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Forsmark site investigation

Hydraulic interference test in borehole HFM14

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Abstract

Two interference tests were performed at Forsmark with borehole HFM14 used as pumping borehole. HFM14 is situated by drill site 5 in the north-western part of the candidate area. It is approximately 150 m long and inclined c. 60° north by north-west. The tests were performed in order to increase the understanding of the hydraulic conditions in the northern part of the candidate area at Forsmark. The main purpose of the interference tests was to document how different fracture zones in the upper part of the rock are connected hydraulically, to quantify their hydraulic properties and to clarify whether there are any hydraulic boundaries in the area. Of special interest are those pressure responses that propagate downwards via deformation zones within the area influenced by the pumping in HFM14, for instance the deformation zones that intersect KFM01A-, -02A, -04A, -05A, -06A and -10A.

The interference tests were performed by pumping in HFM14 and at the same time monitoring pressure responses in different observation sections in surrounding boreholes. All boreholes monitored for potential responses are part of the HMS, the Hydro Monitoring System. In total, 105 observation sections in 36 observation boreholes were included in the interference test. 12 of the 36 boreholes are core-drilled and have 55 sections included in the interference test. 24 boreholes are percussion-drilled with a total of 50 sections. In addition six wells, monitoring the quaternary deposits, were included in the first interference test: SFM001, SFM013, SFM023, SFM030, SFM058 and SFM062. All show some response to pumping in HFM14. The results from the monitoring wells are reported in Appendix 4. Only one observation borehole, KFM10A, containing two sections was included in the second interference test.

The flow period in the first, main interference test lasted for approximately three weeks and the subsequent recovery was measured for about six days. Activities in the area influenced the pressure in many observations sections which made a longer recovery time impossible. The pumping flow rate in HFM14 was relatively constant at c. 348 L/min during the flow period, resulting in a final drawdown in the pumping borehole of about 12 m. These values indicate a specific capacity (~transmissivity) of $5 \cdot 10^{-4}$ m^2/s which is a high value. The capacity of the well was, in conjunction with drilling, estimated at about 36 000 L/h, which is c. 60 times more than a Swedish standard well in fractured rock.

The second interference test was much shorter with a flow period of approximately 3 days and where recovery was measured for c. 2 days. The pumping flow rate was similar to that used in the first test and so was the reached final drawdown. The second interference test was performed in order to get information about borehole KFM10A which was not yet fitted with monitoring equipment for the HMS in time for the first interference test.

Out of the 105 observation sections included in the interference tests, 28 did not respond at all to pumping in HFM14 or responded very weakly. Of the remaining 77 sections, 69 showed distinct pressure responses. Two observation sections stand out as responding most strongly. These sections, KFM10A: 401–500 m and HFM15: 85–95 m, together with 6 other sections, HFM15: 0–84 m, HFM19: 168–182 m, KFM01B: 0–100 m, HFM13: 0–100 m, HFM19: 104–167 m and KFM01B: 101–141m, display responses that are distinct enough to be characterized as potential zone responses between HFM14 and the actual sections.

Significant responses were also observed in the cored borehole sections KFM02A: 411–442 m and KFM02A: 440–518 m located at c. 1,600 m from the pumping borehole. Also, responses were observed in KFM04A: 169–1,001 m and in KFM06A: 341–362 m located c. 800 m from HFM14. In addition weak responses were indicated in the deep sections in KFM06A: 738–748 and KFM06A: 749–826.

Five observation sections, HFM13: 159–173 m, KFM06A: 341–362 m, KFM02A: 411–442 m, KFM02A: 490–518 m and KFM04A: 169–1,001 m, as well as the pumping borehole were evaluated quantitatively using methods for transient evaluation. For the pumping borehole, HFM14, the transmissivity from the transient evaluation was $5.1 \cdot 10^{-4}$ m^2/s. Due to the long distances from, and/or relatively bad hydraulic connection to the pumping borehole, the results from the transient evaluation of the observation sections are very uncertain. It is possible that the evaluated transmissivity values reflect the hydraulic conditions close to the pumping borehole rather than the conditions around the evaluated observation boreholes. However, the estimated hydraulic diffusivity based on the response times for the selected sections was in good agreement with the corresponding estimates from the performed transient analysis.

During the entire first interference test a relatively strong decreasing, natural pressure trend prevailed. In addition, several observation sections were influenced by so called tidal effects, and probably to some extent also by changes of the sea level. Primarily due to the tidal effects the pressure data from certain observation sections exhibit an oscillating behaviour.

Sammanfattning

Två interferenstester har genomförts i Forsmark med borrhål HFM14 som pumphål. HFM14 är beläget vid borrplats 5 i den nordvästra delen av kandidatområdet. Det är ca 150 m långt och lutar ca 60° mot NNW. Huvudsyftet med de utförda interferenstesterna är att dokumentera hur spricksystemen i bergets övre delar hänger ihop hydrauliskt, kvantifiera deras hydrauliska egenskaper, samt att klargöra om det finns några hydrauliska gränser inom området. Av särskild betydelse är tryckresponser som fortplantar sig mot djupet i de deformationszoner som har sitt utgående inom influensområdet för pumpbrunnen, exempelvis de deformationszoner som skär KFM01A-, -02A, -04A, 05A, -6A och -10A.

Interferenstesterna utfördes genom att en tryckavsänkning skapades i HFM14 samtidigt som tryckresponser registrerades i olika observationssektioner i ett flertal omgivande borrhål. Alla borrhål som övervakades ingår i SKBs hydromoniteringssystem, HMS. Totalt övervakades 36 borrhål och sammanlagt 105 observationssektioner ingick i interfenstestet. 12 av de 36 hålen är kärnborrhål med sammanlagt 55 observationssektioner, medan 24 är hammarborrhål med sammanlagt 50 observationssektioner. Utöver dessa har även 6 jordrör inkluderats i det första interferenstestet: SFM001, SFM013, SFM023, SFM030, SFM058 och SFM062. Alla jordrör uppvisar någon respons från pumpningen i HFM14. Resultatet från jordrören rapporteras i Appendix 4. Endast ett borrhål, KFM10A, med två observationssektioner ingick i det andra interferenstestet.

Pumpfasen pågick under ca tre veckor för det första interferenstestet och den påföljande återhämtningen registrerades i ungefär sex dagar. Aktiviteter i området påverkade trycket i ett flertal observationssektioner, vilket omöjliggjorde en längre återhämtningsperiod. Pumpflödet från HFM14 låg relativt konstant runt 348 L/min under pumpfasen och resulterade i en slutlig avsänkning i pumpborrhålet av ca 12 m. Dessa värden indikerar en specifik kapacitet (~transmissivitet) av $5 \cdot 10^{-4}$ m^2/s, vilket är ett högt värde. Brunnskapaciteten i samband med borrning uppskattades till ca 36 000 L/h, vilket är ca 60 ggr mer än en svensk normalbrunn i sprickigt berg.

Det andra interferenstestet pågick under mycket kortare tid med en pumpfas som pågick i ca 3 dygn och med en efterföljande återhämtningsperiod på ungefär två dygn. Pumpflödet motsvarade flödet från det första testet och även avsänkningen var i stort sett densamma. Det andra interferenstestet utfördes för att få information om borrhålet KFM10A som inte var färdiginstrumenterat med HMS-utrustning i tid för det första interferenstestet.

Av de 105 observationssektioner som ingick i interferenstestet reagerade 28 sektioner inte alls eller bara mycket svagt på avsänkningen i HFM14. Av de återstående 77 sektionerna karaktäriserades 69 sektioner av distinkta tryckresponser. Två observationssektioner uppvisar de allra starkaste tryckresponserna. Dessa sektioner, KFM10A: 401–500 m och HFM15: 85–95 m, tillsammans med 6 andra sektioner, HFM15: 0–84 m, HFM19: 168–182 m, KFM01B: 0–100 m, HFM13: 0–100 m, HFM19: 104–167 m och KFM01B: 101–141 m, uppvisar responser som är distinkta nog att kunna karaktäriseras som potentiella hög-transmissiva zonresponser mellan HFM14 och respektive borrhålssektion.

Signifikanta responser observerades också i de kärnborrade borrhålssektionerna KFM02A: 411–442 m och KFM02A: 440–518 m som ligger ca 1 600 m från pumphålet. Även i KFM04A: 169–1 001 m och KFM06A: 341–362 m som ligger ungefär 800 m från HFM14 noterades responser. Svaga responser erhölls också i de djupa sektionerna KFM06A: 738–748 och KFM06A: 749–826.

Fem observationssektioner, HFM13: 159–173 m, KFM06A: 341–362 m, KFM02A: 411–442 m, KFM02A: 490–518 m och KFM04A: 169–1 001 m, samt pumpborrhålet utvärderades kvantitativt med metoder för transient utvärdering. För pumpborrhålet, HFM14, gav den transienta utvärderingen ett värde för transmissiviteten på $5.1 \cdot 10^{-4}$ m^2/s. På grund av de långa avstånden till, och/eller den relativt dåliga hydrauliska kontakten med pumphålet, är resultaten från den transienta utvärderingen av de utvalda observationshålen mycket osäkra. Det är möjligt att de utvärderade transmissiviteterna återspeglar de hydrauliska förhållandena i närheten av pumphålet snarare än förhållandena runt de utvärderade observationshålen. Trots detta stämde den uppskattade hydrauliska diffusiviteten, baserad på responstiderna för de utvalda sektionerna, väl överrens med de korresponderande uppskattningarna från den utförda transienta analysen.

Under hela det första interferenstestet regerade en relativt stark avtagande naturlig trend omgivningarna. Dessutom påverkades många observationssektioner av så kallade tidaleffekter, samt troligen även effekter orsakade av ett föränderligt havsvattenstånd. Framförallt på grund av tidaleffekterna uppvisar vissa berörda sektioner ett oscillerande beteende.

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Appendix 6 Data files of corrected head and drawdown for natural trend (on CD)

1 Introduction

This report documents the results from two hydraulic interference tests performed within the site investigation at Forsmark. They were performed in order to study how different fracture zones are connected hydraulically in the northern part of the candidate area at Forsmark, to quantify their hydraulic properties and to clarify whether there are any major hydraulic boundaries in the area. The locations of the boreholes involved in the interference tests are shown in Figure 1-1. The tests were carried out in July and August of 2006 by Geosigma AB.

The open percussion drilled borehole HFM14 was used as pumping borehole for the tests and 37 surrounding boreholes served as observation wells. The second interference test was shorter and only included one observation borehole with two observation sections. This borehole was not supplied with borehole equipment for pressure registration when the first test was executed and therefore a second test was added to the original plan.

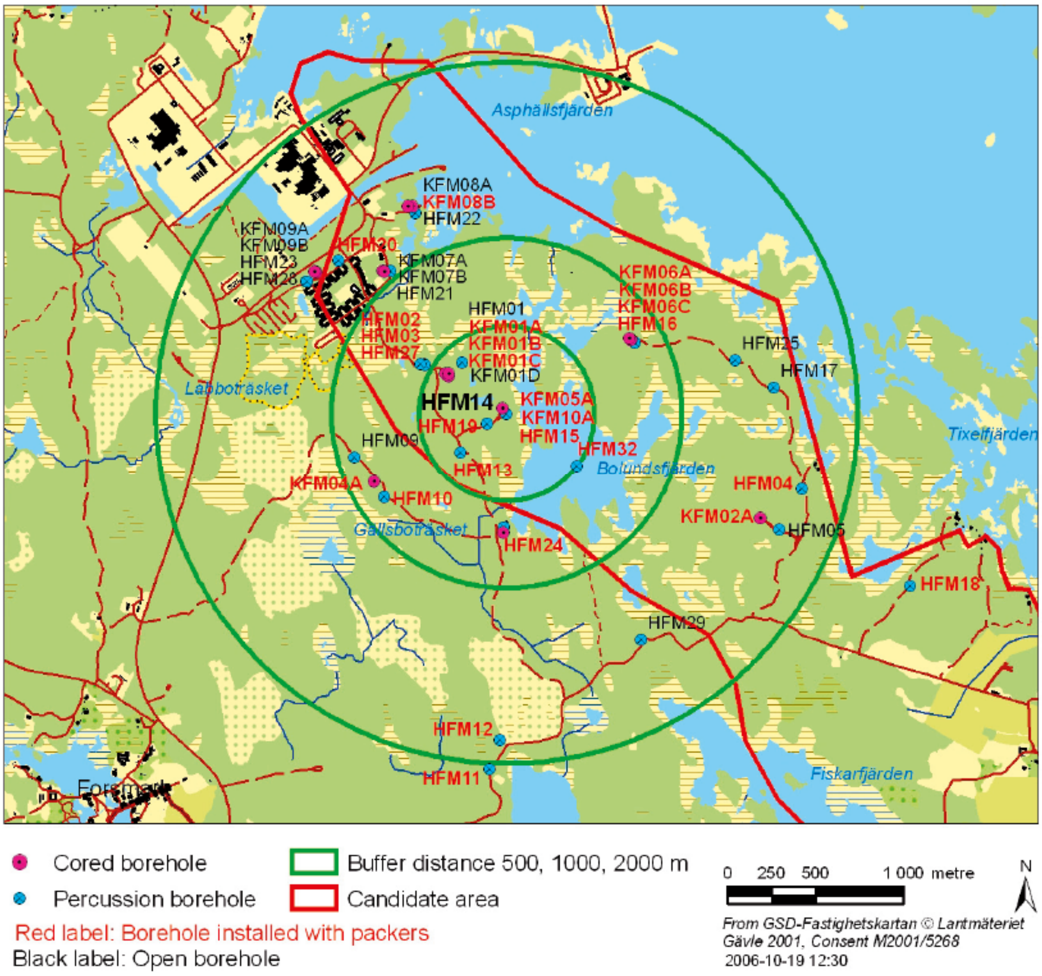


__Figure 1-1.__ The investigation area at Forsmark including part of the candidate area selected for more detailed investigations. The positions of the boreholes included in the interference tests are displayed as well as the areas corresponding to radii of 500 m, 1,000 m and 2,000 m from HFM14, respectively.

The interference tests were conducted in accordance with activity plan AP PF 400-06-038. In Table 1-1, controlling documents for the performance of this activity are listed. Both the activity plan and method descriptions are internal controlling documents of SKB.

From pumping tests and flow logging, /1/, performed prior to the interference tests, the total transmissivity of the pumping borehole, HFM14, was estimated at c. $5.7 \cdot 10^{-4}$ m^2/s.

Table 1-1. Controlling documents for the performance of the activity.

Activity plan	Number	Version
Hydrauliskt interferenstest med hammarborrhål HFM14 som pumphål.	AP PF 400-06-038	1.0
Method documents	**Number**	**Version**
Instruktion för analys av injektions- och enhålspumptester	SKB MD 320.004	1.0
Metodbeskrivning för interferenstester	SKB MD 330.003	1.0

2 Objectives

The main aim of hydraulic interference tests is to get support for interpretations of geologic structures in regard to their hydraulic and geometric properties deduced from single-hole tests. Furthermore, an interference test may provide information about the hydraulic connectivity and hydraulic boundary conditions within the tested area. Finally, interference tests make up the basis for calibration of numerical models of the area.

The interference tests, with borehole HFM14 as pumping borehole, were performed in order to increase the understanding of the hydraulic conditions in the northern part of the candidate area at Forsmark. The primary aim of the interference tests were to document how different fracture zones are connected hydraulically, to quantify their hydraulic properties and to clarify whether there are any major hydraulic boundaries in the area.

The interference tests were performed by pumping in the open percussion drilled borehole HFM14 and monitoring pressure responses in different observation sections in surrounding boreholes. All boreholes monitored for responses are part of the Forsmark HMS, the Hydro Monitoring System. In total, 105 observation sections in 36 observation boreholes were included in the interference tests.

The second test was performed only to include observation borehole KFM10A in the analysis. This borehole was not yet ready for observation by the time the first interference test commenced. Only two sections in borehole KFM10A were included in the second, shorter interference test.

3 Scope

3.1 Boreholes tested

Technical data of the boreholes tested are presented in Table 3-1. Six of the boreholes that, in the Activity Plan, were intended to be included in the interference tests did for various reasons not supply any pressure data and were therefore excluded from the tests. These borehole sections are still presented in tables in this report but no pressure data are available. The excluded boreholes are KFM01D, KFM07A, KFM09B, KFM08A, HFM25 and KFM09A. In this report boreholes are presented in order of distance from the pumping borehole, i.e. the borehole closest to HFM14 is presented first and the borehole furthest away from HFM14 is presented last. The reference point in the boreholes is always top of casing (ToC). The Swedish National coordinate system (RT90 2.5 gon V 0:–15) is used in the x-y-direction together with RHB70 in the z-direction. The coordinates of the boreholes at ground surface are shown in Table 3-2. All section positions are given as length along the borehole (not vertical distance from ToC).

Table 3-1. Pertinent technical data of the tested boreholes. (From SICADA).

Borehole data							
Bh ID	Elevation of top of casing (ToC) (m.a.s.l.)	Borehole interval from ToC (m)	Casing/ Bh-diam. (m)	Inclination-top of bh (from horizontal plane) (º)	Dip-direc-tion-top of borehole (from local N) (º)	Remarks	Drilling finished Date (YYYY-MM-DD)
HFM14	3.912	0.000–3.100	0.235	–59.810	331.748	Borehole	2003-10-09
”		3.100–6.000	0.189			Borehole	
”		6.000–101.300	0.138			Borehole	
”		101.300–150.500	0.136			Borehole	
”		0.100–3.100	0.209			Casing ID	
”		0.000–6.000	0.160			Casing ID	
HFM15	3.878	0.000–6.000	0.176	–43.700	314.305	Borehole	2003-10-15
”		6.000–99.500	0.139			Borehole	
”		0.000–6.000	0.160			Casing ID	
KFM05A	5.528	0.000–12.250	0.340	–59.804	80.897	Borehole	2004-05-05
”		12.250–100.300	0.244			Borehole	
”		100.300–100.350	0.164			Borehole	
”		100.350–110.100	0.086			Borehole	
”		110.100–1,002.710	0.077			Borehole	
”		0.000–100.020	0.200			Casing ID	
”		0.000–12.250	0.310			Casing ID	
”		0.190–12.250	0.309			Casing ID	
”		100.020–100.070	0.170			Casing ID	
HFM19	3.656	0.000–12.040	0.180	–58.103	280.915	Borehole	2003-12-18
”		12.040–185.200	0.137			Borehole	
”		0.000–12.040	0.160			Casing ID	
HFM13	5.687	0.000–4.400	0.235	–58.845	51.194	Borehole	2003-10-02
”		4.400–14.900	0.189			Borehole	
”		14.900–101.000	0.138			Borehole	
”		101.000–152.350	0.137			Borehole	
”		152.350–175.600	0.135			Borehole	
”		0.000–14.900	0.160			Casing ID	

Borehole data							
Bh ID	**Elevation of top of casing (ToC) (m.a.s.l.)**	**Borehole interval from ToC (m)**	**Casing/ Bh-diam. (m)**	**Inclination-top of bh (from horizontal plane) (º)**	**Dip-direc-tion-top of borehole (from local N) (º)**	**Remarks**	**Drilling finished Date (YYYY-MM-DD)**
KFM01C	2.91	0.00–6.15	0.151	–49.61	165.35	Borehole	2005-11-29
		6.15–11.96	0.092			Borehole	
		11.96–450.02	0.076			Borehole	
		0.00–11.96	0.077			Casing ID	
HFM01	1.731	0.000–31.930	0.204	–77.513	34.061	Borehole	2002-05-03
”		31.930–200.200	0.140			Borehole	
”		0.000–31.930	0.160			Casing ID	
KFM01A	3.125	0.000–12.000	0.440	–84.730	318.350	Borehole	2002-10-28
”		12.000–29.400	0.358			Borehole	
”		29.400–100.480	0.251			Borehole	
”		100.480–100.520	0.164			Borehole	
”		100.520–102.130	0.086			Borehole	
”		102.130–1,001.490	0.076			Borehole	
”		0.000–100.400	0.200			Casing ID	
”		0.000–29.400	0.265			Casing ID	
”		97.330–97.330	0.195			Casing ID	
”		101.990–101.990	0.080			Casing ID	
KFM01D [1)]	2.947	0.230–11.610	0.339	–54.896	35.035	Borehole	2006-02-18
		11.610–89.720	0.245			Borehole	
		89.770–91.480	0.086			Borehole	
		91.480–800.240	0.076			Borehole	
		0.000–83.260	0.200			Casing ID	
		0.230–11.530	0.310			Casing ID	
		83.260–89.460	0.200			Casing ID	
		89.460–89.510	0.170			Casing ID	
KFM01B	3.093	0.150–9.170	0.150	–79.040	267.594	Borehole	2004-01-15
”		9.170–15.560	0.101			Borehole	
”		15.560–500.520	0.076			Borehole	
”		0.000–15.530	0.078			Casing ID	
”		0.050–9.050	0.130			Casing ID	
”		8.990–9.090	0.115			Casing ID	
HFM32	0.974	0.000–6.030	0.175	–86.057	116.146	Borehole	2006-01-14
		6.030–106.600	0.139			Borehole	
		106.600–169.650	0.136			Borehole	
		169.650–202.650	0.132			Borehole	
		0.000–5.940	0.160			Casing ID	
		5.940–6.030	0.143			Casing ID	
HFM03	3.148	0.000–13.100	0.204	–87.284	264.528	Borehole	2002-05-28
”		13.100–26.000	0.136			Borehole	
”		0.000–13.100	0.160			Casing ID	
HFM02	3.053	0.000–25.400	0.204	–87.787	6.516	Borehole	2002-05-21
”		25.400–100.000	0.137			Borehole	
”		0.000–25.400	0.160			Casing ID	
HFM27	2.445	0.000–12.030	0.180	–67.827	337.257	Borehole	2005-11-10
		12.030–110.000	0.140			Borehole	
		110.000–127.500	0.139			Borehole	

Borehole data Bh ID	Elevation of top of casing (ToC) (m.a.s.l.)	Borehole interval from ToC (m)	Casing/ Bh-diam. (m)	Inclination-top of bh (from horizontal plane) (º)	Dip-direc-tion-top of borehole (from local N) (º)	Remarks	Drilling finished Date (YYYY-MM-DD)
		0.000–11.940	0.160			Casing ID	
		11.940–12.030	0.143			Casing ID	
HFM24	3.683	0.000–18.030	0.180	–59.564	47.291	Borehole	2005-11-22
		18.030–100.350	0.139			Borehole	
		100.350–151.350	0.138			Borehole	
		0.000–17.940	0.160			Casing ID	
		17.940–18.030	0.143			Casing ID	
KFM04A	8.771	0.000–12.030	0.350	–60.080	45.240	Borehole	2003-11-19
”		12.030–107.330	0.247			Borehole	
”		107.330–107.420	0.161			Borehole	
”		107.420–108.690	0.086			Borehole	
”		108.690–1,001.420	0.077			Borehole	
”		0.000–106.910	0.200			Casing ID	
”		0.000–12.030	0.265			Casing ID	
”		0.000–106.910	0.200			Casing ID	
”		106.910–106.950	0.170			Casing ID	
KFM06A	4.100	0.000–2.120	0.415	–60.250	300.920	Borehole	2004-09-21
”		2.120–12.300	0.333			Borehole	
”		12.300–100.590	0.243			Borehole	
”		100.590–100.640	0.164			Borehole	
”		100.640–102.190	0.086			Borehole	
”		102.190–1,000.640	0.077			Borehole	
”		0.000–100.350	0.200			Casing ID	
”		0.190–2.120	0.392			Casing ID	
”		0.190–12.300	0.309			Casing ID	
”		100.350–100.400	0.170			Casing ID	
KFM06C	4.085	0.00–12.140	0.339	–60.124	26.067	Borehole	2005-06-30
		12.140–18.00	0.260			Borehole	
		18.00–100.350	0.339			Borehole	
		100.350–100.400	0.162			Borehole	
		100.400–102.080	0.086			Borehole	
		102.080–1,000.430	0.077			Borehole	
		0.00–100.070	0.200			Casing ID	
		0.200–12.00	0.280			Casing ID	
		100.070–100.120	0.170			Casing ID	
KFM06B	4.130	0.000–3.880	0.116	–83.520	296.960	Borehole	2003-06-08
”		3.880-4.610	0.101			Borehole	
”		4.610–6.330	0.086			Borehole	
”		6.330–100.330	0.077			Borehole	
”		0.000–4.610	0.078			Casing ID	
HFM10	4.986	0.000–4.500	0.219	–68.700	92.934	Borehole	2003-08-19
”		0.001–11.800	0.190			Borehole	
”		11.800–110.000	0.140			Borehole	
”		110.000–150.000	0.139			Borehole	
”		0.000–11.800	0.160			Casing ID	
HFM16	3.210	0.000–12.020	0.195	–84.218	327.957	Borehole	2003-11-11

Borehole data Bh ID	Elevation of top of casing (ToC) (m.a.s.l.)	Borehole interval from ToC (m)	Casing/ Bh-diam. (m)	Inclination-top of bh (from horizontal plane) (º)	Dip-direc-tion-top of borehole (from local N) (º)	Remarks	Drilling finished Date (YYYY-MM-DD)
”		12.020–82.000	0.140			Borehole	
”		82.000–132.500	0.139			Borehole	
”		0.000–12.020	0.160			Casing ID	
HFM09	5.150	0.000–5.300	0.190	–68.899	139.359	Borehole	2003-06-30
”		5.300–17.000	0.190			Borehole	
”		17.000–50.250	0.141			Borehole	
”		0.000–17.020	0.160			Casing ID	
KFM07B	3.363	0.000–5.180	0.116	–53.713	134.346	Borehole	2005-10-18
		5.180–65.690	0.096			Borehole	
		65.690–298.930	0.076			Borehole	
		0.000–65.290	0.077			Casing ID	
HFM21	3.979	0.000–12.030	0.185	–58.480	88.810	Borehole	2004-06-07
”		12.030–148.000	0.139			Borehole	
”		148.000–202.000	0.137			Borehole	
”		0.000–11.940	0.160			Casing ID	
”		11.940–12.030	0.147			Casing ID	
KFM07A [1)]	3.330	0.000–9.140	0.346	–59.220	261.470	Borehole	2004-12-09
”		9.140–100.350	0.251			Borehole	
”		9.140–100.400	0.252			Borehole	
”		100.350–100.400	0.164			Borehole	
”		100.400–101.950	0.086			Borehole	
”		101.950–1,001.550	0.077			Borehole	
”		0.000–100.050	0.200			Casing ID	
”		0.000–8.940	0.311			Casing ID	
”		0.200–8.940	0.310			Casing ID	
”		100.050–100.100	0.170			Casing ID	
KFM09B [1)]	4.303	0.000–9.120	0.151	–55.081	140.834	Borehole	2005-12-19
		9.120–616.450	0.0773			Borehole	
		0.000–9.120	0.0773			Casing ID	
HFM22	1.539	0.000–12.030	0.180	–58.854	90.081	Borehole	2004-09-10
”		12.030–222.000	0.136			Borehole	
”		0.000–11.940	0.160			Casing ID	
”		11.940–12.030	0.147			Casing ID	
HFM20	2.966	0.000–12.300	0.185	–85.448	354.415	Borehole	2004-06-01
”		12.300–112.700	0.139			Borehole	
”		112.700–250.000	0.138			Borehole	
”		250.000–301.000	0.135			Borehole	
”		0.000–11.940	0.160			Casing ID	
”		11.940–12.030	0.147			Casing ID	
KFM08A [1)]	2.487	0.000–9.140	0.343	–60.887	321.000	Borehole	2005-03-31
		9.140–97.140	0.249			Borehole	
		97.140–102.400	0.086			Borehole	
		102.400–1,001.190	0.077			Borehole	
		0.000–100.150	0.200			Casing ID	
		0.230–9.140	0.310			Casing ID	
		100.150–100.200	0.170			Casing ID	

Borehole data							
Bh ID	**Elevation of top of casing (ToC) (m.a.s.l.)**	**Borehole interval from ToC (m)**	**Casing/ Bh-diam. (m)**	**Inclination-top of bh (from horizontal plane) (º)**	**Dip-direc-tion-top of borehole (from local N) (º)**	**Remarks**	**Drilling finished Date (YYYY-MM-DD)**
KFM08B	2.250	0.000–5.580	0.093	–58.850	270.450	Borehole	2005-01-26
		5.580–200.540	0.076			Borehole	
		0.000–5.580	0.077			Casing ID	
HFM25 [1)]	3.858	0.000–9.100	0.178	–57.814	140.842	Borehole	2005-09-08
		9.100–187.500	0.139			Borehole	
		0.000–8.940	0.168			Casing ID	
		8.940–9.040	0.168			Casing ID	
KFM09A [1)]	4.29	0.000 7.230	0.116	–59.46	200.077	Borehole	2005-10-27
		7.230 7.790	0.096			Borehole	
		7.790 799.670	0.077			Borehole	
		0.000 7.790	0.077			Casing ID	
HFM28	4.266	12.100–117.900	0.137	–84.761	146.783	Borehole	2005-09-14
		117.900–151.200	0.135			Borehole	
		0.000–11.940	0.160			Casing ID	
		11.940–12.030	0.142			Casing ID	
HFM23	4.250	0.000–20.800	0.182	–58.477	324.348	Borehole	2005-09-01
		20.800–115.000	0.136			Borehole	
		115.000–211.500	0.134			Borehole	
		0.000–20.710	0.168			Casing ID	
		20.710–20.800	0.168			Casing ID	
HFM29	4.467	0.000–9.030	0.180	–58.572	29.952	Borehole	2005-12-19
		9.030–85.700	0.140			Borehole	
		85.700–199.700	0.138			Borehole	
		0.000–8.940	0.160			Casing ID	
		8.940–9.030	0.143			Casing ID	
HFM17	3.750	0.000–8.000	0.180	–84.186	318.576	Borehole	2003-12-08
”		8.000–120.500	0.137			Borehole	
”		120.500–210.650	0.136			Borehole	
”		0.000–8.000	0.160			Casing ID	
KFM02A	7.353	0.000–2.390	0.440	–85.385	275.764	Borehole	2003-03-12
”		2.390–11.800	0.358			Borehole	
”		11.800–100.350	0.251			Borehole	
”		100.350–100.420	0.164			Borehole	
”		100.420–102.000	0.086			Borehole	
”		102.000–1,002.440	0.077			Borehole	
”		0.000–100.140	0.200			Casing ID	
”		0.100–11.800	0.265			Casing ID	
HFM05	7.672	0.000–4.600	0.215	–84.961	335.589	Borehole	2002-12-16
		4.600–11.870	0.215			Borehole	
		11.870–101.300	0.136			Borehole	
		101.300–200.100	0.134			Borehole	
		0.000–11.850	0.160			Casing ID	
		11.850–11.870	0.146			Casing ID	
HFM04	3.873	0.000–3.000	0.215	–84.257	336.875	Borehole	2002-12-03
		3.000–12.100	0.215			Borehole	
		12.100–221.700	0.138			Borehole	

Borehole data Bh ID	Elevation of top of casing (ToC) (m.a.s.l.)	Borehole interval from ToC (m)	Casing/ Bh-diam. (m)	Inclination-top of bh (from horizontal plane) (º)	Dip-direc-tion-top of borehole (from local N) (º)	Remarks	Drilling finished Date (YYYY-MM-DD)
		–0.220–2.720	0.244			Casing ID	
		0.000–12.100	0.160			Casing ID	
		12.100–12.120	0.146			Casing ID	
HFM12	7.025	0.000–4.300	0.235	–49.052	245.163	Borehole	2003-09-16
		4.300–14.900	0.189			Borehole	
		14.900–110.000	0.138			Borehole	
		110.000–170.350	0.137			Borehole	
		170.350–209.550	0.135			Borehole	
		0.000–14.900	0.160			Casing ID	
HFM11	7.559	0.000–3.100	0.235	–49.317	63.506	Borehole	2003-09-01
		3.100–11.900	0.190			Borehole	
		11.900–110.200	0.140			Borehole	
		110.200–158.350	0.139			Borehole	
		158.350–182.350	0.139			Borehole	
		0.000–11.900	0.160			Casing ID	
HFM18	5.039	9.00–180.65	0.140	–59.35	313.29	Borehole	2003-12-16
		0.00–9.00	0.160			Casing ID	
KFM10A	4.507	0.230–12.310	0.339	–50.049	10.420	Borehole	2006-06-01
		12.310–60.680	0.244			Borehole	
		60.680–500.160	0.076			Borehole	
		0.000–60.340	0.200			Casing ID	
		0.230–12.230	0.310			Casing ID	
		12.230–12.310	0.281			Casing ID	
		60.340–60.390	0.170			Casing ID	

1) Borehole not used during the interference test in HFM14

Table 3-2. Coordinates of the tested boreholes. (From SICADA).

