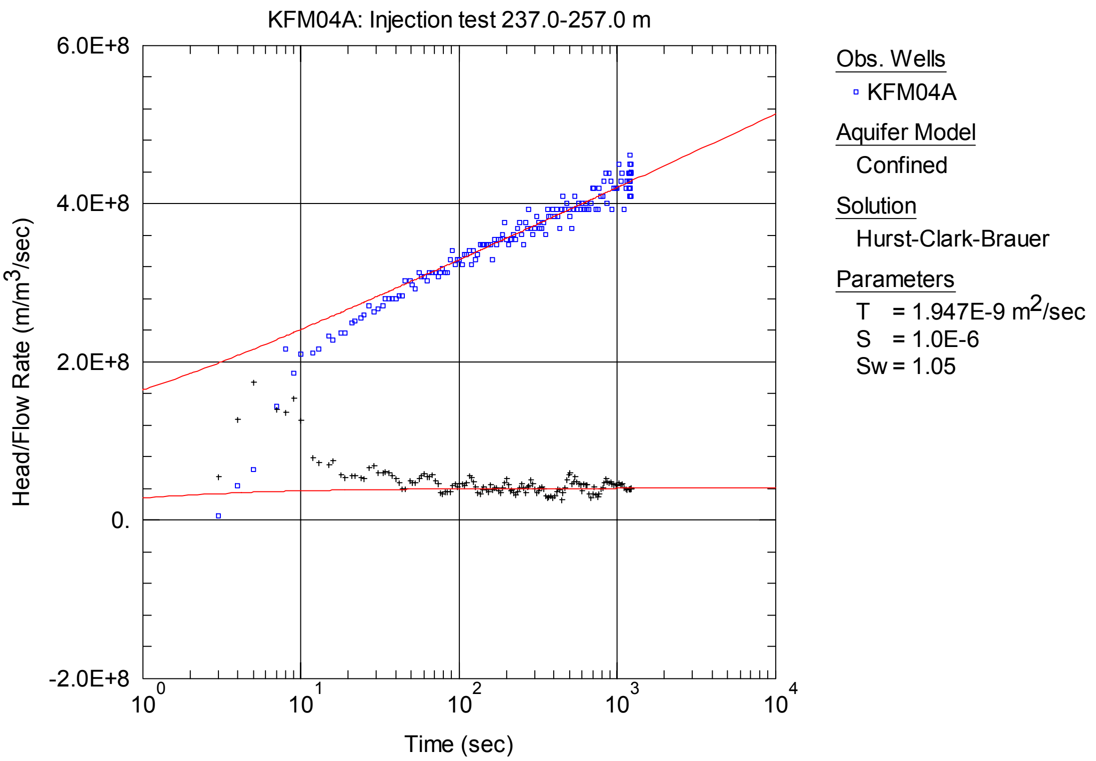


Figure A3-73. *Lin-log plot of head/flow rate (□) and derivative (+) versus time, from the injection test in section 237-257 m in KFM04A.*

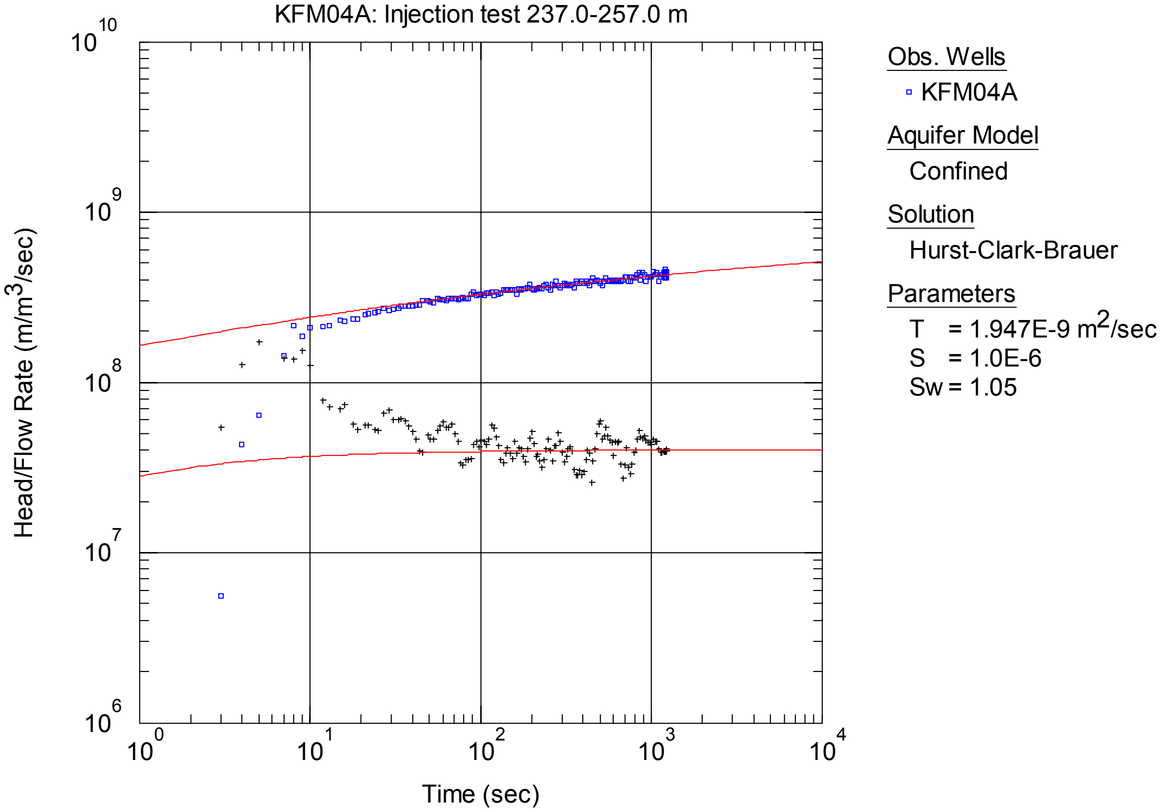


Figure A3-74. *Log-log plot of head/flow rate (□) and derivative (+) versus time, from the injection test in section 237-257 m in KFM04A.*

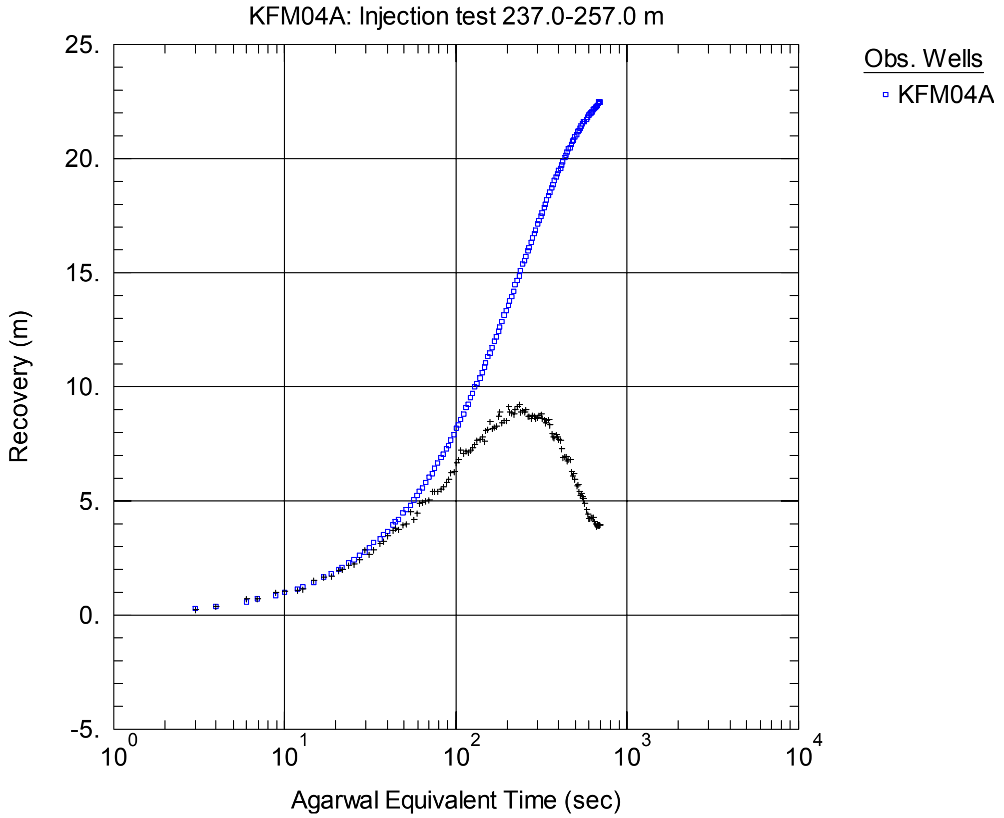


Figure A3-75. *Lin-log plot of recovery (□) and derivative (+) versus equivalent time, from the injection test in section 237-257 m in KFM04A.*

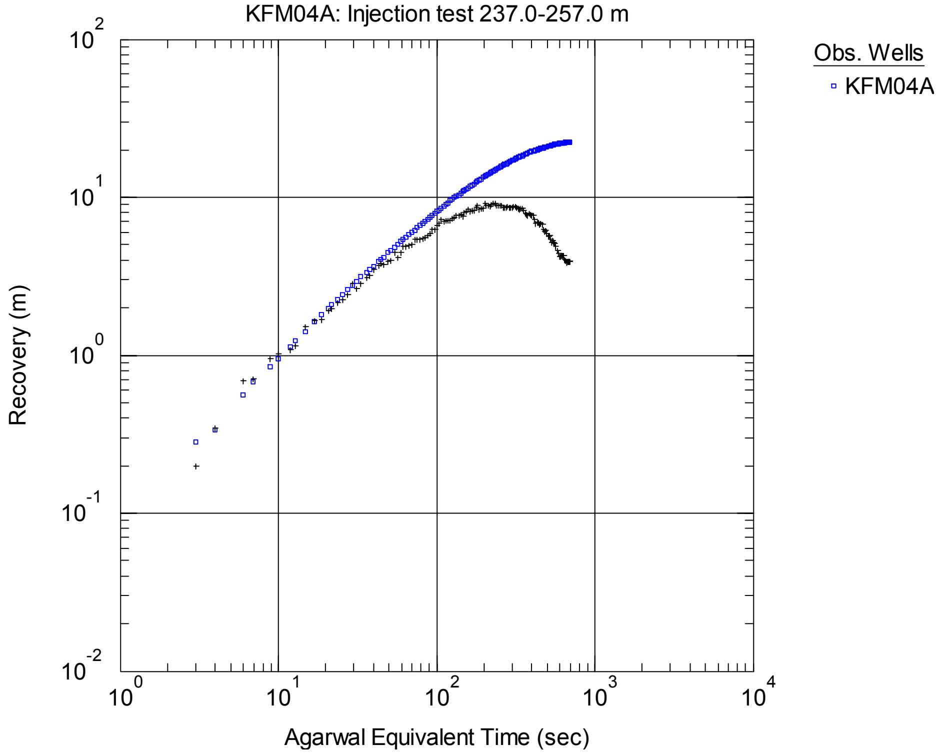


Figure A3-76. *Log-log plot of recovery (□) and derivative (+) versus equivalent time, from the injection test in section 237-257 m in KFM04A.*

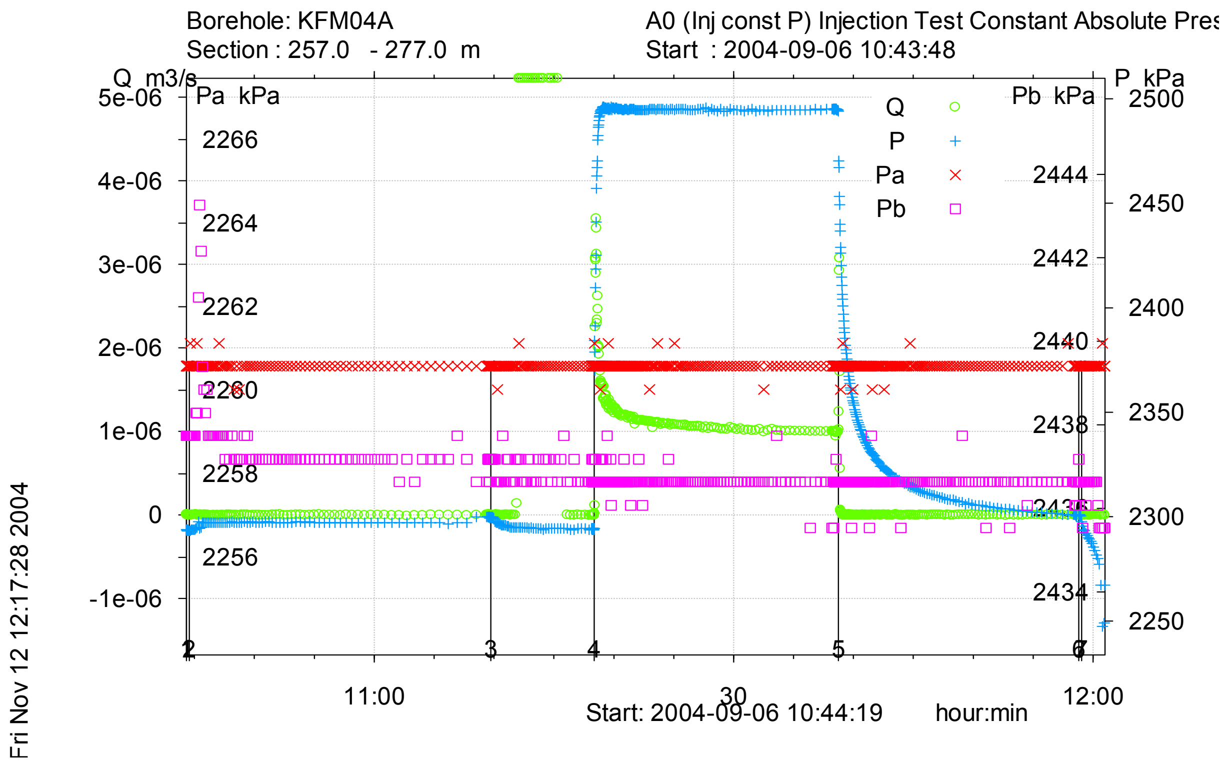


Figure A3-77. *Linear plot of flow rate (Q), pressure (P), pressure above section (Pa) and pressure below section (Pb) versus time from the injection test in section 257-277 m in borehole KFM04A.*

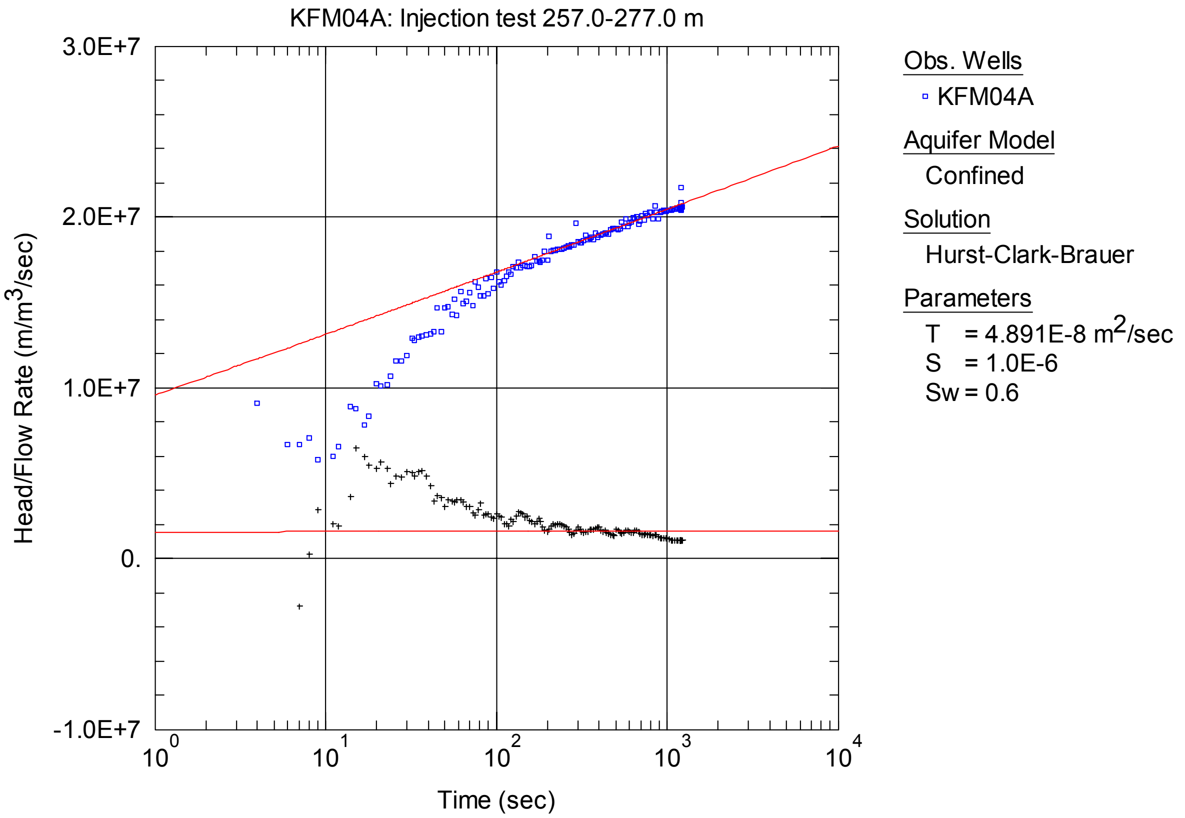


Figure A3-78. *Lin-log plot of head/flow rate (□) and derivative (+) versus time, from the injection test in section 257-277 m in KFM04A.*

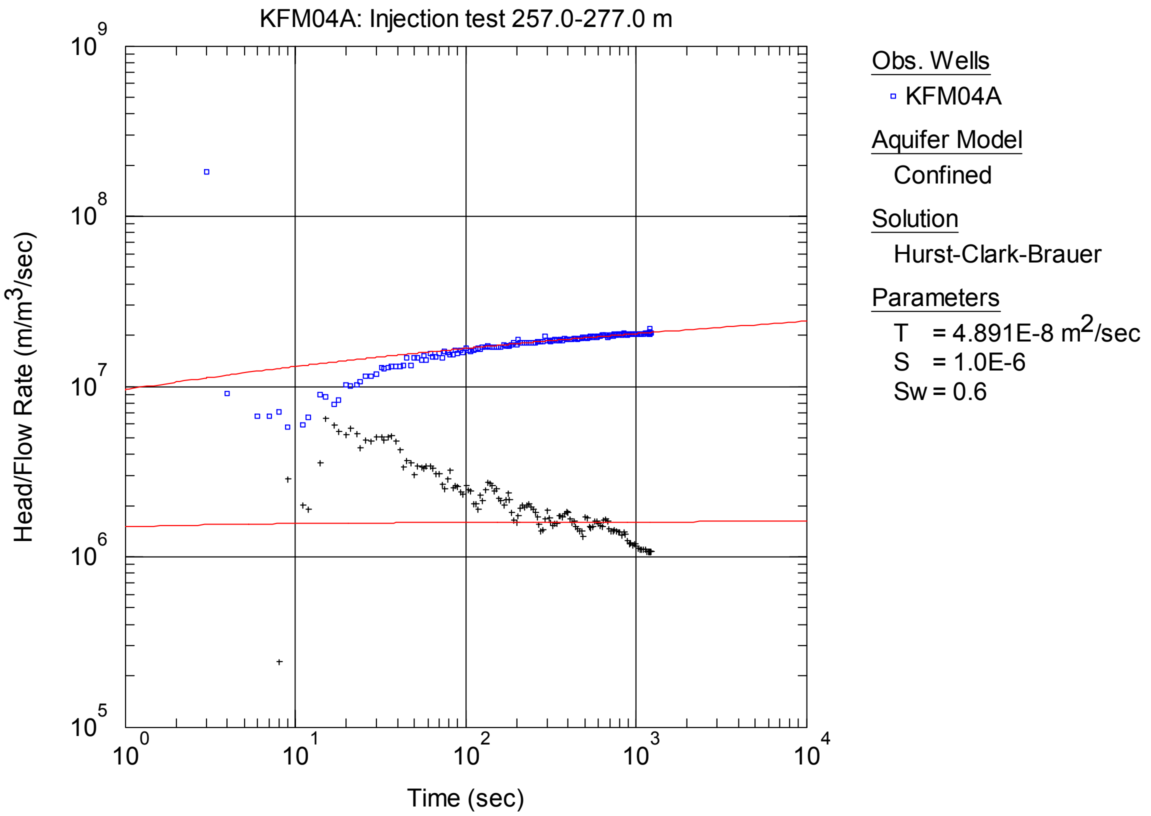


Figure A3-79. *Log-log plot of head/flow rate (□) and derivative (+) versus time, from the injection test in section 257-277 m in KFM04A.*

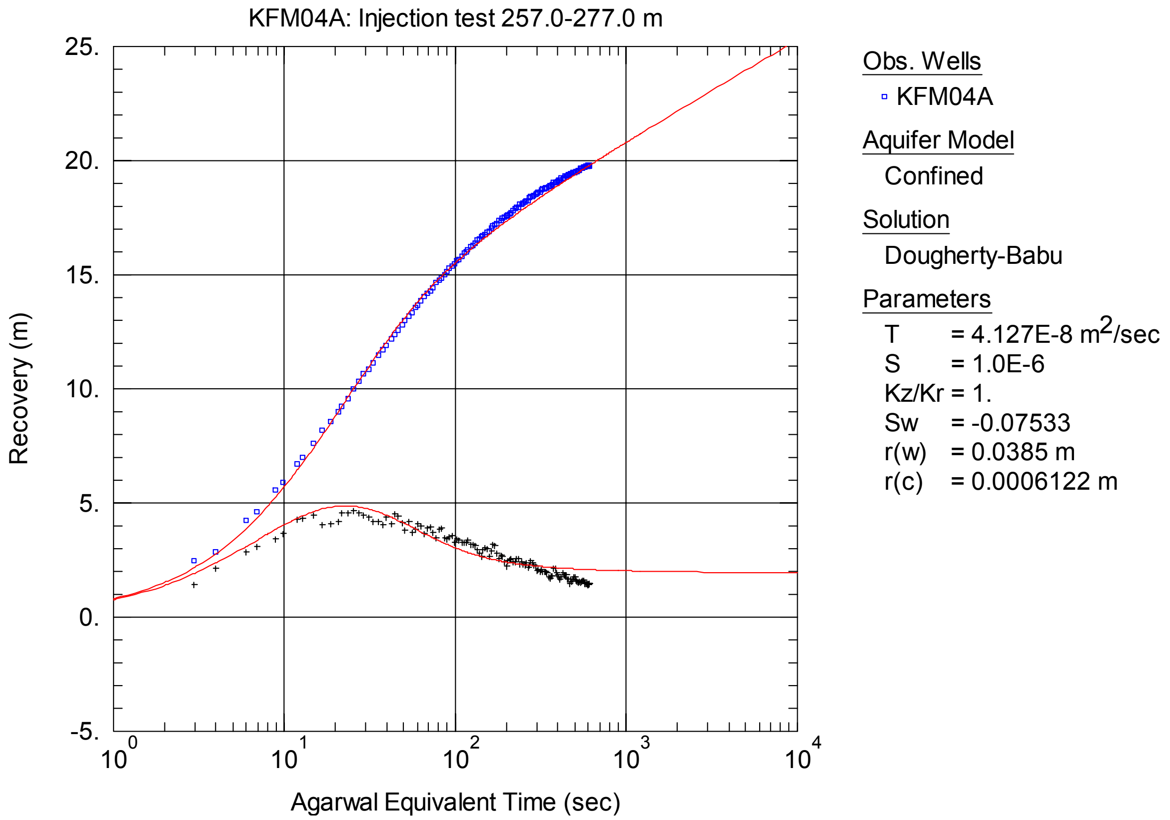


Figure A3-80. *Lin-log plot of recovery (□) and derivative (+) versus equivalent time, from the injection test in section 257-277 m in KFM04A.*

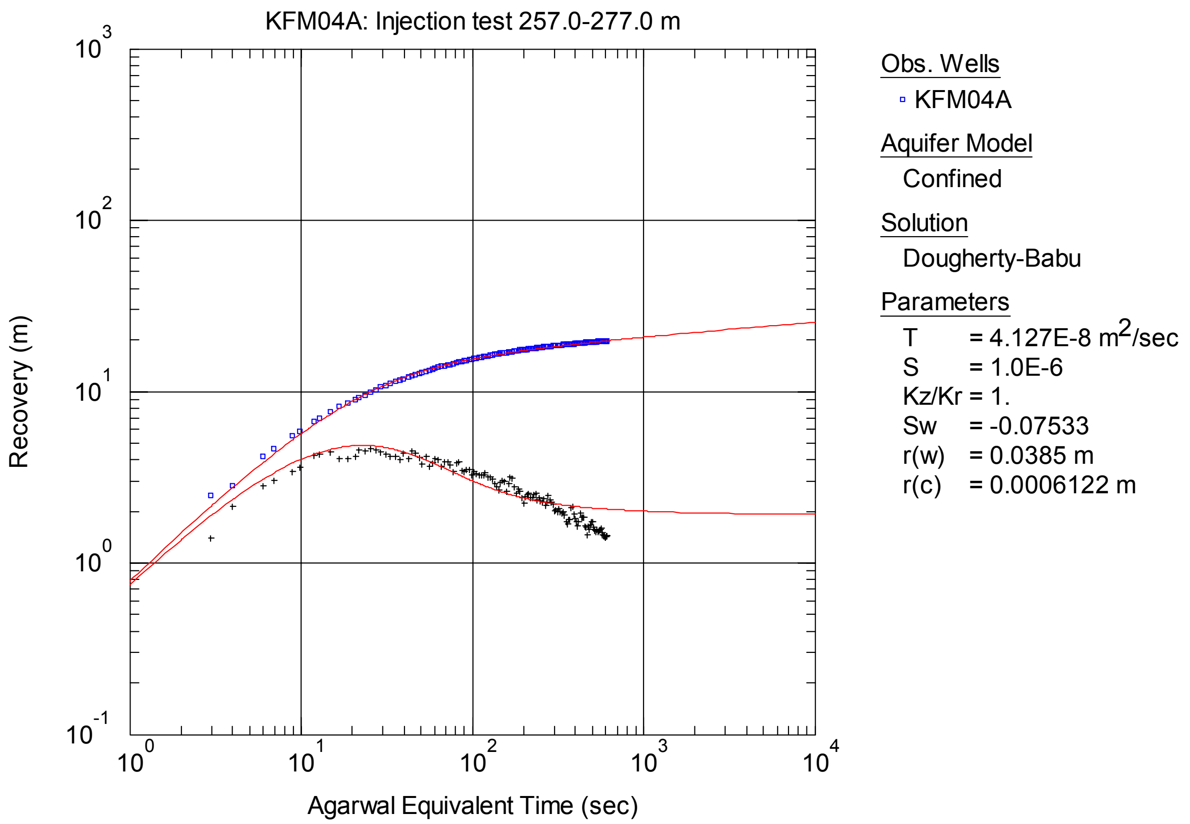


Figure A3-81. *Log-log plot of recovery (□) and derivative (+) versus equivalent time, from the injection test in section 257-277 m in KFM04A.*

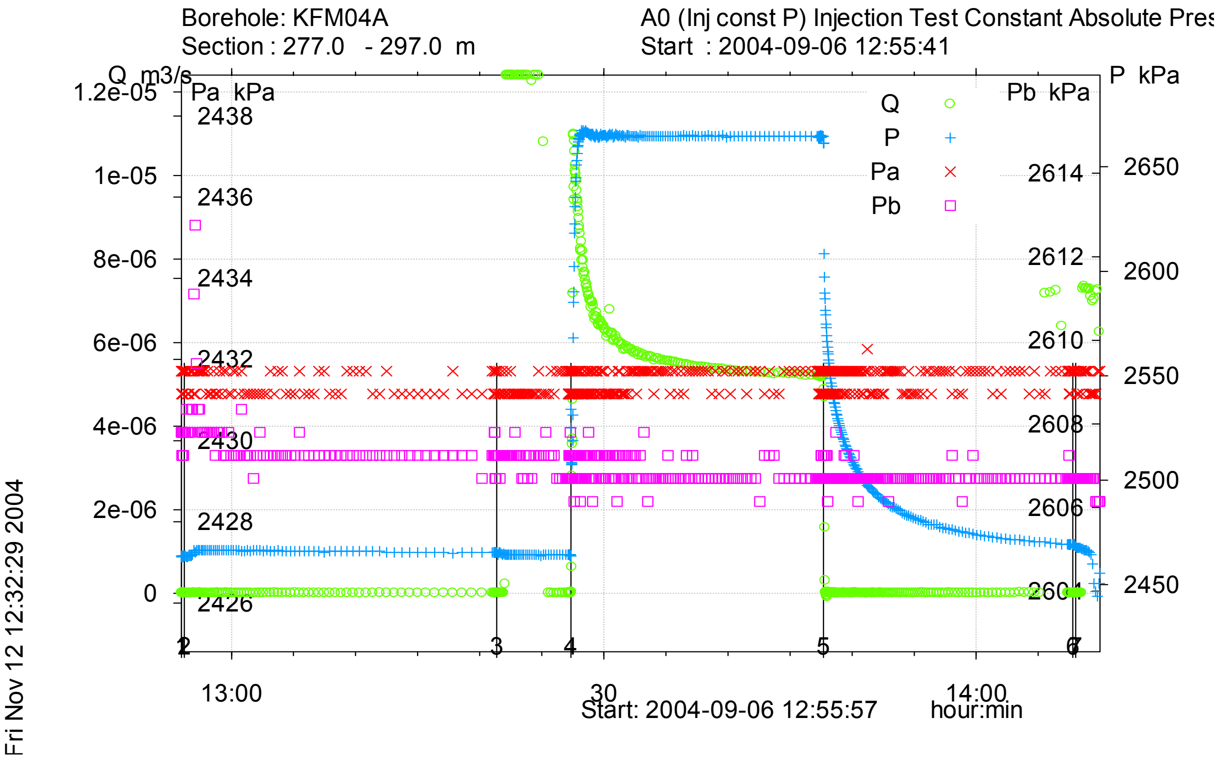


Figure A3-82. *Linear plot of flow rate (Q), pressure (P), pressure above section (Pa) and pressure below section (Pb) versus time from the injection test in section 277-297 m in borehole KFM04A.*

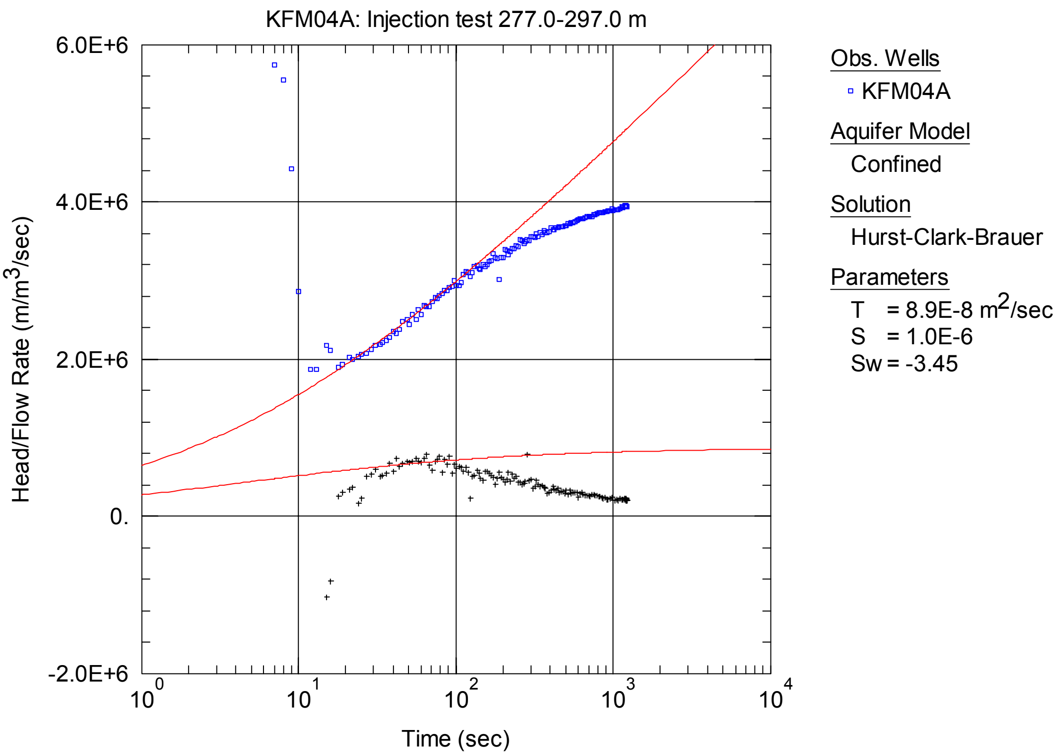


Figure A3-83. *Lin-log plot of head/flow rate (□) and derivative (+) versus time, from the injection test in section 277-297 m in KFM04A.*

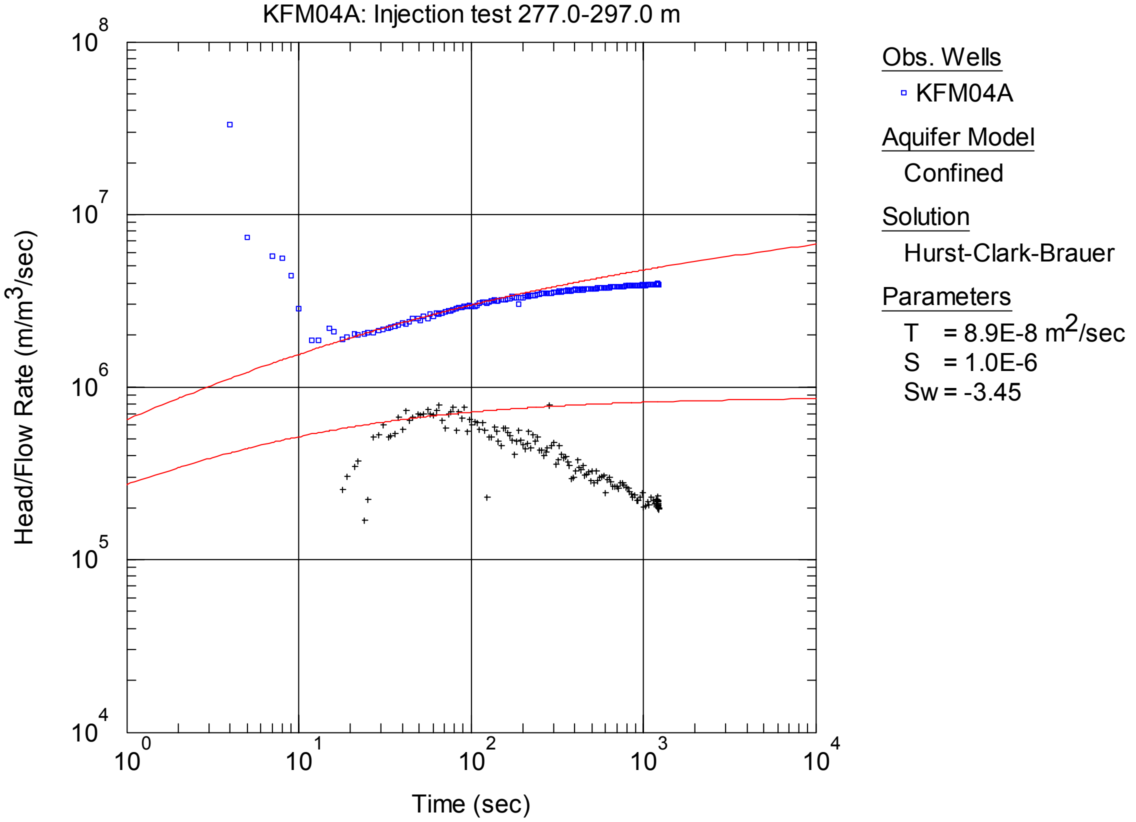


Figure A3-84. Log-log plot of head/flow rate (□) and derivative (+) versus time, from the injection test in section 277-297 m in KFM04A.

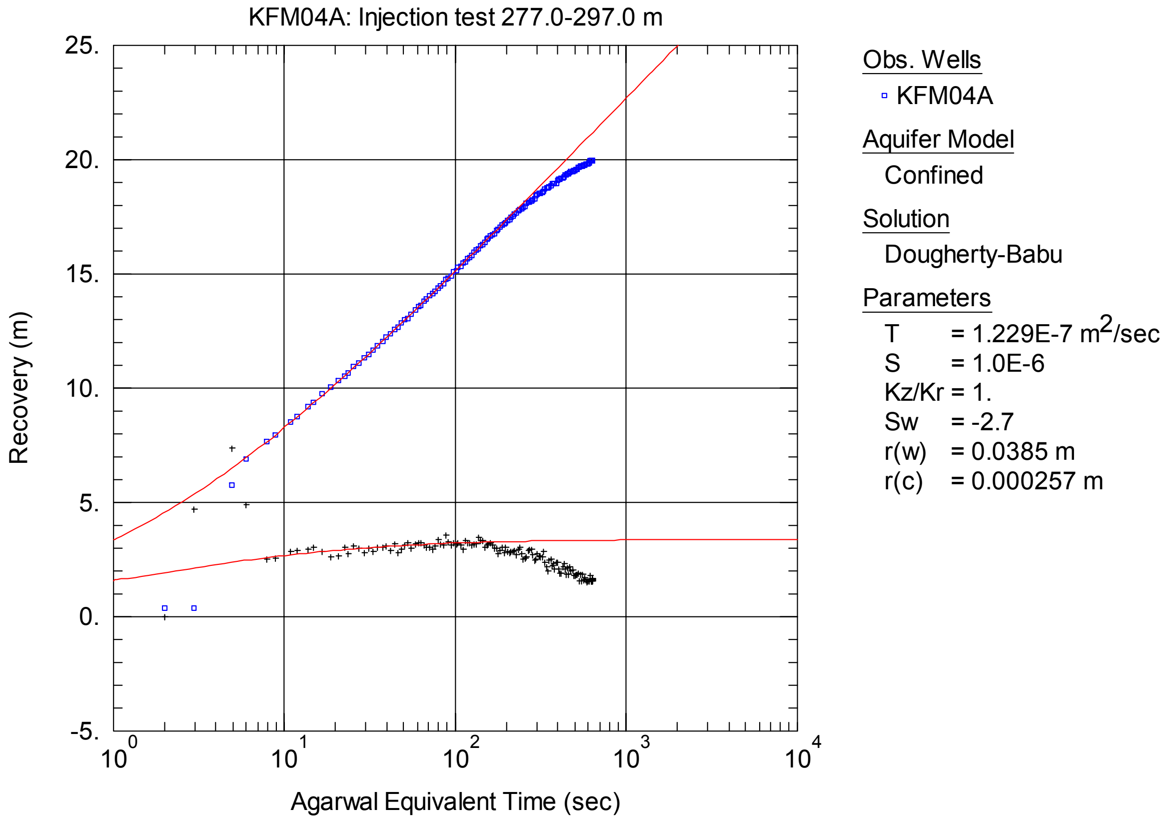


Figure A3-85. Lin-log plot of recovery (□) and derivative (+) versus equivalent time, from the injection test in section 277-297 m in KFM04A.

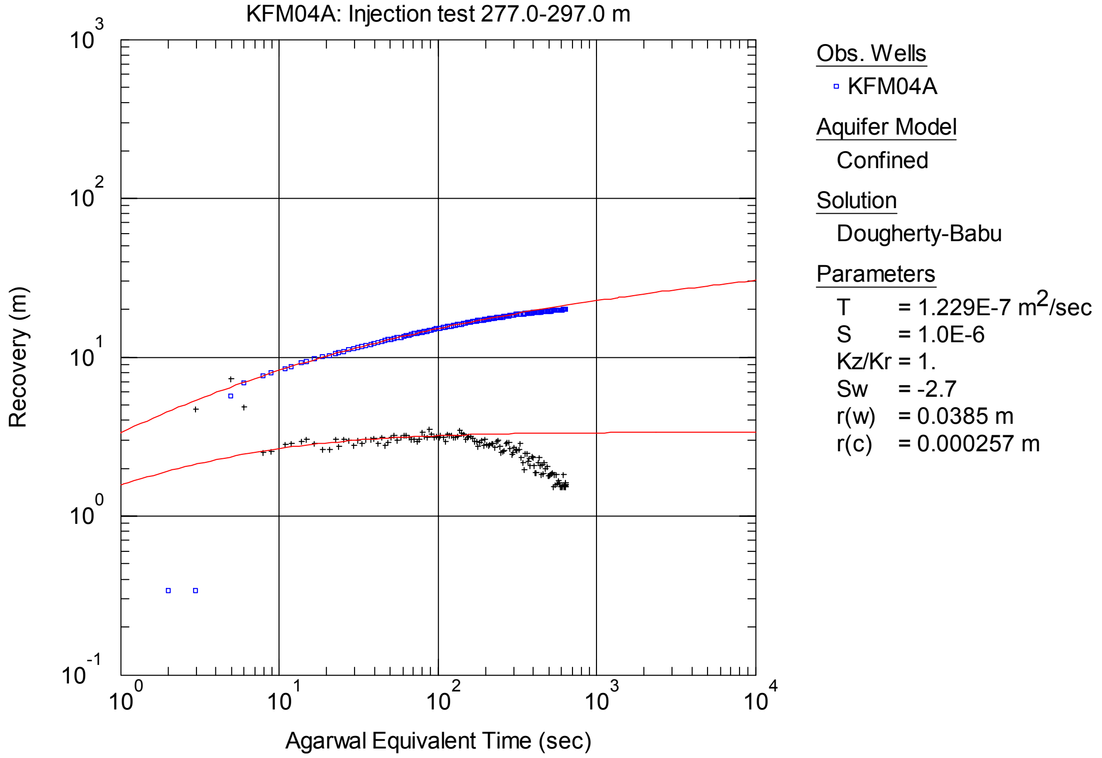


Figure A3-86. *Log-log plot of recovery (□) and derivative (+) versus equivalent time, from the injection test in section 277-297 m in KFM04A.*

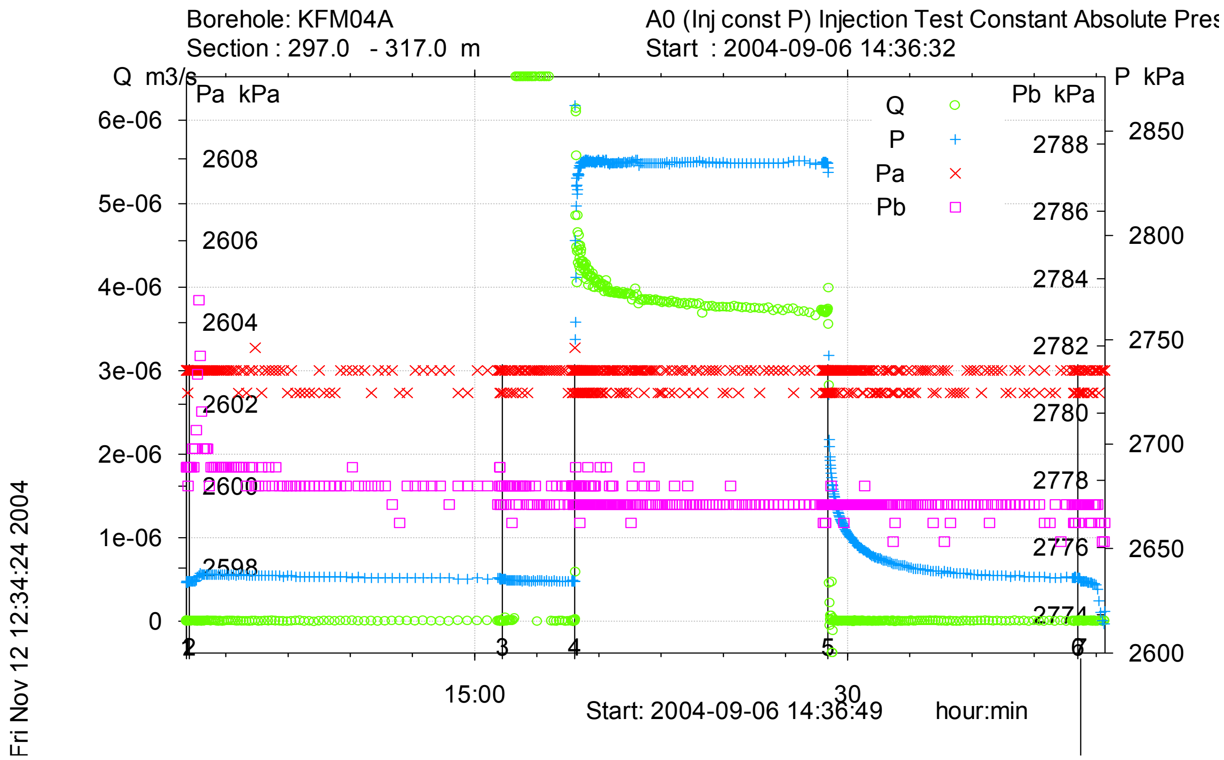


Figure A3-87. *Linear plot of flow rate (Q), pressure (P), pressure above section (Pa) and pressure below section (Pb) versus time from the injection test in section 297-317 m in borehole KFM04A.*

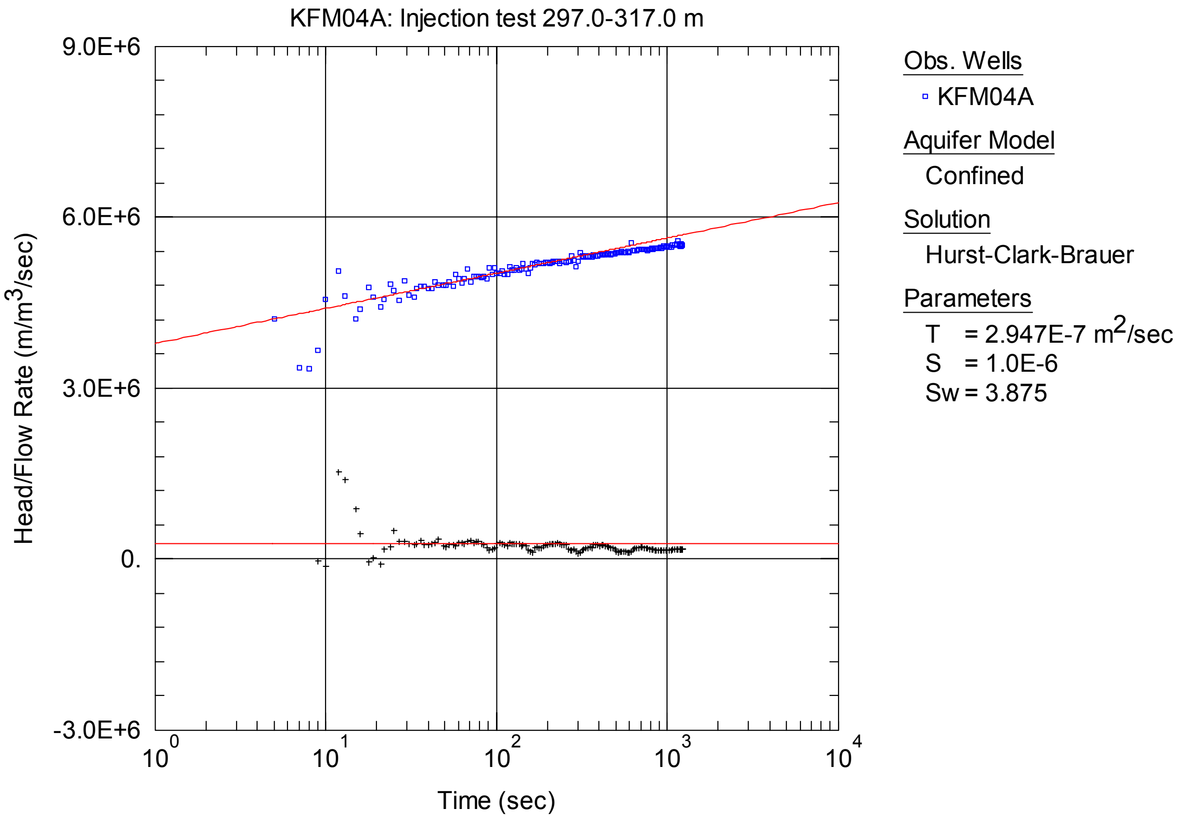


Figure A3-88. *Lin-log plot of head/flow rate (□) and derivative (+) versus time, from the injection test in section 297-317 m in KFM04A.*

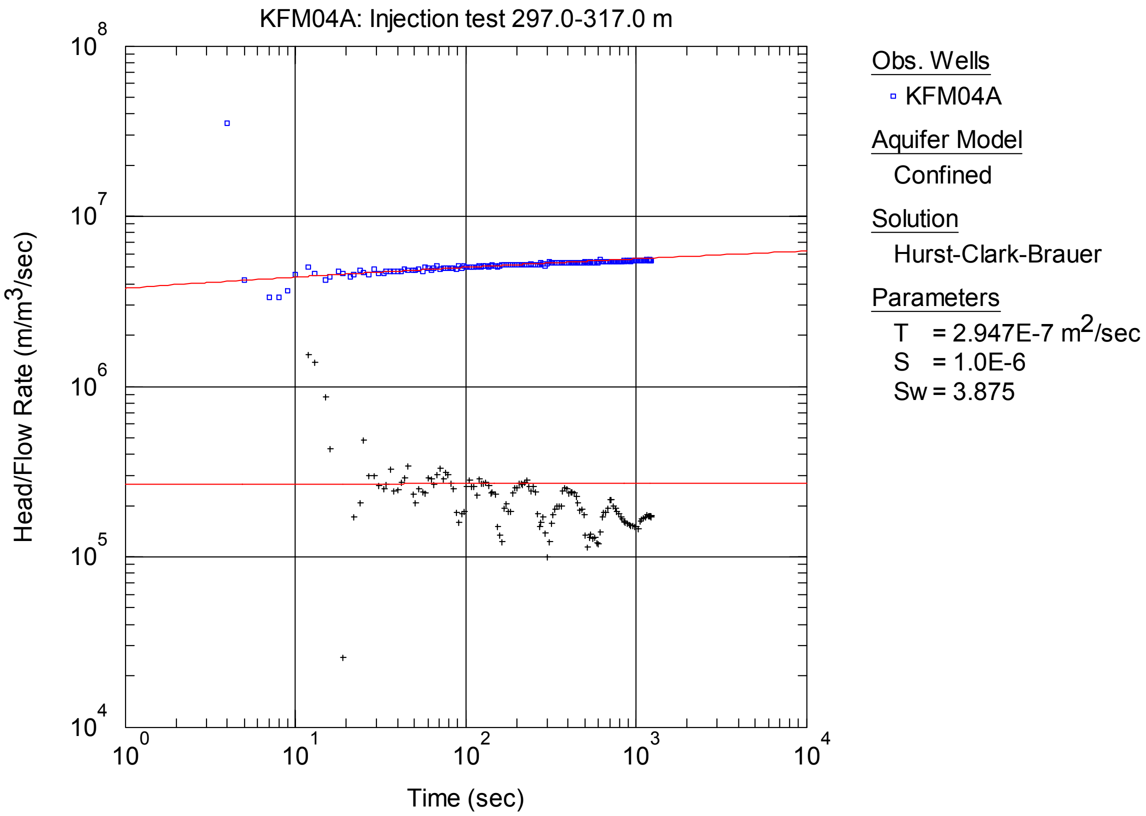


Figure A3-89. *Log-log plot of head/flow rate (□) and derivative (+) versus time, from the injection test in section 297-317 m in KFM04A.*

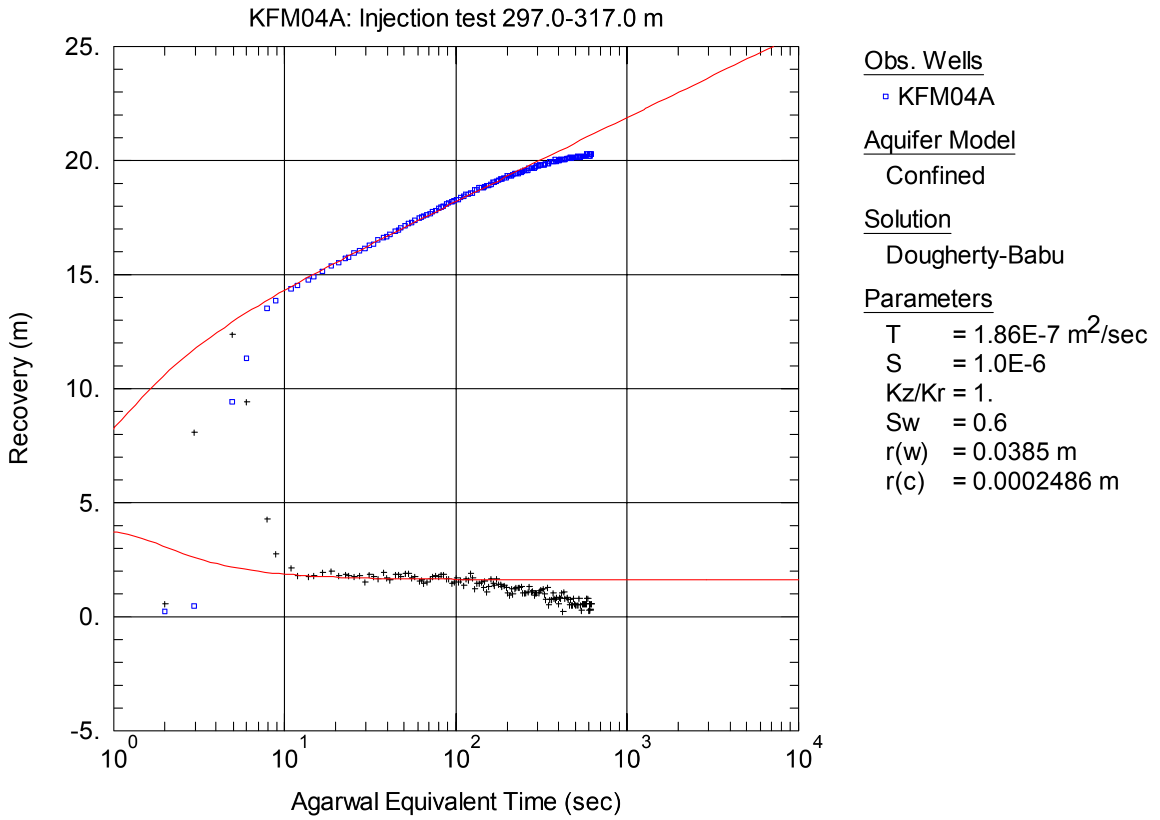


Figure A3-90. *Lin-log plot of recovery (□) and derivative (+) versus equivalent time, from the injection test in section 297-317 m in KFM04A.*

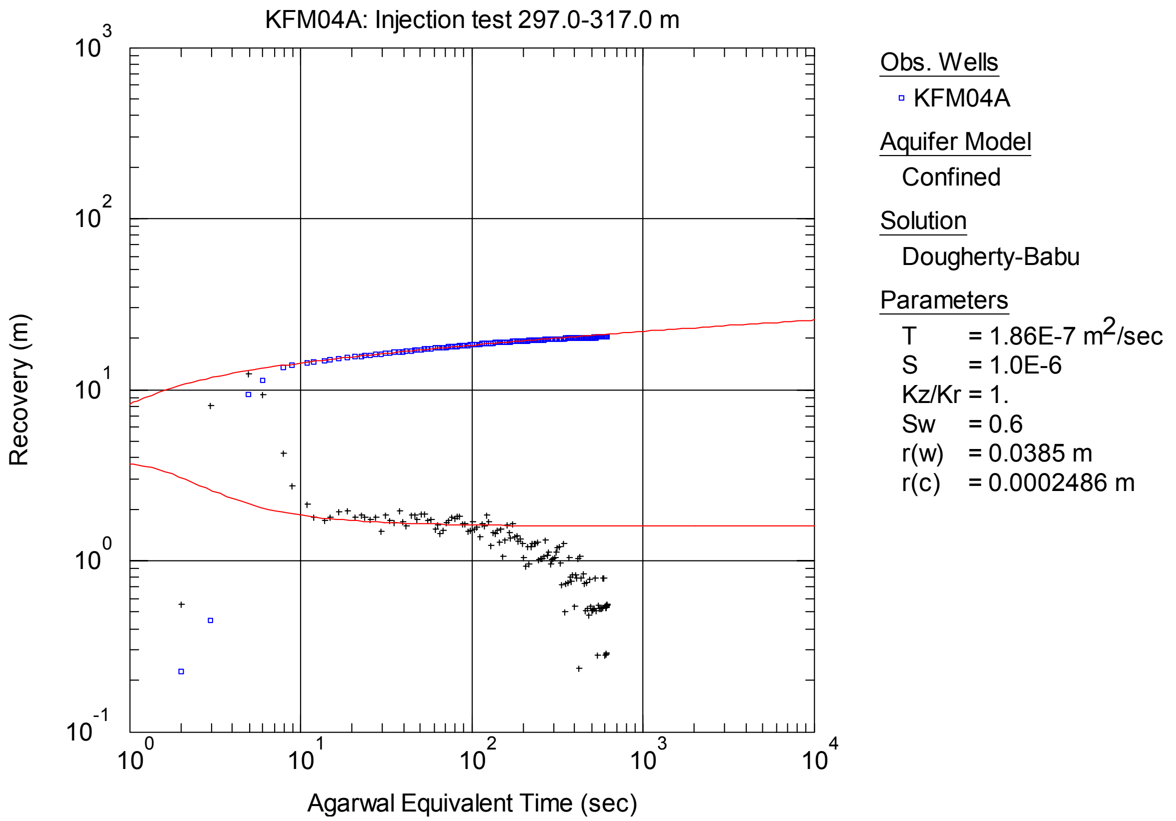


Figure A3-91. *Log-log plot of recovery (□) and derivative (+) versus equivalent time, from the injection test in section 297-317 m in KFM04A.*

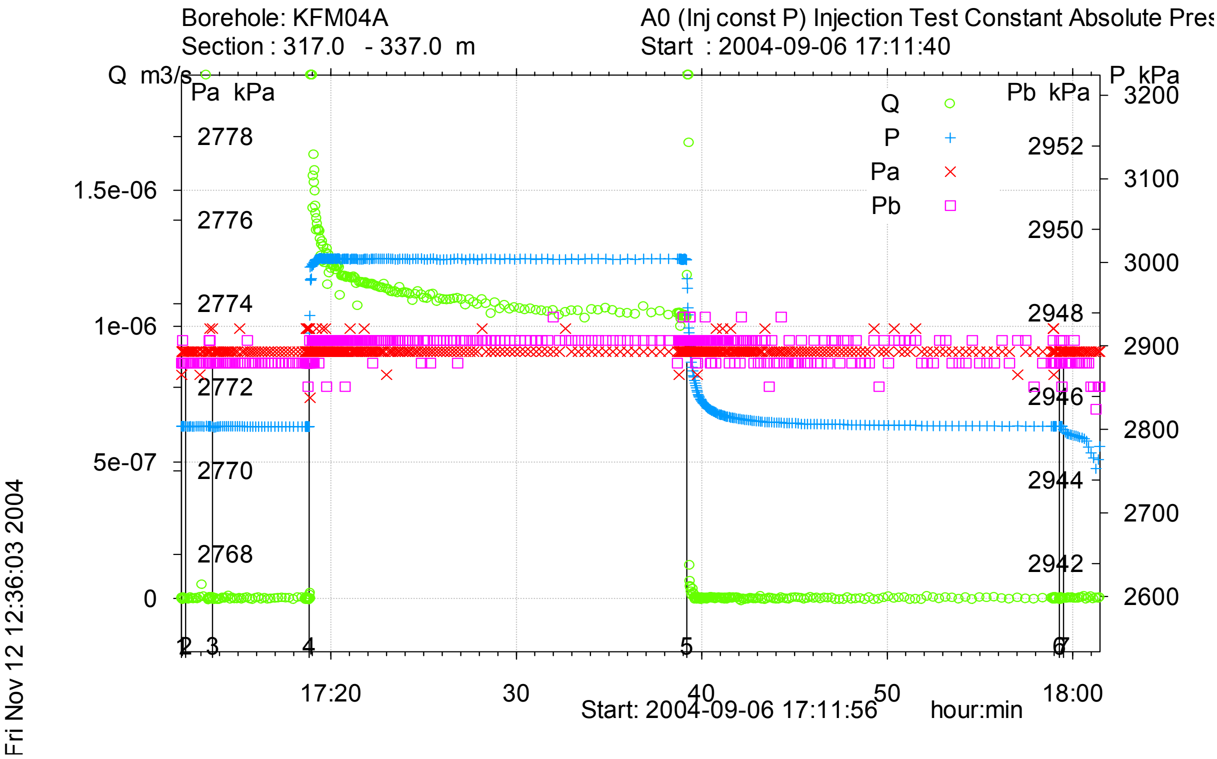


Figure A3-92. *Linear plot of flow rate (Q), pressure (P), pressure above section (Pa) and pressure below section (Pb) versus time from the injection test in section 317-337 m in borehole KFM04A.*

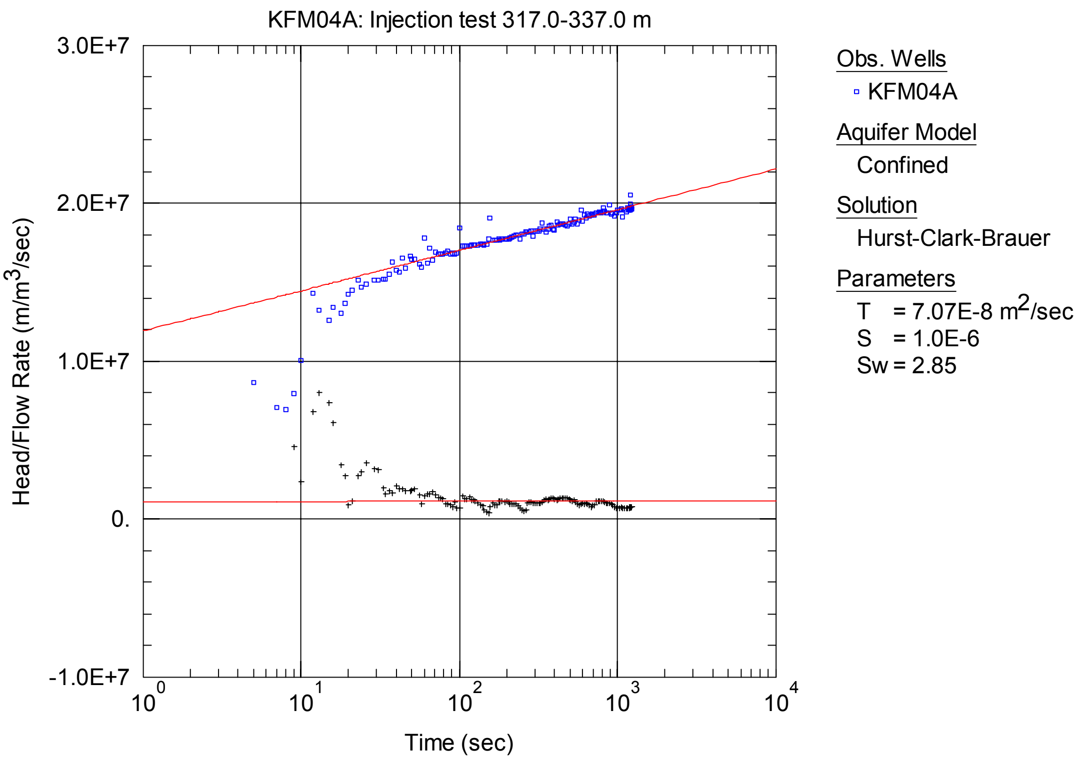


Figure A3-93. *Lin-log plot of head/flow rate (□) and derivative (+) versus time, from the injection test in section 317-337 m in KFM04A.*

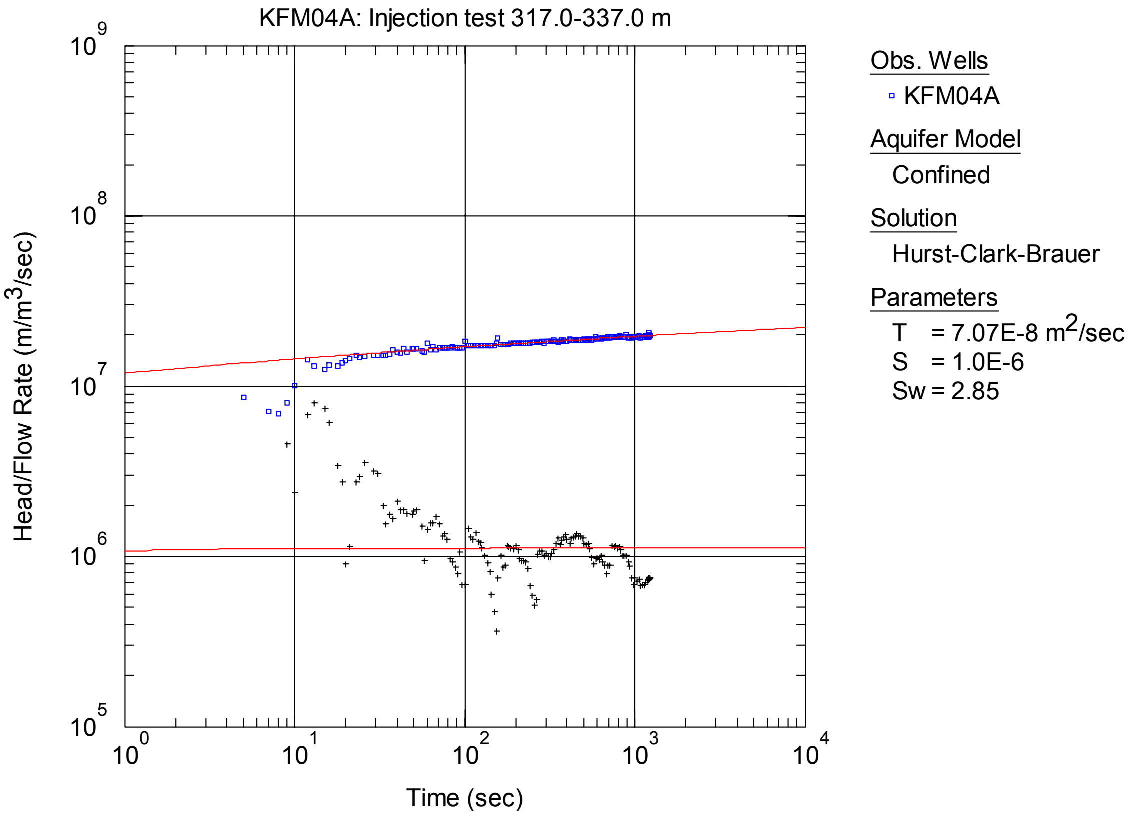


Figure A3-94. *Log-log plot of head/flow rate (□) and derivative (+) versus time, from the injection test in section 317-337 m in KFM04A.*

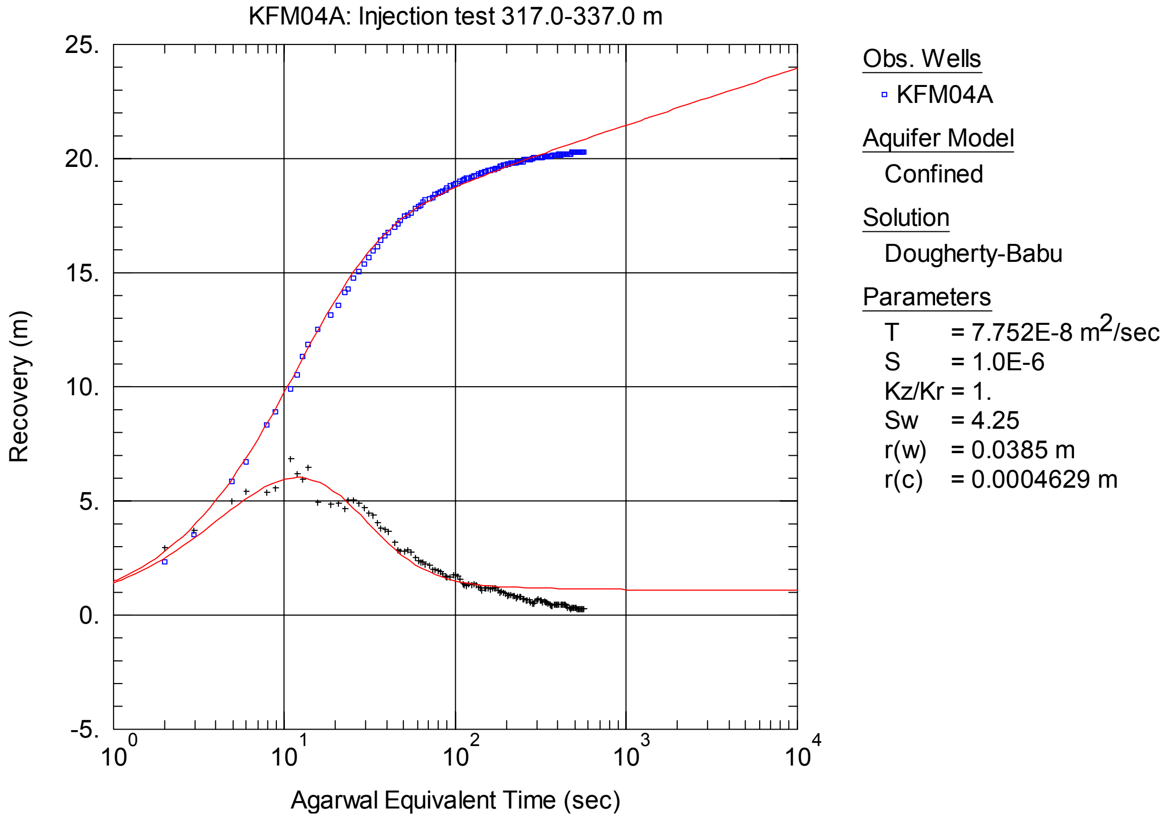


Figure A3-95. *Lin-log plot of recovery (□) and derivative (+) versus equivalent time, from the injection test in section 317-337 m in KFM04A.*

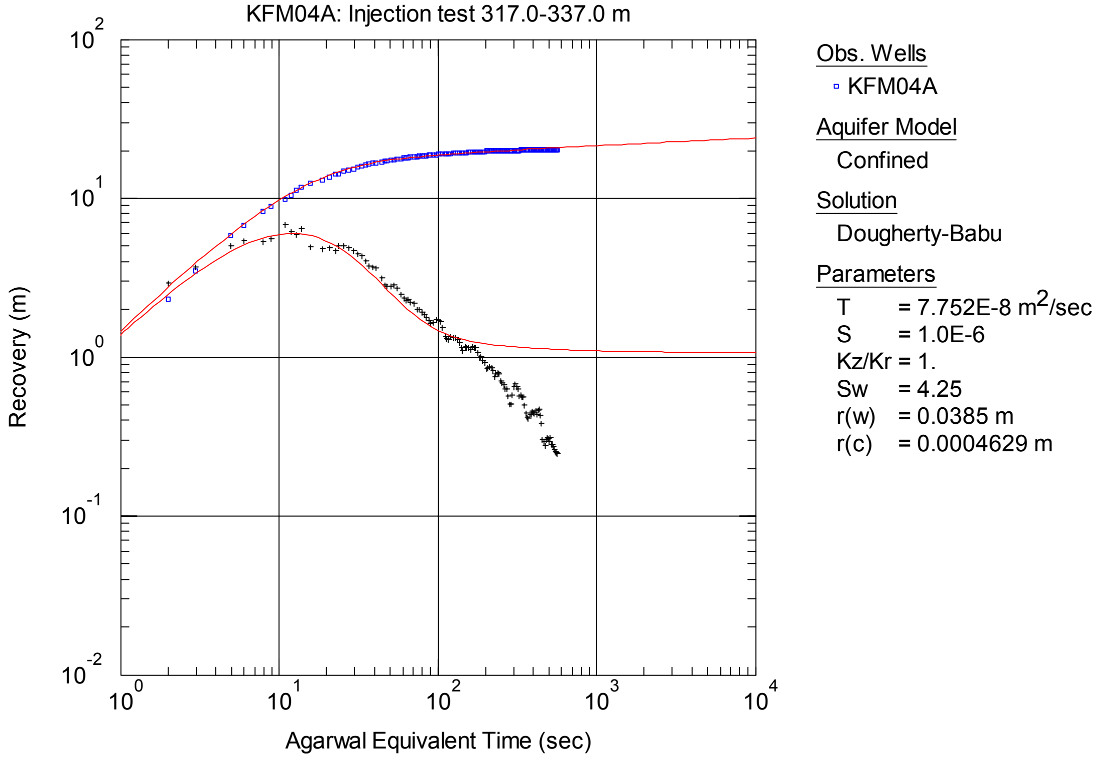


Figure A3-96. *Log-log plot of recovery (□) and derivative (+) versus equivalent time, from the injection test in section 317-337 m in KFM04A.*

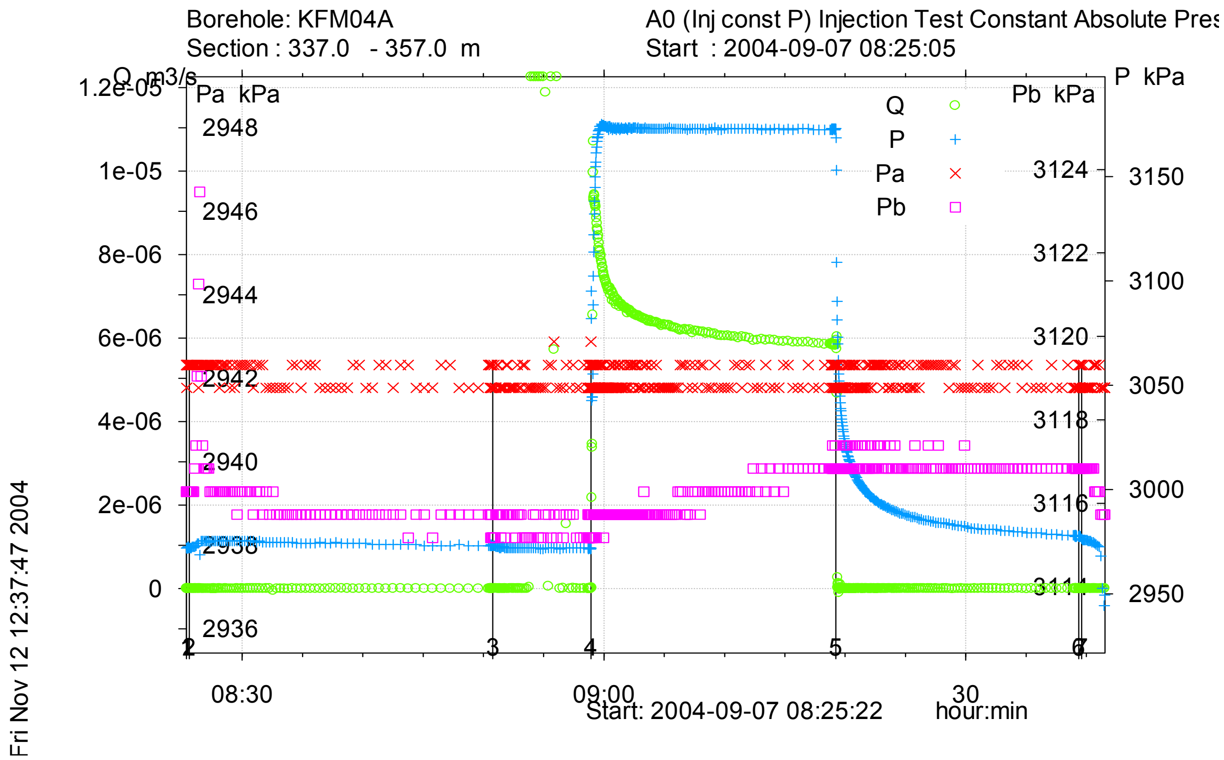


Figure A3-97. *Linear plot of flow rate (Q), pressure (P), pressure above section (Pa) and pressure below section (Pb) versus time from the injection test in section 337-357 m in borehole KFM04A.*