Borehole data Bh ID	Northing (m)	Easting (m)
HFM14	6699313.139	1631734.586
HFM15	6699312.444	1631733.081
KFM05A	6699344.850	1631710.804
HFM19	6699257.585	1631626.925
HFM13	6699093.678	1631474.404
KFM01C	6699526.14	1631403.75
HFM01	6699605.181	1631484.552
KFM01A	6699529.813	1631397.160
KFM01D 1)	6699542.066	1631404.521
KFM01B	6699539.396	1631387.672
HFM32	6699015.036	1632137.068
HFM03	6699592.812	1631272.626
HFM02	6699593.212	1631268.674
HFM27	6699595.263	1631245.935
HFM24	6698662.373	1631719.641

Borehole data Bh ID	Northing (m)	Easting (m)
KFM04A	6698921.744	1630978.964
KFM06A	6699732.880	1632442.510
KFM06C	6699740.961	1632437.029
KFM06B	6699732.240	1632446.410
HFM10	6698834.785	1631037.188
HFM16	6699721.098	1632466.182
HFM09	6699064.648	1630869.120
KFM07B	6700123.622	1631036.833
HFM21	6700125.566	1631074.054
KFM07A 1)	6700127.080	1631031.570
KFM09B 1)	6700119.887	1630638.784
HFM22	6700456.184	1631217.635
HFM20	6700187.496	1630776.681
KFM08A 1)	6700494.492	1631197.060
KFM08B	6700492.750	1631173.270
HFM25 1)	6699616.177	1633039.368
KFM09A 1)	6700115.04	1630647.50
HFM28	6700068.840	1630597.240
HFM23	6700067.686	1630595.433
HFM29	6698018.647	1632502.813
HFM17	6699461.952	1633261.310
KFM02A	6698712.501	1633182.863
HFM05	6698647.275	1633289.721
HFM04	6698878.968	1633420.733
HFM12	6697446.459	1631695.671
HFM11	6697283.402	1631636.333
HFM18	6698326.858	1634037.374
KFM10	6698629.174	1631715.900

1) Section not used during the interference test in HFM14.

3.2 Tests performed

The borehole sections involved in the interference tests in HFM14 are listed in Table 3-3. The times referred to in Table 3-3 are the chosen start and stop times of downloaded data files used for evaluation. Alternatively, for the pumping borehole, the times referred to are the relevant times included in the original file produced by the data logger. The amount of data extracted from HMS, the Hydro Monitoring System, from the observation boreholes was chosen so as to receive an appropriate amount of data that would correspond to available data from the pumping borehole, HFM14, as well as giving adequate information about the pressure conditions prior to as well as after the performed interference test. HMS is registering pressure continuously.

The column "Test section" In Table 3-3 reports the nominal section length. It should be noted, however, that the upper part of the upper section in most boreholes are cased to some depth. The casing length of each borehole can be found in Table 3-1. The hydraulically active section, used for instance when calculating the point of application, is, as a consequence of this, shorter than the nominal length which would explain the discrepancy between the length reported in column "Section length" and the column "Test section" (both given in Table 3-1).

Two separate hydraulic interference tests were actually performed and are presented in this report. The second interference test was added to the plan after the first test was concluded to be able to include observation borehole KFM10A in the analysis.

The test performance was according to the Geosigma quality plan ("Kvalitetsplan för SKB uppdrag – Hydrauliskt interferenstest med hammarborrhål HFM14 som pumphål, K586087, Kristoffer Gokall-Norman, 2006-06-02", Geosigma and SKB internal controlling document) and according to the methodology description for interference tests, SKB MD 330.003. However, no response matrix was prepared since only one major interference test was performed.

Table 3-3. Borehole sections involved in the interference test in HFM14, see Figure 1-1.

Bh ID	Test section (m)	Test type[1]	Test config	Test start date and time (YYYY-MM-DD tt:mm)	Test stop date and time (YYYY-MM-DD tt:mm)
HFM14	0–150	1B	Open borehole	2006-07-04 10:06	2006-07-31 06:00
HFM15	0–84	2	Above packer	2006-06-30 01:00	2006-07-31 06:00
"	85–95	2	Below packer	2006-06-30 01:00	2006-07-31 06:00
KFM05A	0–114	2	Above packer	2006-06-30 01:00	2006-07-31 06:00
	115–253	2	Between packers	2006-06-30 01:00	2006-07-31 06:00
	254–272	2	Between packers	2006-06-30 01:00	2006-07-31 06:00
	273–489	2	Between packers	2006-06-30 01:00	2006-07-31 06:00
	490–698	2	Between packers	2006-06-30 01:00	2006-07-31 06:00
	699–1,002	2	Below packer	2006-06-30 01:00	2006-07-31 06:00
HFM19	0–103	2	Above packer	2006-06-30 01:00	2006-07-31 06:00
"	104–167	2	Between packers	2006-06-30 01:00	2006-07-31 06:00
"	168–182	2	Below packer	2006-06-30 01:00	2006-07-31 06:00
HFM13	0–100	2	Above packer	2006-06-30 01:00	2006-07-31 06:00
"	101–158	2	Between packers	2006-06-30 01:00	2006-07-31 06:00
"	159–173	2	Below packer	2006-06-30 01:00	2006-07-31 06:00
KFM01C	0–58	2	Above packer	2006-06-30 01:00	2006-07-31 06:00
	59–237	2	Between packers	2006-06-30 01:00	2006-07-31 06:00
	238–450	2	Below packer	2006-06-30 01:00	2006-07-31 06:00
HFM01	0–200	2	Open borehole	2006-06-30 01:00	2006-07-31 06:00
KFM01A	0–108	2	Above packer	2006-06-30 01:00	2006-07-31 06:00
"	109–130	2	Between packers	2006-06-30 01:00	2006-07-31 06:00
"	131–204	2	Between packers	2006-06-30 01:00	2006-07-31 06:00
"	205–373	2	Between packers	2006-06-30 01:00	2006-07-31 06:00
"	374–430	2	Between packers	2006-06-30 01:00	2006-07-31 06:00
"	431–1002	2	Below packer	2006-06-30 01:00	2006-07-31 06:00
KFM01D 2)	0–800	–	–	–	–
KFM01B	0–100	2	Above packer	2006-06-30 01:00	2006-07-31 06:00
"	101–141	2	Between packers	2006-06-30 01:00	2006-07-31 06:00
"	142–500	2	Below packer	2006-06-30 01:00	2006-07-31 06:00
HFM32	0–25	2	Above packer	2006-06-30 01:00	2006-07-31 06:00
	26–31	2	Between packers	2006-06-30 01:00	2006-07-31 06:00
	32–97	2	Between packers	2006-06-30 01:00	2006-07-31 06:00
	98–203	2	Below packer	2006-06-30 01:00	2006-07-31 06:00
HFM03	0–18	2	Above packer	2006-06-30 01:00	2006-07-31 06:00
"	19–26	2	Below packer	2006-06-30 01:00	2006-07-31 06:00
HFM02	0–37	2	Above packer	2006-06-30 01:00	2006-07-31 06:00

Bh ID	Test section (m)	Test type[1]	Test config	Test start date and time (YYYY-MM-DD tt:mm)	Test stop date and time (YYYY-MM-DD tt:mm)
”	38–48	2	Between packers	2006-06-30 01:00	2006-07-31 06:00
”	49–100	2	Below packer	2006-06-30 01:00	2006-07-31 06:00
HFM27	0–24	2	Above packer	2006-06-30 01:00	2006-07-31 06:00
	25–45	2	Between packers	2006-06-30 01:00	2006-07-31 06:00
	46–58	2	Between packers	2006-06-30 01:00	2006-07-31 06:00
	59–128	2	Below packer	2006-06-30 01:00	2006-07-31 06:00
HFM24	0–151	2	Open borehole	2006-06-30 01:00	2006-07-31 06:00
KFM04A	0–168	2	Above packer	2006-06-30 01:00	2006-07-31 06:00
	169–1,001	2	Below packer	2006-06-30 01:00	2006-07-31 06:00
KFM06A	0–150	2	Above packer	2006-06-30 01:00	2006-07-31 06:00
	151–246	2	Between packers	2006-06-30 01:00	2006-07-31 06:00
	247–340	2	Between packers	2006-06-30 01:00	2006-07-31 06:00
	341–362	2	Between packers	2006-06-30 01:00	2006-07-31 06:00
	363–737	2	Between packers	2006-06-30 01:00	2006-07-31 06:00
	738–748	2	Between packers	2006-06-30 01:00	2006-07-31 06:00
	749–826	2	Between packers	2006-06-30 01:00	2006-07-31 06:00
	827–1,001	2	Below packer	2006-06-30 01:00	2006-07-31 06:00
KFM06C	0–186	2	Above packer	2006-06-30 01:00	2006-07-31 06:00
	187–280	2	Between packers	2006-06-30 01:00	2006-07-31 06:00
	281–350	2	Between packers	2006-06-30 01:00	2006-07-31 06:00
	351–401	2	Between packers	2006-06-30 01:00	2006-07-31 06:00
	402–530	2	Between packers	2006-06-30 01:00	2006-07-31 06:00
	531–540	2	Between packers	2006-06-30 01:00	2006-07-31 06:00
	541–646	2	Between packers	2006-06-30 01:00	2006-07-31 06:00
	647–666	2	Between packers	2006-06-30 01:00	2006-07-31 06:00
	667–872	2	Between packers	2006-06-30 01:00	2006-07-31 06:00
	873–1,001	2	Below packer	2006-06-30 01:00	2006-07-31 06:00
KFM06B	0–26	2	Above packer	2006-06-30 01:00	2006-07-31 06:00
	27–50	2	Between packers	2006-06-30 01:00	2006-07-31 06:00
	51–100	2	Below packer	2006-06-30 01:00	2006-07-31 06:00
HFM10	0–99	2	Above packer	2006-06-30 01:00	2006-07-31 06:00
”	100–150	2	Below packer	2006-06-30 01:00	2006-07-31 06:00
HFM16	0–53	2	Above packer	2006-06-30 01:00	2006-07-31 06:00
	54–67	2	Between packers	2006-06-30 01:00	2006-07-31 06:00
	68–132	2	Below packer	2006-06-30 01:00	2006-07-31 06:00
HFM09	0–50	2	Open borehole	2006-06-30 01:00	2006-07-31 06:00
KFM07B	0–299	2	Open borehole	2006-06-30 01:00	2006-07-31 06:00
HFM21	0–202	2	Open borehole	2006-06-30 01:00	2006-07-31 06:00
KFM07A [2)]	0–1,002	–	–	–	–
KFM09B [2)]	0–616	–	–	–	–
HFM22	0–222	2	Open borehole	2006-06-30 01:00	2006-07-31 06:00
HFM20	0–48	2	Above packer	2006-06-30 01:00	2006-07-31 06:00
”	49–100	2	Between packers	2006-06-30 01:00	2006-07-31 06:00
”	101–130	2	Between packers	2006-06-30 01:00	2006-07-31 06:00
”	131–301	2	Below packer	2006-06-30 01:00	2006-07-31 06:00
KFM08A [2)]	0–1,001	–	–	–	–
KFM08B	0–70	2	Above packer	2006-06-30 01:00	2006-07-31 06:00

Bh ID	Test section (m)	Test type[1]	Test config	Test start date and time (YYYY-MM-DD tt:mm)	Test stop date and time (YYYY-MM-DD tt:mm)
	71–112	2	Between packers	2006-06-30 01:00	2006-07-31 06:00
	113–200	2	Below packer	2006-06-30 01:00	2006-07-31 06:00
HFM25 [2)]	0–188	–	–	–	–
KFM09A [2)]	0–800	–	–	–	–
HFM28	0–151	2	Open borehole	2006-06-30 01:00	2006-07-31 06:00
HFM23	0–212	2	Open borehole	2006-06-30 01:00	2006-07-31 06:00
HFM29	0–200	2	Open borehole	2006-06-30 01:00	2006-07-31 06:00
HFM17	0–211	2	Open borehole	2006-06-30 01:00	2006-07-31 06:00
KFM02A	0–132	2	Above packer	2006-06-30 01:00	2006-07-31 06:00
”	133–240	2	Between packers	2006-06-30 01:00	2006-07-31 06:00
”	241–410	2	Between packers	2006-06-30 01:00	2006-07-31 06:00
”	411–442	2	Between packers	2006-06-30 01:00	2006-07-31 06:00
”	443–489	2	Between packers	2006-06-30 01:00	2006-07-31 06:00
”	490–518	2	Between packers	2006-06-30 01:00	2006-07-31 06:00
”	519–888	2	Between packers	2006-06-30 01:00	2006-07-31 06:00
”	889–1,002	2	Below packer	2006-06-30 01:00	2006-07-31 06:00
HFM05	0–200	2	Open borehole	2006-06-30 01:00	2006-07-31 06:00
HFM04	0–57	2	Above packer	2006-06-30 01:00	2006-07-31 06:00
	58–66	2	Between packers	2006-06-30 01:00	2006-07-31 06:00
	67–222	2	Below packer	2006-06-30 01:00	2006-07-31 06:00
HFM12	0–56.5	2	Above packer	2006-06-30 01:00	2006-07-31 06:00
	57.5–210	2	Below packer	2006-06-30 01:00	2006-07-31 06:00
HFM11	0–53	2	Above packer	2006-06-30 01:00	2006-07-31 06:00
	54–182	2	Below packer	2006-06-30 01:00	2006-07-31 06:00
HFM18	0–28	2	Above packer	2006-06-30 01:00	2006-07-31 06:00
	28–41	2	Between packers	2006-06-30 01:00	2006-07-31 06:00
	42–180	2	Below packer	2006-06-30 01:00	2006-07-31 06:00
KFM10 [3)]	0–400	2	Above packer	2006-09-08 13:09	2006-09-13 09:00
	401–500	2	Below packer	2006-09-08 13:09	2006-09-13 09:00

[1)] 1B: Pumping test-submersible pump, 2: Interference test.

[2)] Section not used during the interference test in HFM14.

[3)] Section tested during a shorter, second pumping.

The interpreted points of application, see explanation below, and lengths of the borehole sections involved in the interference test together with their estimated transmissivities from previous investigations (/1/–/29/) are presented in Table 3-4. The distances between the pumping borehole and the observation borehole sections are shown in Table 3-5. The distances between the hydraulic points of application in the boreholes were calculated.

The estimations of the points of application in the pumping borehole and in the different observation borehole sections respectively were made in one of two ways. If it was obvious that a certain flow anomaly, identified from e.g. flow logging, contributed to the major part of the transmissivity in one section, the position of that anomaly was chosen as the point of application. Alternatively, if no evident part of the section could be chosen with regard to transmissivity, either the midpoint of the section was selected or, if several parts of the section have comparable values of transmissivity, a point of balance calculation was made to estimate the point of application.

Table 3-4. Points of application and lengths of the test sections in the interference test in HFM14 as well as their estimated transmissivities from previous investigations /1/–/29/.

Bh ID	Test section (m)	Point of application (m below TOC)	Section length (m)	Transmissivity (m^2/s)
HFM14	0–150	20	144	$4.7\cdot10^{-4}$
HFM15	0–84	50	84	$2.2\cdot10^{-4}$
”	85–95	89	10	$1.0\cdot10^{-4}$
KFM05A	0–114	109	14	$1.2\cdot10^{-3}$
	115–253	145	138	$5.3\cdot10^{-6}$
	254–272	256	18	$2.2\cdot10^{-8}$
	273–489	292	216	$5.1\cdot10^{-9}$
	490–698	594	208	$1.2\cdot10^{-9}$
	699–1,002	850	303	$1.2\cdot10^{-10}$
HFM19	0–103	101	91	$4.0\cdot10^{-5}$
”	104–167	150	63	$2.2\cdot10^{-5}$
”	168–182	176	14	$2.7\cdot10^{-4}$
HFM13	0–100	50	85	–
”	101–158	106	57	$2.1\cdot10^{-5}$
”	159–173	162	14	$2.9\cdot10^{-4}$
KFM01C	0–58	38	46	$7.1\cdot10^{-4}$
	59–237	85	178	$2.4\cdot10^{-4}$
	238–450	436	212	$1.8\cdot10^{-8}$
HFM01	0–200	51	168	$6.3\cdot10^{-5}$
KFM01A	0–108	105	6	–
”	109–130	118	21	$1.1\cdot10^{-7}$
”	131–204	148	73	$1.6\cdot10^{-7}$
”	205–373	285	168	$1.9\cdot10^{-8}$
”	374–430	402	56	$9.5\cdot10^{-10}$
”	431–1,002	715	571	$5.5\cdot10^{-9}$
KFM01D [1)]	0–800	445	710	–
KFM01B	0–100	54	91	–
”	101–141	121	40	–
”	142–500	321	358	–
HFM32	0–25	19	19	$7.2\cdot10^{-4}$
	26–31	29	5	$2.3\cdot10^{-4}$
	32–97	64	65	$1.7\cdot10^{-5}$
	98–203	150	105	$1.7\cdot10^{-5}$
HFM03	0–18	15	5	–
”	19–26	21	7	$4.2\cdot10^{-4}$
HFM02	0–37	31	12	–
”	38–48	43	10	$5.9\cdot10^{-4}$
”	49–100	74	51	–
HFM27	0–24	20	12	$1.3\cdot10^{-5}$
	25–45	28	20	$2.3\cdot10^{-5}$
	46–58	54	12	$4.0\cdot10^{-5}$
	59–128	119	69	$6.7\cdot10^{-6}$
HFM24	0–151	35	133	$1.1\cdot10^{-4}$
KFM04A	0–168	114	61	$6.1\cdot10^{-5}$
	169–1,001	220	832	$9.9\cdot10^{-5}$
KFM06A	0–150	130	50	$6.0\cdot10^{-5}$
	151–246	215	95	$2.7\cdot10^{-5}$
	247–340	267	93	$7.5\cdot10^{-5}$

Bh ID	Test section (m)	Point of application (m below TOC)	Section length (m)	Transmissivity (m^2/s)
	341–362	357	21	$6.8·10^{-6}$
	363–737	392	374	$3.1·10^{-7}$
	738–748	743	10	$1.2·10^{-7}$
	749–826	775	77	$1.9·10^{-8}$
	827–1,000	913	173	$1.3·10^{-9}$
KFM06C	0–186	144	86	$6.6·10^{-5}$
	187–280	214	93	$1.8·10^{-6}$
	281–350	316	69	$1.4·10^{-6}$
	351–401	395	50	$8.3·10^{-6}$
	402–530	422	128	$8.2·10^{-8}$
	531–540	536	9	$1.1·10^{-6}$
	541–646	593	105	$1.0·10^{-9}$
	647–666	658	19	$9.5·10^{-8}$
	667–872	770	205	$1.0·10^{-8}$
	873–1,001	927	128	$1.3·10^{-8}$
KFM06B	0–26	11	21	$2.8·10^{-6}$
	27–50	45	23	$2.9·10^{-4}$
	51–100	56	49	$2.4·10^{-4}$
HFM10	0–99	50	87	–
”	100–150	118	50	$3.1·10^{-4}$
HFM16	0–53	41	41	$1.2·10^{-4}$
	54–67	58	13	$3.5·10^{-4}$
	68–132	69	64	$5.7·10^{-5}$
HFM09	0–50	26	33	$3.7·10^{-4}$
KFM07B	0–299	236	942)	$4.9·10^{-8}$
HFM21	0–202	68	190	$6.8·10^{-4}$
KFM07A [1)]	0–1,002	122	902	$1.4·10^{-3}$
KFM09B [1)]	0–616	35	607	$2.3·10^{-6}$
HFM22	0–222	62	210	$1.6·10^{-4}$
HFM20	0–48	25	36	$5.7·10^{-5}$
”	49–100	77	51	$1.8·10^{-6}$
”	101–130	118	29	$1.0·10^{-5}$
”	131–301	215	170	–
KFM08A [1)]	0–1,001	310	901	$4.8·10^{-6}$
KFM08B	0–70	26	64	$3.9·10^{-5}$
	71–112	92	41	$3.9·10^{-7}$
	113–200	174	87	$6.0·10^{-7}$
HFM25 [1)]	0–188	99	179	$3.8·10^{-7}$
KFM09A [1)]	0–800	301	692 [2)]	$1.4·10^{-6}$
HFM28	0–151	82	139	$9.0·10^{-6}$
HFM23	0–212	30	191	$4.3·10^{-6}$
HFM29	0–200	105	191	$6.8·10^{-8}$
HFM17	0–211	31	203	$3.9·10^{-5}$
KFM02A	0–132	118	32	$3.0·10^{-4}$
”	133–240	173	107	$5.1·10^{-6}$
”	241–410	282	169	$1.3·10^{-5}$
”	411–442	428	31	$2.5·10^{-6}$
”	443–489	478	46	$3.9·10^{-7}$
”	490–518	513	46	$2.1·10^{-6}$
”	519–888	558	369	$6.0·10^{-9}$

Bh ID	Test section (m)	Point of application (m below TOC)	Section length (m)	Transmissivity (m^2/s)
”	889–1,002	945	113	–
HFM05	0–200	153	188	$4.0 \cdot 10^{-4}$
HFM04	0–57	35	45	–
	58–66	62	8	$7.9 \cdot 10^{-5}$
	67–222	145	155	–
HFM12	0–56.5	22	41.5	$9.0 \cdot 10^{-6}$
	57.5–210	117	152.5	$7.9 \cdot 10^{-6}$
HFM11	0–53	43	41	$2.2 \cdot 10^{-5}$
	54–182	125	128	$2.8 \cdot 10^{-5}$
HFM18	0–28	19	19	–
	28–41	35	13	$7.8 \cdot 10^{-5}$
	42–180	111	138	$8.4 \cdot 10^{-5}$
KFM10 3)	0–400	90	340	–
	401–500	432	99	–

1) Section not used during the interference test in HFM14.

2) The hydraulically active section is short due to grouting.

3) Section tested during a shorter, second pumping.

Table 3-5. Calculated distances from the pumping borehole HFM14 to the observation borehole sections involved in the interference test in HFM14.

Pumping section in HFM14 (m)	Observation sections Borehole ID	Section (m)	Point of Application	Distance to HFM14@20 m (m)
0–150	HFM15	0–84	50	32.6
”	”	85–95	89	71.3
0–150	KFM05A	0–114	109	88.2
”	”	115–253	145	123.1
”	”	254–272	256	232.7
”	”	273–489	292	268.5
”	”	490–698	594	568.2
”	”	699–1,002	850	821.4
0–150	HFM19	0–103	101	183.0
”	”	104–167	150	224.8
”	”	168–182	176	248.1
0–150	HFM13	0–100	50	319.0
”	”	101–158	106	302.1
”	”	159–173	162	296.6
0–150	KFM01C	0–58	38	367.5
”	”	59–237	85	350.0
”	”	238–450	436	403.9
0–150	HFM01	0–200	51	379.0
0–150	KFM01A	0–108	105	411.9
”	”	109–130	118	416.1
”	”	131–204	148	427.4
”	”	205–373	285	500.3
”	”	374–430	402	582.3
”	”	431–1,002	715	849.6
0–150	KFM01D 1)	0–800	445	582.2

Pumping section in HFM14 (m)	Observation sections Borehole ID	Section (m)	Point of Application	Distance to HFM14@20 m (m)
0–150	KFM01B	0–100	54	415.9
”	”	101–141	121	438.3
”	”	142–500	321	555.6
0–150	HFM32	0–25	19	511.1
”	”	26–31	29	512.0
”	”	32–97	64	517.8
”	”	98–203	150	546.2
0–150	HFM03	0–18	15	532.1
”	”	19–26	21	532.4
0–150	HFM02	0–37	31	535.7
”	”	38–48	43	536.3
”	”	49–100	74	539.0
0–150	HFM27	0–24	20	561.8
”	”	25–45	28	564.2
”	”	46–58	54	573.4
”	”	59–128	119	602.1
0–150	HFM24	0–151	35	647.4
0–150	KFM04A	0–168	114	803.8
		169–1,001	220	772.9
0–150	KFM06A	0–150	130	797.5
”	”	151–246	215	793.1
”	”	247–340	267	795.5
”	”	341–362	357	810.3
”	”	363–737	392	816.1
”	”	738–748	743	979.9
”	”	749–826	775	1,001.4
”	”	827–1,000	913	1,103.2
0–150	KFM06C	0–186	144	892.4
”	”	187–280	214	935.5
”	”	281–350	316	1,007.4
”	”	351–401	395	1,069.1
”	”	402–530	422	1,091.2
”	”	531–540	536	1,188.3
”	”	541–646	593	1,238.4
”	”	647–666	658	1,296.7
”	”	667–872	770	1,398.5
”	”	873–1,001	927	1,543.5
0–150	KFM06B	0–26	11	825.1
”	”	27–50	45	823.5
”	”	51–100	56	823.3
0–150	HFM10	0–99	50	836.1
”	”	100–150	118	830.8
0–150	HFM16	0–53	41	837.5
”	”	54–67	58	838.0
”	”	68–132	69	838.5
0–150	HFM09	0–50	26	894.8
0–150	KFM07B	0–299	236	931.4
0–150	HFM21	0–202	68	1,012.6
0–150	KFM07A [1)]	0–1,002	122	1,103.6

Pumping section in HFM14 (m)	Observation sections Borehole ID	Section (m)	Point of Application	Distance to HFM14@20 m (m)
0–150	KFM09B [1)]	0–616	35	1,332.4
0–150	HFM22	0–222	62	1,227.4
0–150	HFM20	0–48	25	1,289.0
”	”	49–100	77	1,292.4
”	”	101–130	118	1,295.9
”	”	131–301	215	1,308.5
0–150	KFM08A [1)]	0–1,000	310	1,470.5
0–150	KFM08B	0–70	26	1,302.5
”	”	71–112	92	1,320.5
”	”	113–200	174	1,348.8
0–150	HFM25 [1)]	0–188	99	1,371.9
0–150	KFM09A [1)]	0–800	301	1,341.5
0–150	HFM28	0–151	82	1,349.0
0–150	HFM23	0–212	30	1,373.1
0–150	HFM29	0–200	105	1,499.5
0–150	HFM17	0–211	31	1,536.5
0–150	KFM02A	0–132	118	1,570.7
”	”	133–240	173	1,571.1
”	”	241–410	282	1,576.1
”	”	411–442	428	1,593.7
”	”	443–489	478	1,602.6
”	”	490–518	513	1,609.5
”	”	519–888	558	1,619.2
”	”	889–1,002	945	1,739.8
0–150	HFM05	0–200	153	1,712.0
0–150	HFM04	0–57	35	1,746.5
”	”	58–66	62	1,746.8
”	”	67–222	145	1,758.6
0–150	HFM12	0–56.5	22	1,881.9
”	”	57.5–210	117	1,911.8
0–150	HFM11	0–53	43	2,027.6
”	”	54–182	125	2,007.8
0–150	HFM18	0–28	19	2,506.2
”		29–41	35	2,495.5
”		42–180	111	2,455.6
0–150 2)	KFM10	0–400	90	636.9
		401–500	432	492.1

[1)] Section not used during the interference test in HFM14.

[2)] Section measured during a shorter, second pumping.

3.3 Equipment check

An equipment check was performed at the Geosigma engineering workshop in Uppsala as well as at the site as a simple and fast test to establish the operating status of sensors and other equipment. In addition, calibration constants were implemented and checked.

To check the function of the pressure sensors, the pressure in air was recorded and found to be as expected. Submerged in water, the pressure coincided well with the total head of water, while lowering.

4 Description of equipment

4.1 Overview

The temporary test system used for the interference test is described in Geosigma quality plan (“Kvalitetsplan för SKB uppdrag – Hydrauliskt interferenstest med hammarborrhål HFM14 som pumphål, K586087, Kristoffer Gokall-Norman, 2006-06-02”, Geosigma and SKB internal controlling document). The equipment in the pumping borehole, HFM14, consisted primarily of the following parts:

- A dual 4” submersible pump with submarine contact and steel pipe to the ground surface.
- Plastic hose and pipe for transporting the pumped water into the sea.
- 1 pressure transducer in the borehole.
- Flow meter at the surface.
- Data logger to sample data from the flow meter and the pressure transducer.
- Flow rate control valve at the surface.
- PC to visualize the data.

All the observation sections included in the interference test are part of the SKB hydro monitoring system (HMS), where pressure is recorded continuously.

The estimated lower and upper practical measurement limits for the actual equipment used for the interference test, expressed in terms of specific flow (Q/s), are Q/s-L=$2\cdot10^{-6}$ m^2/s and Q/s-U=$2\cdot10^{-2}$ m^2/s, respectively.

4.2 Measurement sensors

Technical data of the sensors used together with estimated data specifications of the test system for pumping tests are given in Table 4-1.

Table 4-1. Technical data of measurement sensors used as well as estimated data specifications of the test system for pumping tests (based on current laboratory and field experiences).

Technical specification Parameter		Unit	Sensor	Test system	Comments
p-absolute	Output signal	mA	4–20		Depending on uncertainties of the sensor position
	Meas. range	kPa	0–1,500		
	Resolution	kPa	0.05		
	Accuracy	kPa	±1.5 *	±10	
Flow rate (surface)	Output signal	mA	4–20		Passive
	Meas. range	L/min	1–1,000	1 – c. 600	Pumping tests
	Resolution	L/min	0.1	1	
	Accuracy	% o.r.**	± 0.5	± 0.5	

* Includes hysteresis, linearity and repeatability.

** Maximum error in % of actual reading (% o.r.).

Table 4-2 shows the type and position for each transducer used in the test. Positions are given in metre from reference point, i.e. top of casing (ToC).

Table 4-2. Type and position of pressure sensors (position from ToC) used in the interference test in HFM14.

Borehole information				Sensors	
ID	Test interval (m)	Test configuration	Test type[1)]	Type	Position (m b ToC)
HFM14	0–150	Open borehole	1B	P-absolute	23.5
HFM15	0–84	Above packer	2	HMS	29.8
”	85–95	Below packer	2	HMS	29.8
KFM05A	0–114	Above packer	2	HMS	39.3
	115–253	Between packers	2	HMS	39.3
	254–272	Between packers	2	HMS	39.3
	273–489	Between packers	2	HMS	39.3
	490–698	Between packers	2	HMS	39.3
	699–1,002	Below packer	2	HMS	39.3
HFM19	0–103	Above packer	2	HMS	29.8
”	104–167	Between packers	2	HMS	29.8
”	168–182	Below packer	2	HMS	29.8
HFM13	0–100	Above packer	2	HMS	29.8
”	101–158	Between packers	2	HMS	29.8
”	159–173	Below packer	2	HMS	29.8
KFM01C	0–58	Above packer	2	HMS	29.8
	59–237	Between packers	2	HMS	29.8
	238–450	Below packer	2	HMS	29.8
HFM01	0–200	Open borehole	2	HMS	10.0
KFM01A	0–108	Above packer	2	HMS	39.3
”	109–130	Between packers	2	HMS	39.3
”	131–204	Between packers	2	HMS	39.3
”	205–373	Between packers	2	HMS	39.3
”	374–430	Between packers	2	HMS	39.3
”	431–1,002	Below packer	2	HMS	39.3
KFM01D [2)]	0–800	–	–	–	–
KFM01B	0–100	Above packer	2	HMS	29.3
”	101–141	Between packers	2	HMS	29.3
”	142–500	Below packer	2	HMS	29.3
HFM32	0–25	Above packer	2	HMS	39.3
	26–31	Between packers	2	HMS	39.3
	32–97	Between packers	2	HMS	39.3
	98–203	Below packer	2	HMS	39.3
HFM03	0–18	Above packer	2	HMS	29.3
”	19–26	Below packer	2	HMS	29.3
HFM02	0–37	Above packer	2	HMS	29.3
”	38–48	Between packers	2	HMS	29.3
”	49–100	Below packer	2	HMS	29.3
HFM27	0–24	Above packer	2	HMS	21.8
	25–45	Between packers	2	HMS	21.8
	46–58	Between packers	2	HMS	21.8
	59–128	Below packer	2	HMS	21.8

Borehole information				Sensors	
ID	Test interval (m)	Test configuration	Test type[1)]	Type	Position (m b ToC)
HFM24	0–151	Open borehole	2	HMS	15.0
KFM04A	0–168	Above packer	2	HMS	10.0
	169–1,001	Below packer	2	HMS	14.0
KFM06A	0–150	Above packer	2	HMS	39.3
	151–246	Between packers	2	HMS	39.3
	247–340	Between packers	2	HMS	39.3
	341–362	Between packers	2	HMS	39.3
	363–737	Between packers	2	HMS	39.3
	738–748	Between packers	2	HMS	39.3
	749–826	Between packers	2	HMS	39.3
	827–1,001	Below packer	2	HMS	39.3
KFM06C	0–186	Above packer	2	HMS	39.3
	187–280	Between packers	2	HMS	39.3
	281–350	Between packers	2	HMS	39.3
	351–401	Between packers	2	HMS	39.3
	402–530	Between packers	2	HMS	39.3
	531–540	Between packers	2	HMS	39.3
	541–646	Between packers	2	HMS	39.3
	647–666	Between packers	2	HMS	39.3
	667–872	Between packers	2	HMS	39.3
	873–1,001	Below packer	2	HMS	39.3
KFM06B	0–26	Above packer	2	HMS	23.8
	27–50	Between packers	2	HMS	23.8
	51–100	Below packer	2	HMS	23.8
HFM10	0–99	Above packer	2	HMS	29.3
”	100–150	Below packer	2	HMS	29.3
HFM16	0–53	Above packer	2	HMS	39.3
	54–67	Between packers	2	HMS	39.3
	68–132	Below packer	2	HMS	39.3
HFM09	0–50	Open borehole	2	HMS	5.0
KFM07B	0–299	Open borehole	2	HMS	10.0
HFM21	0–202	Open borehole	2	HMS	15.0
KFM07A [2)]	0–1,002	Open borehole	–	–	–
KFM09B [2)]	0–616	Open borehole	–	–	–
HFM22	0–222	Open borehole	2	HMS	15.0
HFM20	0–48	Above packer	2	HMS	39.3
”	49–100	Between packers	2	HMS	39.3
”	101–130	Between packers	2	HMS	39.3
”	131–301	Below packer	2	HMS	39.3
KFM08A [1)]	0–1,001	Open borehole	–	–	–
KFM08B	0–70	Above packer	2	HMS	29.8
	71–112	Between packers	2	HMS	29.8
	113–200	Below packer	2	HMS	29.8
HFM25 [1)]	0–188	Open borehole	–	–	–
KFM09A [1)]	0–800	Open borehole	–	–	–
HFM28	0–151	Open borehole	2	HMS	10.0

Borehole information				Sensors	
ID	Test interval (m)	Test configuration	Test type[1)]	Type	Position (m b ToC)
HFM23	0–212	Open borehole	2	HMS	15.0
HFM29	0–200	Open borehole	2	HMS	10.0
HFM17	0–211	Open borehole	2	HMS	10.0
KFM02A	0–132	Above packer	2	HMS	39.3
”	133–240	Between packers	2	HMS	39.3
”	241–410	Between packers	2	HMS	39.3
”	411–442	Between packers	2	HMS	39.3
”	443–489	Between packers	2	HMS	39.3
”	490–518	Between packers	2	HMS	39.3
”	519–888	Between packers	2	HMS	39.3
”	889–1,002	Below packer	2	HMS	39.3
HFM05	0–200	Open borehole	2	HMS	15.0
HFM04	0–57	Above packer	2	HMS	29.3
”	58–66	Between packers	2	HMS	29.3
”	67–222	Below packer	2	HMS	29.3
HFM12	0–56.5	Above packer	2	HMS	39.3
	57.5–210	Below packer	2	HMS	39.3
HFM11	0–53	Above packer	2	HMS	39.3
”	54–182	Below packer	2	HMS	39.3
HFM18	0–27	Above packer	2	HMS	24.8
”	28–41	Between packers	2	HMS	24.8
”	42–180	Below packer	2	HMS	24.8
KFM10	0–400	Above packer	2	HMS	9.4
”	401–500	Below packer	2	HMS	13.4

1) 1B: Pumping test-submersible pump, 2: Interference test (observation borehole during pumping in another borehole).

2) Section not used during the interference test in HFM14.

5 Execution

5.1 Preparations

A simple two point calibration of the pressure transducer that was used in the pumping borehole, was conducted just prior to start of pumping. The flow meter was calibrated in May, 2004 but a change of measurement interval made it necessary to do an adjustment of the calibration constants in situ. Manual measurements made in the field showed that the flow meter was accurate. Before the tests, function checks and cleaning of equipment were performed according to the Activity Plan.

5.2 Procedure

The interference test in HFM14 was carried out as a constant flow rate test followed by a subsequent pressure recovery period. The pressure interference was recorded in totally 105 sections in 36 observation boreholes, both cored and percussion drilled boreholes, all part of the HMS (Hydro Monitoring System). The flow rate in the pumping borehole was chosen based on the results from earlier pumping tests and flow logging in HFM14, /1/. It was not possible to perform a standard capacity test in the pumping borehole prior to the start of the test. Instead, the fine tuning of the flow rate had to be done during the initial time of the interference test. The flow rate was manually adjusted by a control valve and monitored by an electromagnetic flow meter. The data logger sampled data at a suitable frequency determined by the operator, see Table 5-1. Pumping in HFM14 was carried out using two coupled 4” submersible pumps during a period of c. 21 days. The subsequent pressure recovery was measured for c. 6 days.

The discharged water from the pumping borehole was led into the sea approximately 80 m east of HFM14.

In HFM14, the absolute pressure transducer connected to the data-logger was attached to the pump pipe approximately 23.5 m below top of casing. The transducers were connected directly to the data logger via cables. In the observation boreholes the hydro monitoring system was utilized for pressure registration.

Approximate sampling intervals for flow rate and pressure in the pumping borehole HFM14 are presented in Table 5-1. During the first hours of pumping the sampling frequency was adjusted manually and Table 5-1 reflects only the character of the changes of frequency intervals. After the stop of pumping the sampling frequency was automatically changed in accordance with Table 5-1.

Table 5-1. Approximate sampling intervals used for pressure registration in HFM14 during the interference test in HFM14.

Time interval (s) from start/stop of pumping	Sampling interval (s)
1–300	1
301–600	10
601–3,600	60
> 3,600	300
> 3,600 [1)]	600

[1)] The 600 s sampling interval was used during recovery instead of the 300 s interval.

The observation boreholes are either fitted with removable miniTroll transducers equipped with an attached logger or with stationary equipment for measuring pressure in the different sections. The miniTroll transducers were logging a pressure value with the standard frequency of one reading every two hours. In addition, logging was done in case there was a pressure change of at least 0.1 m since the last logging. The stationary installations were set to automatically log once every 5 minutes and conditionally at a pressure change of 0.01 m.

A second shorter interference test was also performed in September of 2006. The reason for this was to be able to get information from the observation borehole KFM10A which was not fitted with any pressure transducers during the first test. The flow control valve was set in the same position as in the first test and a manual measurement of the flow rate just prior to the stop of pumping showed that the flow rate was comparable with that from the first interference test even though the flow meter was out of order for the entire second test.

5.3 Data handling

Flow and pressure data from the pumping borehole, HFM14, were downloaded from the logger (Campbell CR 5000) to a laptop running the program PC9000 and are, already in the logger, transformed to engineering units. All files are comma–separated (*.DAT) when copied to a computer. A list of the data files from the data logger is shown in Appendix 1.

5.4 Analyses and interpretation

When performed, both qualitative and quantitative analyses have been carried out in accordance with the methodology descriptions for interference tests, SKB MD 330.003, and are reported in Chapter 6 below. Methods for constant-flow rate tests in an equivalent porous medium were used by the analyses and interpretation of the tests.

The main objective of the interference test was to document how different fracture zones are connected hydraulically, to quantify their hydraulic properties and to clarify whether there are any major hydraulic boundaries in the area. Quantitative evaluation of five selected observation sections was also included in the commission. One section in each of the boreholes HFM13: 159–173 m, KFM06A: 341–362 m, KFM02A: 411–442 m, KFM02A: 490–518 m and KFM04A: 169–1,001 m was chosen for analyses with regard to transmissivity and storativity. Other borehole sections included in the interference tests were only qualitatively analysed, mainly by means of the response analysis reported in section 6 below.

Data from all available observation sections were used in the primary qualitative analyses. The qualitative analysis of the responses in interference test in HFM14 was primarily based on time versus pressure diagrams together with response diagrams. Linear diagrams of pressure versus time for all test sections are presented in Chapter 6 for each borehole included in the test.

For the five selected observation sections the dominating flow regimes (pseudo-linear, pseudo-radial and pseudo-spherical flow, respectively) and possible outer boundary conditions were identified. In particular, pseudo-radial flow is reflected by a constant (horizontal) derivative in the diagrams, whereas no-flow- and constant head boundaries are characterized by rapid increase and decrease of the derivative, respectively.

Different values were applied on the filter coefficient (step length) by the calculation of the pressure derivative to investigate the effect of this coefficient on the derivative. It is desired to achieve maximum smoothing of the derivative without altering the original shape of the data.

Quantitative evaluation was only undertaken of the responses in the five above mentioned selected observation sections, HFM13: 159–173 m, KFM06A: 341–362 m, KFM02A: 411–442 m, KFM02A: 490–518 m and KFM04A: 169–1,001 m. The sections were selected based on the results of the preliminary qualitative analyses (response analysis) and for comparison with results produced by tracer dilution tests. In addition, the response in the pumping borehole HFM14 was evaluated as a single-hole pumping test according to the methods described in /30/.

The quantitative transient analysis was performed by a special version of the test analysis software AQTESOLV that enables both visual and automatic type curve matching. The transient evaluation was carried out as an iterative process of type curve matching and automatic non-linear regression. The quantitative, transient interpretation of the hydraulic parameters (transmissivity and storativity) is normally based on the identified pseudo-radial flow regime during the tests in log-log and lin-log data diagrams.

For the single-hole pumping test in HFM14 the storativity was calculated using an empirical regression relationship between storativity and transmissivity, see Equation (5-1), Rhén et al. (1997) /31/. Firstly, the transmissivity and skin factor were obtained by type curve matching on the data curve using a fixed storativity value of 10^{-6} according to the instruction SKB MD 320.004. From the transmissivity value obtained, the storativity was then calculated according to Equation (5-1) and the type curve matching was repeated. In most cases the change of storativity does not significantly alter the calculated transmissivity by the new type curve matching. Instead, the estimated skin factor, which is strongly correlated to the storativity using the effective borehole radius concept, is altered correspondingly.

$$S=0.0007\cdot T^{0.5} \qquad (5\text{-}1)$$

S = storativity (–)

T = transmissivity (m^2/s)

5.5 Nonconformities

- Due to the fact that no capacity test could be performed in HFM14 prior to pumping start, the adjustments to reach the intended constant flow rate took longer time than predicted.
- Six of the observation boreholes originally intended to be included in the interference test (KFM01D, KFM07A, KFM09B, KFM08A, HFM25 and KFM09A) did for various reasons not provide any pressure data and were therefore excluded from the interference test.
- In some of the observation sections, data from the pressure loggers are transmitted via radio link. In four of the boreholes fitted with such devices (HFM11, HFM12, HFM32 and HFM20) the communication was not working properly and a lot of data were therefore lost. This made analysis of these sections difficult or not possible.
- The flow meter broke down almost 6 days before stop of pumping. The flow between this time and the stop of pumping was estimated by linear regression.
- An extra pumping in HFM14 was conducted between the 8th and 11th of September to introduce a pressure interference in borehole KFM10A which was not ready for pressure measurement during the main interference test.
- Some wells, monitoring the quaternary deposits, were also included in the report that were not intended to be included from the beginning.

6 Results

6.1 Nomenclature and symbols

The nomenclature and symbols used for the results of the single-hole and interference test are according to the Instruction for analysis of single-hole injection- and pumping tests (SKB MD 320.004) and the methodology description for interference tests (SKB MD 330.003), respectively (both are SKB internal controlling documents). Additional symbols used are explained in the text.

6.2 Interference test 1 in HFM14

The start and stop of pumping occurred on July, 4 and July 25, respectively. The test stop is regarded at July 31st. After this time, some minor intermittent pumping activities were performed within the area which affected the recovery in some of the boreholes. The overall data acquisition was continued until August, 8.

During the interference test the pressure was registered in a number of cored boreholes and percussion boreholes in rock. In addition, the pressure was registered in six wells monitoring the quaternary deposits. The pressure responses in all monitored observation sections in the rock are presented in Figures 6-3 through 6-37 whereas the responses in the quaternary deposit boreholes are presented in Figure A4-1. All observation boreholes in the rock included in the test and their approximate distances to the pumping borehole HFM14 are marked in Figure 1-1. The location of the boreholes monitoring the quaternary deposit are shown in Figure A4-2. Six of the observation boreholes originally intended to be included in the interference test have for various reasons not provided any pressure data and are therefore excluded from the interference test. These sections, KFM01D, KFM07A, KFM09B, KFM08A, HFM25 and KFM09A, are still included in tables in this report even though pressure data are not presented for these sections.

Visual inspection of the pressure responses in the observation sections, presented in Figures 6-3 through 6-37, indicates that significant responses were registered in c. 65% of the 105 observation sections included in the interference test. 28 sections were completely unaffected during the time of the interference test. The measured drawdowns (s_p) at the end of the flow period and the estimated response time lags (dt_L) in all of the observation sections are shown in Tables 6-114 and 6-115, respectively. The response time is defined as the time lag after start of pumping until a drawdown response of 0.01 m was observed in the actual observation section.

All pressure data presented in this report have been corrected for atmospheric pressure changes by subtracting the latter pressure from the measured (absolute) pressure. This is also true for the data received from the HMS. It should be observed that no further corrections of the measured drawdown have been made, e.g. due to natural trends, precipitation, tidal effects etc, as discussed below. All times presented are Swedish summer times, i.e. adjustment for daylight saving time has been made for any reported times.

During the interference test, approximately 10 mm of total precipitation (c. 4 mm during the flow period) was reported at two stations in the vicinity of the boreholes included in the test, see Figure A2-10. In the figure the start and stop times of the interference test and flow period are marked. Most of the rain fell on two occasions but no evidence that the precipitation has significantly influenced the pressure in the observation boreholes has been noted. There is however a possibility that the recovery has been affected to some extent due to the precipitation even though it is not apparent. In the figure also the air pressure together with the sea-water level from one station in the vicinity of the investigation area during the interference test period are included.

There are strong indications of a natural trend of decreasing groundwater pressure during the entire hydraulic interference test period. At the end of the recovery period, the pressure in many observation sections had not returned to the levels that prevailed prior to the start of pumping and the decreasing natural trend continued. This effect can be observed in, for instance, Figure 6-6. The effect may not be as strong as is indicated by Figure 6-6 since the pressure might have continued to rise, had the recovery time been long enough. The length of the recovery period, however, was controlled by other activities in the area that disturbed the pressure in the observation sections, cf. Figure 6-6.

No correction for the natural decreasing pressure trend has been done in the preliminary qualitative response analysis described in the main report. Corrected head and drawdown data for the natural trend together with the correction procedure are presented in Appendix 5. The natural trend is different in each observation section. The strength of some of the responses described in the response analysis below is thus overestimated due to the natural decreasing trend. However, in the quantitative transient analysis of the responses in the five selected observation sections corrections for the natural trend were made, see Section 6.5.

The pressure in several of the observation sections included in the interference test was displaying an oscillating behaviour. This is believed to be naturally caused by so called tidal fluctuations or earth tides in combination with changes of the sea water level. These phenomena have, to some extent, been investigated previously in /32/. This effect can be observed, for instance, in many sections in borehole KFM06A, Figure 6-17a and 6-17b. This effect will not be further commented on in every section in which it appears. Only on some occasions where it is unusually strong or if it affects the analysis will it be commented on.

In the transient evaluation of the responses in the pumping borehole and selected observation sections, the models described in /33/ and /34/ respectively were used. Due to the variable flow rate during the first c. 2 hours of pumping and then again about two days into the flow period, the tests were analysed as variable flow rate tests by the transient evaluation.

6.2.1 Pumping borehole HFM14: 0–150 m

General test data for the pumping test in HFM14 are presented in Table 6-1. According to Table 3-1, the borehole is cased to 6.0 m. The uncased interval of this section is thus c. 6–150 m.

Comments on the test

The test was performed as a constant-flow rate pumping test. The mean flow rate was c. 341 L/min and the duration of the flow period was c. 21 days. An approximately constant flow rate was reached after c. 2 hours. About 39 hours into the flow period the pressure suddenly drops (cf. Figure 6-1), probably due to formation properties although no real explanation has been found. Small changes in pressure or flow rate can be identified also later in the flow period, nothing to the same extent however, and the dominating appearance is a slowly decreasing trend that lasts for the entire flow period. The adjustment to reach a suitable flow rate was made complicated by the fact that no capacity test in the borehole was possible prior to the test. About 15.5 days into the pumping period the flow meter breaks down. The flow rate from this moment until the end of the pumping has been estimated by linear extrapolation. The final drawdown in HFM14 was approximately 12 m. The pressure recovery was measured for almost 6 days. Overviews of the flow rate and pressure responses in HFM14 are presented in Figures 6-1 and 6-2. The pressure responses in log-log and lin-log diagrams during the flow period are presented in Figures A2-1 and A2-2 in Appendix 2. In Figures A2-3 and A2-4, log-log and lin-log diagrams of the recovery period are shown.

Table 6-1. General test data for the pumping test in HFM14: 0–150 m.

General test data			
Pumping borehole	HFM14		
Test type[1)]	Constant Rate withdrawal and recovery test		
Test section (open borehole/packed-off section):	open borehole		
Test No	1		
Field crew	(GEOSIGMA AB)		
Test equipment system			
General comment	Interference test		
	Nomenclature	**Unit**	**Value**
Borehole length	L	m	150.50
Casing length	L_c	m	6.00
Test section – secup	Secup	m	6.00
Test section – seclow	Seclow	m	150.50
Test section length	L_w	m	144.50
Test section diameter[2)]	$2 \cdot r_w$	mm	136–138
Test start (start of pressure registration)		yymmdd hh:mm	060704 10:06
Packer expanded		yymmdd hh:mm:ss	
Start of flow period		yymmdd hh:mm:ss	060704 10:06:40
Stop of flow period		yymmdd hh:mm:ss	060725 14:11:24
Test stop (stop of pressure registration)		yymmdd hh:mm	060731 06:00
Total flow time	t_p	min	30485
Total recovery time	t_F	min	8149
Pressure data			
Relative pressure in test section before start of flow period	p_i	kPa	162.74
Relative pressure in test section before stop of flow period	p_p	kPa	44.77
Relative pressure in test section at stop of recovery period	p_F	kPa	156.51
Pressure change during flow period (p_i–p_p)	dp_p	kPa	117.97
Flow data			
Flow rate from test section just before stop of flow period [3)]	Q_p	m^3/s	0.00568
Mean (arithmetic) flow rate during flow period	Q_m	m^3/s	0.00580
Total volume discharged during flow period	V_p	m^3	10600
Manual groundwater level measurements in HFM14 (6.0–150.5 m)	GW level		

Date YYYY-MM-DD	Time tt:mm	Time (min)	(m b. ToC)	(m.a.s.l.)
2006-06-30	16:44	–5362	4.16	0.32

1) Constant Head injection and recovery or Constant Rate withdrawal and recovery.

2) Nominal diameter.

3) The flow meter was out of order for the last days and the number given is an estimation of the actual flow.

Interpreted flow regimes

During the flow period, WBS is indicated during the first c. 60 seconds, although the data are quite scattered. Between approximately 100 and 1,000 s, a short period of pseudo-radial flow is believed to be present. From c. 10^5 s and throughout the flow period a pseudo-spherical flow regime is dominating.

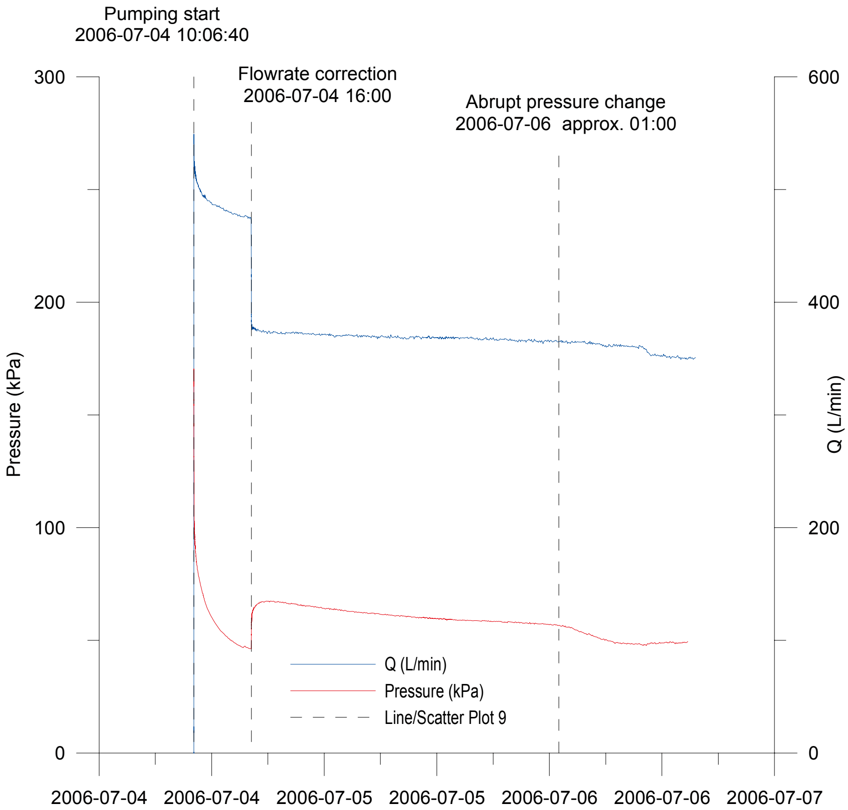


Figure 6-1. *Linear plot of flow rate and pressure versus time in the pumping borehole HFM14 during the first few days of pumping.*

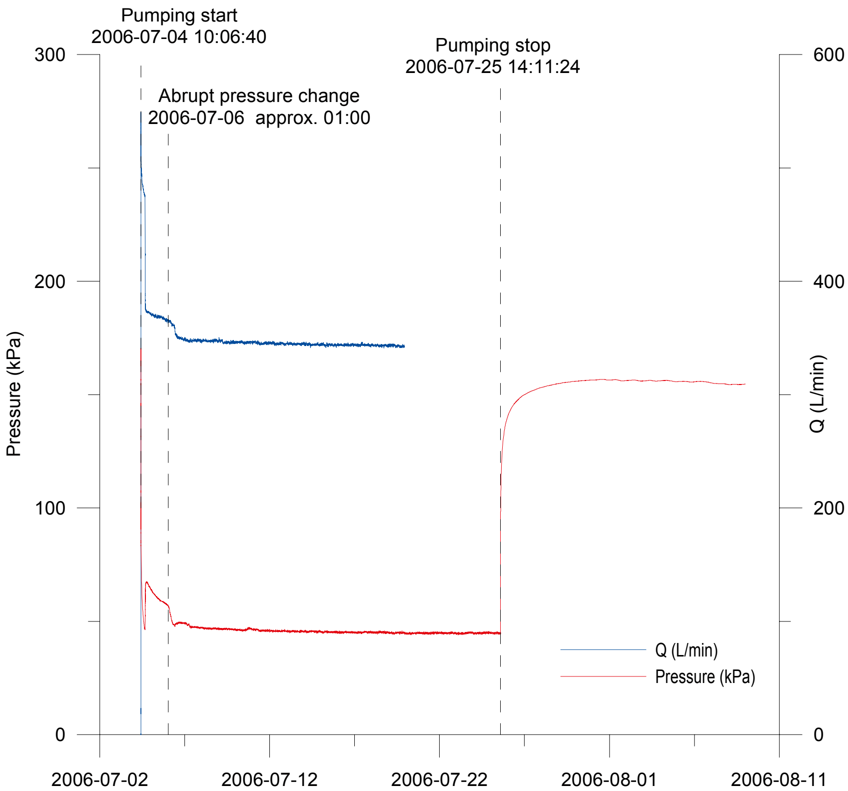


Figure 6-2. *Linear plot of flow rate and pressure versus time in the pumping borehole HFM14 during the entire interference test in HFM14.*

During the recovery period, a possible period of PRF between c. 2,000 and 20,000 s is present. A transition period, probably into a PSF, is following the period of pseudo-radial flow and lasts until the end of the pumping phase.

Interpreted parameters

Transient, quantitative interpretation of the flow period is shown in log-log and lin-log diagrams in Figures A2-1 and A2-2 and of the recovery period in Figures A2-3 and A2-4, all in Appendix 2. The results from the transient evaluation of the single-hole pumping test in HFM14 are summarized in Table 6-119 and in the Test Summary Sheet.

6.2.2 Observation section HFM15: 0–84 m

In Figure 6-3 an overview of the pressure responses in observation borehole HFM15 is shown. General test data from the observation section HFM15, 0–84 m, are presented in Table 6-2. According to Table 3-1, the borehole is cased to 6.0 m. The uncased interval of this section is thus c. 6–84 m.

Comments on the test

A very quick response to pumping is indicated in this section. The total drawdown during the flow period was c. 8.4 m. A drawdown of 0.01 m was reached approximately 2 seconds after start of pumping in HFM14. There was a total recovery of c. 7.8 m during the recovery period lasting for approximately 6 days. The sudden drop of pressure that was observed in the pumping borehole can also be clearly seen in this section.

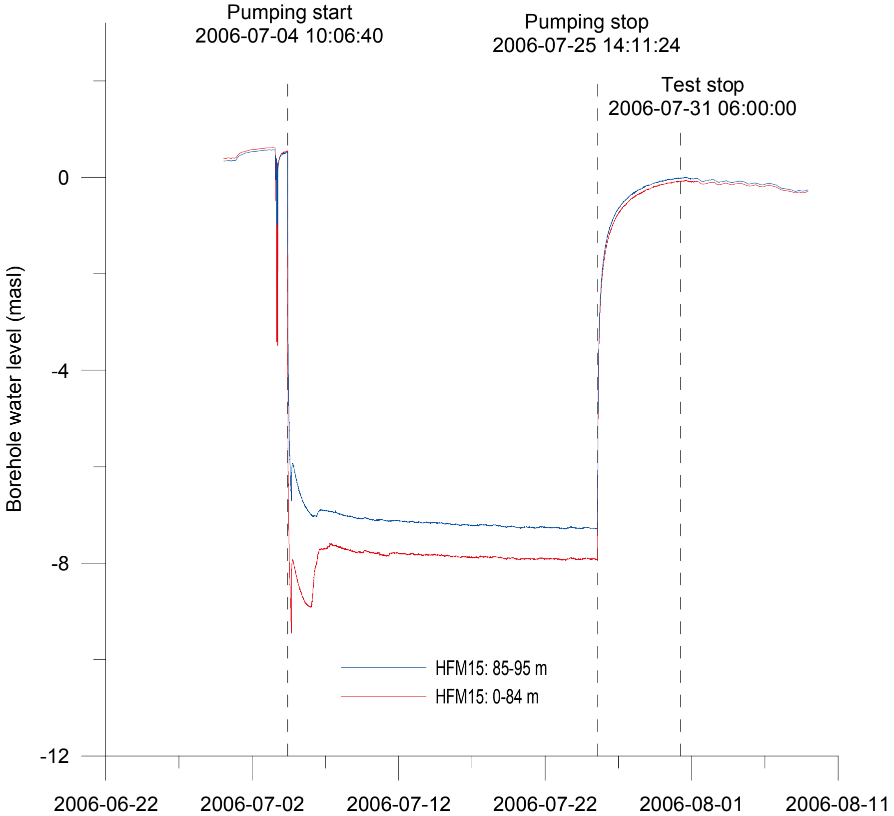


Figure 6-3. *Linear plot of pressure versus time in the observation sections in HFM15 during the interference test in HFM14.*

Table 6-2. General test data from the observation section HFM15: 0–84 m during the interference test in HFM14.

Pressure data	Nomenclature	Unit	Value
Hydraulic head in test section before start of flow period	h_i	m.a.s.l.	0.48
Hydraulic head in test section before stop of flow period	h_p	m.a.s.l.	–7.93
Hydraulic head in test section at stop of recovery period	h_F	m.a.s.l.	–0.08
Hydraulic head change during flow period (h_i–h_p)	dh_p	m	8.41

6.2.3 Observation section HFM15: 85–95 m

In Figure 6-3 an overview of the pressure responses in observation borehole HFM15 is shown. General test data from the observation section HFM15, 85–95 m, are presented in Table 6-3.

Comments on the test

A very quick response to pumping is indicated in this section. The total drawdown during the flow period was c. 7.8 m. A drawdown of 0.01 m was reached approximately 5 seconds after start of pumping in HFM14. There was a total recovery of c. 7.3 m during the recovery period lasting for approximately 6 days. The sudden drop of pressure that was observed in the pumping borehole is also clearly visible in this section.

6.2.4 Observation section KFM05A: 0–114 m

In Figure 6-4 an overview of the pressure responses in observation borehole KFM05A is shown. General test data from the observation section KFM05A, 0–114 m, are presented in Table 6-4. According to Table 3-1, the borehole is cased to 100.07 m. The uncased interval of this section is thus c. 100–114 m.

Comments on the test

A clear response to pumping was recorded in this section. The total drawdown during the flow period was c. 5.5 m. A drawdown of 0.01 m was reached approximately 60 seconds after the pumping started in HFM14. There was a total recovery of c. 5.1 m during the recovery period lasting for approximately 6 days.

Table 6-3. General test data from the observation section HFM15: 85–89 m during the interference test in HFM14.

Pressure data	Nomenclature	Unit	Value
Hydraulic head in test section before start of flow period	h_i	m.a.s.l.	0.52
Hydraulic head in test section before stop of flow period	h_p	m.a.s.l.	–7.28
Hydraulic head in test section at stop of recovery period	h_F	m.a.s.l.	–0.02
Hydraulic head change during flow period (h_i–h_p)	dh_p	m	7.80

Table 6-4. General test data from the observation section KFM05A: 0–114 m during the interference test in HFM14.