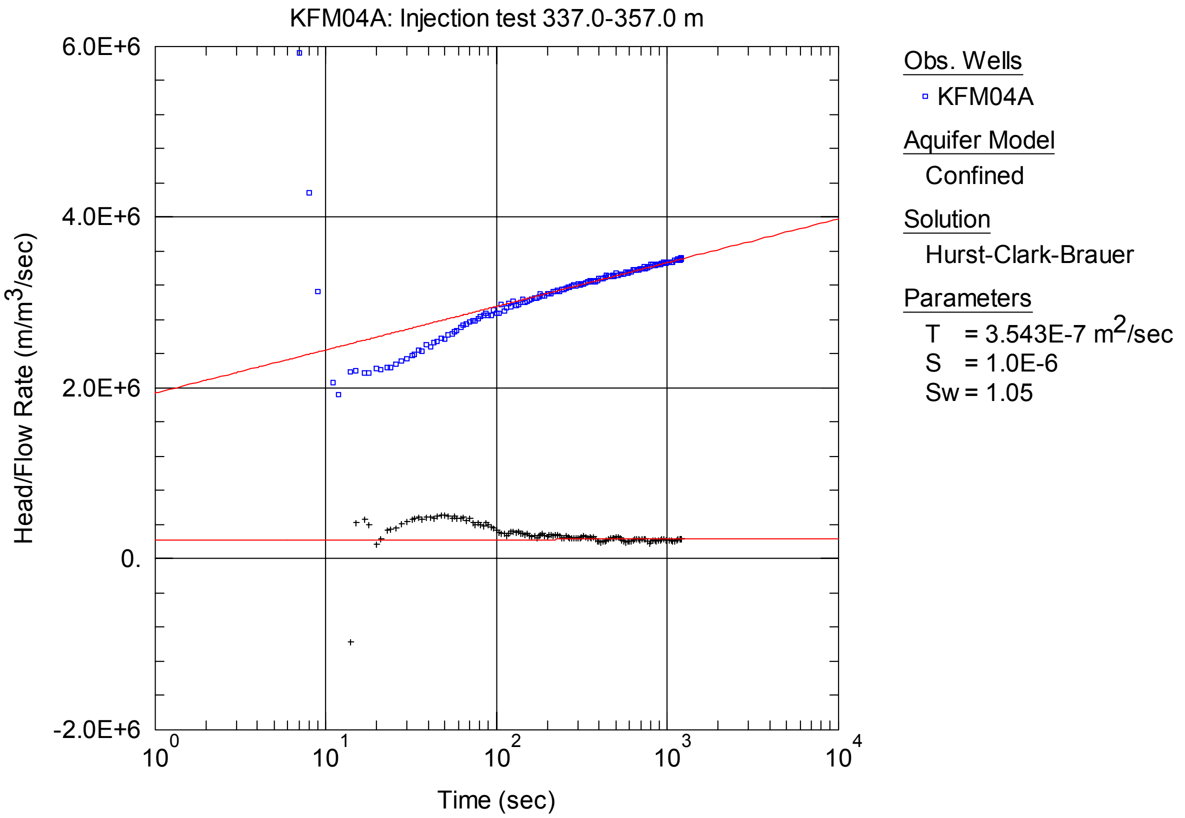


Figure A3-98. *Lin-log plot of head/flow rate (□) and derivative (+) versus time, from the injection test in section 337-357 m in KFM04A.*

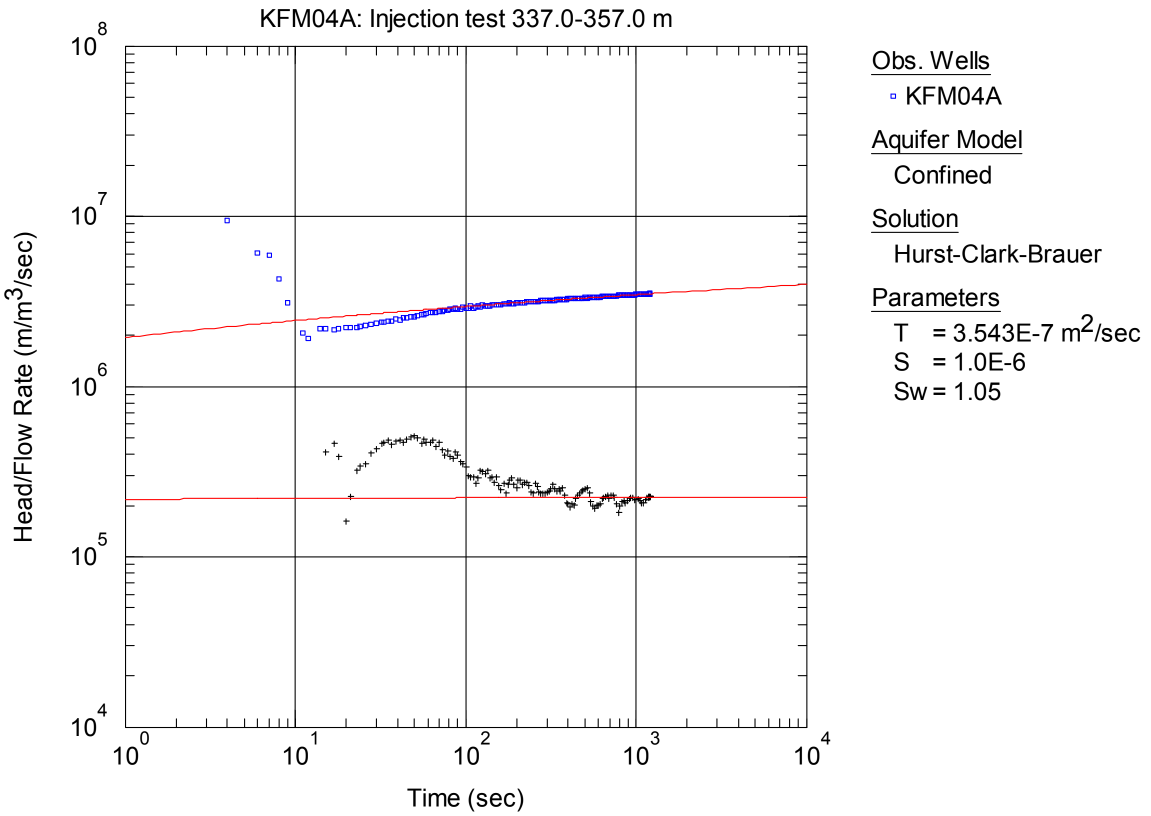


Figure A3-99. *Log-log plot of head/flow rate (□) and derivative (+) versus time, from the injection test in section 337-357 m in KFM04A.*

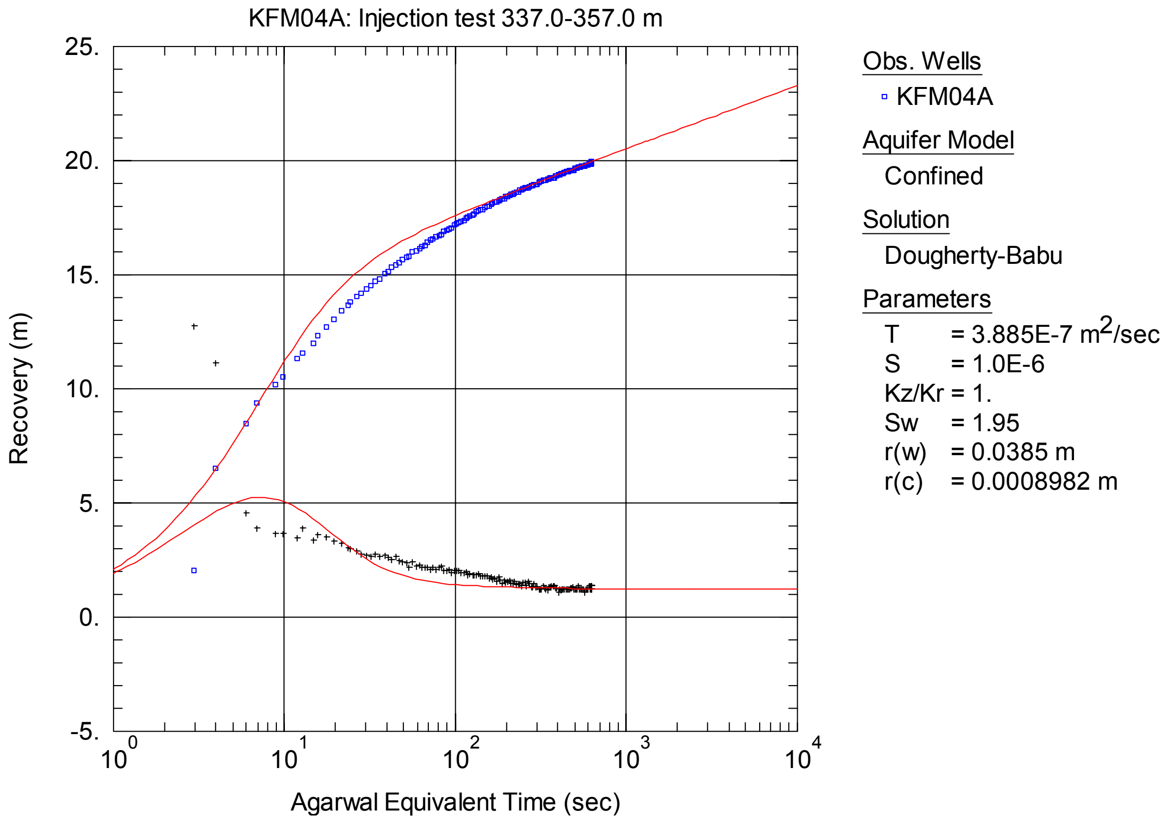


Figure A3-100. *Lin-log plot of recovery (□) and derivative (+) versus equivalent time, from the injection test in section 337-357 m in KFM04A.*

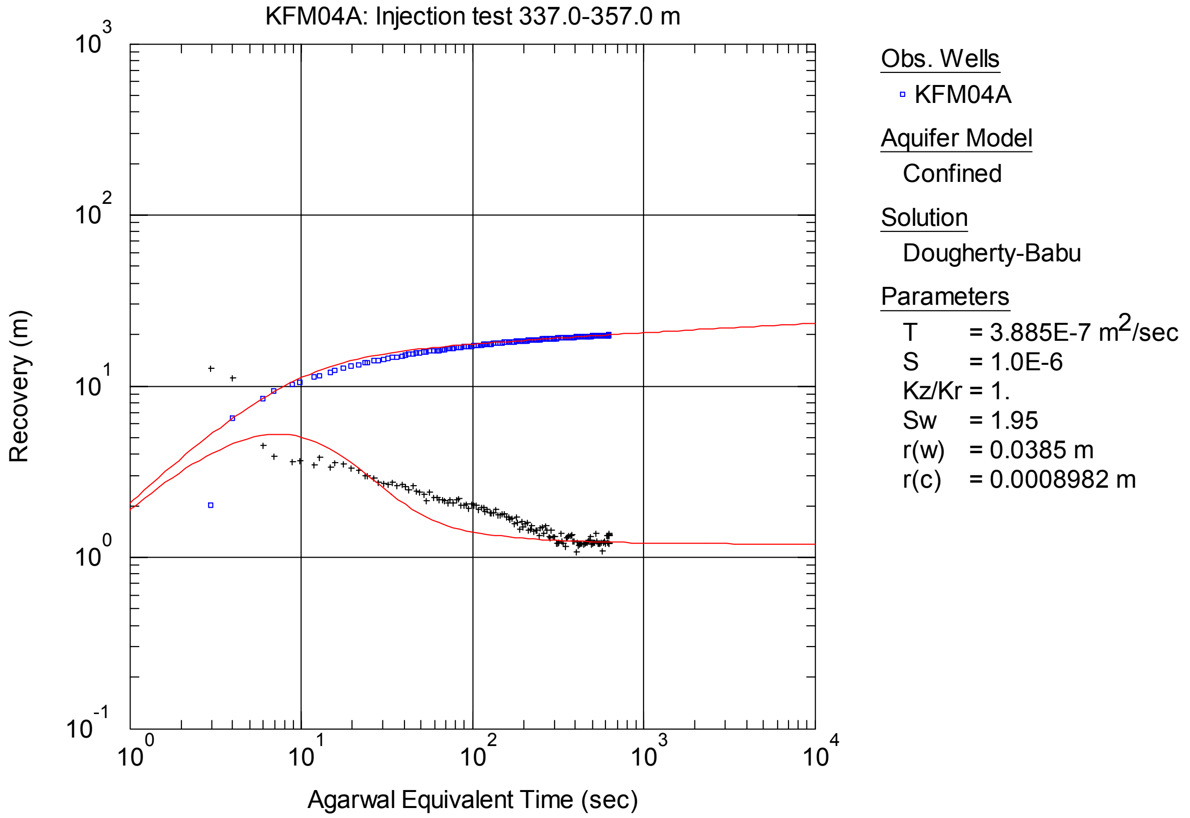


Figure A3-101. *Log-log plot of recovery (□) and derivative (+) versus equivalent time, from the injection test in section 337-357 m in KFM04A.*

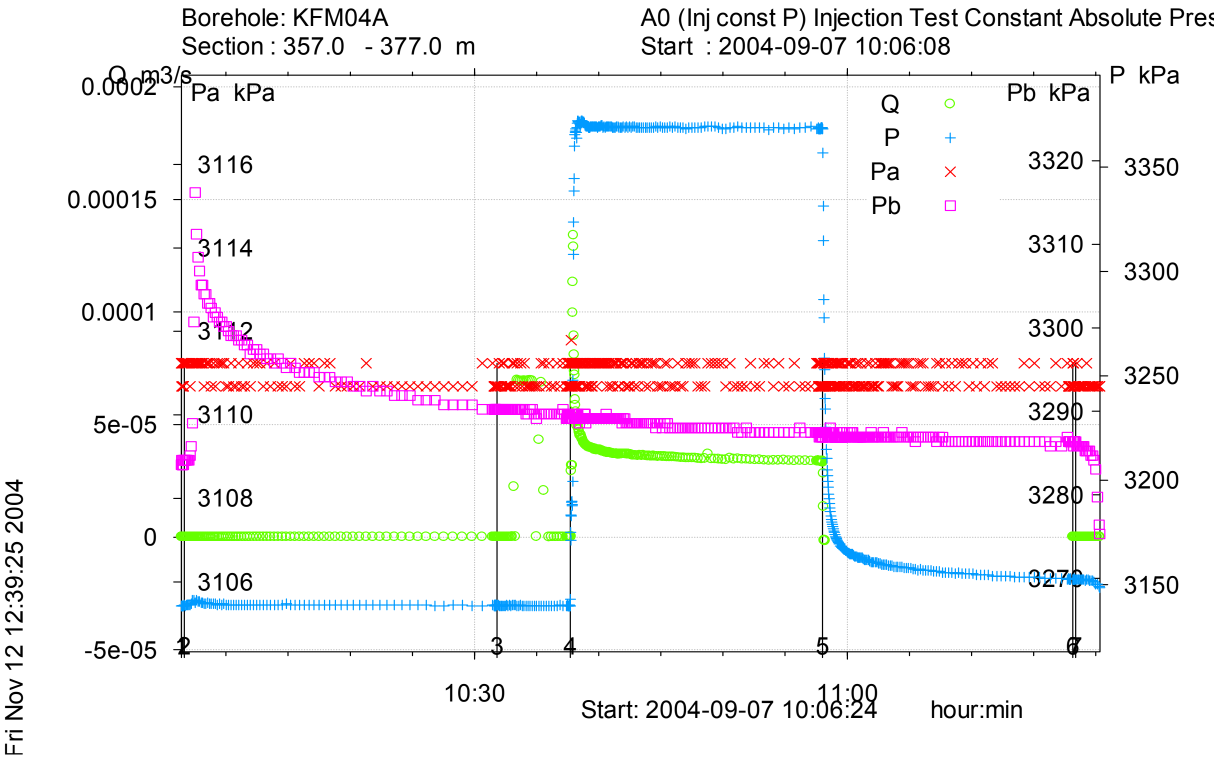


Figure A3-102. *Linear plot of flow rate (Q), pressure (P), pressure above section (Pa) and pressure below section (Pb) versus time from the injection test in section 357-377 m in borehole KFM04A.*

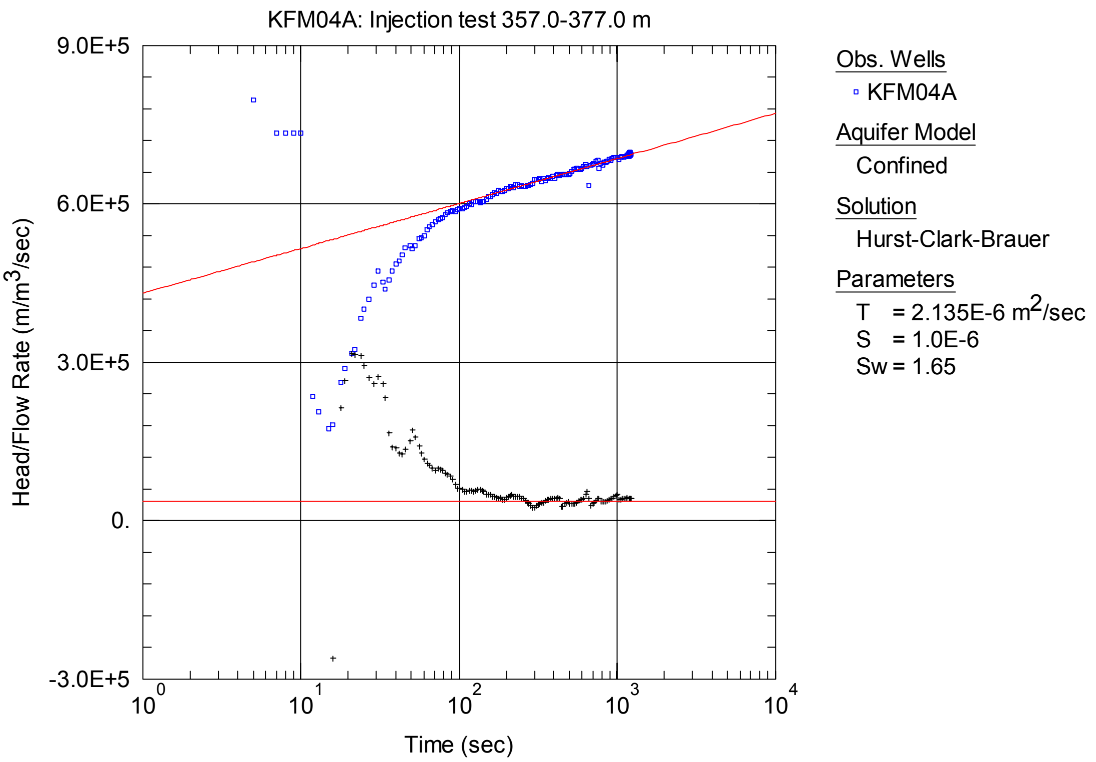


Figure A3-103. *Lin-log plot of head/flow rate (□) and derivative (+) versus time, from the injection test in section 357-377 m in KFM04A.*

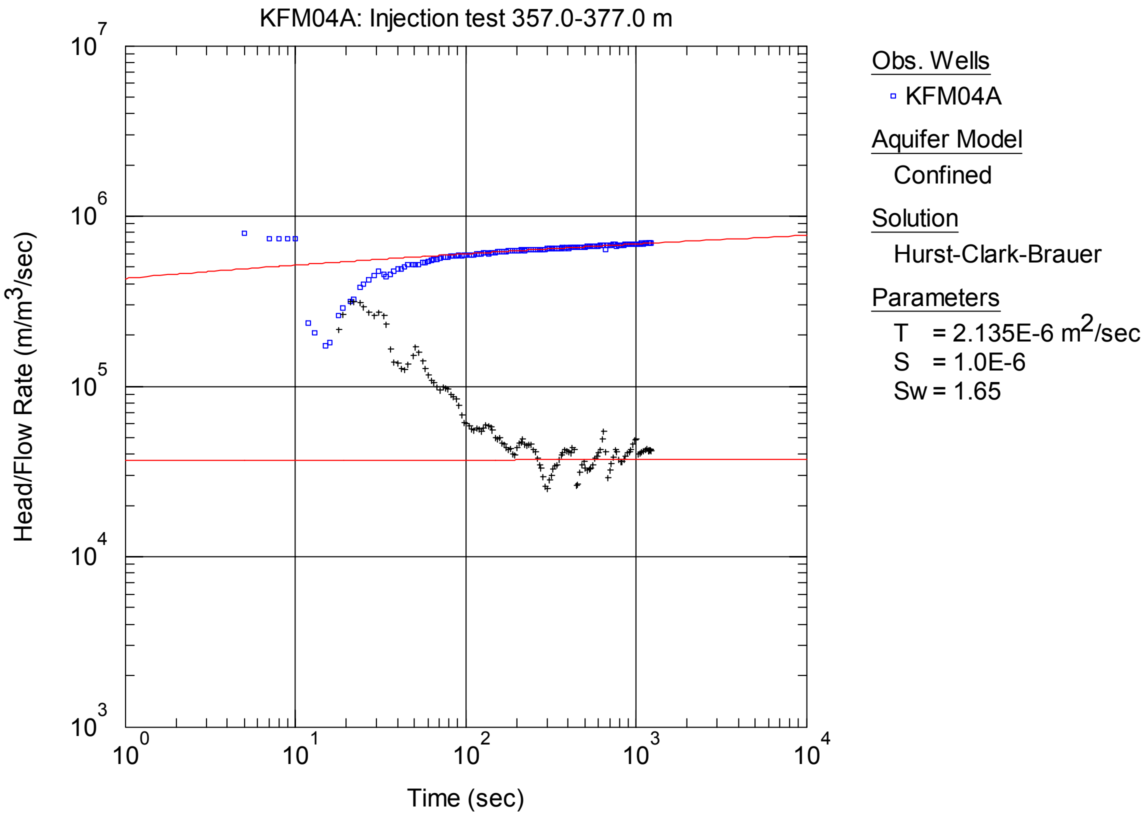


Figure A3-104. *Log-log plot of head/flow rate (□) and derivative (+) versus time, from the injection test in section 357-377 m in KFM04A.*

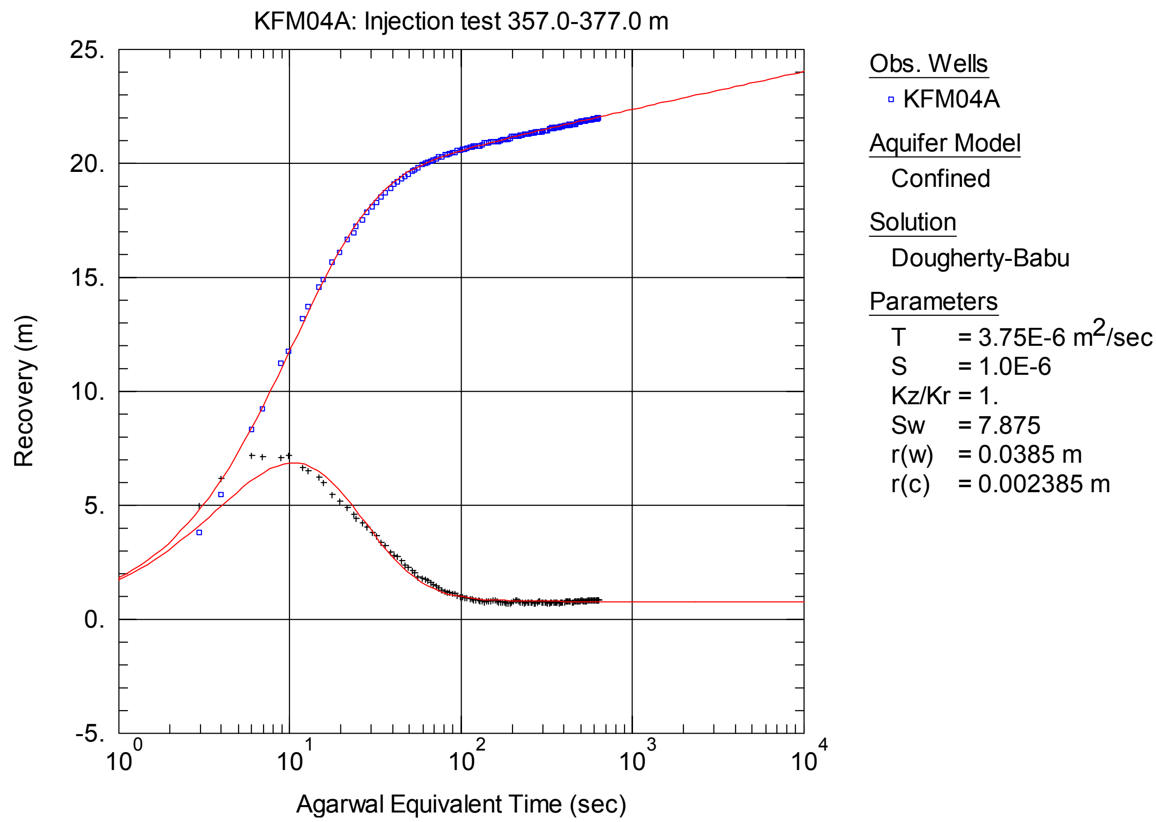


Figure A3-105. *Lin-log plot of recovery (□) and derivative (+) versus equivalent time, from the injection test in section 357-377 m in KFM04A.*

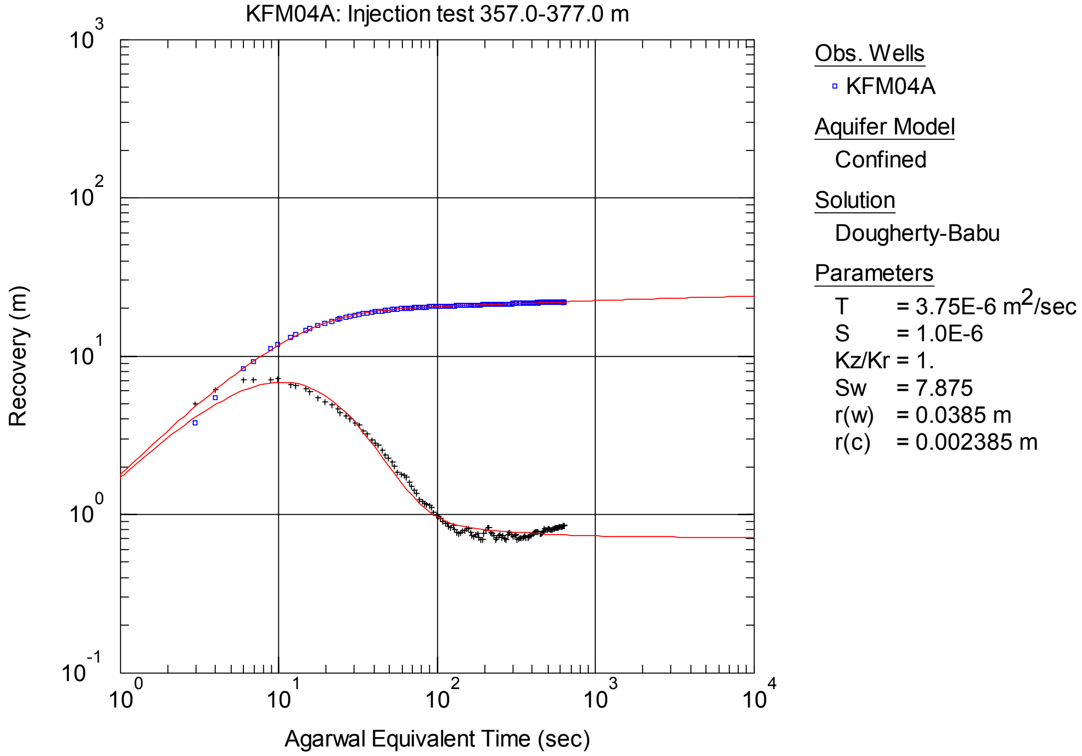


Figure A3-106. *Log-log plot of recovery (□) and derivative (+) versus equivalent time, from the injection test in section 357-377 m in KFM04A.*

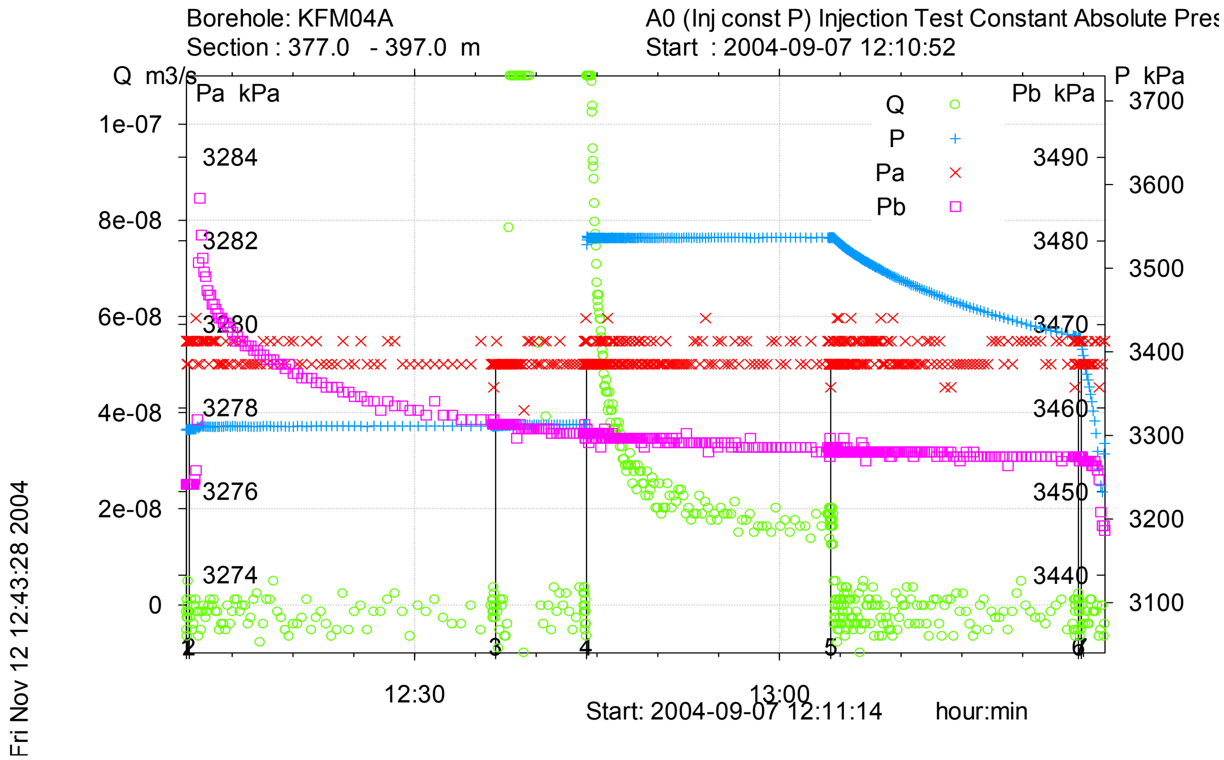


Figure A3-107. *Linear plot of flow rate (Q), pressure (P), pressure above section (Pa) and pressure below section (Pb) versus time from the injection test in section 377-397 m in borehole KFM04A.*

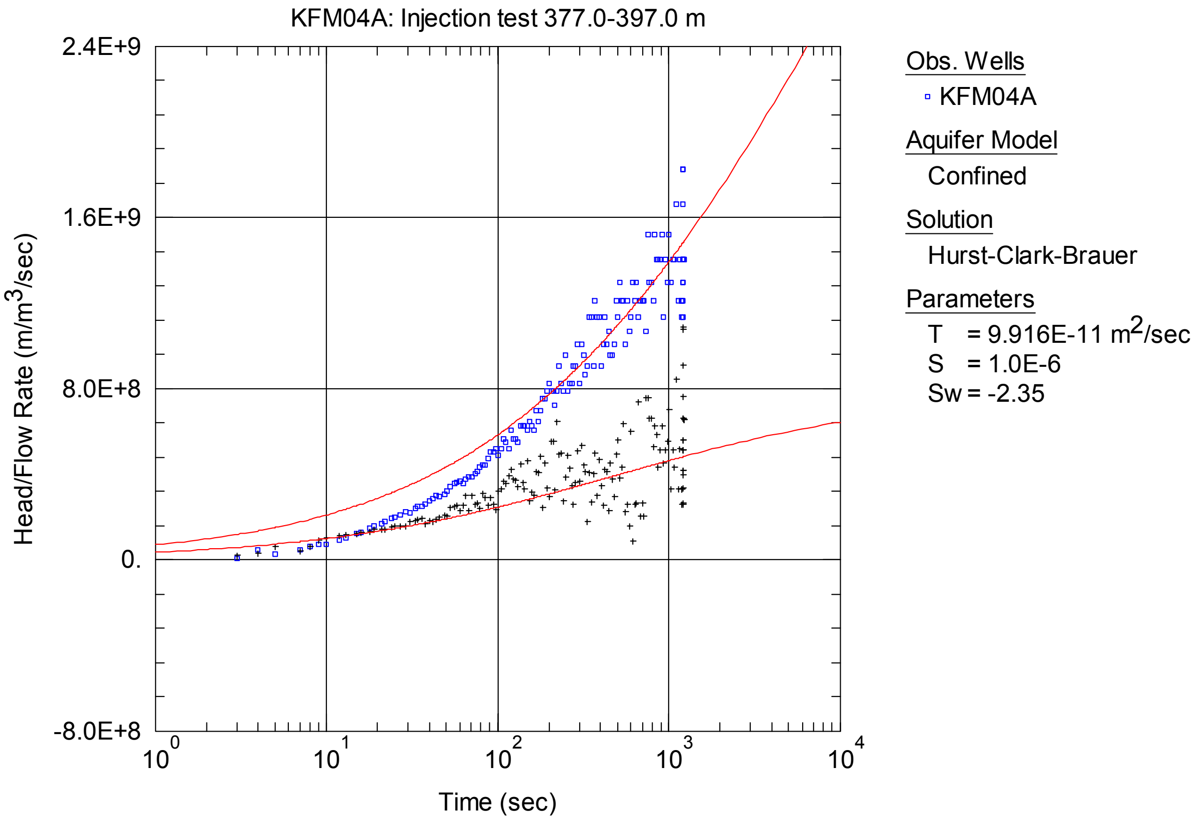


Figure A3-108. *Lin-log plot of head/flow rate (□) and derivative (+) versus time, from the injection test in section 377-397 m in KFM04A.*

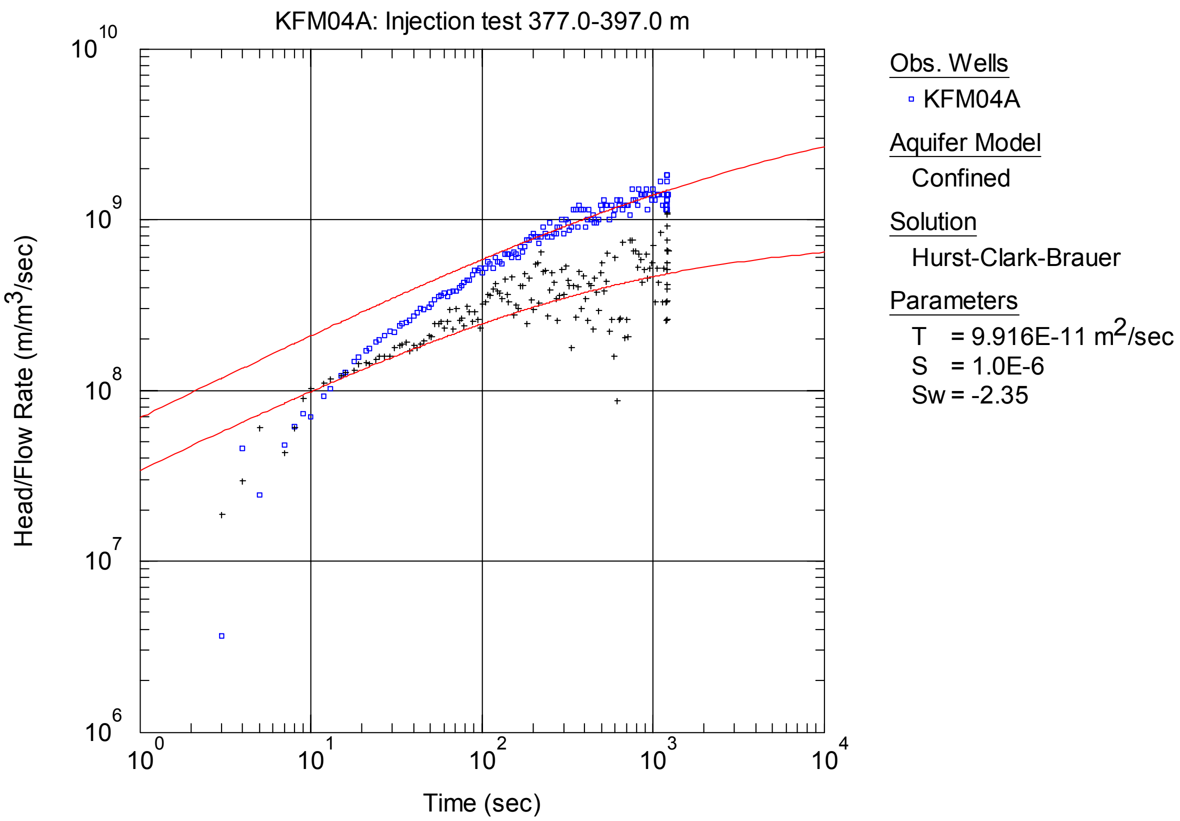


Figure A3-109. *Log-log plot of head/flow rate (□) and derivative (+) versus time, from the injection test in section 377-397 m in KFM04A.*

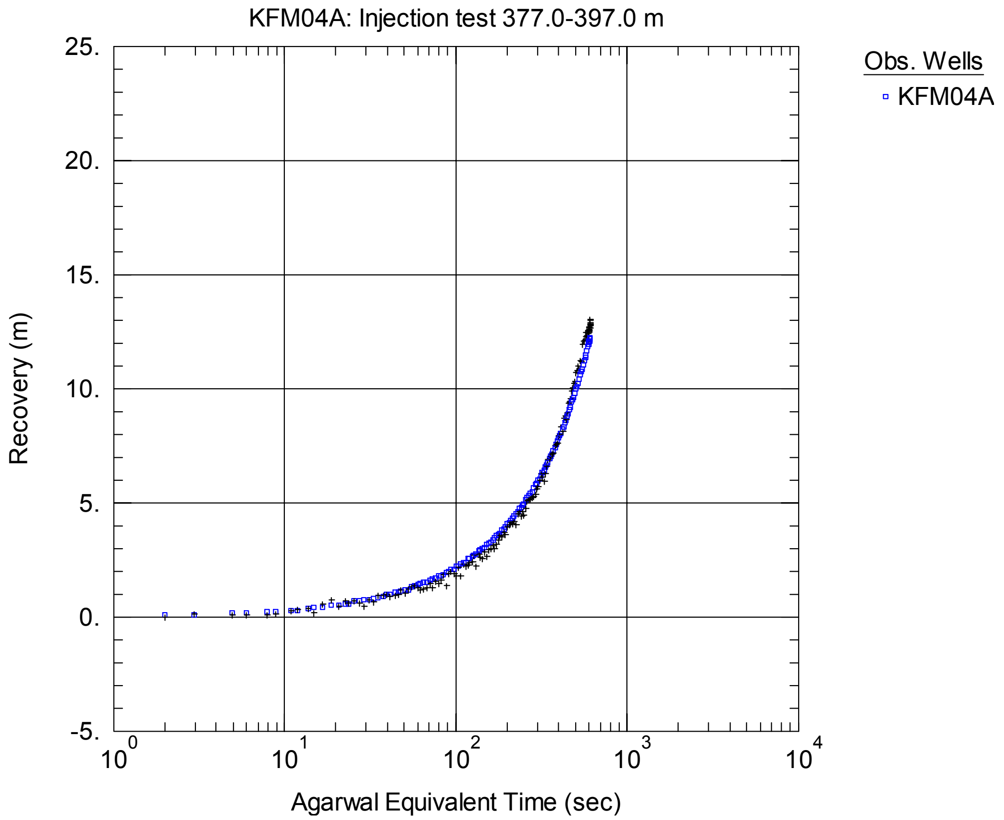


Figure A3-110. *Lin-log plot of recovery (□) and derivative (+) versus equivalent time, from the injection test in section 377-397 m in KFM04A.*

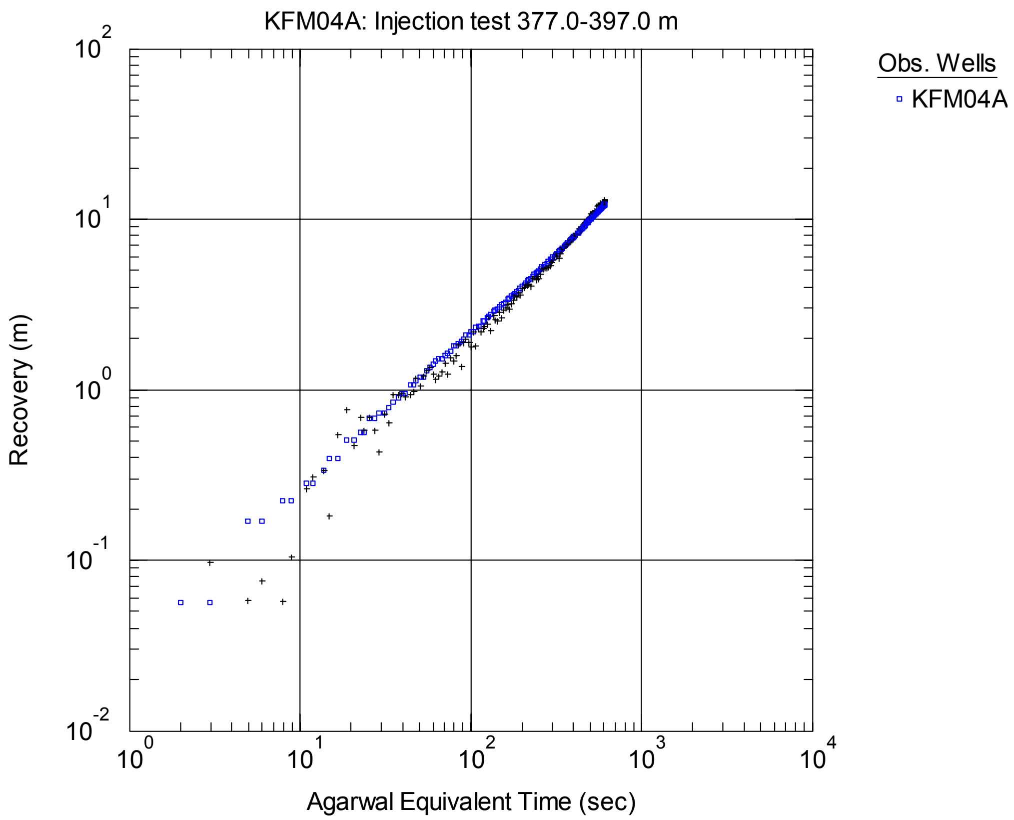


Figure A3-111. *Log-log plot of recovery (□) and derivative (+) versus equivalent time, from the injection test in section 377-397 m in KFM04A.*

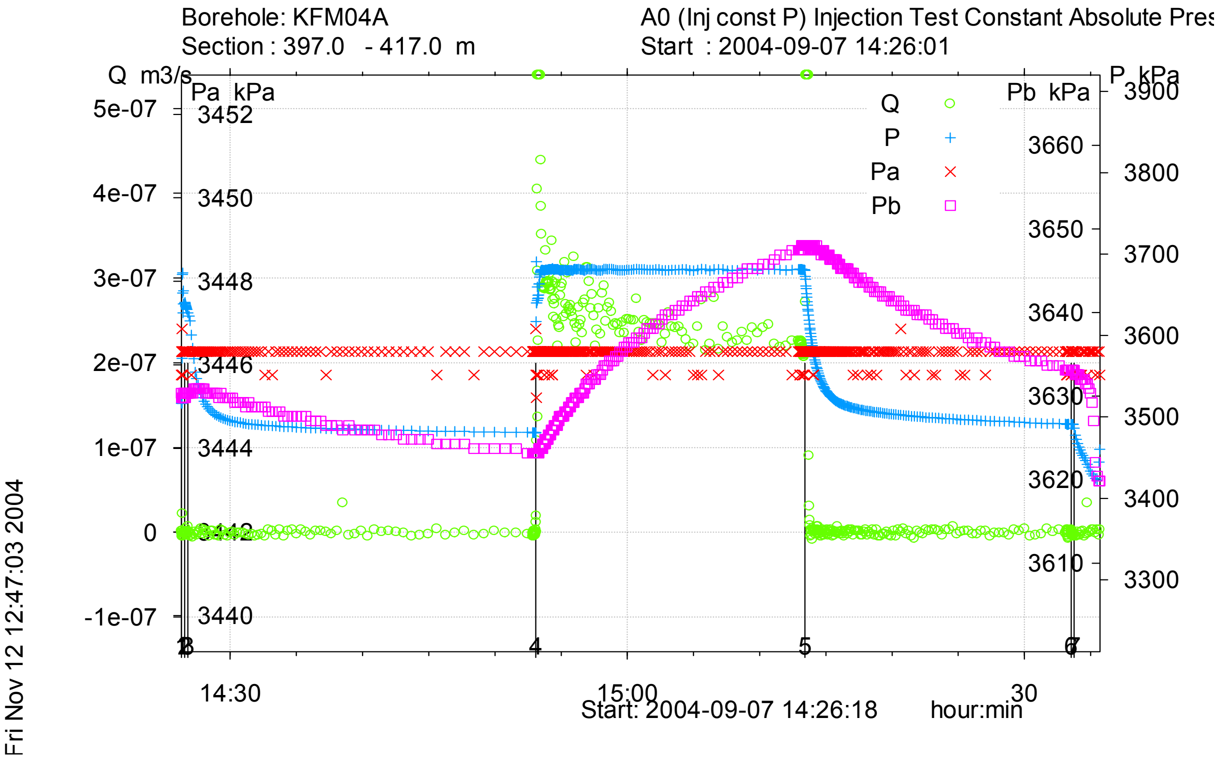


Figure A3-112. Linear plot of flow rate (Q), pressure (P), pressure above section (Pa) and pressure below section (Pb) versus time from the injection test in section 397-417 m in borehole KFM04A.

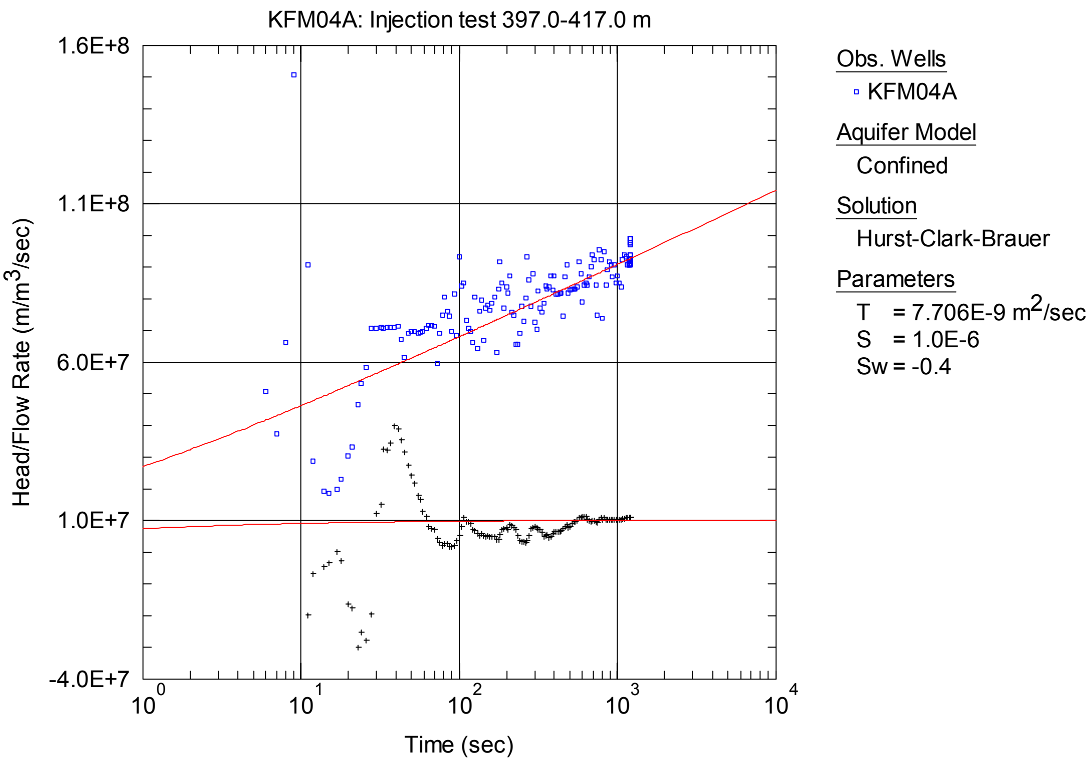


Figure A3-113. Lin-log plot of head/flow rate (□) and derivative (+) versus time, from the injection test in section 397-417 m in KFM04A.

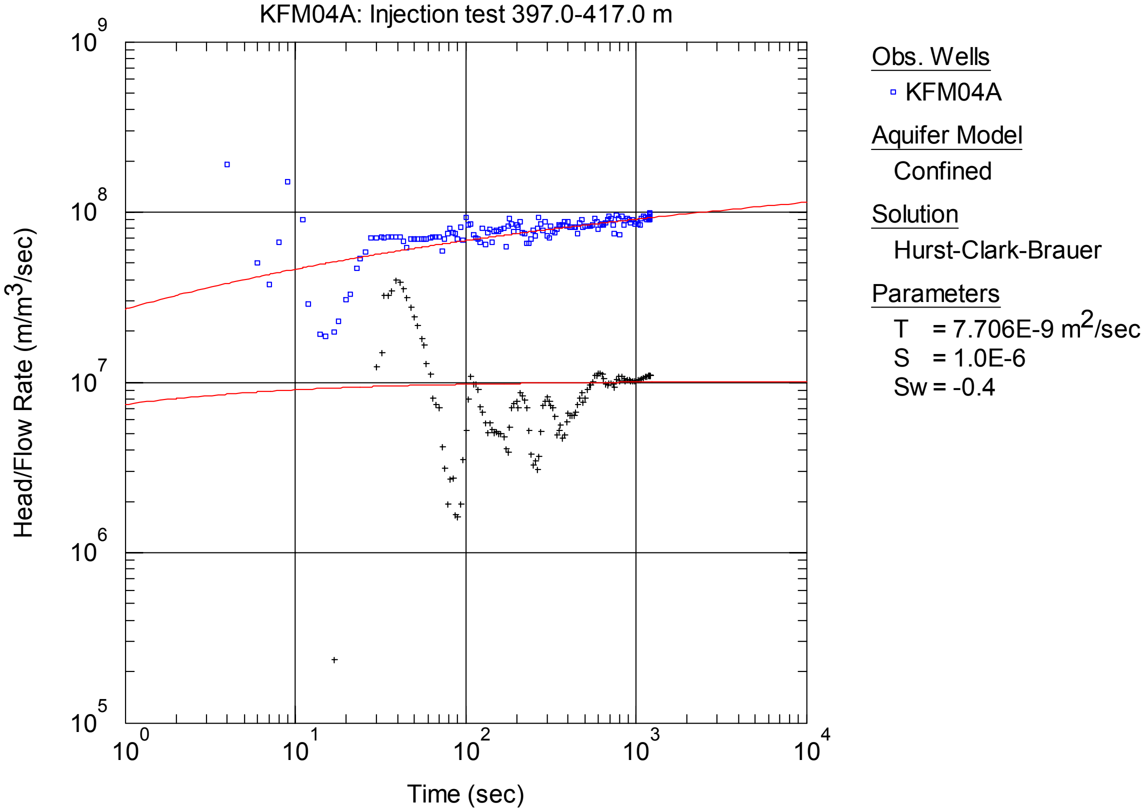


Figure A3-114. *Log-log plot of head/flow rate (□) and derivative (+) versus time, from the injection test in section 397-417 m in KFM04A.*

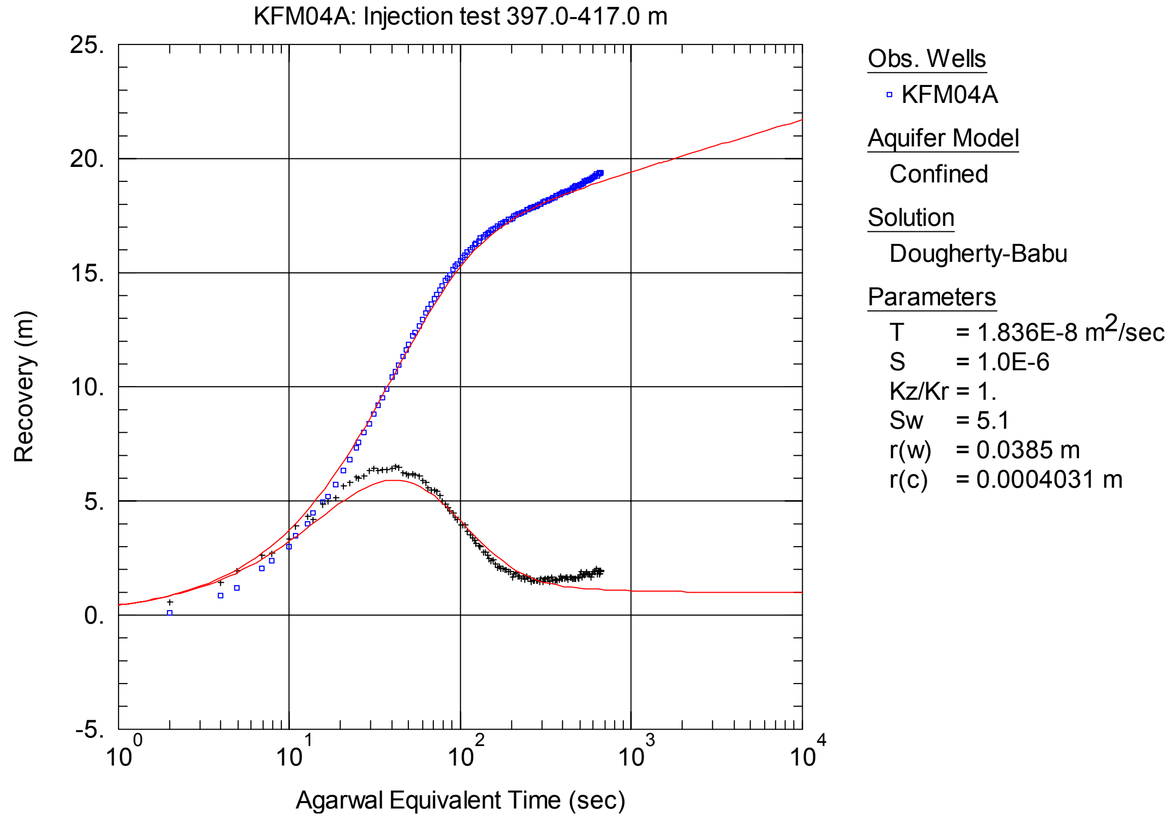


Figure A3-115. *Lin-log plot of recovery (□) and derivative (+) versus equivalent time, from the injection test in section 397-417 m in KFM04A.*

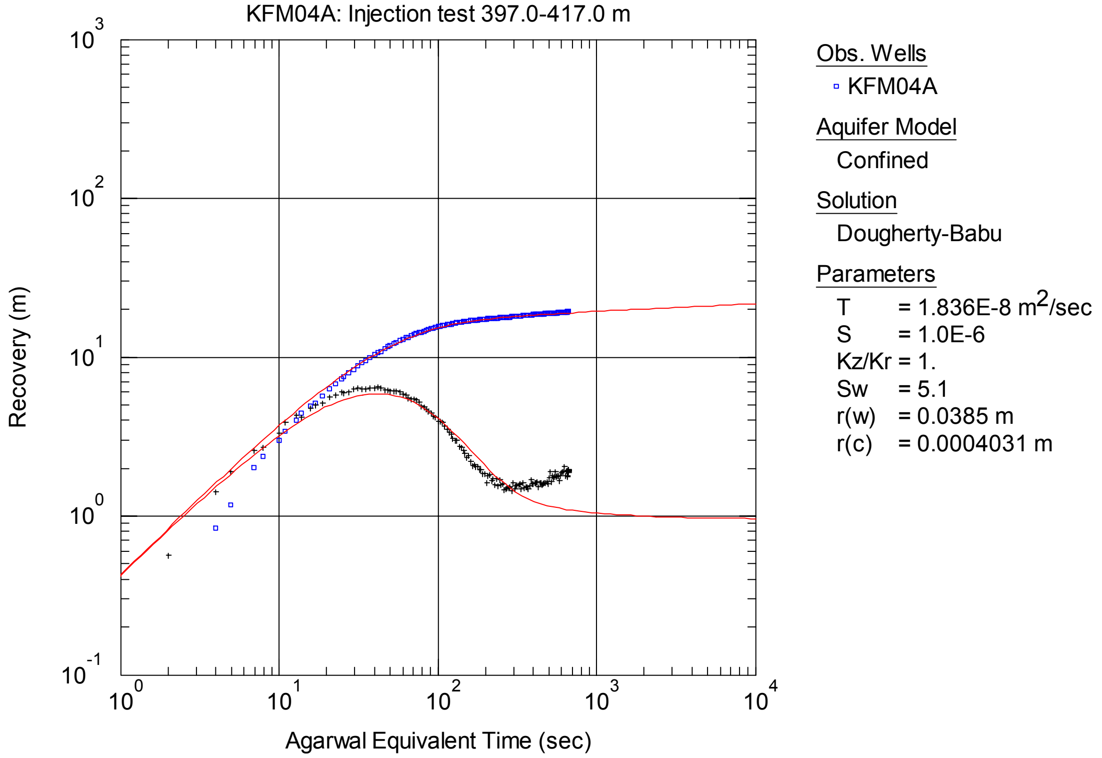


Figure A3-116. Log-log plot of recovery (□) and derivative (+) versus equivalent time, from the injection test in section 397-417 m in KFM04A.

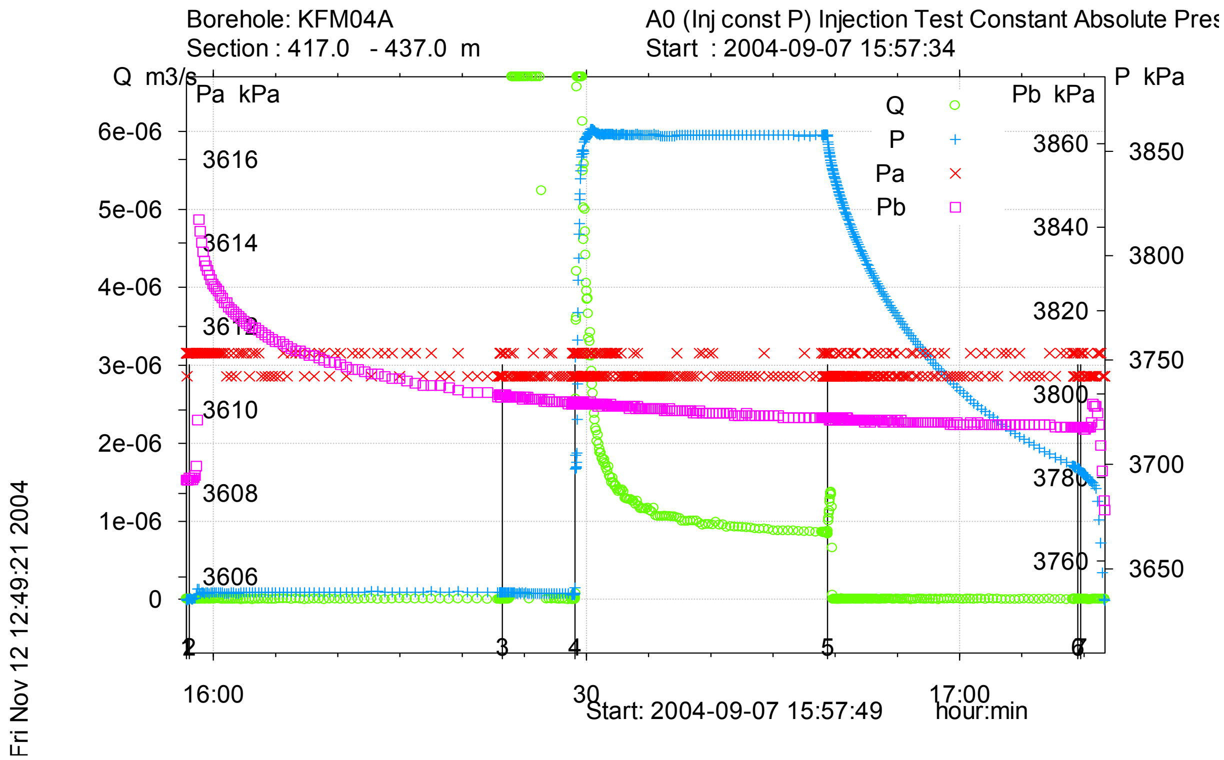


Figure A3-117. Linear plot of flow rate (Q), pressure (P), pressure above section (Pa) and pressure below section (Pb) versus time from the injection test in section 417-437 m in borehole KFM04A.

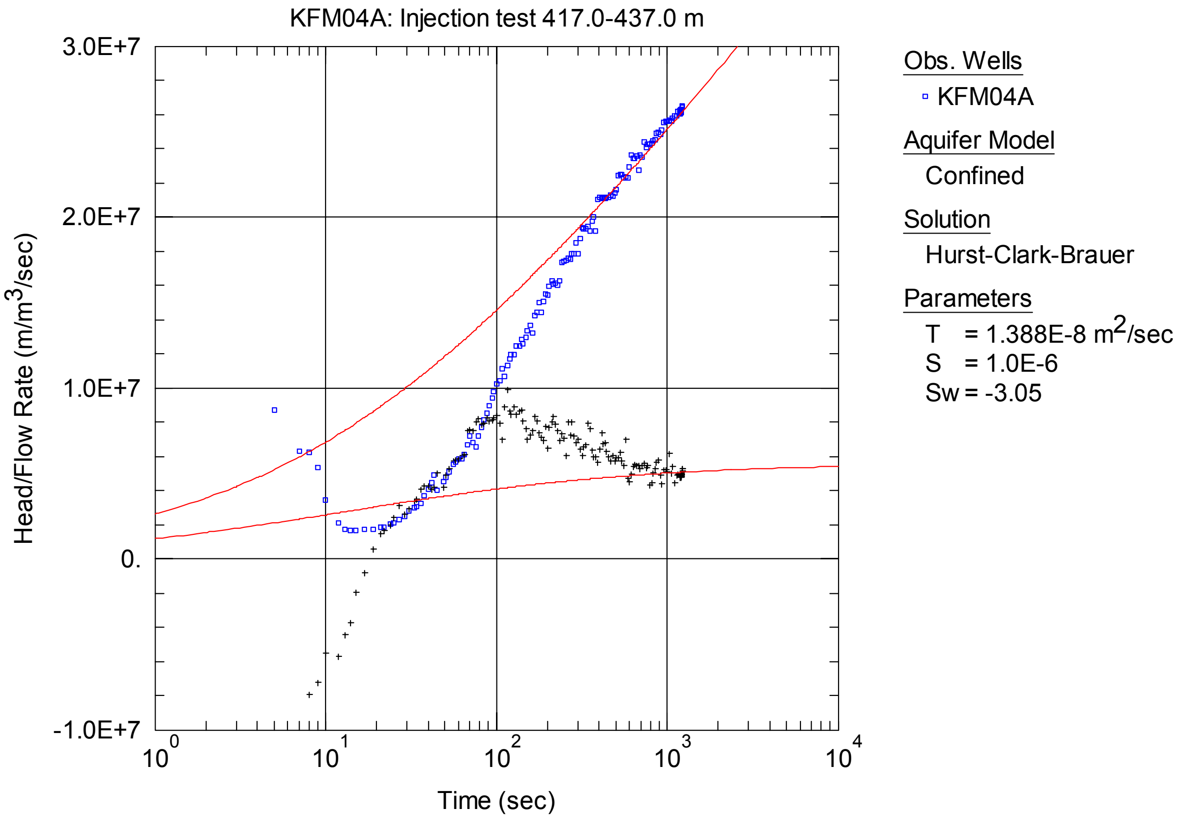


Figure A3-118. *Lin-log plot of head/flow rate (□) and derivative (+) versus time, from the injection test in section 417-437 m in KFM04A.*

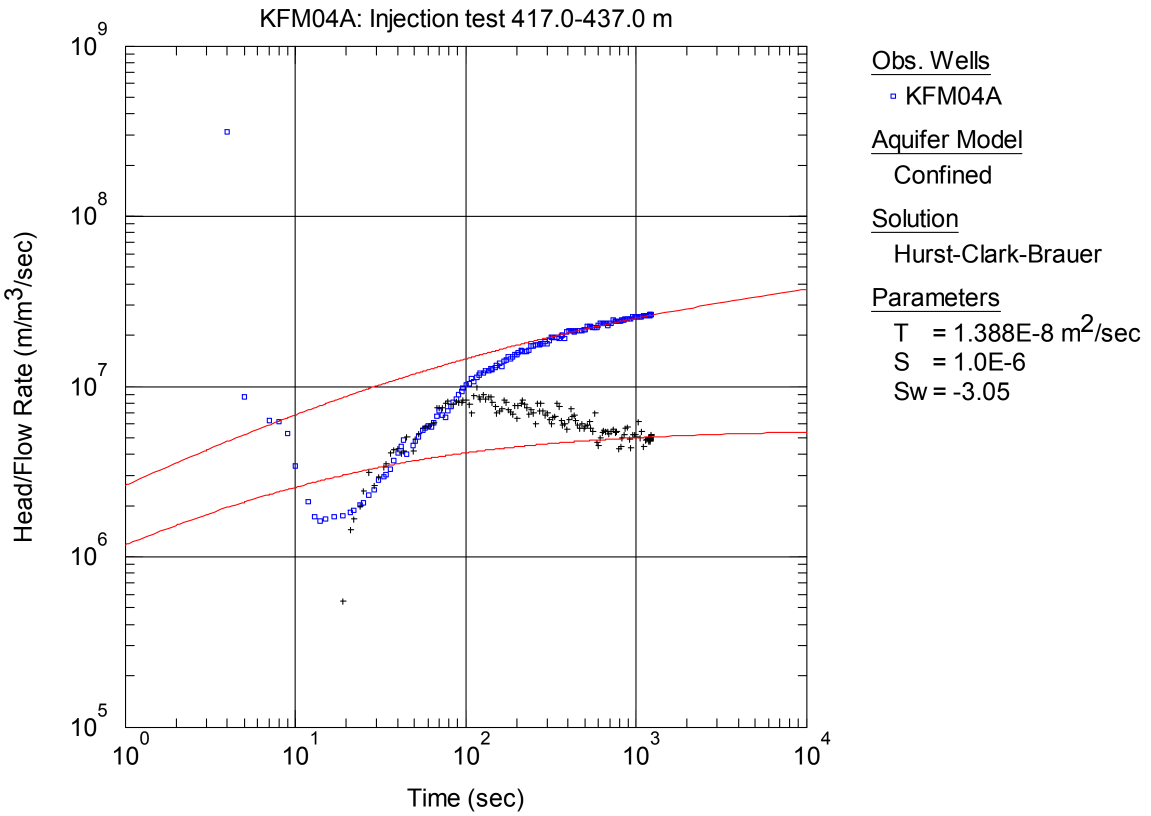


Figure A3-119. *Log-log plot of head/flow rate (□) and derivative (+) versus time, from the injection test in section 417-437 m in KFM04A.*

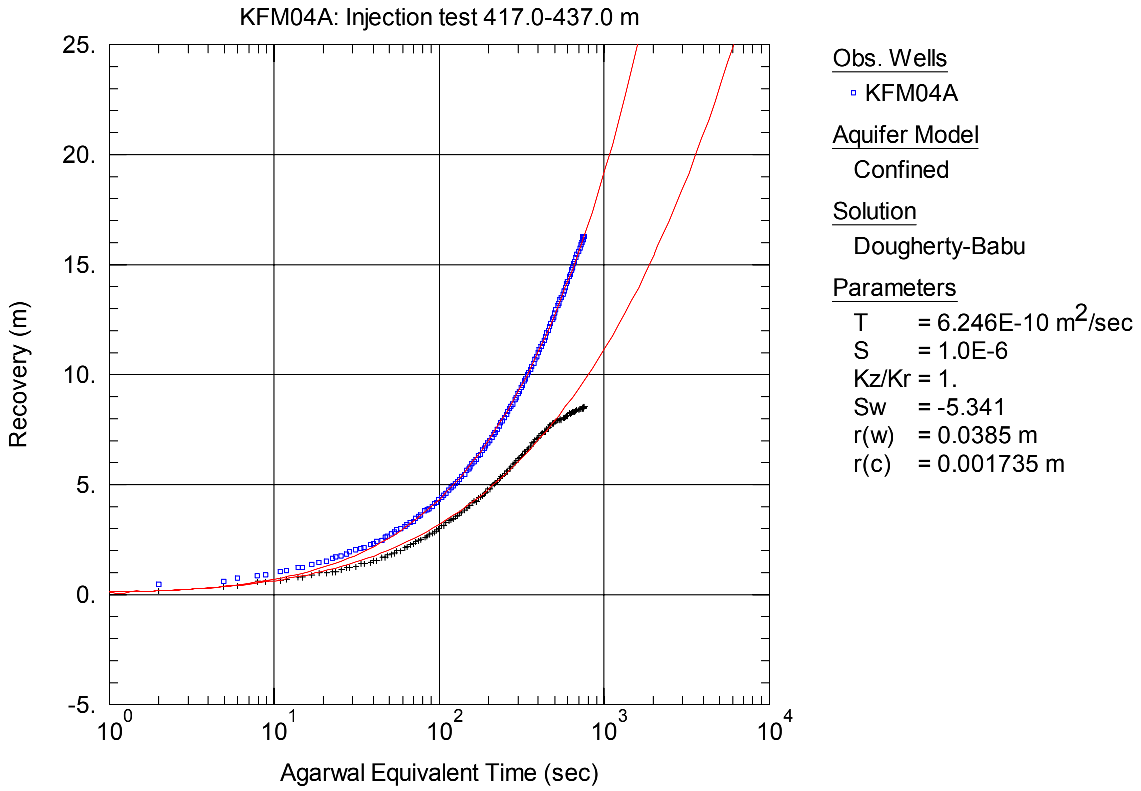


Figure A3-120. *Lin-log plot of recovery (□) and derivative (+) versus equivalent time, from the injection test in section 417-437 m in KFM04A. The type curve fit is only to show that an assumption of PRF is not valid.*

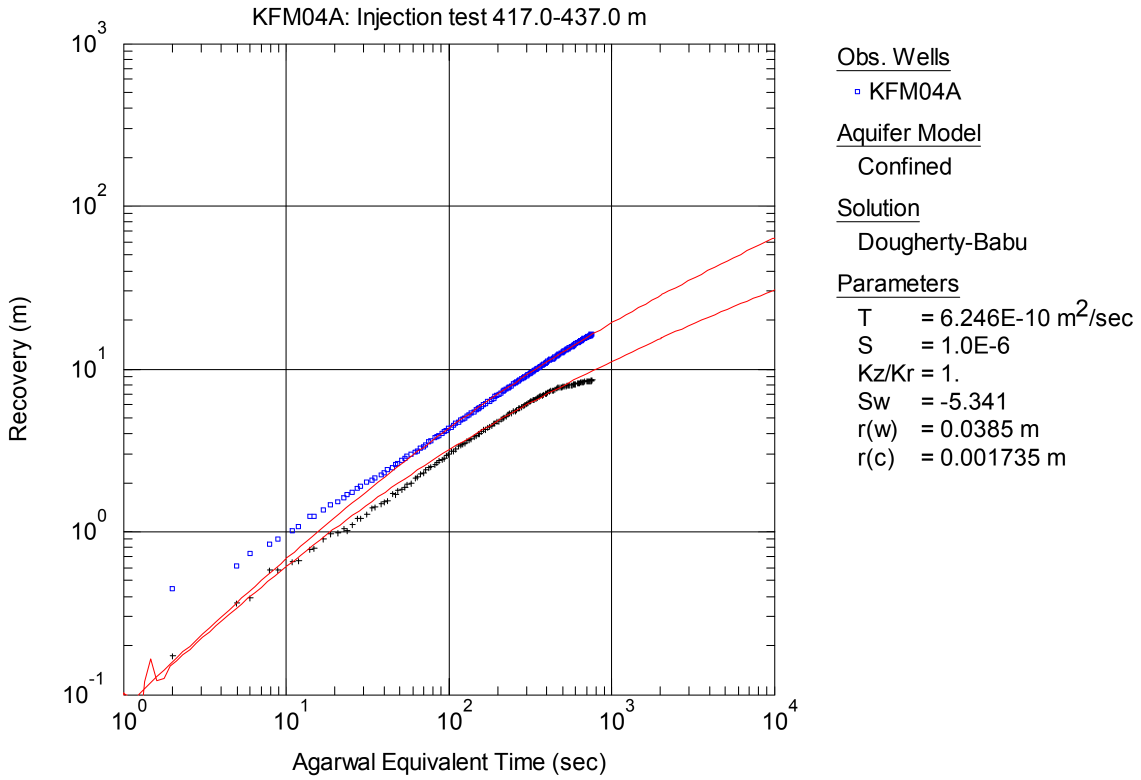


Figure A3-121. *Log-log plot of recovery (□) and derivative (+) versus equivalent time, from the injection test in section 417-437 m in KFM04A. The type curve fit is only to show that an assumption of PRF is not valid.*

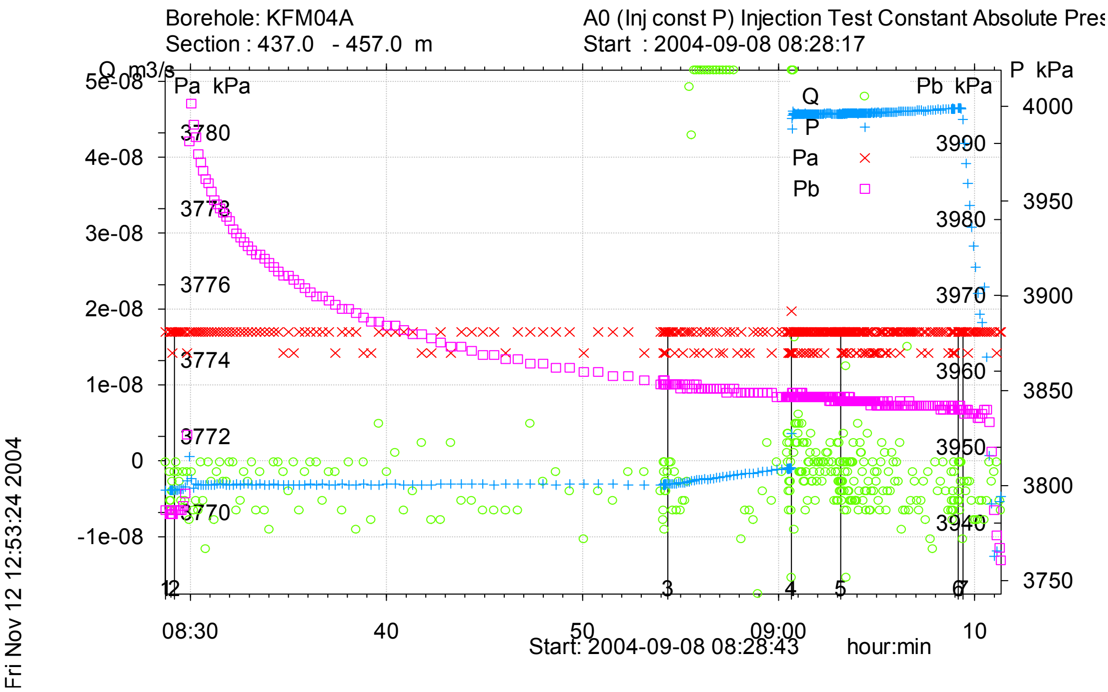


Figure A3-122. Linear plot of flow rate (Q), pressure (P), pressure above section (Pa) and pressure below section (Pb) versus time from the injection test in section 437-457 m in borehole KFM04A.