Pressure data	Nomenclature	Unit	Value
Hydraulic head in test section before start of flow period	h_i	m.a.s.l.	0.11
Hydraulic head in test section before stop of flow period	h_p	m.a.s.l.	–5.36
Hydraulic head in test section at stop of recovery period	h_F	m.a.s.l.	–0.28
Hydraulic head change during flow period (h_i–h_p)	dh_p	m	5.47

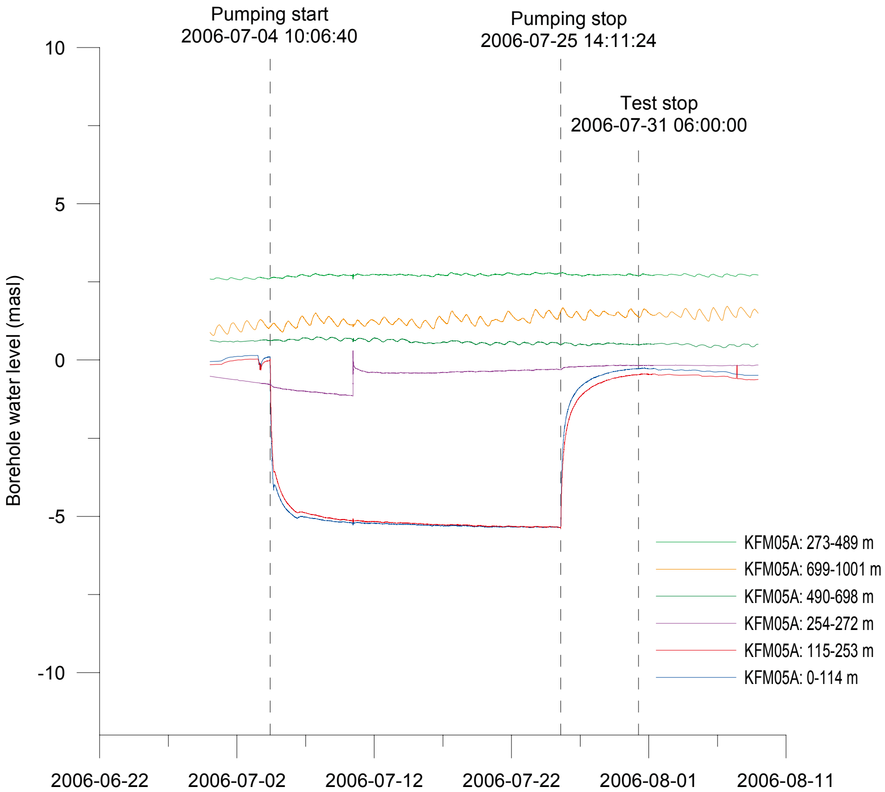


Figure 6-4. *Linear plot of pressure versus time in the observation sections in KFM05A during the interference test in HFM14.*

6.2.5 Observation section KFM05A: 115–253 m

In Figure 6-4 an overview of the pressure responses in observation borehole KFM05A is shown. General test data from the observation section KFM05A, 115–253 m, are presented in Table 6-5.

Comments on the test

A clear response to pumping was detected also in this section. The total drawdown during the flow period was c. 5.4 m. A drawdown of 0.01 m was reached approximately 6 minutes after the pumping started in HFM14. There was a total recovery of c. 4.9 m during the recovery period lasting for approximately 6 days.

6.2.6 Observation section KFM05A: 254–272 m

In Figure 6-4 an overview of the pressure responses in observation borehole KFM05A is shown. General test data from the observation section KFM05A, 254–272 m, are presented in Table 6-6.

Table 6-5. General test data from the observation section KFM05A: 115–253 m during the interference test in HFM14.

Pressure data	Nomenclature	Unit	Value
Hydraulic head in test section before start of flow period	h_i	m.a.s.l.	0.00
Hydraulic head in test section before stop of flow period	h_p	m.a.s.l.	–5.36
Hydraulic head in test section at stop of recovery period	h_F	m.a.s.l.	–0.46
Hydraulic head change during flow period (h_i–h_p)	dh_p	m	5.36

Table 6-6. General test data from the observation section KFM05A: 254–272 m during the interference test in HFM14.

Pressure data	Nomenclature	Unit	Value
Hydraulic head in test section before start of flow period	h_i	m.a.s.l.	–0.77
Hydraulic head in test section before stop of flow period	h_p	m.a.s.l.	–0.30
Hydraulic head in test section at stop of recovery period	h_F	m.a.s.l.	–0.18
Hydraulic head change during flow period (h_i–h_p)	dh_p	m	–0.47

Comments on the test

No effects of pumping can be seen in this section. The pressure is decreasing during the first few days but the rate of decrease is similar to the rate before start of pumping. A jump to a new pressure level is also indicated which is believed to be equipment related. It is unlikely that this section is influenced by pumping in HFM14.

6.2.7 Observation section KFM05A: 273–489 m

In Figure 6-4 an overview of the pressure responses in observation borehole KFM05A is shown. General test data from the observation section KFM05A, 273–489 m, are presented in Table 6-7.

Comments on the test

No effects of pumping can be seen in this section. It is unlikely that this section is influenced by pumping in HFM14. The pressure in the test section is showing a slight oscillating behaviour. This is believed to be natural fluctuations, mainly caused by so called tidal effects which, in part, have been studied previously in /32/.

6.2.8 Observation section KFM05A: 490–698 m

In Figure 6-4 an overview of the pressure responses in observation borehole KFM05A is shown. General test data from the observation section KFM05A, 490–698 m, are presented in Table 6-8.

Table 6-7. General test data from the observation section KFM05A: 273–489 m during the interference test in HFM14.

Pressure data	Nomenclature	Unit	Value
Hydraulic head in test section before start of flow period	h_i	m.a.s.l.	2.61
Hydraulic head in test section before stop of flow period	h_p	m.a.s.l.	2.79
Hydraulic head in test section at stop of recovery period	h_F	m.a.s.l.	2.69
Hydraulic head change during flow period (h_i–h_p)	dh_p	m	–0.18

Table 6-8. General test data from the observation section KFM05A: 490–698 m during the interference test in HFM14.

Pressure data	Nomenclature	Unit	Value
Hydraulic head in test section before start of flow period	h_i	m.a.s.l.	1.07
Hydraulic head in test section before stop of flow period	h_p	m.a.s.l.	1.55
Hydraulic head in test section at stop of recovery period	h_F	m.a.s.l.	1.37
Hydraulic head change during flow period (h_i–h_p)	dh_p	m	–0.48

Comments on the test

No effects of pumping can be seen in this section. It is improbable that this section is influenced by pumping in HFM14.

6.2.9 Observation section KFM05A: 699–1,002 m

In Figure 6-4 an overview of the pressure responses in observation borehole KFM05A is shown. General test data from the observation section KFM05A, 699–1,002 m, are presented in Table 6-9.

Comments on the test

No effects of pumping can be seen in this section. It is improbable that this section is at all influenced by pumping in HFM14.

6.2.10 Observation section HFM19: 0–103 m

In Figure 6-5 an overview of the pressure responses in observation borehole HFM19 is shown. General test data from the observation section HFM19, 0–103 m, are presented in Table 6-10. According to Table 3-1, the borehole is cased to 12.04 m. The uncased interval of this section is thus c. 12–103 m.

Comments on the test

A clear response to pumping was recorded in this section. The total drawdown during the flow period was c. 6.2 m. A drawdown of 0.01 m was reached approximately 7 minutes after the pumping started in HFM14. There was a total recovery of c. 5.8 m during the recovery period that lasted for approximately 6 days. The sudden pressure decrease that was observed in the pumping borehole, HFM14, can be clearly seen also in this section.

Table 6-9. General test data from the observation section KFM05A: 699–1,002 m during the interference test in HFM14.

Pressure data	Nomenclature	Unit	Value
Hydraulic head in test section before start of flow period	h_i	m.a.s.l.	0.62
Hydraulic head in test section before stop of flow period	h_p	m.a.s.l.	0.49
Hydraulic head in test section at stop of recovery period	h_F	m.a.s.l.	0.48
Hydraulic head change during flow period (h_i–h_p)	dh_p	m	0.13

Table 6-10. General test data from the observation section HFM19: 0–103 m during the interference test in HFM14.

Pressure data	Nomenclature	Unit	Value
Hydraulic head in test section before start of flow period	h_i	m.a.s.l.	0.64
Hydraulic head in test section before stop of flow period	h_p	m.a.s.l.	–5.59
Hydraulic head in test section at stop of recovery period	h_F	m.a.s.l.	0.22
Hydraulic head change during flow period (h_i–h_p)	dh_p	m	6.23

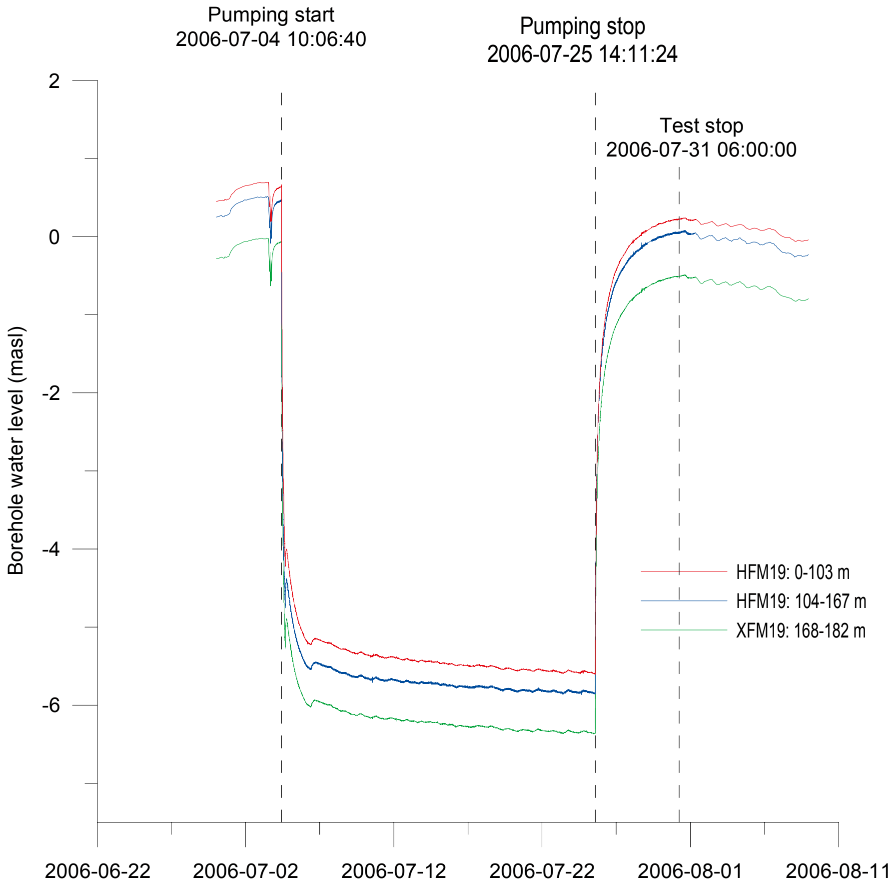


Figure 6-5. *Linear plot of pressure versus time in the observation sections in HFM19 during the interference test in HFM14.*

6.2.11 Observation section HFM19: 104–167 m

In Figure 6-5 an overview of the pressure responses in observation borehole HFM19 is shown. General test data from the observation section HFM19, 104–167 m, are presented in Table 6-11.

Comments on the test

A clear response to pumping was recorded in this section. The total drawdown during the flow period was c. 6.3 m. A drawdown of 0.01 m was reached approximately 3 minutes after the pumping started in HFM14. There was a total recovery of c. 5.9 m during the recovery period that lasted for approximately 6 days. The sudden pressure decrease that was observed in the pumping borehole, HFM14, can be clearly seen also in this section.

Table 6-11. General test data from the observation section HFM19: 104–167 m during the interference test in HFM14.

Pressure data	Nomenclature	Unit	Value
Hydraulic head in test section before start of flow period	h_i	m.a.s.l.	0.46
Hydraulic head in test section before stop of flow period	h_p	m.a.s.l.	–5.84
Hydraulic head in test section at stop of recovery period	h_F	m.a.s.l.	0.05
Hydraulic head change during flow period (h_i–h_p)	dh_p	m	6.30

6.2.12 Observation section HFM19: 168–182 m

In Figure 6-5 an overview of the pressure responses in observation borehole HFM19 is shown. General test data from the observation section HFM19, 168–182 m, are presented in Table 6-12.

Comments on the test

A clear response to pumping was recorded in this section. The total drawdown during the flow period was c. 6.3 m. A drawdown of 0.01 m was reached approximately 2 minutes after the pumping started in HFM14, which is the fastest responding section in HFM19. There was a total recovery of c. 5.8 m during the recovery period that lasted for approximately 6 days. The sudden pressure decrease that was observed in the pumping borehole, HFM14, can be clearly seen also in this section.

6.2.13 Observation section HFM13: 0–100 m

In Figure 6-6 an overview of the pressure responses in observation borehole HFM13 is shown. General test data from the observation section HFM13, 0–100 m, are presented in Table 6-13. According to Table 3-1, the borehole is cased to 14.9 m. The uncased interval of this section is thus c. 15–100 m.

Comments on the test

This section indicates a clear response to pumping in HFM14. A total drawdown during the flow period of c. 6.1 m was registered and a drawdown of 0.01 m was reached approximately 5 minutes after the pumping started in HFM14. There was a total recovery of c. 5.6 m during the recovery period that lasted for approximately 6 days. The sudden pressure decrease that was observed in the pumping borehole, HFM14, is slightly indicated also in this section.

Table 6-12. General test data from the observation section HFM19: 168–182 m during the interference test in HFM14.

Pressure data	Nomenclature	Unit	Value
Hydraulic head in test section before start of flow period	h_i	m.a.s.l.	–0.06
Hydraulic head in test section before stop of flow period	h_p	m.a.s.l.	–6.36
Hydraulic head in test section at stop of recovery period	h_F	m.a.s.l.	–0.51
Hydraulic head change during flow period (h_i–h_p)	dh_p	m	6.30

Table 6-13. General test data from the observation section HFM13: 0–100 m during the interference test in HFM14.

Pressure data	Nomenclature	Unit	Value
Hydraulic head in test section before start of flow period	h_i	m.a.s.l.	0.09
Hydraulic head in test section before stop of flow period	h_p	m.a.s.l.	–5.99
Hydraulic head in test section at stop of recovery period	h_F	m.a.s.l.	–0.34
Hydraulic head change during flow period (h_i–h_p)	dh_p	m	6.08

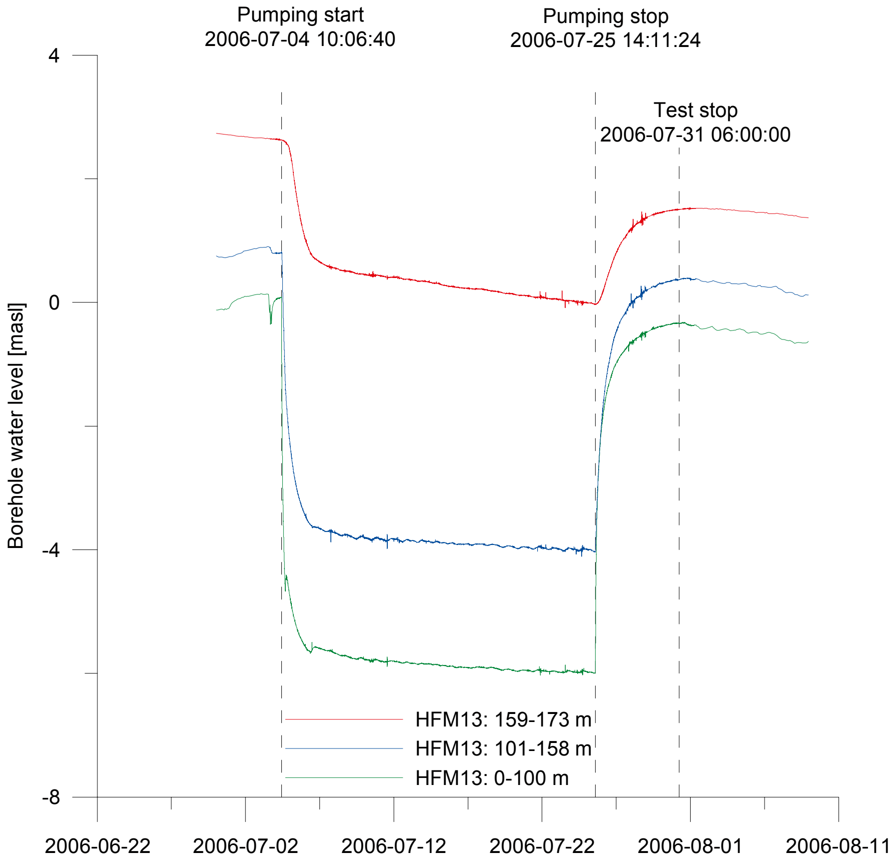


Figure 6-6. *Linear plot of pressure versus time in the observation sections in HFM13 during the interference test in HFM14.*

6.2.14 Observation section HFM13: 101–158 m

In Figure 6-6 an overview of the pressure responses in observation borehole HFM13 is shown. General test data from the observation section HFM13, 101–158 m, are presented in Table 6-14.

Comments on the test

This section also indicates a clear response to pumping in HFM14. A total drawdown during the flow period of c. 4.8 m was registered and a drawdown of 0.01 m was reached approximately 39 minutes after the pumping started in HFM14. There was a total recovery of c. 4.4 m during the recovery period that lasted for approximately 6 days.

Table 6-14. General test data from the observation section HFM13: 101–158 m during the interference test in HFM14.

Pressure data	Nomenclature	Unit	Value
Hydraulic head in test section before start of flow period	h_i	m.a.s.l.	0.81
Hydraulic head in test section before stop of flow period	h_p	m.a.s.l.	–4.02
Hydraulic head in test section at stop of recovery period	h_F	m.a.s.l.	0.37
Hydraulic head change during flow period (h_i–h_p)	dh_p	m	4.83

6.2.15 Observation section HFM13: 159–173 m

In Figure 6-6 an overview of the pressure responses in observation borehole HFM13 is shown. General test data from the observation section HFM13, 159–173 m, are presented in Table 6-15.

Comments on the test

This section also indicates a clear response to pumping in HFM14. A total drawdown during the flow period of c. 2.7 m was registered and a drawdown of 0.01 m was reached approximately 3 hours after the pumping started in HFM14. There was a total recovery of c. 1.5 m during the recovery period of approximately 6 days.

6.2.16 Observation section KFM01C: 0–58 m

In Figure 6-7 an overview of the pressure responses in observation borehole KFM01C is shown. General test data from the observation section KFM01C, 0–58 m, are presented in Table 6-16. According to Table 3-1, the borehole is cased to 11.96 m. The uncased interval of this section is thus c. 12–58 m.

Comments on the test

The pumping in HFM14 caused a clear response in this section. The total drawdown during the flow period was c. 2.8 m. A drawdown of 0.01 m was reached approximately 13 minutes after the pumping started in HFM14. There was a total recovery of c. 2.5 m during the recovery period that lasted for approximately 6 days.

Table 6-15. General test data from the observation section HFM13: 159–173 m during the interference test in HFM14.

Pressure data	Nomenclature	Unit	Value
Hydraulic head in test section before start of flow period	h_i	m.a.s.l.	2.63
Hydraulic head in test section before stop of flow period	h_p	m.a.s.l.	–0.03
Hydraulic head in test section at stop of recovery period	h_F	m.a.s.l.	1.50
Hydraulic head change during flow period (h_i–h_p)	dh_p	m	2.66

Table 6-16. General test data from the observation section KFM01C: 0–58 m during the interference test in HFM14.

Pressure data	Nomenclature	Unit	Value
Hydraulic head in test section before start of flow period	h_i	m	–979.05
Hydraulic head in test section before stop of flow period	h_p	m	–981.90
Hydraulic head in test section at stop of recovery period	h_F	m	–979.43
Hydraulic head change during flow period (h_i–h_p)	dh_p	m	2.85

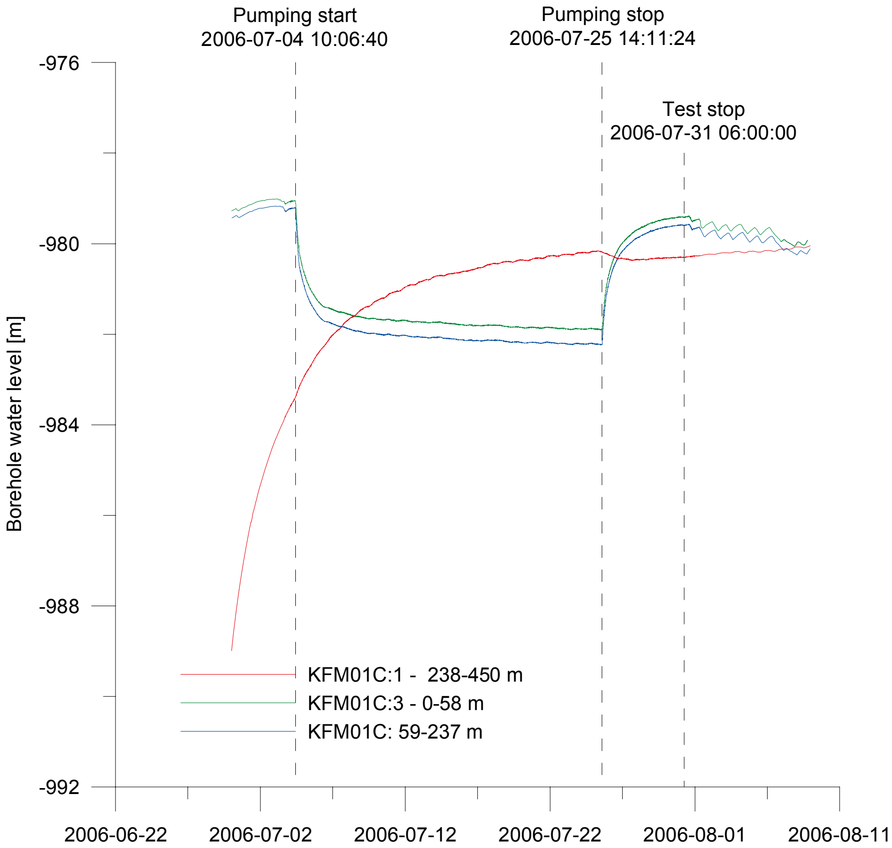


Figure 6-7. *Linear plot of pressure versus time in the observation sections in KFM01C during the interference test in HFM14.*

6.2.17 Observation section KFM01C: 59–237 m

In Figure 6-7 an overview of the pressure responses in observation borehole KFM01C is shown. General test data from the observation section KFM01C, 59–237 m, are presented in Table 6-17.

Comments on the test

The pumping in HFM14 caused a clear response in this section. The total drawdown during the flow period was c. 3.0 m. A drawdown of 0.01 m was reached approximately 10 minutes after the pumping started in HFM14. There was a total recovery of c. 2.6 m during the recovery period that lasted for approximately 6 days.

Table 6-17. General test data from the observation section KFM01C: 59–237 m during the interference test in HFM14.

Pressure data	Nomenclature	Unit	Value
Hydraulic head in test section before start of flow period	h_i	m	–979.20
Hydraulic head in test section before stop of flow period	h_p	m	–982.23
Hydraulic head in test section at stop of recovery period	h_F	m	–979.59
Hydraulic head change during flow period (h_i–h_p)	dh_p	m	3.03

6.2.18 Observation section KFM01C: 238–450 m

In Figure 6-7 an overview of the pressure responses in observation borehole KFM01C is shown. General test data from the observation section KFM01C, 238–450 m, are presented in Table 6-18.

Comments on the test

This section appears to be unaffected by the pumping in HFM14. The pressure is increasing throughout the entire test period except for a small decrease during the initial recovery period.

Table 6-18. General test data from the observation section KFM01C: 238–450 m during the interference test in HFM14.

Pressure data	Nomenclature	Unit	Value
Hydraulic head in test section before start of flow period	h_i	m	–983.40
Hydraulic head in test section before stop of flow period	h_p	m	–980.18
Hydraulic head in test section at stop of recovery period	h_F	m	–980.30
Hydraulic head change during flow period (h_i–h_p)	dh_p	m	–3.22

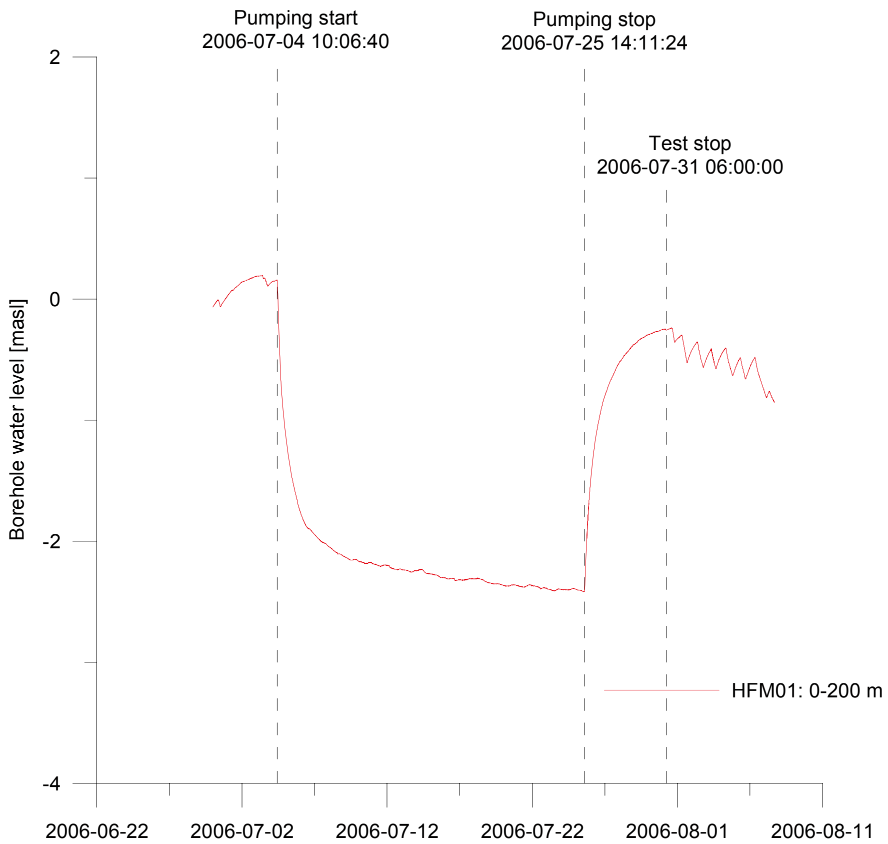


***Figure 6-8.** Linear plot of pressure versus time in the observation sections in HFM01 during the interference test in HFM14.*

6.2.19 Observation section HFM01: 0–200 m

In Figure 6-8 an overview of the pressure responses in observation borehole HFM01 is shown. General test data from the observation section HFM01, 0–200 m, are presented in Table 6-19. According to Table 3-1, the borehole is cased to 31.93 m. The uncased interval of this section is thus c. 32–200 m.

Comments on the test

The pressure response to pumping in HFM14 is clearly observed in this observation section. The total drawdown during the flow period was c. 2.6 m. A drawdown of 0.01 m was reached approximately 18 minutes after the pumping started in HFM14. There was a total recovery of c. 2.2 m during the recovery period that lasted for approximately 6 days.

6.2.20 Observation section KFM01A: 0–108 m

In Figure 6-9 an overview of the pressure responses in observation borehole KFM01A is shown. General test data from the observation section KFM01A, 0–108 m, are presented in Table 6-20. According to Table 3-1, the borehole is cased to 101.99 m. The uncased interval of this section is thus c. 102–108 m.

Comments on the test

This section appears to be affected by the pumping in HFM14. The total drawdown during the flow period was c. 0.44 m and a drawdown of 0.01 m was reached approximately 45 hours after the pumping started in HFM14. There was a total recovery of c. 0.1 m during the recovery period that lasted for approximately 6 days.

6.2.21 Observation section KFM01A: 109–130 m

In Figure 6-9 an overview of the pressure responses in observation borehole KFM01A is shown. General test data from the observation section KFM01A, 109–130 m, are presented in Table 6-21.

Table 6-19. General test data from the observation section HFM01: 0–200 m during the interference test in HFM14.

Pressure data	Nomenclature	Unit	Value
Hydraulic head in test section before start of flow period	h_i	m.a.s.l.	0.16
Hydraulic head in test section before stop of flow period	h_p	m.a.s.l.	–2.42
Hydraulic head in test section at stop of recovery period	h_F	m.a.s.l.	–0.26
Hydraulic head change during flow period (h_i–h_p)	dh_p	m	2.58

Table 6-20. General test data from the observation section KFM01A: 0–108 m during the interference test in HFM14.

Pressure data	Nomenclature	Unit	Value
Hydraulic head in test section before start of flow period	h_i	m.a.s.l.	–1.44
Hydraulic head in test section before stop of flow period	h_p	m.a.s.l.	–1.88
Hydraulic head in test section at stop of recovery period	h_F	m.a.s.l.	–1.77
Hydraulic head change during flow period (h_i–h_p)	dh_p	m	0.44

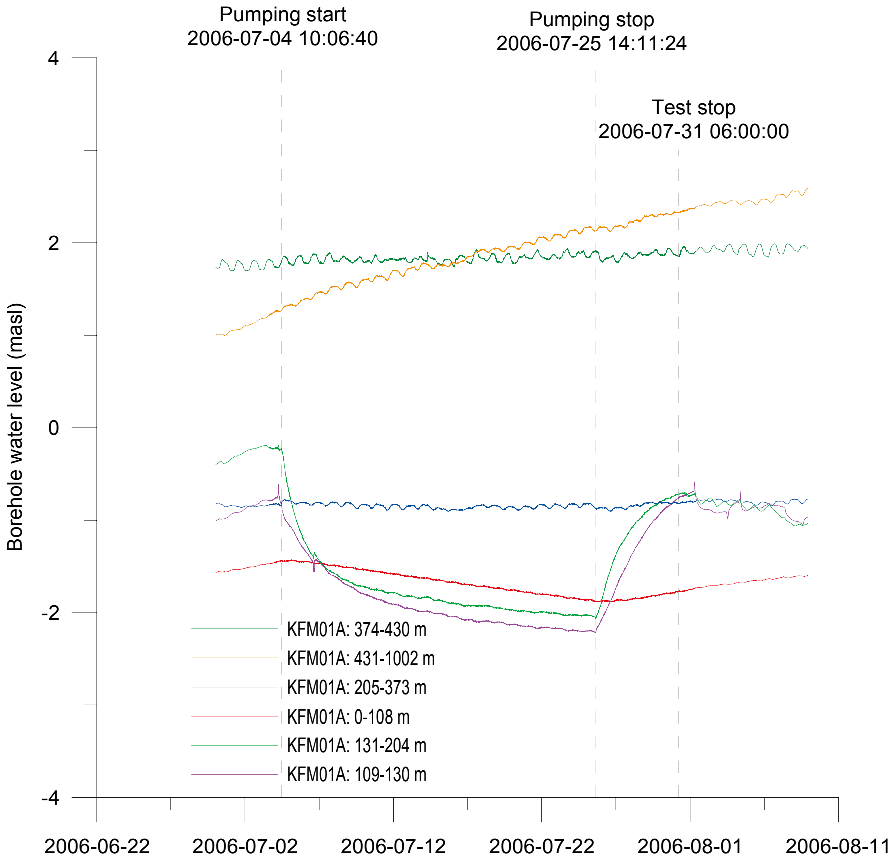


Figure 6-9. *Linear plot of pressure versus time in the observation sections in KFM01A during the interference test in HFM14.*

Table 6-21. General test data from the observation section KFM01A: 109–130 m during the interference test in HFM14.

Pressure data	Nomenclature	Unit	Value
Hydraulic head in test section before start of flow period	h_i	m.a.s.l.	–0.82
Hydraulic head in test section before stop of flow period	h_p	m.a.s.l.	–2.21
Hydraulic head in test section at stop of recovery period	h_F	m.a.s.l.	–0.75
Hydraulic head change during flow period (h_i–h_p)	dh_p	m	1.39

Comments on the test

The pressure response to pumping in HFM14 can be clearly observed in this observation section. The total drawdown during the flow period was c. 1.4 m. A drawdown of 0.01 m was reached approximately 35 minutes after the pumping started in HFM14. There was a total recovery of c. 1.5 m during the recovery period that lasted for approximately 6 days.