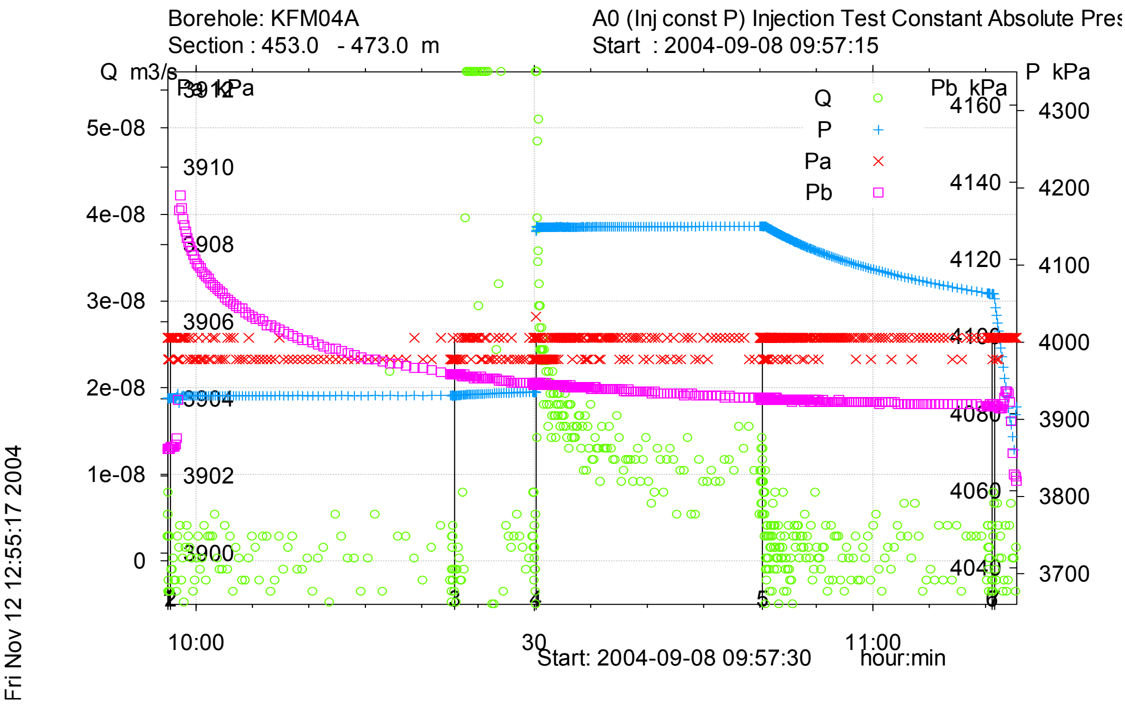


Figure A3-123. Linear plot of flow rate (Q), pressure (P), pressure above section (Pa) and pressure below section (Pb) versus time from the injection test in section 453-473 m in borehole KFM04A.

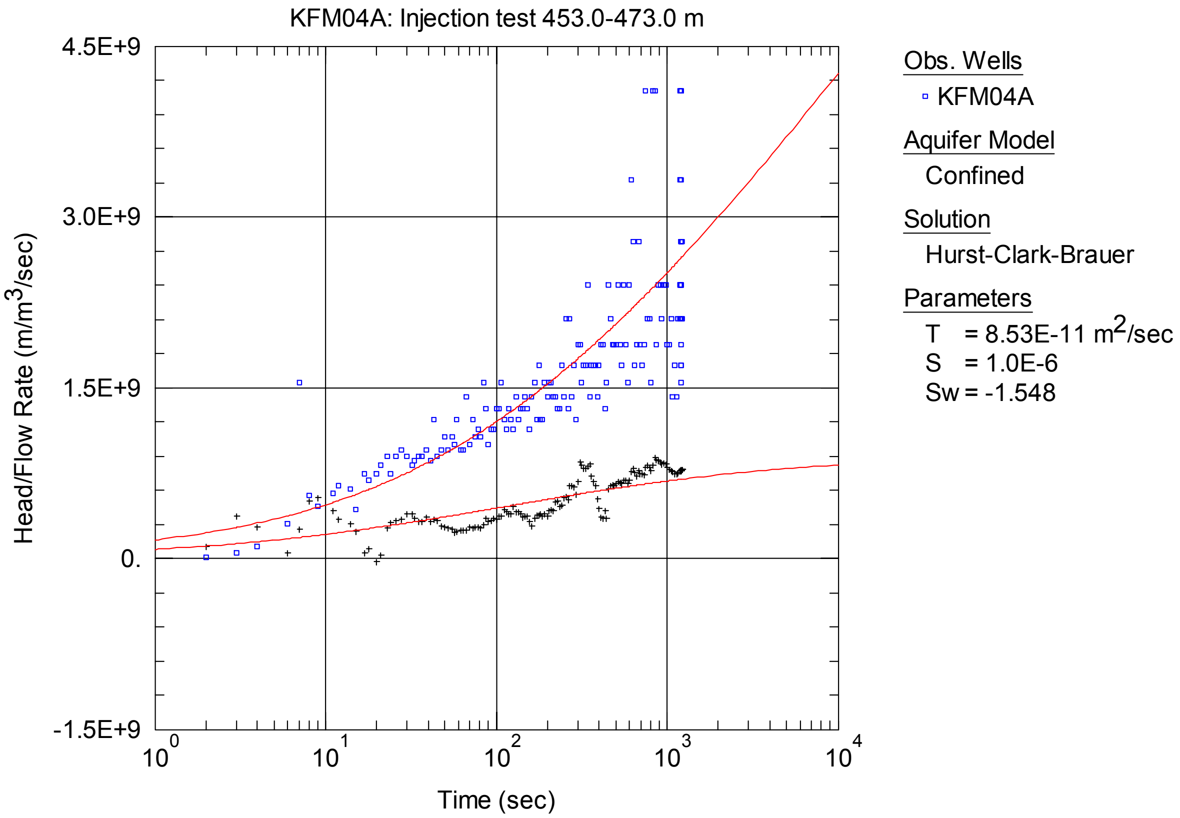


Figure A3-124. *Lin-log plot of head/flow rate (□) and derivative (+) versus time, from the injection test in section 453-473 m in KFM04A.*

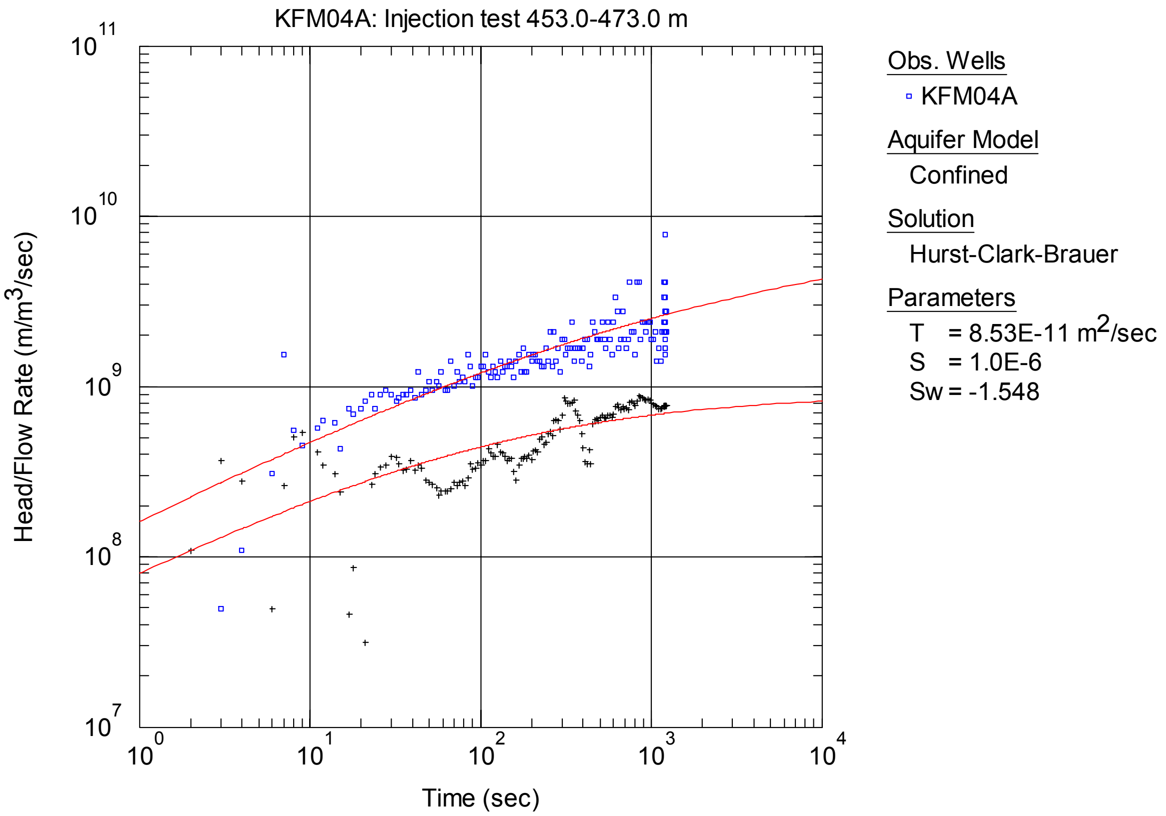


Figure A3-125. *Log-log plot of head/flow rate (□) and derivative (+) versus time, from the injection test in section 453-473 m in KFM04A.*

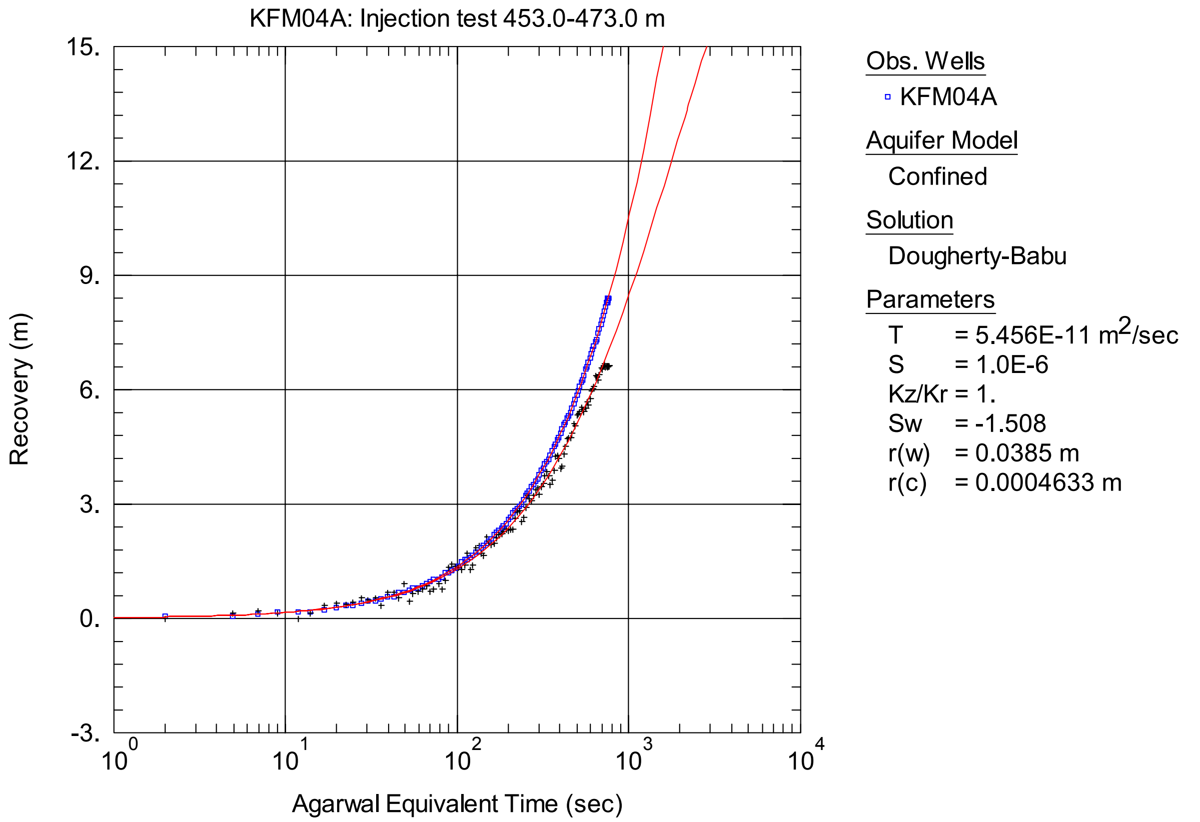


Figure A3-126. *Lin-log plot of recovery (□) and derivative (+) versus equivalent time, from the injection test in section 453-473 m in KFM04A.*

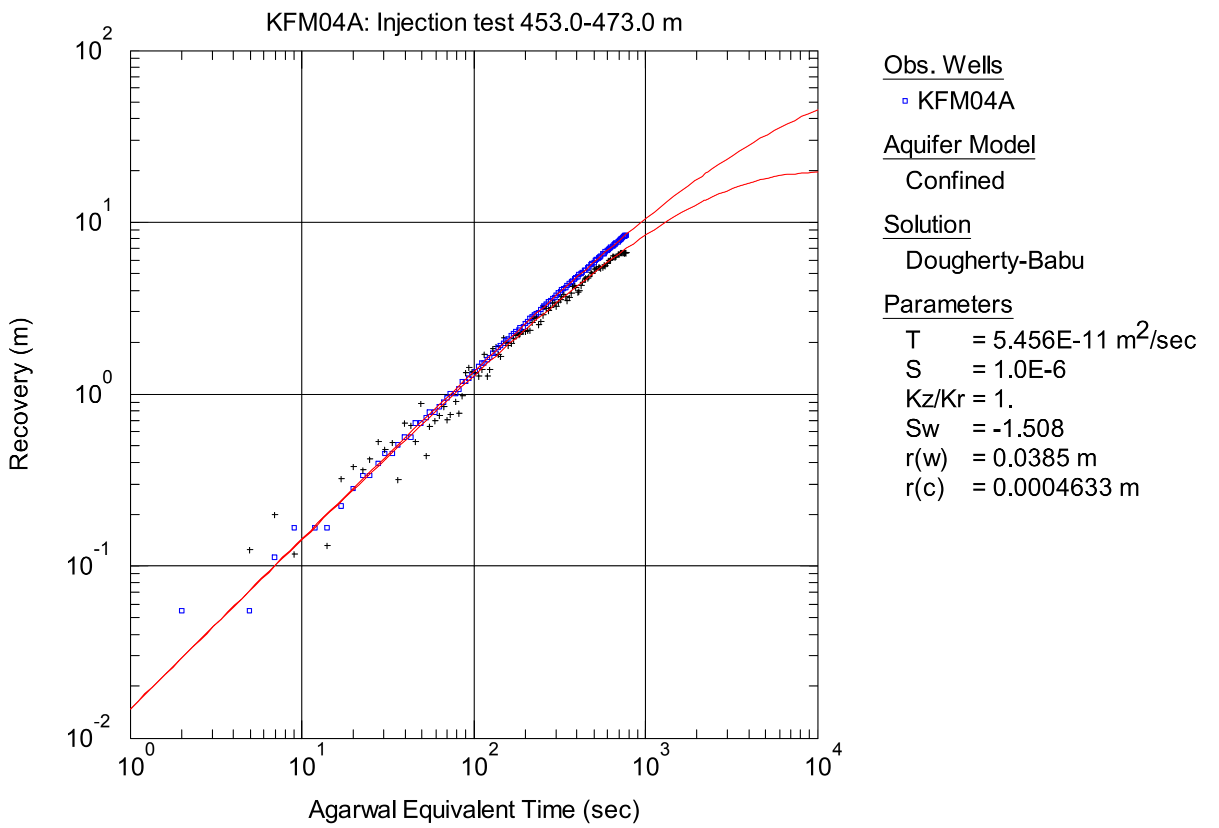


Figure A3-127. *Log-log plot of recovery (□) and derivative (+) versus equivalent time, from the injection test in section 453-473 m in KFM04A.*

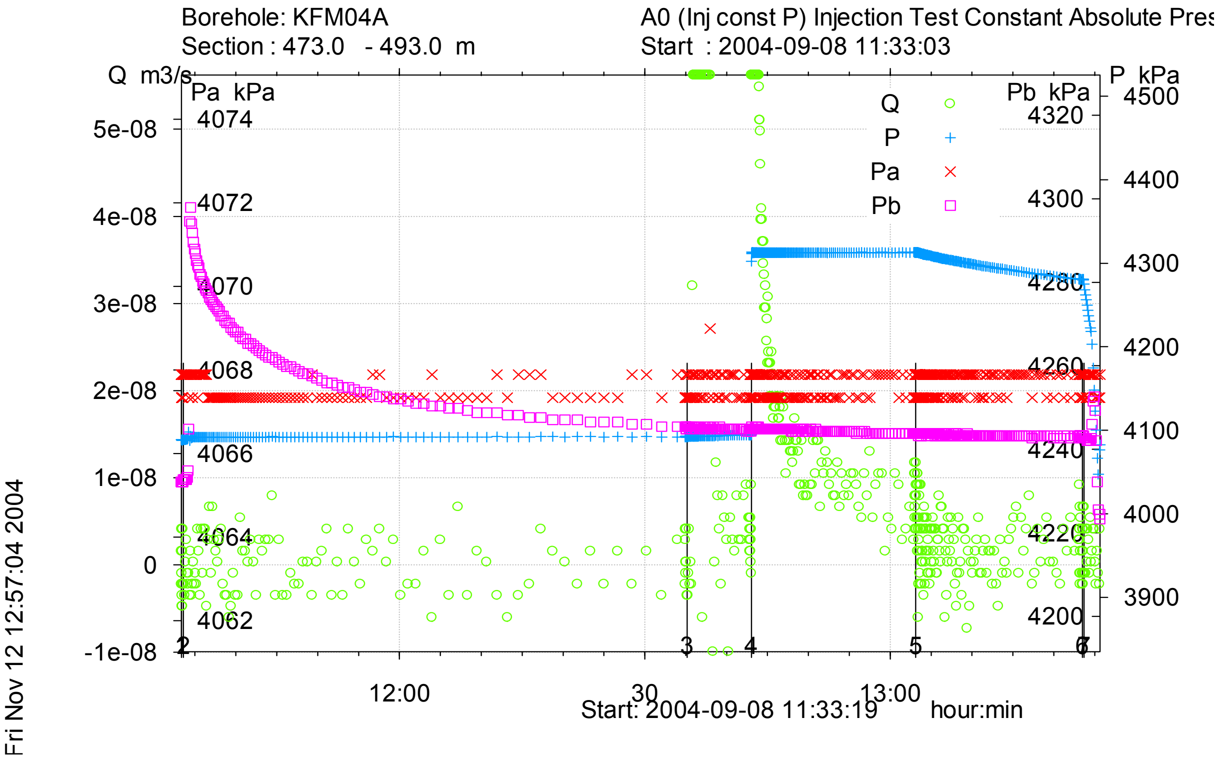


Figure A3-128. Linear plot of flow rate (Q), pressure (P), pressure above section (Pa) and pressure below section (Pb) versus time from the injection test in section 473-493 m in borehole KFM04A.

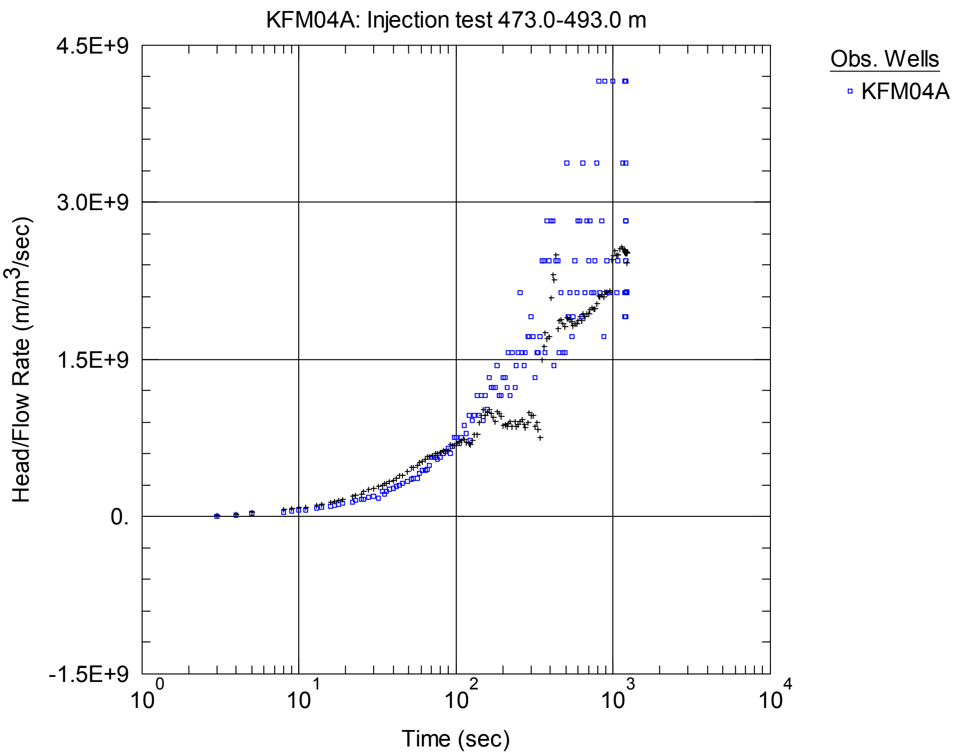


Figure A3-129. Lin-log plot of head/flow rate (□) and derivative (+) versus time, from the injection test in section 473-493 m in KFM04A.

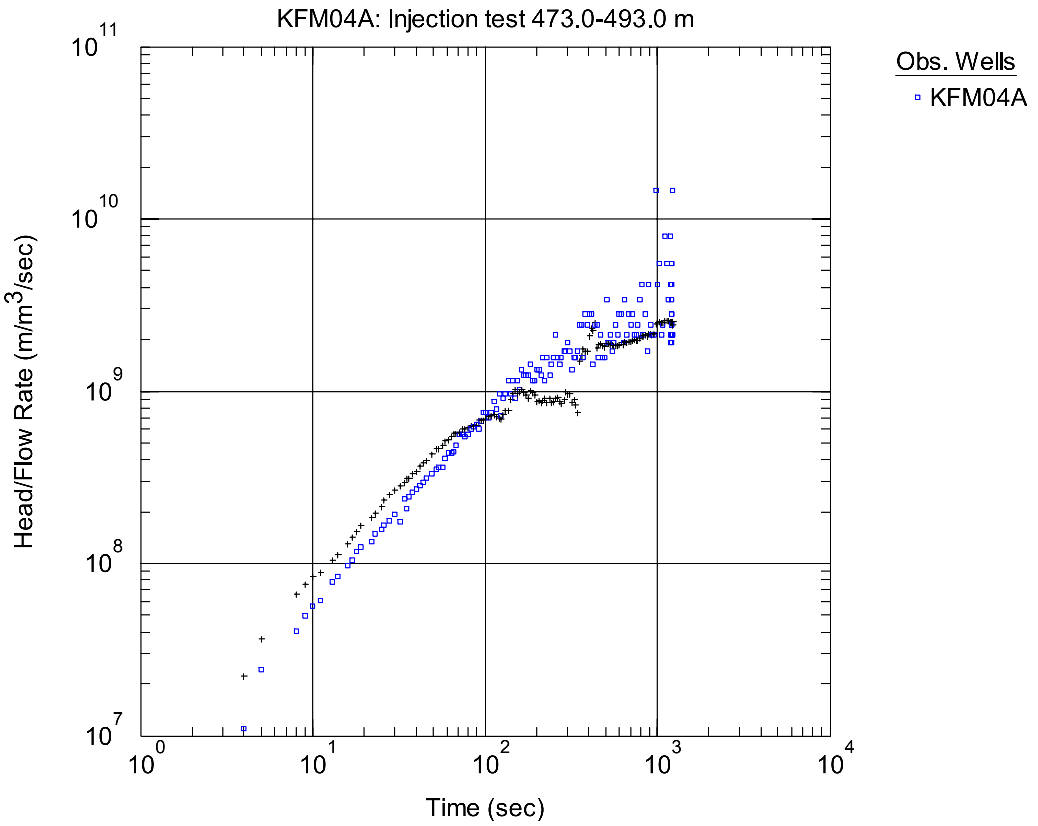


***Figure A3-130.** Log-log plot of head/flow rate (□) and derivative (+) versus time, from the injection test in section 473-493 m in KFM04A.*

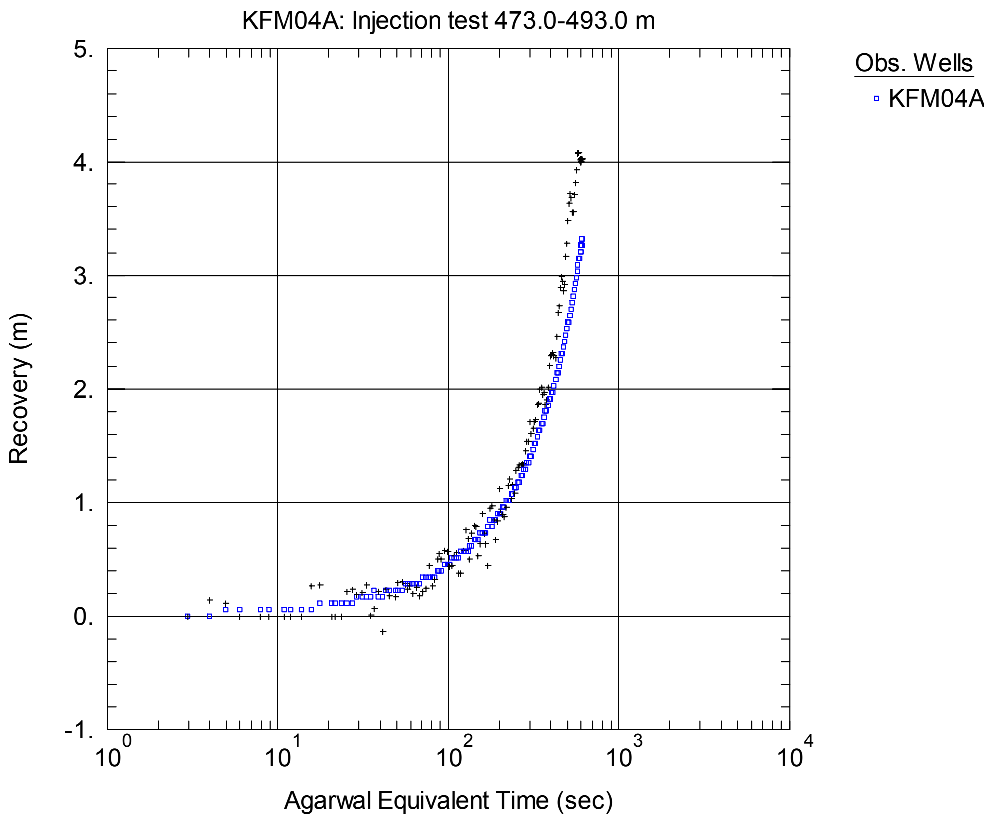


***Figure A3-131.** Lin-log plot of recovery (□) and derivative (+) versus equivalent time, from the injection test in section 473-493 m in KFM04A.*

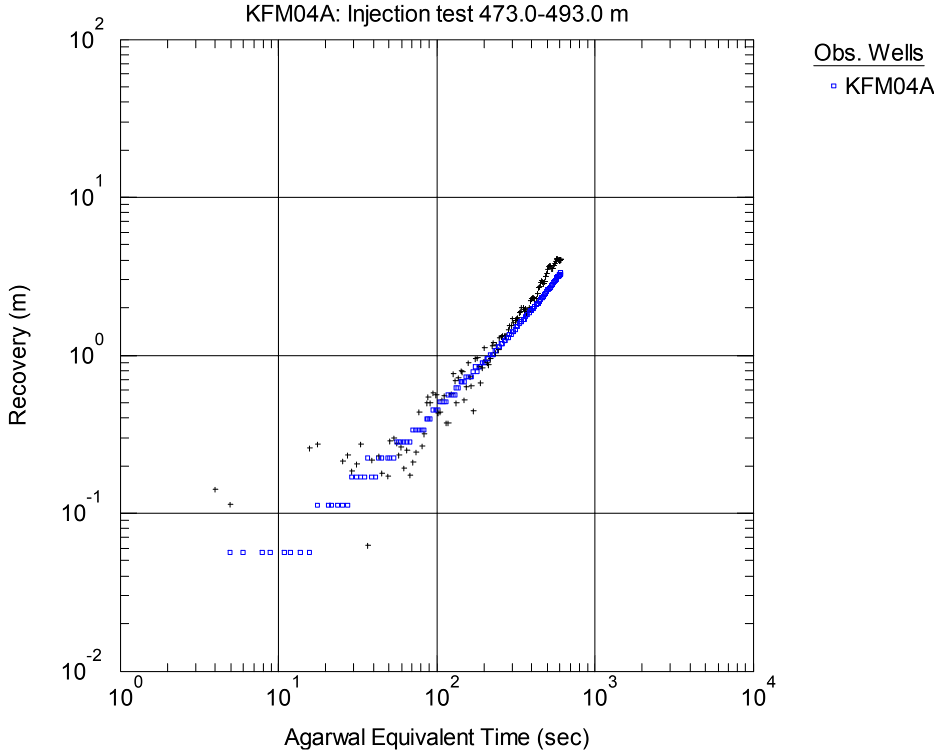


__Figure A3-132.__ Log-log plot of recovery (□) and derivative (+) versus equivalent time, from the injection test in section 473-493 m in KFM04A.

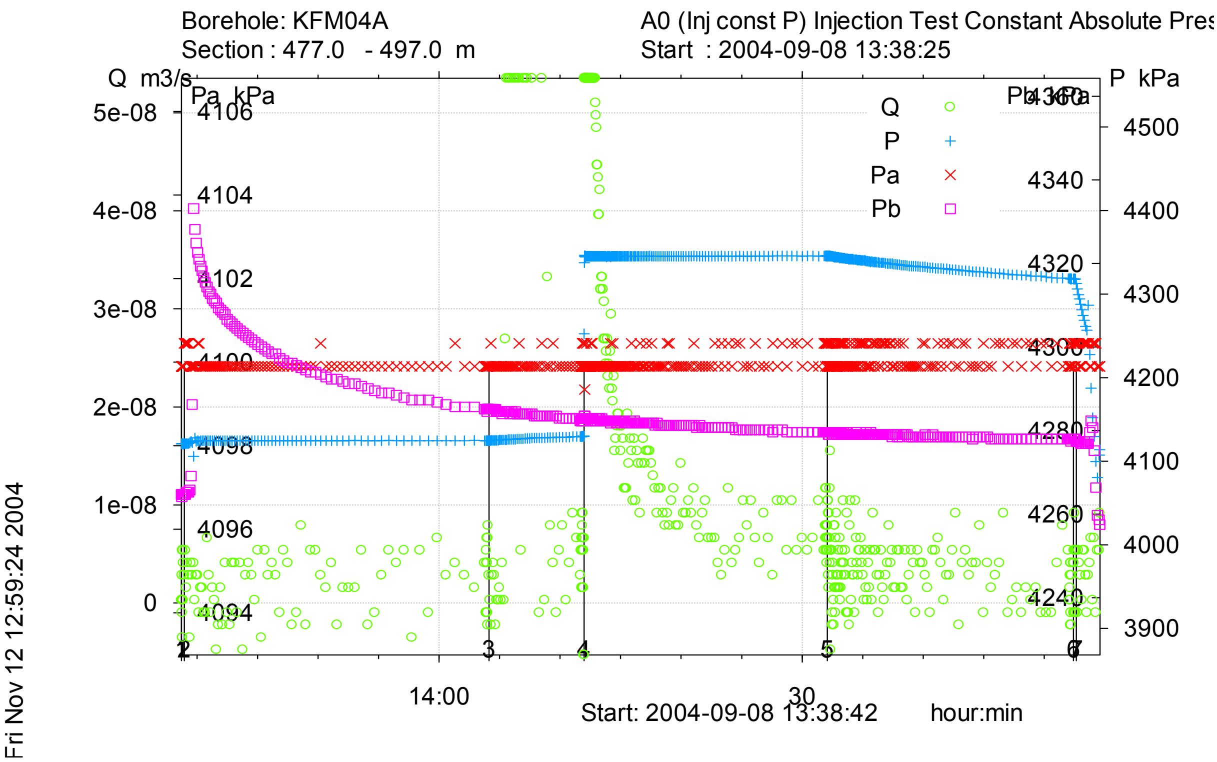


__Figure A3-133.__ Linear plot of flow rate (Q), pressure (P), pressure above section (Pa) and pressure below section (Pb) versus time from the injection test in section 477-497 m in borehole KFM04A.

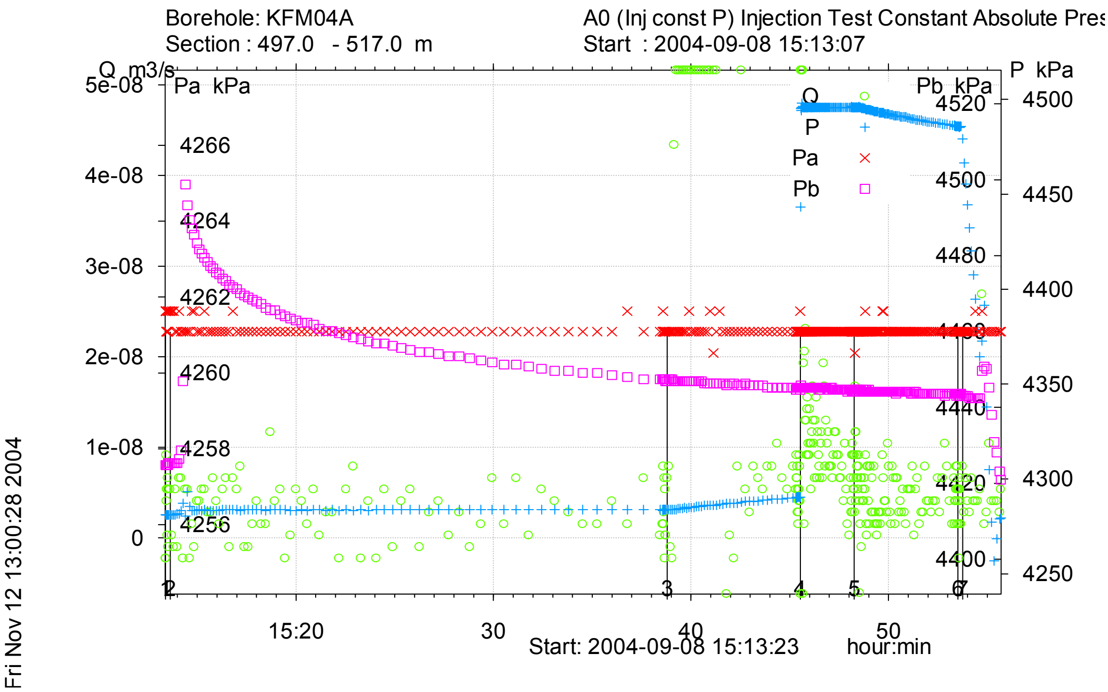


Figure A3-134. *Linear plot of flow rate (Q), pressure (P), pressure above section (Pa) and pressure below section (Pb) versus time from the injection test in section 497-517 m in borehole KFM04A.*

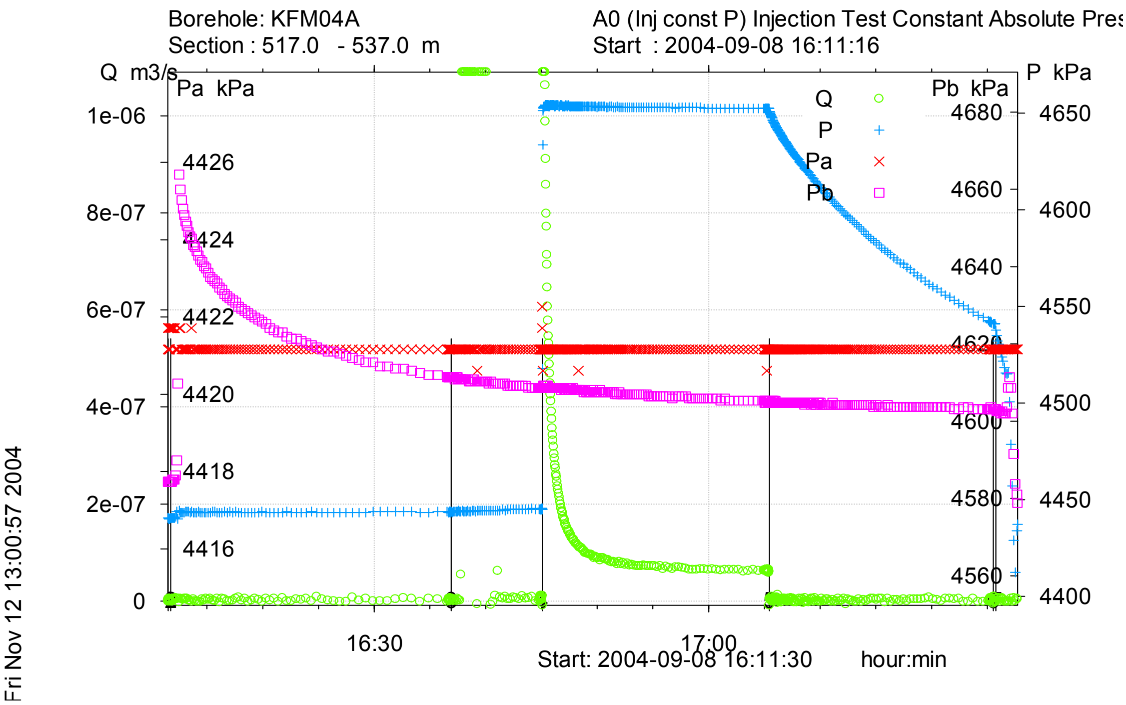


Figure A3-135. *Linear plot of flow rate (Q), pressure (P), pressure above section (Pa) and pressure below section (Pb) versus time from the injection test in section 517-537 m in borehole KFM04A.*

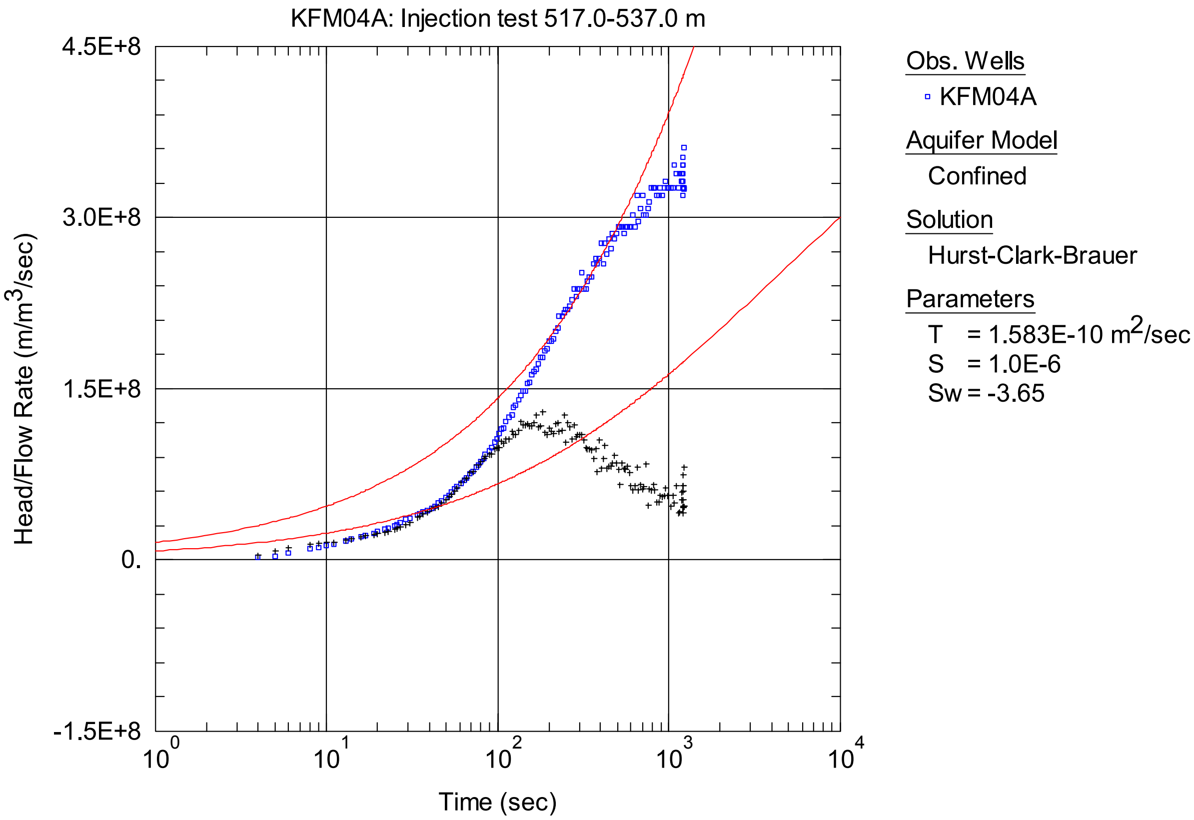


Figure A3-136. *Lin-log plot of head/flow rate (□) and derivative (+) versus time, from the injection test in section 517-537 m in KFM04A.*

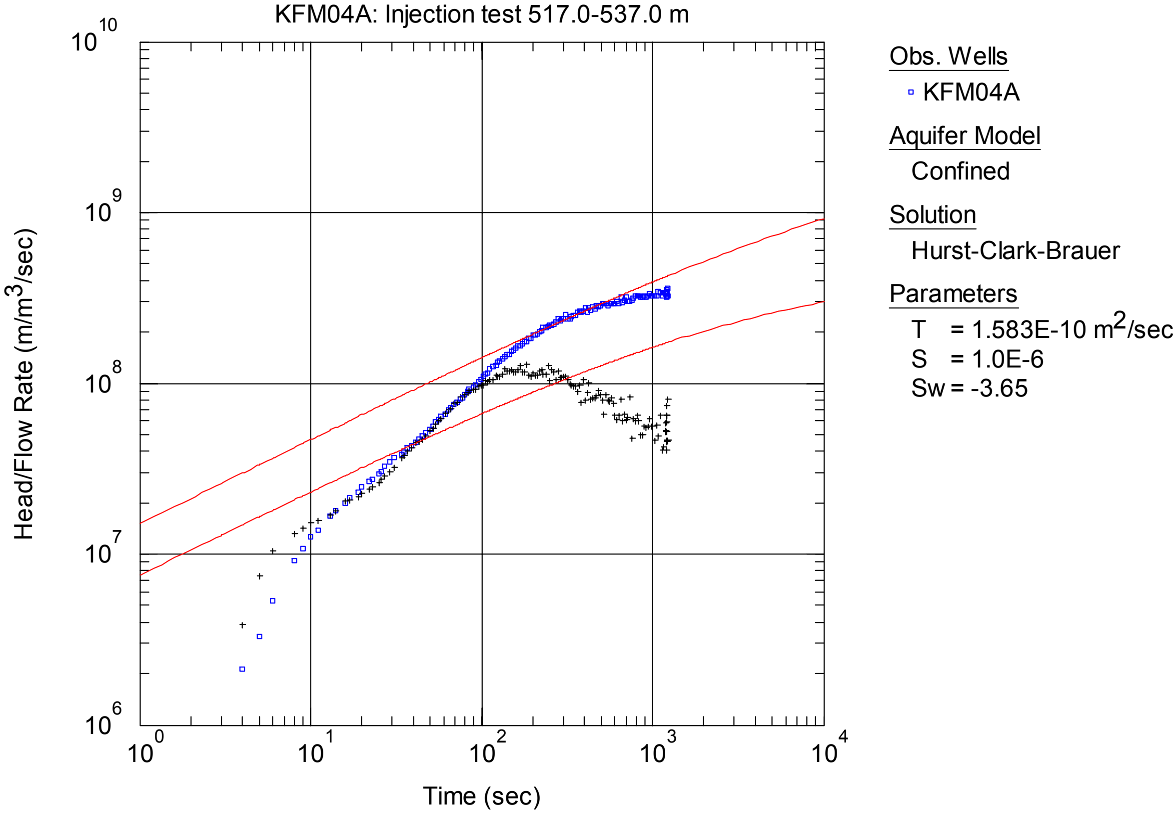


Figure A3-137. *Log-log plot of head/flow rate (□) and derivative (+) versus time, from the injection test in section 517-537 m in KFM04A.*

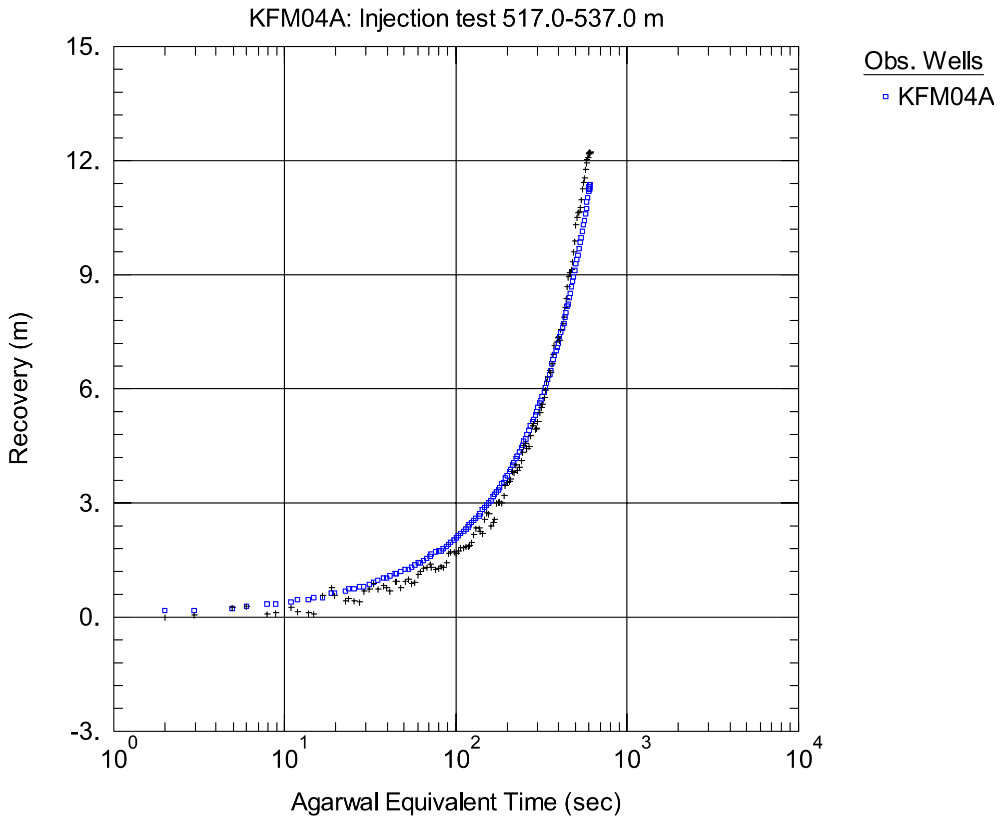


Figure A3-138. *Lin-log plot of recovery (□) and derivative (+) versus equivalent time, from the injection test in section 517-537 m in KFM04A.*

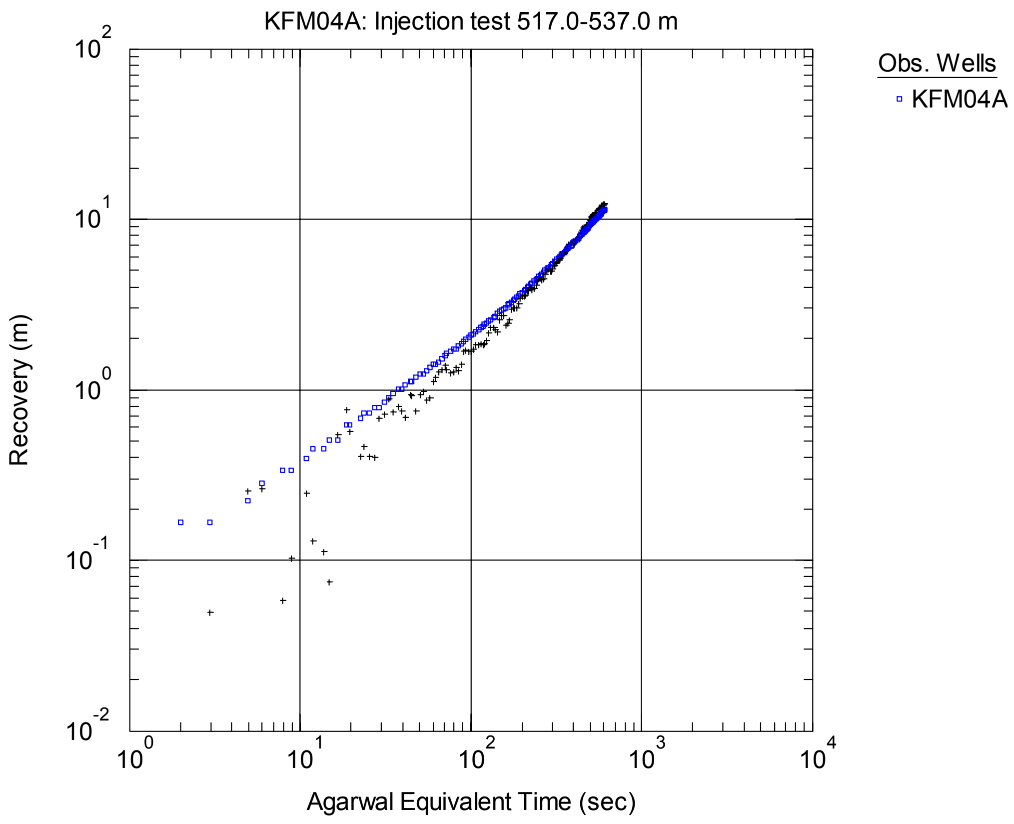


Figure A3-139. *Log-log plot of recovery (□) and derivative (+) versus equivalent time, from the injection test in section 517-537 m in KFM04A.*

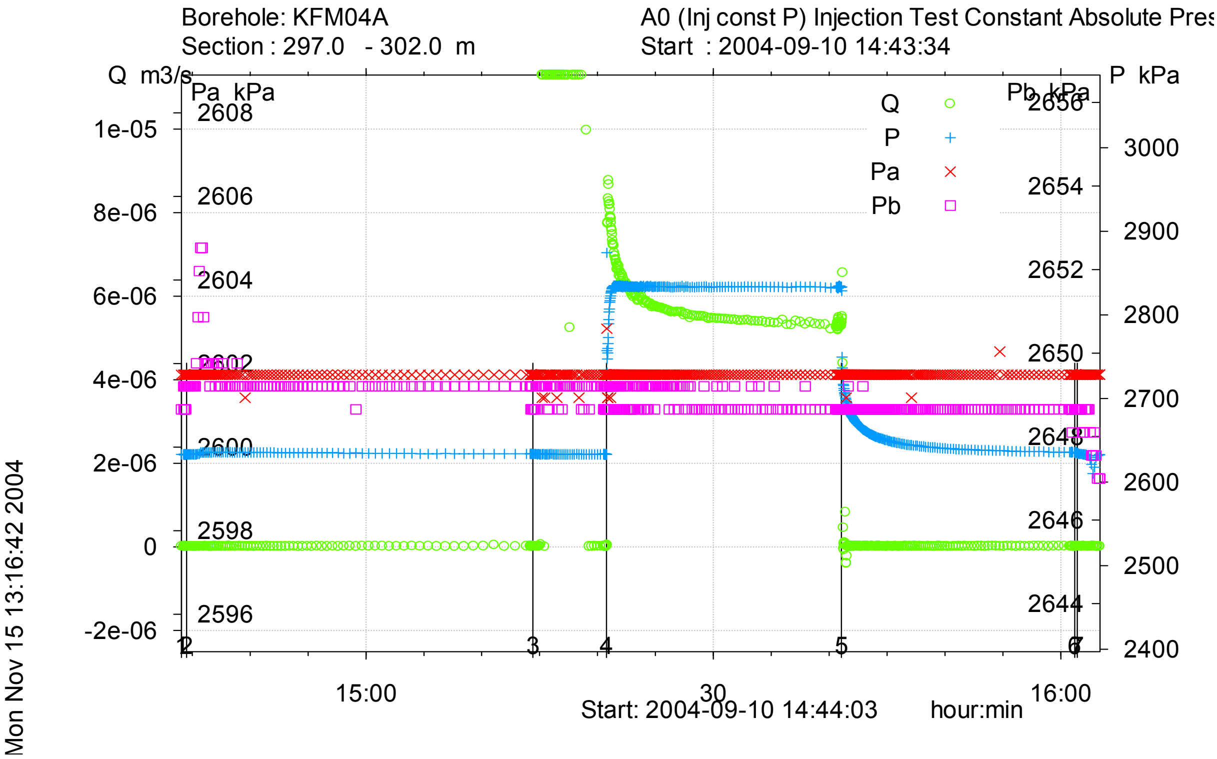


Figure A3-140. *Linear plot of flow rate (Q), pressure (P), pressure above section (Pa) and pressure below section (Pb) versus time from the injection test in section 297-302 m in borehole KFM04A.*

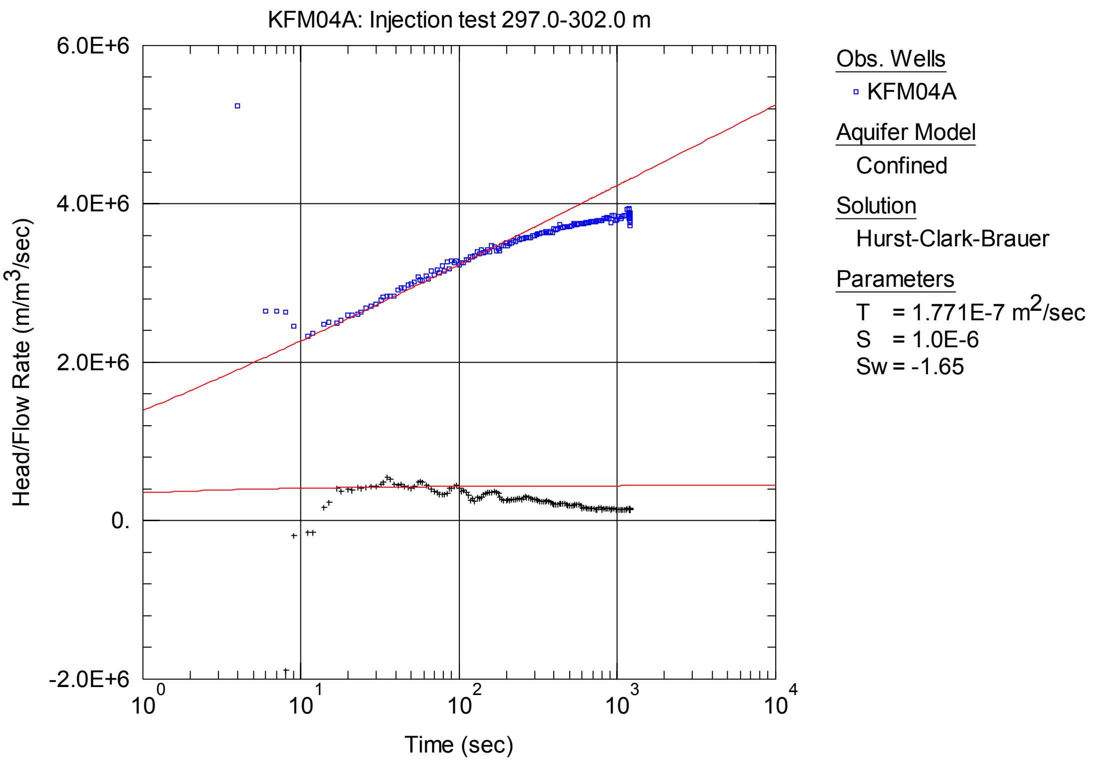


Figure A3-141. *Lin-log plot of head/flow rate (□) and derivative (+) versus time, from the injection test in section 297-302 m in KFM04A.*

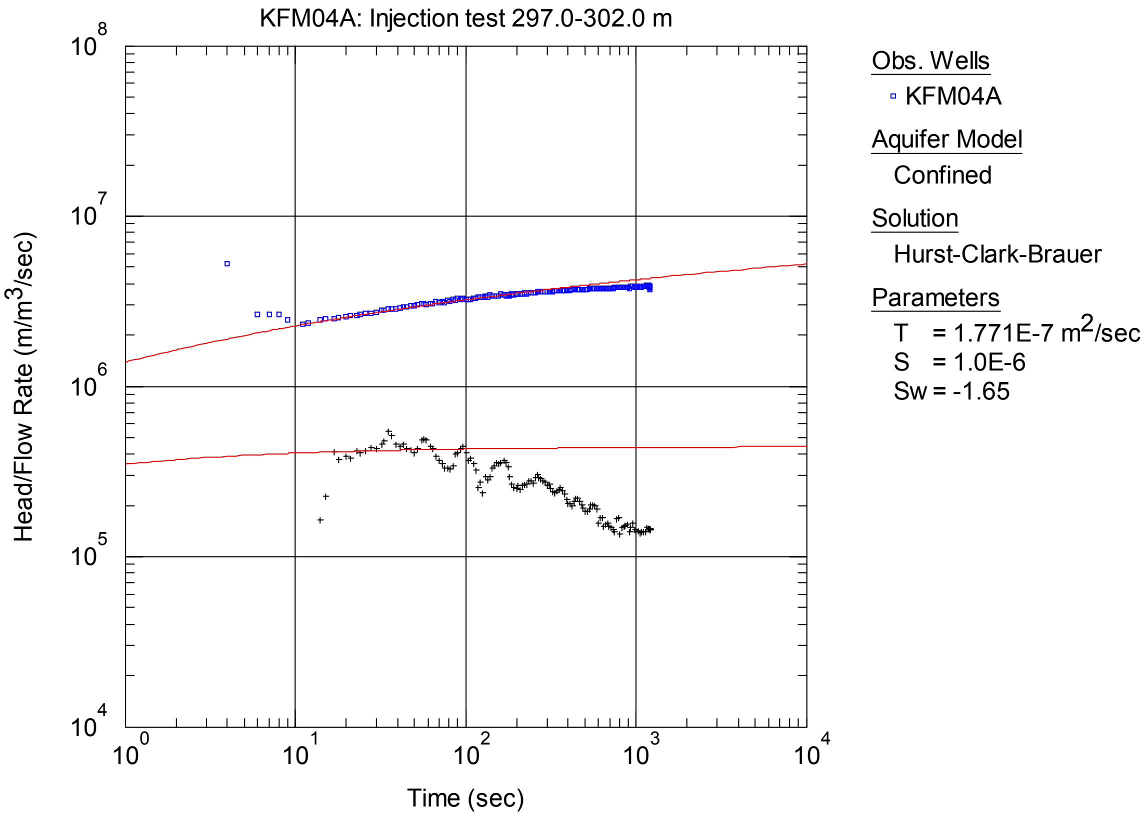


***Figure A3-142.** Log-log plot of head/flow rate (□) and derivative (+) versus time, from the injection test in section 297-302 m in KFM04A.*

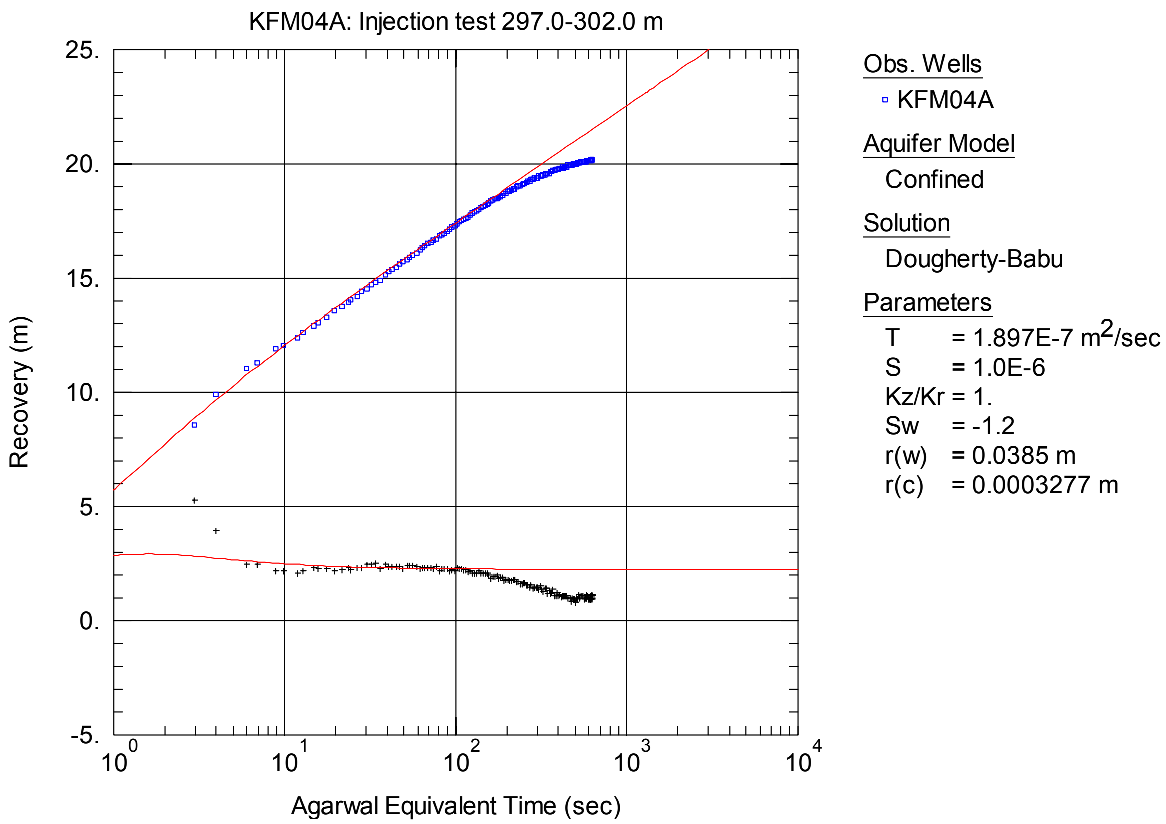


***Figure A3-143.** Lin-log plot of recovery (□) and derivative (+) versus equivalent time, from the injection test in section 297-302 m in KFM04A.*

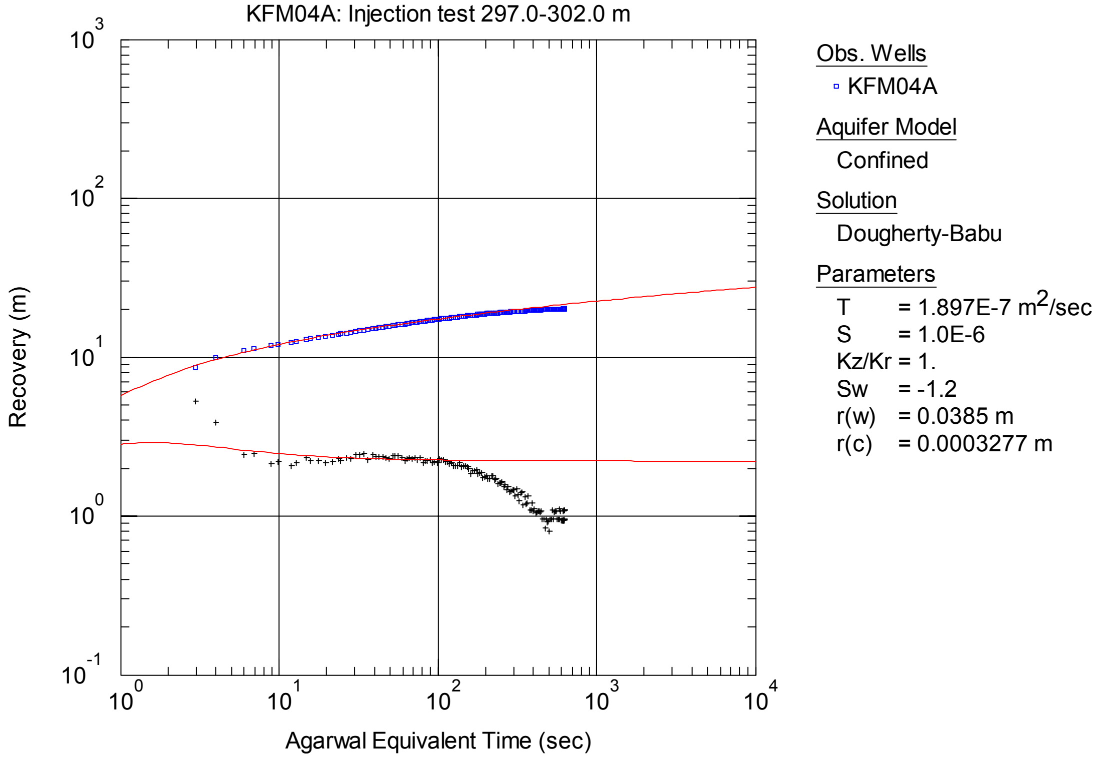


***Figure A3-144.** Log-log plot of recovery (□) and derivative (+) versus equivalent time, from the injection test in section 297-302 m in KFM04A.*

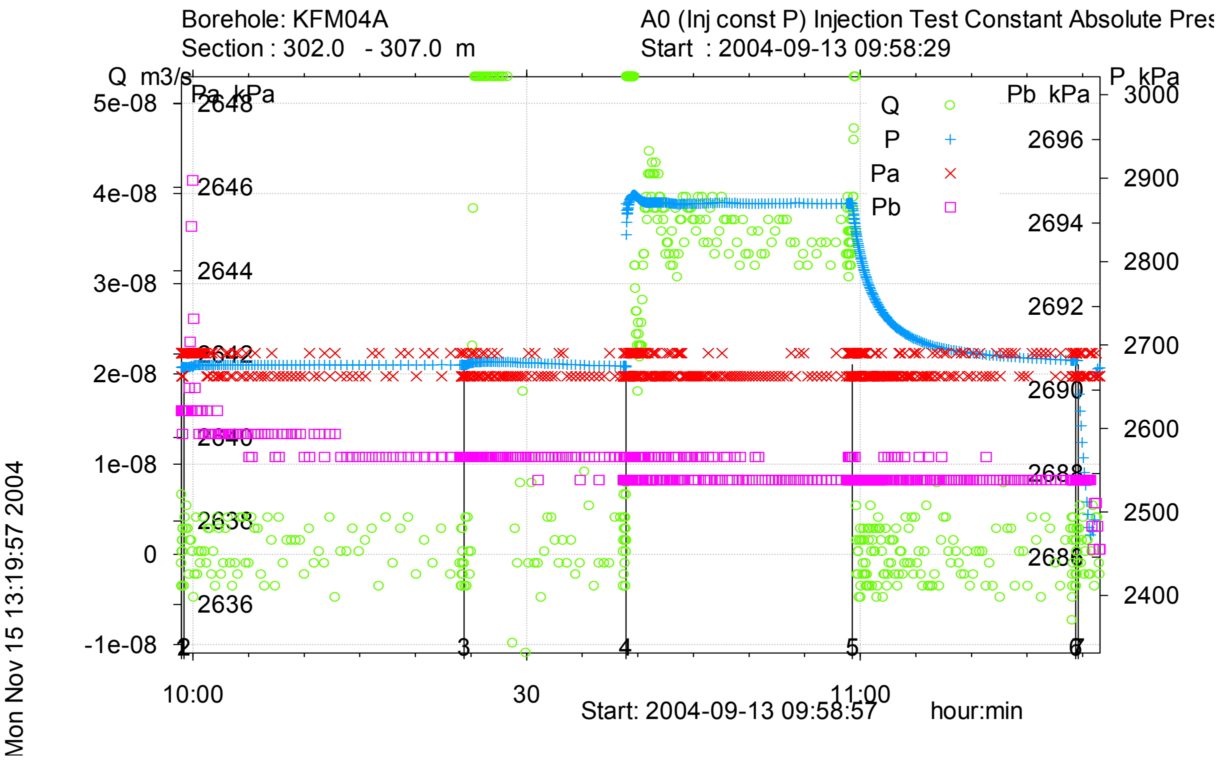


***Figure A3-145.** Linear plot of flow rate (Q), pressure (P), pressure above section (Pa) and pressure below section (Pb) versus time from the injection test in section 302-307 m in borehole KFM04A.*

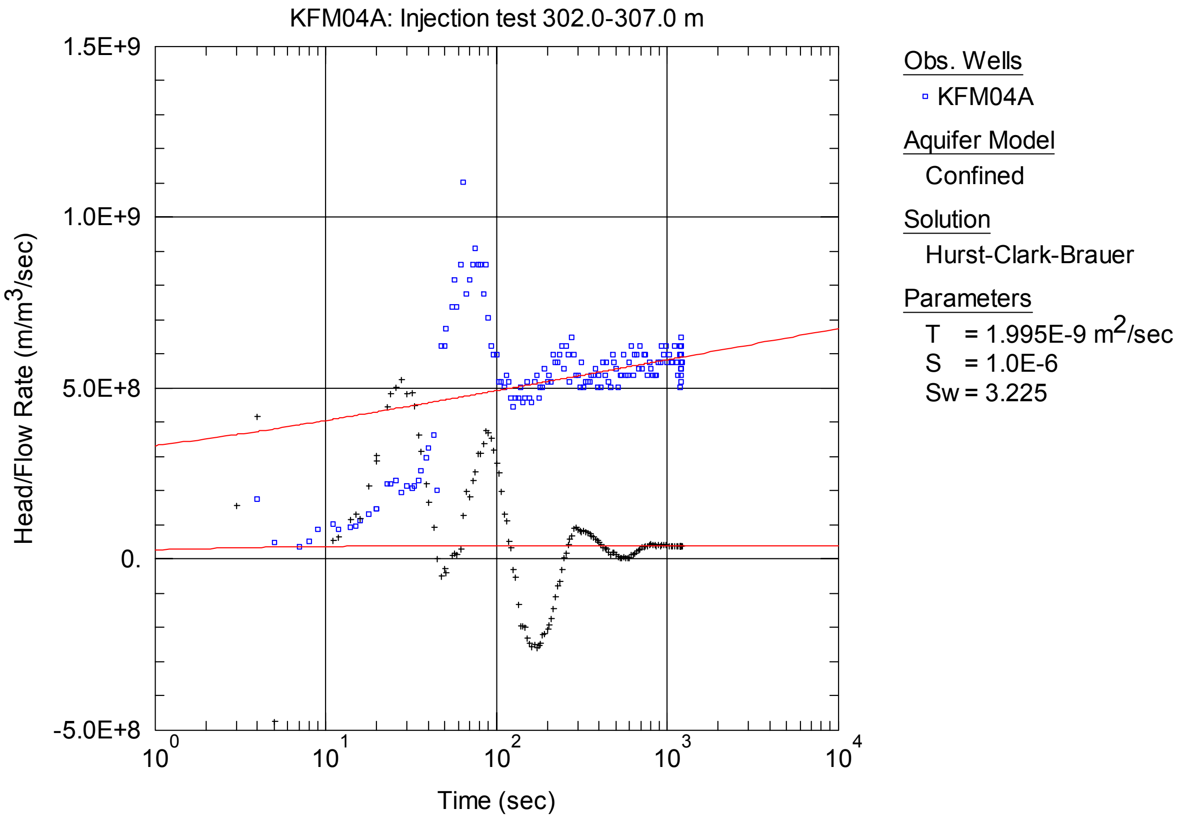


Figure A3-146. *Lin-log plot of head/flow rate (□) and derivative (+) versus time, from the injection test in section 302-307 m in KFM04A.*

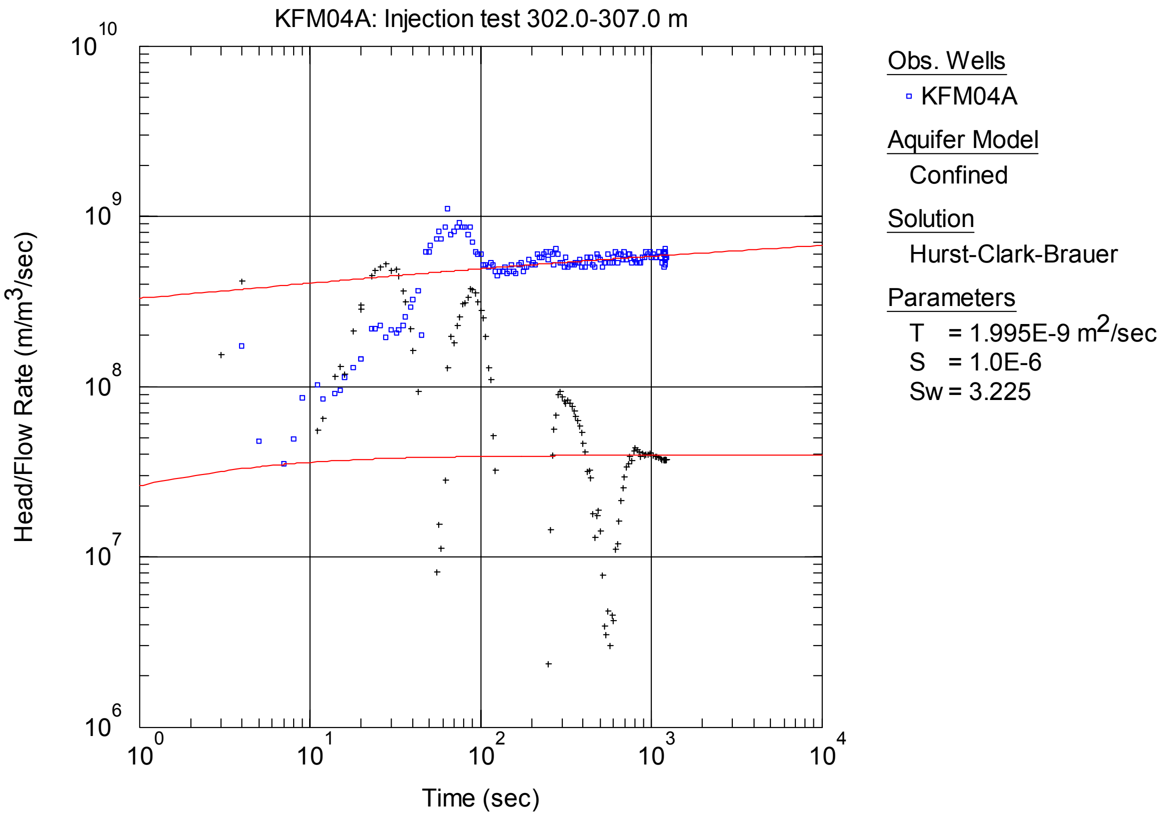


Figure A3-147. *Log-log plot of head/flow rate (□) and derivative (+) versus time, from the injection test in section 302-307 m in KFM04A.*

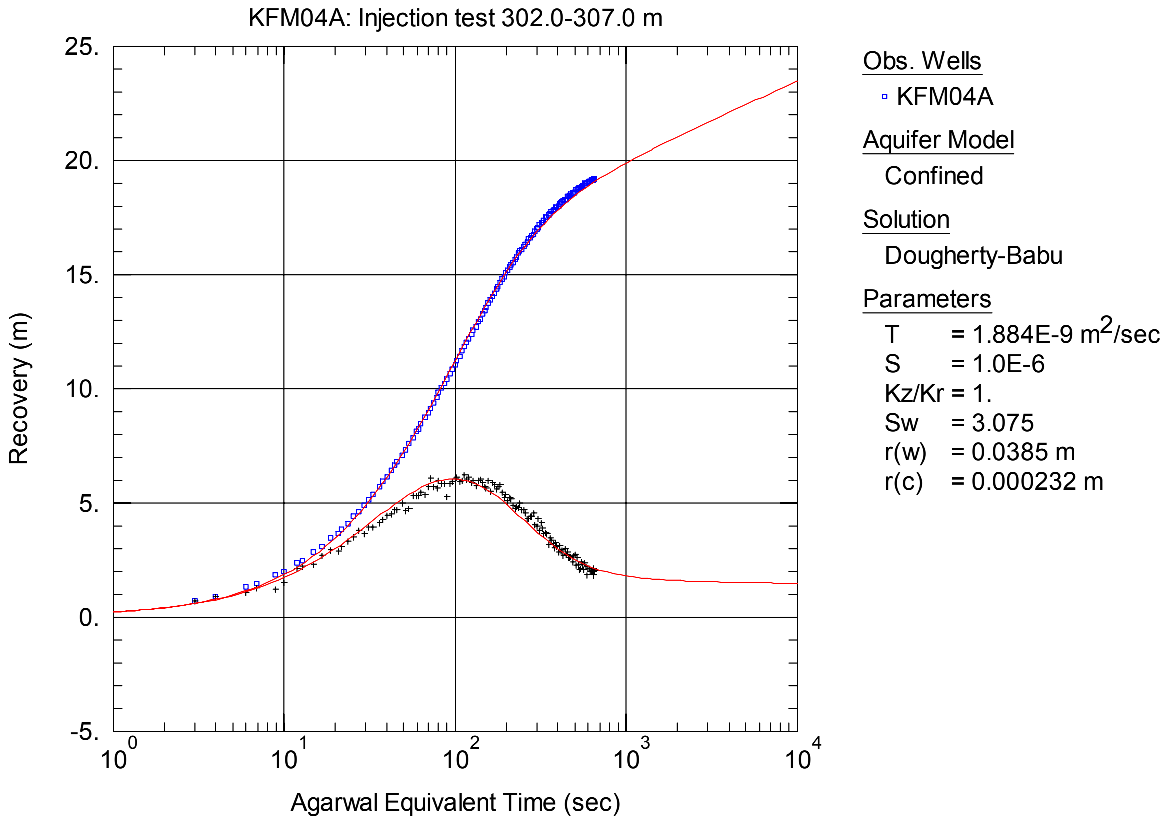


***Figure A3-148.** Lin-log plot of recovery (□) and derivative (+) versus equivalent time, from the injection test in section 302-307 m in KFM04A.*

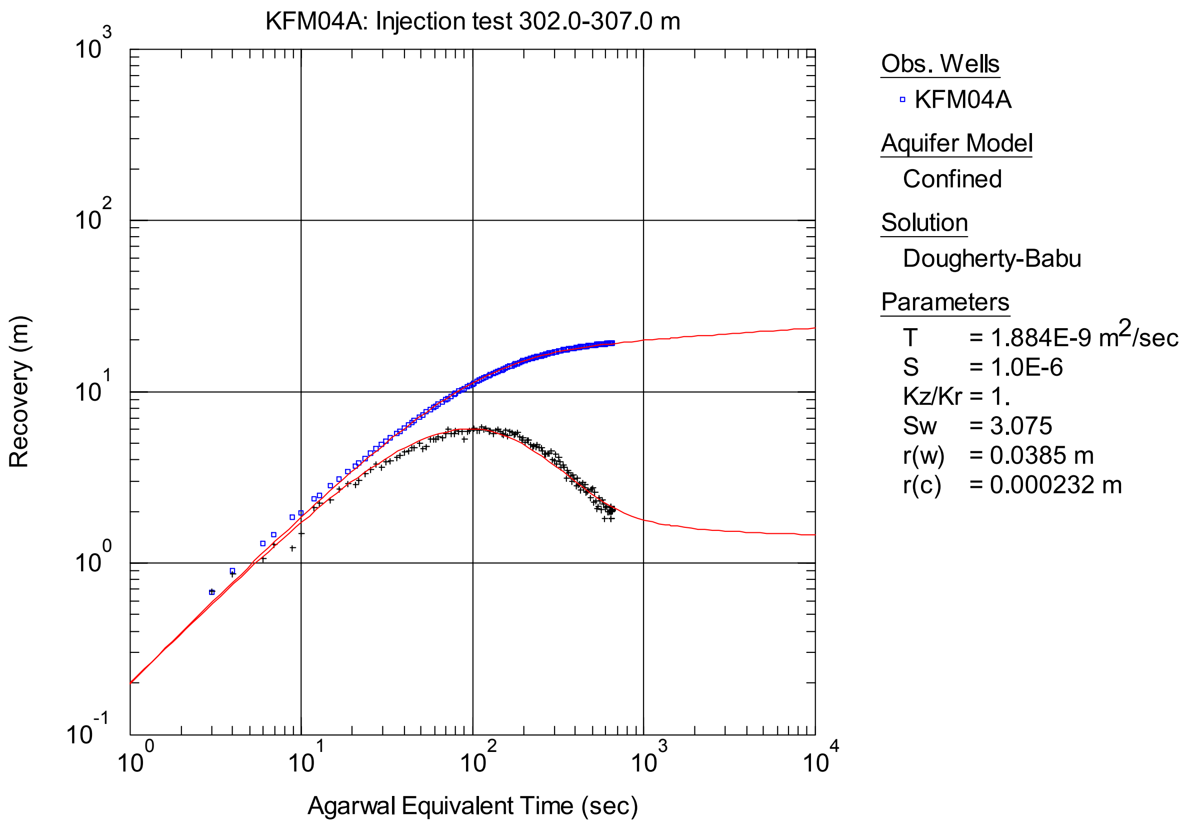


***Figure A3-149.** Log-log plot of recovery (□) and derivative (+) versus equivalent time, from the injection test in section 302-307 m in KFM04A.*

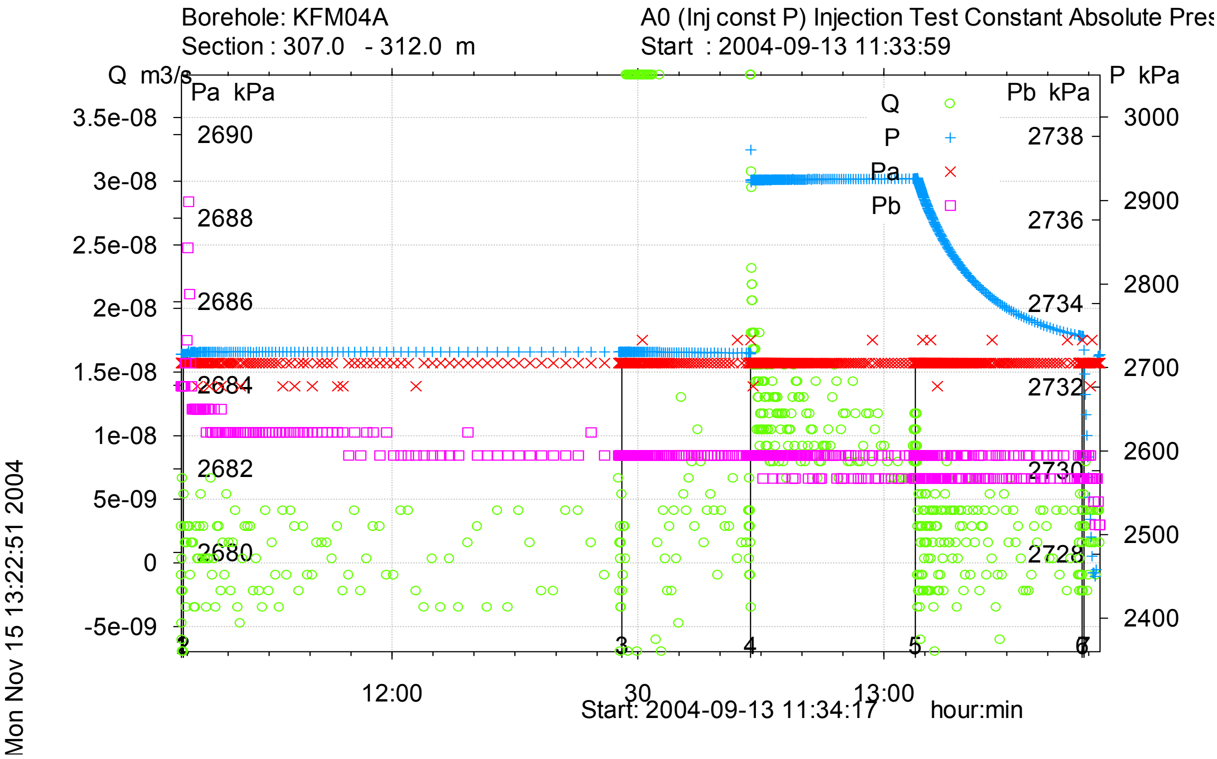


Figure A3-150. *Linear plot of flow rate (Q), pressure (P), pressure above section (Pa) and pressure below section (Pb) versus time from the injection test in section 307-312 m in borehole KFM04A.*

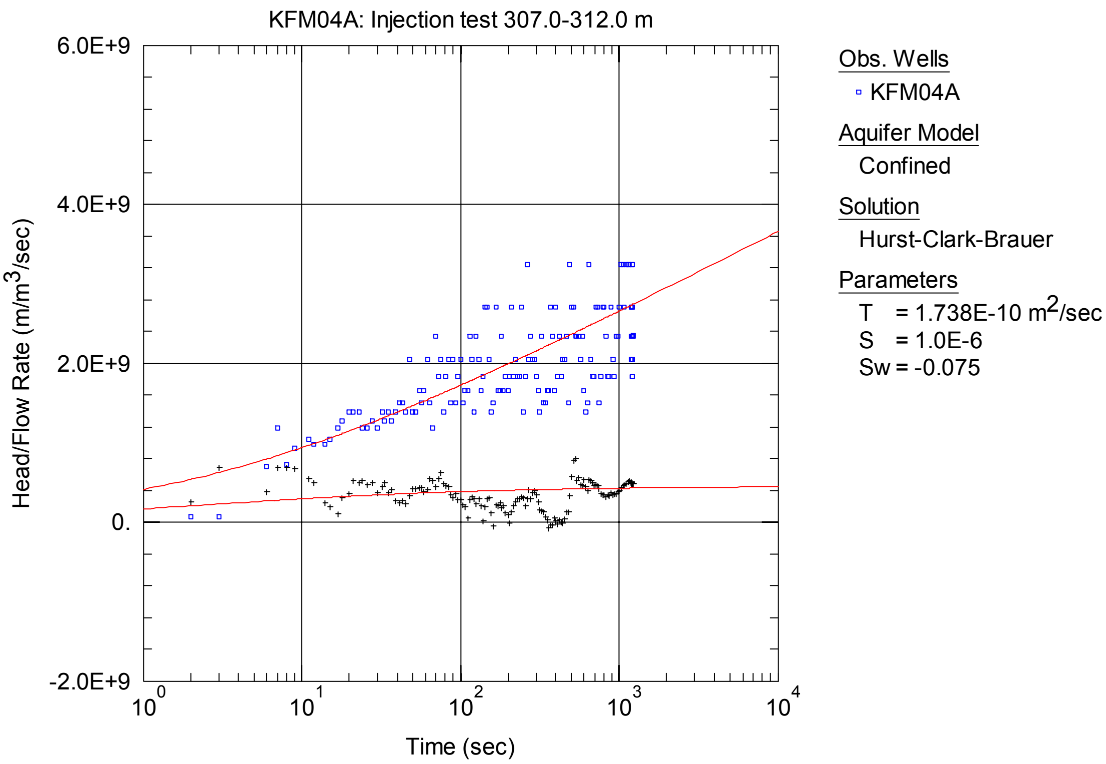


Figure A3-151. *Lin-log plot of head/flow rate (□) and derivative (+) versus time, from the injection test in section 307-312 m in KFM04A.*

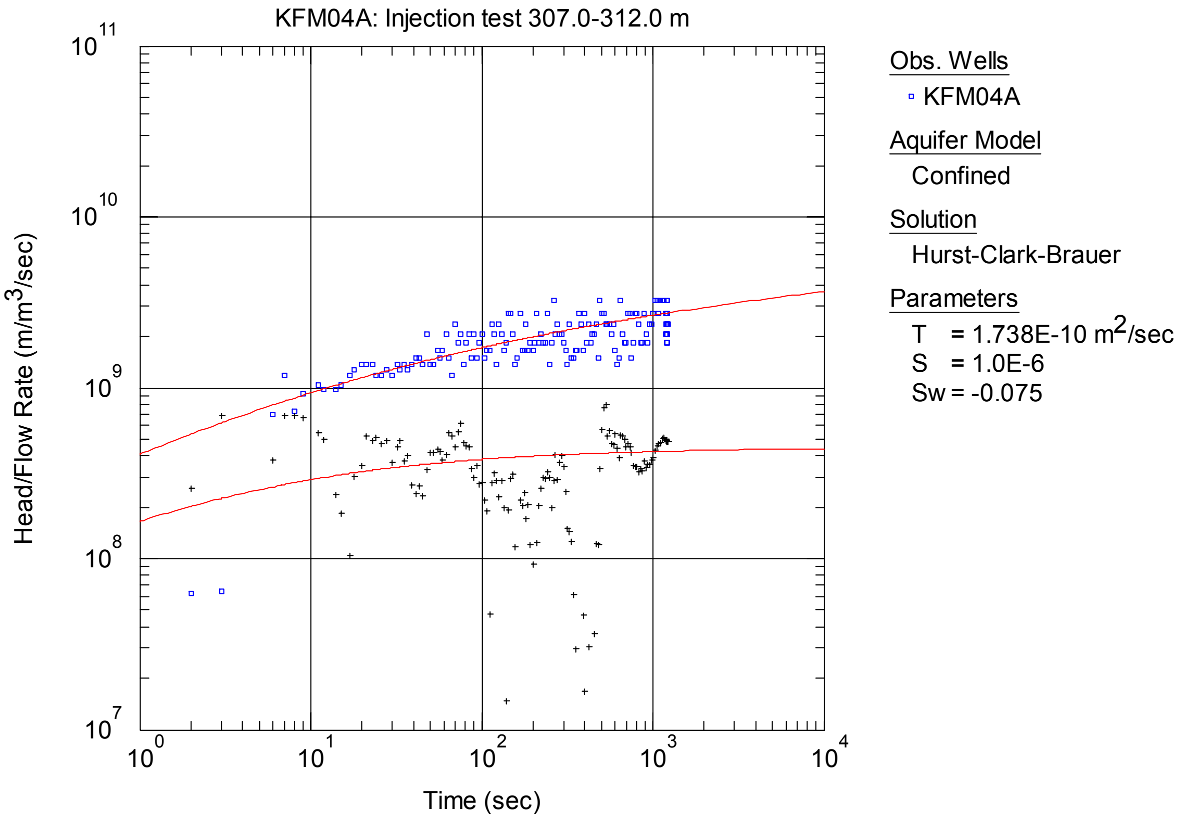


Figure A3-152. *Log-log plot of head/flow rate (□) and derivative (+) versus time, from the injection test in section 307-312 m in KFM04A.*

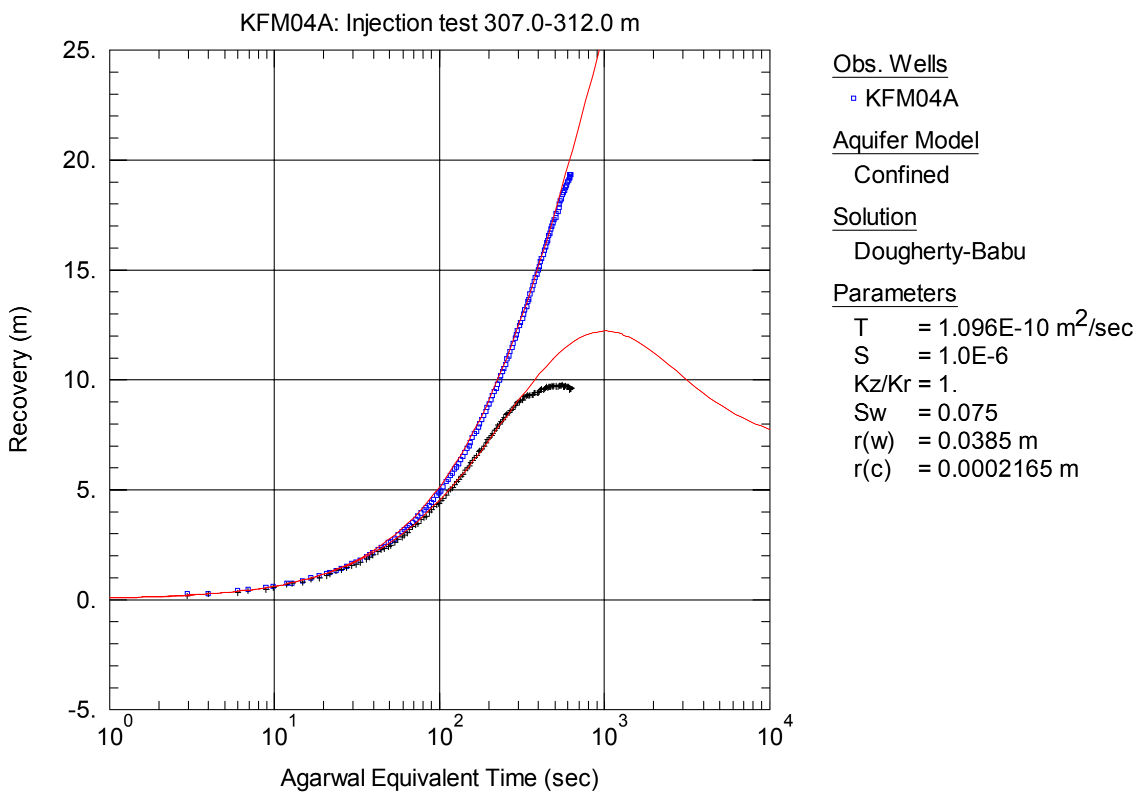


Figure A3-153. *Lin-log plot of recovery (□) and derivative (+) versus equivalent time, from the injection test in section 307-312 m in KFM04A. The type curve fit is only to show that an assumption of PRF is not valid.*

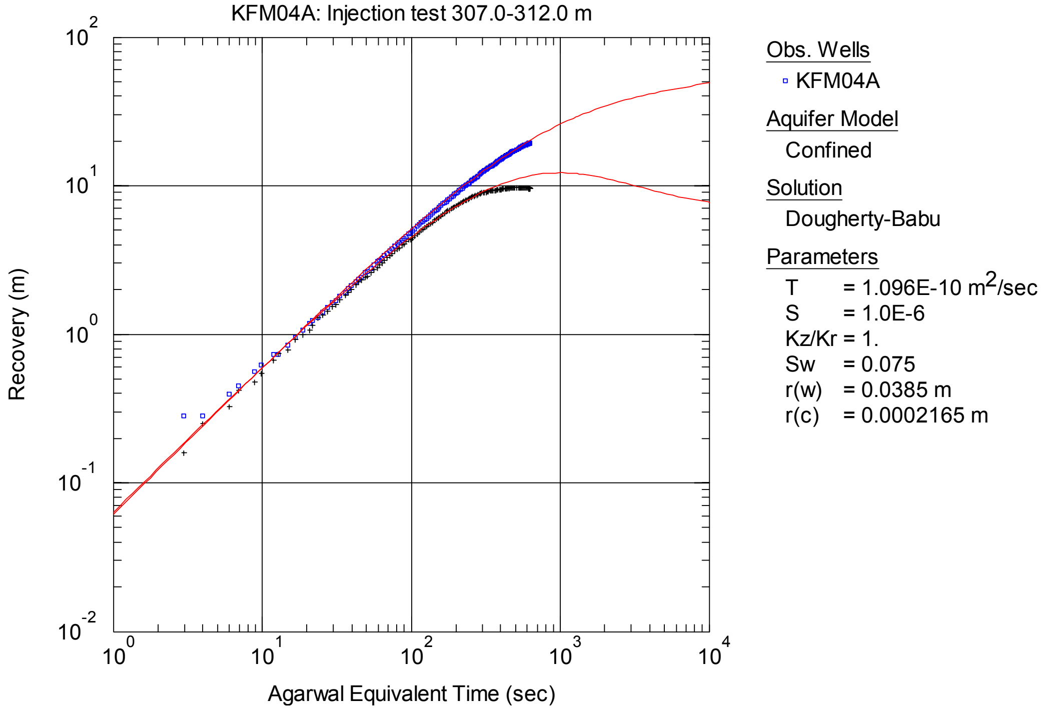


Figure A3-154. *Log-log plot of recovery (□) and derivative (+) versus equivalent time, from the injection test in section 307-312 m in KFM04A. The type curve fit is only to show that an assumption of PRF is not valid.*

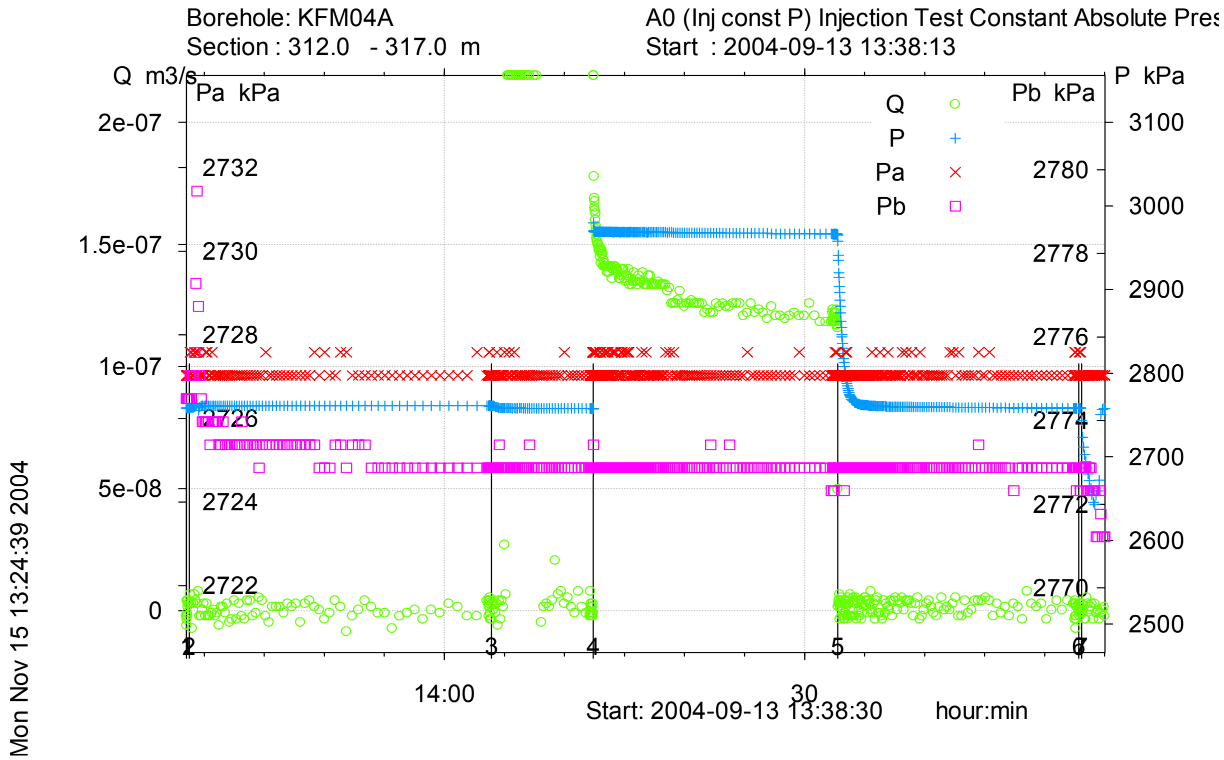


Figure A3-155. *Linear plot of flow rate (Q), pressure (P), pressure above section (Pa) and pressure below section (Pb) versus time from the injection test in section 312-317 m in borehole KFM04A.*

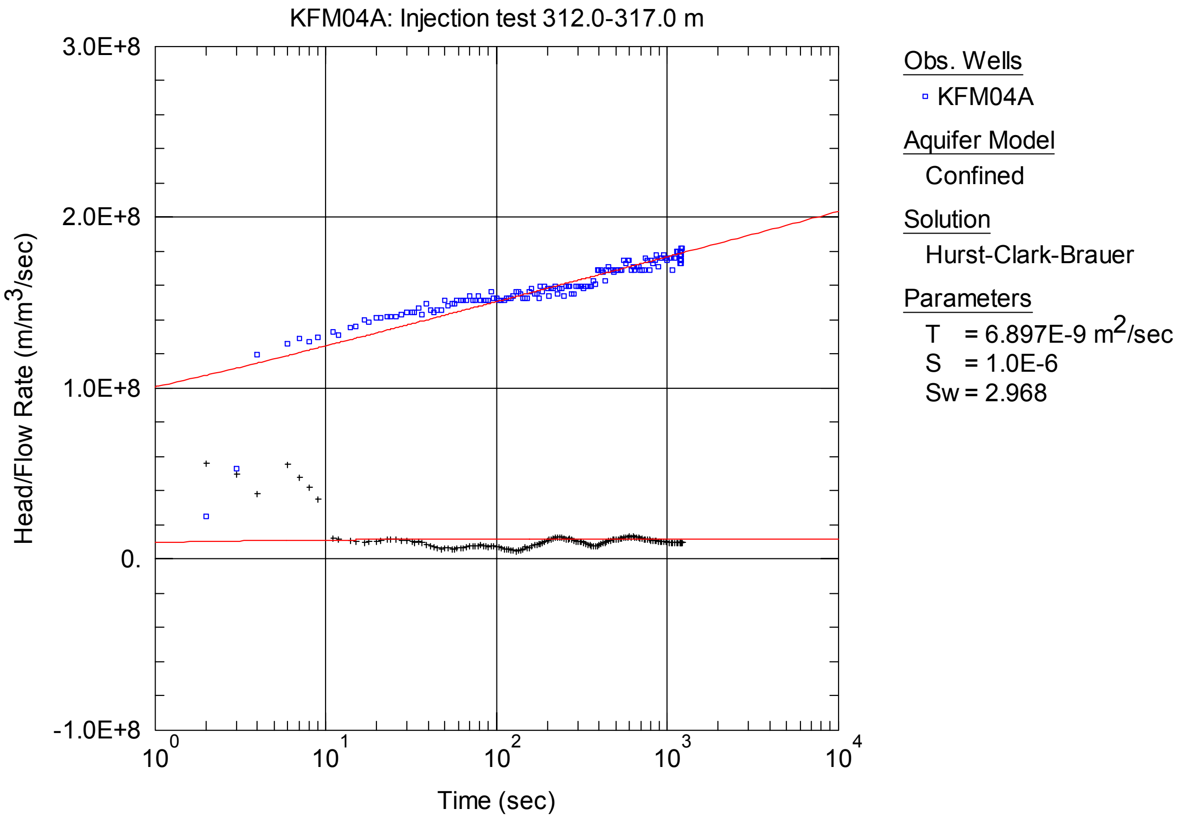


Figure A3-156. *Lin-log plot of head/flow rate (□) and derivative (+) versus time, from the injection test in section 312-317 m in KFM04A.*

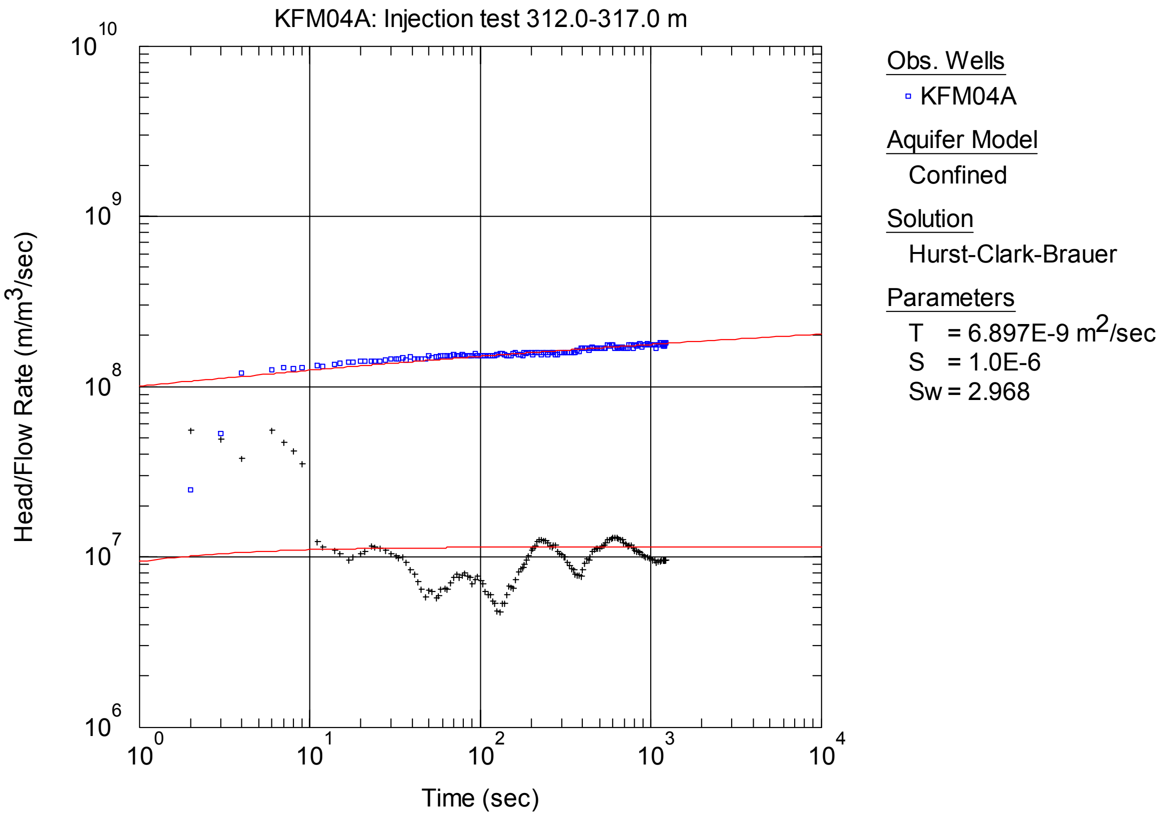


Figure A3-157. *Log-log plot of head/flow rate (□) and derivative (+) versus time, from the injection test in section 312-317 m in KFM04A.*

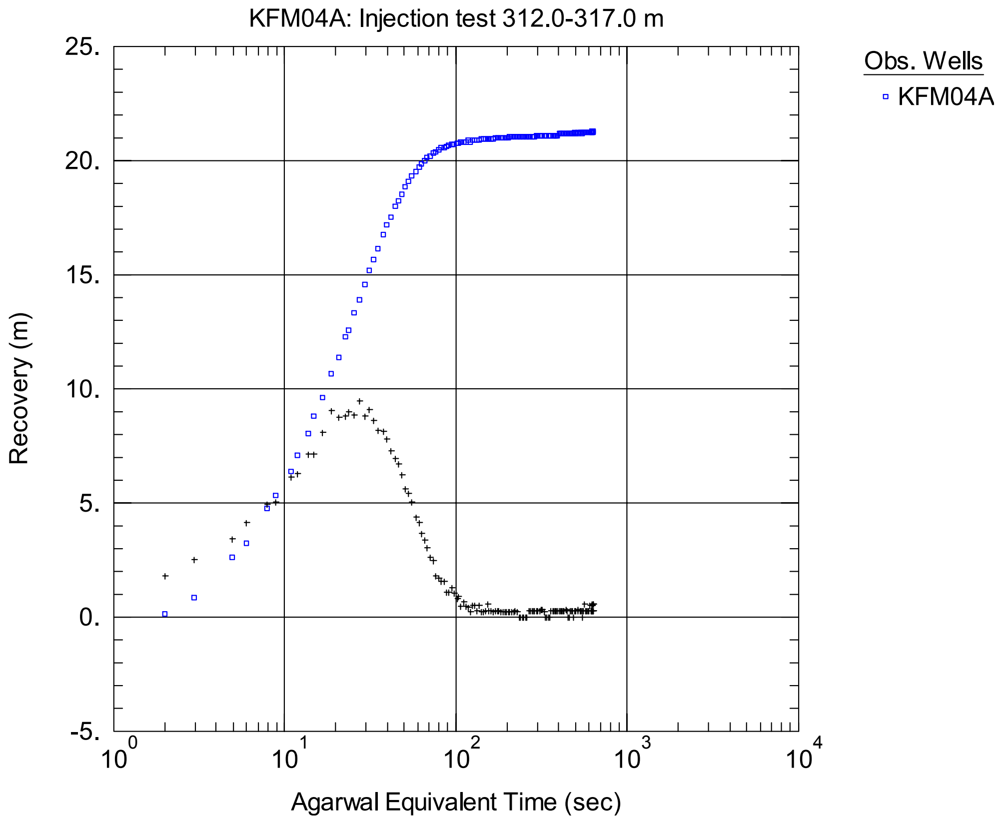


Figure A3-158. *Lin-log plot of recovery (□) and derivative (+) versus equivalent time, from the injection test in section 312-317 m in KFM04A.*

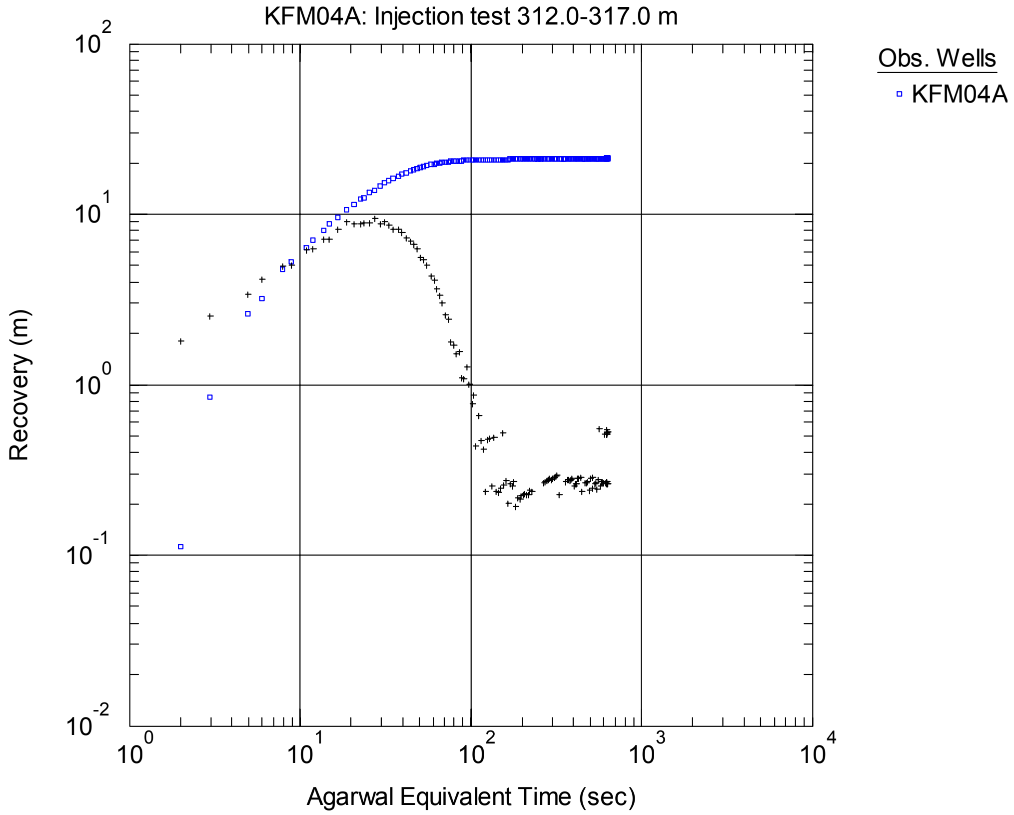


Figure A3-159. *Log-log plot of recovery (□) and derivative (+) versus equivalent time, from the injection test in section 312-317 m in KFM04A.*

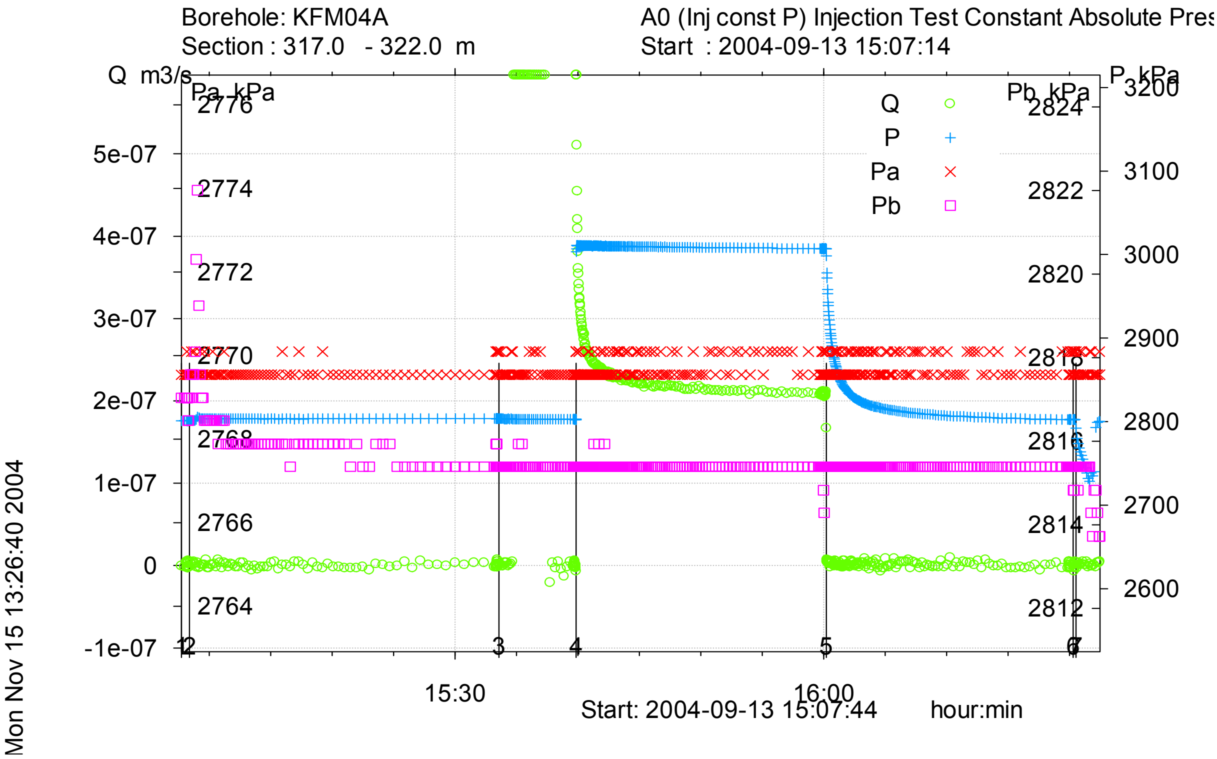


Figure A3-160. *Linear plot of flow rate (Q), pressure (P), pressure above section (Pa) and pressure below section (Pb) versus time from the injection test in section 317-322 m in borehole KFM04A.*

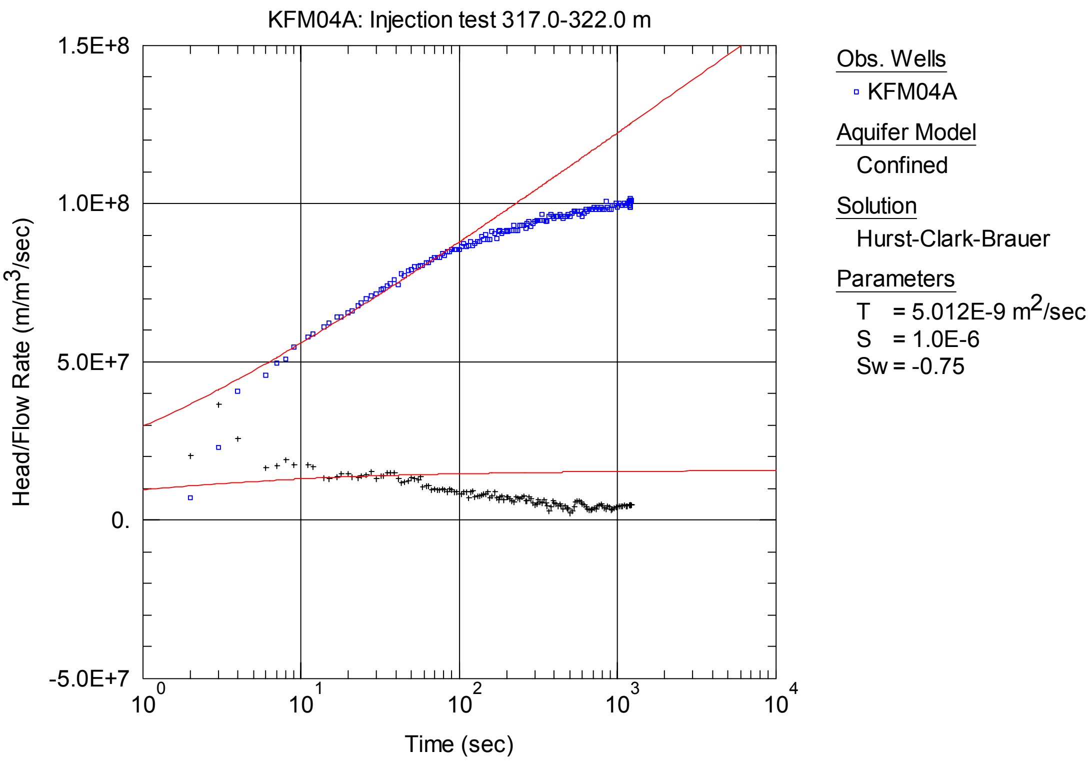


Figure A3-161. *Lin-log plot of head/flow rate (□) and derivative (+) versus time, from the injection test in section 317-322 m in KFM04A.*

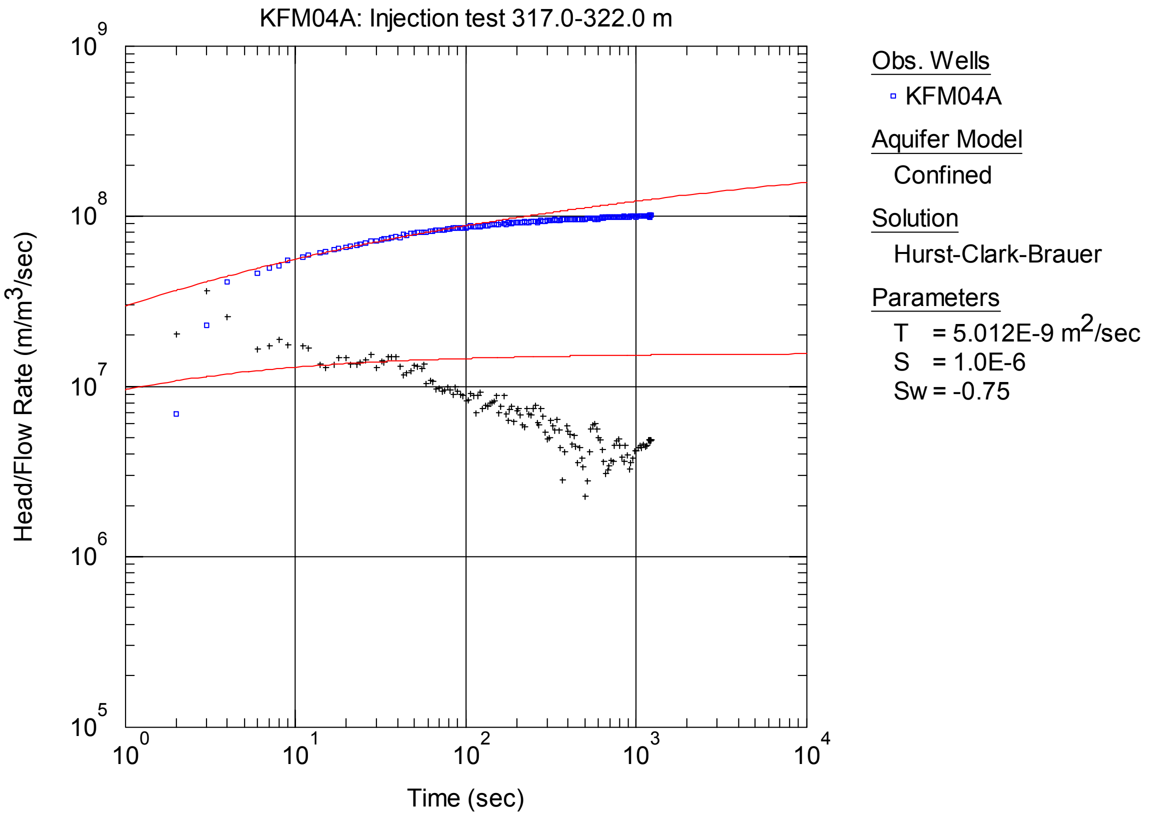


Figure A3-162. *Log-log plot of head/flow rate (□) and derivative (+) versus time, from the injection test in section 317-322 m in KFM04A.*

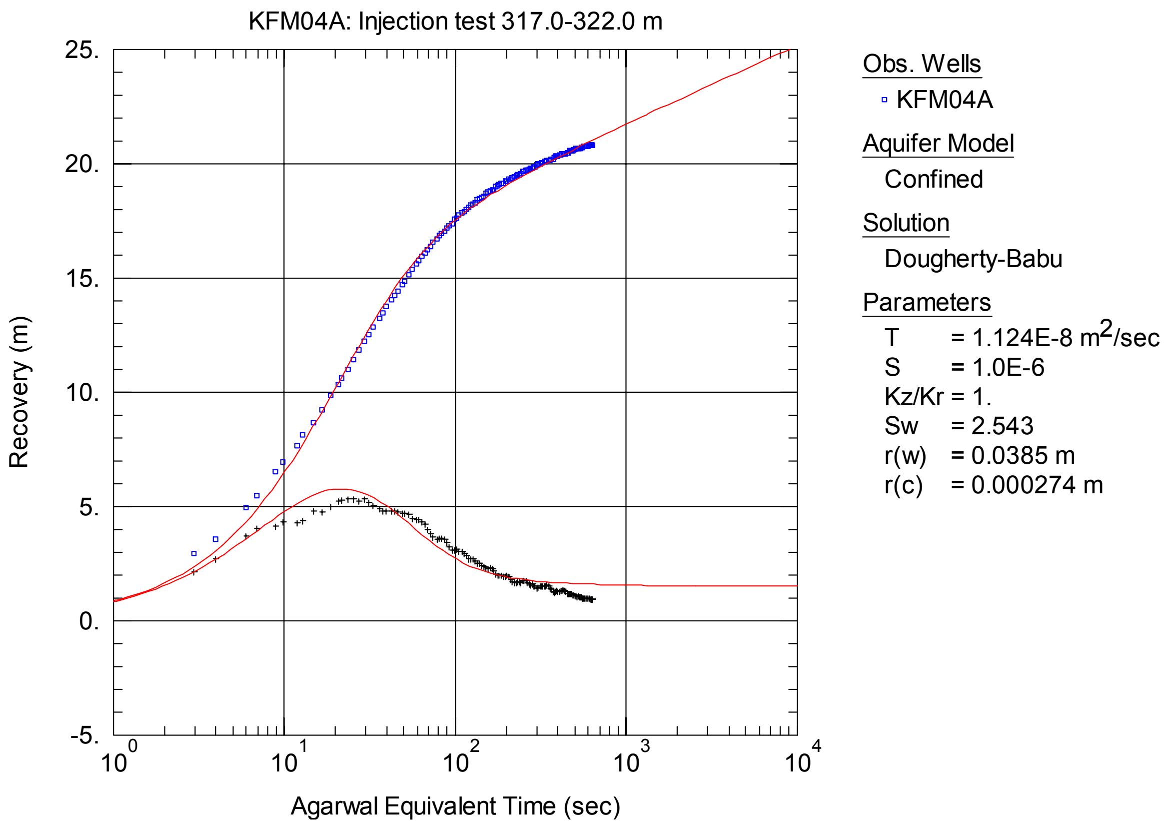


Figure A3-163. *Lin-log plot of recovery (□) and derivative (+) versus equivalent time, from the injection test in section 317-322 m in KFM04A.*

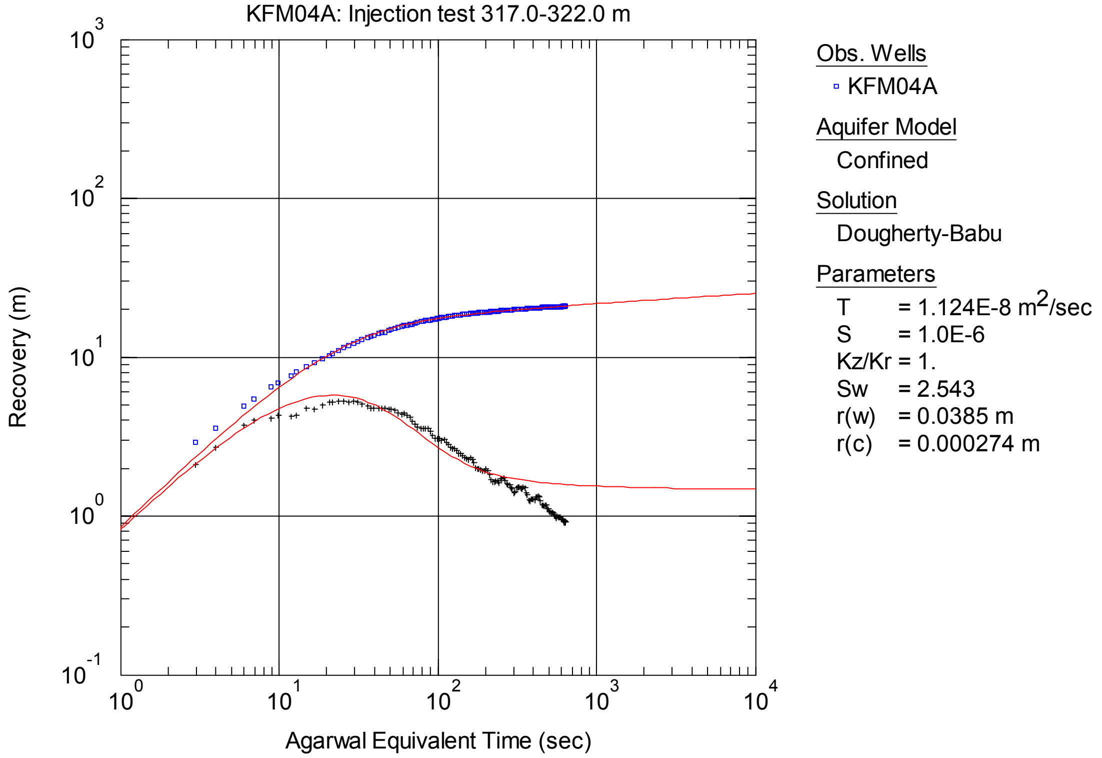


Figure A3-164. *Log-log plot of recovery (□) and derivative (+) versus equivalent time, from the injection test in section 317-322 m in KFM04A.*

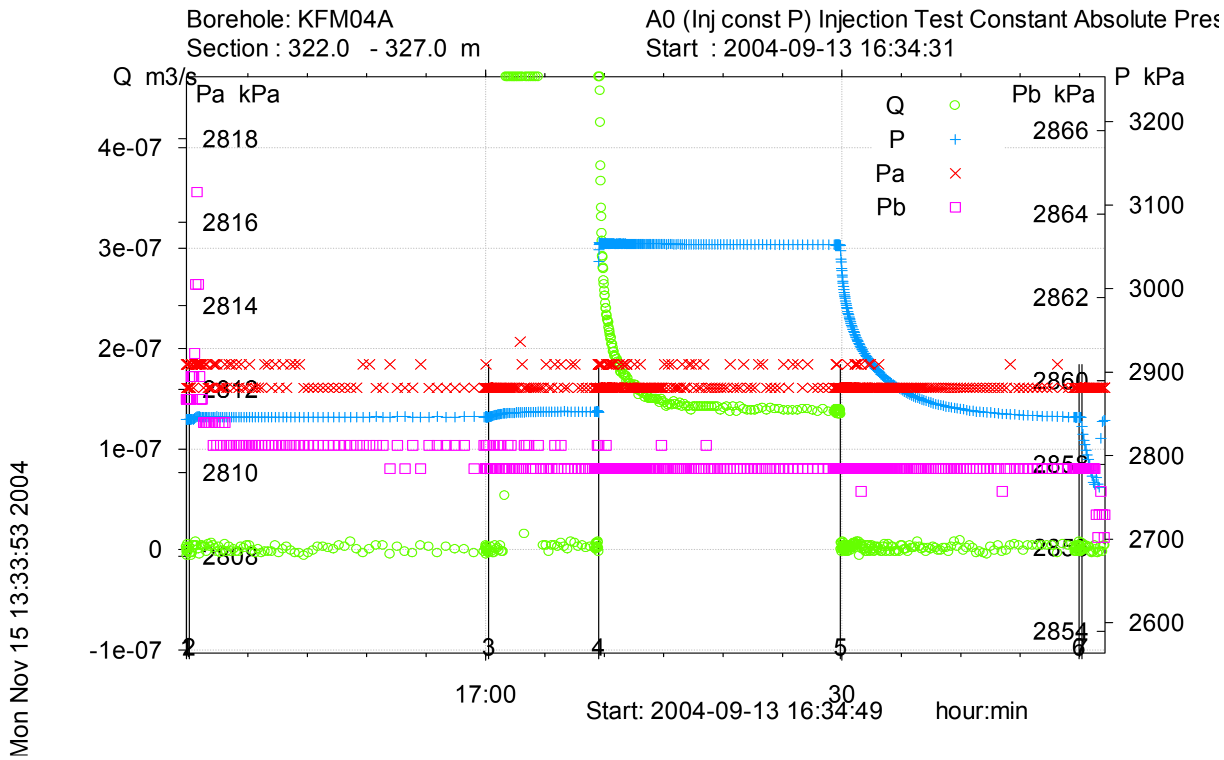


Figure A3-165. *Linear plot of flow rate (Q), pressure (P), pressure above section (Pa) and pressure below section (Pb) versus time from the injection test in section 322-327 m in borehole KFM04A.*

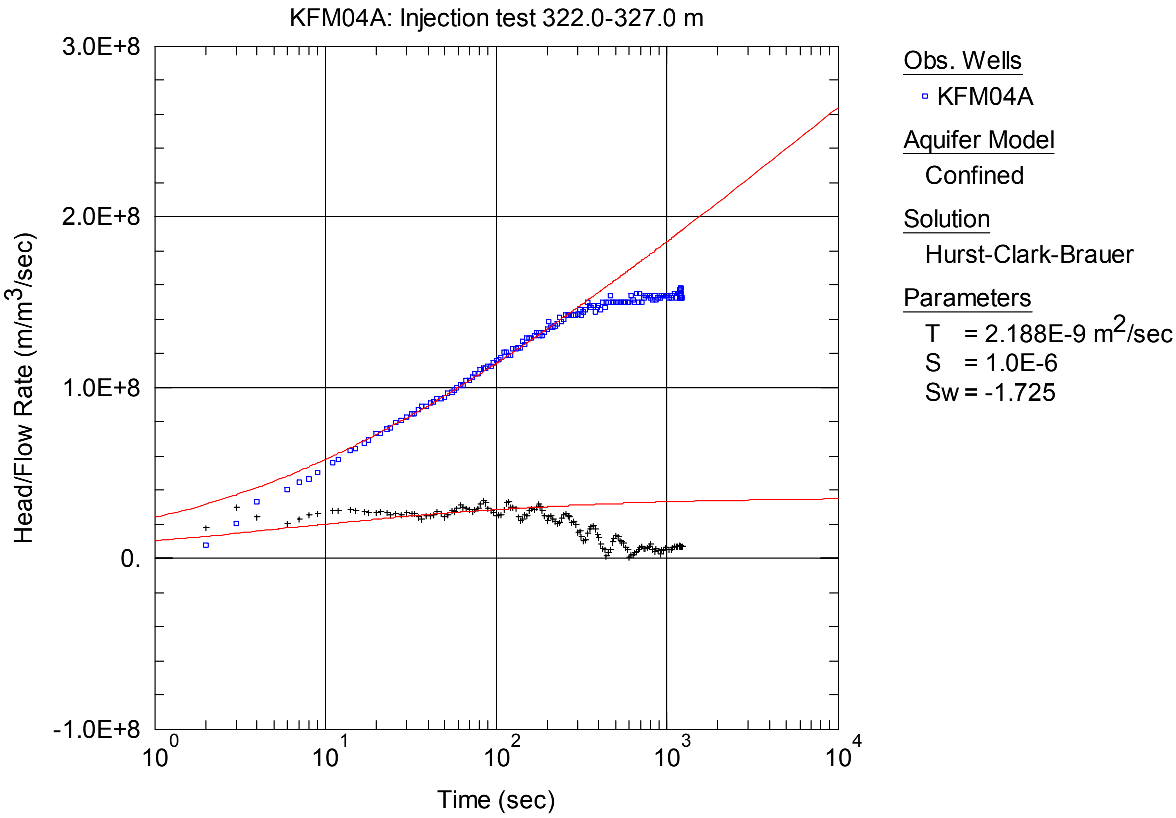


Figure A3-166. *Lin-log plot of head/flow rate (□) and derivative (+) versus time, from the injection test in section 322-327 m in KFM04A.*

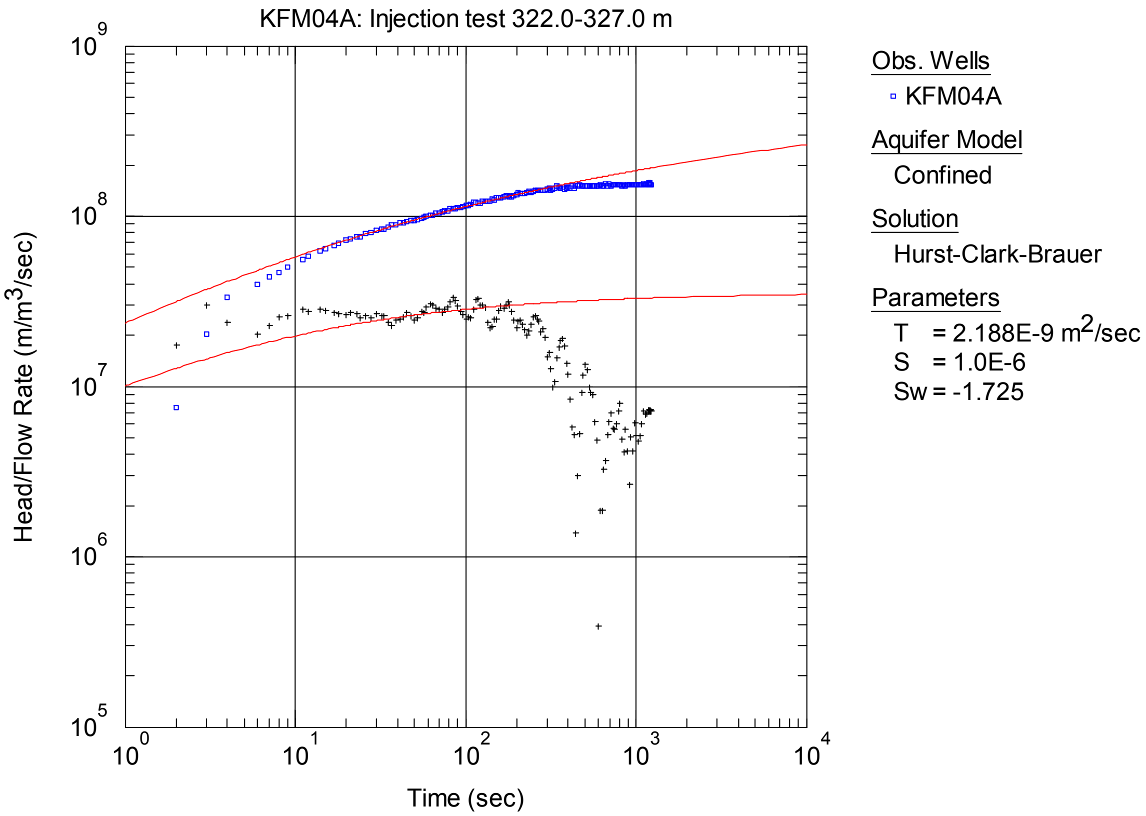


Figure A3-167. *Log-log plot of head/flow rate (□) and derivative (+) versus time, from the injection test in section 322-327 m in KFM04A.*

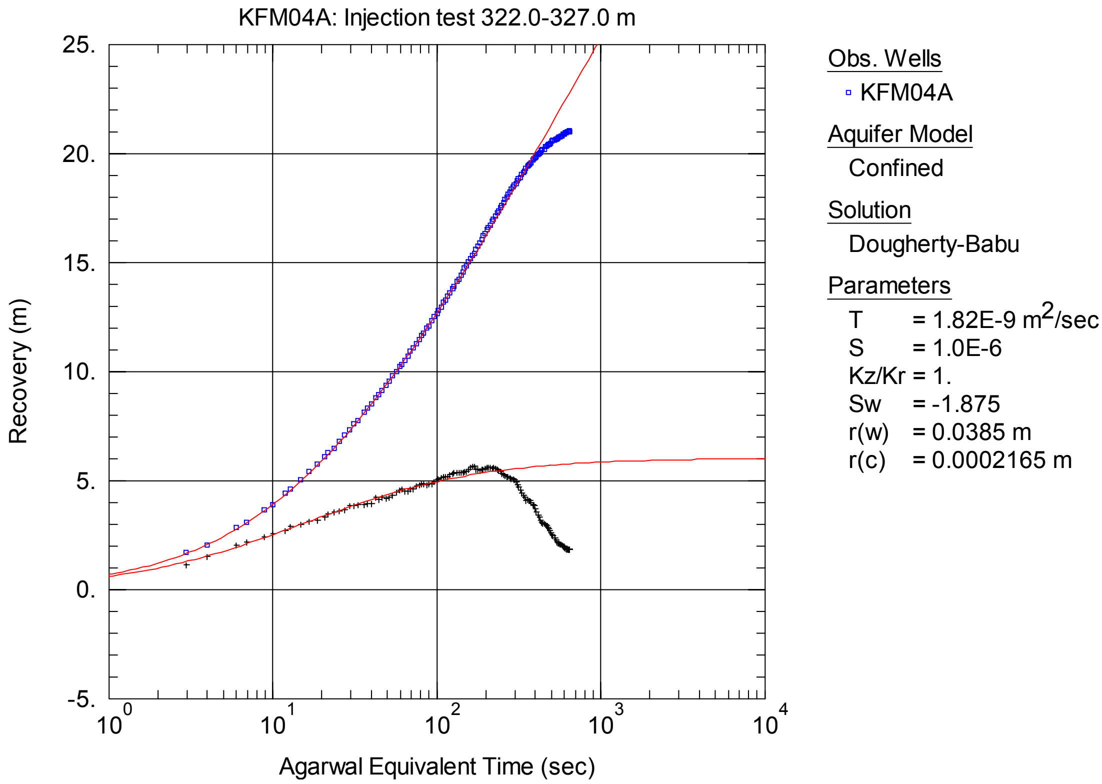


Figure A3-168. *Lin-log plot of recovery (□) and derivative (+) versus equivalent time, showing fit to Dougherty-Babu solution, from the injection test in section 322-327 m in KFM04A.*

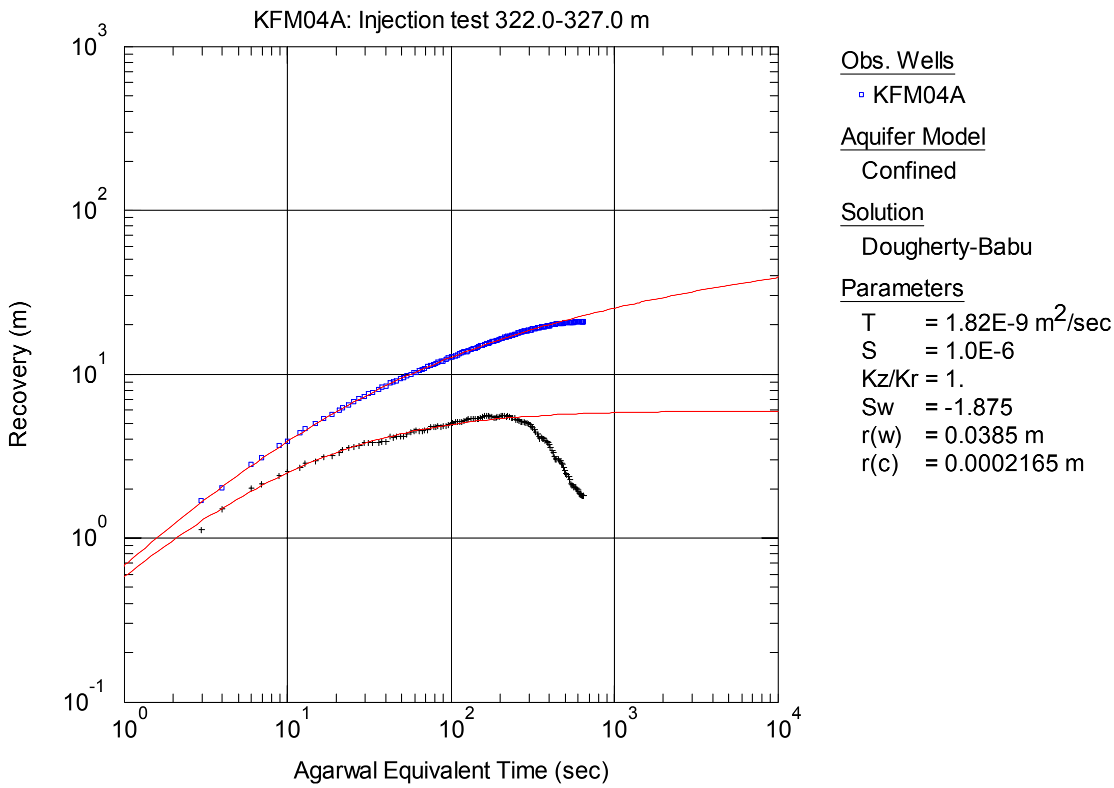


Figure A3-169. *Log-log plot of recovery (□) and derivative (+) versus equivalent time, showing fit to Dougherty-Babu solution, from the injection test in section 322-327 m in KFM04A.*

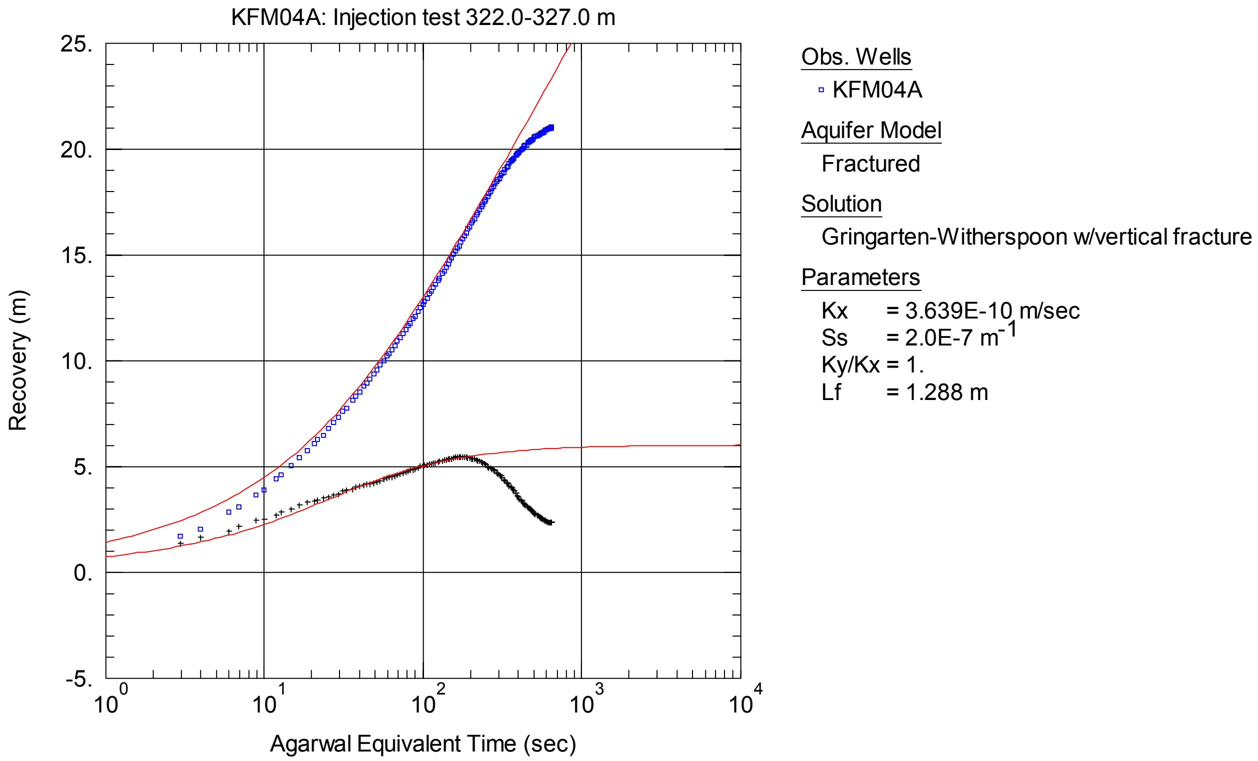


Figure A3-170. *Lin-log plot of recovery (□) and derivative (+) versus equivalent time, showing fit to Gringarten-Witherspoon solution, from the injection test in section 322-327 m in KFM04A.*

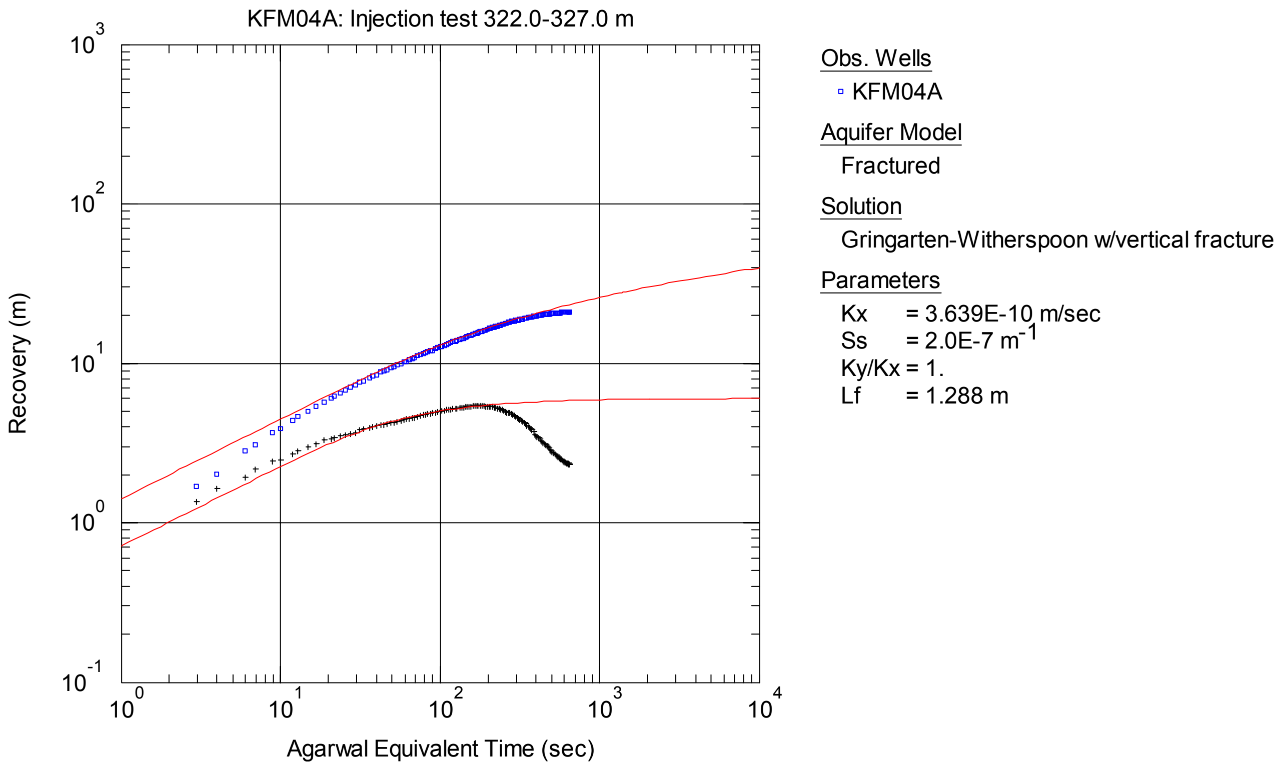


Figure A3-171. *Log-log plot of recovery (□) and derivative (+) versus equivalent time, showing fit to Gringarten-Witherspoon solution, from the injection test in section 322-327 m in KFM04A.*

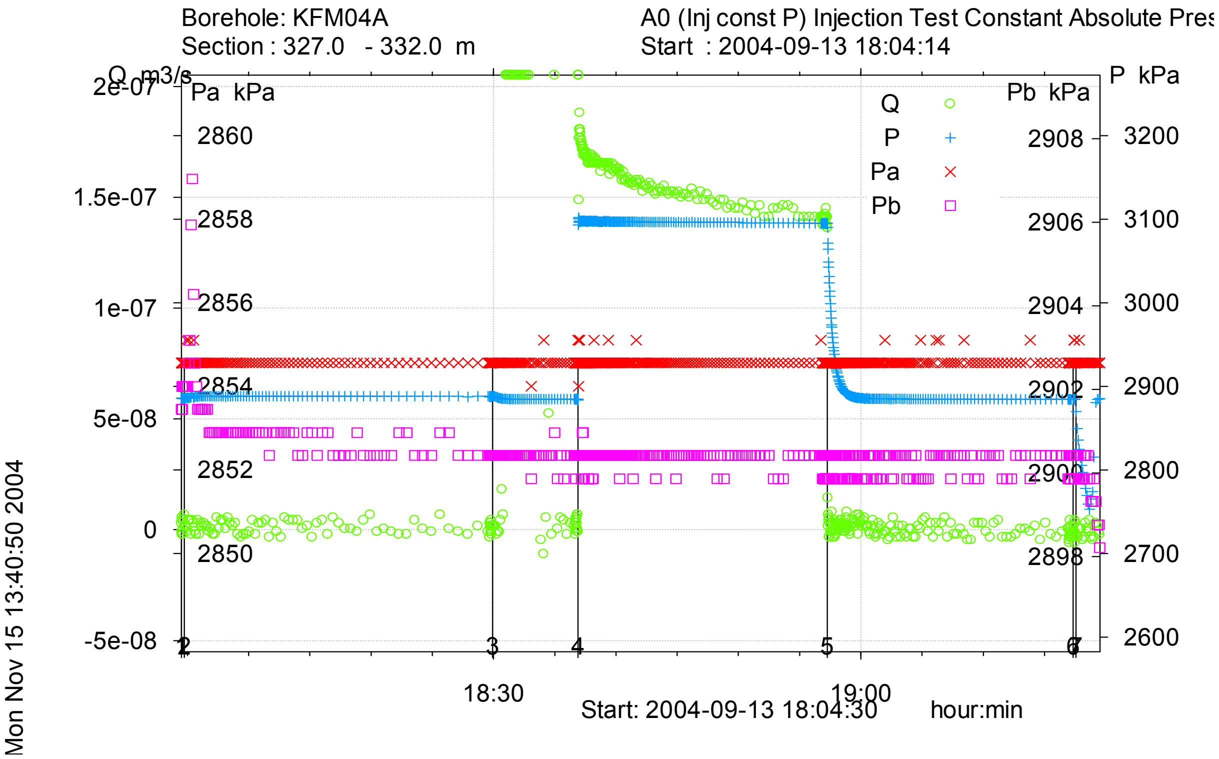


Figure A3-172. Linear plot of flow rate (Q), pressure (P), pressure above section (Pa) and pressure below section (Pb) versus time from the injection test in section 327-332 m in borehole KFM04A.