6.2.22 Observation section KFM01A: 131–204 m

In Figure 6-9 an overview of the pressure responses in observation borehole KFM01A is shown. General test data from the observation section KFM01A, 131–204 m, are presented in Table 6-22.

Comments on the test

The pressure response to pumping in HFM14 can be clearly observed also in this observation section. The total drawdown during the flow period was c. 1.8 m. A drawdown of 0.01 m was reached approximately 103 minutes after the pumping started. There was a total recovery of c. 1.3 m during the recovery period that lasted for approximately 6 days.

6.2.23 Observation section KFM01A: 205–373 m

In Figure 6-9 an overview of the pressure responses in observation borehole KFM01A is shown. General test data from the observation section KFM01A, 205–373 m, are presented in Table 6-23.

Comments on the test

This section appears to be virtually unaffected by the pumping in HFM14. The oscillating behaviour, discussed previously, makes it hard to isolate any possible influence from the pumping.

6.2.24 Observation section KFM01A: 374–430 m

In Figure 6-9 an overview of the pressure responses in observation borehole KFM01A is shown. General test data from the observation section KFM01A, 374–430 m, are presented in Table 6-24.

Comments on the test

This section appears to be virtually unaffected by the pumping in HFM14. The oscillating behaviour, discussed previously, makes it hard to isolate any possible influence from the pumping.

Table 6-22. General test data from the observation section KFM01A: 131–204 m during the interference test in HFM14.

Pressure data	Nomenclature	Unit	Value
Hydraulic head in test section before start of flow period	h_i	m.a.s.l.	–0.24
Hydraulic head in test section before stop of flow period	h_p	m.a.s.l.	–2.05
Hydraulic head in test section at stop of recovery period	h_F	m.a.s.l.	–0.72
Hydraulic head change during flow period (h_i–h_p)	dh_p	m	1.81

Table 6-23. General test data from the observation section KFM01A: 205–373 m during the interference test in HFM14.

Pressure data	Nomenclature	Unit	Value
Hydraulic head in test section before start of flow period	h_i	m.a.s.l.	–0.84
Hydraulic head in test section before stop of flow period	h_p	m.a.s.l.	–0.86
Hydraulic head in test section at stop of recovery period	h_F	m.a.s.l.	–0.82
Hydraulic head change during flow period (h_i–h_p)	dh_p	m	0.02

Table 6-24. General test data from the observation section KFM01A: 374–430 m during the interference test in HFM14.

Pressure data	Nomenclature	Unit	Value
Hydraulic head in test section before start of flow period	h_i	m.a.s.l.	1.78
Hydraulic head in test section before stop of flow period	h_p	m.a.s.l.	1.91
Hydraulic head in test section at stop of recovery period	h_F	m.a.s.l.	1.85
Hydraulic head change during flow period (h_i–h_p)	dh_p	m	–0.13

6.2.25 Observation section KFM01A: 431–1,002 m

In Figure 6-9 an overview of the pressure responses in observation borehole KFM01A is shown. General test data from the observation section KFM01A, 431–1,002 m, are presented in Table 6-25.

Comments on the test

This section appears to be completely unaffected by the pumping in HFM14. The pressure in the test section is increasing during the entire test.

6.2.26 Observation section KFM01D: 0-800 m

There are no test data available from the observation section KFM01D, 0–800 m.

Comments on the test

No pressure data have been retrieved from this observation section and it is therefore excluded from the interference test even though it was originally intended to be part of the test.

6.2.27 Observation section KFM01B: 0–100 m

In Figure 6-10 an overview of the pressure responses in observation borehole KFM01B is shown. General test data from the observation section KFM01B, 0–100 m, are presented in Table 6-27. According to Table 3-1, the borehole is cased to 9.09 m. The uncased interval of this section is thus c. 9–100 m.

Table 6-25. General test data from the observation section KFM01A: 431–1,002 m during the interference test in HFM14.

Pressure data	Nomenclature	Unit	Value
Hydraulic head in test section before start of flow period	h_i	m.a.s.l.	1.26
Hydraulic head in test section before stop of flow period	h_p	m.a.s.l.	2.13
Hydraulic head in test section at stop of recovery period	h_F	m.a.s.l.	2.32
Hydraulic head change during flow period (h_i–h_p)	dh_p	m	–0.87

Table 6-26. General test data from the observation section KFM01D: 0–800 m during the interference test in HFM14.

Pressure data	Nomenclature	Unit	Value
Hydraulic head in test section before start of flow period	h_i	m.a.s.l.	–
Hydraulic head in test section before stop of flow period	h_p	m.a.s.l.	–
Hydraulic head in test section at stop of recovery period	h_F	m.a.s.l.	–
Hydraulic head change during flow period (h_i–h_p)	dh_p	m	–

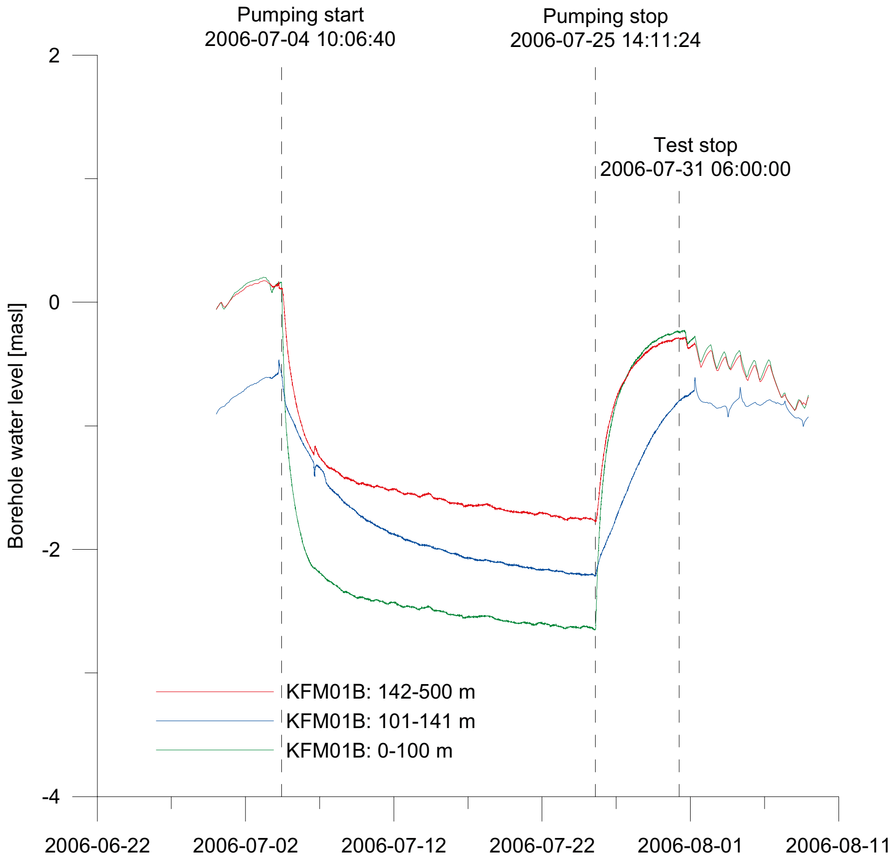


Figure 6-10. *Linear plot of pressure versus time in the observation sections in KFM01B during the interference test in HFM14.*

Table 6-27. General test data from the observation section KFM01B: 0–100 m during the interference test in HFM14.

Pressure data	Nomenclature	Unit	Value
Hydraulic head in test section before start of flow period	h_i	m.a.s.l.	0.16
Hydraulic head in test section before stop of flow period	h_p	m.a.s.l.	–2.65
Hydraulic head in test section at stop of recovery period	h_F	m.a.s.l.	–0.24
Hydraulic head change during flow period (h_i–h_p)	dh_p	m	2.81

Comments on the test

A clear response to pumping was recorded in this section. The total drawdown during the flow period was c. 2.8 m. A drawdown of 0.01 m was reached approximately 200 seconds after the pumping started in HFM14. There was a total recovery of c. 2.4 m during the recovery period that lasted for approximately 6 days.

6.2.28 Observation section KFM01B: 101–141 m

In Figure 6-10 an overview of the pressure responses in observation borehole KFM01B is shown. General test data from the observation section KFM01B, 101–141 m, are presented in Table 6-28.

Table 6-28. General test data from the observation section KFM01B: 101–141 m during the interference test in HFM14.

Pressure data	Nomenclature	Unit	Value
Hydraulic head in test section before start of flow period	h_i	m.a.s.l.	–0.57
Hydraulic head in test section before stop of flow period	h_p	m.a.s.l.	–2.21
Hydraulic head in test section at stop of recovery period	h_F	m.a.s.l.	–0.80
Hydraulic head change during flow period (h_i–h_p)	dh_p	m	1.64

Comments on the test

A clear response to pumping was recorded in this section. The total drawdown during the flow period was c. 1.6 m. A drawdown of 0.01 m was reached approximately 200 seconds after the pumping started in HFM14. There was a total recovery of c. 1.4 m during the recovery period that lasted for approximately 6 days.

6.2.29 Observation section KFM01B: 142–500 m

In Figure 6-10 an overview of the pressure responses in observation borehole KFM01B is shown. General test data from the observation section KFM01B, 142–500 m, are presented in Table 6-29.

Comments on the test

A clear response to pumping was recorded in this section. The total drawdown during the flow period was c. 1.9 m. A drawdown of 0.01 m was reached approximately 83 minutes after the pumping started in HFM14. There was a total recovery of c. 1.5 m during the recovery period that lasted for approximately 6 days.

6.2.30 Observation section HFM32: 0–25 m

In Figure 6-11 an overview of the pressure responses in observation borehole HFM32 is shown. General test data from the observation section HFM32, 0–25 m, are presented in Table 6-30. According to Table 3-1, the borehole is cased to 6.03 m. The uncased interval of this section is thus c. 6–25 m.

Table 6-29. General test data from the observation section KFM01B: 142–500 m during the interference test in HFM14.

Pressure data	Nomenclature	Unit	Value
Hydraulic head in test section before start of flow period	h_i	m.a.s.l.	0.11
Hydraulic head in test section before stop of flow period	h_p	m.a.s.l.	–1.77
Hydraulic head in test section at stop of recovery period	h_F	m.a.s.l.	–0.29
Hydraulic head change during flow period (h_i–h_p)	dh_p	m	1.88

Table 6-30. General test data from the observation section HFM32: 0–25 m during the interference test in HFM14.

Pressure data	Nomenclature	Unit	Value
Hydraulic head in test section before start of flow period	h_i	m.a.s.l.	–0.03
Hydraulic head in test section before stop of flow period	h_p	m.a.s.l.	–0.27
Hydraulic head in test section at stop of recovery period	h_F	m.a.s.l.	–0.21
Hydraulic head change during flow period (h_i–h_p)	dh_p	m	0.24

Comments on the test

A weak but rather distinct effect from the pumping in HFM14 can be seen in this section. The pressure data are not very stable though, and for long periods of time data are missing entirely. This is due to poor transmission via the radio link that is used to transfer data from the site to the HMS-data base. During the first days of drawdown a few measurements have been recorded but later on and especially during the recovery nothing can be said about the characteristics of the pressure curve. Still, an approximation of total drawdown can be made from values reported 2006-07-18. The total drawdown was at that point c. 0.2 m and a drawdown of 0.01 m was reached approximately 136 minutes into the flow period. It should be emphasised that the scattered pressure data make it very hard to define the time to reach a 0.01 m drawdown.

6.2.31 Observation section HFM32: 26–31 m

In Figure 6-11 an overview of the pressure responses in observation borehole HFM32 is shown. General test data from the observation section HFM32, 26–31 m, are presented in Table 6-31.

Table 6-31. General test data from the observation section HFM32: 26–31 m during the interference test in HFM14.

Pressure data	Nomenclature	Unit	Value
Hydraulic head in test section before start of flow period	h_i	m.a.s.l.	–0.07
Hydraulic head in test section before stop of flow period	h_p	m.a.s.l.	–0.35
Hydraulic head in test section at stop of recovery period	h_F	m.a.s.l.	–0.24
Hydraulic head change during flow period (h_i–h_p)	dh_p	m	0.28

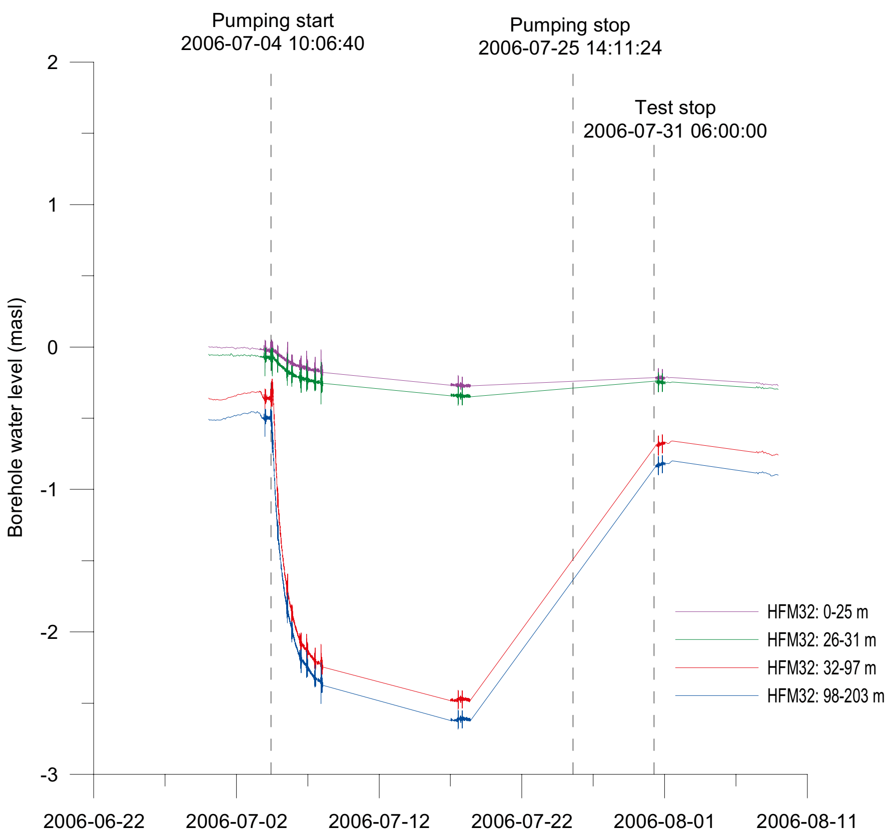


Figure 6-11. Linear plot of pressure versus time in the observation sections in HFM32 during the interference test in HFM14.

Comments on the test

A weak but rather distinct effect from the pumping in HFM14 can be seen in this section. The pressure data are not very stable though and for long periods of time data are missing entirely. This is due to poor transmission via the radio link that is used to transfer data from the site to the HMS-data base. During the first days of drawdown a few measurements have been recorded, but later on, and especially during the recovery, nothing can be said about the characteristics of the pressure curve. Still, an approximation of total drawdown can be made from values reported 2006-07-18. The total drawdown was at that point c. 0.3 m and a drawdown of 0.01 m was reached approximately 6 hours into the flow period. It should be emphasised that the scattered pressure data entail that it is very hard to define the time to reach a 0.01 m drawdown.

6.2.32 Observation section HFM32: 32–97 m

In Figure 6-11 an overview of the pressure responses in observation borehole HFM32 is shown. General test data from the observation section HFM32, 32–97 m, are presented in Table 6-32.

Comments on the test

An undisputable effect from the pumping in HFM14 can be seen in this section. The pressure data are not very stable though and for long periods of time data are missing entirely. This is due to poor transmission via the radio link that is used to transfer data from the site to the HMS-data base. During the first days of drawdown a few measurements have been recorded but later on, and especially during the recovery, nothing can be said about the characteristics of the pressure curve. Still, an approximation of total drawdown can be made from values reported 2006-07-18. The total drawdown was at that point c. 2.1 m and a drawdown of 0.01 m was reached approximately 4 hours into the flow period. It should be emphasised that the scattered pressure data render it very hard to define the time to reach a 0.01 m drawdown.

6.2.33 Observation section HFM32: 98–203 m

In Figure 6-11 an overview of the pressure responses in observation borehole HFM32 is shown. General test data from the observation section HFM32, 98–203 m, are presented in Table 6-33.

Table 6-32. General test data from the observation section HFM32: 32–97 m during the interference test in HFM14.

Pressure data	Nomenclature	Unit	Value
Hydraulic head in test section before start of flow period	h_i	m.a.s.l.	–0.35
Hydraulic head in test section before stop of flow period	h_p	m.a.s.l.	–2.48
Hydraulic head in test section at stop of recovery period	h_F	m.a.s.l.	–0.69
Hydraulic head change during flow period (h_i–h_p)	dh_p	m	2.13

Table 6-33. General test data from the observation section HFM32: 98–203 m during the interference test in HFM14.

Pressure data	Nomenclature	Unit	Value
Hydraulic head in test section before start of flow period	h_i	m.a.s.l.	–0.49
Hydraulic head in test section before stop of flow period	h_p	m.a.s.l.	–2.62
Hydraulic head in test section at stop of recovery period	h_F	m.a.s.l.	–0.84
Hydraulic head change during flow period (h_i–h_p)	dh_p	m	2.13

Comments on the test

An undisputable effect from the pumping in HFM14 can be seen in this section. The pressure data are not very stable though and for long periods of time data are missing entirely. This is due to poor transmission via the radio link that is used to transfer data from the site to the HMS-data base. During the first days of drawdown a few measurements have been recorded but later on and especially during the recovery nothing can be said about the characteristic of the pressure curve. Still, an approximation of total drawdown can be made from values reported 2006-07-18. The total drawdown was at that point c. 2.1 m and a drawdown of 0.01 m was reached approximately 1 hour into the flow period. It should be emphasised that the scattered pressure data makes it very hard to define the time to reach a 0.01 m drawdown.

6.2.34 Observation section HFM03: 0–18 m

In Figure 6-12 an overview of the pressure responses in observation borehole HFM03 is shown. General test data from the observation section HFM03, 0–18 m, are presented in Table 6-34. According to Table 3-1, the borehole is cased to 13.1 m. The uncased interval of this section is thus c. 13–18 m.

Comments on the test

The pressure response to pumping in HFM14 is clearly observed in this observation section. The total drawdown during the flow period was c. 2.7 m. A drawdown of 0.01 m was reached approximately 53 minutes after the pumping started in HFM14. There was a total recovery of c. 2.2 m during the recovery period that lasted for approximately 6 days.

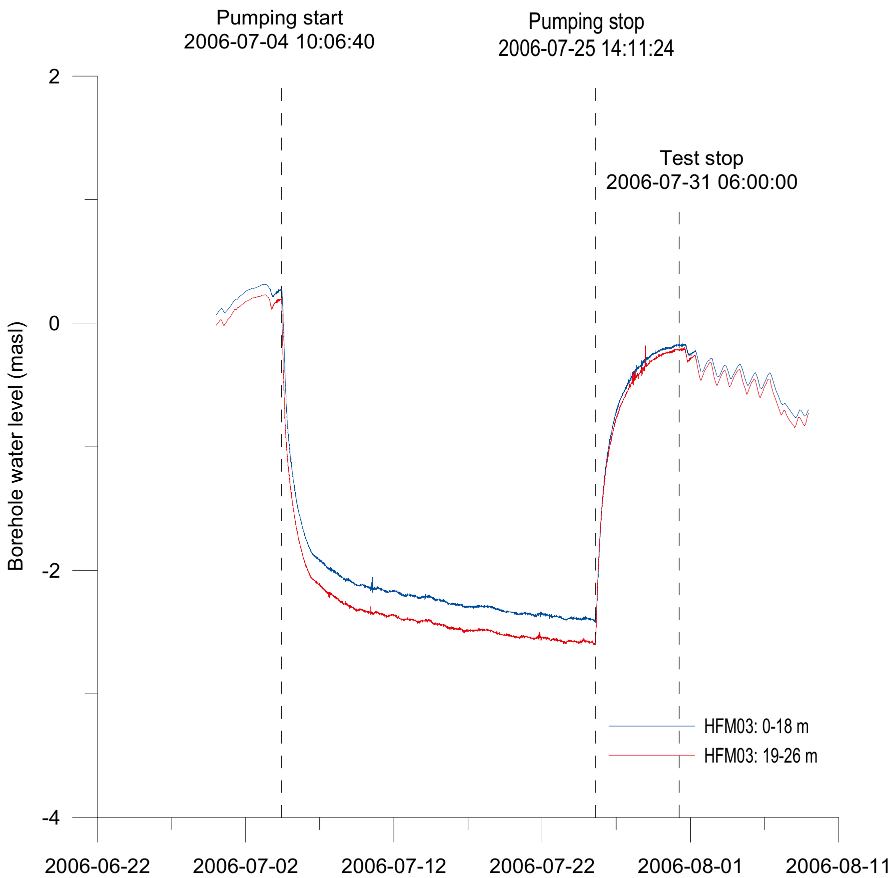


Figure 6-12. *Linear plot of pressure versus time in the observation sections in HFM03 during the interference test in HFM14.*

Table 6-34. General test data from the observation section HFM03: 0–18 m during the interference test in HFM14.

Pressure data	Nomenclature	Unit	Value
Hydraulic head in test section before start of flow period	h_i	m.a.s.l.	0.27
Hydraulic head in test section before stop of flow period	h_p	m.a.s.l.	–2.41
Hydraulic head in test section at stop of recovery period	h_F	m.a.s.l.	–0.18
Hydraulic head change during flow period (h_i–h_p)	dh_p	m	2.68

6.2.35 Observation section HFM03: 19–26 m

In Figure 6-12 an overview of the pressure responses in observation borehole HFM03 is shown. General test data from the observation section HFM03, 19–26 m, are presented in Table 6-35.

Comments on the test

A clear response to pumping was recorded in this section. The total drawdown during the flow period was c. 2.8 m. A drawdown of 0.01 m was reached approximately 23 minutes after the pumping started in HFM14. There was a total recovery of c. 2.4 m during the recovery period that lasted for approximately 6 days.

6.2.36 Observation section HFM02: 0–37 m

In Figure 6-13 an overview of the pressure responses in observation borehole HFM02 is shown. General test data from the observation section HFM02, 0–37 m, are presented in Table 6-36. According to Table 3-1, the borehole is cased to 25.4 m. The uncased interval of this section is thus c. 25–37 m.

Comments on the test

A clear response to pumping was recorded in this section. The total drawdown during the flow period was c. 2.8 m. A drawdown of 0.01 m was reached approximately 13 minutes after the pumping started in HFM14. There was a total recovery of c. 2.4 m during the recovery period that lasted for approximately 6 days.

Table 6-35. General test data from the observation section HFM03: 19–26 m during the interference test in HFM14.

Pressure data	Nomenclature	Unit	Value
Hydraulic head in test section before start of flow period	h_i	m.a.s.l.	0.19
Hydraulic head in test section before stop of flow period	h_p	m.a.s.l.	–2.60
Hydraulic head in test section at stop of recovery period	h_F	m.a.s.l.	–0.22
Hydraulic head change during flow period (h_i–h_p)	dh_p	m	2.79

Table 6-36. General test data from the observation section HFM02: 0–37 m during the interference test in HFM14.

Pressure data	Nomenclature	Unit	Value
Hydraulic head in test section before start of flow period	h_i	m.a.s.l.	0.16
Hydraulic head in test section before stop of flow period	h_p	m.a.s.l.	–2.63
Hydraulic head in test section at stop of recovery period	h_F	m.a.s.l.	–0.23
Hydraulic head change during flow period (h_i–h_p)	dh_p	m	2.79

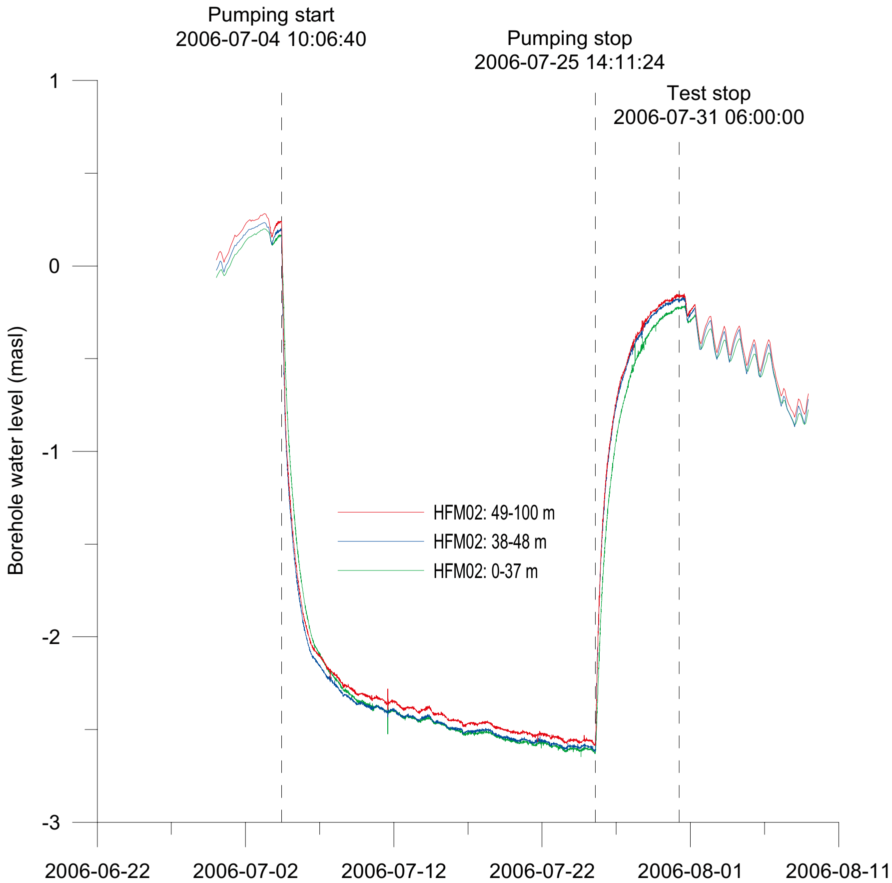


Figure 6-13. *Linear plot of pressure versus time in the observation sections in HFM02 during the interference test in HFM14.*

6.2.37 Observation section HFM02: 38–48 m

In Figure 6-13 an overview of the pressure responses in observation borehole HFM02 is shown. General test data from the observation section HFM02, 38–48 m, are presented in Table 6-37.

Comments on the test

A clear response to pumping was recorded in this section. The total drawdown during the flow period was c. 2.8 m. A drawdown of 0.01 m was reached approximately 13 minutes after the pumping started in HFM14. There was a total recovery of c. 2.4 m during the recovery period that lasted for approximately 6 days.

Table 6-37. General test data from the observation section HFM02: 38–48 m during the interference test in HFM14.

Pressure data	Nomenclature	Unit	Value
Hydraulic head in test section before start of flow period	h_i	m.a.s.l.	0.19
Hydraulic head in test section before stop of flow period	h_p	m.a.s.l.	–2.61
Hydraulic head in test section at stop of recovery period	h_F	m.a.s.l.	–0.18
Hydraulic head change during flow period (h_i–h_p)	dh_p	m	2.8

6.2.38 Observation section HFM02: 49–100 m

In Figure 6-13 an overview of the pressure responses in observation borehole HFM02 is shown. General test data from the observation section HFM02, 49–100 m, are presented in Table 6-38.

Comments on the test

A clear response to pumping was recorded in this section. The total drawdown during the flow period was c. 2.8 m. A drawdown of 0.01 m was reached approximately 16 minutes after the pumping started in HFM14. There was a total recovery of c. 2.4 m during the recovery period that lasted for approximately 6 days.

6.2.39 Observation section HFM27: 0–24 m

In Figure 6-14 an overview of the pressure responses in observation borehole HFM27 is shown. General test data from the observation section HFM27, 0–24 m, are presented in Table 6-39. It should be noted that the pressure values given in Table 6-39 are only valid for relative pressure variations. The transducers had been installed only a short time prior to the interference test and calibration to render absolute values, in metres above sea level, had not yet been performed. According to Table 3-1, the borehole is cased to 12.03 m. The uncased interval of this section is thus c. 12–24 m.

Comments on the test

This section shows a clear response to pumping in HFM14. A total drawdown during the flow period of c. 2.7 m was registered and a drawdown of 0.01 m was reached approximately 23 minutes after the pumping started in HFM14. There was a total recovery of c. 2.3 m during the recovery period that lasted for approximately 6 days.

Table 6-38. General test data from the observation section HFM02: 49–100 m during the interference test in HFM14.

Pressure data	Nomenclature	Unit	Value
Hydraulic head in test section before start of flow period	h_i	m.a.s.l.	0.24
Hydraulic head in test section before stop of flow period	h_p	m.a.s.l.	–2.58
Hydraulic head in test section at stop of recovery period	h_F	m.a.s.l.	–0.17
Hydraulic head change during flow period (h_i–h_p)	dh_p	m	2.82

Table 6-39. General test data from the observation section HFM27: 0–24 m during the interference test in HFM14.

Pressure data	Nomenclature	Unit	Value
Hydraulic head in test section before start of flow period	h_i	m	–9,980.80
Hydraulic head in test section before stop of flow period	h_p	m	–9,983.53
Hydraulic head in test section at stop of recovery period	h_F	m	–9,981.25
Hydraulic head change during flow period (h_i–h_p)	dh_p	m	2.73

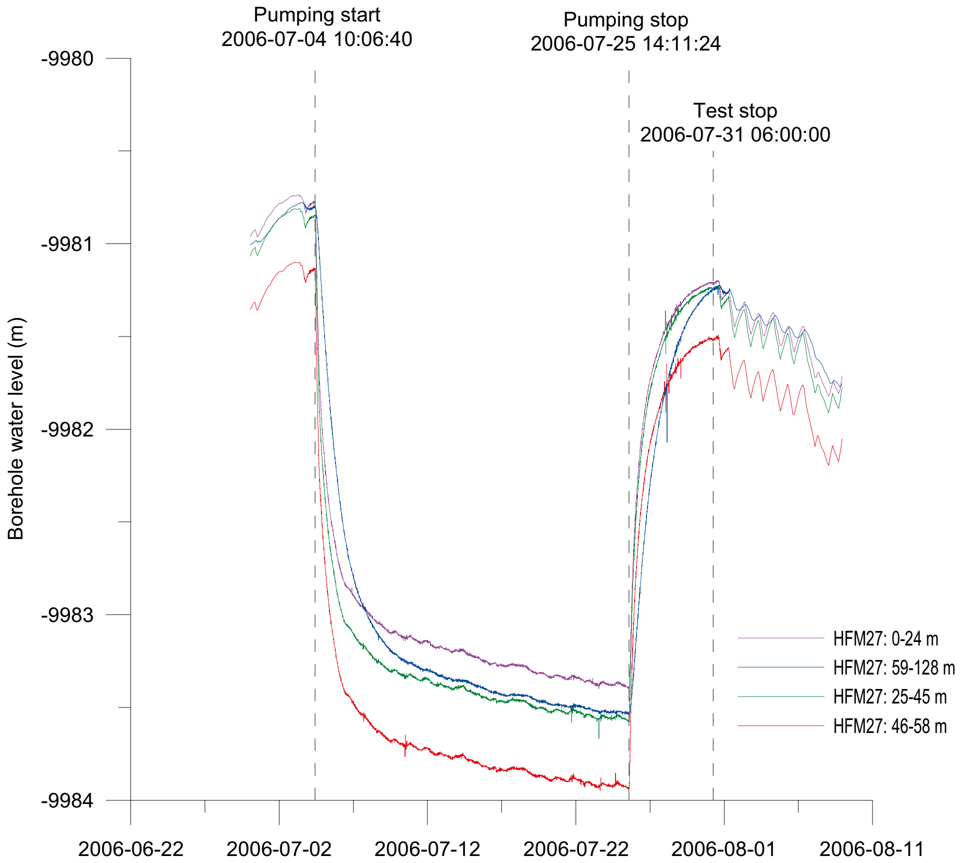


Figure 6-14. *Linear plot of pressure versus time in the observation sections in HFM27 during the interference test in HFM14.*

6.2.40 Observation section HFM27: 25–45 m

In Figure 6-14 an overview of the pressure responses in observation borehole HFM27 is shown. General test data from the observation section HFM27, 25–45 m, are presented in Table 6-40. It should be noted that the pressure values given in Table 6-40 are only valid for relative pressure variations. The transducers had been installed only a short time prior to the interference test and calibration to render absolute values, in metres above sea level, had not yet been performed.

Comments on the test

This section is also demonstrating a clear response to pumping in HFM14. A total drawdown during the flow period of c. 2.8 m was registered and a drawdown of 0.01 m was reached approximately 12 minutes after the pumping started in HFM14. There was a total recovery of c. 2.4 m during the recovery period that lasted for approximately 6 days.

Table 6-40. General test data from the observation section HFM27: 25–45 m during the interference test in HFM14.

Pressure data	Nomenclature	Unit	Value
Hydraulic head in test section before start of flow period	h_i	m	–9,981.13
Hydraulic head in test section before stop of flow period	h_p	m	–9,983.94
Hydraulic head in test section at stop of recovery period	h_F	m	–9,981.52
Hydraulic head change during flow period (h_i–h_p)	dh_p	m	2.81

6.2.41 Observation section HFM27: 46–58 m

In Figure 6-14 an overview of the pressure responses in observation borehole HFM27 is shown. General test data from the observation section HFM27, 46–58 m, are presented in Table 6-41. It should be noted that the pressure values given in Table 6-41 are only valid for relative pressure variations. The transducers had been installed only a short time prior to the interference test and calibration to render absolute values, in metres above sea level, had not yet been performed.

Comments on the test

Also this section is displaying a clear response to pumping in HFM14. A total drawdown during the flow period of c. 2.7 m was registered and a drawdown of 0.01 m was reached approximately 17 minutes after the pumping started. There was a total recovery of c. 2.3 m during the recovery period that lasted for approximately 6 days.

6.2.42 Observation section HFM27: 59–128 m

In Figure 6-14 an overview of the pressure responses in observation borehole HFM27 is shown. General test data from the observation section HFM27, 59–128 m, are presented in Table 6-42. It should be noted that the pressure values given in Table 6-42 are only valid for relative pressure variations. The transducers had been installed only a short time prior to the interference test and calibration to render absolute values, in metres above sea level, had not yet been performed.

Comments on the test

A clear response to pumping was found in this section. A total drawdown during the pumping period of c. 2.6 m was registered. A drawdown of 0.01 m was reached approximately 33 minutes after the pumping started. There was a total recovery of about 2.2 m during the recovery period that lasted for approximately 6 days.

Table 6-41. General test data from the observation section HFM27: 46–58 m during the interference test in HFM14.

Pressure data	Nomenclature	Unit	Value
Hydraulic head in test section before start of flow period	h_i	m	–9,980.85
Hydraulic head in test section before stop of flow period	h_p	m	–9,983.58
Hydraulic head in test section at stop of recovery period	h_F	m	–9,981.24
Hydraulic head change during flow period (h_i–h_p)	dh_p	m	2.73

Table 6-42. General test data from the observation section HFM27: 59–128 m during the interference test in HFM14.

Pressure data	Nomenclature	Unit	Value
Hydraulic head in test section before start of flow period	h_i	m	–9,980.77
Hydraulic head in test section before stop of flow period	h_p	m	–9,983.40
Hydraulic head in test section at stop of recovery period	h_F	m	–9,981.22
Hydraulic head change during flow period (h_i–h_p)	dh_p	m	2.63

6.2.43 Observation section HFM24: 0–151 m

In Figure 6-15 an overview of the pressure responses in observation borehole HFM24 is shown. General test data from the observation section HFM24, 0–151 m, are presented in Table 6-43. According to Table 3-1, the borehole is cased to 18.03 m. The uncased interval of this section is thus c. 18–151 m.

Comments on the test

This section was clearly affected by pumping in HFM14. A total drawdown of c. 1.5 m was registered during the flow period and a drawdown of 0.01 m was reached approximately 17 minutes after the pumping started. There was a total recovery of c. 0.9 m during the recovery period that lasted for approximately 6 days.

Table 6-43. General test data from the observation section HFM24: 0–151 m during the interference test in HFM14.

Pressure data	Nomenclature	Unit	Value
Hydraulic head in test section before start of flow period	h_i	m.a.s.l.	0.81
Hydraulic head in test section before stop of flow period	h_p	m.a.s.l.	–0.72
Hydraulic head in test section at stop of recovery period	h_F	m.a.s.l.	0.14
Hydraulic head change during flow period (h_i–h_p)	dh_p	m	1.53

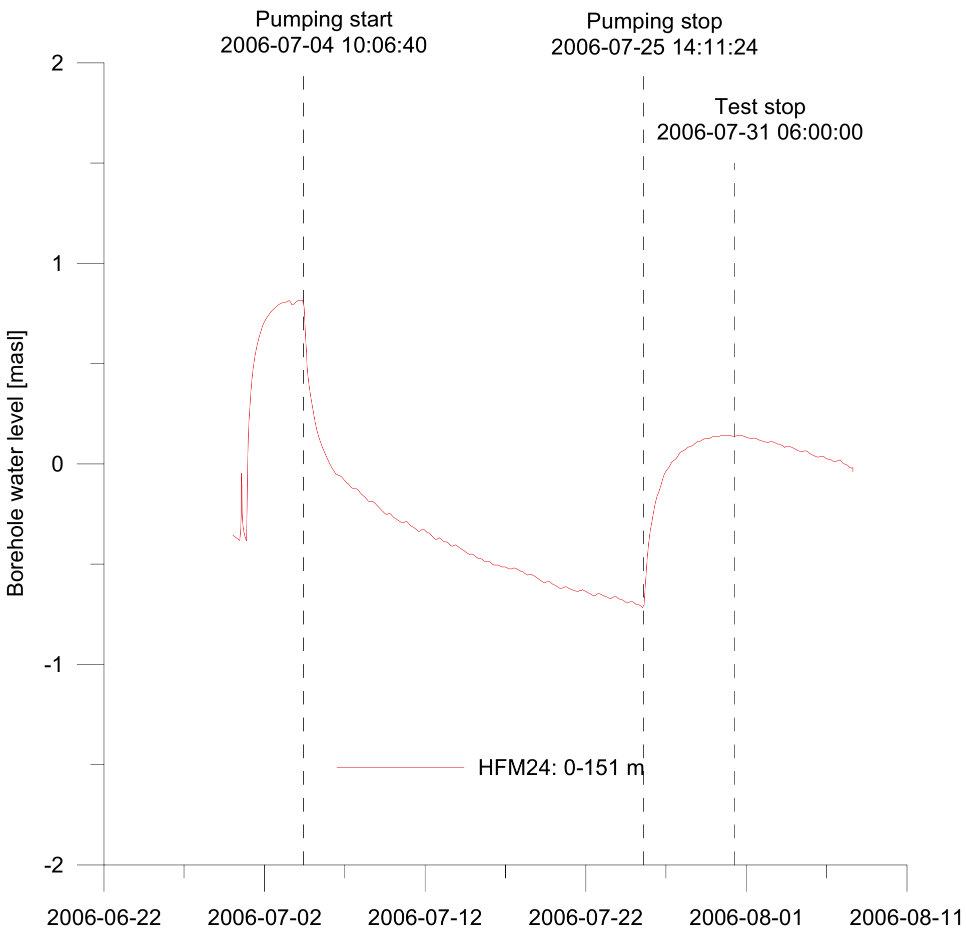


***Figure 6-15.** Linear plot of pressure versus time in the observation section in HFM24 during the interference test in HFM14.*

6.2.44 Observation section KFM04A: 0–168 m

In Figure 6-16 an overview of the pressure responses in observation borehole KFM04A is shown. General test data from the observation section KFM04A, 0–168 m, are presented in Table 6-44. It should be noted that the pressure values given in Table 6-44 are only valid for relative pressure variations. The transducers had been installed only a short time prior to the interference test and calibration to render absolute values, in metres above sea level, had not yet been performed. According to Table 3-1, the borehole is cased to 106.95 m. The uncased interval of this section is thus c. 107–168 m.

Comments on the test

A clear effect from pumping was observed in this observation section. The total drawdown at the end of the flow period was c. 0.7 m and a drawdown of 0.01 m was reached approximately 650 minutes after the pumping started. There was a total recovery of c. 0.1 m during the recovery period that lasted for approximately 6 days.

Table 6-44. General test data from the observation section KFM04A: 0–168 m during the interference test in HFM14.

Pressure data	Nomenclature	Unit	Value
Hydraulic head in test section before start of flow period	h_i	m	1,000.93
Hydraulic head in test section before stop of flow period	h_p	m	1,000.27
Hydraulic head in test section at stop of recovery period	h_F	m	1,000.39
Hydraulic head change during flow period (h_i–h_p)	dh_p	m	0.66

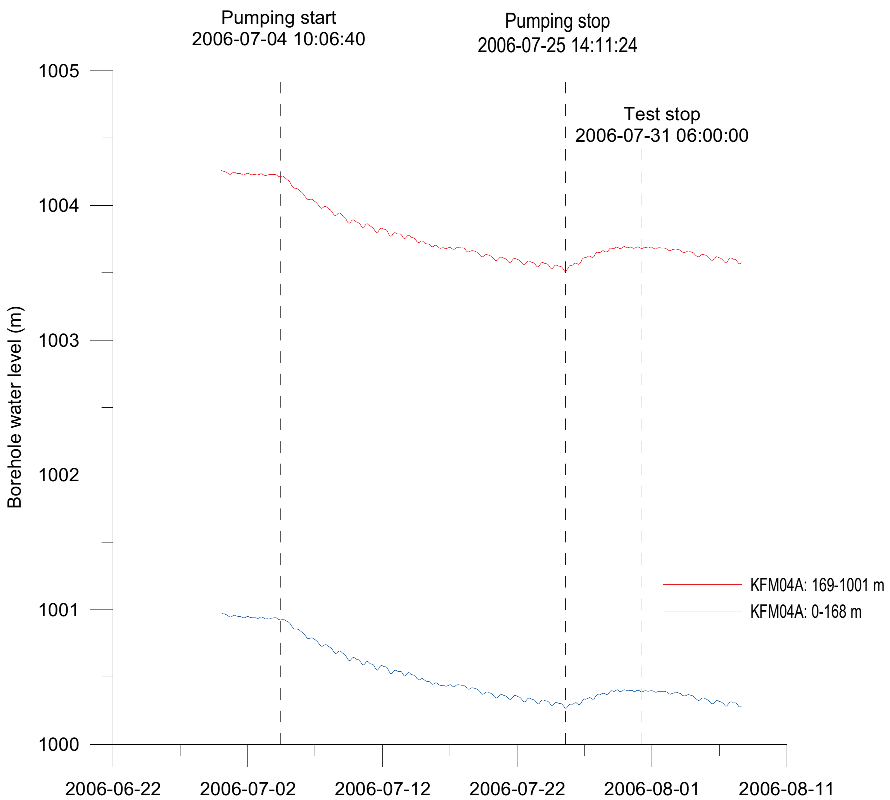


__Figure 6-16.__ Linear plot of pressure versus time in the observation sections in KFM04A during the interference test in HFM14.

6.2.45 Observation section KFM04A: 169–1,001 m

In Figure 6-16 an overview of the pressure responses in observation borehole KFM04A is shown. General test data from the observation section KFM04A, 169–1,001 m, are presented in Table 6-45. It should be noted that the pressure values given in Table 6-45 are only valid for relative pressure variations. The transducers had been installed only a short time prior to the interference test and calibration to render absolute values, in metres above sea level, had not yet been performed.

Comments on the test

A clear effect from pumping was observed in this observation section. The total drawdown at the end of the flow period was c. 0.7 m and a drawdown of 0.01 m was reached approximately 530 minutes after the pumping started. There was a total recovery of c. 0.2 m during the recovery period that lasted for approximately 6 days.

6.2.46 Observation section KFM06A: 0–150 m

In Figure 6-17a an overview of the pressure responses in observation borehole KFM06A is shown. General test data from the observation section KFM06A, 0–150 m, are presented in Table 6-46. According to Table 3-1, the borehole is cased to 100.40 m. The uncased interval of this section is thus c. 100–150 m.

Comments on the test

It seems apparent that this section is influenced by pumping in HFM14. The total drawdown during the flow period was c. 0.7 m. A drawdown of 0.01 m was reached approximately 11 hours after the pumping started. The total recovery during the recovery period of about 6 days was measured at c. 0.5 m.

Table 6-45. General test data from the observation section KFM04A: 169–1,001 m during the interference test in HFM14.

Pressure data	Nomenclature	Unit	Value
Hydraulic head in test section before start of flow period	h_i	m	1,004.21
Hydraulic head in test section before stop of flow period	h_p	m	1,003.51
Hydraulic head in test section at stop of recovery period	h_F	m	1,003.68
Hydraulic head change during flow period (h_i–h_p)	dh_p	m	0.70

Table 6-46. General test data from the observation section KFM06A: 0–150 m during the interference test in HFM14.

Pressure data	Nomenclature	Unit	Value
Hydraulic head in test section before start of flow period	$_{hi}$	m.a.s.l.	0.02
Hydraulic head in test section before stop of flow period	h_p	m.a.s.l.	–0.69
Hydraulic head in test section at stop of recovery period	h_F	m.a.s.l.	–0.18
Hydraulic head change during flow period (h_i–h_p)	dh_p	m	0.71

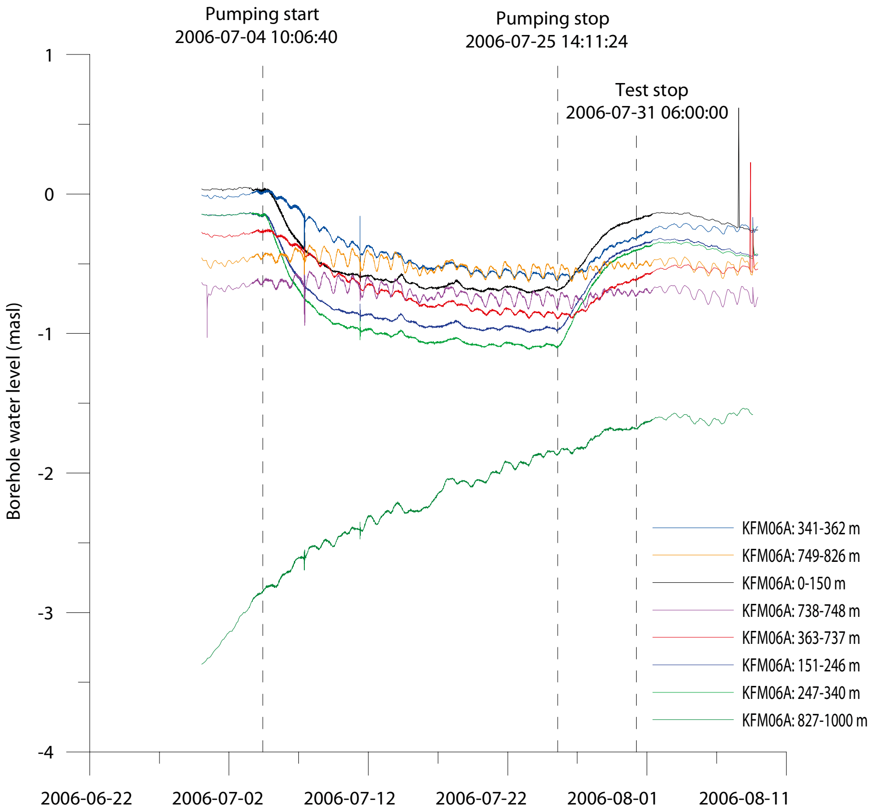


Figure 6-17a. *Linear plot of pressure versus time in the observation sections in KFM06A during the interference test in HFM14.*

6.2.47 Observation section KFM06A: 151–246 m

In Figure 6-17a an overview of the pressure responses in observation borehole KFM06A is shown. General test data from the observation section KFM06A, 151–246 m, are presented in Table 6-47.

Comments on the test

A clear effect from pumping was observed in this observation section. The total drawdown at the end of the flow period was c. 0.8 m and a drawdown of 0.01 m was reached approximately 8 hours after the pumping started. There was a total recovery of c. 0.6 m during the recovery period that lasted for approximately 6 days.

Table 6-47. General test data from the observation section KFM06A: 151–246 m during the interference test in HFM14.

Pressure data	Nomenclature	Unit	Value
Hydraulic head in test section before start of flow period	h_i	m.a.s.l.	–0.16
Hydraulic head in test section before stop of flow period	h_p	m.a.s.l.	–0.98
Hydraulic head in test section at stop of recovery period	h_F	m.a.s.l.	–0.37
Hydraulic head change during flow period (h_i–h_p)	dh_p	m	0.82

6.2.48 Observation section KFM06A: 247–340 m

In Figure 6-17a an overview of the pressure responses in observation borehole KFM06A is shown. General test data from the observation section KFM06A, 247–340 m, are presented in Table 6-48.

Comments on the test

A clear effect from pumping was observed in this observation section. The total drawdown at the end of the flow period was c. 1.0 m and a drawdown of 0.01 m was reached approximately 7 hours after the pumping started. There was a total recovery of c. 0.7 m during the recovery period of approximately 6 days.

6.2.49 Observation section KFM06A: 341–362 m

In Figure 6-17a an overview of the pressure responses in observation borehole KFM06A is shown. General test data from the observation section KFM06A, 341–362 m, are presented in Table 6-49.

Comments on the test

This section clearly responds to pumping in HFM14. The total drawdown at the end of the flow period was c. 0.6 m. A drawdown of 0.01 m was reached approximately 18 hours into the flow period. There was a total recovery of c. 0.3 m during the recovery period of approximately 6 days.

Table 6-48. General test data from the observation section KFM06A: 247–340 m during the interference test in HFM14.

Pressure data	Nomenclature	Unit	Value
Hydraulic head in test section before start of flow period	h_i	m.a.s.l.	–0.15
Hydraulic head in test section before stop of flow period	h_p	m.a.s.l.	–1.10
Hydraulic head in test section at stop of recovery period	h_F	m.a.s.l.	–0.40
Hydraulic head change during flow period (h_i–h_p)	dh_p	m	0.95

Table 6-49. General test data from the observation section KFM06A: 341–362 m during the interference test in HFM14.

Pressure data	Nomenclature	Unit	Value
Hydraulic head in test section before start of flow period	h_i	m.a.s.l.	0.01
Hydraulic head in test section before stop of flow period	h_p	m.a.s.l.	–0.62
Hydraulic head in test section at stop of recovery period	h_F	m.a.s.l.	–0.31
Hydraulic head change during flow period (h_i–h_p)	dh_p	m	0.63

6.2.50 Observation section KFM06A: 363–737 m

In Figure 6-17a an overview of the pressure responses in observation borehole KFM06A is shown. General test data from the observation section KFM06A, 363–737 m, are presented in Table 6-50.

Comments on the test

This section clearly responds to pumping in HFM14. The total drawdown at the end of the flow period was c. 0.6 m. A drawdown of 0.01 m was reached approximately 20 hours into the flow period. There was a total recovery of c. 0.3 m during the recovery period of approximately 6 days.

6.2.51 Observation section KFM06A: 738–748 m

In Figure 6-17a an overview of the pressure responses in observation borehole KFM06A is shown. In addition, this section is included in Figure 6-17b where a high resolution diagram is presented for clarity. General test data from the observation section KFM06A, 738–748 m, are presented in Table 6-51.

Comments on the test

This observation section is probably slightly affected by the pumping in HFM14. There are weak indications of a slight recovery and, as indicated by Table 6-51, there is also a tendency of a slight drawdown. It is however very hard to distinguish a real drawdown from a virtual drawdown since the tidal effects have such a large impact on the pressure data from this section. The suspicion of a slight response is, however, supported by the results from a tracer dilution test, /35/, which was performed in this section in conjunction with the hydraulic interference test described in this report. In Figure 6-17b the weak response is more clearly revealed.

Table 6-50. General test data from the observation section KFM06A: 363–737 m during the interference test in HFM14.

Pressure data	Nomenclature	Unit	Value
Hydraulic head in test section before start of flow period	h_i	m.a.s.l.	–0.27
Hydraulic head in test section before stop of flow period	h_p	m.a.s.l.	–0.89
Hydraulic head in test section at stop of recovery period	h_F	m.a.s.l.	–0.61
Hydraulic head change during flow period (h_i–h_p)	dh_p	m	0.62

Table 6-51. General test data from the observation section KFM06A: 738–748 m during the interference test in HFM14.

Pressure data	Nomenclature	Unit	Value
Hydraulic head in test section before start of flow period	h_i	m.a.s.l.	–0.64
Hydraulic head in test section before stop of flow period	h_p	m.a.s.l.	–0.81
Hydraulic head in test section at stop of recovery period	h_F	m.a.s.l.	–0.73
Hydraulic head change during flow period (h_i–h_p)	dh_p	m	0.17

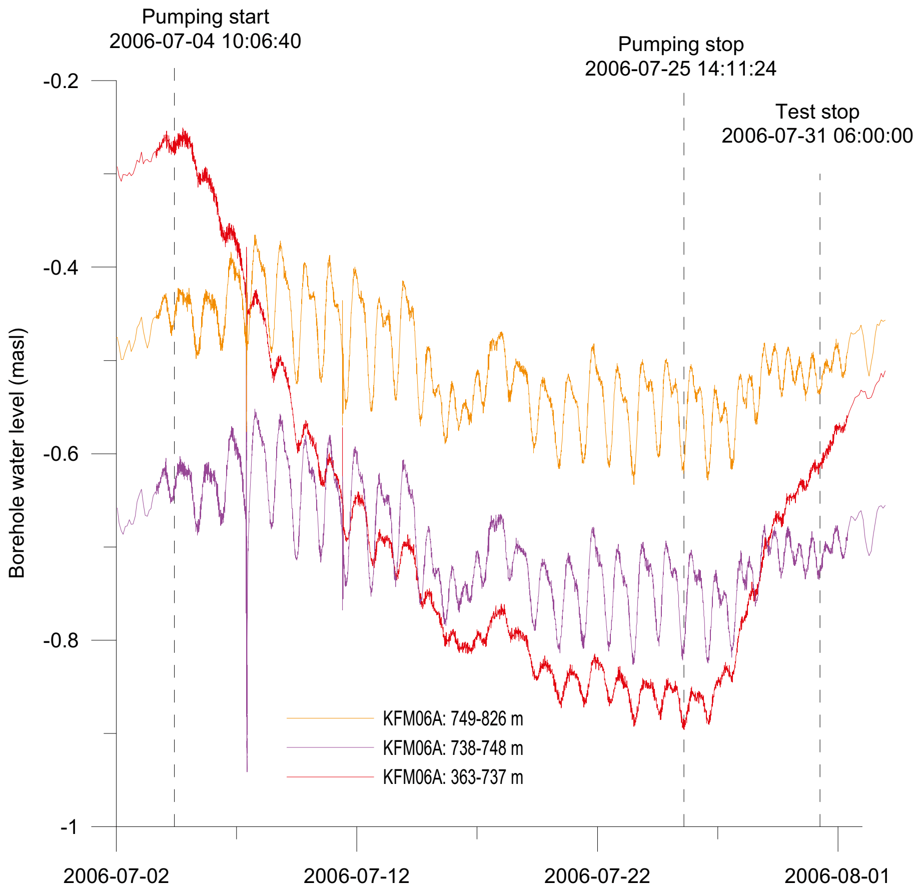


Figure 6-17b. *Higher resolution linear plot of pressure versus time in selected observation sections in KFM06A during the interference test in HFM14.*

6.2.52 Observation section KFM06A: 749–826 m

In Figure 6-17a an overview of the pressure responses in observation borehole KFM06A is shown. In addition, this section is included in Figure 6-17b where a high resolution diagram is displayed for clarity. General test data from the observation section KFM06A, 749–826 m, are presented in Table 6-52.

Comments on the test

This observation section is probably to some extent affected by the pumping in HFM14. The pressure appearance is very similar to that of section KFM06A:738–748 m. There are weak indications of a slight recovery and, as indicated by Table 6-52, there is a tendency of a slight drawdown as well. It is however very hard to distinguish a real drawdown from a virtual drawdown since the tidal effects have such a large impact on the pressure data from this section. In Figure 6-17b the weak response is more clearly revealed.

Table 6-52. General test data from the observation section KFM06A: 749–826 m during the interference test in HFM14.

Pressure data	Nomenclature	Unit	Value
Hydraulic head in test section before start of flow period	h_i	m.a.s.l.	–0.46
Hydraulic head in test section before stop of flow period	h_p	m.a.s.l.	–0.61
Hydraulic head in test section at stop of recovery period	h_F	m.a.s.l.	–0.53
Hydraulic head change during flow period (h_i–h_p)	dh_p	m	0.15

6.2.53 Observation section KFM06A: 827–1,001 m

In Figure 6-17a an overview of the pressure responses in observation borehole KFM06A is shown. General test data from the observation section KFM06A, 827–1,001 m, are presented in Table 6-53.

Comments on the test

This section appears to be completely unaffected by the pumping in HFM14. The pressure in this observation section is rising throughout the entire test.

6.2.54 Observation section KFM06C: 0–186 m

In Figure 6-18 an overview of the pressure responses in observation borehole KFM06C is shown. General test data from the observation section KFM06C, 0–186 m, are presented in Table 6-54. Since no representative initial hydraulic head could be determined in this borehole, see below, the measured recovery of the head at test stop was calculated and presented in the tables below for KFM06C. The head recovery was used as an approximate measure of the responses in this borehole. According to Table 3-1, the borehole is cased to 100.12 m. The uncased interval of this section is thus c. 100–186 m.

Comments on the test

A clear response is visible in this observation section. Due to a lack of, or very scattered, pressure data from the earlier parts of the drawdown period, it is not possible to calculate a total drawdown or the time to reach a 0.01 m drawdown. It is still evident, especially from the recovery period, that the section is influenced by the pumping in HFM14. A head recovery of c. 0.5 m was registered during the recovery period of approximately 6 days.

Table 6-53. General test data from the observation section KFM06A: 827–1,001 m during the interference test in HFM14.

Pressure data	Nomenclature	Unit	Value
Hydraulic head in test section before start of flow period	h_i	m.a.s.l.	–2.85
Hydraulic head in test section before stop of flow period	h_p	m.a.s.l.	–1.87
Hydraulic head in test section at stop of recovery period	h_F	m.a.s.l.	–1.68
Hydraulic head change during flow period (h_i–h_p)	dh_p	m	–0.98

Table 6-54. General test data from the observation section KFM06C: 0–186 m during the interference test in HFM14.

Pressure data	Nomenclature	Unit	Value
Hydraulic head in test section before start of flow period	h_i	m	–
Hydraulic head in test section before stop of flow period	h_p	m	–969.56
Hydraulic head in test section at stop of recovery period	h_F	m	–969.05
Hydraulic head change during flow period (hi–hp)	d_{hp}	m	–
Hydraulic head change during recovery period (h_F–h_p)	dh_F	m	0.51

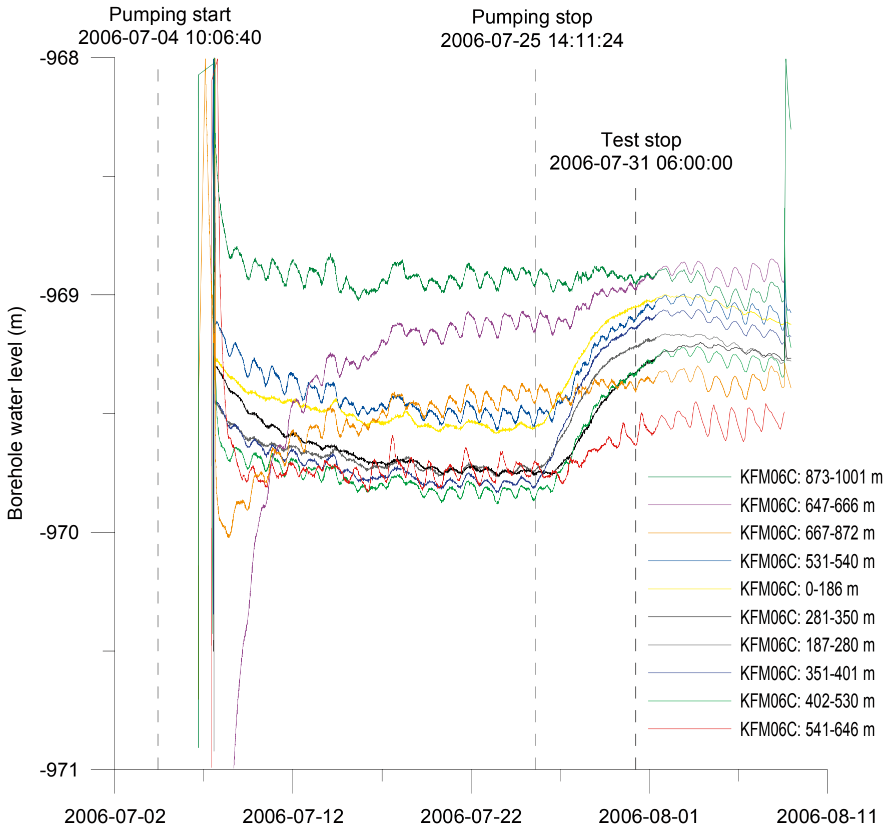


Figure 6-18. *Linear plot of pressure versus time in the observation sections in KFM06C during the interference test in HFM14.*

6.2.55 Observation section KFM06C: 187–280 m

In Figure 6-18 an overview of the pressure responses in observation borehole KFM06C is shown. General test data from the observation section KFM06C, 187–280 m, are presented in Table 6-55. Since no representative initial hydraulic head could be determined in this borehole, see below, the measured recovery of the head at test stop was calculated and presented in the tables below. The head recovery was used as an approximate measure of the responses in this borehole.

Comments on the test

A clear response is visible in this observation section. Due to a lack of, or very scattered, pressure data from the earlier parts of the drawdown period, it is not possible to calculate a total drawdown or the time to reach a 0.01 m drawdown. It is still evident, especially from the recovery period, that the section is influenced by the pumping in HFM14. A head recovery of c. 0.5 m was registered during the recovery period of approximately 6 days.

Table 6-55. General test data from the observation section KFM06C: 187–280 m during the interference test in HFM14.

Pressure data	Nomenclature	Unit	Value
Hydraulic head in test section before start of flow period	h_i	m	–
Hydraulic head in test section before stop of flow period	h_p	m	–969.74
Hydraulic head in test section at stop of recovery period	h_F	m	–969.22
Hydraulic head change during flow period (hi–hp)	d_{hp}	m	–
Hydraulic head change during recovery period (h_F–h_p)	dh_F	m	0.52

6.2.56 Observation section KFM06C: 281–350 m

In Figure 6-18 an overview of the pressure responses in observation borehole KFM06C is shown. General test data from the observation section KFM06C, 281–350 m, are presented in Table 6-56. Since no representative initial hydraulic head could be determined in this borehole, see below, the measured recovery of the head at test stop was calculated and presented in the tables below. The head recovery was used as an approximate measure of the responses in this borehole.

Comments on the test

A clear response is visible in this observation section. Due to a lack of, or very scattered, pressure data from the earlier parts of the drawdown period, it is not possible to calculate a total drawdown or the time to reach a 0.01 m drawdown. It is still evident, especially from the recovery period, that the section is influenced by the pumping in HFM14. A head recovery of c. 0.4 m was registered during the recovery period of approximately 6 days.