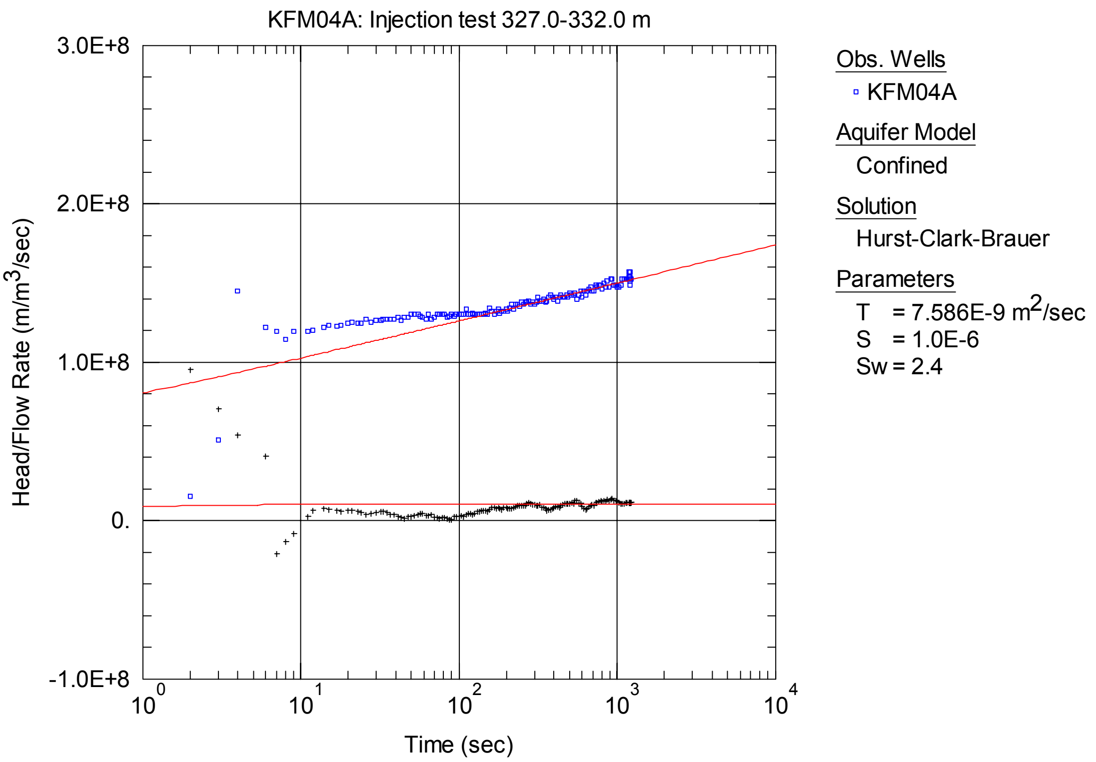


Figure A3-173. Lin-log plot of head/flow rate (□) and derivative (+) versus time, from the injection test in section 327-332 m in KFM04A.

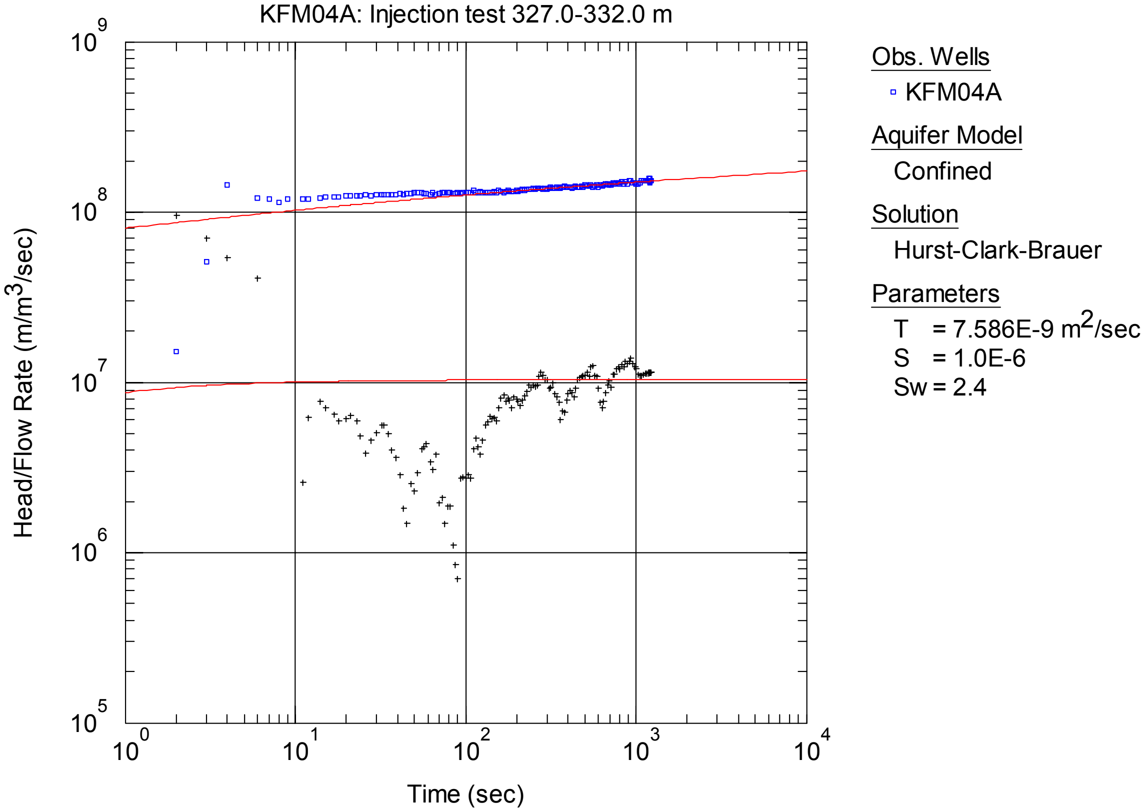


Figure A3-174. *Log-log plot of head/flow rate (□) and derivative (+) versus time, from the injection test in section 327-332 m in KFM04A.*

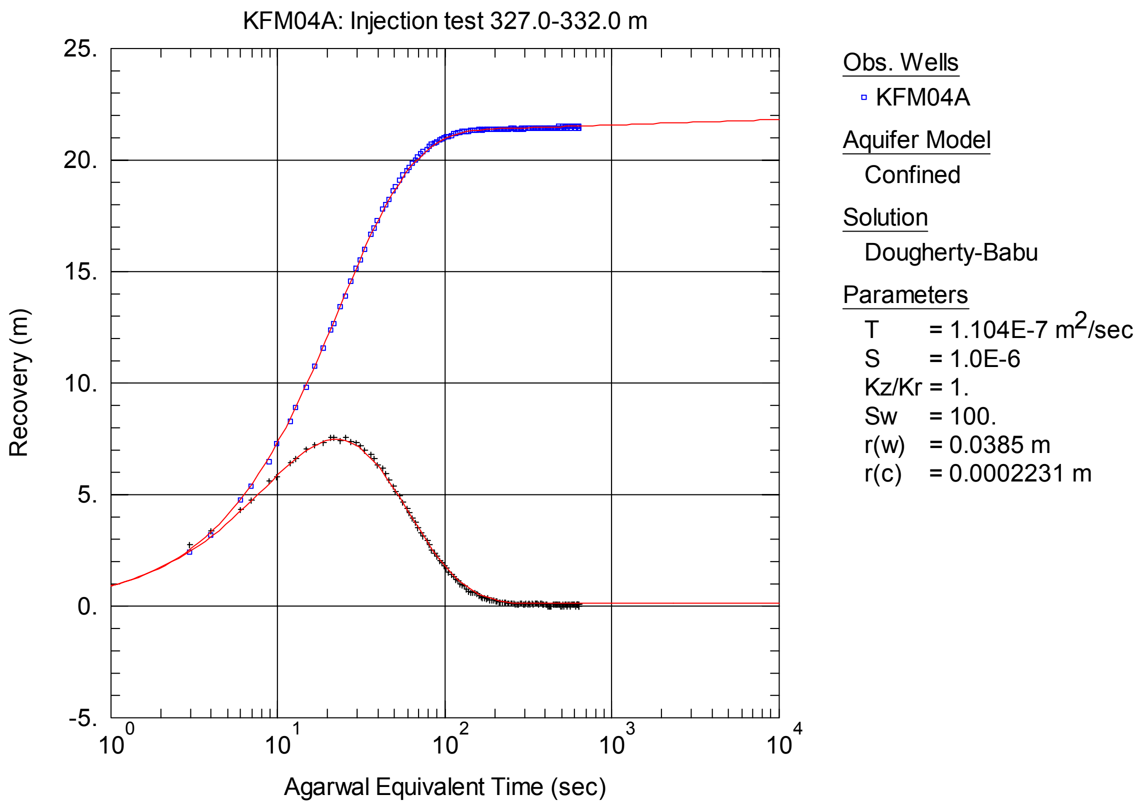


Figure A3-175. *Lin-log plot of recovery (□) and derivative (+) versus equivalent time, from the injection test in section 327-332 m in KFM04A. The type curve fit is only to show that an assumption of PRF is not valid.*

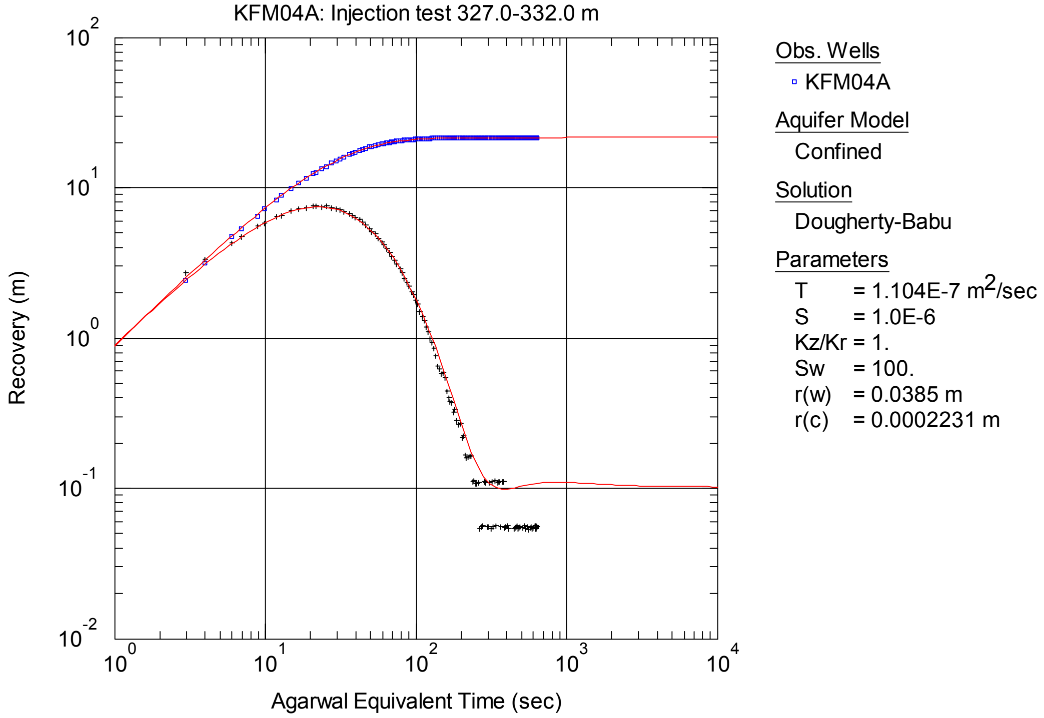


Figure A3-176. *Log-log plot of recovery (□) and derivative (+) versus equivalent time, from the injection test in section 327-332 m in KFM04A. The type curve fit is only to show that an assumption of PRF is not valid.*

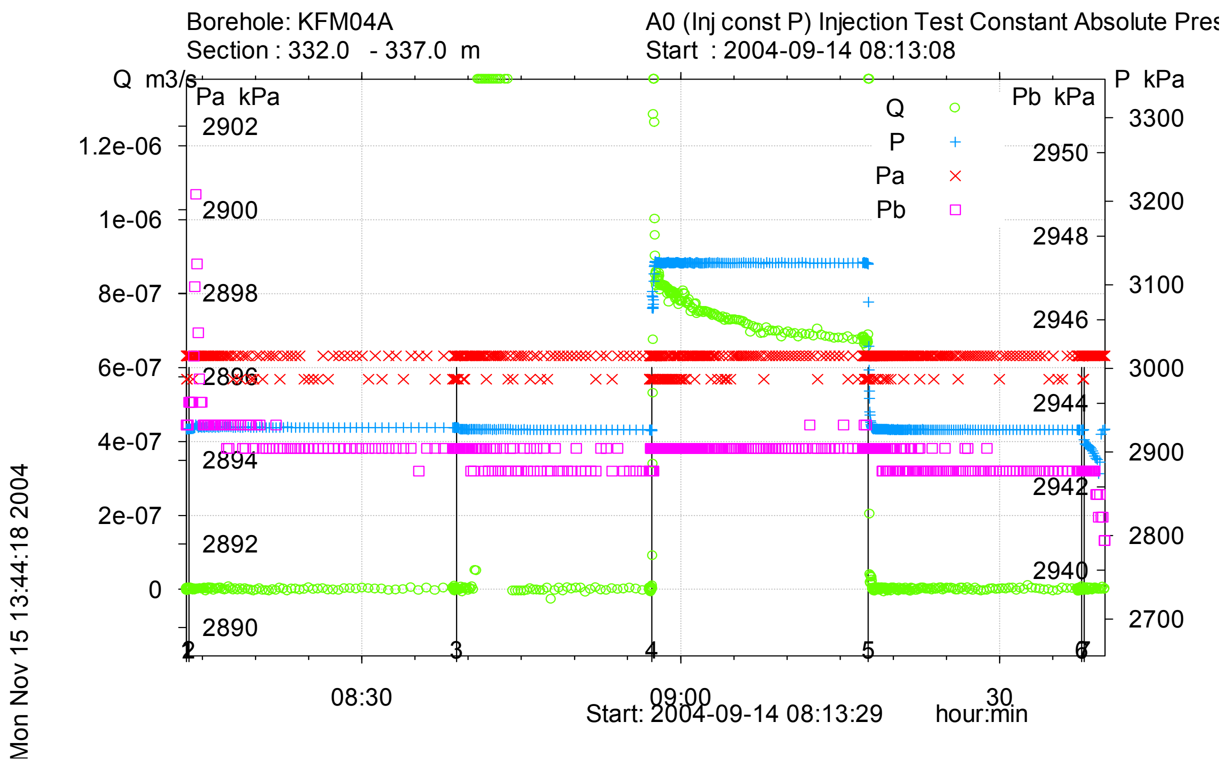


Figure A3-177. *Linear plot of flow rate (Q), pressure (P), pressure above section (Pa) and pressure below section (Pb) versus time from the injection test in section 332-337 m in borehole KFM04A.*

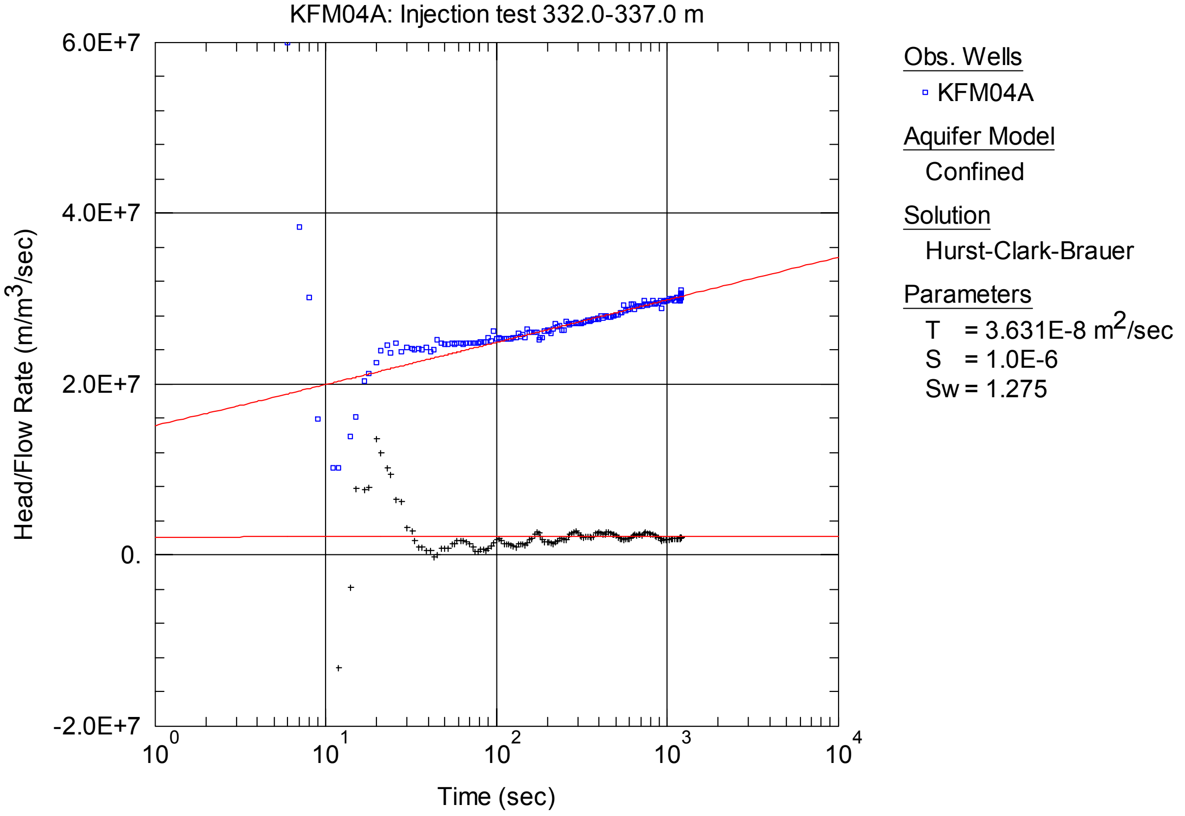


Figure A3-178. *Lin-log plot of head/flow rate (□) and derivative (+) versus time, from the injection test in section 332-337 m in KFM04A.*

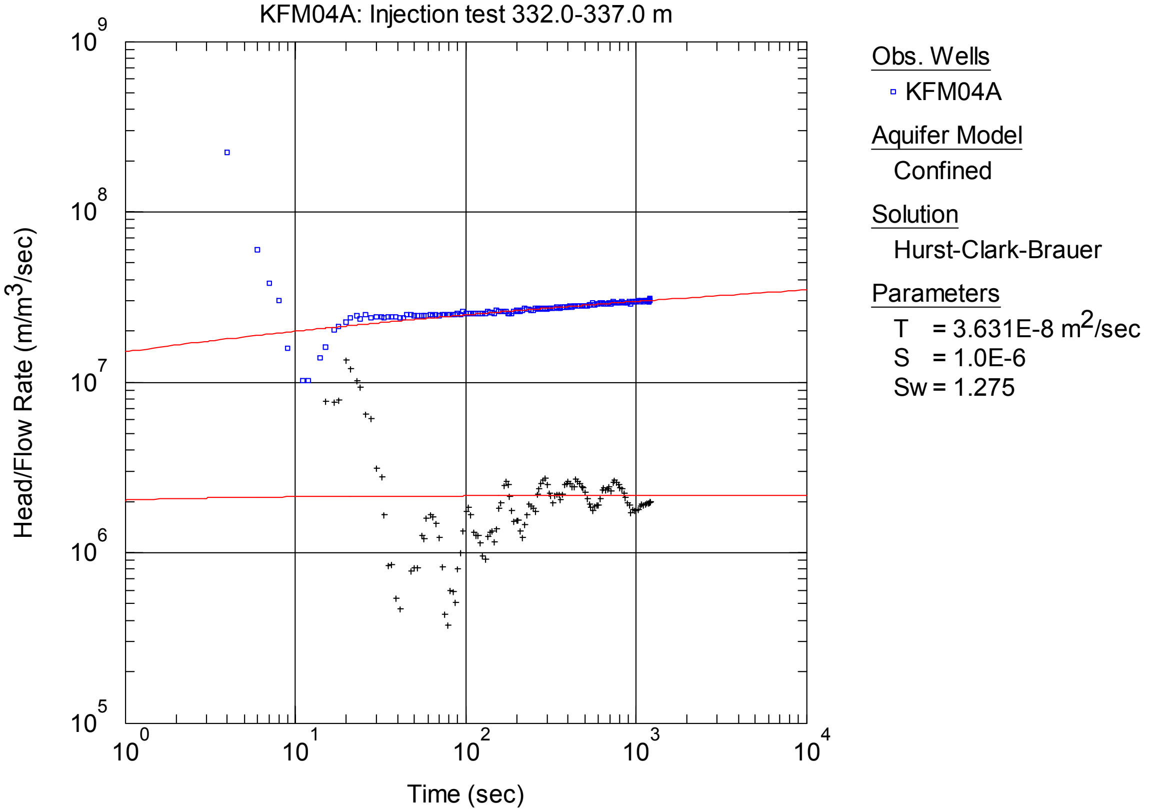


Figure A3-179. *Log-log plot of head/flow rate (□) and derivative (+) versus time, from the injection test in section 332-337 m in KFM04A.*

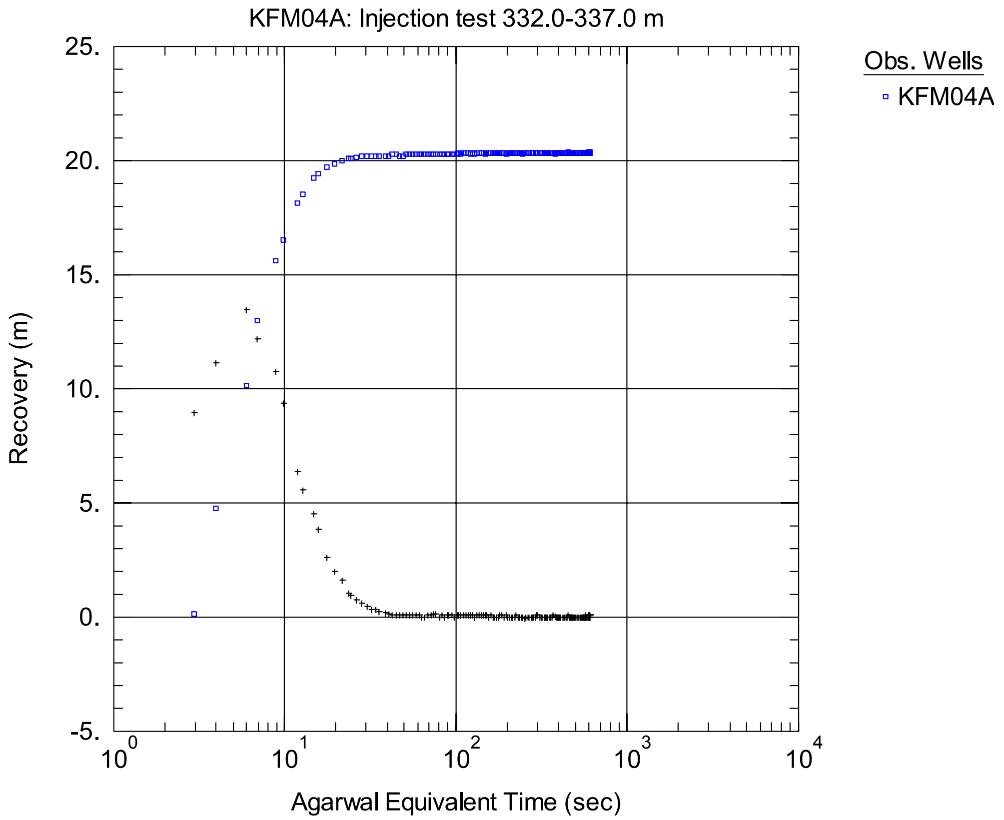


Figure A3-180. *Lin-log plot of recovery (□) and derivative (+) versus equivalent time, from the injection test in section 332-337 m in KFM04A.*

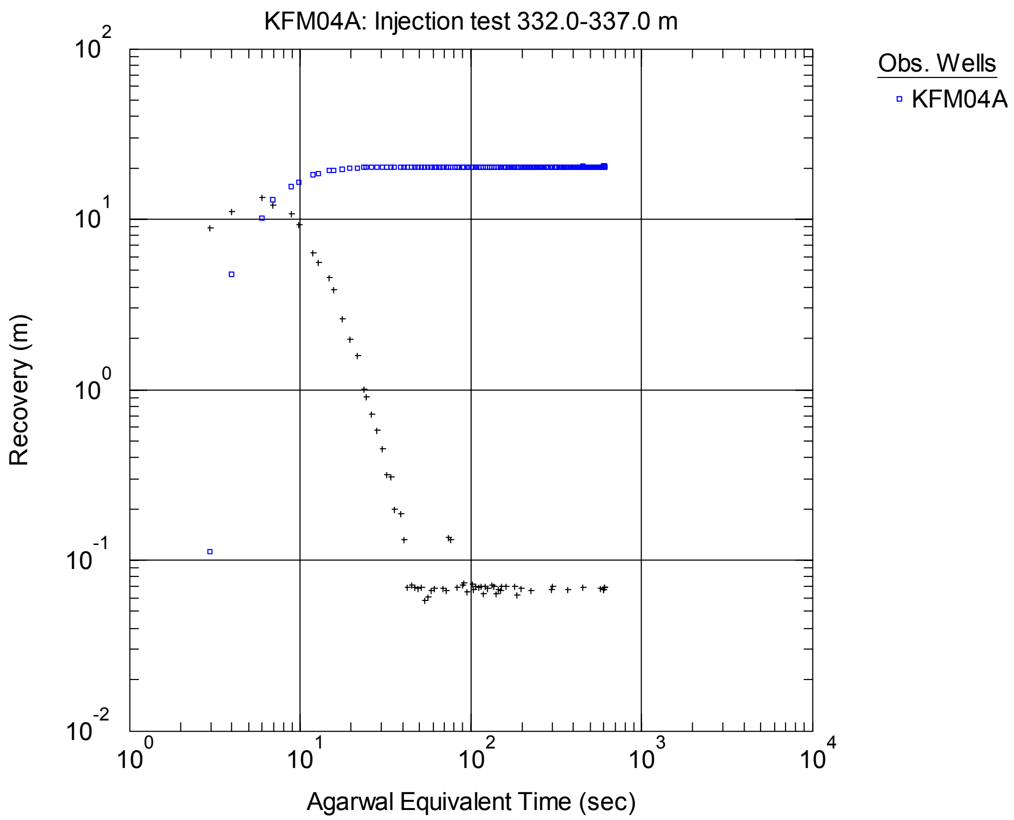


Figure A3-181. *Log-log plot of recovery (□) and derivative (+) versus equivalent time, from the injection test in section 332-337 m in KFM04A.*

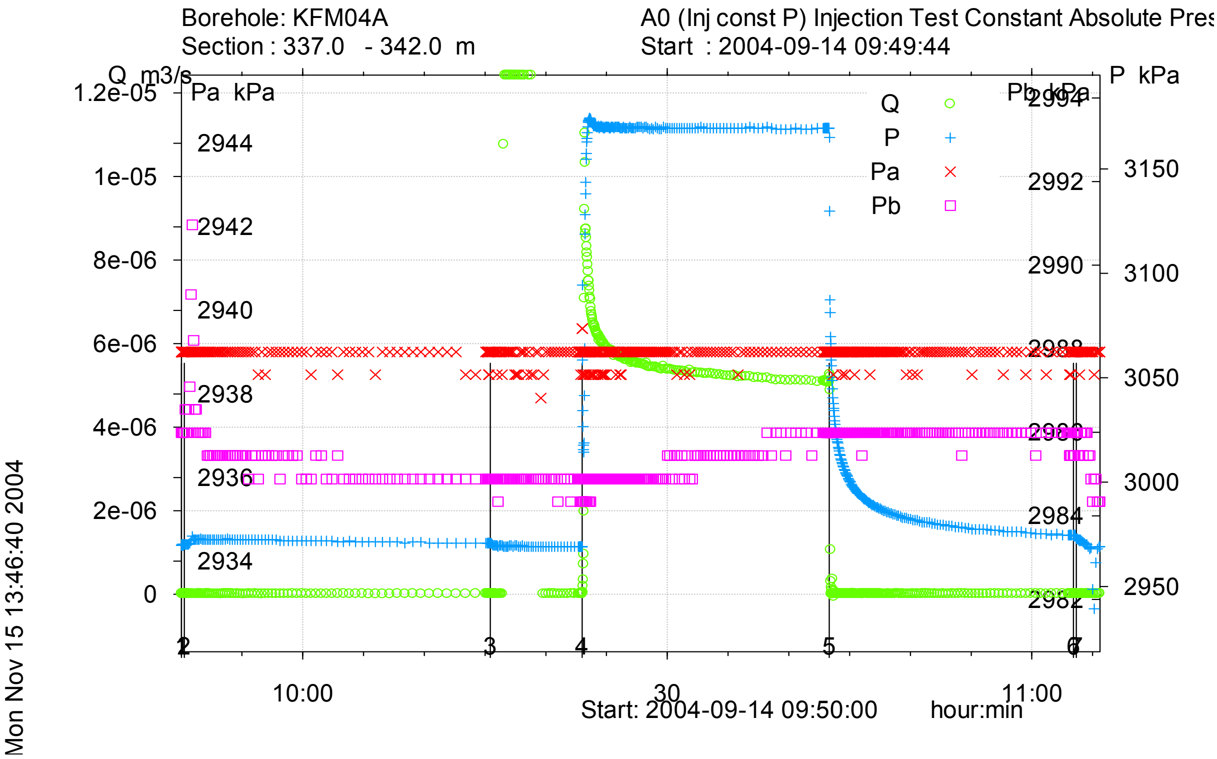


Figure A3-182. *Linear plot of flow rate (Q), pressure (P), pressure above section (Pa) and pressure below section (Pb) versus time from the injection test in section 337-342 m in borehole KFM04A.*

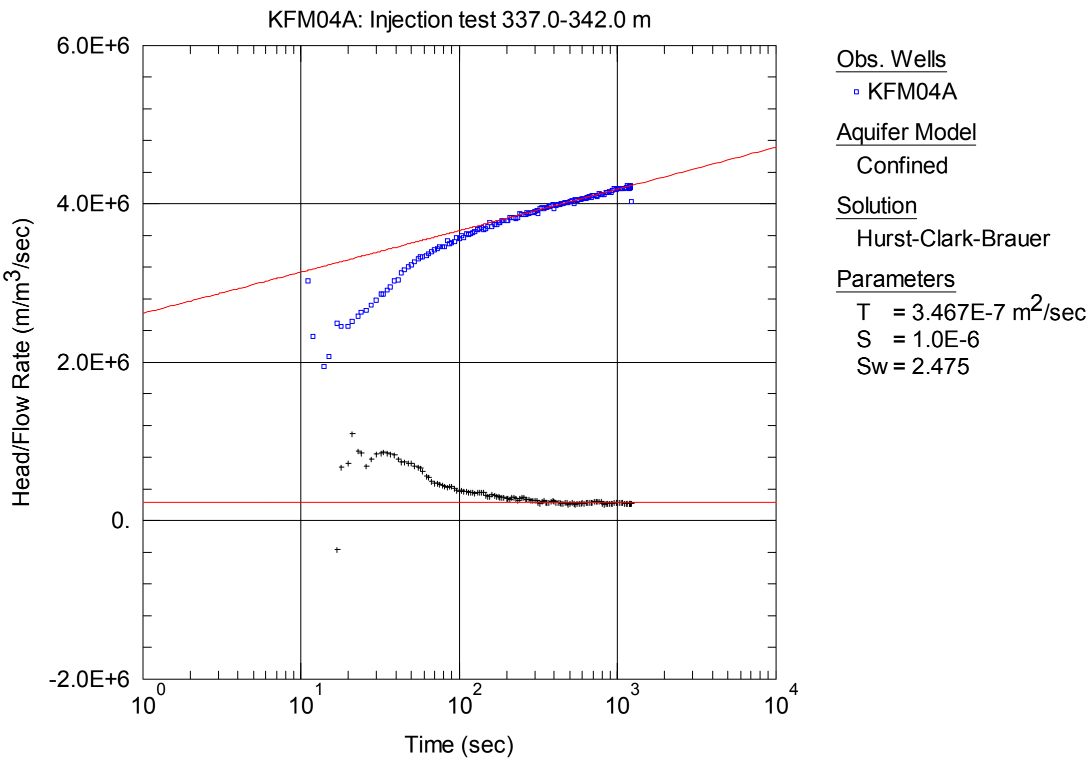


Figure A3-183. *Lin-log plot of head/flow rate (□) and derivative (+) versus time, from the injection test in section 337-342 m in KFM04A.*

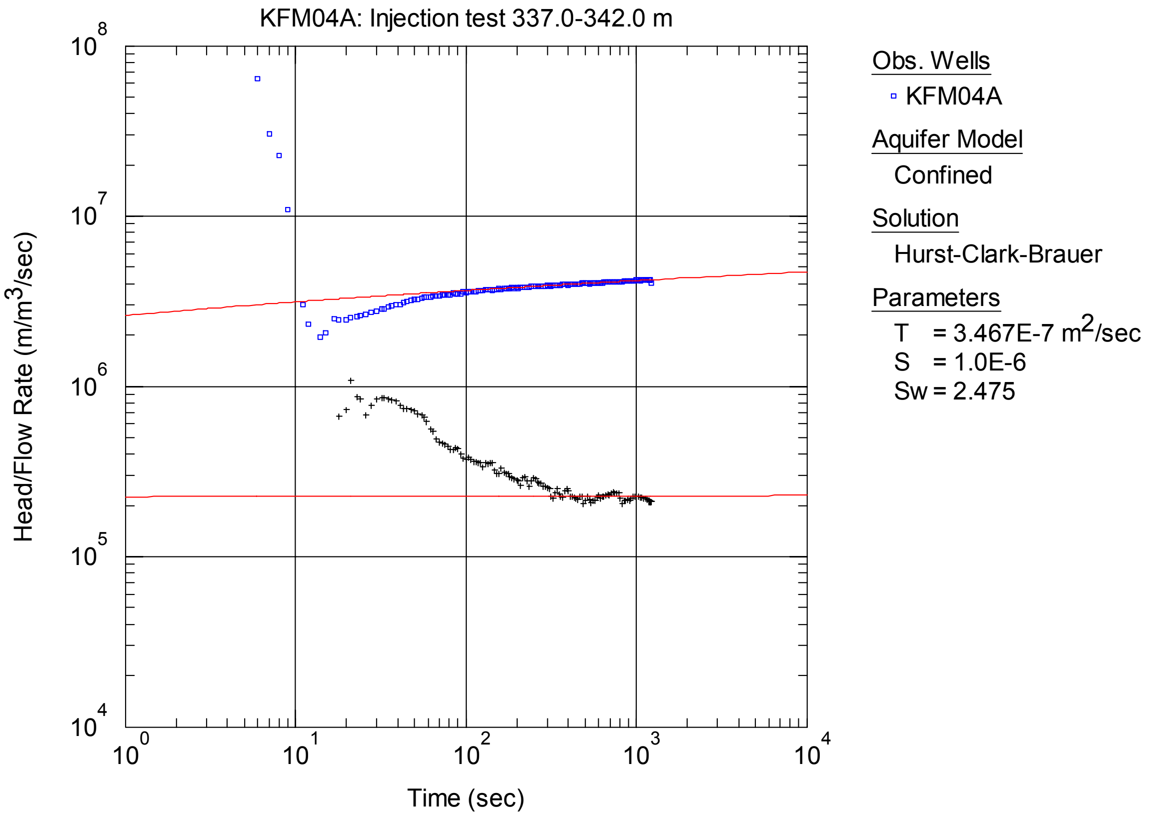


Figure A3-184. *Log-log plot of head/flow rate (□) and derivative (+) versus time, from the injection test in section 337-342 m in KFM04A.*

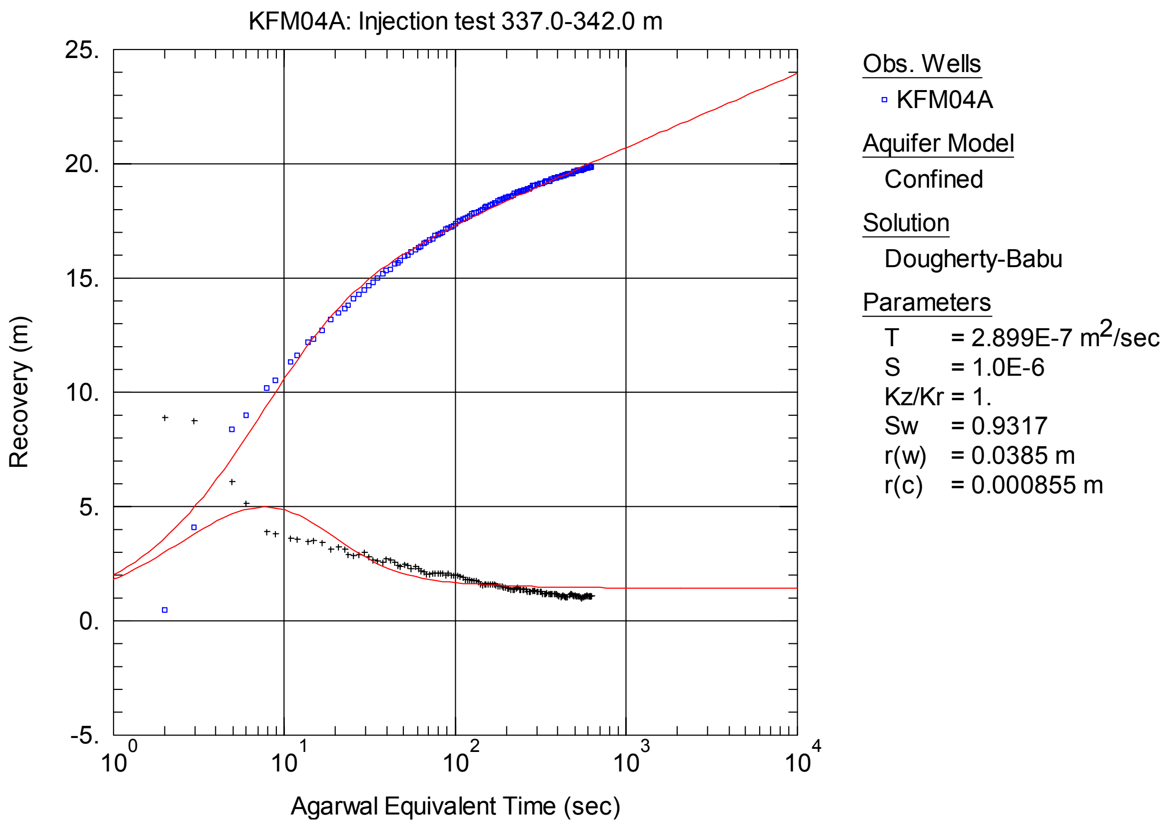


Figure A3-185. *Lin-log plot of recovery (□) and derivative (+) versus equivalent time, from the injection test in section 337-342 m in KFM04A.*

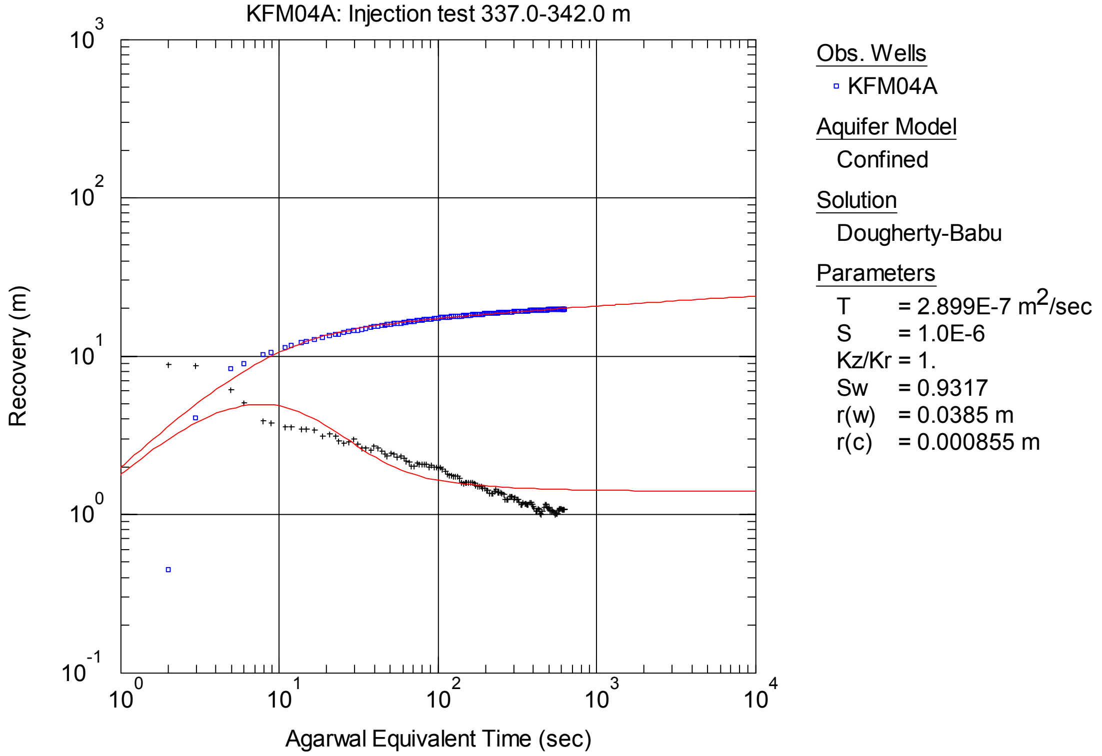


Figure A3-186. *Log-log plot of recovery (□) and derivative (+) versus equivalent time, from the injection test in section 337-342 m in KFM04A.*

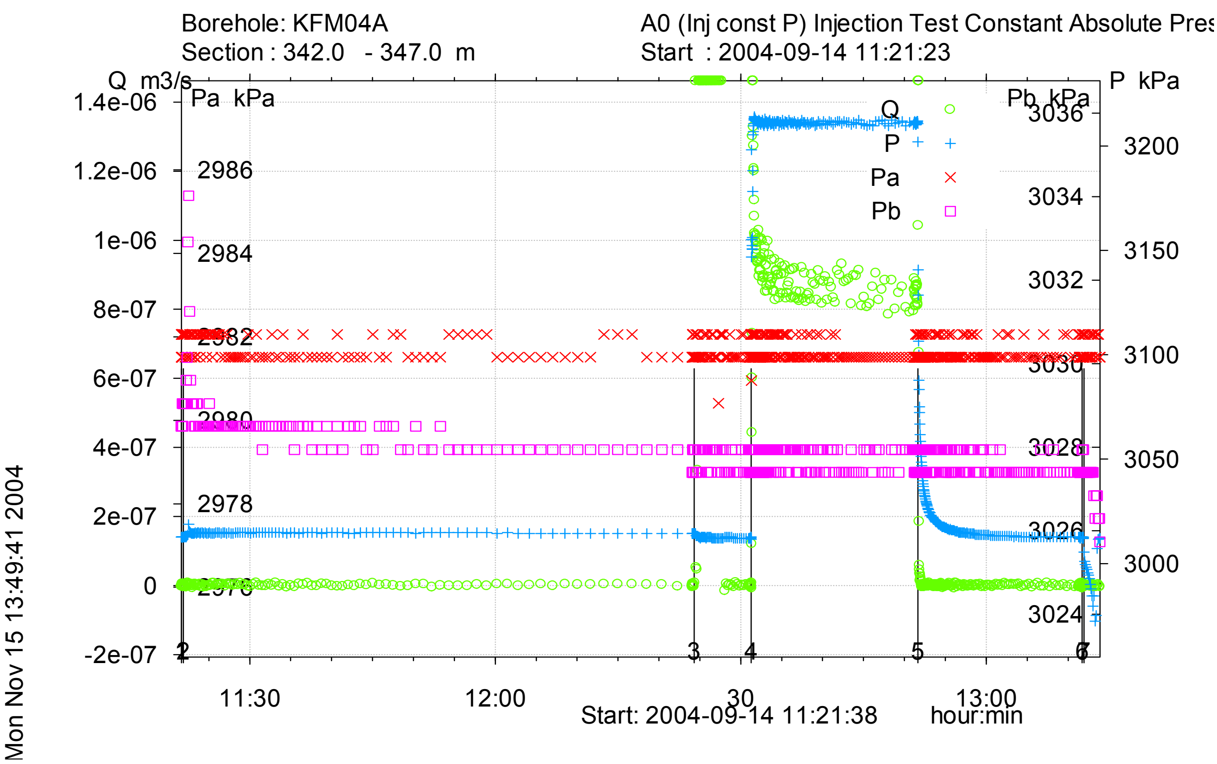


Figure A3-187. *Linear plot of flow rate (Q), pressure (P), pressure above section (Pa) and pressure below section (Pb) versus time from the injection test in section 342-347 m in borehole KFM04A.*

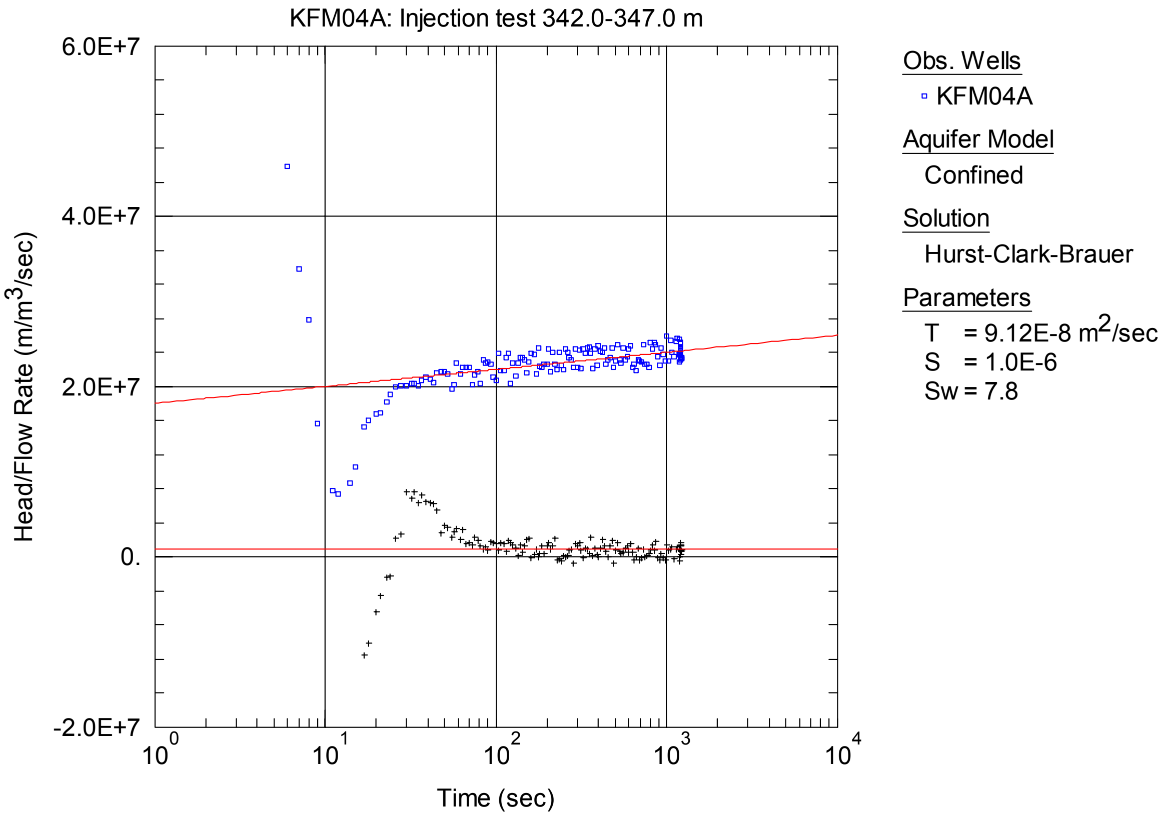


Figure A3-188. *Lin-log plot of head/flow rate (□) and derivative (+) versus time, from the injection test in section 342-347 m in KFM04A.*

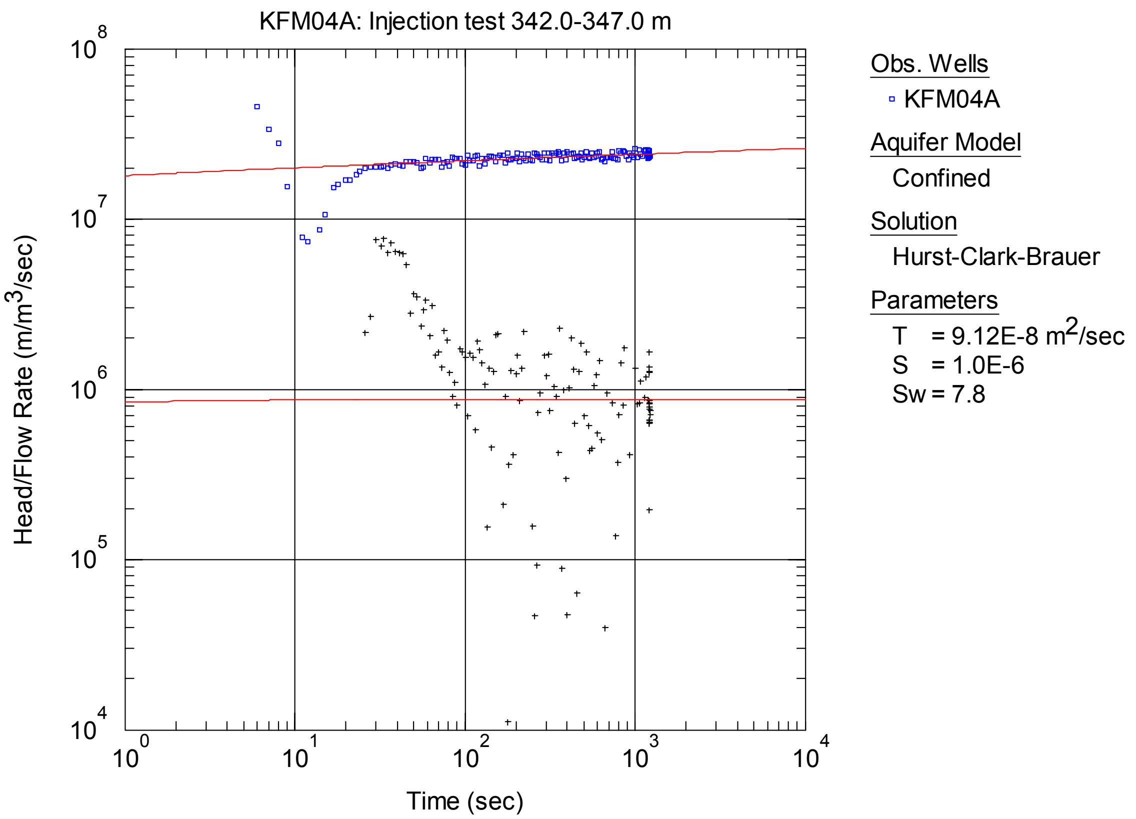


Figure A3-189. *Log-log plot of head/flow rate (□) and derivative (+) versus time, from the injection test in section 342-347 m in KFM04A.*

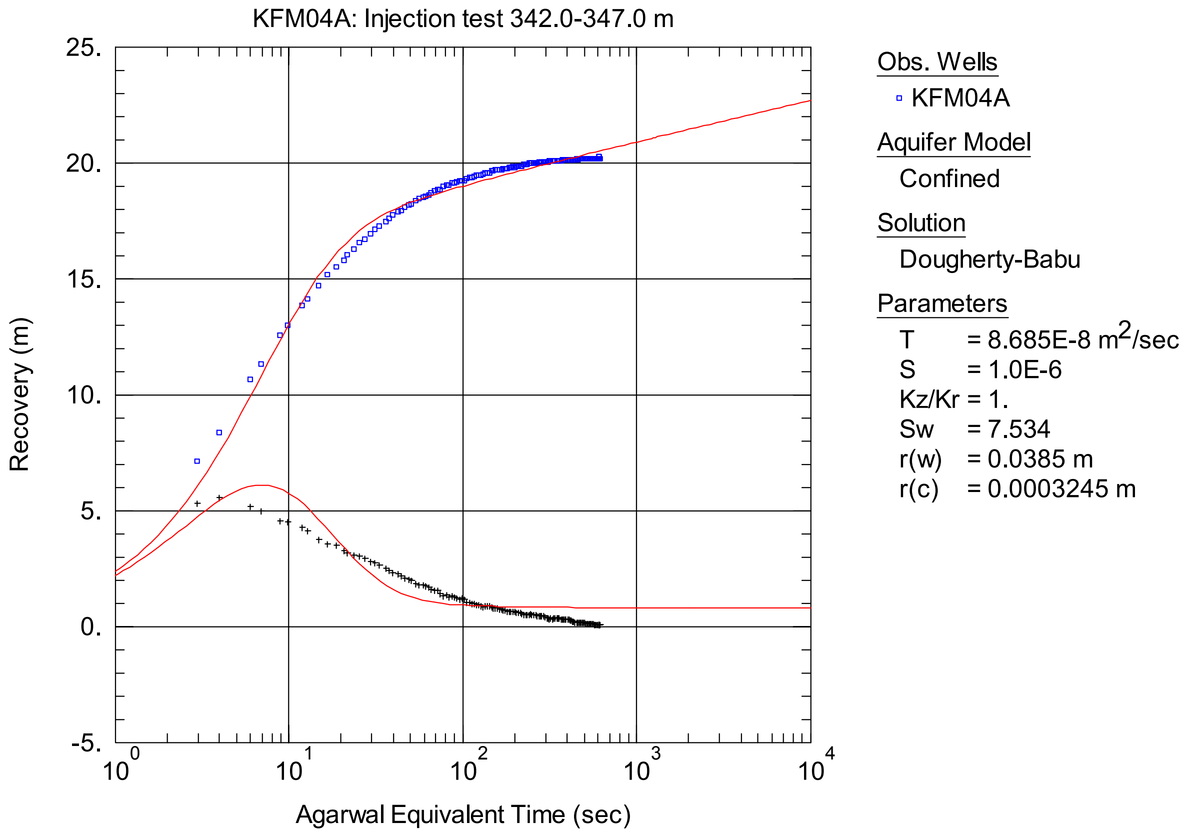


Figure A3-190. *Lin-log plot of recovery (□) and derivative (+) versus equivalent time, from the injection test in section 342-347 m in KFM04A.*

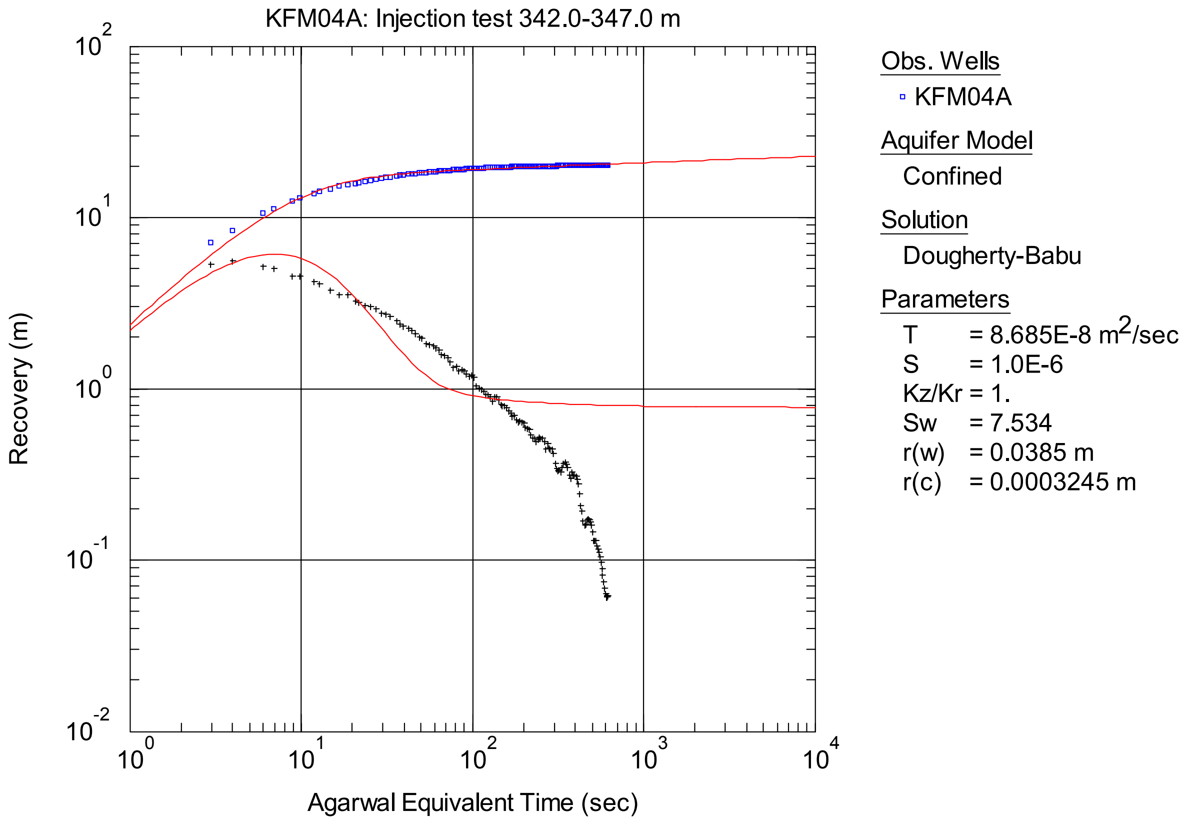


Figure A3-191. *Log-log plot of recovery (□) and derivative (+) versus equivalent time, from the injection test in section 342-347 m in KFM04A.*

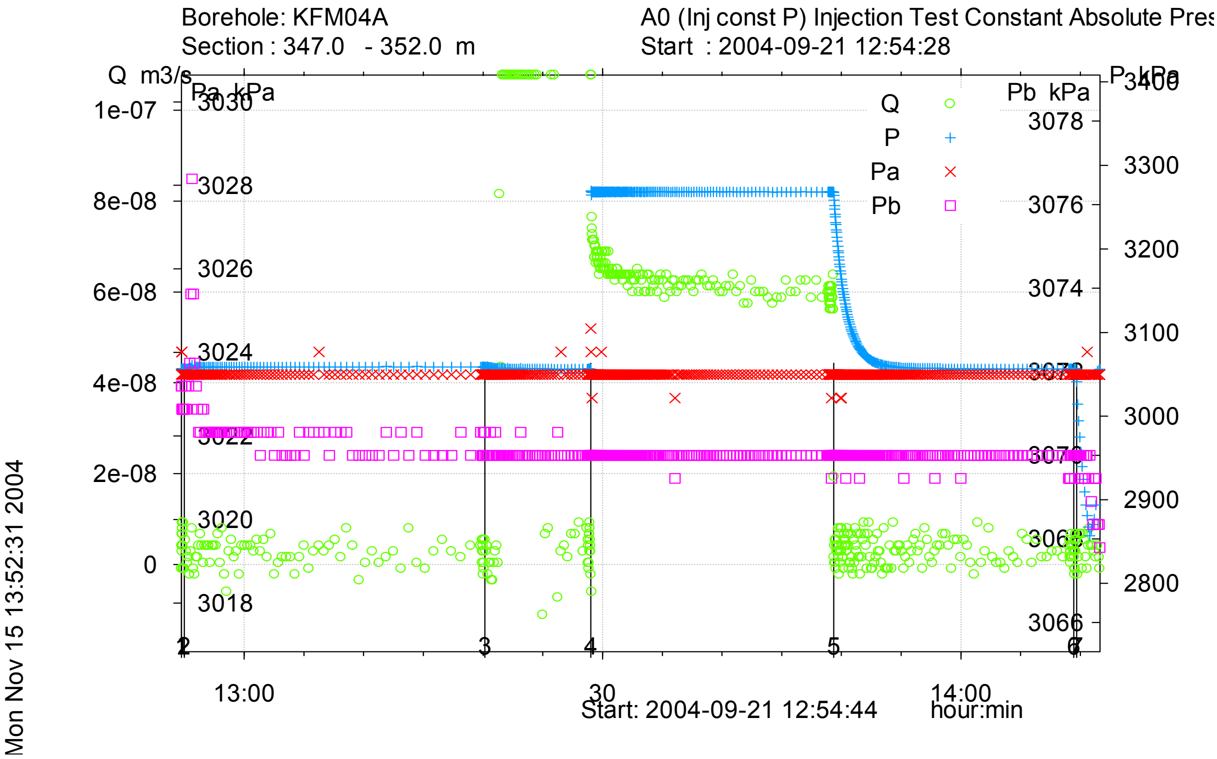


***Figure A3-192.** Linear plot of flow rate (Q), pressure (P), pressure above section (Pa) and pressure below section (Pb) versus time from the injection test in section 347-352 m in borehole KFM04A.*

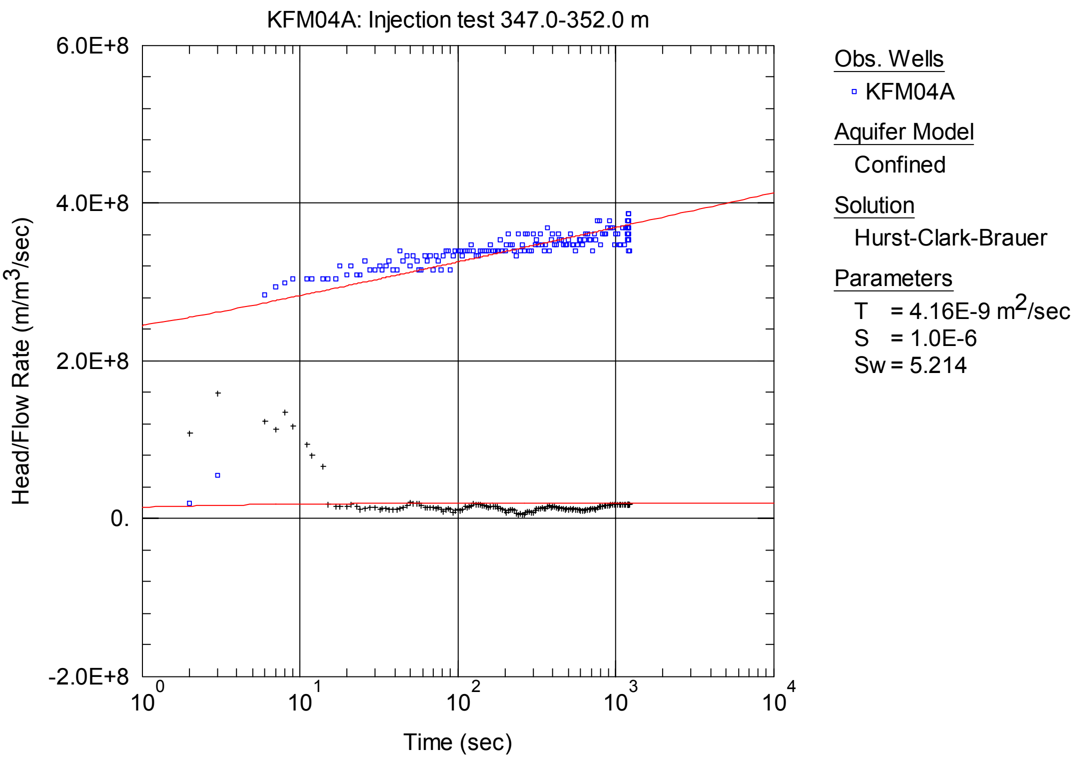


***Figure A3-193.** Lin-log plot of head/flow rate (□) and derivative (+) versus time, from the injection test in section 347-352 m in KFM04A.*

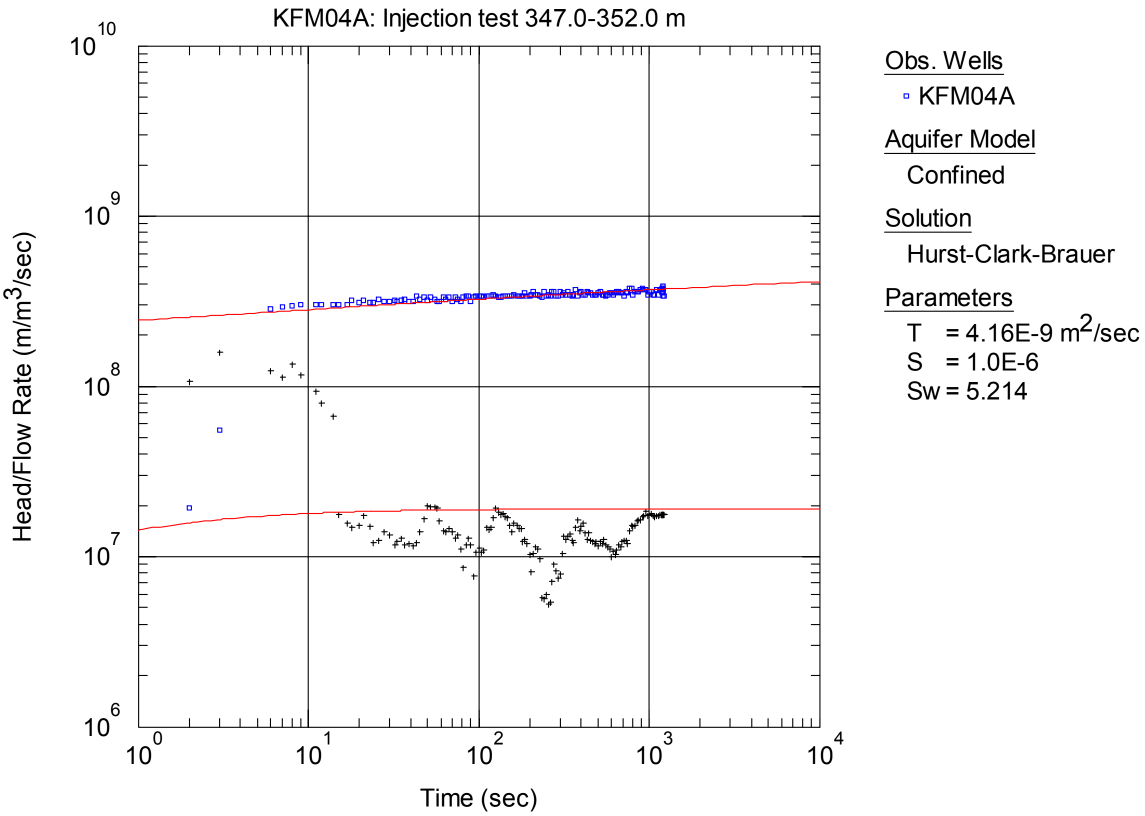


Figure A3-194. *Log-log plot of head/flow rate (□) and derivative (+) versus time, from the injection test in section 347-352 m in KFM04A.*

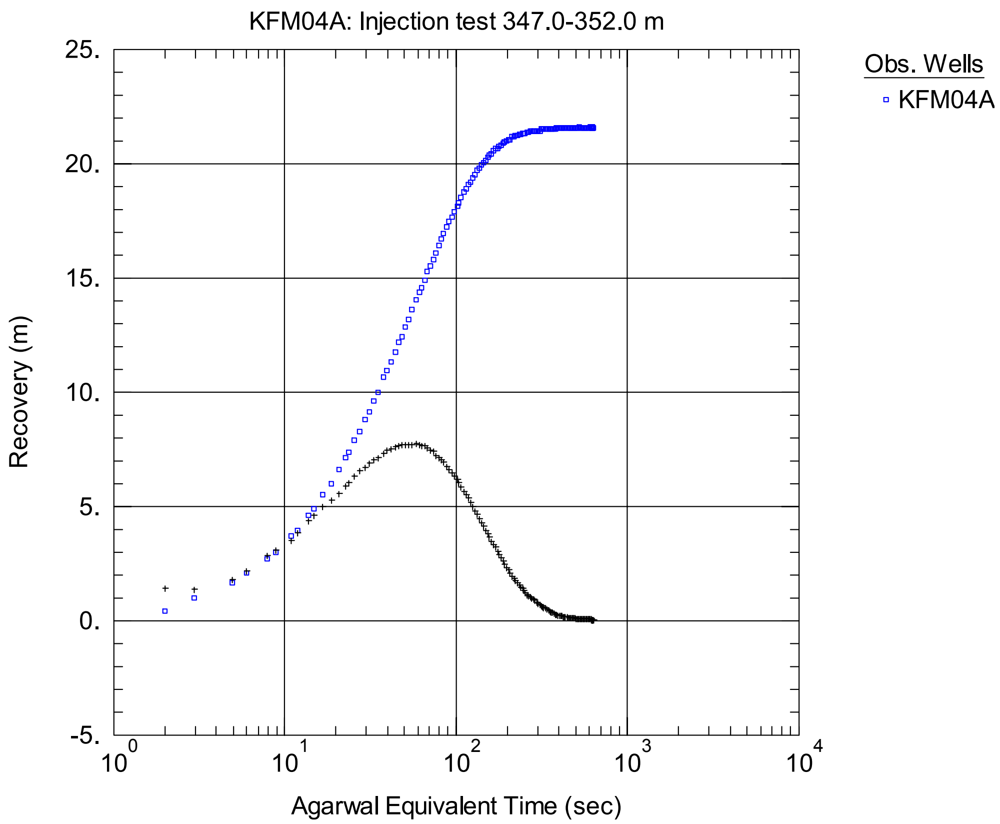


Figure A3-195. *Lin-log plot of recovery (□) and derivative (+) versus equivalent time, from the injection test in section 347-352 m in KFM04A.*

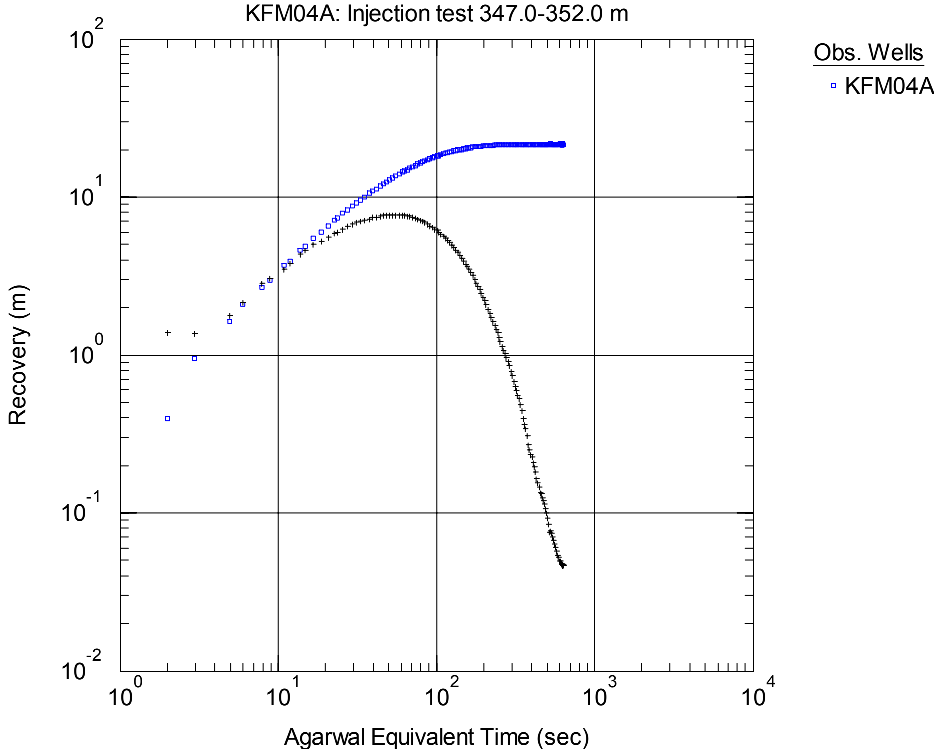


***Figure A3-196.** Log-log plot of recovery (□) and derivative (+) versus equivalent time, from the injection test in section 347-352 m in KFM04A.*

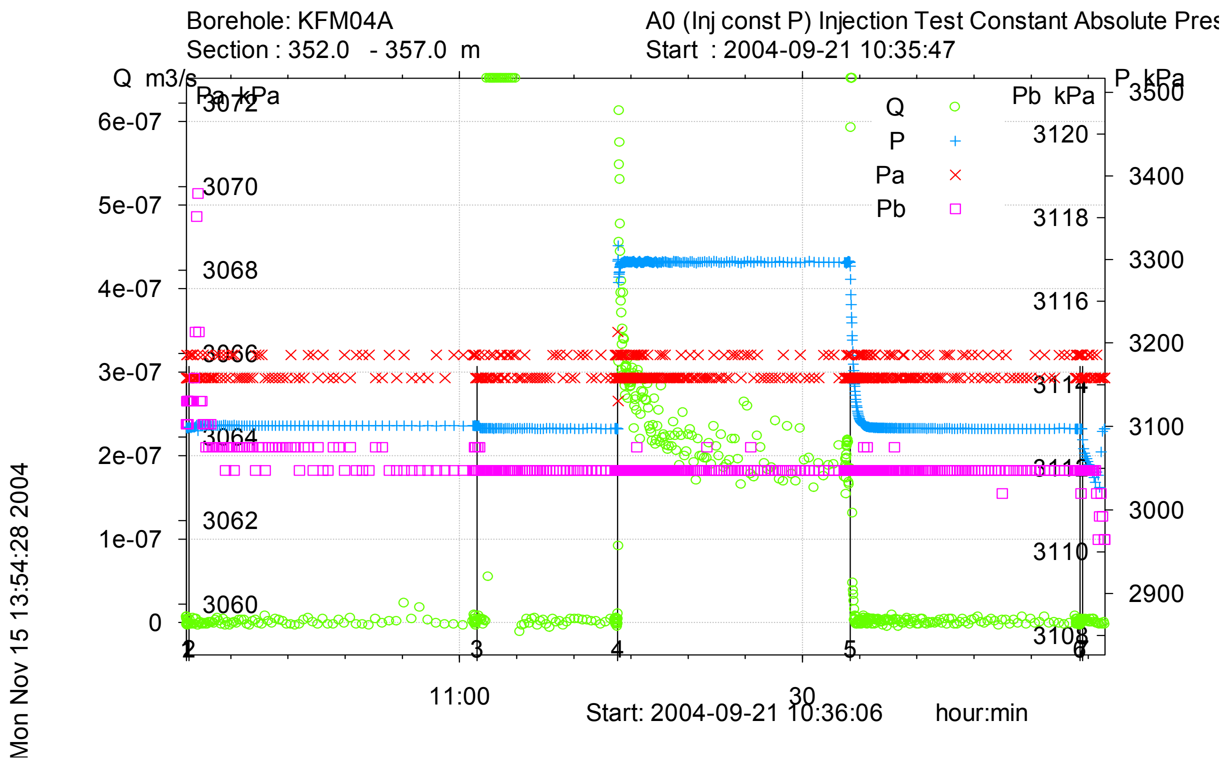


***Figure A3-197.** Linear plot of flow rate (Q), pressure (P), pressure above section (Pa) and pressure below section (Pb) versus time from the injection test in section 352-357 m in borehole KFM04A.*