6.2.57 Observation section KFM06C: 351–401 m

In Figure 6-18 an overview of the pressure responses in observation borehole KFM06C is shown. General test data from the observation section KFM06C, 351–401 m, are presented in Table 6-57. Since no representative initial hydraulic head could be determined in this borehole, see below, the measured recovery of the head at test stop was calculated and presented in the tables below. The head recovery was used as an approximate measure of the responses in this borehole.

Comments on the test

A clear response is visible in this observation section. Due to a lack of, or very scattered, pressure data from the earlier parts of the drawdown period, it is not possible to calculate a total drawdown or the time to reach a 0.01 m drawdown. It is still evident, especially from the recovery period, that the section is influenced by the pumping in HFM14. A head recovery of c. 0.7 m was registered during the recovery period of approximately 6 days.

Table 6-56. General test data from the observation section KFM06C: 281–350 m during the interference test in HFM14.

Pressure data	Nomenclature	Unit	Value
Hydraulic head in test section before start of flow period	h_i	m	–
Hydraulic head in test section before stop of flow period	h_p	m	–969.75
Hydraulic head in test section at stop of recovery period	h_F	m	–969.33
Hydraulic head change during flow period (hi–hp)	d_{hp}	m	–
Hydraulic head change during recovery period (h_F–h_p)	dh_F	m	0.42

Table 6-57. General test data from the observation section KFM06C: 351–401 m during the interference test in HFM14.

Pressure data	Nomenclature	Unit	Value
Hydraulic head in test section before start of flow period	h_i	m	–
Hydraulic head in test section before stop of flow period	h_p	m	–969.81
Hydraulic head in test section at stop of recovery period	h_F	m	–969.14
Hydraulic head change during flow period (hi–hp)	d_{hp}	m	–
Hydraulic head change during recovery period (h_F–h_p)	dh_F	m	0.67

6.2.58 Observation section KFM06C: 402–530 m

In Figure 6-18 an overview of the pressure responses in observation borehole KFM06C is shown. General test data from the observation section KFM06C, 402–530 m, are presented in Table 6-58. Since no representative initial hydraulic head could be determined in this borehole, see below, the measured recovery of the head at test stop was calculated and presented in the tables below. The head recovery was used as an approximate measure of the responses in this borehole.

Comments on the test

A clear response is visible in this observation section. Due to a lack of, or very scattered, pressure data from the earlier parts of the drawdown period, it is not possible to calculate a total drawdown or the time to reach a 0.01 m drawdown. It is still evident, especially from the recovery period, that the section is influenced by the pumping in HFM14. A head recovery of c. 0.5 m was registered during the recovery period of approximately 6 days.

6.2.59 Observation section KFM06C: 531–540 m

In Figure 6-18 an overview of the pressure responses in observation borehole KFM06C is shown. General test data from the observation section KFM06C, 531–540 m, are presented in Table 6-59. Since no representative initial hydraulic head could be determined in this borehole, see below, the measured recovery of the head at test stop was calculated and presented in the tables below. The head recovery was used as an approximate measure of the responses in this borehole.

Comments on the test

A clear response is visible in this observation section. Due to a lack of, or very scattered, pressure data from the earlier parts of the drawdown period, it is not possible to calculate a total drawdown or the time to reach a 0.01 m drawdown. It is still evident, especially from the recovery period, that the section is influenced by the pumping in HFM14. A head recovery of c. 0.4 m was registered during the recovery period of approximately 6 days.

Table 6-58. General test data from the observation section KFM06C: 402–530 m during the interference test in HFM14.

Pressure data	Nomenclature	Unit	Value
Hydraulic head in test section before start of flow period	h_i	m	–
Hydraulic head in test section before stop of flow period	h_p	m	–969.85
Hydraulic head in test section at stop of recovery period	h_F	m	–969.34
Hydraulic head change during flow period (hi–hp)	d_{hp}	m	–
Hydraulic head change during recovery period (h_F–h_p)	dh_F	m	0.51

Table 6-59. General test data from the observation section KFM06C: 531–540 m during the interference test in HFM14.

Pressure data	Nomenclature	Unit	Value
Hydraulic head in test section before start of flow period	h_i	m	–
Hydraulic head in test section before stop of flow period	h_p	m	–969.54
Hydraulic head in test section at stop of recovery period	h_F	m	–969.11
Hydraulic head change during flow period (hi–hp)	d_{hp}	m	–
Hydraulic head change during recovery period (h_F–h_p)	dh_F	m	0.43

6.2.60 Observation section KFM06C: 541–646 m

In Figure 6-18 an overview of the pressure responses in observation borehole KFM06C is shown. General test data from the observation section KFM06C, 541–646 m, are presented in Table 6-60. Since no representative initial hydraulic head could be determined in this borehole, see below, the measured recovery of the head at test stop was calculated and presented in the tables below. The head recovery was used as an approximate measure of the responses in this borehole.

Comments on the test

This section is probably not affected by the pumping in HFM14. Due to a lack of, or very scattered, pressure data from the earlier parts of the drawdown period, it is not possible to calculate a total drawdown or the time to reach a 0.01 m drawdown. An apparent head recovery of c. 0.1 m was registered during the recovery period of approximately 6 days. The head increase during the recovery period is assumed to be due to precipitation during this period, cf. Figure A2-10 in Appendix 2. This borehole section, as well as most sections in KFM06C, is strongly influenced by tidal effects which makes the interpretation of responses in the lower part of the borehole uncertain.

6.2.61 Observation section KFM06C: 647–666 m

In Figure 6-18 an overview of the pressure responses in observation borehole KFM06C is shown. General test data from the observation section KFM06C, 647–666 m, are presented in Table 6-61. Since no representative initial hydraulic head could be determined in this borehole, see below, the measured recovery of the head at test stop was calculated and presented in the tables below. The head recovery was used as an approximate measure of the responses in this borehole.

Table 6-60. General test data from the observation section KFM06C: 541–646 m during the interference test in HFM14.

Pressure data	Nomenclature	Unit	Value
Hydraulic head in test section before start of flow period	h_i	m	–
Hydraulic head in test section before stop of flow period	h_p	m	–969.70
Hydraulic head in test section at stop of recovery period	h_F	m	–969.63
Hydraulic head change during flow period (hi–hp)	d_{hp}	m	–
Hydraulic head change during recovery period (h_F–h_p)	dh_F	m	0.07

Table 6-61. General test data from the observation section KFM06C: 647–666 m during the interference test in HFM14.

Pressure data	Nomenclature	Unit	Value
Hydraulic head in test section before start of flow period	h_i	m	–
Hydraulic head in test section before stop of flow period	h_p	m	–969.15
Hydraulic head in test section at stop of recovery period	h_F	m	–968.98
Hydraulic head change during flow period (hi–hp)	d_{hp}	m	–
Hydraulic head change during recovery period (h_F–h_p)	dh_F	m	0.17

Comments on the test

This section is probably not affected by the pumping in HFM14. Although there is a head recovery of c. 0.2 m during the recovery period lasting for approximately 6 days, the pressure was continuously rising throughout the entire flow period. The head increase during the recovery period is assumed to be due to precipitation during this period, cf. Figure A2-10 in Appendix 2. This borehole section, as well as all sections in KFM06C, is missing data from the earliest part of the drawdown period which makes the interpretation of responses even more difficult.

6.2.62 Observation section KFM06C: 667–872 m

In Figure 6-18 an overview of the pressure responses in observation borehole KFM06C is shown. General test data from the observation section KFM06C, 667–872 m, are presented in Table 6-62. Since no representative initial hydraulic head could be determined in this borehole, see below, the measured recovery of the head at test stop was calculated and presented in the tables below. The head recovery was used as an approximate measure of the responses in this borehole.

Comments on the test

This section is probably not affected by the pumping in HFM14. Although there is a head recovery of c. 0.05 m during the recovery period lasting for approximately 6 days, the pressure was continuously rising throughout the entire flow period. The head increase during the recovery period is assumed to be due to precipitation during this period, cf. Figure A2-10 in Appendix 2. This borehole section, as well as all sections in KFM06C, is missing data from the earliest part of the drawdown period which makes the interpretation of responses even more difficult. Furthermore, the section is strongly affected by tidal effects which make the interpretation of responses in the lower part of the borehole uncertain.

6.2.63 Observation section KFM06C: 873–1,001 m

In Figure 6-18 an overview of the pressure responses in observation borehole KFM06C is shown. General test data from the observation section KFM06C, 873–1,001 m, are presented in Table 6-63. Since no representative initial hydraulic head could be determined in this borehole, see below, the measured recovery of the head at test stop was calculated and presented in the tables below. The head recovery was used as an approximate measure of the responses in this borehole.

Comments on the test

There are no indications of this section being influenced by the pumping in HFM14. Only tidal effects are clearly present.

Table 6-62. General test data from the observation section KFM06C: 667–872 m during the interference test in HFM14.

Pressure data	Nomenclature	Unit	Value
Hydraulic head in test section before start of flow period	h_i	m	–
Hydraulic head in test section before stop of flow period	h_p	m	–969.45
Hydraulic head in test section at stop of recovery period	h_F	m	–969.40
Hydraulic head change during flow period (hi–hp)	d_{hp}	m	
Hydraulic head change during recovery period (h_F–h_p)	dh_F	m	0.05

Table 6-63. General test data from the observation section KFM06C: 873–1,001 m during the interference test in HFM14.

Pressure data	Nomenclature	Unit	Value
Hydraulic head in test section before start of flow period	h_i	m	–
Hydraulic head in test section before stop of flow period	h_p	m	–968.96
Hydraulic head in test section at stop of recovery period	h_F	m	–968.95
Hydraulic head change during flow period (hi–hp)	d_{hp}	m	–
Hydraulic head change during recovery period (h_F–h_p)	dh_F	m	0.01

6.2.64 Observation section KFM06B: 0–26 m

In Figure 6-19 an overview of the pressure responses in observation borehole KFM06B is shown. General test data from the observation section KFM06B, 0–26 m, are presented in Table 6-64. According to Table 3-1, the borehole is cased to 4.61 m. The uncased interval of this section is thus c. 5–26 m.

Table 6-64. General test data from the observation section KFM06B: 0–26 m during the interference test in HFM14.

Pressure data	Nomenclature	Unit	Value
Hydraulic head in test section before start of flow period	h_i	m.a.s.l.	0.50
Hydraulic head in test section before stop of flow period	h_p	m.a.s.l.	–0.95
Hydraulic head in test section at stop of recovery period	h_F	m.a.s.l.	0.05
Hydraulic head change during flow period (h_i–h_p)	dh_p	m	1.45

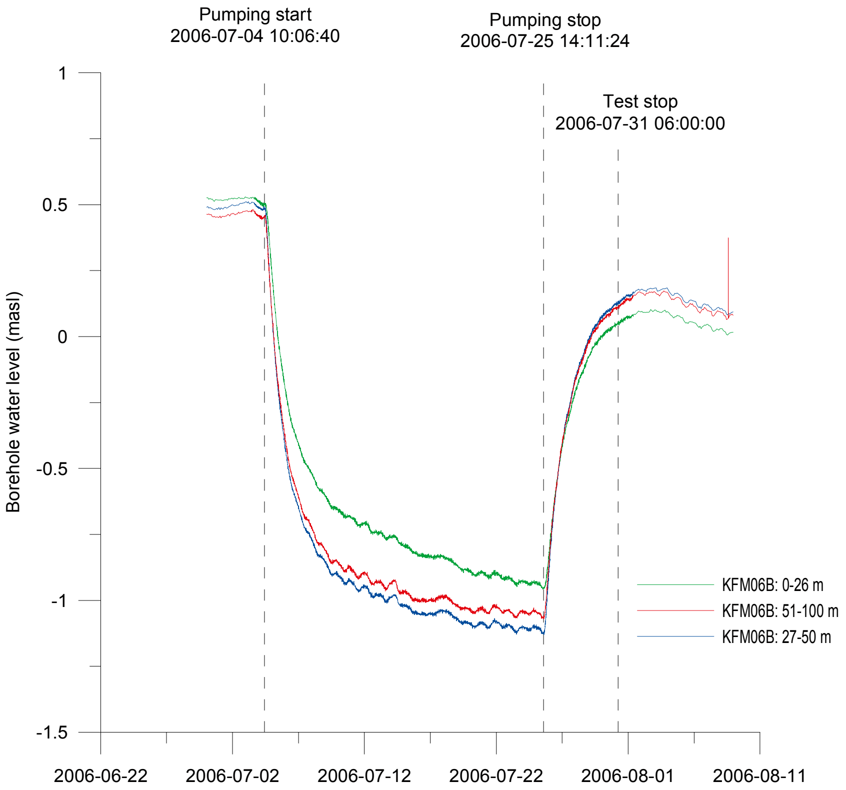


Figure 6-19. Linear plot of pressure versus time in the observation sections in KFM06B during the interference test in HFM14.

Comments on the test

A clear effect from pumping was observed in this observation section. The total drawdown at the end of the flow period was c. 1.4 m and a drawdown of 0.01 m was reached approximately 3 hours after the pumping started. There was a total recovery of c. 1.0 m during the recovery period of approximately 6 days.

6.2.65 Observation section KFM06B: 27–50 m

In Figure 6-19 an overview of the pressure responses in observation borehole KFM06B is shown. General test data from the observation section KFM06B, 27–50 m, are presented in Table 6-65.

Comments on the test

A clear effect from pumping was observed in this observation section. The total drawdown at the end of the flow period was c. 1.6 m and a drawdown of 0.01 m was reached approximately 99 minutes after the pumping started. There was a total recovery of c. 1.2 m during the recovery period of approximately 6 days.

6.2.66 Observation section KFM06B: 51–100 m

In Figure 6-19 an overview of the pressure responses in observation borehole KFM06B is shown. General test data from the observation section KFM06B, 51–100 m, are presented in Table 6-66.

Comments on the test

A clear effect from pumping was observed in this observation section. The total drawdown at the end of the flow period was c. 1.5 m and a drawdown of 0.01 m was reached approximately 93 minutes after the pumping started. There was a total recovery of c. 1.2 m during the recovery period of approximately 6 days.

Table 6-65. General test data from the observation section KFM06B: 27–50 m during the interference test in HFM14.

Pressure data	Nomenclature	Unit	Value
Hydraulic head in test section before start of flow period	h_i	m.a.s.l.	0.48
Hydraulic head in test section before stop of flow period	h_p	m.a.s.l.	–1.12
Hydraulic head in test section at stop of recovery period	h_F	m.a.s.l.	0.12
Hydraulic head change during flow period (h_i–h_p)	dh_p	m	1.60

Table 6-66. General test data from the observation section KFM06B: 51–100 m during the interference test in HFM14.

Pressure data	Nomenclature	Unit	Value
Hydraulic head in test section before start of flow period	h_i	m.a.s.l.	0.46
Hydraulic head in test section before stop of flow period	h_p	m.a.s.l.	–1.06
Hydraulic head in test section at stop of recovery period	h_F	m.a.s.l.	0.11
Hydraulic head change during flow period (h_i–h_p)	dh_p	m	1.52

6.2.67 Observation section HFM10: 0–99 m

In Figure 6-20 an overview of the pressure responses in observation borehole HFM10 is shown. General test data from the observation section HFM10, 0–99 m, are presented in Table 6-67. According to Table 3-1, the borehole is cased to 11.8 m. The uncased interval of this section is thus c. 12–99 m.

Comments on the test

This section is possibly responding to the pumping in HFM14. Prior to the start of pumping there was a clear decreasing trend in the recorded hydraulic head in this observation section. It seems however, that the slope of the pressure curve is changing slightly at the time of pump start, cf. Figure 6-20. At the start of recovery the pressure curve is again changing its slope slightly, although no real recovery is detected. The response is likely to be weaker than is indicated by the total drawdown of approximately 0.7 m shown in Table 6-67.

Table 6-67. General test data from the observation section HFM10: 0–99 m during the interference test in HFM14.

Pressure data	Nomenclature	Unit	Value
Hydraulic head in test section before start of flow period	h_i	m.a.s.l.	2.14
Hydraulic head in test section before stop of flow period	h_p	m.a.s.l.	1.48
Hydraulic head in test section at stop of recovery period	h_F	m.a.s.l.	1.46
Hydraulic head change during flow period (h_i–h_p)	dh_p	m	0.66

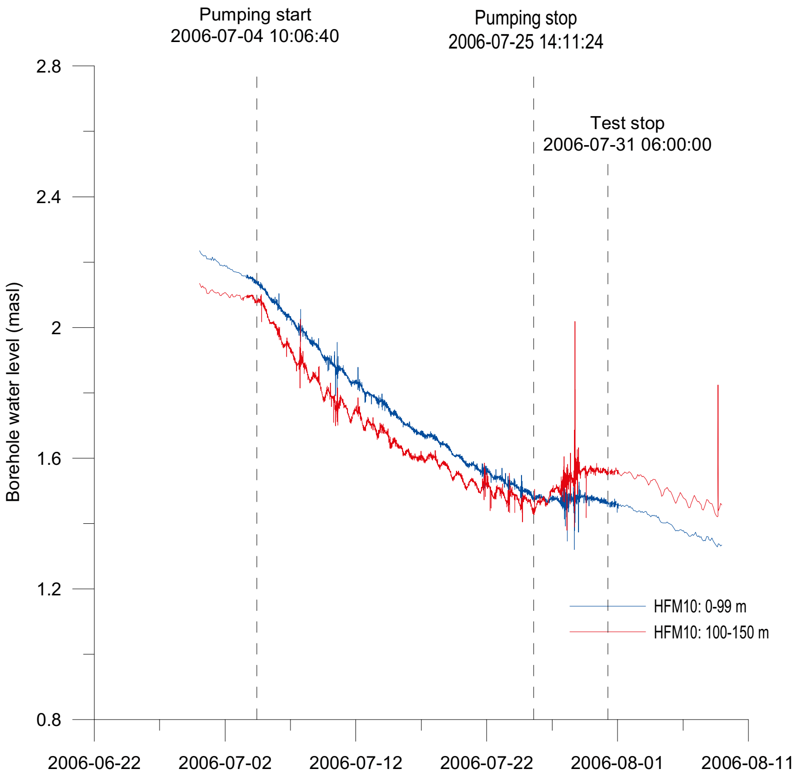


Figure 6-20. *Linear plot of pressure versus time in the observation sections in HFM10 during the interference test in HFM14.*

6.2.68 Observation section HFM10: 100–150 m

In Figure 6-20 an overview of the pressure responses in observation borehole HFM10 is shown. General test data from the observation section HFM10, 100–150 m, are presented in Table 6-68.

Comments on the test

A probable pressure response to pumping in HFM14 is indicated in this section. The response is very similar to that of section HFM10: 0–99 m, but the decreasing pressure trend prior to the start of pumping is not as strong and the recovery is more evident, proposing a more clear effect from pumping. A total recovery of c. 0.1 m was measured during the recovery period of approximately 6 days.

6.2.69 Observation section HFM16: 0–53 m

In Figure 6-21 an overview of the pressure responses in observation borehole HFM16 is shown. General test data from the observation section HFM16, 0–53 m, are presented in Table 6-69. According to Table 3-1, the borehole is cased to 12.02 m. The uncased interval of this section is thus c. 12–53 m.

Comments on the test

The pumping in HFM14 caused a clear response in this section. The total drawdown during the flow period was c. 1.6 m. A drawdown of 0.01 m was reached approximately 133 minutes after the pumping started in HFM14. There was a total recovery of c. 1.2 m during the recovery period that lasted for approximately 6 days.

Table 6-68. General test data from the observation section HFM10: 100–150 m during the interference test in HFM14.

Pressure data	Nomenclature	Unit	Value
Hydraulic head in test section before start of flow period	h_i	m.a.s.l.	2.08
Hydraulic head in test section before stop of flow period	h_p	m.a.s.l.	1.43
Hydraulic head in test section at stop of recovery period	h_F	m.a.s.l.	1.56
Hydraulic head change during flow period (h_i–h_p)	dh_p	m	0.65

Table 6-69. General test data from the observation section HFM16: 0–53 m during the interference test in HFM14.

Pressure data	Nomenclature	Unit	Value
Hydraulic head in test section before start of flow period	h_i	m.a.s.l.	0.46
Hydraulic head in test section before stop of flow period	h_p	m.a.s.l.	–1.11
Hydraulic head in test section at stop of recovery period	h_F	m.a.s.l.	0.11
Hydraulic head change during flow period (h_i–h_p)	dh_p	m	1.57

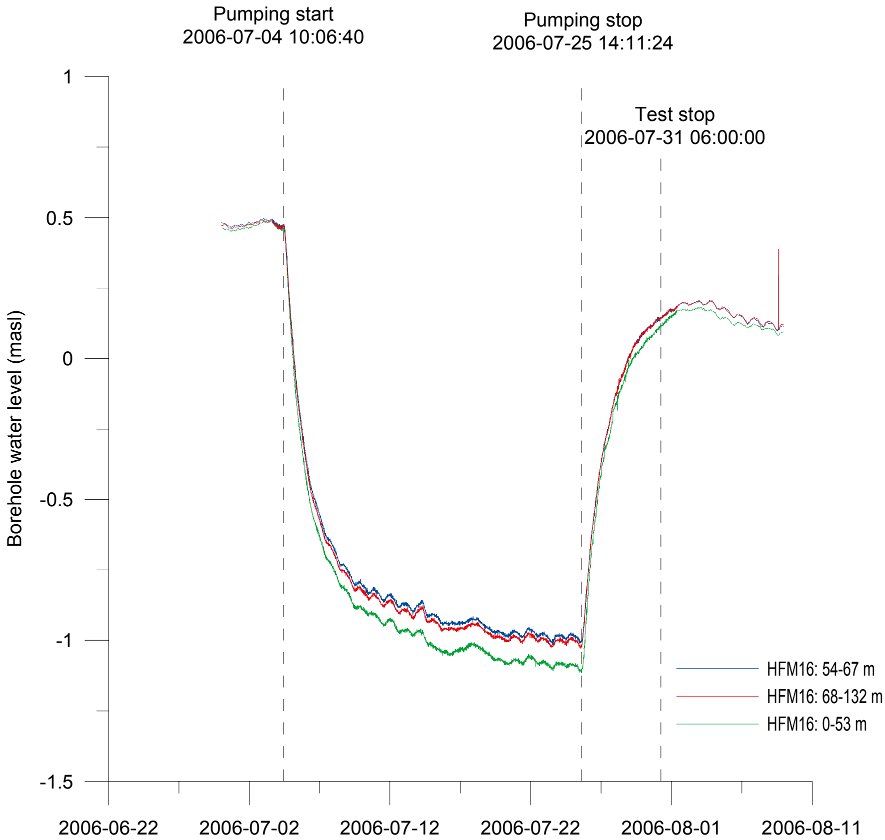


Figure 6-21. *Linear plot of pressure versus time in the observation sections in HFM16 during the interference test in HFM14.*

6.2.70 Observation section HFM16: 54–67 m

In Figure 6-21 an overview of the pressure responses in observation borehole HFM16 is shown. General test data from the observation section HFM16, 54–67 m, are presented in Table 6-70.

Comments on the test

The pumping in HFM14 caused a clear response in this section. The total drawdown during the flow period was c. 1.5 m. A drawdown of 0.01 m was reached approximately 133 minutes after the pumping started in HFM14. There was a total recovery of c. 1.1 m during the recovery period that lasted for approximately 6 days.

Table 6-70. General test data from the observation section HFM16: 54–67 m during the interference test in HFM14.

Pressure data	Nomenclature	Unit	Value
Hydraulic head in test section before start of flow period	h_i	m.a.s.l.	0.47
Hydraulic head in test section before stop of flow period	h_p	m.a.s.l.	–1.00
Hydraulic head in test section at stop of recovery period	h_F	m.a.s.l.	0.14
Hydraulic head change during flow period (h_i–h_p)	dh_p	m	1.47

6.2.71 Observation section HFM16: 68–132 m

In Figure 6-21 an overview of the pressure responses in observation borehole HFM16 is shown. General test data from the observation section HFM16, 68–132 m, are presented in Table 6-71.

Comments on the test

The pumping in HFM14 caused a clear response in this section. The total drawdown during the flow period was c. 1.5 m. A drawdown of 0.01 m was reached approximately 113 minutes after the pumping started in HFM14. There was a total recovery of c. 1.2 m during the recovery period that lasted for approximately 6 days.

6.2.72 Observation section HFM09: 0–50 m

In Figure 6-22 an overview of the pressure responses in observation borehole HFM09 is shown. General test data from the observation section HFM09, 0–50 m, are presented in Table 6-72. According to Table 3-1, the borehole is cased to 17.02 m. The uncased interval of this section is thus c. 17–50 m.

Table 6-71. General test data from the observation section HFM16: 68–132 m during the interference test in HFM14.

Pressure data	Nomenclature	Unit	Value
Hydraulic head in test section before start of flow period	h_i	m.a.s.l.	0.47
Hydraulic head in test section before stop of flow period	h_p	m.a.s.l.	–1.02
Hydraulic head in test section at stop of recovery period	h_F	m.a.s.l.	0.14
Hydraulic head change during flow period (h_i–h_p)	dh_p	m	1.49

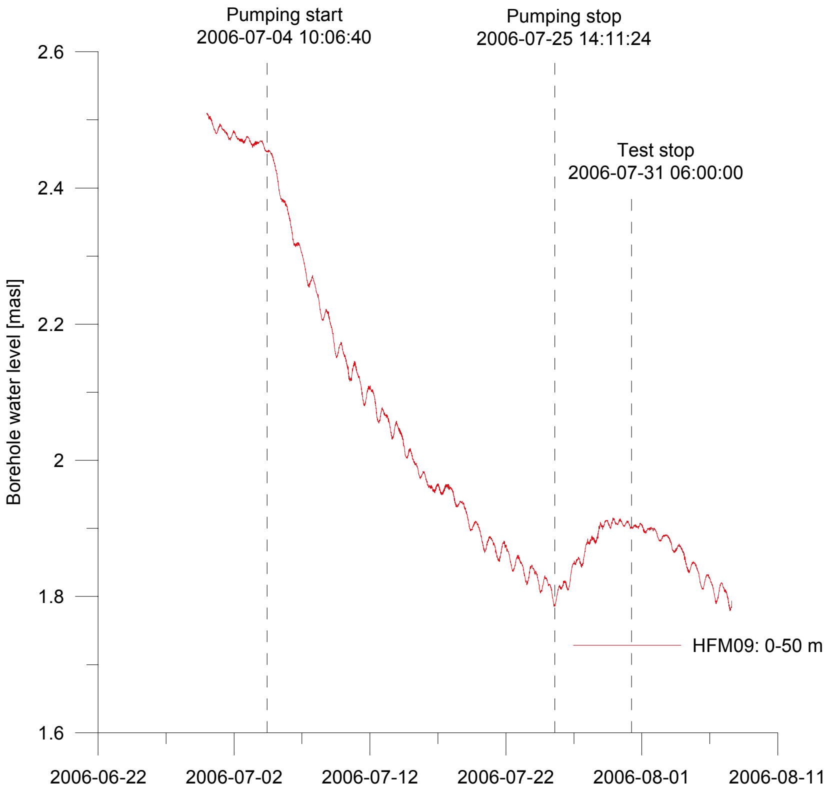


__Figure 6-22.__ Linear plot of pressure versus time in the observation section in HFM09 during the interference test in HFM14.

Table 6-72. General test data from the observation section HFM09: 0–50 m during the interference test in HFM14.

Pressure data	Nomenclature	Unit	Value
Hydraulic head in test section before start of flow period	h_i	m.a.s.l.	2.45
Hydraulic head in test section before stop of flow period	h_p	m.a.s.l.	1.79
Hydraulic head in test section at stop of recovery period	h_F	m.a.s.l.	1.90
Hydraulic head change during flow period (h_i–h_p)	dh_p	m	0.66

Comments on the test

This section is responding to the pumping in HFM14. The total drawdown during the flow period was measured at c. 0.7 m and a drawdown of 0.01 m was reached approximately 9 hours after the pumping started in HFM14. There was a total recovery of c. 0.1 m during the recovery period that lasted for approximately 6 days.

6.2.73 Observation section KFM07B: 0–299 m

In Figure 6-23 an overview of the pressure responses in observation borehole KFM07B is shown. General test data from the observation section KFM07B, 0–299 m, are presented in Table 6-73. According to Table 3-1, the borehole is cased to 65.29 m. The uncased interval of this section is thus c. 65–299 m.

Comments on the test

A clear response to pumping was recorded in this observation section. A total drawdown of c. 1.6 m was measured during the flow period. A drawdown of 0.01 m was reached approximately 133 minutes after the pumping started in HFM14. There was a total recovery of c. 1.2 m during the recovery period that lasted for approximately 6 days.

6.2.74 Observation section HFM21: 0–202 m

In Figure 6-23 an overview of the pressure responses in observation borehole HFM21 is shown. General test data from the observation section HFM21, 0–202 m, are presented in Table 6-74. According to Table 3-1, the borehole is cased to 12.03 m. The uncased interval of this section is thus c. 12–202 m.

Table 6-73. General test data from the observation section KFM07B: 0–299 m during the interference test in HFM14.

Pressure data	Nomenclature	Unit	Value
Hydraulic head in test section before start of flow period	h_i	m.a.s.l.	0.06
Hydraulic head in test section before stop of flow period	h_p	m.a.s.l.	–1.50
Hydraulic head in test section at stop of recovery period	h_F	m.a.s.l.	–0.26
Hydraulic head change during flow period (h_i–h_p)	dh_p	m	1.56

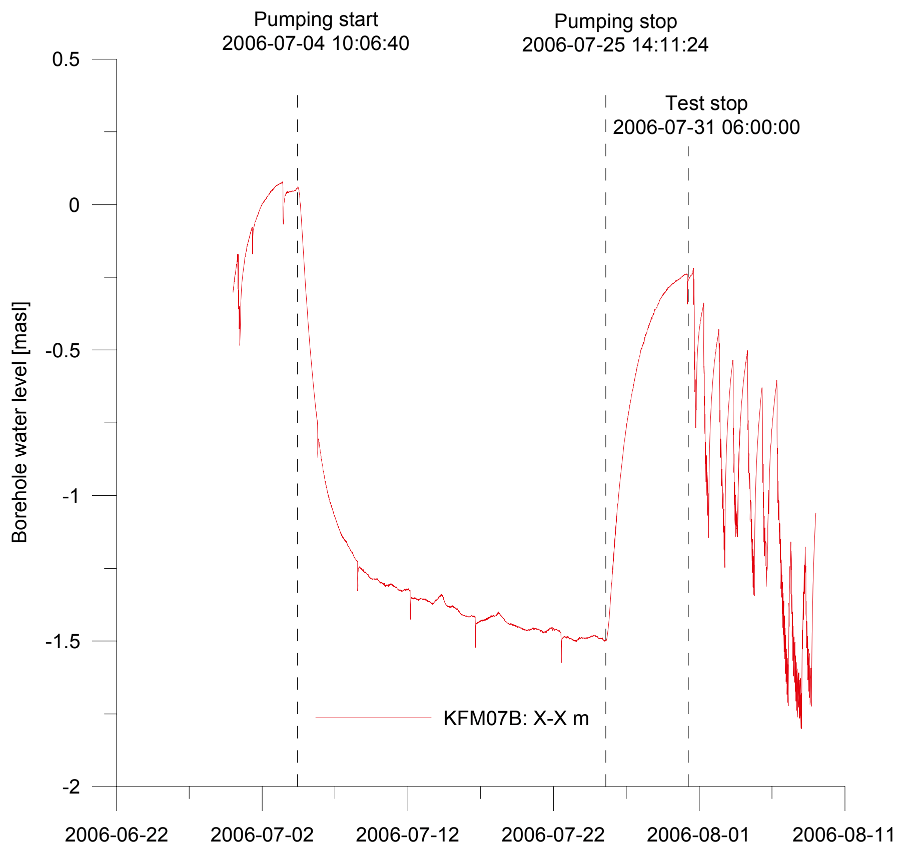


Figure 6-23. *Linear plot of pressure versus time in the observation section in KFM07B during the interference test in HFM14.*

Table 6-74. General test data from the observation section HFM21: 0–202 m during the interference test in HFM14.