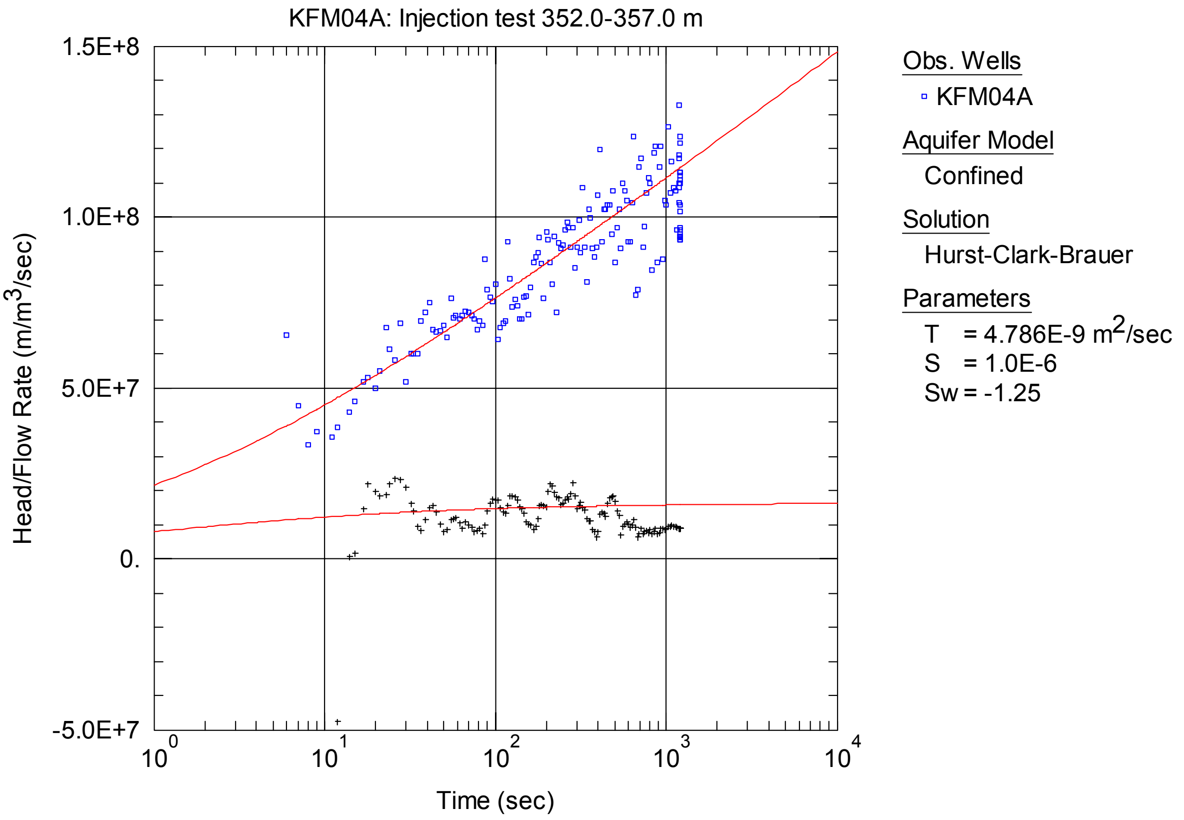


Figure A3-198. *Lin-log plot of head/flow rate (□) and derivative (+) versus time, from the injection test in section 352-357 m in KFM04A.*

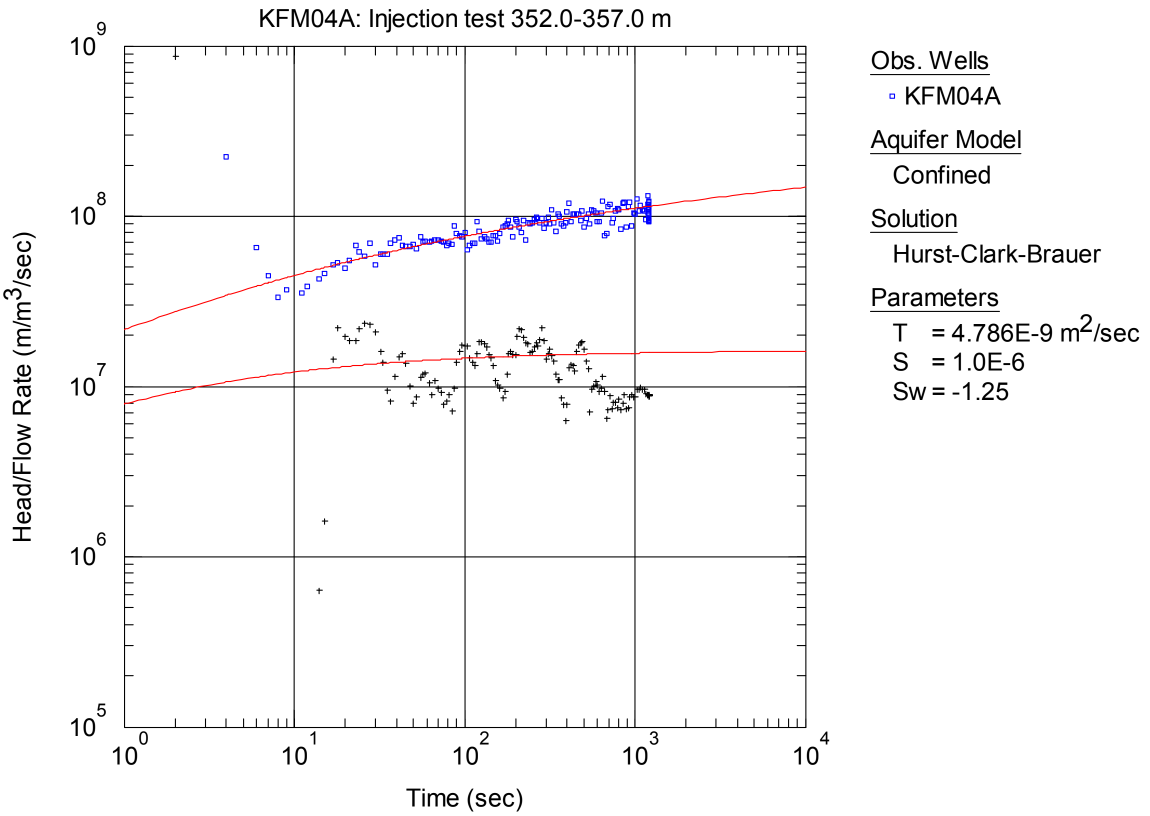


Figure A3-199. *Log-log plot of head/flow rate (□) and derivative (+) versus time, from the injection test in section 352-357 m in KFM04A.*

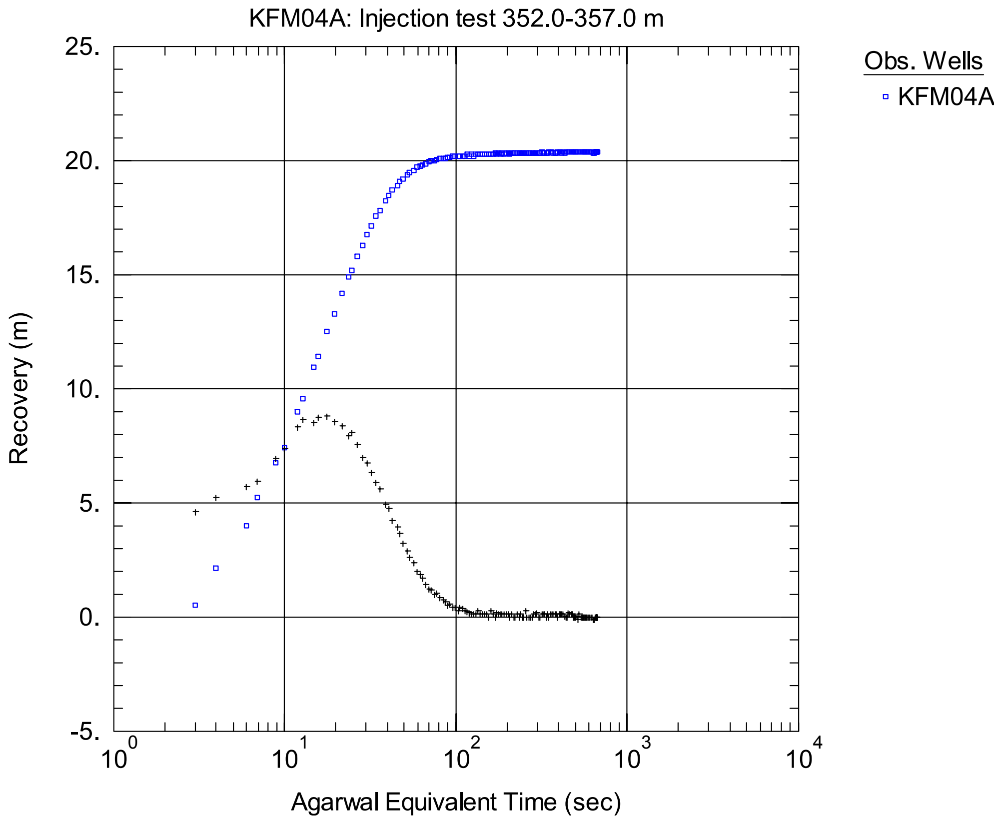


Figure A3-200. *Lin-log plot of recovery (□) and derivative (+) versus equivalent time, from the injection test in section 352-357 m in KFM04A.*

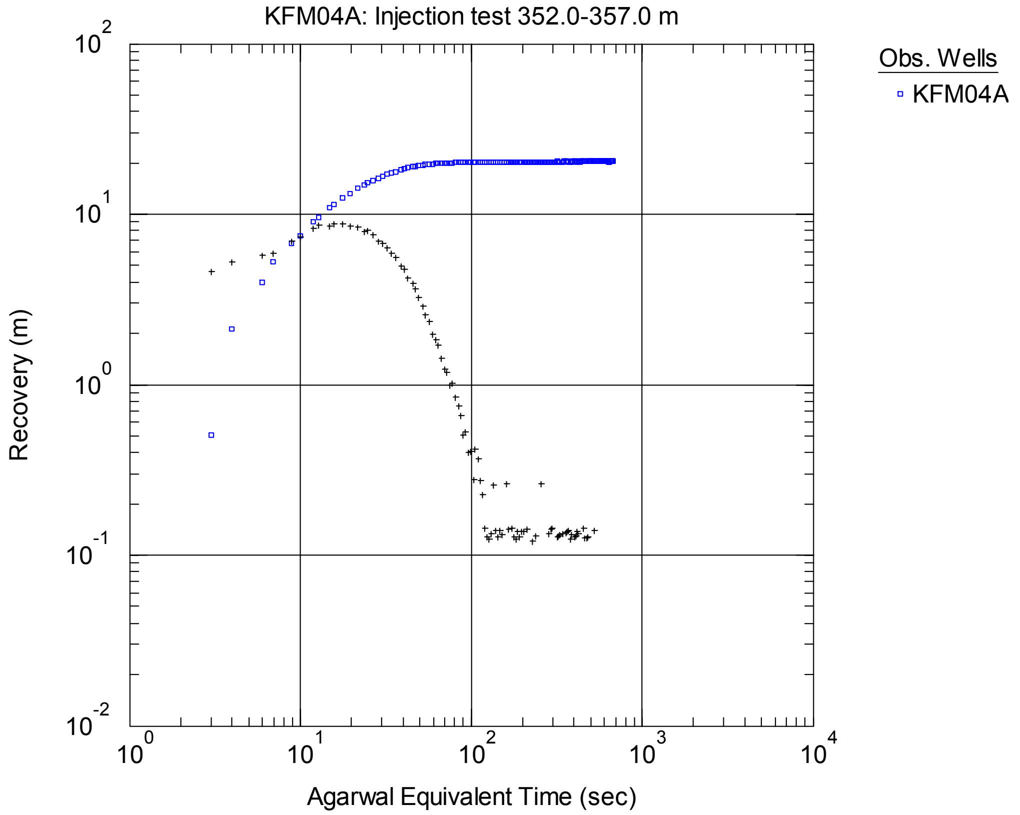


Figure A3-201. *Log-log plot of recovery (□) and derivative (+) versus equivalent time, from the injection test in section 352-357 m in KFM04A.*

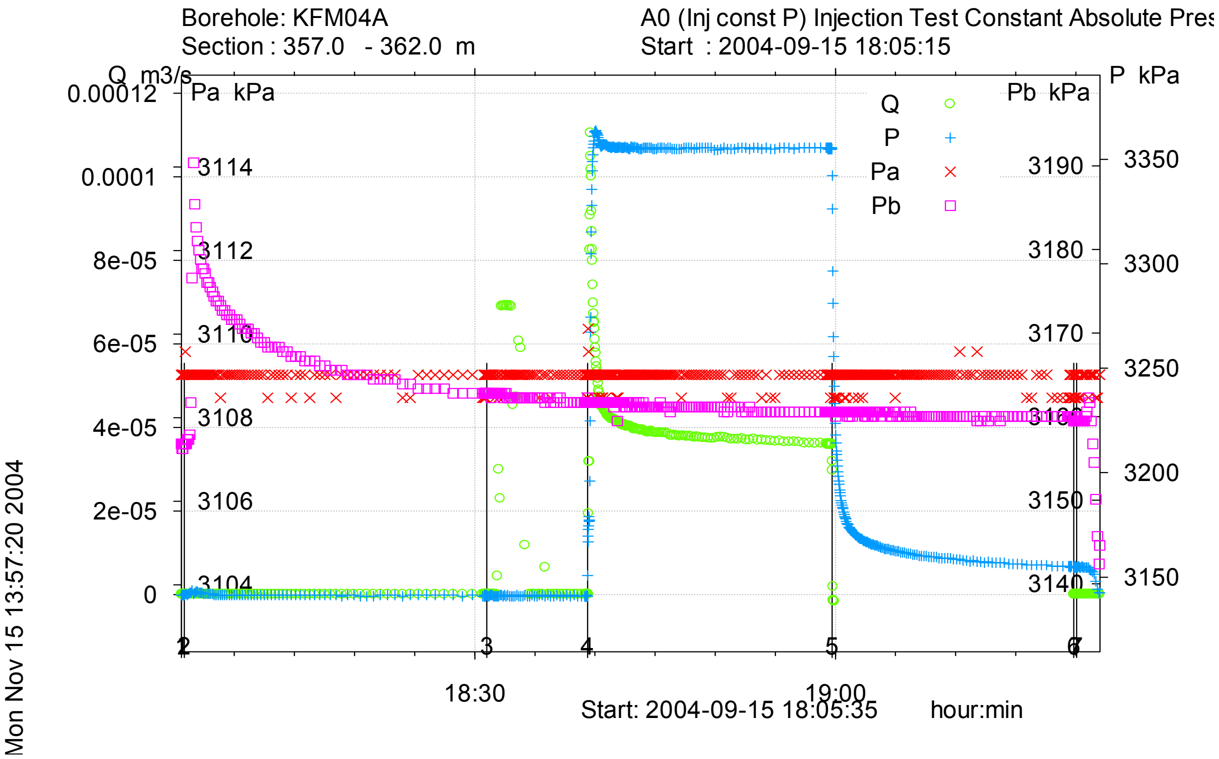


Figure A3-202. *Linear plot of flow rate (Q), pressure (P), pressure above section (Pa) and pressure below section (Pb) versus time from the injection test in section 357-362 m in borehole KFM04A.*

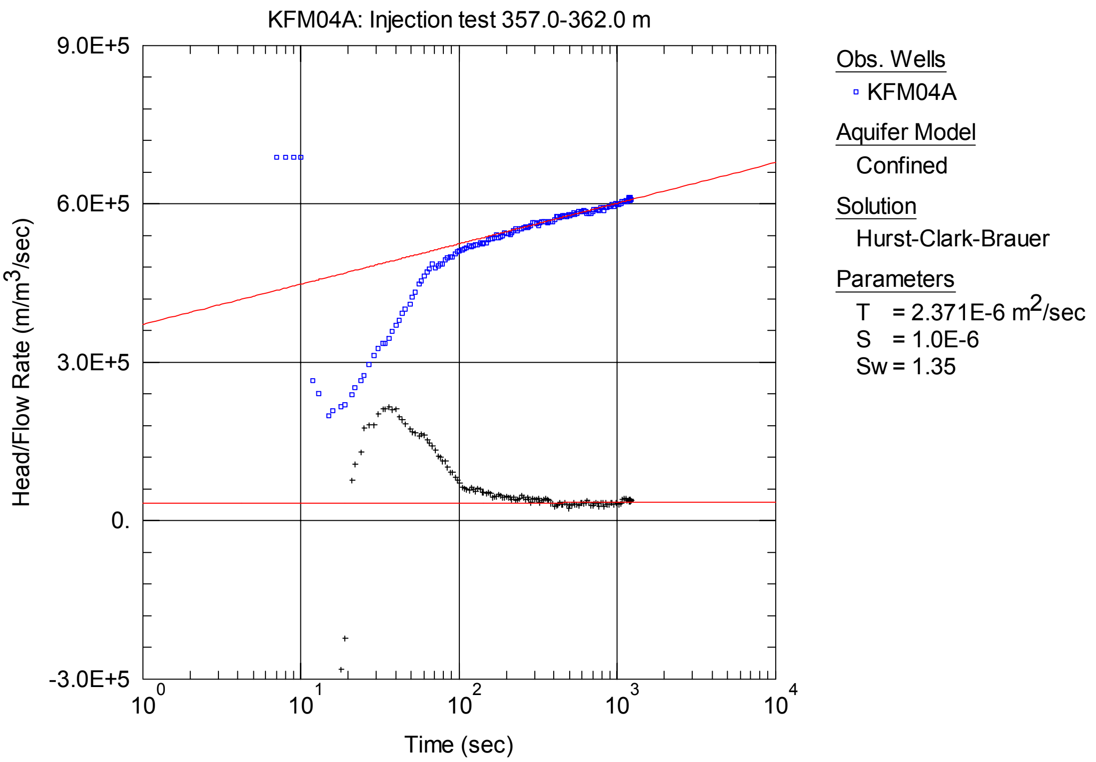


Figure A3-203. *Lin-log plot of head/flow rate (□) and derivative (+) versus time, from the injection test in section 357-362 m in KFM04A.*

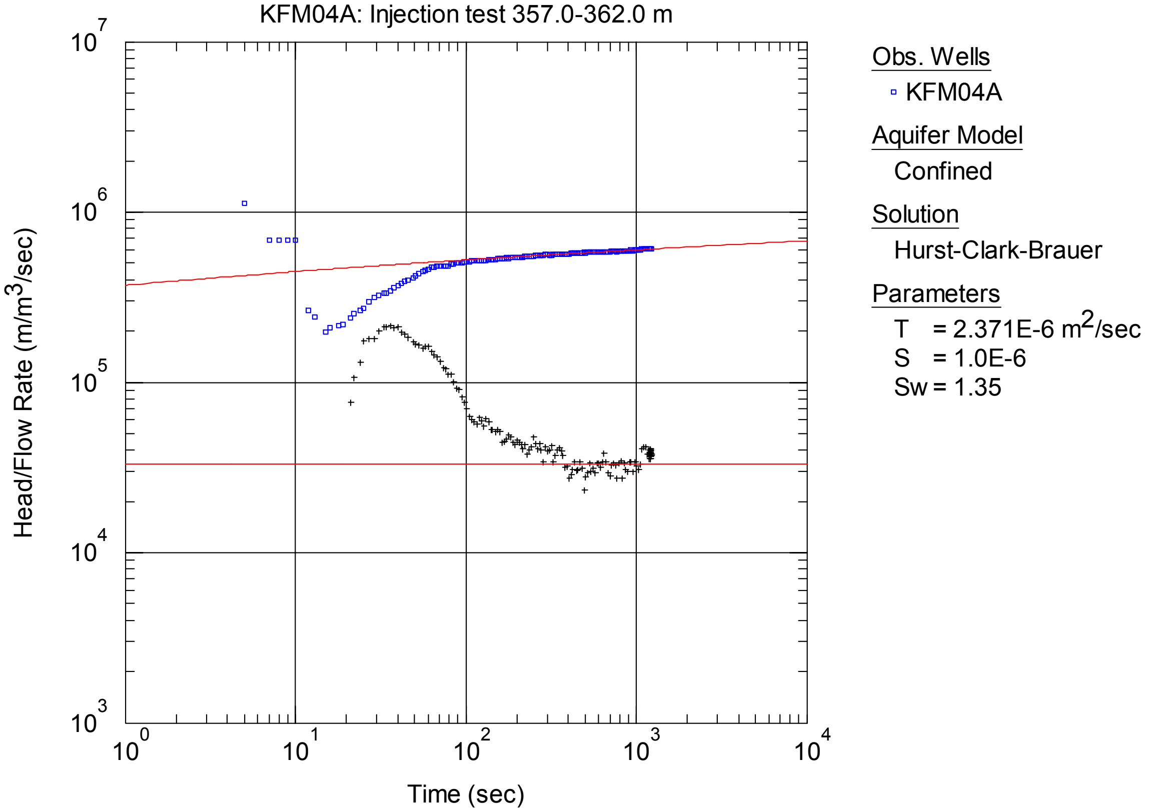


__Figure A3-204.__ Log-log plot of head/flow rate (□) and derivative (+) versus time, from the injection test in section 357-362 m in KFM04A.

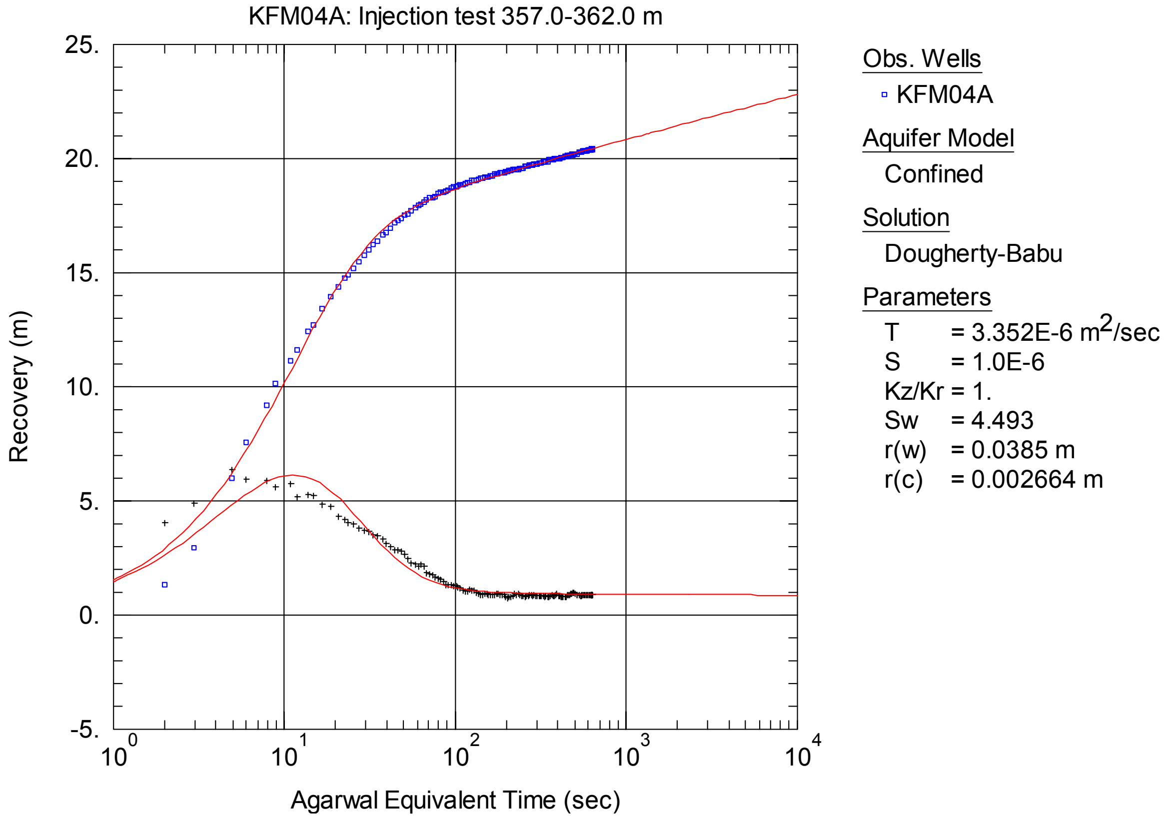


__Figure A3-205.__ Lin-log plot of recovery (□) and derivative (+) versus equivalent time, from the injection test in section 357-362 m in KFM04A.

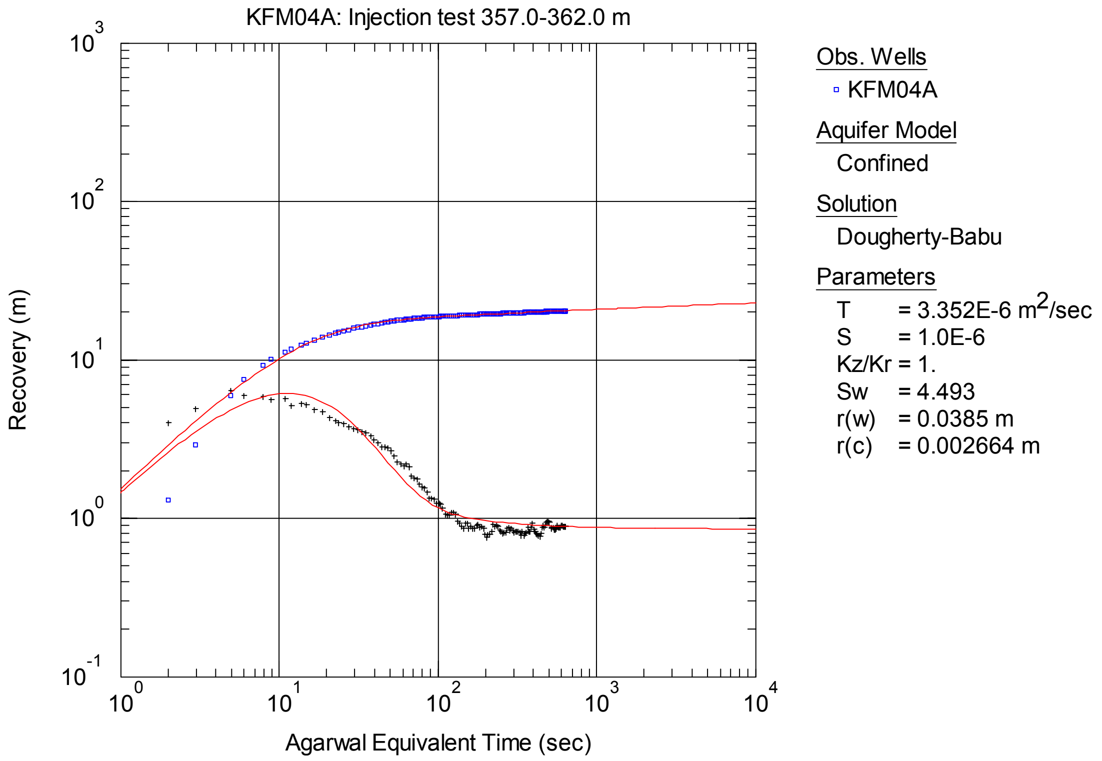


Figure A3-206. *Log-log plot of recovery (□) and derivative (+) versus equivalent time, from the injection test in section 357-362 m in KFM04A.*

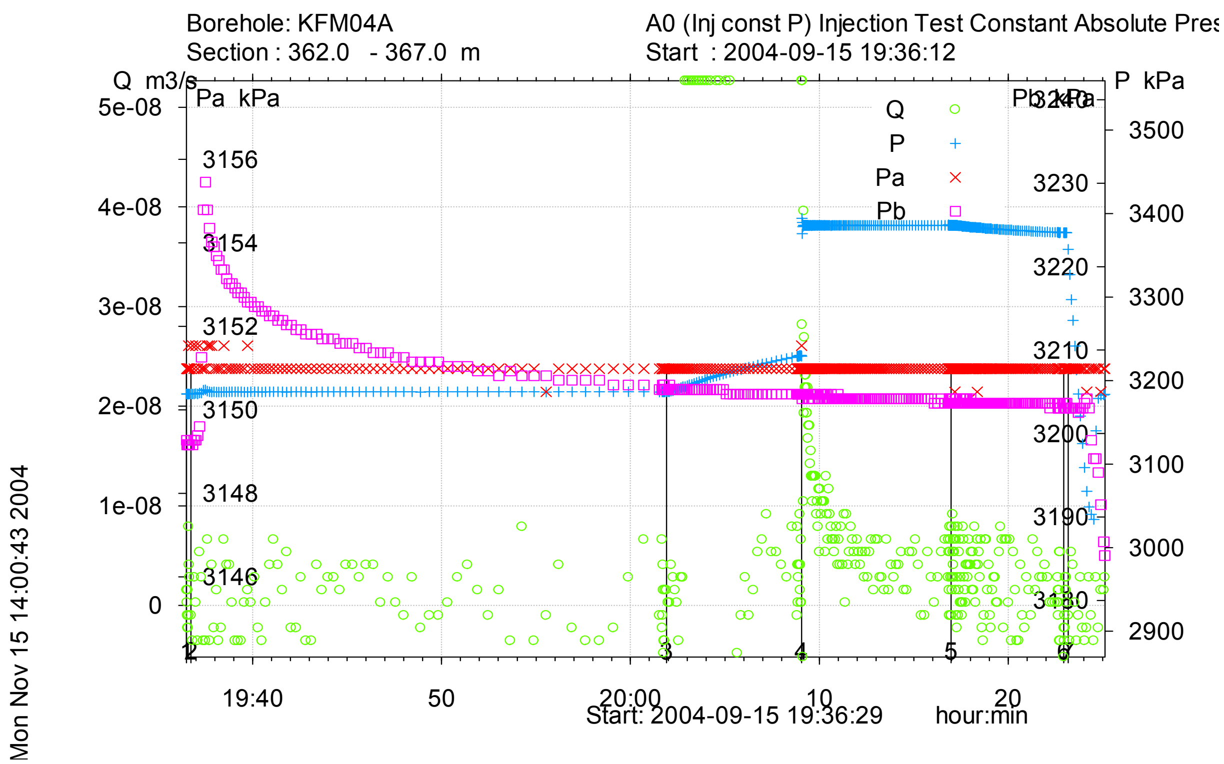


Figure A3-207. *Linear plot of flow rate (Q), pressure (P), pressure above section (Pa) and pressure below section (Pb) versus time from the injection test in section 362-367 m in borehole KFM04A.*

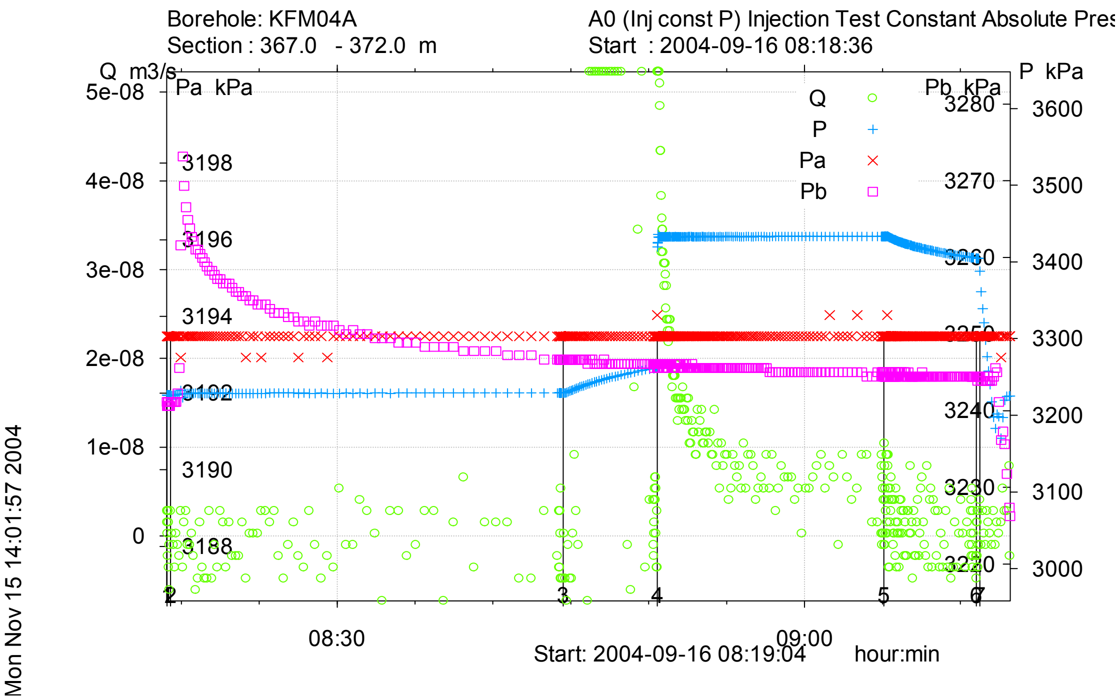


Figure A3-208. *Linear plot of flow rate (Q), pressure (P), pressure above section (Pa) and pressure below section (Pb) versus time from the injection test in section 367-372 m in borehole KFM04A.*

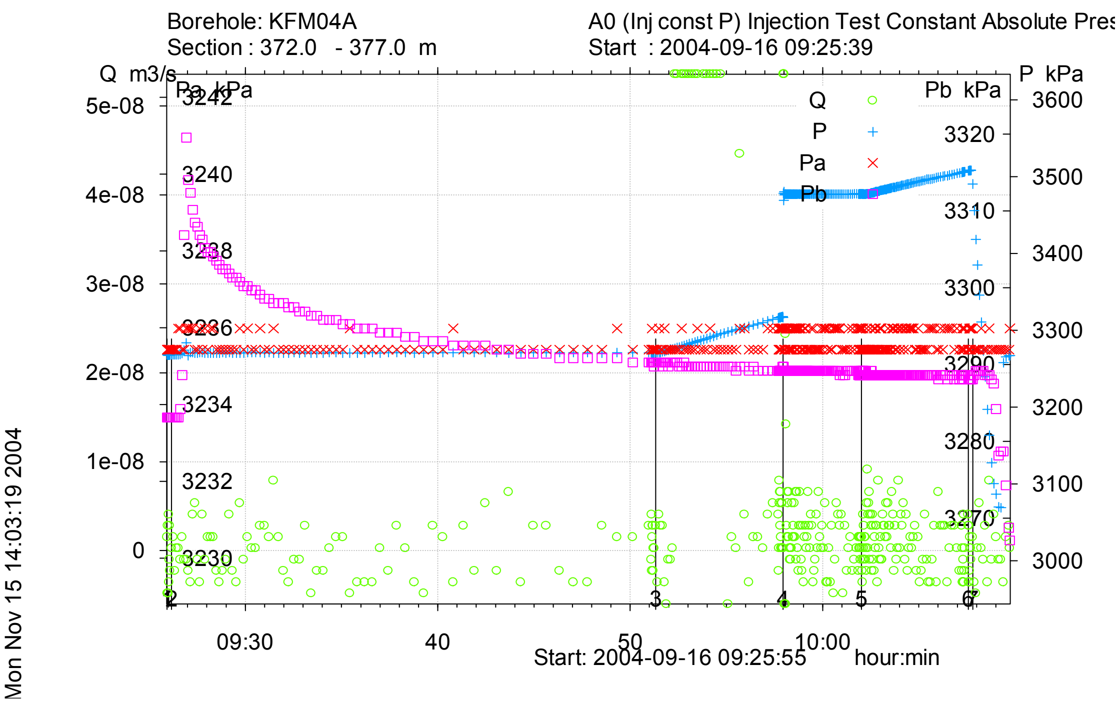


Figure A3-209. *Linear plot of flow rate (Q), pressure (P), pressure above section (Pa) and pressure below section (Pb) versus time from the injection test in section 372-377 m in borehole KFM04A.*

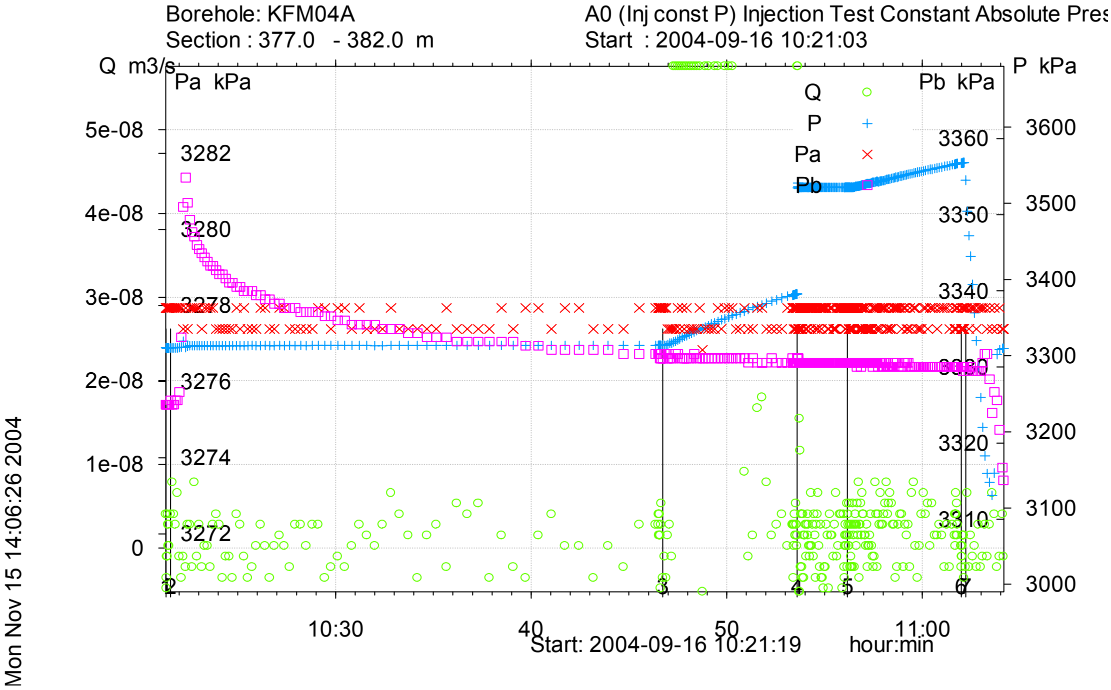


Figure A3-210. Linear plot of flow rate (Q), pressure (P), pressure above section (Pa) and pressure below section (Pb) versus time from the injection test in section 377-382 m in borehole KFM04A.

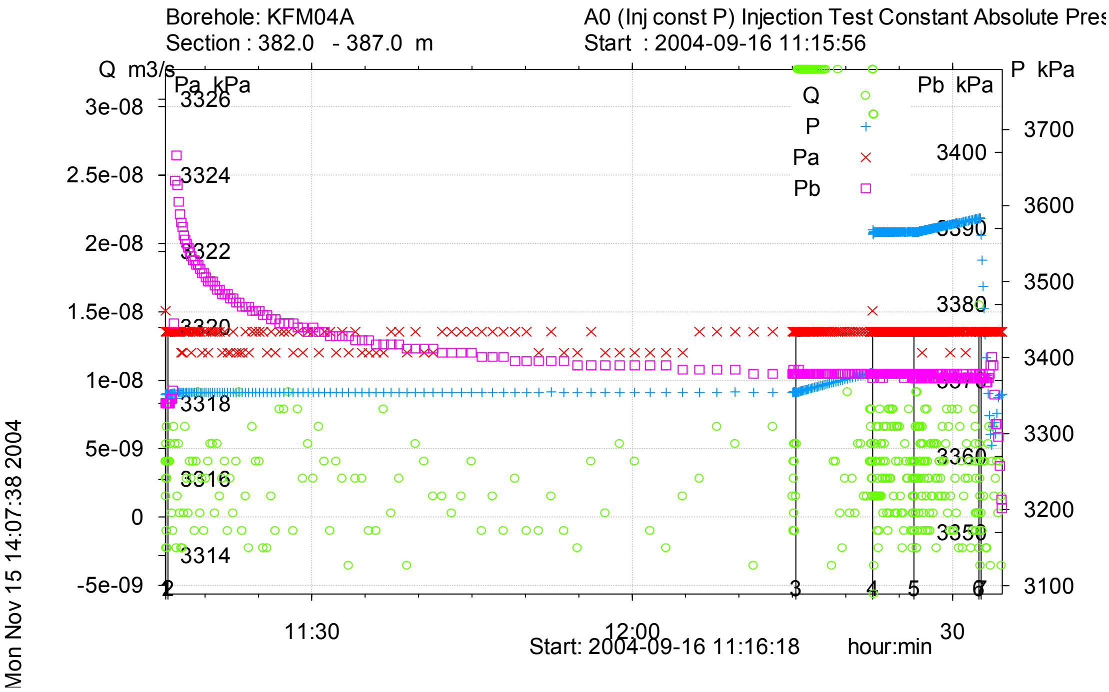


Figure A3-211. Linear plot of flow rate (Q), pressure (P), pressure above section (Pa) and pressure below section (Pb) versus time from the injection test in section 382-387 m in borehole KFM04A.

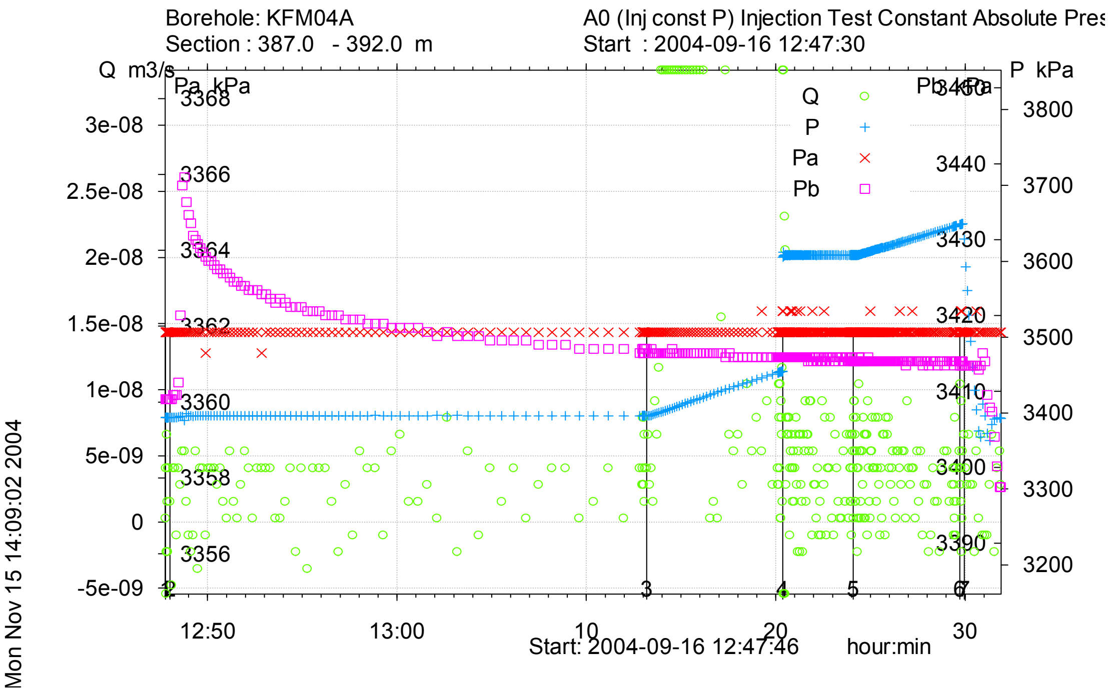


***Figure A3-212.** Linear plot of flow rate (Q), pressure (P), pressure above section (Pa) and pressure below section (Pb) versus time from the injection test in section 387-392 m in borehole KFM04A.*

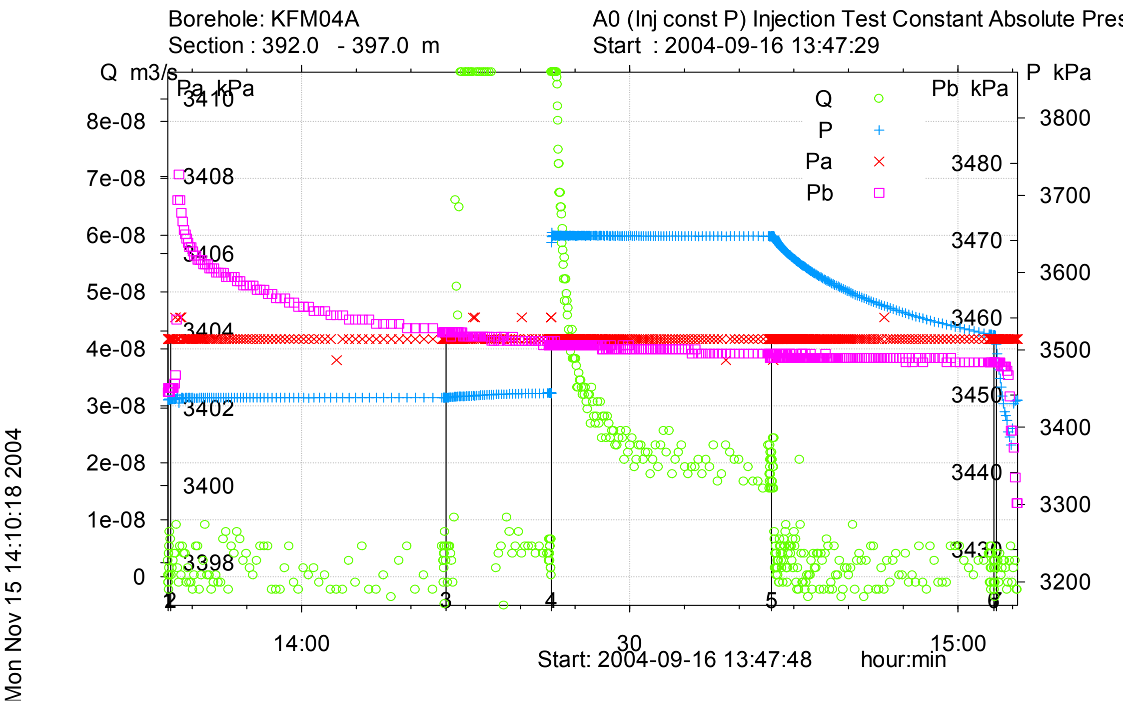


***Figure A3-213.** Linear plot of flow rate (Q), pressure (P), pressure above section (Pa) and pressure below section (Pb) versus time from the injection test in section 392-397 m in borehole KFM04A.*

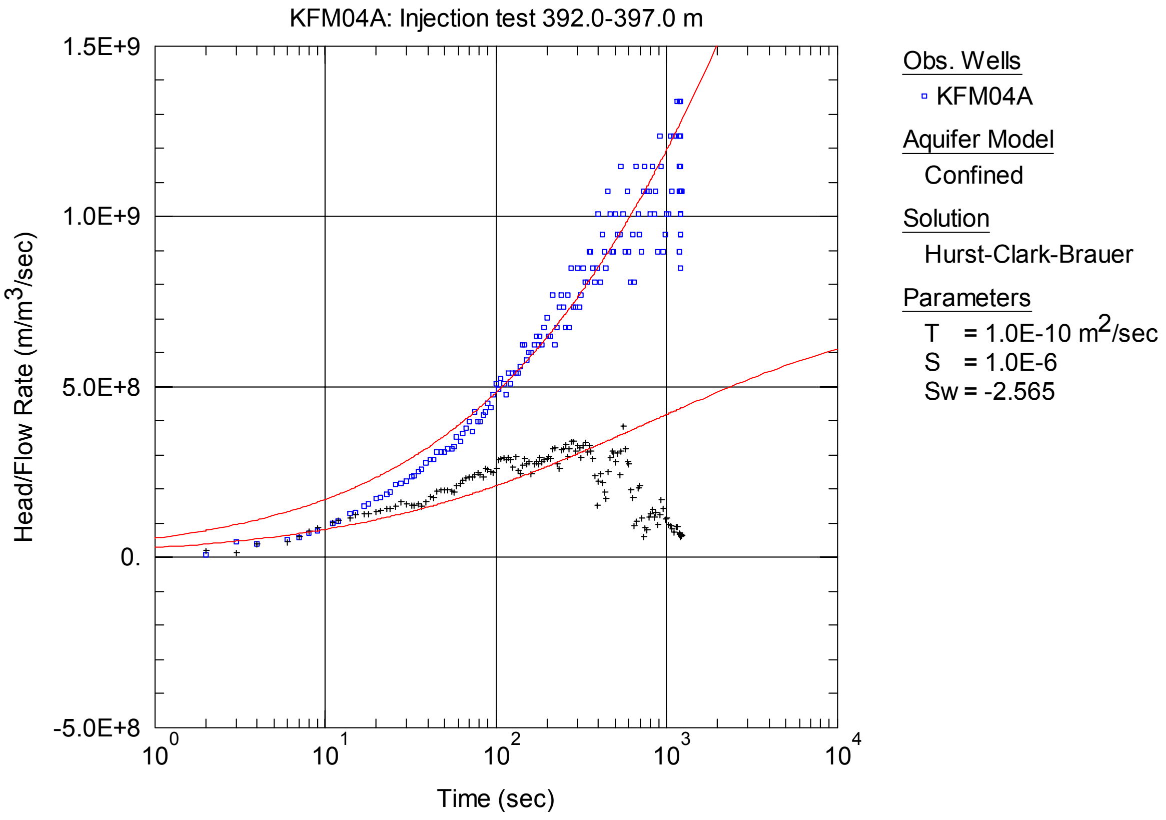


Figure A3-214. *Lin-log plot of head/flow rate (□) and derivative (+) versus time, from the injection test in section 392-397 m in KFM04A.*

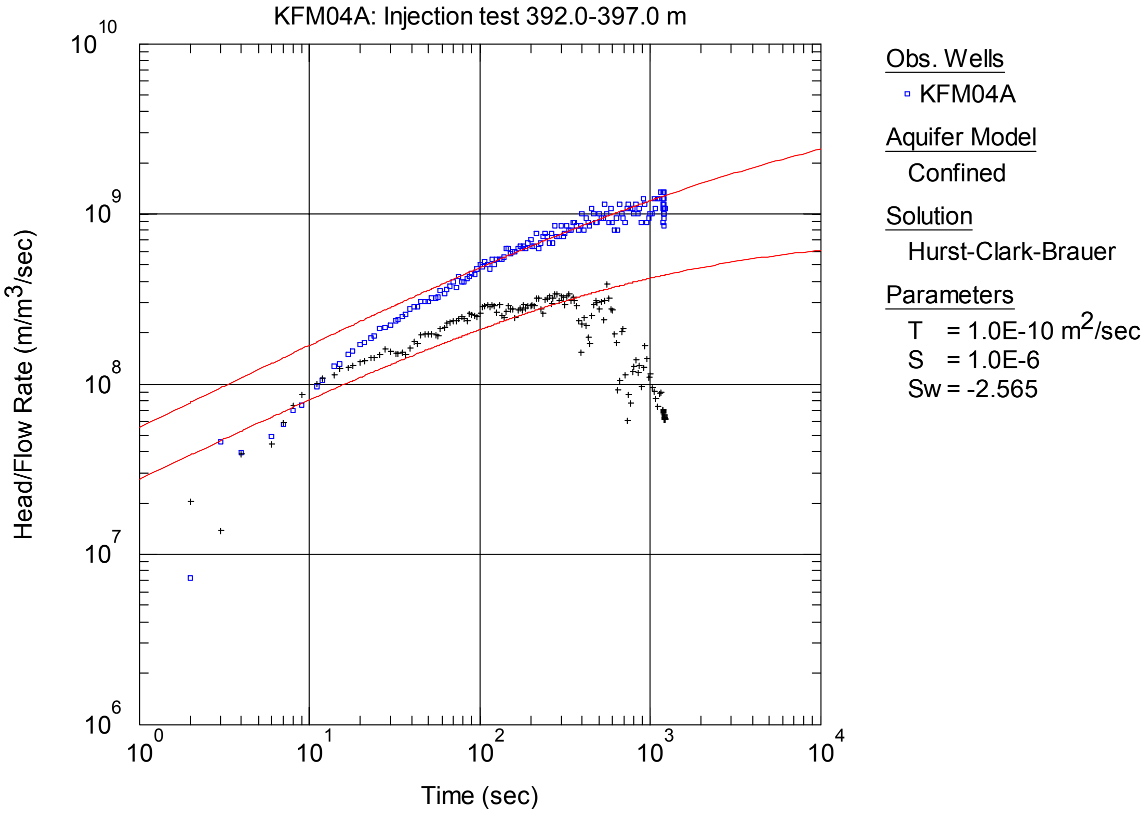


Figure A3-215. *Log-log plot of head/flow rate (□) and derivative (+) versus time, from the injection test in section 392-397 m in KFM04A.*

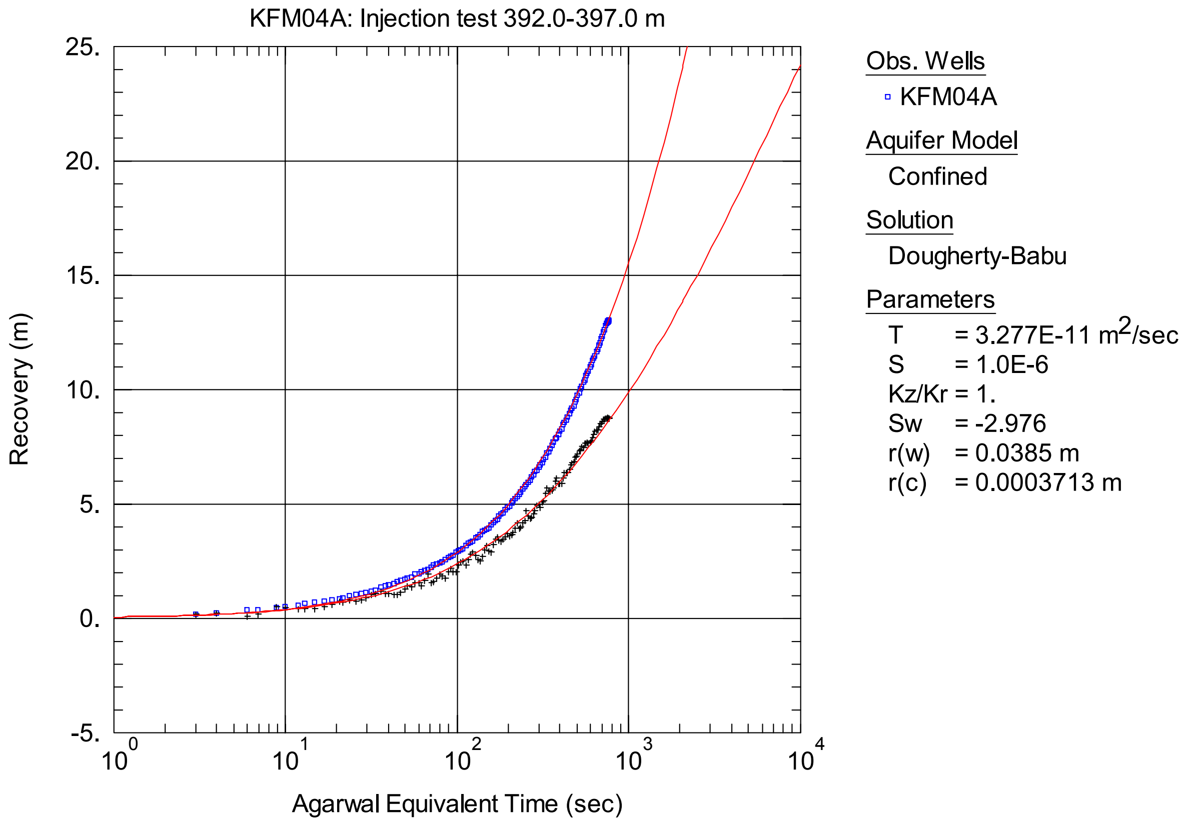


Figure A3-216. *Lin-log plot of recovery (□) and derivative (+) versus equivalent time, from the injection test in section 392-397 m in KFM04A.*

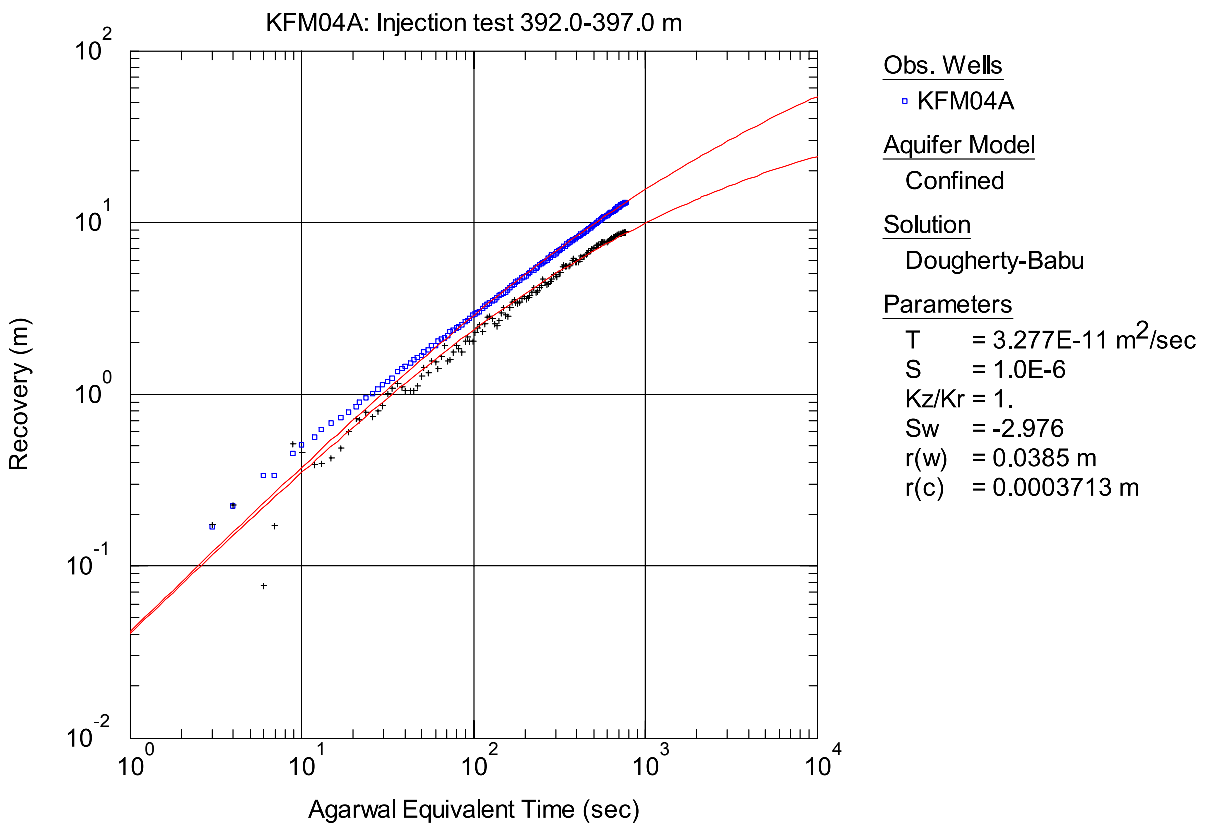


Figure A3-217. *Log-log plot of recovery (□) and derivative (+) versus equivalent time, from the injection test in section 392-397 m in KFM04A.*

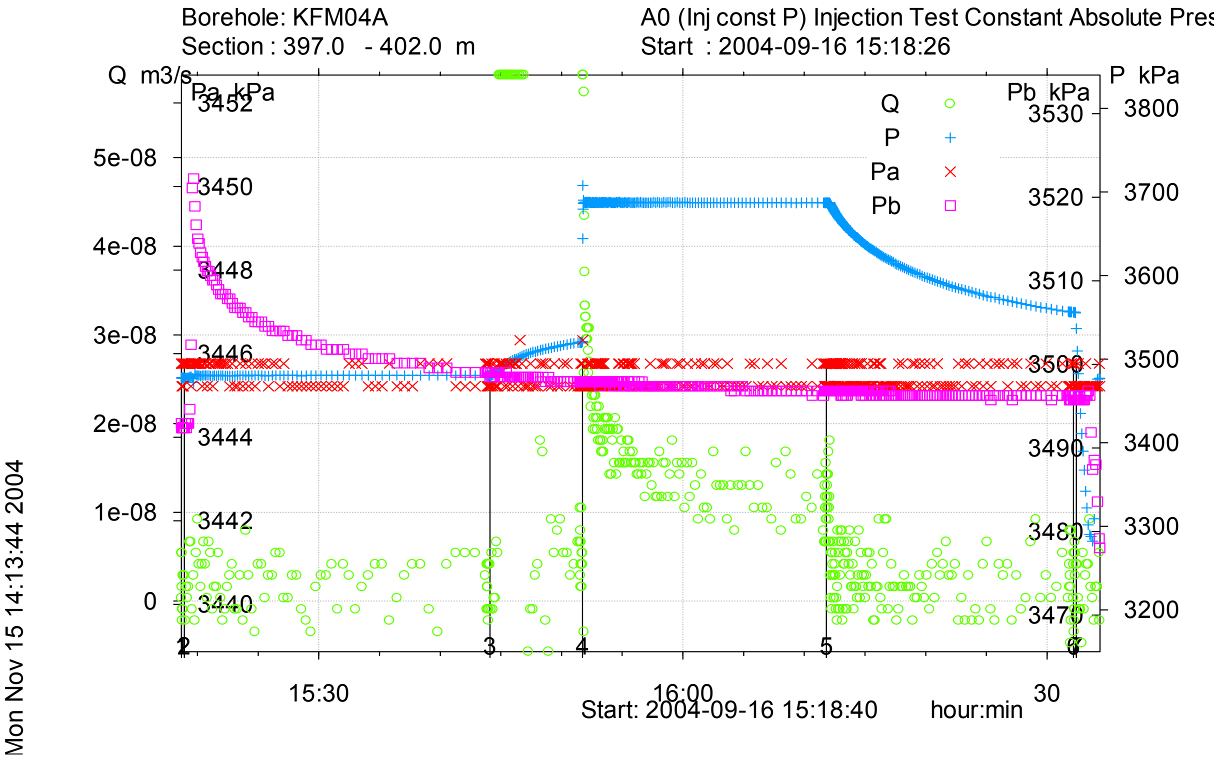


Figure A3-218. Linear plot of flow rate (Q), pressure (P), pressure above section (Pa) and pressure below section (Pb) versus time from the injection test in section 397-402 m in borehole KFM04A.

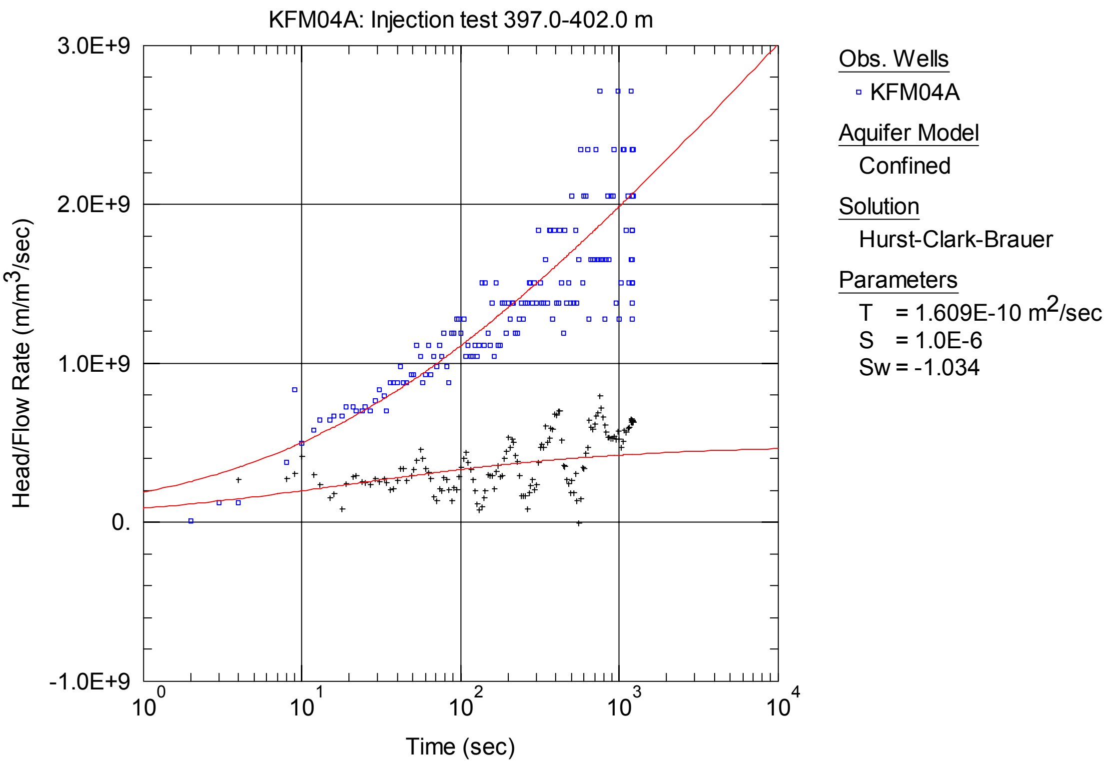


Figure A3-219. Lin-log plot of head/flow rate (□) and derivative (+) versus time, from the injection test in section 397-402 m in KFM04A.

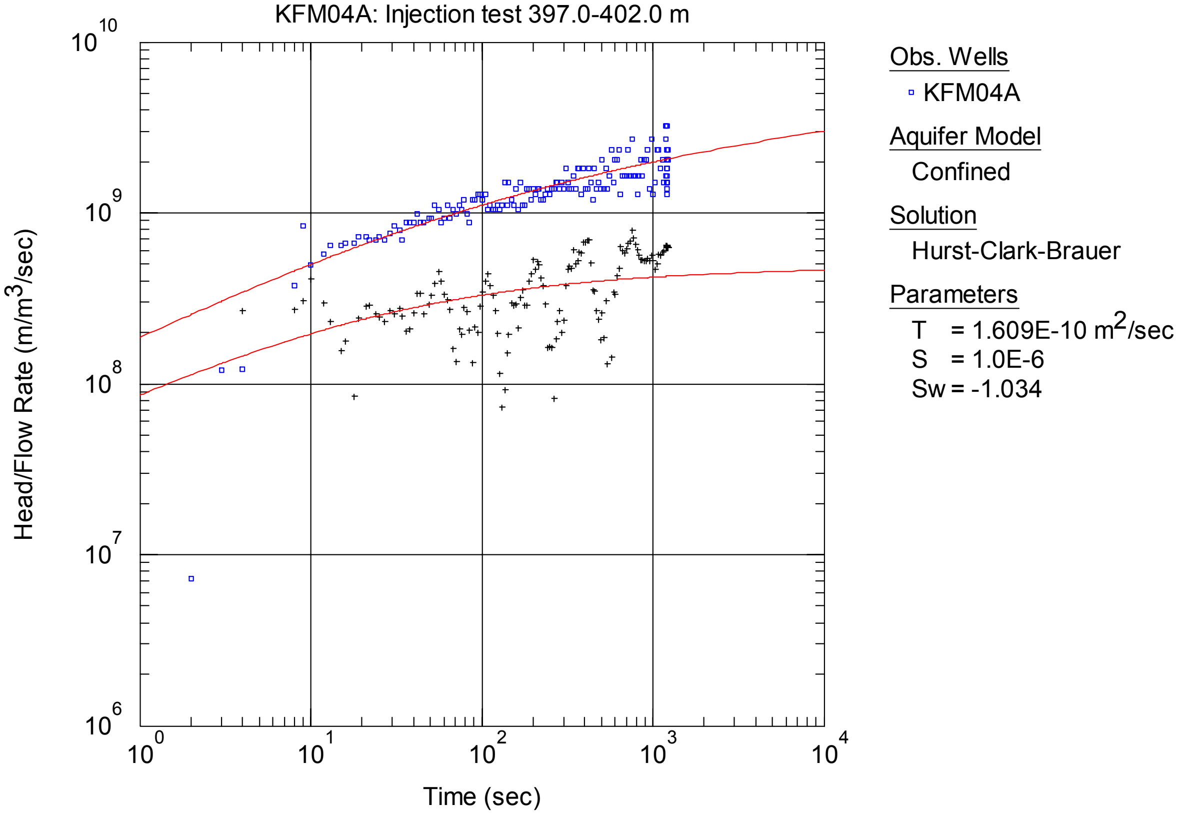


***Figure A3-220.** Log-log plot of head/flow rate (□) and derivative (+) versus time, from the injection test in section 397-402 m in KFM04A.*

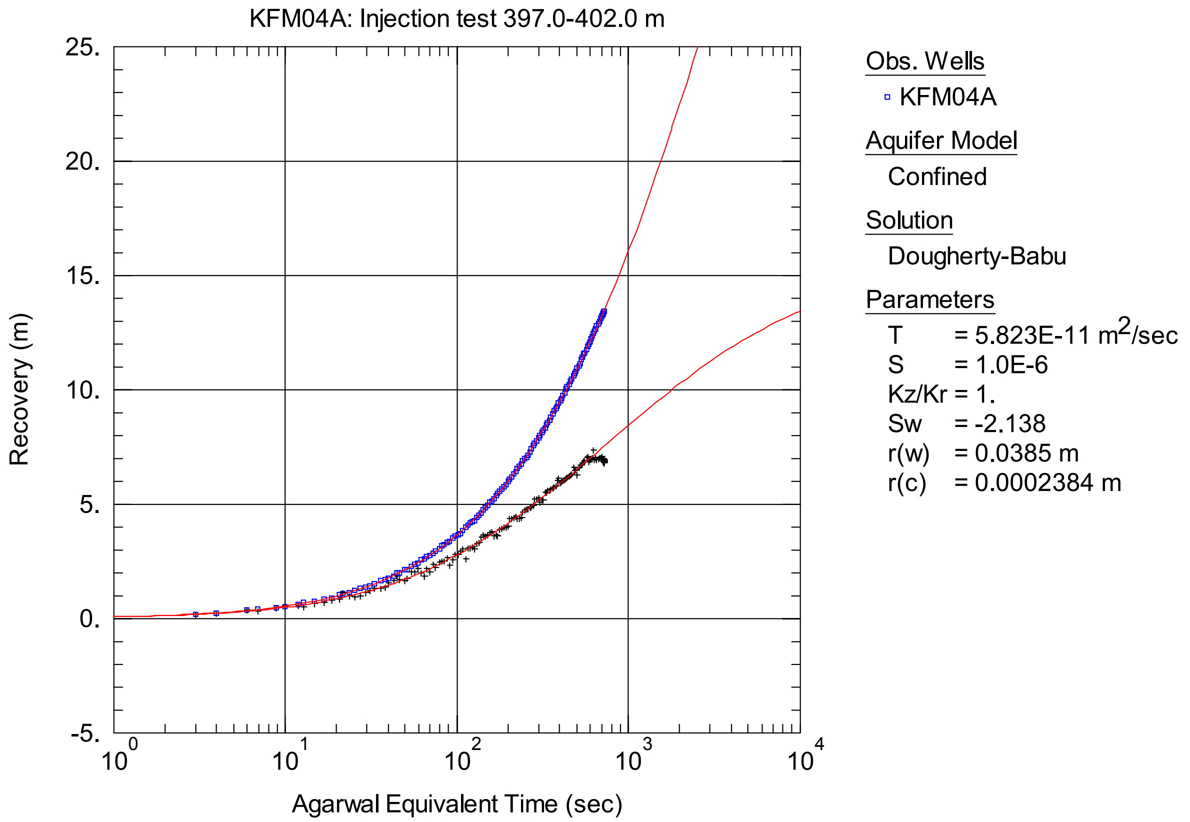


***Figure A3-221.** Lin-log plot of recovery (□) and derivative (+) versus equivalent time, from the injection test in section 397-402 m in KFM04A.*

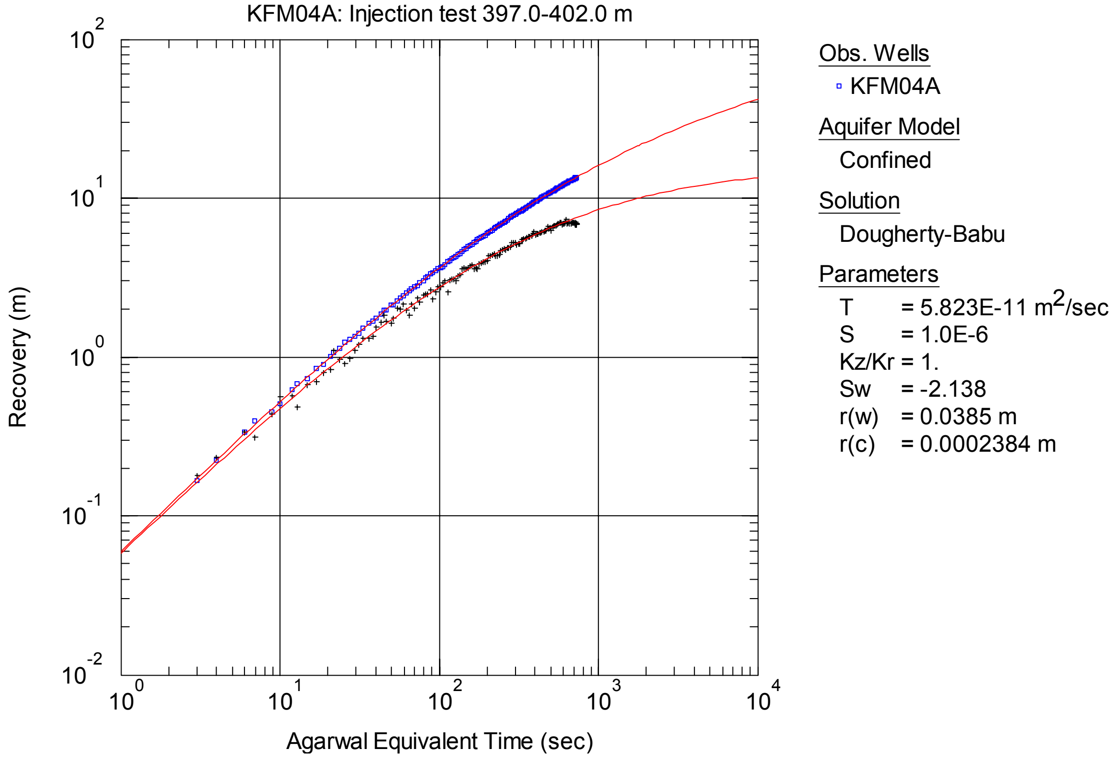


***Figure A3-222.** Log-log plot of recovery (□) and derivative (+) versus equivalent time, from the injection test in section 397-402 m in KFM04A.*

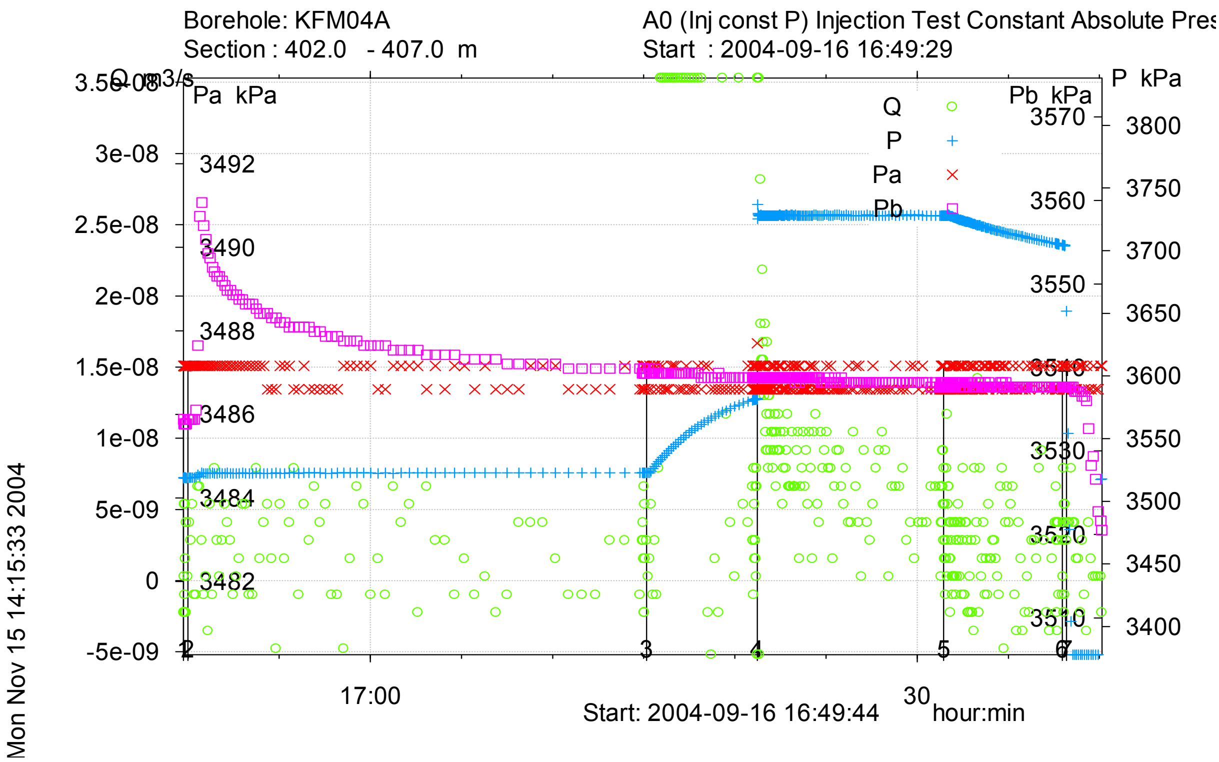


***Figure A3-223.** Linear plot of flow rate (Q), pressure (P), pressure above section (Pa) and pressure below section (Pb) versus time from the injection test in section 402-407 m in borehole KFM04A.*

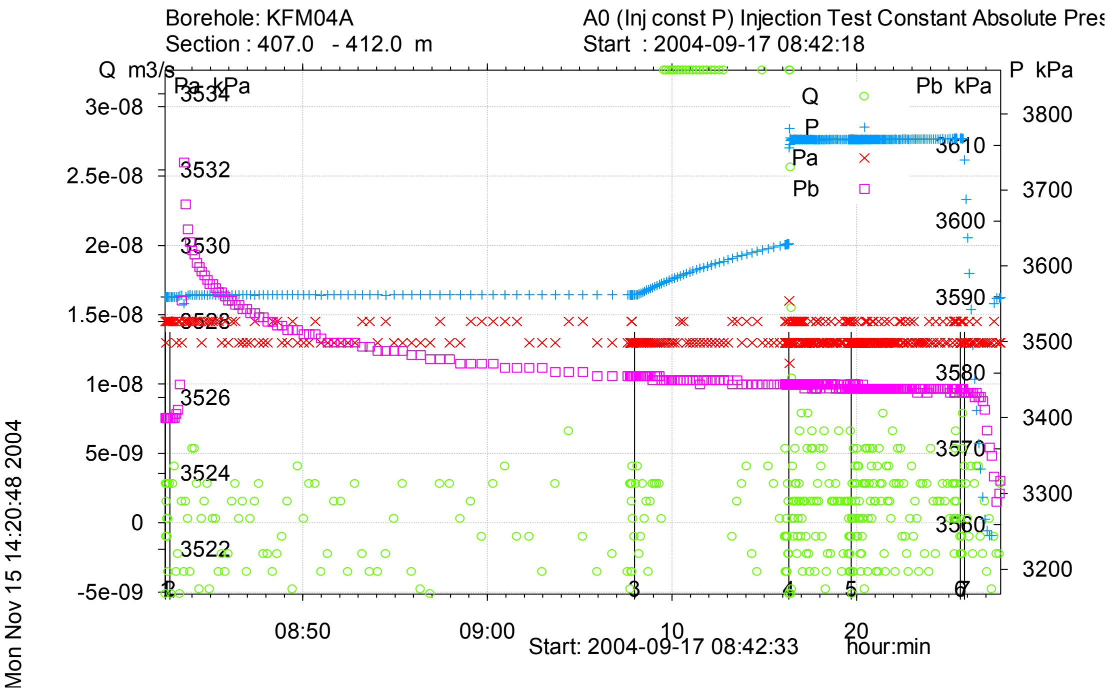


Figure A3-224. *Linear plot of flow rate (Q), pressure (P), pressure above section (Pa) and pressure below section (Pb) versus time from the injection test in section 407-412 m in borehole KFM04A.*

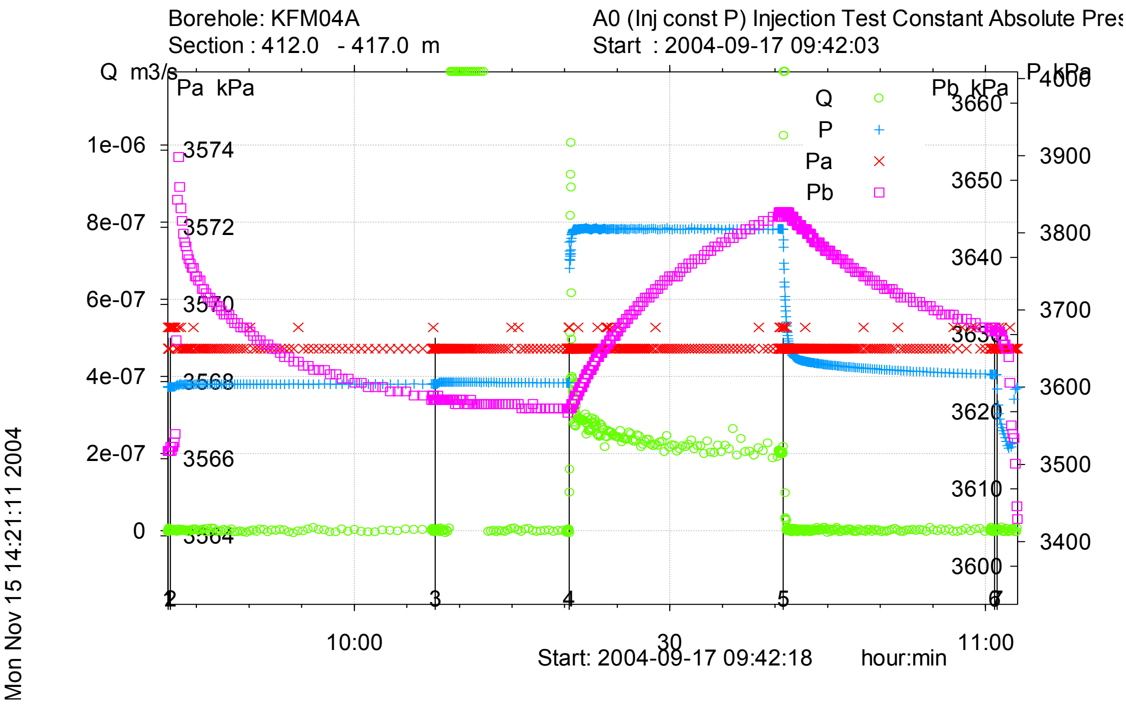


Figure A3-225. *Linear plot of flow rate (Q), pressure (P), pressure above section (Pa) and pressure below section (Pb) versus time from the injection test in section 412-417 m in borehole KFM04A.*

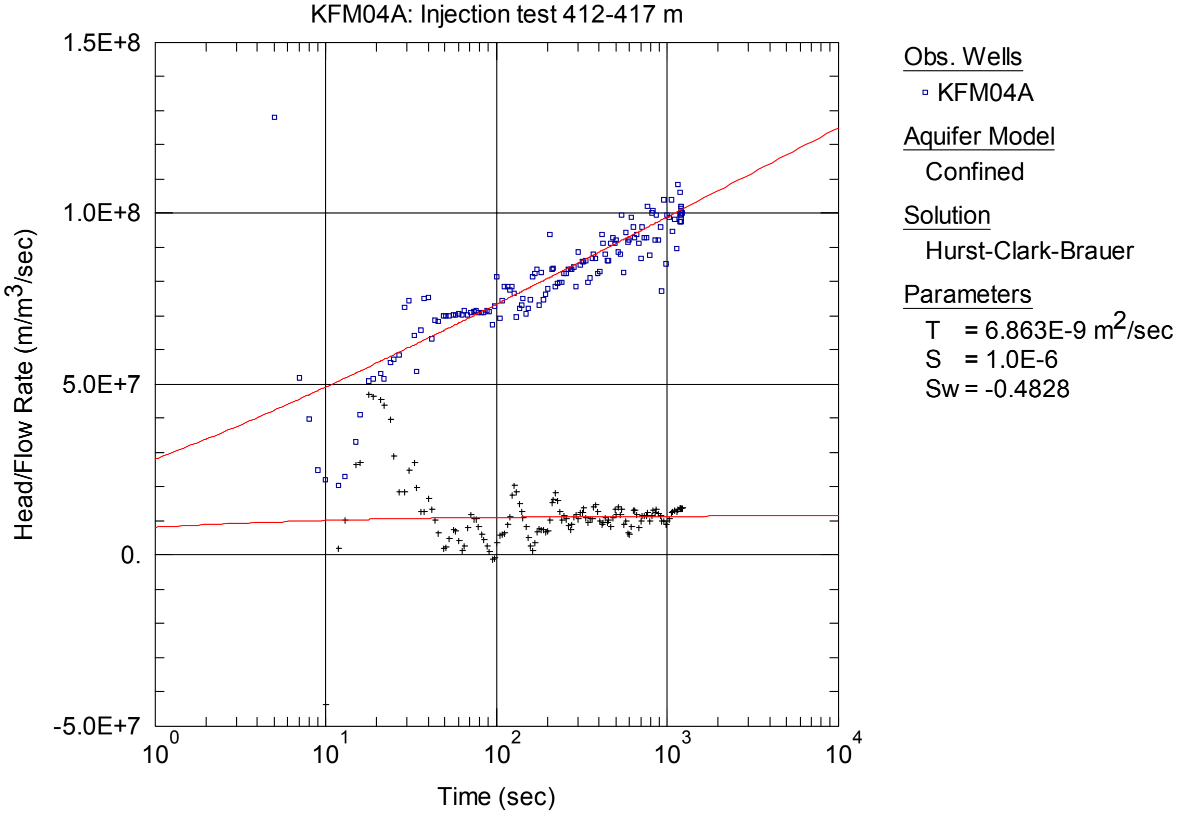


Figure A3-226. *Lin-log plot of head/flow rate (□) and derivative (+) versus time, from the injection test in section 412-417 m in KFM04A.*

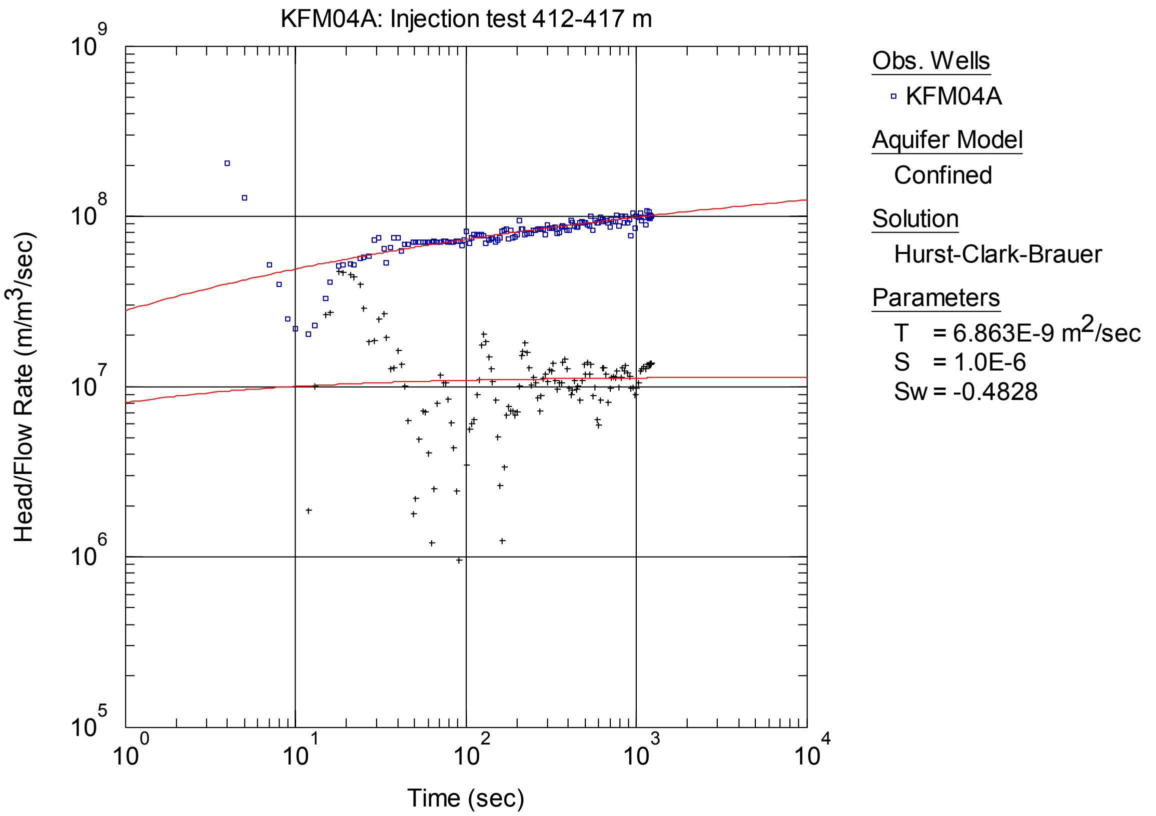


Figure A3-227. *Log-log plot of head/flow rate (□) and derivative (+) versus time, from the injection test in section 412-417 m in KFM04A.*

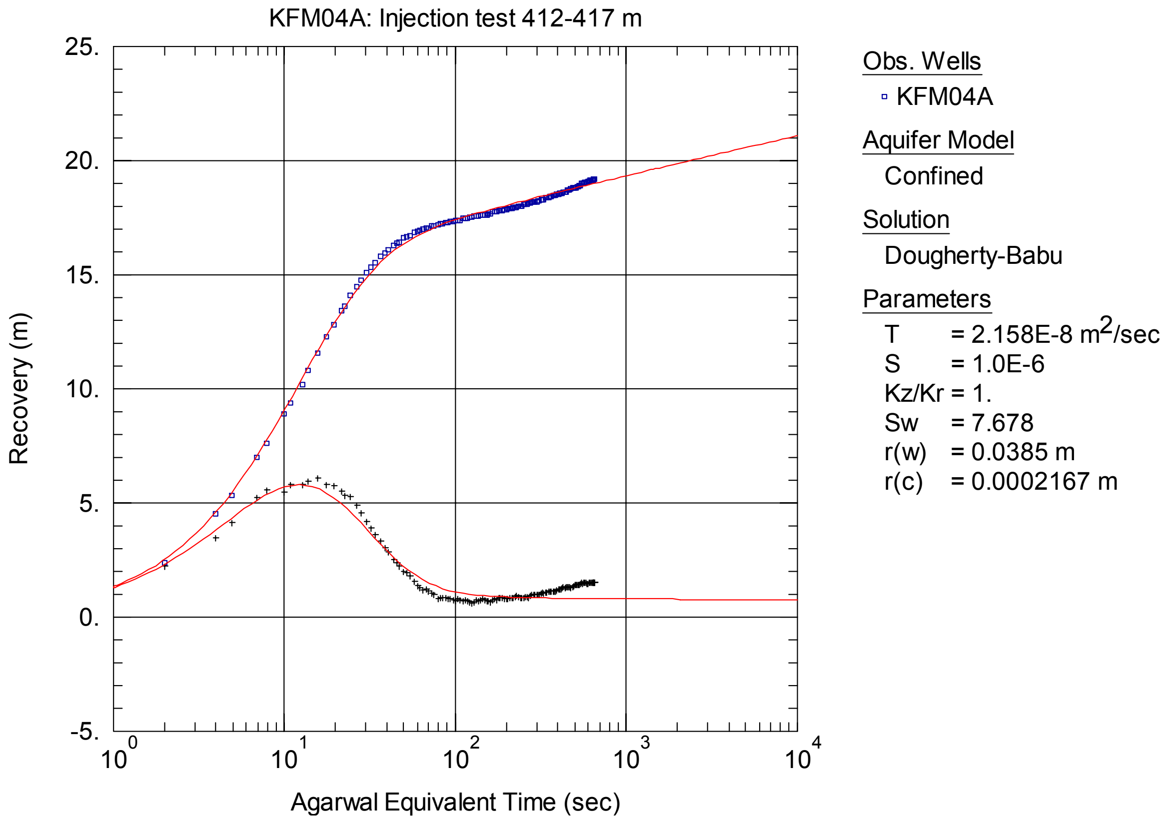


Figure A3-228. *Lin-log plot of recovery (□) and derivative (+) versus equivalent time, from the injection test in section 412-417 m in KFM04A.*

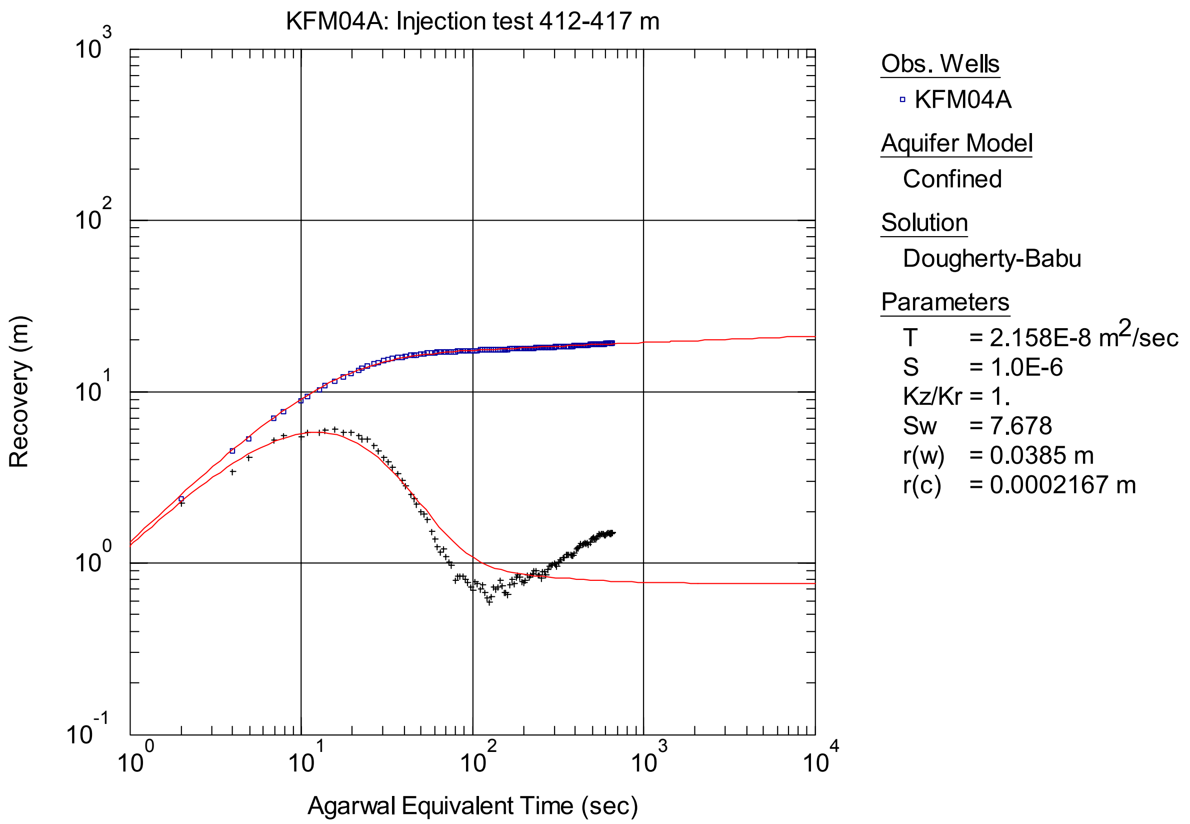


Figure A3-229. *Log-log plot of recovery (□) and derivative (+) versus equivalent time, from the injection test in section 412-417 m in KFM04A.*

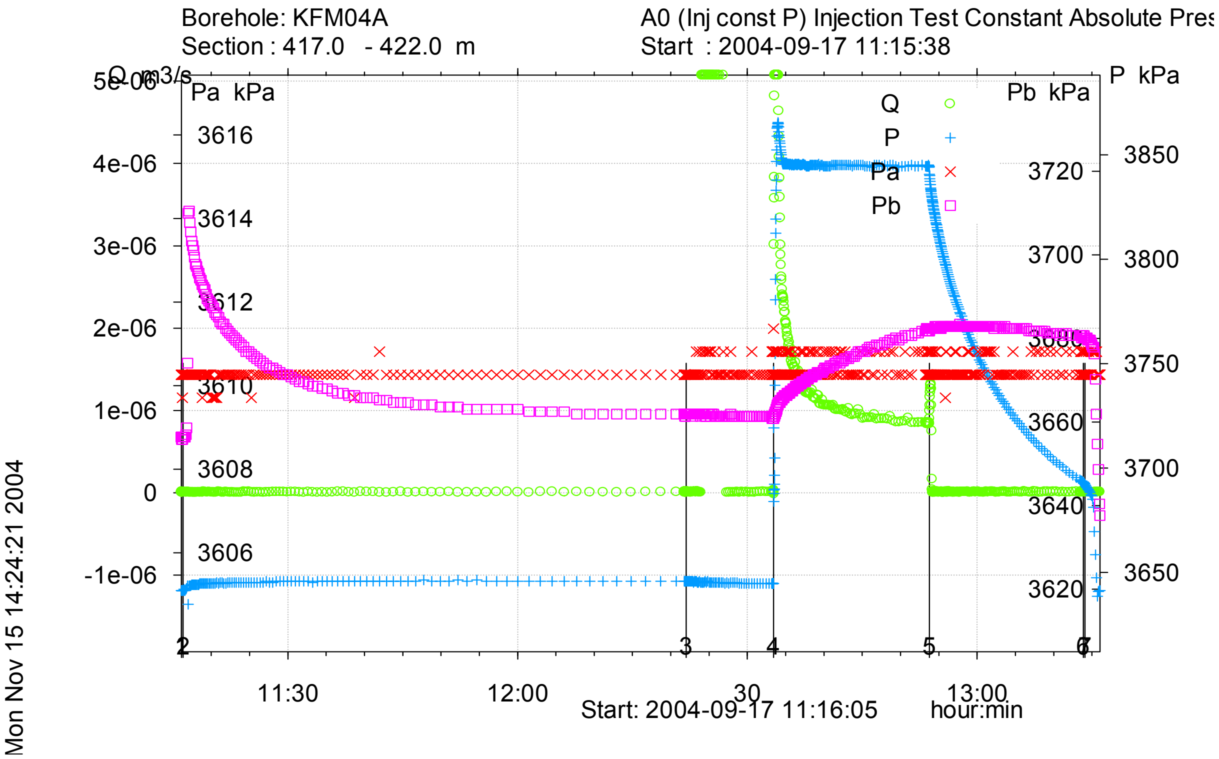


***Figure A3-230.** Linear plot of flow rate (Q), pressure (P), pressure above section (Pa) and pressure below section (Pb) versus time from the injection test in section 417-422 m in borehole KFM04A.*

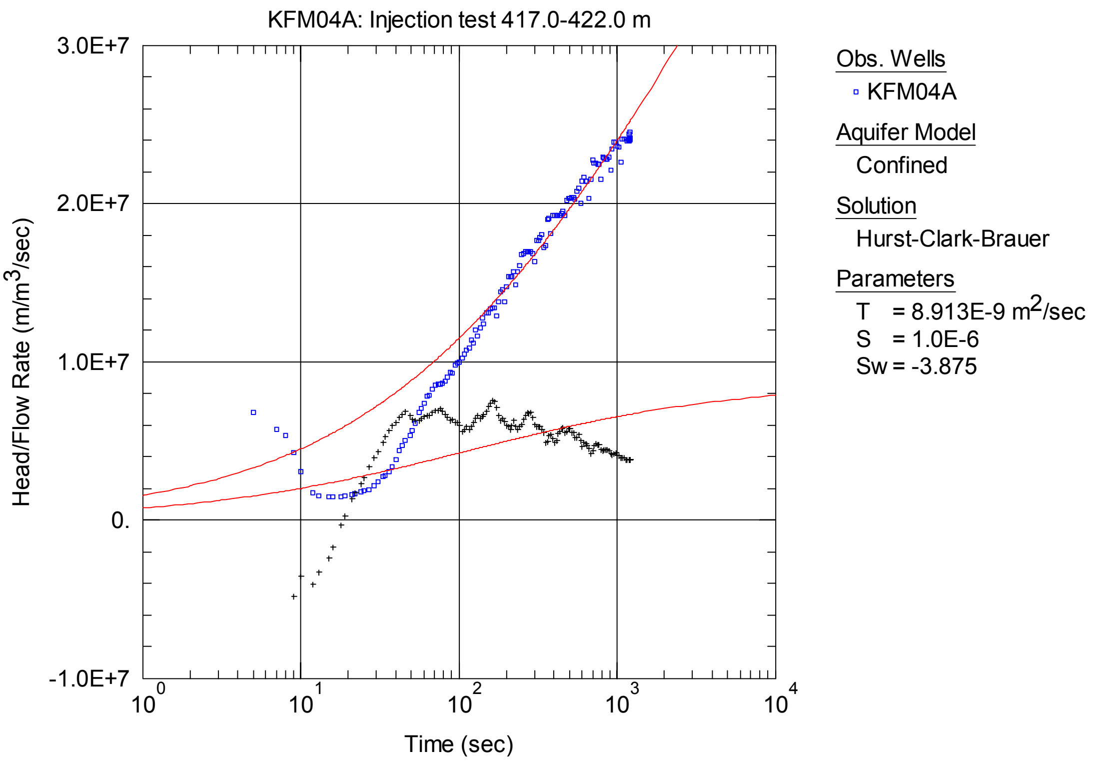


***Figure A3-231.** Lin-log plot of head/flow rate (□) and derivative (+) versus time, from the injection test in section 417-422 m in KFM04A.*

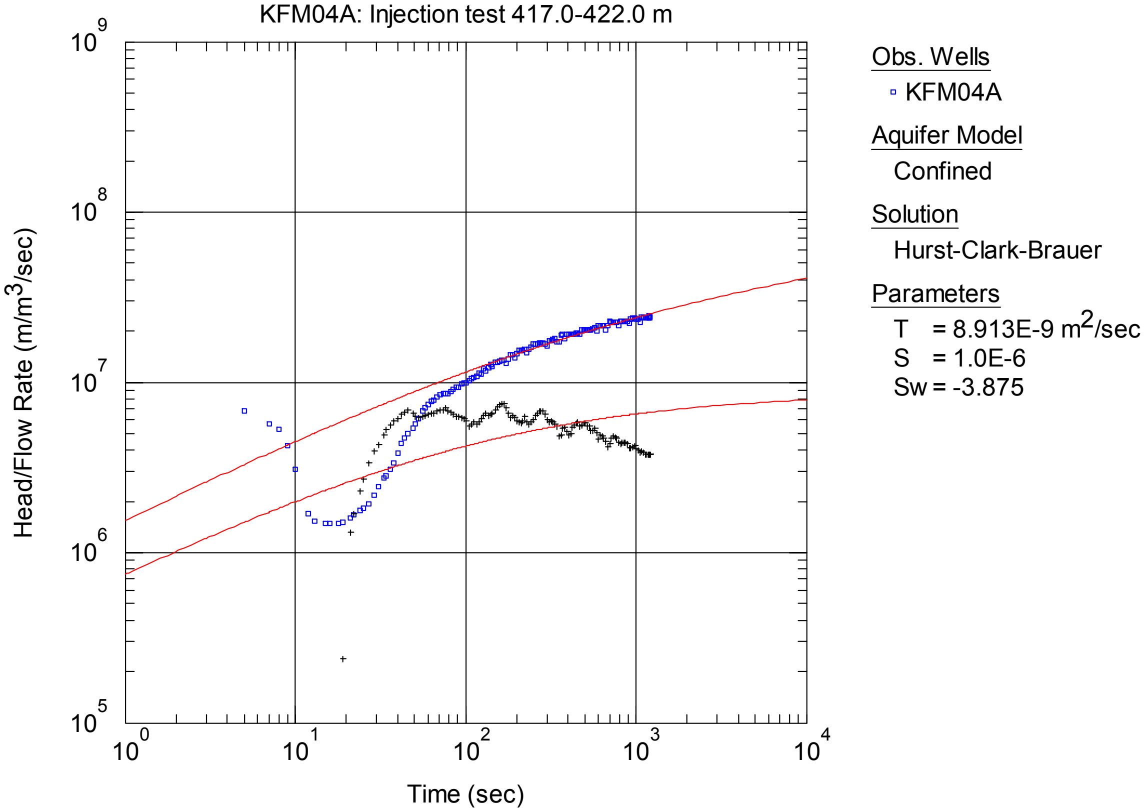


***Figure A3-232.** Log-log plot of head/flow rate (□) and derivative (+) versus time, from the injection test in section 417-422 m in KFM04A.*

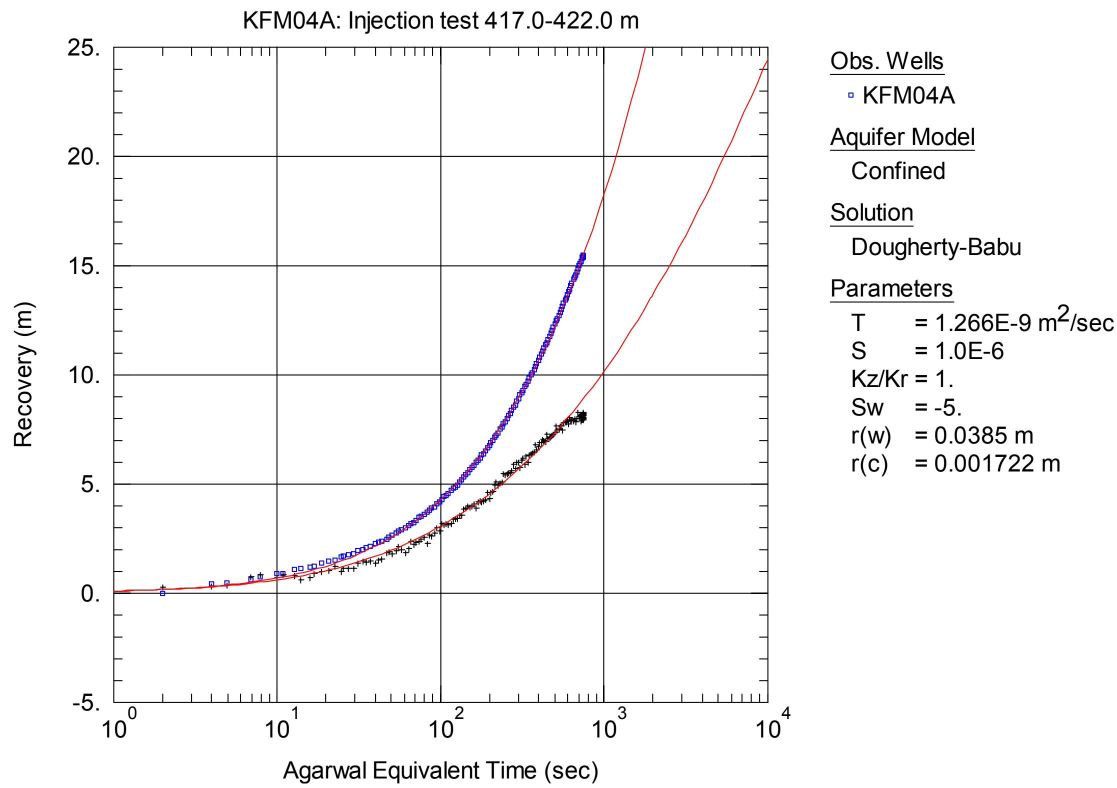


***Figure A3-233.** Lin-log plot of recovery (□) and derivative (+) versus equivalent time, from the injection test in section 417-422 m in KFM04A. . The type curve fit is only to show that an assumption of PRF is not valid.*

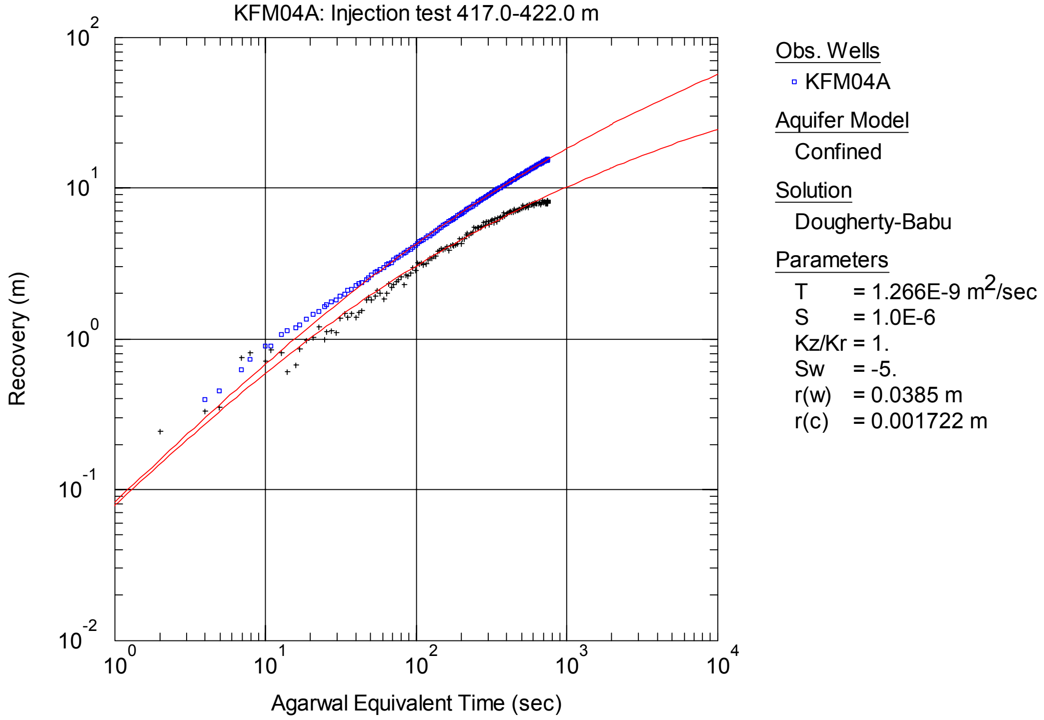


Figure A3-234. *Log-log plot of recovery (□) and derivative (+) versus equivalent time, from the injection test in section 417-422 m in KFM04A. . The type curve fit is only to show that an assumption of PRF is not valid.*

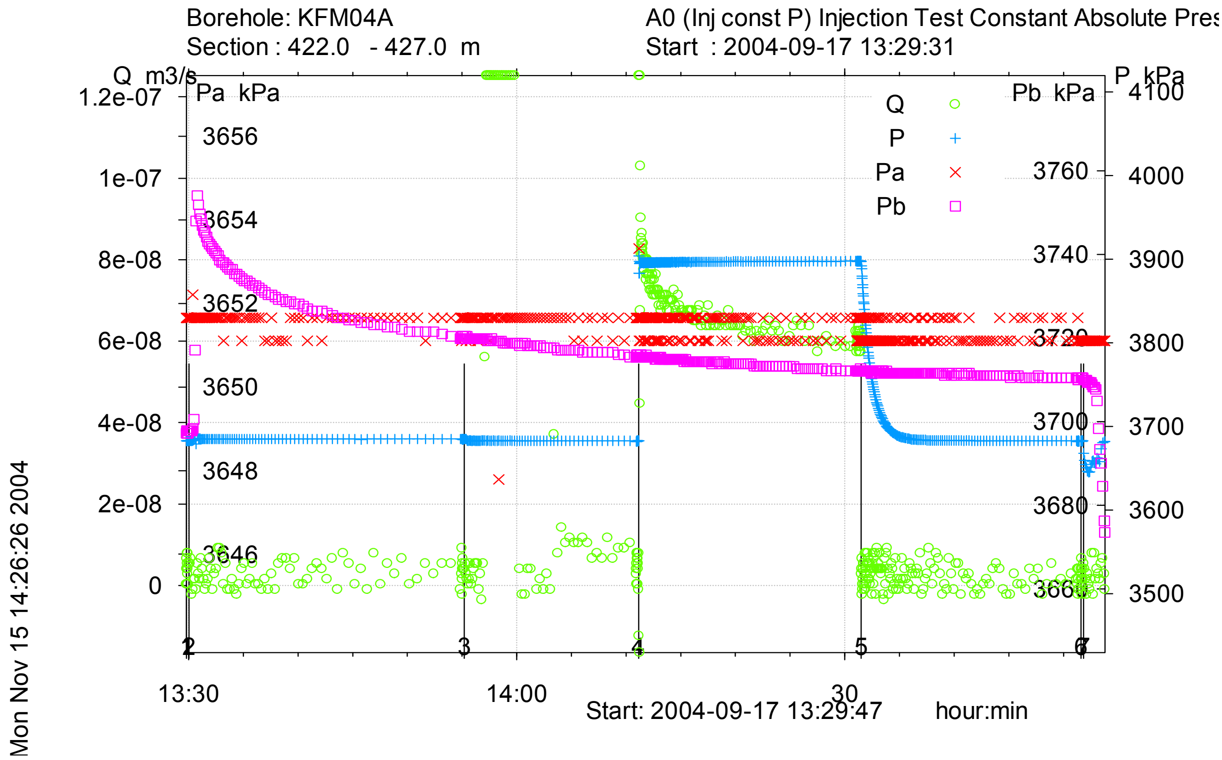


Figure A3-235. *Linear plot of flow rate (Q), pressure (P), pressure above section (Pa) and pressure below section (Pb) versus time from the injection test in section 422-427 m in borehole KFM04A.*

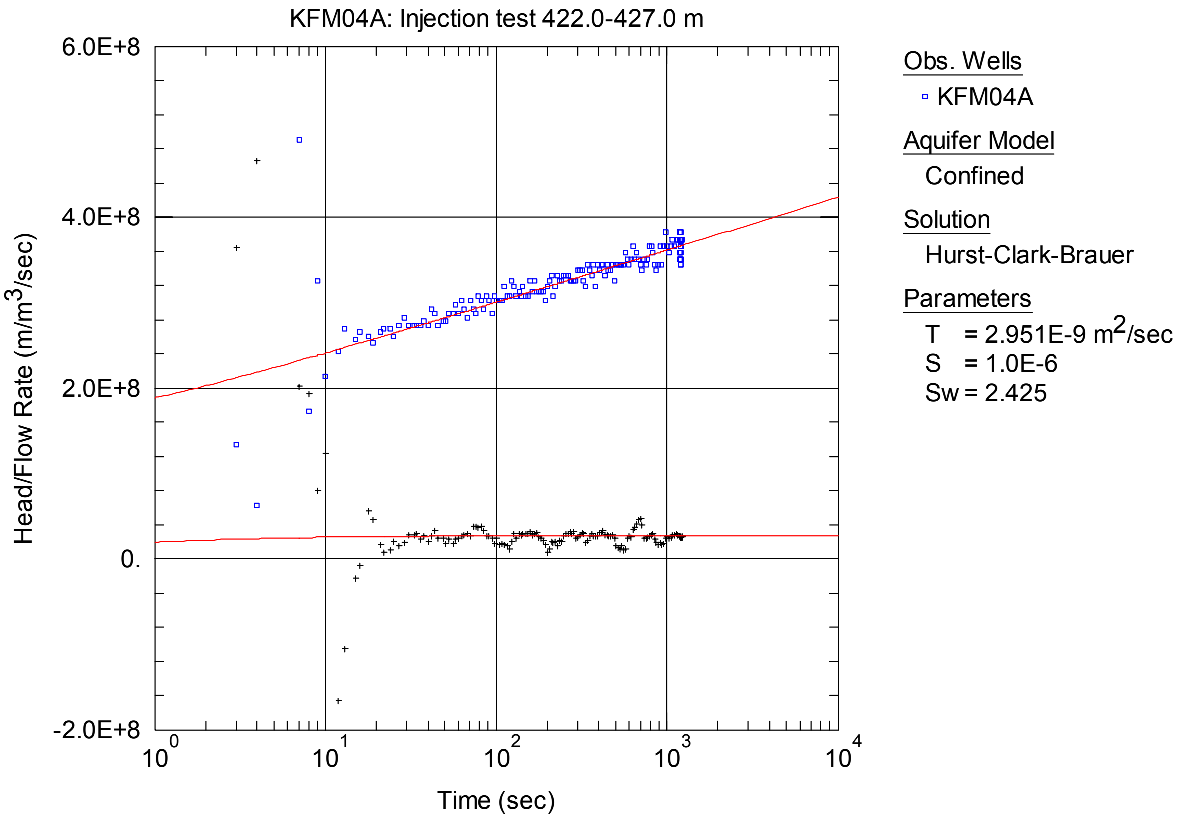


Figure A3-236. *Lin-log plot of head/flow rate (□) and derivative (+) versus time, from the injection test in section 422-427 m in KFM04A.*

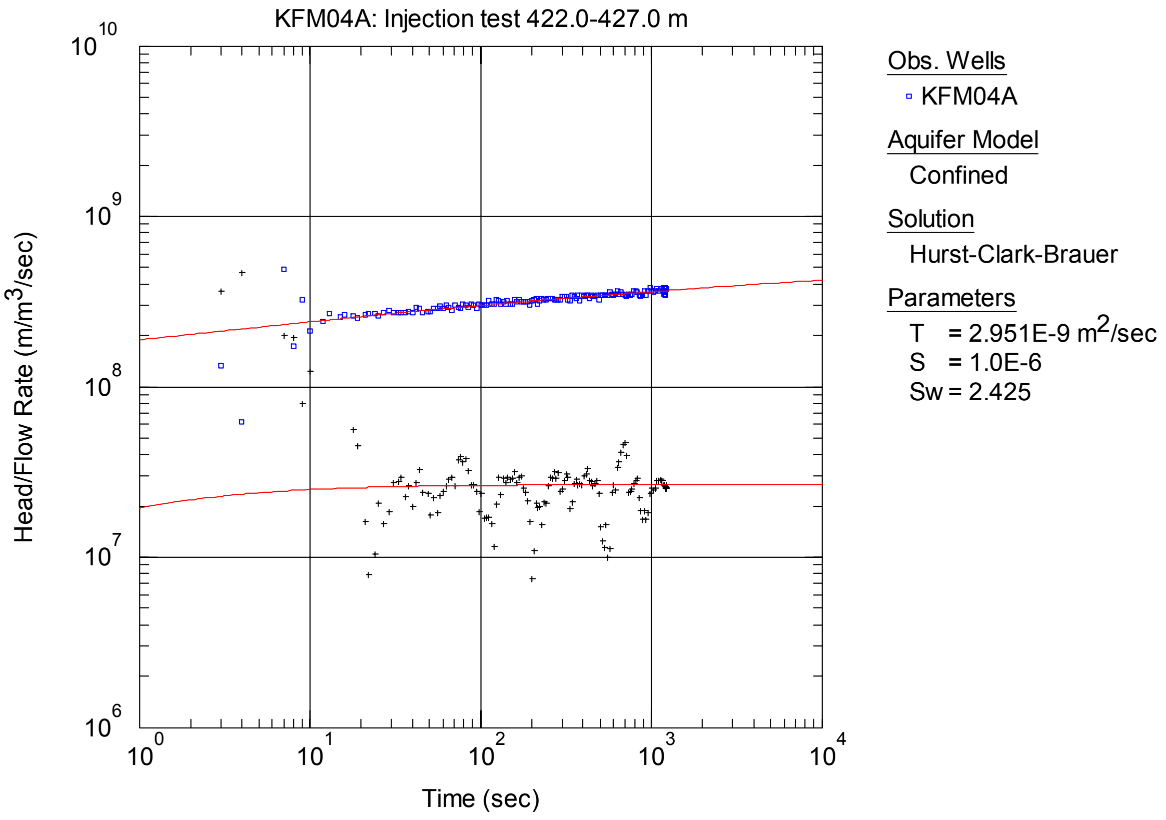


Figure A3-237. *Log-log plot of head/flow rate (□) and derivative (+) versus time, from the injection test in section 422-427 m in KFM04A.*

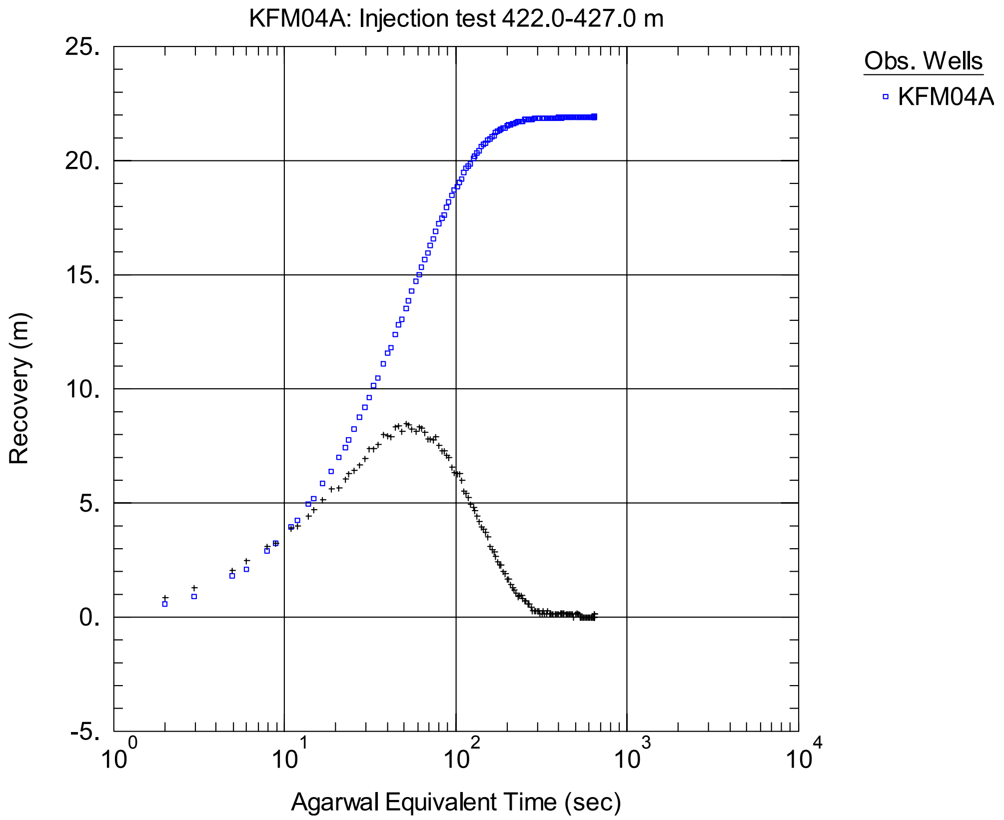


Figure A3-238. *Lin-log plot of recovery (□) and derivative (+) versus equivalent time, from the injection test in section 422-427 m in KFM04A.*

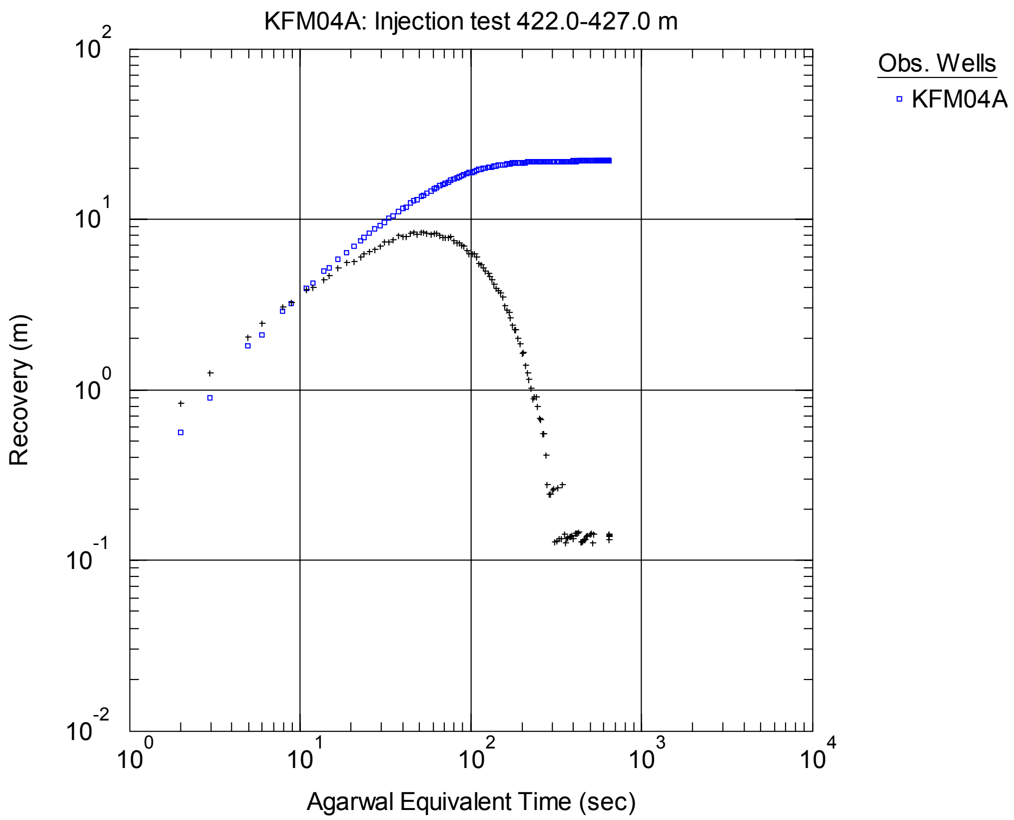


Figure A3-239. *Log-log plot of recovery (□) and derivative (+) versus equivalent time, from the injection test in section 422-427 m in KFM04A.*

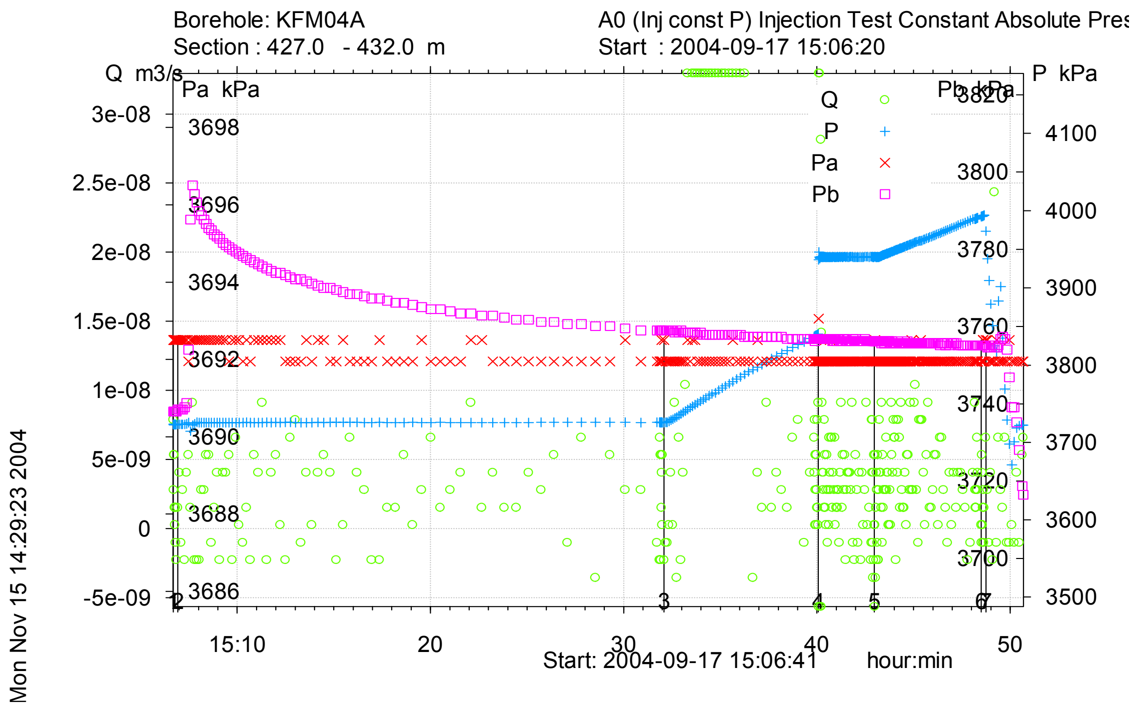


Figure A3-240. Linear plot of flow rate (Q), pressure (P), pressure above section (Pa) and pressure below section (Pb) versus time from the injection test in section 427-432 m in borehole KFM04A.

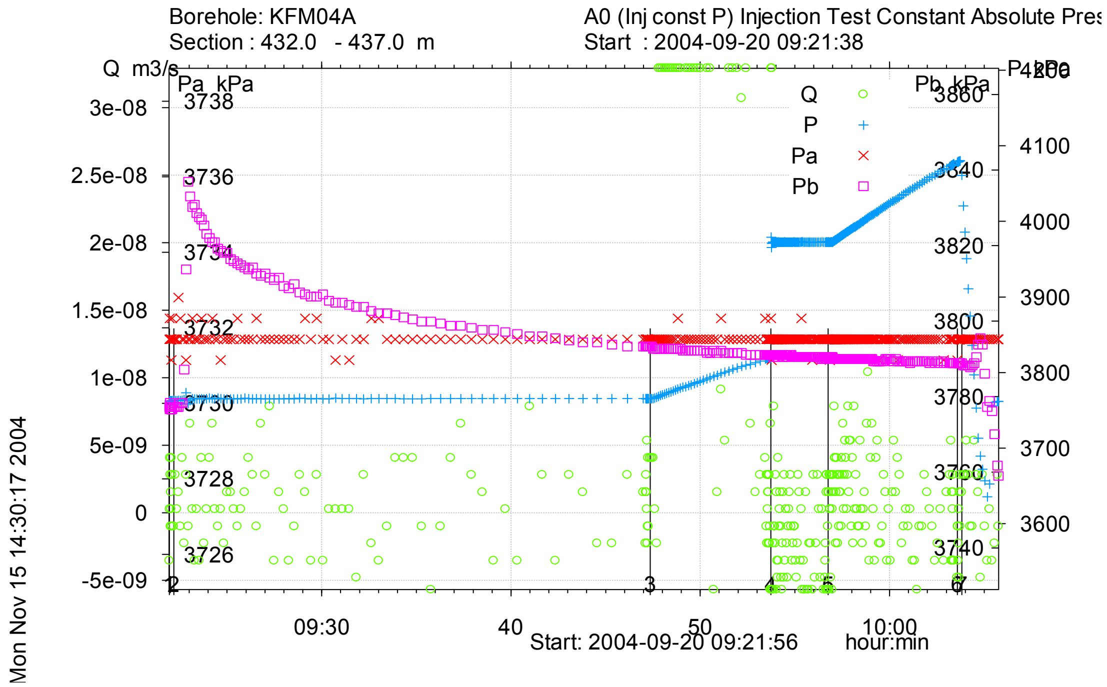


Figure A3-241. Linear plot of flow rate (Q), pressure (P), pressure above section (Pa) and pressure below section (Pb) versus time from the injection test in section 432-437 m in borehole KFM04A.

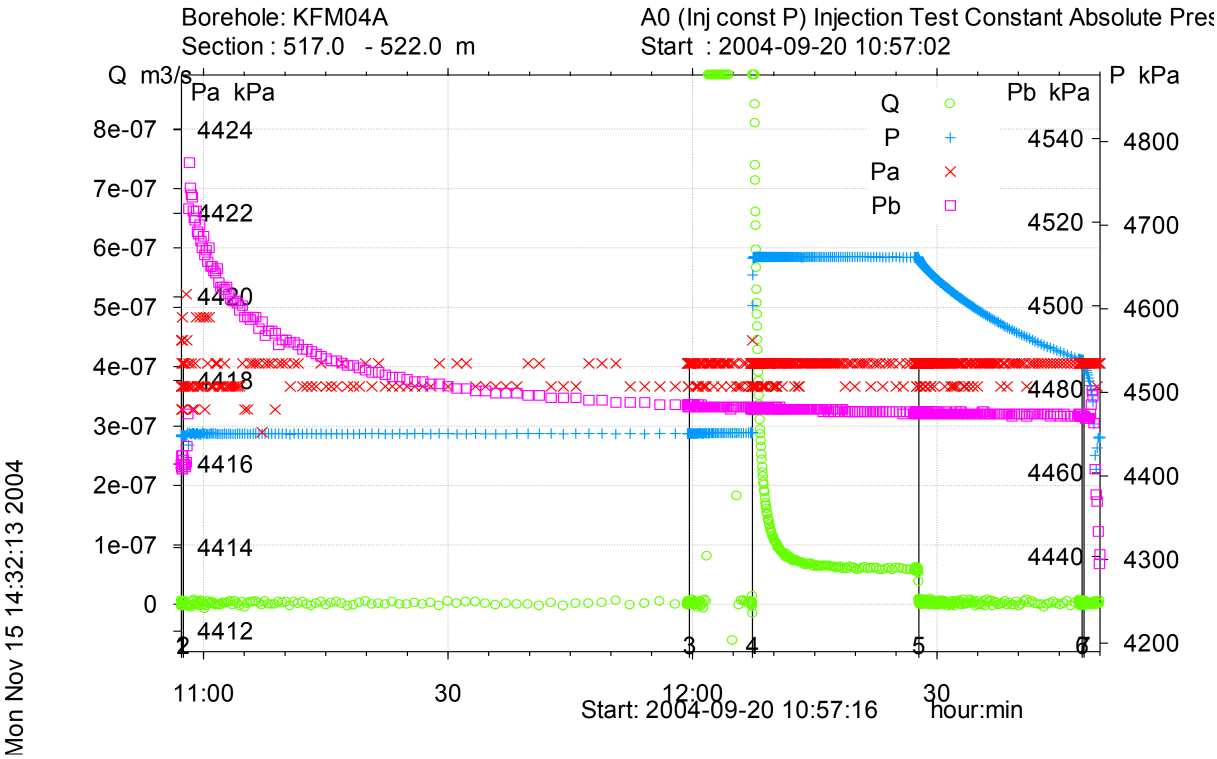


Figure A3-242. *Linear plot of flow rate (Q), pressure (P), pressure above section (Pa) and pressure below section (Pb) versus time from the injection test in section 517-522 m in borehole KFM04A.*

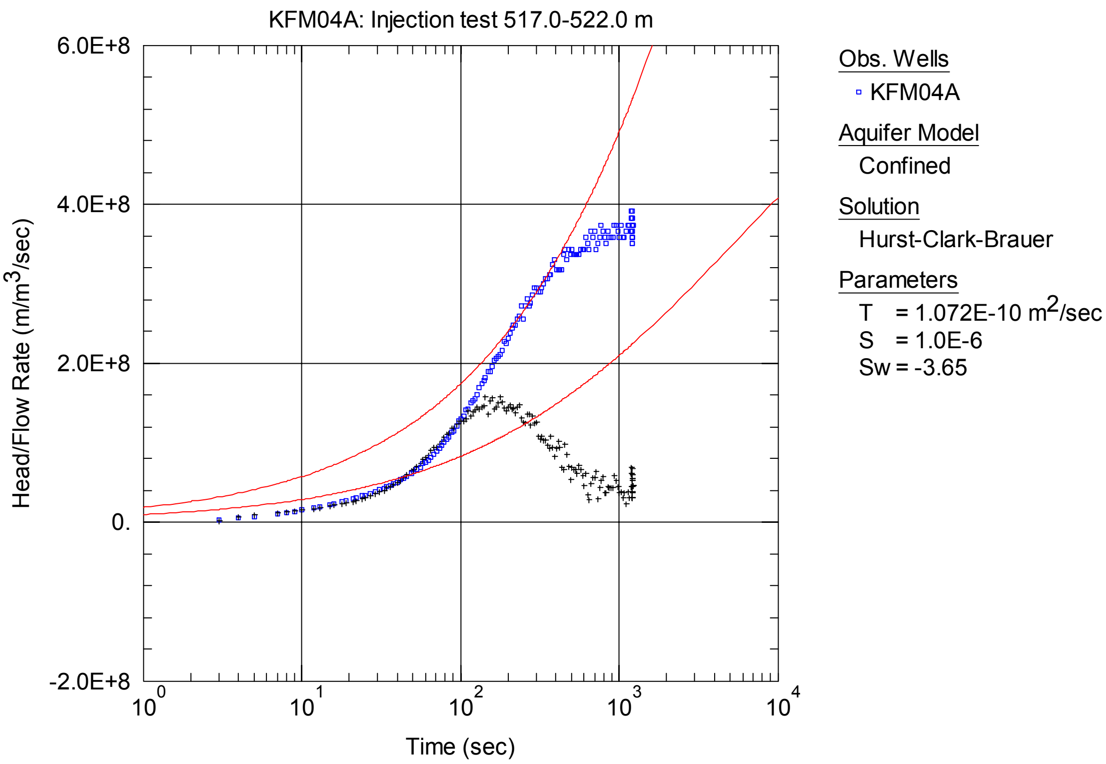


Figure A3-243. *Lin-log plot of head/flow rate (□) and derivative (+) versus time, from the injection test in section 517-522 m in KFM04A.*

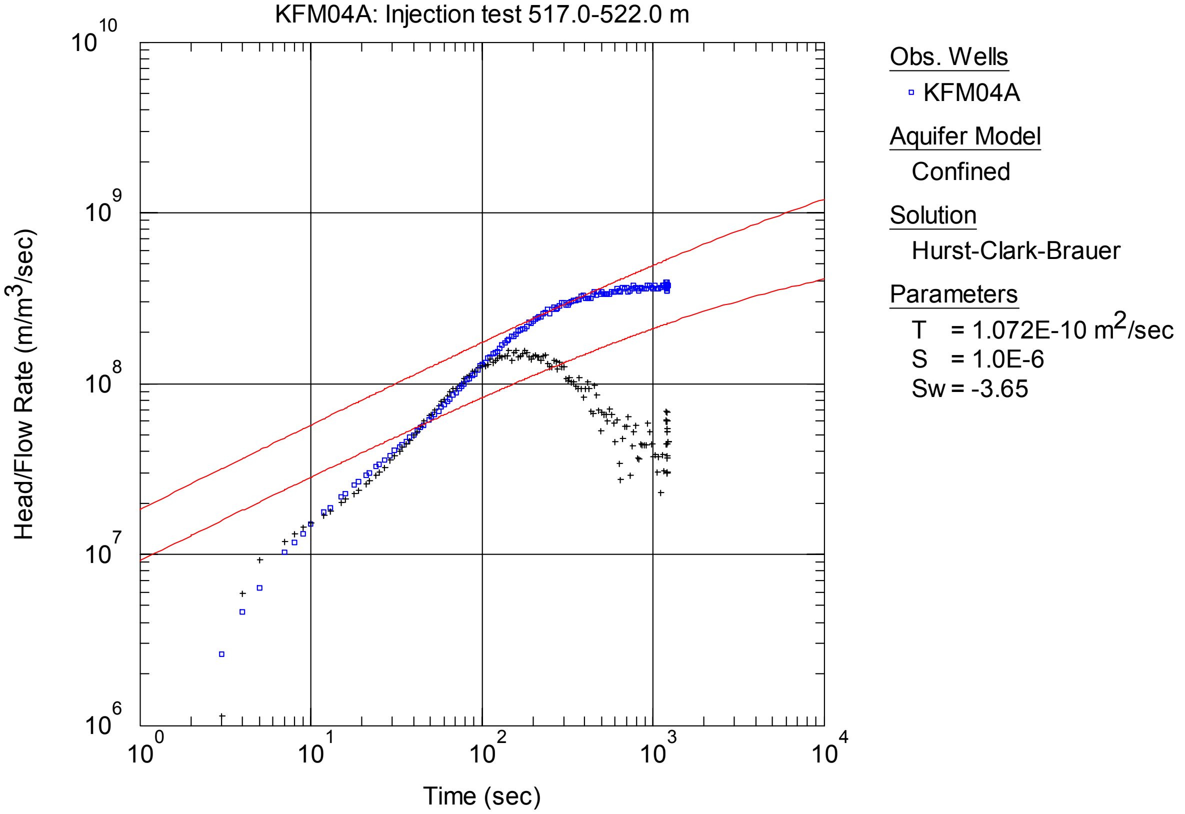


Figure A3-244. *Log-log plot of head/flow rate (□) and derivative (+) versus time, from the injection test in section 517-522 m in KFM04A.*

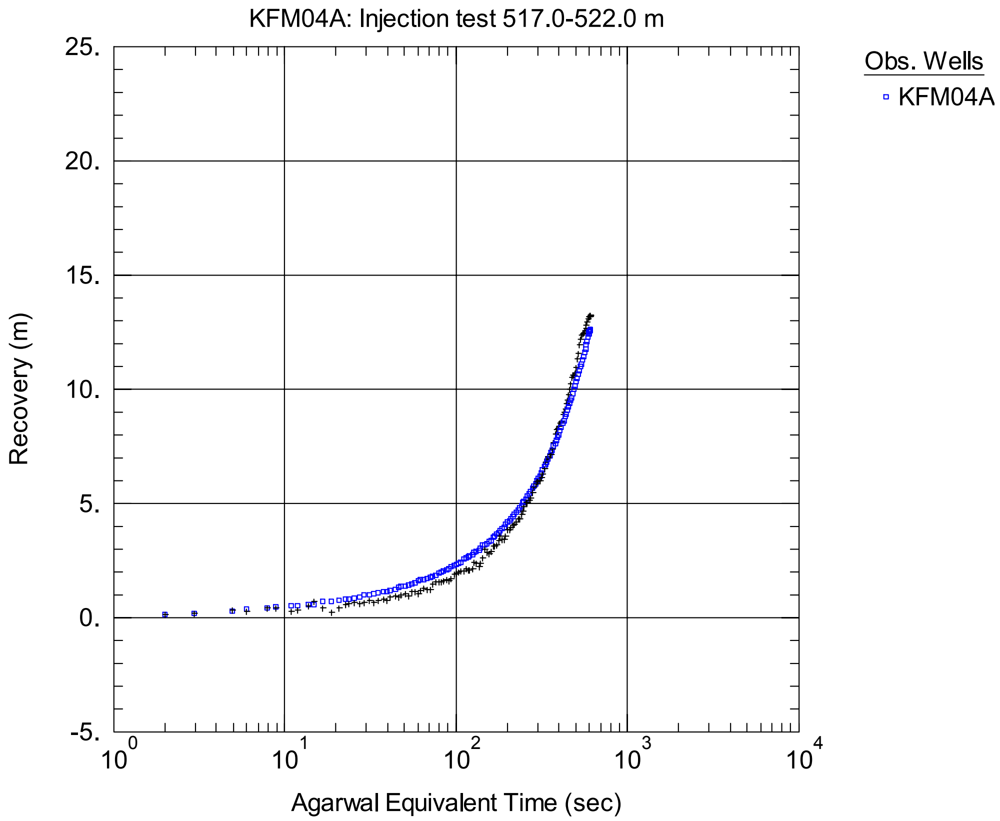


Figure A3-245. *Lin-log plot of recovery (□) and derivative (+) versus equivalent time, from the injection test in section 517-522 m in KFM04A.*

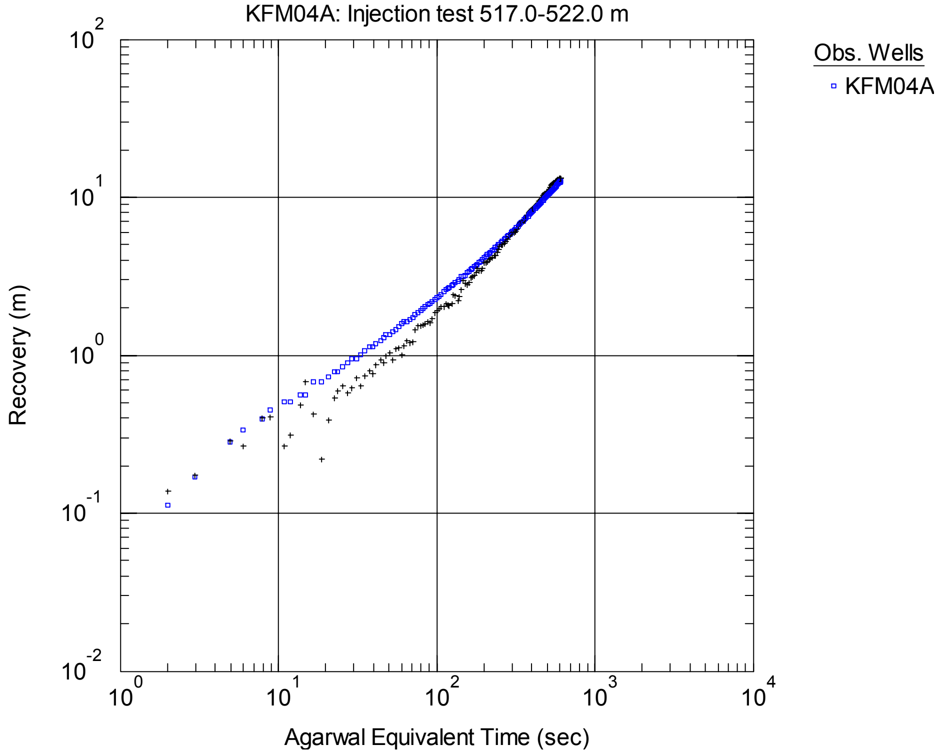


Figure A3-246. *Log-log plot of recovery (□) and derivative (+) versus equivalent time, from the injection test in section 517-522 m in KFM04A.*

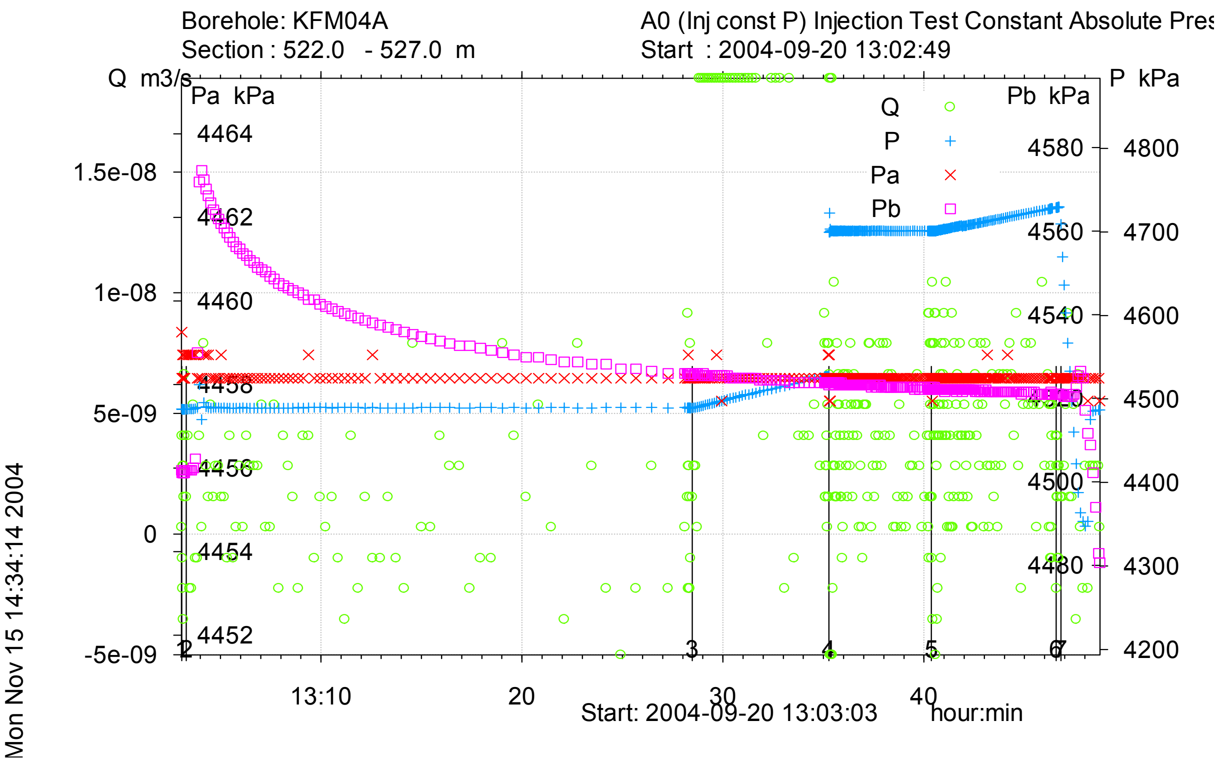


Figure A3-247. *Linear plot of flow rate (Q), pressure (P), pressure above section (Pa) and pressure below section (Pb) versus time from the injection test in section 522-527 m in borehole KFM04A.*

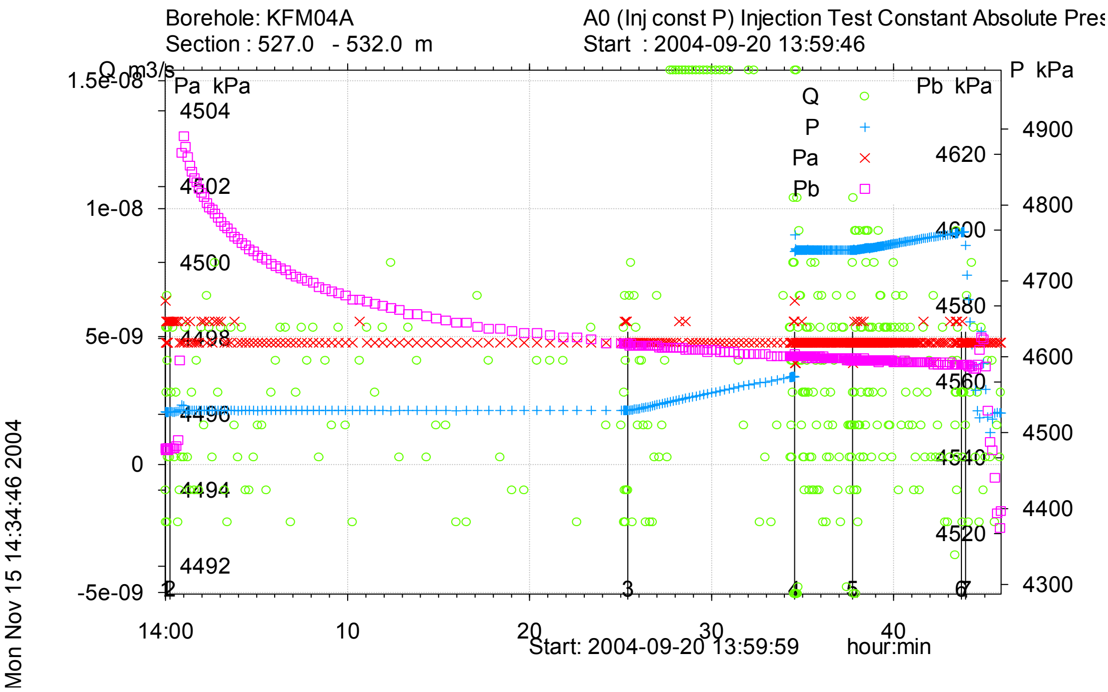


Figure A3-248. Linear plot of flow rate (Q), pressure (P), pressure above section (Pa) and pressure below section (Pb) versus time from the injection test in section 527-532 m in borehole KFM04A.

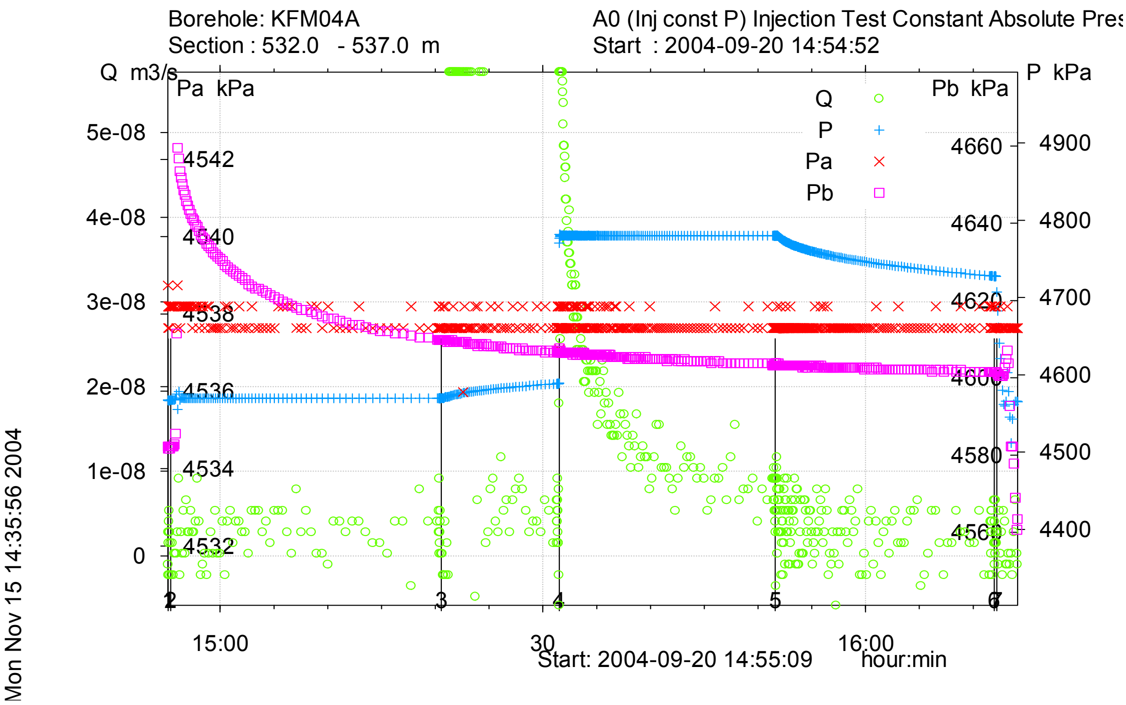
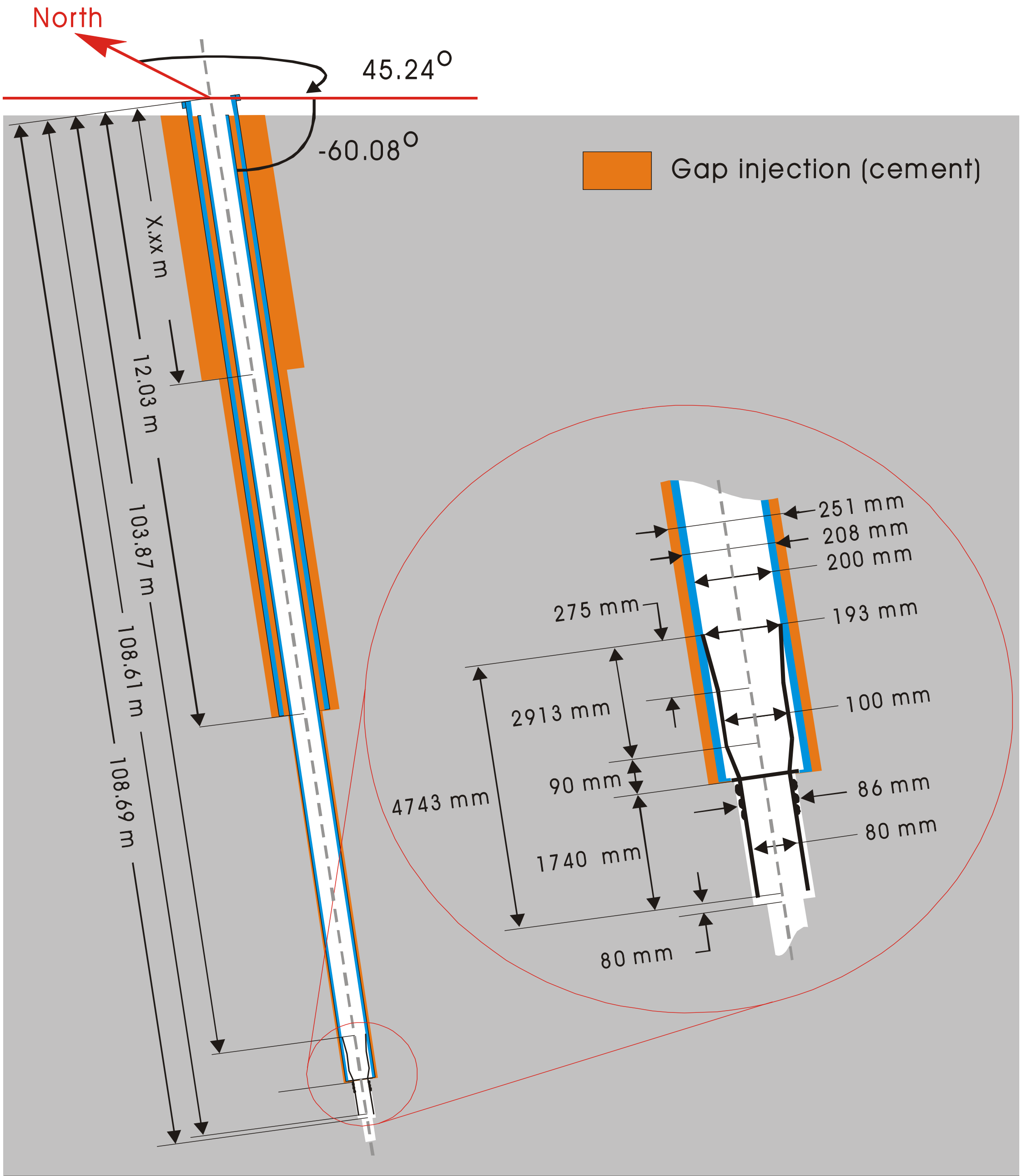


Figure A3-249. Linear plot of flow rate (Q), pressure (P), pressure above section (Pa) and pressure below section (Pb) versus time from the injection test in section 532-537 m in borehole KFM04A.

Appendix 4. Borehole technical data

Technical data

Borehole KFM04A



Drilling reference point

Northing:	6698921.74	(m), RT90 2,5 gon V 0:-15
Easting:	1630978.96	(m), RT90 2,5 gon V 0:-15
Elevation:	8.77	(m), RHB 70

Drilling period

Drilling start date: 2003-05-20
Drilling stop date: 2003-11-19

Borehole

Lenght: 1001.42 m

Appendix 5. Sicada tables

Nomenclature plu_s_hole_test_d

Column	Datatype	Unit	Column Description	Alt. Symbol
site	CHAR		Investigation site name	
activity_type	CHAR		Activity type code	
start_date	DATE		Date (yymmdd hh:mm:ss)	
stop_date	DATE		Date (yymmdd hh:mm:ss)	
project	CHAR		project code	
idcode	CHAR		Object or borehole identification code	
secup	FLOAT	m	Upper section limit (m)	
seclow	FLOAT	m	Lower section limit (m)	
section_no	INTEGER	number	Section number	
test_type	CHAR		Test type code (1-7), see table description	
formation_type	CHAR		1: Rock, 2: Soil (superficial deposits)	
start_flow_period	DATE	yyyymmdd	Date & time of pumping/injection start (YYYY-MM-DD hh:mm:ss)	
stop_flow_period	DATE	yyyymmdd	Date & time of pumping/injection stop (YYYY-MM-DD hh:mm:ss)	
flow_rate_end_qp	FLOAT	m**3/s	Flow rate at the end of the flowing period	
value_type_qp	CHAR		0:true value,-1<lower meas.limit1:>upper meas.limit	
mean_flow_rate_qm	FLOAT	m**3/s	Arithmetic mean flow rate during flow period	
q_measl__l	FLOAT	m**3/s	Estimated lower measurement limit of flow rate	**Q-measl-L**
q_measl__u	FLOAT	m**3/s	Estimated upper measurement limit of flow rate	Q-measl-U
tot_volume_vp	FLOAT	m**3	Total volume of pumped(positive) or injected(negative) water	
dur_flow_phase_tp	FLOAT	s	Duration of the flowing period of the test	
dur_rec_phase_tf	FLOAT	s	Duration of the recovery period of the test	
initial_head_hi	FLOAT	m	Hydraulic head in test section at start of the flow period	
head_at_flow_end_hp	FLOAT	m	Hydraulic head in test section at stop of the flow period.	
final_head_hf	FLOAT	m	Hydraulic head in test section at stop of recovery period.	
initial_press_pi	FLOAT	kPa	Groundwater pressure in test section at start of flow period	
press_at_flow_end_pp	FLOAT	kPa	Groundwater pressure in test section at stop of flow period.	
final_press_pf	FLOAT	kPa	Ground water pressure at the end of the recovery period.	
fluid_temp_tew	FLOAT	oC	Measured section fluid temperature, see table description	
fluid_elcond_ecw	FLOAT	mS/m	Measured section fluid el. conductivity,see table descr.	
fluid_salinity_tdsw	FLOAT	mg/l	Total salinity of section fluid based on EC,see table descr.	

Column	Datatype	Unit	Column Description	Alt. Symbol
fluid_salinity_tdswm	FLOAT	mg/l	Tot. section fluid salinity based on water sampling,see...	
reference	CHAR		SKB report No for reports describing data and evaluation	
comments	VARCHAR		Short comment to data	
error_flag	CHAR		If error_flag = "*" then an error occured and an error	
in_use	CHAR		If in_use = "*" then the activity has been selected as	
sign	CHAR		Signature for QA data accknowledge (QA - OK)	
lp	FLOAT	m	Hydraulic point of application	

Nomenclature plu_s_hole_test_ed1

Column	Datatype	Unit	Column Description	Alt. Symbol
site	CHAR		Investigation site name	
activity_type	CHAR		Activity type code	
start_date	DATE		Date (yymmdd hh:mm:ss)	
stop_date	DATE		Date (yymmdd hh:mm:ss)	
project	CHAR		project code	
idcode	CHAR		Object or borehole identification code	
secup	FLOAT	m	Upper section limit (m)	
seclow	FLOAT	m	Lower section limit (m)	
section_no	INTEGER	number	Section number	
test_type	CHAR		Test type code (1-7), see table description!	
formation_type	CHAR		Formation type code. 1: Rock, 2: Soil (superficial deposits)	
lp	FLOAT	m	Hydraulic point of application for test section, see descr.	
seclen_class	FLOAT	m	Planned ordinary test interval during test campaign.	
spec_capacity_q_s	FLOAT	m**2/s	Specific capacity (Q/s) of test section, see table descript.	Q/s
value_type_q_s	CHAR		0:true value,-1:Q/s<lower meas.limit,1:Q/s>upper meas.limit	
transmissivity_tq	FLOAT	m**2/s	Tranmissivity based on Q/s, see table description	
value_type_tq	CHAR		0:true value,-1:TQ<lower meas.limit,1:TQ>upper meas.limit.	
bc_tq	CHAR		Best choice code. 1 means TQ is best choice of T, else 0	
transmissivity_moye	FLOAT	m**2/s	Transmissivity,TM, based on Moye (1967)	T_M
bc_tm	CHAR		Best choice code. 1 means Tmoye is best choice of T, else 0	
value_type_tm	CHAR		0:true value,-1:TM<lower meas.limit,1:TM>upper meas.limit.	
hydr_cond_moye	FLOAT	m/s	K_M: Hydraulic conductivity based on Moye (1967)	K_M

Column	Datatype	Unit	Column Description	Alt. Symbol
formation_width_b	FLOAT	m	b:Aquifer thickness repr. for T(generally b=Lw) ,see descr.	b
width_of_channel_b	FLOAT	m	B:Inferred width of formation for evaluated TB	
tb	FLOAT	m**3/s	TB:Flow capacity in 1D formation of T & width B, see descr.	
l_measl_tb	FLOAT	m**3/s	Estimated lower meas. limit for evaluated TB,see description	
u_measl_tb	FLOAT	m**3/s	Estimated upper meas. limit of evaluated TB,see description	
sb	FLOAT	m	SB:S=storativity,B=width of formation,1D model,see descript.	
assumed_sb	FLOAT	m	SB* : Assumed SB,S=storativity,B=width of formation,see...	
leakage_factor_lf	FLOAT	m	Lf:1D model for evaluation of Leakage factor	
transmissivity_tt	FLOAT	m**2/s	TT:Transmissivity of formation, 2D radial flow model,see...	T_T
value_type_tt	CHAR		0:true value,-1:TT<lower meas.limit,1:TT>upper meas.limit,	
bc_tt	CHAR		Best choice code. 1 means TT is best choice of T, else 0	
l_measl_q_s	FLOAT	m**2/s	Estimated lower meas. limit for evaluated TT,see table descr	Q/s-measl-L
u_measl_q_s	FLOAT	m**2/s	Estimated upper meas. limit for evaluated TT,see description	Q/s-measl-U
storativity_s	FLOAT		S:Storativity of formation based on 2D rad flow,see descr.	
assumed_s	FLOAT		Assumed Storativity,2D model evaluation,see table descr.	
leakage_coeff	FLOAT	1/s	K'/b':2D rad flow model evaluation of leakage coeff,see desc	
hydr_cond_ksf	FLOAT	m/s	Ksf:3D model evaluation of hydraulic conductivity,see desc.	
value_type_ksf	CHAR		0:true value,-1:Ksf<lower meas.limit,1:Ksf>upper meas.limit,	
l_measl_ksf	FLOAT	m/s	Estimated lower meas.limit for evaluated Ksf,see table desc.	
u_measl_ksf	FLOAT	m/s	Estimated upper meas.limit for evaluated Ksf,see table descr	
spec_storage_ssf	FLOAT	1/m	Ssf:Specific storage,3D model evaluation,see table descr.	
assumed_ssf	FLOAT	1/m	Ssf*:Assumed Spec.storage,3D model evaluation,see table des.	
c	FLOAT	m**3/pa	C: Wellbore storage coefficient; flow or recovery period	C
cd	FLOAT		CD: Dimensionless wellbore storage coefficient	
skin	FLOAT		Skin factor;best estimate of flow/recovery period,see descr.	ξ
dt1	FLOAT	s	Estimated start time of evaluation, see table description	dt_1
dt2	FLOAT	s	Estimated stop time of evaluation. see table description	dt_2
t1	FLOAT	s	Start time for evaluated parameter from start flow period	
t2	FLOAT	s	Stop time for evaluated parameter from start of flow period	
dte1	FLOAT	s	Start time for evaluated parameter from start of recovery	
dte2	FLOAT	s	Stop time for evaluated parameter from start of recovery	
p_horner	FLOAT	kPa	p*:Horner extrapolated pressure, see table description	
transmissivity_t_nlr	FLOAT	m**2/s	T_NLR Transmissivity based on None Linear Regression...	
storativity_s_nlr	FLOAT		S_NLR=storativity based on None Linear Regression,see..	

Column	Datatype	Unit	Column Description	Alt. Symbol
value_type_t_nlr	CHAR		0:true value,-1:T_NLR<lower meas.limit,1:>upper meas.limit	
bc_t_nlr	CHAR		Best choice code. 1 means T_NLR is best choice of T, else 0	
c_nlr	FLOAT	m**3/pa	Wellbore storage coefficient, based on NLR, see descr.	
cd_nlr	FLOAT		Dimensionless wellbore storage constant, see table descrip.	
skin_nlr	FLOAT		Skin factor based on Non Linear Regression,see desc.	
transmissivity_t_grf	FLOAT	m**2/s	T_GRF:Transmissivity based on Genelized Radial Flow,see...	
value_type_t_grf	CHAR		0:true value,-1:T_GRF<lower meas.limit,1:>upper meas.limit	
bc_t_grf	CHAR		Best choice code. 1 means T_GRF is best choice of T, else 0	
storativity_s_grf	FLOAT		S_GRF:Storativity based on Generalized Radial Flow, see des.	
flow_dim_grf	FLOAT		Inferred flow dimesion based on Generalized Rad. Flow model	
comment	VARCHAR	no_unit	Short comment to the evaluated parameters	
error_flag	CHAR		If error_flag = "*" then an error occured and an error	
in_use	CHAR		If in_use = "*" then the activity has been selected as	
sign	CHAR		Signature for QA data accknowledge (QA - OK)	

Nomenclature plu_s_hole_test_obs

Column	Datatype	Unit	Column Description
site	CHAR		Investigation site name
activity_type	CHAR		Activity type code
idcode	CHAR		Object or borehole identification code
start_date	DATE		Date (yymmdd hh:mm:ss)
secup	FLOAT	m	Upper section limit (m)
seclow	FLOAT	m	Lower section limit (m)
obs_secup	FLOAT	m	Upper limit of observation section
obs_seclow	FLOAT	m	Lower limit of observation section
pi_above	FLOAT	kPa	Groundwater pressure above test section,start of flow period
pp_above	FLOAT	kPa	Groundwater pressure above test section,at stop flow period
pf_above	FLOAT	kPa	Groundwater pressure above test section at stop recovery per
pi_below	FLOAT	kPa	Groundwater pressure below test section at start flow period
pp_below	FLOAT	kPa	Groundwater pressure below test section at stop flow period
pf_below	FLOAT	kPa	Groundwater pressure below test section at stop recovery per
comments	VARCHAR		Comment text row (unformatted text)

KFM04A plu_s_hole_test_d. Left (This result table to SICADA includes more columns which are empty, these columns are not presented here.)

idcode	start_date	stop_date	secup	seclow	test_type	formation_type	start_flow_period	stop_flow_period	flow_rate_end_qp	value_type_qp	mean_flow_rate_qm
KFM04A	20040823 09:11	20040823 10:59	117.00	217.00	3	1	20040823 09:56:58	20040823 10:27:05	5.16E-04	0	5.42E-04
KFM04A	20040823 13:54	20040823 15:36	217.00	317.00	3	1	20040823 14:34:17	20040823 15:04:35	4.96E-04	0	5.07E-04
KFM04A	20040823 17:07	20040823 18:47	317.00	417.00	3	1	20040823 17:44:54	20040823 18:15:11	3.94E-05	0	4.31E-05
KFM04A	20040824 08:43	20040824 10:25	417.00	517.00	3	1	20040824 09:23:23	20040824 09:53:48	7.76E-07	0	1.21E-06
KFM04A	20040824 13:14	20040824 14:57	517.00	617.00	3	1	20040824 13:54:34	20040824 14:24:56	1.20E-07	0	2.62E-07
KFM04A	20040830 17:37	20040830 19:27	617.00	717.00	3	1	20040430 18:25:04	20040430 18:55:25	8.41E-08	0	1.63E-07
KFM04A	20040825 12:53	20040825 14:52	717.00	817.00	3	1	20040825 13:49:35	20040825 14:20:04	9.00E-09	0	5.31E-08
KFM04A	20040827 13:53	20040827 15:56	817.00	917.00	3	1	20040827 14:53:55	20040827 15:23:56		-1	
KFM04A	20040827 09:01	20040827 11:35	872.00	972.00	3	1	20040827 10:32:37	20040827 11:03:48	6.73E-08	0	1.01E-07
KFM04A	20040902 11:11	20040902 13:32	117.00	137.00	3	1	20040902 12:49:48	20040902 13:10:07	3.18E-05	0	3.40E-05
KFM04A	20040902 14:07	20040902 16:09	137.00	157.00	3	1	20040902 15:26:50	20040902 15:47:09	1.18E-05	0	1.23E-05
KFM04A	20040902 18:02	20040902 19:31	157.00	177.00	3	1	20040902 18:48:39	20040902 19:08:58	2.42E-05	0	2.54E-05
KFM04A	20040903 08:30	20040903 09:49	177.00	197.00	3	1	20040903 09:07:18	20040903 09:27:25	2.40E-05	0	3.10E-05
KFM04A	20040903 10:11	20040903 11:41	197.00	217.00	3	1	20040903 10:58:32	20040903 11:18:49	4.28E-04	0	4.40E-04
KFM04A	20040903 13:34	20040903 14:59	217.00	237.00	3	1	20040903 14:17:21	20040903 14:37:37	5.07E-04	0	5.09E-04
KFM04A	20040906 09:04	20040906 10:23	237.00	257.00	3	1	20040906 09:40:45	20040906 10:01:08	5.43E-08	0	7.16E-08
KFM04A	20040906 10:43	20040906 12:00	257.00	277.00	3	1	20040906 11:18:22	20040906 11:38:43	9.95E-07	0	1.10E-06
KFM04A	20040906 12:55	20040906 14:09	277.00	297.00	3	1	20040906 13:27:20	20040906 13:47:40	5.19E-06	0	5.71E-06
KFM04A	20040906 14:36	20040906 15:50	297.00	317.00	3	1	20040906 15:08:03	20040906 15:28:23	3.71E-06	0	3.82E-06
KFM04A	20040906 17:11	20040906 18:01	317.00	337.00	3	1	20040906 17:18:50	20040906 17:39:10	1.04E-06	0	1.10E-06
KFM04A	20040907 08:25	20040907 09:41	337.00	357.00	3	1	20040907 08:58:55	20040907 09:19:13	5.83E-06	0	6.26E-06
KFM04A	20040907 10:06	20040907 11:20	357.00	377.00	3	1	20040907 10:37:42	20040907 10:58:01	3.37E-05	0	3.63E-05
KFM04A	20040907 12:10	20040907 13:26	377.00	397.00	3	1	20040907 12:44:07	20040907 13:04:27	1.82E-08	0	3.96E-08
KFM04A	20040907 14:26	20040907 15:35	397.00	417.00	3	1	20040907 14:53:05	20040907 15:13:22	2.20E-07	0	2.51E-07
KFM04A	20040907 15:57	20040907 17:11	417.00	437.00	3	1	20040907 16:29:03	20040907 16:49:23	8.55E-07	0	1.41E-06
KFM04A	20040908 08:28	20040908 09:11	437.00	457.00	3	1	20040908 09:00:39	20040908 09:03:11		-1	
KFM04A	20040908 09:57	20040908 11:12	453.00	473.00	3	1	20040908 10:30:09	20040908 10:50:31	1.00E-08	0	1.92E-08

idcode	start_date	stop_date	secup	seclow	test_type	formation_type	start_flow_period	stop_flow_period	flow_rate_end_qp	value_type_qp	mean_flow_rate_qm
KFM04A	20040908 11:33	20040908 13:25	473.00	493.00	3	1	20040908 12:43:00	20040908 13:03:23	7.56E-09	0	2.62E-08
KFM04A	20040908 13:38	20040908 14:54	477.00	497.00	3	1	20040908 14:11:58	20040908 14:32:20		-1	
KFM04A	20040908 15:13	20040908 15:55	497.00	517.00	3	1	20040908 15:45:32	20040908 15:48:17		-1	
KFM04A	20040908 16:11	20040908 17:27	517.00	537.00	3	1	20040908 16:45:05	20040908 17:05:26	6.33E-08	0	1.45E-07
KFM04A	20040910 14:43	20040910 16:03	297.00	302.00	3	1	20040910 15:20:46	20040910 15:41:04	5.28E-06	0	5.60E-06
KFM04A	20040913 09:58	20040913 11:21	302.00	307.00	3	1	20040913 10:38:56	20040913 10:59:17	3.39E-08	0	3.92E-08
KFM04A	20040913 11:33	20040913 13:26	307.00	312.00	3	1	20040913 12:43:44	20040913 13:04:05	9.13E-09	0	1.09E-08
KFM04A	20040913 13:38	20040913 14:55	312.00	317.00	3	1	20040913 14:12:24	20040913 14:32:43	1.19E-07	0	1.30E-07
KFM04A	20040913 15:07	20040913 16:22	317.00	322.00	3	1	20040913 15:39:51	20040913 16:00:12	2.08E-07	0	2.24E-07
KFM04A	20040913 16:34	20040913 17:52	322.00	327.00	3	1	20040913 17:09:31	20040913 17:29:52	1.38E-07	0	1.56E-07
KFM04A	20040913 18:04	20040913 19:19	327.00	332.00	3	1	20040913 18:36:54	20040913 18:57:15	1.41E-07	0	1.53E-07
KFM04A	20040914 08:13	20040914 09:39	332.00	337.00	3	1	20040914 08:57:17	20040914 09:17:35	6.71E-07	0	7.26E-07
KFM04A	20040914 09:49	20040914 11:05	337.00	342.00	3	1	20040914 10:22:59	20040914 10:43:18	5.08E-06	0	5.39E-06
KFM04A	20040914 11:21	20040914 13:13	342.00	347.00	3	1	20040914 12:31:16	20040914 12:51:37	8.49E-07	0	8.72E-07
KFM04A	20040921 12:54	20040921 14:11	347.00	352.00	3	1	20040921 13:29:01	20040921 13:49:20	5.92E-08	0	6.38E-08
KFM04A	20040921 10:35	20040921 11:56	352.00	357.00	3	1	20040921 11:13:50	20040921 11:34:08	1.85E-07	0	2.16E-07
KFM04A	20040915 18:05	20040915 19:21	357.00	362.00	3	1	20040915 18:39:22	20040915 18:59:42	3.59E-05	0	3.90E-05
KFM04A	20040915 19:36	20040915 20:25	362.00	367.00	3	1	20040915 20:03:09	20040915 20:11:05		-1	
KFM04A	20040916 08:18	20040916 09:13	367.00	372.00	3	1	20040916 08:50:33	20040916 09:05:06		-1	
KFM04A	20040916 09:25	20040916 10:09	372.00	377.00	3	1	20040916 09:57:57	20040916 10:02:02		-1	
KFM04A	20040916 10:21	20040916 11:04	377.00	382.00	3	1	20040916 10:53:36	20040916 10:56:11		-1	
KFM04A	20040916 11:15	20040916 12:34	382.00	387.00	3	1	20040916 12:22:31	20040916 12:26:23		-1	
KFM04A	20040916 12:47	20040916 13:31	387.00	392.00	3	1	20040916 13:20:22	20040916 13:24:06		-1	
KFM04A	20040916 13:47	20040916 15:05	392.00	397.00	3	1	20040916 14:22:51	20040916 14:43:12	1.87E-08	0	3.17E-08
KFM04A	20040916 15:18	20040916 16:34	397.00	402.00	3	1	20040916 15:51:43	20040916 16:12:05	1.14E-08	0	1.66E-08
KFM04A	20040916 16:49	20040916 17:40	402.00	407.00	3	1	20040916 17:21:13	20040916 17:31:28		-1	
KFM04A	20040917 08:42	20040917 09:27	407.00	412.00	3	1	20040917 09:16:20	20040917 09:19:43		-1	
KFM04A	20040917 09:42	20040917 11:03	412.00	417.00	3	1	20040917 10:20:26	20040917 10:40:46	2.04E-07	0	2.35E-07
KFM04A	20040917 11:15	20040917 13:16	417.00	422.00	3	1	20040917 12:33:24	20040917 12:53:42	8.45E-07	0	1.36E-06
KFM04A	20040917 13:29	20040917 14:53	422.00	427.00	3	1	20040917 14:11:09	20040917 14:31:29	5.92E-08	0	6.75E-08
KFM04A	20040917 15:06	20040917 15:50	427.00	432.00	3	1	20040917 15:40:05	20040917 15:43:00		-1	

idcode	start_date	stop_date	secup	seclow	test_type	formation_type	start_flow_period	stop_flow_period	flow_rate_end_qp	value_type_qp	mean_flow_rate_qm
KFM04A	20040920 09:21	20040920 10:05	432.00	437.00	3	1	20040920 09:53:44	20040920 09:56:46		-1	
KFM04A	20040920 10:57	20040920 12:49	517.00	522.00	3	1	20040920 12:07:22	20040920 12:27:42	5.70E-08	0	1.18E-07
KFM04A	20040920 13:02	20040920 13:48	522.00	527.00	3	1	20040920 13:35:16	20040920 13:40:23		-1	
KFM04A	20040920 13:59	20040920 14:45	527.00	532.00	3	1	20040920 14:34:33	20040920 14:37:45		-1	
KFM04A	20040920 14:54	20040920 16:14	532.00	537.00	3	1	20040920 15:31:31	20040920 15:51:51		-1	

KFM04A plu_s_hole_test_d. Right (This result table to SICADA includes more columns which are empty, these columns are not presented here.)

idcode	secup	seclow	q_measl_l	q_measl_u	tot_volume_vp	dur_flow_phase_tp	dur_rec_phase_tf	initial_press_pi	press_at_flow_end_pp	final_press_pf	fluid_temp_tew	reference	comments
KFM04A	117.00	217.00	1.7E-08	1.0E-03	-9.80E-01	1807	1806	1095.62	1265.47	1096.03	7.05	P-04-293	
KFM04A	217.00	317.00	1.7E-08	1.0E-03	-9.22E-01	1818	1806	1952.56	2192.65	1953.12	8.92	P-04-293	
KFM04A	317.00	417.00	1.7E-08	1.0E-03	-7.83E-02	1817	1805	2789.80	3014.41	2808.56	8.54	P-04-293	
KFM04A	417.00	517.00	1.7E-08	1.0E-03	-2.21E-03	1825	1800	3600.80	3814.11	3646.34	9.89	P-04-293	
KFM04A	517.00	617.00	1.7E-08	1.0E-03	-4.78E-04	1822	1800	4395.81	4682.10	4524.95	10.81	P-04-293	
KFM04A	617.00	717.00	1.7E-08	1.0E-03	-2.97E-04	1821	1808	5170.11	5370.40	5255.10	11.70	P-04-293	
KFM04A	717.00	817.00	5.0E-09	1.0E-03	-9.70E-05	1829	1829	5921.52	6107.78	6081.30	12.65	P-04-293	
KFM04A	817.00	917.00	5.0E-09	1.0E-03		1801	1821	6654.16	6839.05	6824.69	13.70	P-04-293	
KFM04A	872.00	972.00	1.7E-08	1.0E-03	-1.89E-04	1871	1787	7013.99	7222.00	7060.35	14.12	P-04-293	Due to high pressure below test section during packer inflation, the pressure in the packers were set to 11,5 bar instead of the usual pressure above 16 bar.
KFM04A	117.00	137.00	1.7E-08	1.0E-03	-4.15E-02	1219	1208	1080.10	1280.58	1080.65	6.85	P-04-293	
KFM04A	137.00	157.00	1.7E-08	1.0E-03	-1.51E-02	1219	1208	1255.60	1462.56	1256.15	7.13	P-04-293	
KFM04A	157.00	177.00	1.7E-08	1.0E-03	-3.10E-02	1219	1208	1428.89	1632.20	1430.00	7.20	P-04-293	
KFM04A	177.00	197.00	1.7E-08	1.0E-03	-3.74E-02	1207	1206	1604.40	1816.18	1618.20	7.35	P-04-293	
KFM04A	197.00	217.00	1.7E-08	1.0E-03	-5.36E-01	1217	1210	1778.38	1982.58	1778.80	9.04	P-04-293	
KFM04A	217.00	237.00	1.7E-08	1.0E-03	-6.19E-01	1216	1210	1951.26	2187.34	1950.99	9.11	P-04-293	
KFM04A	237.00	257.00	1.7E-08	1.0E-03	-8.75E-05	1223	1203	2122.62	2350.97	2130.91	8.21	P-04-293	
KFM04A	257.00	277.00	1.7E-08	1.0E-03	-1.34E-03	1221	1203	2294.13	2494.60	2300.34	8.34	P-04-293	
KFM04A	277.00	297.00	1.7E-08	1.0E-03	-6.96E-03	1220	1206	2463.98	2664.58	2469.22	8.55	P-04-293	
KFM04A	297.00	317.00	1.7E-08	1.0E-03	-4.66E-03	1220	1206	2634.23	2834.57	2636.44	8.71	P-04-293	
KFM04A	317.00	337.00	1.7E-08	1.0E-03	-1.34E-03	1220	1206	2803.11	3003.70	2803.66	8.91	P-04-293	
KFM04A	337.00	357.00	1.7E-08	1.0E-03	-7.62E-03	1218	1208	2971.90	3172.80	2977.51	9.11	P-04-293	
KFM04A	357.00	377.00	1.7E-08	1.0E-03	-4.42E-02	1219	1208	3139.77	3368.66	3152.46	9.02	P-04-293	
KFM04A	377.00	397.00	5.0E-09	1.0E-03	-4.83E-05	1220	1221	3313.06	3536.58	3417.92	9.49	P-04-293	
KFM04A	397.00	417.00	1.7E-08	1.0E-03	-3.05E-04	1217	1206	3480.28	3680.70	3490.77	9.67	P-04-293	
KFM04A	417.00	437.00	1.7E-08	1.0E-03	-1.72E-03	1220	1207	3638.00	3857.80	3698.83	9.87	P-04-293	
KFM04A	437.00	457.00	5.0E-09	1.0E-03		152	360	3809.22	3995.89	3998.51	10.06	P-04-293	

idcode	secup	seclow	q_measl__l	q_measl__u	tot_volume_vp	dur_flow_phase_tp	dur_rec_phase_tf	initial_press_pi	press_at_flow_end_pp	final_press_pf	fluid_temp_tew	reference	comments
KFM04A	453.00	473.00	8.0E-09	1.0E-03	-2.35E-05	1222	1221	3935.18	4150.28	4063.08	10.20	P-04-293	
KFM04A	473.00	493.00	6.0E-09	1.0E-03	-3.21E-05	1223	1222	4094.50	4312.54	4280.52	10.37	P-04-293	
KFM04A	477.00	497.00	9.0E-09	1.0E-03		1222	1221	4129.87	4345.65	4318.06	10.40	P-04-293	
KFM04A	497.00	517.00	8.0E-09	1.0E-03		165	315	4290.46	4495.77	4485.84	10.60	P-04-293	
KFM04A	517.00	537.00	1.7E-08	1.0E-03	-1.77E-04	1221	1206	4445.27	4652.50	4541.58	10.78	P-04-293	
KFM04A	297.00	302.00	1.7E-08	1.0E-03	-6.82E-03	1218	1208	2632.97	2833.30	2635.74	8.71	P-04-293	
KFM04A	302.00	307.00	1.7E-08	1.0E-03	-4.79E-05	1221	1205	2674.91	2869.73	2681.53	8.78	P-04-293	
KFM04A	307.00	312.00	6.6E-09	1.0E-03	-1.33E-05	1221	1221	2716.63	2926.03	2737.83	8.82	P-04-293	
KFM04A	312.00	317.00	1.7E-08	1.0E-03	-1.58E-04	1219	1205	2757.70	2966.31	2757.70	8.85	P-04-293	
KFM04A	317.00	322.00	1.7E-08	1.0E-03	-2.73E-04	1221	1205	2802.95	3007.01	2802.40	8.90	P-04-293	
KFM04A	322.00	327.00	1.7E-08	1.0E-03	-1.91E-04	1221	1205	2852.60	3052.00	2846.00	8.95	P-04-293	
KFM04A	327.00	332.00	1.7E-08	1.0E-03	-1.87E-04	1221	1205	2884.22	3094.91	2884.09	8.99	P-04-293	
KFM04A	332.00	337.00	1.7E-08	1.0E-03	-8.84E-04	1218	1205	2926.50	3125.80	2926.58	9.05	P-04-293	
KFM04A	337.00	342.00	1.7E-08	1.0E-03	-6.57E-03	1219	1206	2969.07	3169.41	2974.59	9.14	P-04-293	
KFM04A	342.00	347.00	1.7E-08	1.0E-03	-1.07E-03	1221	1205	3012.26	3211.50	3012.67	9.15	P-04-293	
KFM04A	347.00	352.00	1.7E-08	1.0E-03	-7.78E-05	1219	1206	3055.80	3267.87	3056.35	9.18	P-04-293	
KFM04A	352.00	357.00	1.7E-08	1.0E-03	-2.63E-04	1218	1206	3097.20	3297.12	3097.20	9.21	P-04-293	
KFM04A	357.00	362.00	1.7E-08	1.0E-03	-4.76E-02	1220	1206	3140.80	3355.20	3155.15	8.94	P-04-293	
KFM04A	362.00	367.00	8.0E-09	1.0E-03		476	358	3229.52	3385.84	3377.56	9.33	P-04-293	
KFM04A	367.00	372.00	8.0E-09	1.0E-03		873	356	3261.52	3433.31	3405.71	9.38	P-04-293	
KFM04A	372.00	377.00	8.0E-09	1.0E-03		245	333	3317.40	3477.73	3506.71	9.42	P-04-293	
KFM04A	377.00	382.00	8.0E-09	1.0E-03		155	349	3381.15	3521.05	3552.51	9.47	P-04-293	
KFM04A	382.00	387.00	8.0E-09	1.0E-03		232	365	3380.19	3565.34	3582.31	9.52	P-04-293	
KFM04A	387.00	392.00	9.1E-09	1.0E-03		224	338	3454.83	3608.25	3646.89	9.56	P-04-293	
KFM04A	392.00	397.00	9.1E-09	1.0E-03	-3.87E-05	1221	1219	3444.20	3647.16	3519.95	9.61	P-04-293	
KFM04A	397.00	402.00	7.0E-09	1.0E-03	-2.03E-05	1222	1221	3520.36	3687.17	3556.38	9.66	P-04-293	
KFM04A	402.00	407.00	8.0E-09	1.0E-03		615	390	3581.62	3728.01	3704.84	9.71	P-04-293	
KFM04A	407.00	412.00	8.0E-09	1.0E-03		203	355	3629.22	3766.64	3767.75	9.76	P-04-293	
KFM04A	412.00	417.00	1.7E-08	1.0E-03	-2.86E-04	1220	1206	3605.49	3804.87	3616.53	9.80	P-04-293	
KFM04A	417.00	422.00	1.7E-08	1.0E-03	-1.65E-03	1218	1206	3644.68	3844.50	3693.24	9.86	P-04-293	
KFM04A	422.00	427.00	1.7E-08	1.0E-03	-8.24E-05	1220	1206	3682.76	3897.72	3682.21	9.90	P-04-293	

idcode	secup	seclow	q_measl__l	q_measl__u	tot_volume_vp	dur_flow_phase_tp	dur_rec_phase_tf	initial_press_pi	press_at_flow_end_pp	final_press_pf	fluid_temp_tew	reference	comments
KFM04A	427.00	432.00	9.0E-09	1.0E-03		175	332	3839.77	3940.22	3990.71	9.94	P-04-293	
KFM04A	432.00	437.00	8.0E-09	1.0E-03		182	410	3819.77	3972.64	4076.26	9.99	P-04-293	
KFM04A	517.00	522.00	1.7E-08	1.0E-03	-1.44E-04	1220	1203	4451.27	4661.26	4538.75	10.76	P-04-293	
KFM04A	522.00	527.00	9.0E-09	1.0E-03		307	372	4527.30	4701.01	4728.04	10.81	P-04-293	
KFM04A	527.00	532.00	9.0E-09	1.0E-03		192	359	4573.93	4740.74	4763.36	10.86	P-04-293	
KFM04A	532.00	537.00	8.0E-09	1.0E-03		1220	1221	4588.96	4779.91	4728.04	10.90	P-04-293	

KFM04A plu_s_hole_test_ed1. Left (This result table to SICADA includes more columns which are empty, these columns are not presented here.)

idcode	start_date	stop_date	secup	seclow	test_type	formation_type	spec_capacity_q_s	value_type_q_s	transmissivity_moye	bc_tm	value_type_tm	hydr_cond_moye	formation_width_b
KFM04A	20040823 09:11	20040823 10:59	117.00	217.00	3	1	2.98E-05	0	3.87E-05	0	0	3.87E-07	100.00
KFM04A	20040823 13:54	20040823 15:36	217.00	317.00	3	1	2.03E-05	0	2.64E-05	0	0	2.64E-07	100.00
KFM04A	20040823 17:07	20040823 18:47	317.00	417.00	3	1	1.72E-06	0	2.24E-06	0	0	2.24E-08	100.00
KFM04A	20040824 08:43	20040824 10:25	417.00	517.00	3	1	3.57E-08	0	4.64E-08	0	0	4.64E-10	100.00
KFM04A	20040824 13:14	20040824 14:57	517.00	617.00	3	1	4.11E-09	0	5.34E-09	1	0	5.34E-11	100.00
KFM04A	20040830 17:37	20040830 19:27	617.00	717.00	3	1	4.12E-09	0	5.36E-09	0	0	5.36E-11	100.00
KFM04A	20040825 12:53	20040825 14:52	717.00	817.00	3	1	4.74E-10	0	6.16E-10	1	0	6.16E-12	100.00
KFM04A	20040827 13:53	20040827 15:56	817.00	917.00	3	1	2.50E-10	-1	3.25E-10	0	-1	3.25E-12	100.00
KFM04A	20040827 09:01	20040827 11:35	872.00	972.00	3	1	3.18E-09	0	4.13E-09	0	0	4.13E-11	100.00
KFM04A	20040902 11:11	20040902 13:32	117.00	137.00	3	1	1.56E-06	0	1.62E-06	0	0	8.12E-08	20.00
KFM04A	20040902 14:07	20040902 16:09	137.00	157.00	3	1	5.59E-07	0	5.83E-07	0	0	2.92E-08	20.00
KFM04A	20040902 18:02	20040902 19:31	157.00	177.00	3	1	1.17E-06	0	1.22E-06	0	0	6.11E-08	20.00
KFM04A	20040903 08:30	20040903 09:49	177.00	197.00	3	1	1.11E-06	0	1.16E-06	0	0	5.81E-08	20.00
KFM04A	20040903 10:11	20040903 11:41	197.00	217.00	3	1	2.06E-05	0	2.15E-05	0	0	1.07E-06	20.00
KFM04A	20040903 13:34	20040903 14:59	217.00	237.00	3	1	2.11E-05	0	2.20E-05	1	0	1.10E-06	20.00
KFM04A	20040906 09:04	20040906 10:23	237.00	257.00	3	1	2.33E-09	0	2.44E-09	0	0	1.22E-10	20.00
KFM04A	20040906 10:43	20040906 12:00	257.00	277.00	3	1	4.87E-08	0	5.08E-08	0	0	2.54E-09	20.00
KFM04A	20040906 12:55	20040906 14:09	277.00	297.00	3	1	2.54E-07	0	2.65E-07	0	0	1.33E-08	20.00
KFM04A	20040906 14:36	20040906 15:50	297.00	317.00	3	1	1.82E-07	0	1.90E-07	0	0	9.49E-09	20.00
KFM04A	20040906 17:11	20040906 18:01	317.00	337.00	3	1	5.07E-08	0	5.30E-08	0	0	2.65E-09	20.00
KFM04A	20040907 08:25	20040907 09:41	337.00	357.00	3	1	2.85E-07	0	2.97E-07	0	0	1.49E-08	20.00
KFM04A	20040907 10:06	20040907 11:20	357.00	377.00	3	1	1.44E-06	0	1.51E-06	0	0	7.53E-08	20.00
KFM04A	20040907 12:10	20040907 13:26	377.00	397.00	3	1	7.99E-10	0	8.34E-10	1	0	4.17E-11	20.00
KFM04A	20040907 14:26	20040907 15:35	397.00	417.00	3	1	1.08E-08	0	1.12E-08	0	0	5.62E-10	20.00
KFM04A	20040907 15:57	20040907 17:11	417.00	437.00	3	1	3.82E-08	0	3.99E-08	0	0	1.99E-09	20.00
KFM04A	20040908 08:28	20040908 09:11	437.00	457.00	3	1	2.50E-10	-1	2.61E-10	0	-1	1.31E-11	20.00
KFM04A	20040908 09:57	20040908 11:12	453.00	473.00	3	1	4.56E-10	0	4.76E-10	1	0	2.38E-11	20.00

idcode	start_date	stop_date	secup	seclow	test_type	formation_type	spec_capacity_q_s	value_type_q_s	transmissivity_moye	bc_tm	value_type_tm	hydr_cond_moye	formation_width_b
KFM04A	20040908 11:33	20040908 13:25	473.00	493.00	3	1	3.40E-10	0	3.55E-10	1	0	1.78E-11	20.00
KFM04A	20040908 13:38	20040908 14:54	477.00	497.00	3	1	4.50E-10	-1	4.70E-10	0	-1	2.35E-11	20.00
KFM04A	20040908 15:13	20040908 15:55	497.00	517.00	3	1	4.00E-10	-1	4.18E-10	0	-1	2.09E-11	20.00
KFM04A	20040908 16:11	20040908 17:27	517.00	537.00	3	1	3.00E-09	0	3.13E-09	1	0	1.57E-10	20.00
KFM04A	20040910 14:43	20040910 16:03	297.00	302.00	3	1	2.59E-07	0	2.13E-07	0	0	4.26E-08	5.00
KFM04A	20040913 09:58	20040913 11:21	302.00	307.00	3	1	1.71E-09	0	1.40E-09	0	0	2.81E-10	5.00
KFM04A	20040913 11:33	20040913 13:26	307.00	312.00	3	1	4.28E-10	0	3.52E-10	0	0	7.05E-11	5.00
KFM04A	20040913 13:38	20040913 14:55	312.00	317.00	3	1	5.62E-09	0	4.62E-09	0	0	9.25E-10	5.00
KFM04A	20040913 15:07	20040913 16:22	317.00	322.00	3	1	9.98E-09	0	8.22E-09	0	0	1.64E-09	5.00
KFM04A	20040913 16:34	20040913 17:52	322.00	327.00	3	1	6.77E-09	0	5.57E-09	0	0	1.11E-09	5.00
KFM04A	20040913 18:04	20040913 19:19	327.00	332.00	3	1	6.57E-09	0	5.41E-09	0	0	1.08E-09	5.00
KFM04A	20040914 08:13	20040914 09:39	332.00	337.00	3	1	3.30E-08	0	2.72E-08	0	0	5.44E-09	5.00
KFM04A	20040914 09:49	20040914 11:05	337.00	342.00	3	1	2.49E-07	0	2.05E-07	0	0	4.10E-08	5.00
KFM04A	20040914 11:21	20040914 13:13	342.00	347.00	3	1	4.18E-08	0	3.44E-08	1	0	6.89E-09	5.00
KFM04A	20040921 12:54	20040921 14:11	347.00	352.00	3	1	2.74E-09	0	2.26E-09	0	0	4.51E-10	5.00
KFM04A	20040921 10:35	20040921 11:56	352.00	357.00	3	1	9.08E-09	0	7.48E-09	0	0	1.50E-09	5.00
KFM04A	20040915 18:05	20040915 19:21	357.00	362.00	3	1	1.65E-06	0	1.35E-06	0	0	2.71E-07	5.00
KFM04A	20040915 19:36	20040915 20:25	362.00	367.00	3	1	4.00E-10	-1	3.29E-10	0	-1	6.59E-11	5.00
KFM04A	20040916 08:18	20040916 09:13	367.00	372.00	3	1	4.00E-10	-1	3.29E-10	0	-1	6.59E-11	5.00
KFM04A	20040916 09:25	20040916 10:09	372.00	377.00	3	1	4.00E-10	-1	3.29E-10	0	-1	6.59E-11	5.00
KFM04A	20040916 10:21	20040916 11:04	377.00	382.00	3	1	4.00E-10	-1	3.29E-10	0	-1	6.59E-11	5.00
KFM04A	20040916 11:15	20040916 12:34	382.00	387.00	3	1	4.00E-10	-1	3.29E-10	0	-1	6.59E-11	5.00
KFM04A	20040916 12:47	20040916 13:31	387.00	392.00	3	1	4.55E-10	-1	3.75E-10	0	-1	7.49E-11	5.00
KFM04A	20040916 13:47	20040916 15:05	392.00	397.00	3	1	9.02E-10	0	7.43E-10	1	0	1.49E-10	5.00
KFM04A	20040916 15:18	20040916 16:34	397.00	402.00	3	1	6.68E-10	0	5.50E-10	1	0	1.10E-10	5.00
KFM04A	20040916 16:49	20040916 17:40	402.00	407.00	3	1	4.00E-10	-1	3.29E-10	0	-1	6.59E-11	5.00
KFM04A	20040917 08:42	20040917 09:27	407.00	412.00	3	1	4.00E-10	-1	3.29E-10	0	-1	6.59E-11	5.00
KFM04A	20040917 09:42	20040917 11:03	412.00	417.00	3	1	1.00E-08	0	8.26E-09	0	0	1.65E-09	5.00
KFM04A	20040917 11:15	20040917 13:16	417.00	422.00	3	1	4.15E-08	0	3.42E-08	0	0	6.83E-09	5.00
KFM04A	20040917 13:29	20040917 14:53	422.00	427.00	3	1	2.70E-09	0	2.23E-09	0	0	4.45E-10	5.00
KFM04A	20040917 15:06	20040917 15:50	427.00	432.00	3	1	4.50E-10	-1	3.71E-10	0	-1	7.41E-11	5.00

idcode	start_date	stop_date	secup	seclow	test_type	formation_type	spec_capacity_q_s	value_type_q_s	transmissivity_moye	bc_tm	value_type_tm	hydr_cond_moye	formation_width_b
KFM04A	20040920 09:21	20040920 10:05	432.00	437.00	3	1	4.00E-10	-1	3.29E-10	0	-1	6.59E-11	5.00
KFM04A	20040920 10:57	20040920 12:49	517.00	522.00	3	1	2.66E-09	0	2.19E-09	1	0	4.39E-10	5.00
KFM04A	20040920 13:02	20040920 13:48	522.00	527.00	3	1	4.50E-10	-1	3.71E-10	0	-1	7.41E-11	5.00
KFM04A	20040920 13:59	20040920 14:45	527.00	532.00	3	1	4.50E-10	-1	3.71E-10	0	-1	7.41E-11	5.00
KFM04A	20040920 14:54	20040920 16:14	532.00	537.00	3	1	4.00E-10	-1	3.29E-10	0	-1	6.59E-11	5.00

KFM04A plu_s_hole_test_ed1. Right (This result table to SICADA includes more columns which are empty, these columns are not presented here.)

idcode	secup	seclow	transmissivity_tt	value_type_tt	bc_tt	l_measl_q_s	u_measl_q_s	assumed_s	c	cd	skin	t1	t2	dte1	dte2	comment
KFM04A	117.00	217.00	3.55E-05	0	1	9.6E-10	5.0E-04	1.00E-06			-1.48	30	200			
KFM04A	217.00	317.00	2.82E-05	0	1	6.8E-10	5.0E-04	1.00E-06			0.12	20	200			
KFM04A	317.00	417.00	2.00E-06	0	1	7.3E-10	5.0E-04	1.00E-06			-0.55	200	600			
KFM04A	417.00	517.00	1.30E-08	0	1	7.7E-10	5.0E-04	1.00E-06			-3.19	600	1800			
KFM04A	517.00	617.00	9.89E-10	0	0	5.7E-10	5.0E-04	1.00E-06	4.07E-10		-2.86	400	1800			
KFM04A	617.00	717.00	1.04E-09	0	1	8.2E-10	5.0E-04	1.00E-06	3.43E-10		-2.73	600	1200			
KFM04A	717.00	817.00		0	0	2.6E-10	5.0E-04	1.00E-06	3.05E-10							
KFM04A	817.00	917.00		-1	0	2.5E-10	5.0E-04	1.00E-06								
KFM04A	872.00	972.00	2.24E-09	0	1	7.9E-10	5.0E-04	1.00E-06	2.02E-10		-0.38	100	800			
KFM04A	117.00	137.00	1.85E-06	0	1	8.2E-10	5.0E-04	1.00E-06			-0.11	200	1200			
KFM04A	137.00	157.00	8.95E-07	0	1	7.9E-10	5.0E-04	1.00E-06			2.89	250	1200			
KFM04A	157.00	177.00	1.10E-06	0	1	8.0E-10	5.0E-04	1.00E-06			-0.71			15	100	
KFM04A	177.00	197.00	3.99E-07	0	1	7.7E-10	5.0E-04	1.00E-06			-4.72	100	1800			
KFM04A	197.00	217.00	4.00E-05	0	1	8.0E-10	5.0E-04	1.00E-06			3.81	100	1000			
KFM04A	217.00	237.00	6.71E-05	0	0	6.9E-10	5.0E-04	1.00E-06			8.63	100	1000			
KFM04A	237.00	257.00	1.95E-09	0	1	7.2E-10	5.0E-04	1.00E-06	5.53E-11		1.05	100	1200			
KFM04A	257.00	277.00	4.89E-08	0	1	8.2E-10	5.0E-04	1.00E-06			0.60	200	1200			
KFM04A	277.00	297.00	1.23E-07	0	1	8.2E-10	5.0E-04	1.00E-06			-2.65			10	200	
KFM04A	297.00	317.00	1.86E-07	0	1	8.2E-10	5.0E-04	1.00E-06			0.60			10	100	
KFM04A	317.00	337.00	7.07E-08	0	1	8.2E-10	5.0E-04	1.00E-06	7.04E-11		2.85	100	1200			
KFM04A	337.00	357.00	3.54E-07	0	1	8.1E-10	5.0E-04	1.00E-06			1.05	300	1200			
KFM04A	357.00	377.00	2.14E-06	0	1	7.1E-10	5.0E-04	1.00E-06			1.65	200	1200			
KFM04A	377.00	397.00	9.92E-11	0	0	2.2E-10	5.0E-04	1.00E-06	9.26E-11		-2.35	200	1200			
KFM04A	397.00	417.00	7.71E-09	0	1	8.2E-10	5.0E-04	1.00E-06	3.64E-11		-0.40	500	1200			
KFM04A	417.00	437.00	1.39E-08	0	1	7.4E-10	5.0E-04	1.00E-06			-3.05	500	1200			
KFM04A	437.00	457.00		-1	0	2.5E-10	5.0E-04	1.00E-06								
KFM04A	453.00	473.00	8.53E-11	0	0	3.6E-10	5.0E-04	1.00E-06	6.79E-11		-1.55	100	1200			

idcode	secup	seclow	transmissivity_tt	value_type_tt	bc_tt	l_measl_q_s	u_measl_q_s	assumed_s	c	cd	skin	t1	t2	dte1	dte2	comment
KFM04A	473.00	493.00		0	0	2.7E-10	5.0E-04	1.00E-06	1.54E-10							
KFM04A	477.00	497.00		-1	0	4.5E-10	5.0E-04	1.00E-06								
KFM04A	497.00	517.00		-1	0	4.0E-10	5.0E-04	1.00E-06								
KFM04A	517.00	537.00	1.58E-10	0	0	7.9E-10	5.0E-04	1.00E-06	3.23E-10		-3.65	200	500			
KFM04A	297.00	302.00	1.90E-07	0	1	8.2E-10	5.0E-04	1.00E-06			-1.20			10	100	
KFM04A	302.00	307.00	2.00E-09	0	1	8.4E-10	5.0E-04	1.00E-06	2.07E-11		3.23	200	1200			
KFM04A	307.00	312.00	1.74E-10	0	1	3.1E-10	5.0E-04	1.00E-06	1.69E-11		-0.08	100	1200			
KFM04A	312.00	317.00	6.70E-09	0	1	7.8E-10	5.0E-04	1.00E-06	1.52E-11		2.97	100	1200			
KFM04A	317.00	322.00	5.01E-09	0	1	8.0E-10	5.0E-04	1.00E-06	2.64E-11		-0.75	10	60			
KFM04A	322.00	327.00	2.19E-09	0	1	8.2E-10	5.0E-04	1.00E-06			-1.73	10	200			
KFM04A	327.00	332.00	7.59E-09	0	1	7.8E-10	5.0E-04	1.00E-06	1.60E-11		2.40	300	1200			
KFM04A	332.00	337.00	3.63E-08	0	1	8.2E-10	5.0E-04	1.00E-06			1.28	400	1200			
KFM04A	337.00	342.00	3.47E-07	0	1	8.2E-10	5.0E-04	1.00E-06			2.48	400	1200			
KFM04A	342.00	347.00	9.12E-08	0	0	8.2E-10	5.0E-04	1.00E-06	3.76E-11		7.80	50	1200			
KFM04A	347.00	352.00	4.16E-09	0	1	7.7E-10	5.0E-04	1.00E-06	1.81E-11		5.21	20	1200			
KFM04A	352.00	357.00	4.79E-09	0	1	8.2E-10	5.0E-04	1.00E-06	1.88E-11		-1.25	30	1200			
KFM04A	357.00	362.00	2.37E-06	0	1	7.6E-10	5.0E-04	1.00E-06			1.35	300	1200			
KFM04A	362.00	367.00		-1	0	4.0E-10	5.0E-04	1.00E-06								
KFM04A	367.00	372.00		-1	0	4.0E-10	5.0E-04	1.00E-06								
KFM04A	372.00	377.00		-1	0	4.0E-10	5.0E-04	1.00E-06								
KFM04A	377.00	382.00		-1	0	4.0E-10	5.0E-04	1.00E-06								
KFM04A	382.00	387.00		-1	0	4.0E-10	5.0E-04	1.00E-06								
KFM04A	387.00	392.00		-1	0	4.6E-10	5.0E-04	1.00E-06								
KFM04A	392.00	397.00	1.00E-10	0	0	4.4E-10	5.0E-04	1.00E-06	4.75E-11		-2.57	100	400			
KFM04A	397.00	402.00	1.61E-10	0	0	4.1E-10	5.0E-04	1.00E-06	1.93E-11		-1.03	20	1200			
KFM04A	402.00	407.00		-1	0	4.0E-10	5.0E-04	1.00E-06								
KFM04A	407.00	412.00		-1	0	4.0E-10	5.0E-04	1.00E-06								
KFM04A	412.00	417.00	6.86E-09	0	1	8.2E-10	5.0E-04	1.00E-06	1.60E-11		-0.48	200	1200			
KFM04A	417.00	422.00	8.91E-09	0	1	8.2E-10	5.0E-04	1.00E-06			-3.88	200	600			
KFM04A	422.00	427.00	2.95E-09	0	1	7.6E-10	5.0E-04	1.00E-06	1.51E-11		2.42	30	1200			
KFM04A	427.00	432.00		-1	0	4.5E-10	5.0E-04	1.00E-06								

idcode	secup	seclow	transmissivity_tt	value_type_tt	bc_tt	l_measl_q_s	u_measl_q_s	assumed_s	c	cd	skin	t1	t2	dte1	dte2	comment
KFM04A	432.00	437.00		-1	0	4.0E-10	5.0E-04	1.00E-06								
KFM04A	517.00	522.00	1.07E-10	0	0	7.8E-10	5.0E-04	1.00E-06			-3.65	200	500			
KFM04A	522.00	527.00		-1	0	4.5E-10	5.0E-04	1.00E-06								
KFM04A	527.00	532.00		-1	0	4.5E-10	5.0E-04	1.00E-06								
KFM04A	532.00	537.00		-1	0	4.0E-10	5.0E-04	1.00E-06								

KFM04A plu_s_hole_test_obs (This result table to SICADA includes more columns which are empty, these columns are not presented here.)

idcode	start_date	stop_date	secup	seclow	obs_secup	obs_seclow	pi_above	pp_above	pf_above	pi_below	pp_below	pf_below	comments
KFM04A	20040823 09:11	20040823 10:59	117.00	217.00	106.95	116.00	1040.34	1041.17	1041.17				
KFM04A	20040823 09:11	20040823 10:59	117.00	217.00	218.00	1001.42				1921.15	1925.01	1921.97	
KFM04A	20040823 13:54	20040823 15:36	217.00	317.00	106.95	216.00	1912.80	1915.01	1913.90				
KFM04A	20040823 13:54	20040823 15:36	217.00	317.00	318.00	1001.42				2778.30	2778.30	2778.30	
KFM04A	20040823 17:07	20040823 18:47	317.00	417.00	106.95	316.00	2771.60	2771.73	2771.73				
KFM04A	20040823 17:07	20040823 18:47	317.00	417.00	418.00	1001.42				3619.73	3652.30	3631.32	
KFM04A	20040824 08:43	20040824 10:25	417.00	517.00	106.95	416.00	3608.87	3609.01	3609.15				
KFM04A	20040824 08:43	20040824 10:25	417.00	517.00	518.00	1001.42				4435.75	4432.44	4430.78	
KFM04A	20040824 13:14	20040824 14:57	517.00	617.00	106.95	516.00	4420.06	4419.51	4419.51				
KFM04A	20040824 13:14	20040824 14:57	517.00	617.00	618.00	1001.42				5228.04	5225.27	5224.17	
KFM04A	20040830 17:37	20040830 19:27	617.00	717.00	106.95	616.00	5210.69	5210.00	5210.00				
KFM04A	20040830 17:37	20040830 19:27	617.00	717.00	718.00	1001.42				6032.47	6022.39	6014.80	
KFM04A	20040825 12:53	20040825 14:52	717.00	817.00	106.95	716.00	5978.27	5977.58	5977.30				
KFM04A	20040825 12:53	20040825 14:52	717.00	817.00	818.00	1001.42				6749.11	6743.04	6739.73	
KFM04A	20040827 13:53	20040827 15:56	817.00	917.00	106.95	816.00	6720.86	6720.86	6720.86				
KFM04A	20040827 13:53	20040827 15:56	817.00	917.00	918.00	1001.42				7459.13	7458.58	7458.03	
KFM04A	20040827 09:01	20040827 11:35	872.00	972.00	106.95	871.00	7121.63	7121.77	7121.63				
KFM04A	20040827 09:01	20040827 11:35	872.00	972.00	973.00	1001.42				8290.62	8293.38	8282.89	
KFM04A	20040902 11:11	20040902 13:32	117.00	137.00	106.95	116.00	1042.82	1043.37	1042.82				
KFM04A	20040902 11:11	20040902 13:32	117.00	137.00	138.00	1001.42				1224.60	1224.74	1224.74	
KFM04A	20040902 14:07	20040902 16:09	137.00	157.00	106.95	136.00	1218.78	1218.92	1218.36				
KFM04A	20040902 14:07	20040902 16:09	137.00	157.00	158.00	1001.42				1399.89	1399.75	1400.86	
KFM04A	20040902 18:02	20040902 19:31	157.00	177.00	106.95	156.00	1391.84	1392.66	1392.80				
KFM04A	20040902 18:02	20040902 19:31	157.00	177.00	178.00	1001.42				1574.37	1574.09	1574.23	
KFM04A	20040903 08:30	20040903 09:49	177.00	197.00	106.95	176.00	1568.07	1568.35	1568.35				
KFM04A	20040903 08:30	20040903 09:49	177.00	197.00	198.00	1001.42				1748.56	1748.70	1748.70	

idcode	start_date	stop_date	secup	seclow	obs_secup	obs_seclow	pi_above	pp_above	pf_above	pi_below	pp_below	pf_below	comments
KFM04A	20040903 10:11	20040903 11:41	197.00	217.00	106.95	196.00	1742.22	1742.36	1742.79				
KFM04A	20040903 10:11	20040903 11:41	197.00	217.00	218.00	1001.42				1922.06	1925.37	1922.61	
KFM04A	20040903 13:34	20040903 14:59	217.00	237.00	106.95	216.00	1915.84	1917.22	1916.66				
KFM04A	20040903 13:34	20040903 14:59	217.00	237.00	238.00	1001.42				2093.21	2093.63	2093.21	
KFM04A	20040906 09:04	20040906 10:23	237.00	257.00	106.95	236.00	2088.34	2088.48	2088.34				
KFM04A	20040906 09:04	20040906 10:23	237.00	257.00	258.00	1001.42				2265.48	2265.48	2264.92	
KFM04A	20040906 10:43	20040906 12:00	257.00	277.00	106.95	256.00	2260.71	2260.57	2260.57				
KFM04A	20040906 10:43	20040906 12:00	257.00	277.00	278.00	1001.42				2436.77	2436.63	2436.63	
KFM04A	20040906 12:55	20040906 14:09	277.00	297.00	106.95	276.00	2431.28	2431.42	2431.70				
KFM04A	20040906 12:55	20040906 14:09	277.00	297.00	298.00	1001.42				2606.96	2606.68	2606.68	
KFM04A	20040906 14:36	20040906 15:50	297.00	317.00	106.95	296.00	2602.82	2602.69	2602.82				
KFM04A	20040906 14:36	20040906 15:50	297.00	317.00	318.00	1001.42				2777.56	2777.28	2777.28	
KFM04A	20040906 17:11	20040906 18:01	317.00	337.00	106.95	316.00	2772.98	2772.84	2772.84				
KFM04A	20040906 17:11	20040906 18:01	317.00	337.00	338.00	1001.42				2946.65	2947.33	2946.79	
KFM04A	20040907 08:25	20040907 09:41	337.00	357.00	106.95	336.00	2942.31	2942.04	2941.76				
KFM04A	20040907 08:25	20040907 09:41	337.00	357.00	358.00	1001.42				3115.73	3116.97	3116.83	
KFM04A	20040907 10:06	20040907 11:20	357.00	377.00	106.95	356.00	3110.95	3110.67	3110.67				
KFM04A	20040907 10:06	20040907 11:20	357.00	377.00	378.00	1001.42				3289.09	3287.16	3286.33	
KFM04A	20040907 12:10	20040907 13:26	377.00	397.00	106.95	376.00	3279.59	3279.04	3279.04				
KFM04A	20040907 12:10	20040907 13:26	377.00	397.00	398.00	1001.42				3456.94	3455.42	3454.18	
KFM04A	20040907 14:26	20040907 15:35	397.00	417.00	106.95	396.00	3446.45	3446.17	3446.31				
KFM04A	20040907 14:26	20040907 15:35	397.00	417.00	418.00	1001.42				3623.12	3647.83	3633.06	
KFM04A	20040907 15:57	20040907 17:11	417.00	437.00	106.95	416.00	3611.08	3610.94	3611.36				
KFM04A	20040907 15:57	20040907 17:11	417.00	437.00	438.00	1001.42				3797.59	3794.28	3792.07	
KFM04A	20040908 08:28	20040908 09:11	437.00	457.00	106.95	436.00	3774.48	3774.75	3774.20				
KFM04A	20040908 08:28	20040908 09:11	437.00	457.00	458.00	1001.42				3956.59	3956.46	3954.95	
KFM04A	20040908 09:57	20040908 11:12	453.00	473.00	106.95	452.00	3905.72	3905.58	3905.58				
KFM04A	20040908 09:57	20040908 11:12	453.00	473.00	474.00	1001.42				4087.73	4083.86	4082.48	
KFM04A	20040908 11:33	20040908 13:25	473.00	493.00	106.95	472.00	4067.88	4067.88	4067.88				
KFM04A	20040908 11:33	20040908 13:25	473.00	493.00	494.00	1001.42				4244.66	4243.70	4242.59	
KFM04A	20040908 13:38	20040908 14:54	477.00	497.00	106.95	476.00	4100.17	4100.44	4099.89				
KFM04A	20040908 13:38	20040908 14:54	477.00	497.00	498.00	1001.42				4282.63	4279.60	4277.93	

idcode	start_date	stop_date	secup	seclow	obs_secup	obs_seclow	pi_above	pp_above	pf_above	pi_below	pp_below	pf_below	comments
KFM04A	20040908 15:13	20040908 15:55	497.00	517.00	106.95	496.00	4261.22	4261.09	4261.09				
KFM04A	20040908 15:13	20040908 15:55	497.00	517.00	518.00	1001.42				4445.09	4444.26	4443.57	
KFM04A	20040908 16:11	20040908 17:27	517.00	537.00	106.95	516.00	4421.58	4421.16	4421.16				
KFM04A	20040908 16:11	20040908 17:27	517.00	537.00	538.00	1001.42				4608.65	4605.34	4603.13	
KFM04A	20040910 14:43	20040910 16:03	297.00	302.00	106.95	296.00	2601.72	2601.72	2601.72				
KFM04A	20040910 14:43	20040910 16:03	297.00	302.00	303.00	1001.42				2648.78	2648.64	2648.64	
KFM04A	20040913 09:58	20040913 11:21	302.00	307.00	106.95	301.00	2641.74	2641.88	2642.02				
KFM04A	20040913 09:58	20040913 11:21	302.00	307.00	308.00	1001.42				2688.12	2687.84	2687.84	
KFM04A	20040913 11:33	20040913 13:26	307.00	312.00	106.95	306.00	2684.66	2684.52	2684.52				
KFM04A	20040913 11:33	20040913 13:26	307.00	312.00	313.00	1001.42				2730.35	2730.08	2729.80	
KFM04A	20040913 13:38	20040913 14:55	312.00	317.00	106.95	311.00	2727.16	2727.16	2727.02				
KFM04A	20040913 13:38	20040913 14:55	312.00	317.00	318.00	1001.42				2772.86	2772.86	2772.86	
KFM04A	20040913 15:07	20040913 16:22	317.00	322.00	106.95	316.00	2769.80	2769.80	2770.08				
KFM04A	20040913 15:07	20040913 16:22	317.00	322.00	323.00	1001.42				2815.38	2815.38	2815.38	
KFM04A	20040913 16:34	20040913 17:52	322.00	327.00	106.95	321.00	2812.45	2812.03	2812.03				
KFM04A	20040913 16:34	20040913 17:52	322.00	327.00	328.00	1001.42				2858.03	2857.89	2857.89	
KFM04A	20040913 18:04	20040913 19:19	327.00	332.00	106.95	326.00	2854.69	2854.55	2854.55				
KFM04A	20040913 18:04	20040913 19:19	327.00	332.00	333.00	1001.42				2900.41	2900.27	2900.41	
KFM04A	20040914 08:13	20040914 09:39	332.00	337.00	106.95	331.00	2896.36	2896.22	2896.50				
KFM04A	20040914 08:13	20040914 09:39	332.00	337.00	338.00	1001.42				2942.64	2942.92	2942.37	
KFM04A	20040914 09:49	20040914 11:05	337.00	342.00	106.95	336.00	2939.14	2939.00	2939.00				
KFM04A	20040914 09:49	20040914 11:05	337.00	342.00	343.00	1001.42				2984.47	2985.98	2985.44	
KFM04A	20040914 11:21	20040914 13:13	342.00	347.00	106.95	341.00	2981.92	2981.64	2981.51				
KFM04A	20040914 11:21	20040914 13:13	342.00	347.00	348.00	1001.42				3027.80	3027.67	3027.39	
KFM04A	20040921 12:54	20040921 14:11	347.00	352.00	106.95	346.00	3023.74	3023.46	3023.46				
KFM04A	20040921 12:54	20040921 14:11	347.00	352.00	353.00	1001.42				3069.99	3069.99	3069.99	
KFM04A	20040921 10:35	20040921 11:56	352.00	357.00	106.95	351.00	3066.10	3065.41	3065.96				
KFM04A	20040921 10:35	20040921 11:56	352.00	357.00	358.00	1001.42				3111.95	3111.95	3111.95	
KFM04A	20040915 18:05	20040915 19:21	357.00	362.00	106.95	356.00	3108.88	3109.02	3109.02				
KFM04A	20040915 18:05	20040915 19:21	357.00	362.00	363.00	1001.42				3161.64	3160.53	3159.99	

idcode	start_date	stop_date	secup	seclow	obs_secup	obs_seclow	pi_above	pp_above	pf_above	pi_below	pp_below	pf_below	comments
KFM04A	20040915 19:36	20040915 20:25	362.00	367.00	106.95	361.00	3151.12	3150.98	3150.98				
KFM04A	20040915 19:36	20040915 20:25	362.00	367.00	368.00	1001.42				3204.71	3203.74	3203.05	
KFM04A	20040916 08:18	20040916 09:13	367.00	372.00	106.95	366.00	3193.62	3193.48	3193.48				
KFM04A	20040916 08:18	20040916 09:13	367.00	372.00	373.00	1001.42				3245.98	3244.74	3244.46	
KFM04A	20040916 09:25	20040916 10:09	372.00	377.00	106.95	371.00	3235.98	3235.71	3235.98				
KFM04A	20040916 09:25	20040916 10:09	372.00	377.00	378.00	1001.42				3289.32	3288.90	3288.63	
KFM04A	20040916 10:21	20040916 11:04	377.00	382.00	106.95	376.00	3277.94	3277.94	3277.94				
KFM04A	20040916 10:21	20040916 11:04	377.00	382.00	383.00	1001.42				3330.72	3330.59	3330.03	
KFM04A	20040916 11:15	20040916 12:34	382.00	387.00	106.95	381.00	3320.03	3319.89	3319.89				
KFM04A	20040916 11:15	20040916 12:34	382.00	387.00	388.00	1001.42				3370.75	3370.75	3370.34	
KFM04A	20040916 12:47	20040916 13:31	387.00	392.00	106.95	386.00	3361.98	3361.84	3361.84				
KFM04A	20040916 12:47	20040916 13:31	387.00	392.00	393.00	1001.42				3414.51	3414.24	3413.96	
KFM04A	20040916 13:47	20040916 15:05	392.00	397.00	106.95	391.00	3404.07	3403.79	3403.79				
KFM04A	20040916 13:47	20040916 15:05	392.00	397.00	398.00	1001.42				3456.61	3455.09	3454.26	
KFM04A	20040916 15:18	20040916 16:34	397.00	402.00	106.95	396.00	3445.48	3445.34	3445.21				
KFM04A	20040916 15:18	20040916 16:34	397.00	402.00	403.00	1001.42				3497.89	3496.78	3496.22	
KFM04A	20040916 16:49	20040916 17:40	402.00	407.00	106.95	401.00	3487.01	3486.74	3486.60				
KFM04A	20040916 16:49	20040916 17:40	402.00	407.00	408.00	1001.42				3538.74	3537.91	3537.64	
KFM04A	20040917 08:42	20040917 09:27	407.00	412.00	106.95	406.00	3527.72	3527.58	3527.44				
KFM04A	20040917 08:42	20040917 09:27	407.00	412.00	413.00	1001.42				3578.49	3578.21	3577.93	
KFM04A	20040917 09:42	20040917 11:03	412.00	417.00	106.95	411.00	3569.13	3569.13	3568.85				
KFM04A	20040917 09:42	20040917 11:03	412.00	417.00	418.00	1001.42				3620.45	3645.70	3630.93	
KFM04A	20040917 11:15	20040917 13:16	417.00	422.00	106.95	416.00	3610.66	3610.39	3610.80				
KFM04A	20040917 11:15	20040917 13:16	417.00	422.00	423.00	1001.42				3661.03	3682.01	3680.08	
KFM04A	20040917 13:29	20040917 14:53	422.00	427.00	106.95	421.00	3651.65	3651.51	3651.10				
KFM04A	20040917 13:29	20040917 14:53	422.00	427.00	428.00	1001.42				3715.42	3712.24	3710.44	
KFM04A	20040917 15:06	20040917 15:50	427.00	432.00	106.95	426.00	3691.95	3691.95	3691.95				
KFM04A	20040917 15:06	20040917 15:50	427.00	432.00	433.00	1001.42				3756.82	3756.27	3755.17	
KFM04A	20040920 09:21	20040920 10:05	432.00	437.00	106.95	431.00	3731.83	3731.70	3731.70				
KFM04A	20040920 09:21	20040920 10:05	432.00	437.00	438.00	1001.42				3791.05	3790.23	3788.84	
KFM04A	20040920 10:57	20040920 12:49	517.00	522.00	106.95	516.00	4418.54	4418.40	4418.40				
KFM04A	20040920 10:57	20040920 12:49	517.00	522.00	523.00	1001.42				4475.12	4474.57	4473.46	

idcode	start_date	stop_date	secup	seclow	obs_secup	obs_seclow	pi_above	pp_above	pf_above	pi_below	pp_below	pf_below	comments
KFM04A	20040920 13:02	20040920 13:48	522.00	527.00	106.95	521.00	4458.42	4458.14	4458.14				
KFM04A	20040920 13:02	20040920 13:48	522.00	527.00	528.00	1001.42				4523.57	4522.19	4520.94	
KFM04A	20040920 13:59	20040920 14:45	527.00	532.00	106.95	526.00	4498.31	4497.89	4497.89				
KFM04A	20040920 13:59	20040920 14:45	527.00	532.00	533.00	1001.42				4566.78	4565.95	4564.57	
KFM04A	20040920 14:54	20040920 16:14	532.00	537.00	106.95	531.00	4537.78	4537.64	4537.64				
KFM04A	20040920 14:54	20040920 16:14	532.00	537.00	538.00	1001.42				4606.66	4603.21	4601.56	