Pressure data	Nomenclature	Unit	Value
Hydraulic head in test section before start of flow period	h_i	m.a.s.l.	0.07
Hydraulic head in test section before stop of flow period	h_p	m.a.s.l.	–1.47
Hydraulic head in test section at stop of recovery period	h_F	m.a.s.l.	–0.30
Hydraulic head change during flow period (h_i–h_p)	dh_p	m	1.54

Comments on the test

The data from this section are slightly corrupted and show sudden drops of pressure on several occasions. It seems however, when looking past the deviant data, that the section is visibly affected by the pumping in HFM14. A total drawdown of c. 1.5 m was registered during the flow period and a drawdown of 0.01 m was reached approximately 27 minutes after the pumping started in HFM14. There was a total recovery of c. 1.2 m during the recovery period that lasted for approximately 6 days.

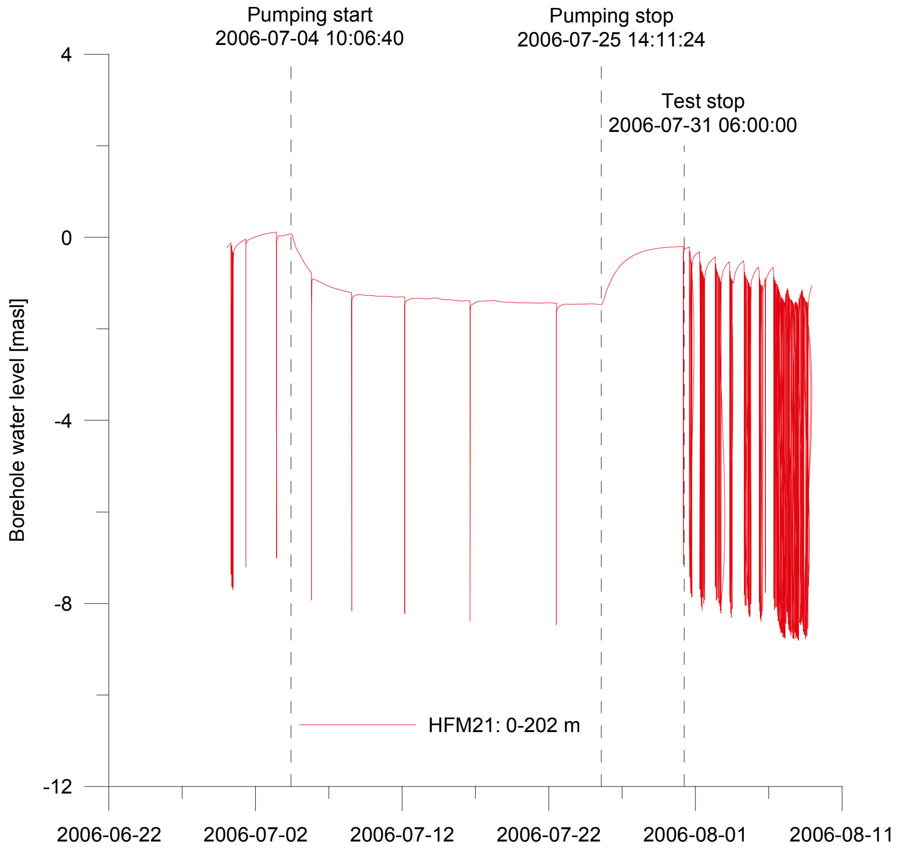


Figure 6-24. *Linear plot of pressure versus time in the observation section in HFM21 during the interference test in HFM14.*

6.2.75 Observation section KFM07A: 0–1,002 m

There are no test data available from the observation section KFM07A, 0–1,002 m.

Comments on the test

There was no registration of pressure in this section during the interference test in HFM14.

Table 6-75. General test data from the observation section KFM07A: 0–1,002 m during the interference test in HFM14.

Pressure data	Nomenclature	Unit	Value
Hydraulic head in test section before start of flow period	h_i	m	–
Hydraulic head in test section before stop of flow period	h_p	m	–
Hydraulic head in test section at stop of recovery period	h_F	m	–
Hydraulic head change during flow period (h_i–h_p)	dh_p	m	–

6.2.76 Observation section KFM09B: 0–616 m

There are no test data available from the observation section KFM09B, 0–616 m.

Comments on the test

There was no registration of pressure in this section during the interference test in HFM14.

6.2.77 Observation section HFM22: 0–222 m

In Figure 6-25 an overview of the pressure responses in observation borehole HFM22 is shown. General test data from the observation section HFM22, 0–222 m, are presented in Table 6-77. According to Table 3-1, the borehole is cased to 12.03 m. The uncased interval of this section is thus c. 12–222 m.

Comments on the test

A clear response to pumping was recorded in this observation section. A total drawdown of c. 1.4 m was measured during the flow period. A drawdown of 0.01 m was reached approximately 193 minutes after the pumping started in HFM14. There was a total recovery of c. 1.1 m during the recovery period that lasted for approximately 6 days.

6.2.78 Observation section HFM20: 0–48 m

In Figure 6-26 an overview of the pressure responses in observation borehole HFM20 is shown. General test data from the observation section HFM20, 0–48 m, are presented in Table 6-78. According to Table 3-1, the borehole is cased to 12.03 m. The uncased interval of this section is thus c. 12–48 m.

Table 6-76. General test data from the observation section KFM09B: 0–616 m during the interference test in HFM14.

Pressure data	Nomenclature	Unit	Value
Hydraulic head in test section before start of flow period	h_i	m	–
Hydraulic head in test section before stop of flow period	h_p	m	–
Hydraulic head in test section at stop of recovery period	h_F	m	–
Hydraulic head change during flow period (h_i–h_p)	dh_p	m	–

Table 6-77. General test data from the observation section HFM22: 0–222 m during the interference test in HFM14.

Pressure data	Nomenclature	Unit	Value
Hydraulic head in test section before start of flow period	h_i	m.a.s.l.	–0.11
Hydraulic head in test section before stop of flow period	h_p	m.a.s.l.	–1.48
Hydraulic head in test section at stop of recovery period	h_F	m.a.s.l.	–0.40
Hydraulic head change during flow period (h_i–h_p)	dh_p	m	1.37

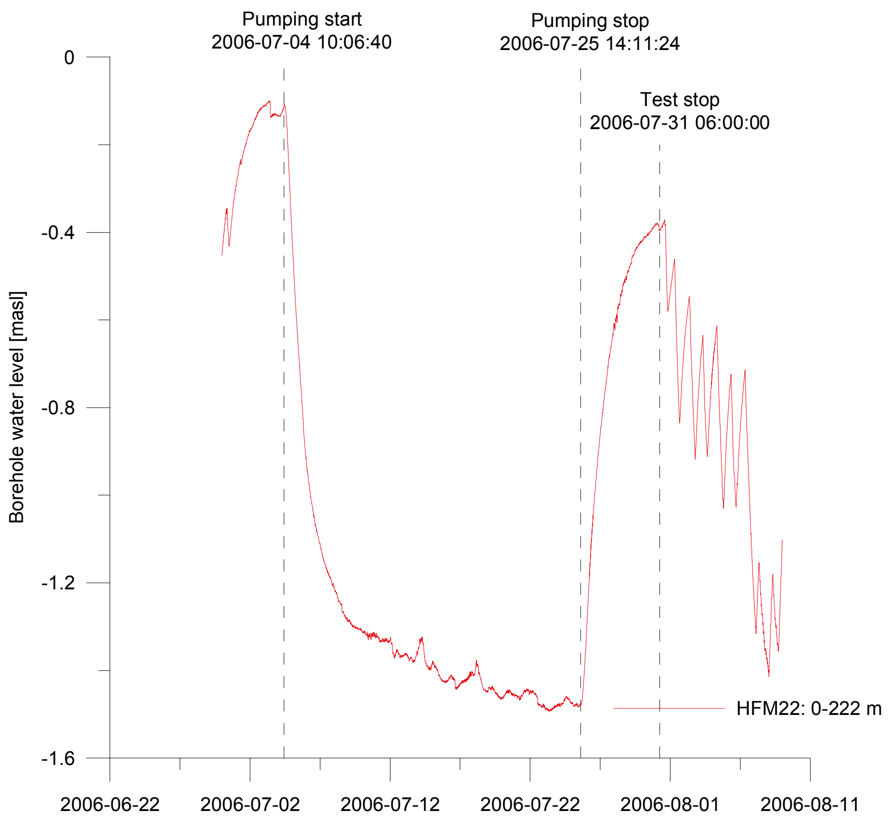


Figure 6-25. *Linear plot of pressure versus time in the observation section in HFM22 during the interference test in HFM14.*

Table 6-78. General test data from the observation section HFM20: 0–48 m during the interference test in HFM14.

Pressure data	Nomenclature	Unit	Value
Hydraulic head in test section before start of flow period	h_i	m.a.s.l.	0.45
Hydraulic head in test section before stop of flow period	h_p	m.a.s.l.	–0.26
Hydraulic head in test section at stop of recovery period	h_F	m.a.s.l.	–0.08
Hydraulic head change during flow period (h_i–h_p)	dh_p	m	0.71

Comments on the test

It is very likely that an effect from the pumping in HFM14 can be seen in this section. The pressure data are not at all stable though and for long periods of time data are missing entirely. This is due to poor transmission via the radio link that is used to transfer data from the site to the HMS-data base. During the first days of drawdown a few measurements have been recorded but later on, and especially during the recovery, nothing can be said about the characteristics of the pressure curve. Still, an approximation of total drawdown can be made from values reported 2006-07-16 18:23. The total drawdown was at that point c. 0.7 m and a drawdown of 0.01 m was reached approximately 17 hours into the flow period.

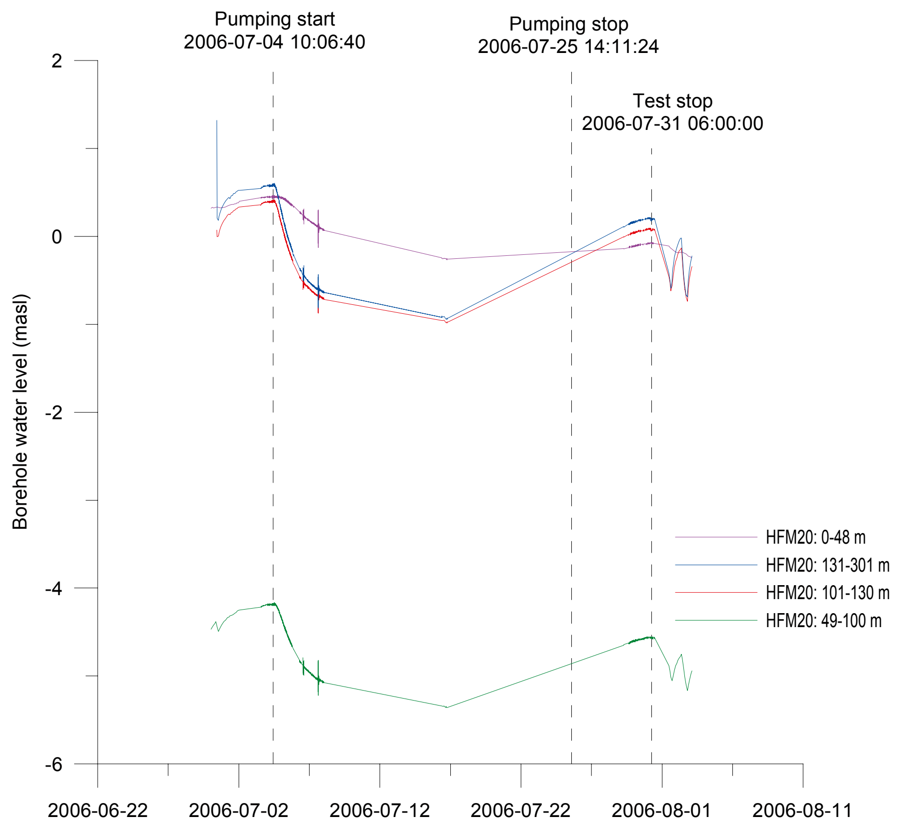


Figure 6-26. *Linear plot of pressure versus time in the observation sections in HFM20 during the interference test in HFM14.*

6.2.79 Observation section HFM20: 49–100 m

In Figure 6-26 an overview of the pressure responses in observation borehole HFM20 is shown. General test data from the observation section HFM20, 49–100 m, are presented in Table 6-79.

Comments on the test

It is very likely that an effect from the pumping in HFM14 can be seen in this section. The pressure data are not at all stable though, and for long periods of time data are missing entirely. This is due to poor transmission via the radio link that is used to transfer data from the site to the HMS-data base. During the first days of drawdown a few measurements have been recorded but later on, and especially during the recovery, nothing can be said about the characteristics of the pressure curve. Still, an approximation of total drawdown can be made from values reported 2006-07-16 18:23. The total drawdown was at that point c. 1.2 m and a drawdown of 0.01 m was reached approximately 5.4 hours into the flow period.

Table 6-79. General test data from the observation section HFM20: 49–100 m during the interference test in HFM14.

Pressure data	Nomenclature	Unit	Value
Hydraulic head in test section before start of flow period	h_i	m.a.s.l.	–4.19
Hydraulic head in test section before stop of flow period	h_p	m.a.s.l.	–5.36
Hydraulic head in test section at stop of recovery period	h_F	m.a.s.l.	–4.56
Hydraulic head change during flow period (h_i–h_p)	dh_p	m	1.17

6.2.80 Observation section HFM20: 101–130 m

In Figure 6-26 an overview of the pressure responses in observation borehole HFM20 is shown. General test data from the observation section HFM20, 101–130 m, are presented in Table 6-80.

Comments on the test

It is very likely that an effect from the pumping in HFM14 can be seen in this section. The pressure data are not at all stable though and for long periods of time data are missing entirely. This is due to poor transmission via the radio link that is used to transfer data from the site to the HMS-data base. During the first days of drawdown a few measurements have been recorded but later on, and especially during the recovery, nothing can be said about the characteristic of the pressure curve. Still, an approximation of total drawdown can be made from values reported 2006-07-16 18:23. The total drawdown was at that point c. 1.4 m and a drawdown of 0.01 m was reached approximately 3.8 hours into the flow period.

6.2.81 Observation section HFM20: 131–301 m

In Figure 6-26 an overview of the pressure responses in observation borehole HFM20 is shown. General test data from the observation section HFM20, 131–301 m, are presented in Table 6-81.

Comments on the test

It is very likely that an effect from the pumping in HFM14 can be seen in this section. The pressure data are not at all stable though and for long periods of time data are missing entirely. This is due to poor transmission via the radio link that is used to transfer data from the site to the HMS-data base. During the first days of drawdown a few measurements have been recorded but later on, and especially during the recovery, nothing can be said about the characteristics of the pressure curve. Still, an approximation of total drawdown can be made from values reported 2006-07-16 18:23. The total drawdown was at that point c. 1.5 m and a drawdown of 0.01 m was reached approximately 3.4 hours into the flow period.

Table 6-80. General test data from the observation section HFM20: 101–130 m during the interference test in HFM14.

Pressure data	Nomenclature	Unit	Value
Hydraulic head in test section before start of flow period	h_i	m.a.s.l.	0.40
Hydraulic head in test section before stop of flow period	h_p	m.a.s.l.	–0.98
Hydraulic head in test section at stop of recovery period	h_F	m.a.s.l.	0.07
Hydraulic head change during flow period (h_i–h_p)	dh_p	m	1.38

Table 6-81. General test data from the observation section HFM20: 131–301 m during the interference test in HFM14.

Pressure data	Nomenclature	Unit	Value
Hydraulic head in test section before start of flow period	h_i	m.a.s.l.	0.58
Hydraulic head in test section before stop of flow period	h_p	m.a.s.l.	–0.94
Hydraulic head in test section at stop of recovery period	h_F	m.a.s.l.	0.19
Hydraulic head change during flow period (h_i–h_p)	dh_p	m	1.52

6.2.82 Observation section KFM08A: 0–1,001 m

There are no test data available from the observation section KFM08A, 0–1,001 m.

Comments on the test

There was no registration of pressure in this section during the interference test in HFM14.

6.2.83 Observation section KFM08B: 0–70 m

In Figure 6-27 an overview of the pressure responses in observation borehole KFM08B is shown. General test data from the observation section KFM08B, 0–70 m, are presented in Table 6-83. According to Table 3-1, the borehole is cased to 5.58 m. The uncased interval of this section is thus c. 6–70 m.

Table 6-82. General test data from the observation section KFM08A: 0–1,001 m during the interference test in HFM14.

Pressure data	Nomenclature	Unit	Value
Hydraulic head in test section before start of flow period	h_i	m	–
Hydraulic head in test section before stop of flow period	h_p	m	–
Hydraulic head in test section at stop of recovery period	h_F	m	–
Hydraulic head change during flow period (h_i–h_p)	dh_p	m	–

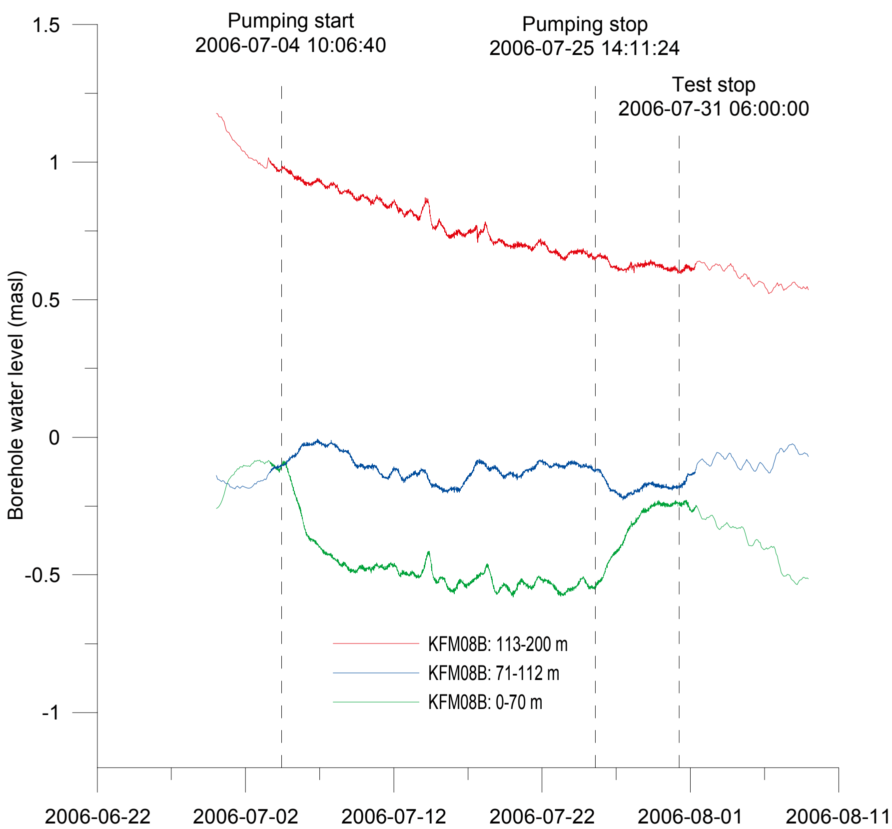


***Figure 6-27.** Linear plot of pressure versus time in the observation sections in KFM08B during the interference test in HFM14.*

Table 6-83. General test data from the observation section KFM08B: 0–70 m during the interference test in HFM14.

Pressure data	Nomenclature	Unit	Value
Hydraulic head in test section before start of flow period	h_i	m.a.s.l.	–0.11
Hydraulic head in test section before stop of flow period	h_p	m.a.s.l.	–0.54
Hydraulic head in test section at stop of recovery period	h_F	m.a.s.l.	–0.24
Hydraulic head change during flow period (h_i–h_p)	dh_p	m	0.43

Comments on the test

This section is likely to be influenced by the pumping in HFM14. The response is not very strong but changes in the pressure are evident in connection to start and stop of pumping. A total drawdown of c. 0.4 m was registered during the flow period and a drawdown of 0.01 m was reached approximately 9.5 hours after the pumping started in HFM14. There was a total recovery of c. 0.3 m during the recovery period that lasted for approximately 6 days.

6.2.84 Observation section KFM08B: 71–112 m

In Figure 6-27 an overview of the pressure responses in observation borehole KFM08B is shown. General test data from the observation section KFM08B, 71–112 m, are presented in Table 6-84.

Comments on the test

No response to pumping is detected in this section. It is unlikely that this section is influenced by pumping in HFM14. The pressure in the test section is displaying a very erratic behaviour which does not seem to be connected to the pumping in HFM14.

6.2.85 Observation section KFM08B: 113–200 m

In Figure 6-27 an overview of the pressure responses in observation borehole KFM08B is shown. General test data from the observation section KFM08B, 113–200 m, are presented in Table 6-85.

Table 6-84. General test data from the observation section KFM08B: 71–112 m during the interference test in HFM14.

Pressure data	Nomenclature	Unit	Value
Hydraulic head in test section before start of flow period	h_i	m.a.s.l.	–0.10
Hydraulic head in test section before stop of flow period	h_p	m.a.s.l.	–0.12
Hydraulic head in test section at stop of recovery period	h_F	m.a.s.l.	–0.18
Hydraulic head change during flow period (h_i–h_p)	dh_p	m	0.02

Table 6-85. General test data from the observation section KFM08B: 113–200 m during the interference test in HFM14.

Pressure data	Nomenclature	Unit	Value
Hydraulic head in test section before start of flow period	h_i	m.a.s.l.	0.97
Hydraulic head in test section before stop of flow period	h_p	m.a.s.l.	0.65
Hydraulic head in test section at stop of recovery period	h_F	m.a.s.l.	0.60
Hydraulic head change during flow period (h_i–h_p)	dh_p	m	0.32

Comments on the test

No clear response to pumping is detected in this section. It is unlikely that this section is influenced by pumping in HFM14. Although the pressure is decreasing during the flow period, there is a trend of decreasing pressure prior to the start of pumping which makes it hard to distinguish the possible effects of pumping from a trend of some other origin. There is however a slight change in the slope of the pressure curve at the start of the recovery period which may indicate a slight influence from the pumping borehole.

6.2.86 Observation section HFM25: 0–188 m

There are no test data available from the observation section HFM25, 0–188 m.

Comments on the test

There was no registration of pressure in this section during the interference test in HFM14.

6.2.87 Observation section KFM09A: 0–800 m

There are no test data available from the observation section KFM09A, 0–800 m.

Comments on the test

There was no registration of pressure in this section during the interference test in HFM14.

6.2.88 Observation section HFM28: 0–151 m

In Figure 6-28 an overview of the pressure responses in observation borehole HFM28 is shown. General test data from the observation section HFM28, 0–151 m, are presented in Table 6-88. According to Table 3-1, the borehole is cased to 12.03 m. The uncased interval of this section is thus c. 12–151 m.

Table 6-86. General test data from the observation section HFM25: 0–188 m during the interference test in HFM14.

Pressure data	Nomenclature	Unit	Value
Hydraulic head in test section before start of flow period	h_i	m	–
Hydraulic head in test section before stop of flow period	h_p	m	–
Hydraulic head in test section at stop of recovery period	h_F	m	–
Hydraulic head change during flow period (h_i–h_p)	dh_p	m	–

Table 6-87. General test data from the observation section KFM09A: 0–800 m during the interference test in HFM14.

Pressure data	Nomenclature	Unit	Value
Hydraulic head in test section before start of flow period	h_i	m	–
Hydraulic head in test section before stop of flow period	h_p	m	–
Hydraulic head in test section at stop of recovery period	h_F	m	–
Hydraulic head change during flow period (h_i–h_p)	dh_p	m	–

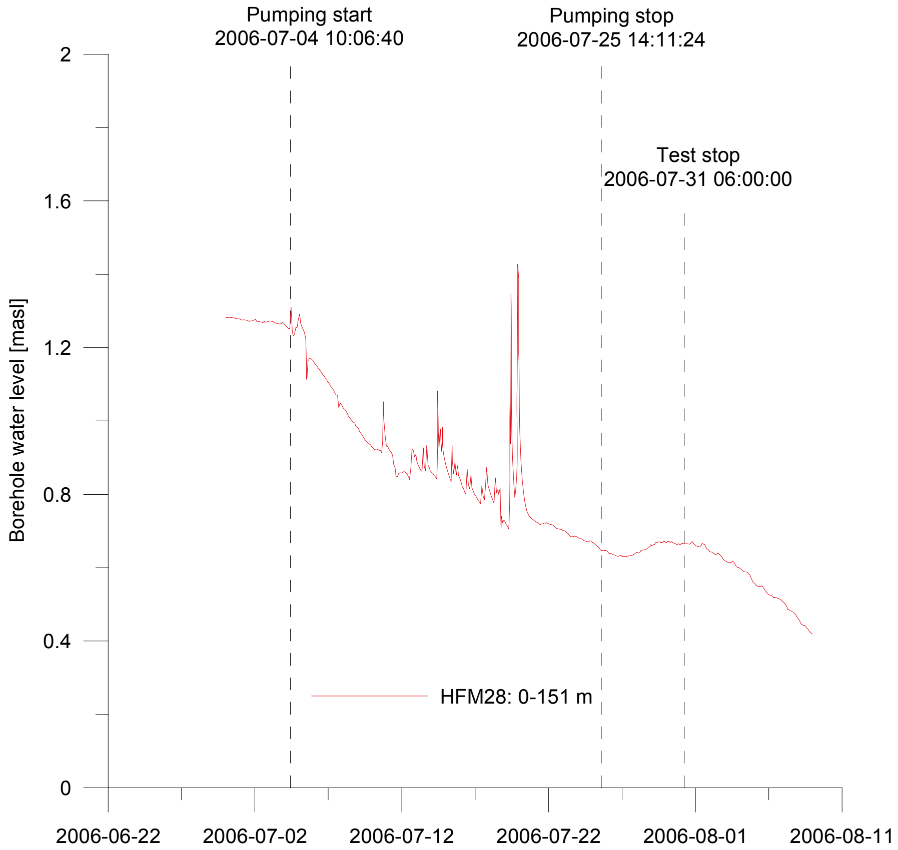


Figure 6-28. *Linear plot of pressure versus time in the observation section in HFM28 during the interference test in HFM14.*

Table 6-88. General test data from the observation section HFM28: 0–151 m during the interference test in HFM14.

Pressure data	Nomenclature	Unit	Value
Hydraulic head in test section before start of flow period	h_i	m.a.s.l.	1.25
Hydraulic head in test section before stop of flow period	h_p	m.a.s.l.	0.65
Hydraulic head in test section at stop of recovery period	h_F	m.a.s.l.	0.67
Hydraulic head change during flow period (h_i–h_p)	dh_p	m	0.60

Comments on the test

This section is clearly influenced by the pumping in HFM14. A total drawdown of c. 0.6 m was registered during the flow period and a drawdown of 0.01 m was reached approximately 23 hours after the pumping started in HFM14. There was a total recovery of c. 0.02 m during the recovery period that lasted for approximately 6 days.

Pressure data from this section were only available on a late stage. The data may therefore not be included in all tables and figures.

6.2.89 Observation section HFM23: 0–212 m

In Figure 6-29 an overview of the pressure responses in observation borehole HFM23 is shown. General test data from the observation section HFM28, 0–212 m, are presented in Table 6-89. According to Table 3-1, the borehole is cased to 20.80 m. The uncased interval of this section is thus c. 21–212 m.

Comments on the test

There are indications that this section is responding to the pumping in HFM14. The pressure in the section is decreasing prior to the start of pumping, but the rate of change is visibly changing at the start of pumping, and later also after stop of pumping which is interpreted as an effect from the pumping. A total drawdown of c. 0.5 m was registered during the flow period and a drawdown of 0.01 m was reached approximately 19 hours after the pumping started in HFM14. The total measured recovery during the c. 6 days recovery period was actually negative. The recovery may be masked by the continued naturally decreasing pressure trend.

Table 6-89. General test data from the observation section HFM23: 0–212 m during the interference test in HFM14.

Pressure data	Nomenclature	Unit	Value
Hydraulic head in test section before start of flow period	h_i	m.a.s.l.	1.07
Hydraulic head in test section before stop of flow period	h_p	m.a.s.l.	0.54
Hydraulic head in test section at stop of recovery period	h_F	m.a.s.l.	0.53
Hydraulic head change during flow period (h_i–h_p)	dh_p	m	0.53

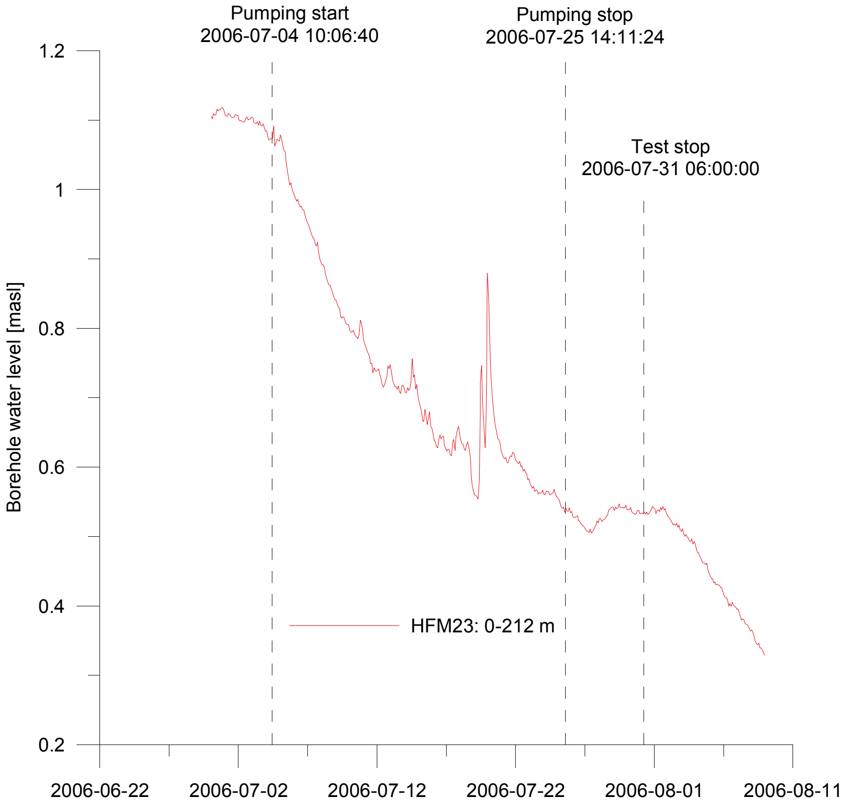


***Figure 6-29.** Linear plot of pressure versus time in the observation section in HFM23 during the interference test in HFM14.*

6.2.90 Observation section HFM29: 0–200 m

In Figure 6-30 an overview of the pressure responses in observation borehole HFM29 is shown. General test data from the observation section HFM29, 0–200 m, are presented in Table 6-90. According to Table 3-1, the borehole is cased to 9.03 m. The uncased interval of this section is thus c. 9–200 m.

Comments on the test

Weak indications of a response to pumping were detected in this section. The total drawdown during the flow period was c. 0.6 m. A drawdown of 0.01 m was reached approximately 31 hours after the pumping started in HFM14. There was no actual pressure recovery during the recovery period lasting for approximately 6 days. Only the fact that the pressure is flatting out in conjunction with the stop of pumping provides an indication of the presence of a hydraulic connection with the pumping borehole. The recovery may be masked by the continued naturally decreasing pressure trend.

Table 6-90. General test data from the observation section HFM29: 0–200 m during the interference test in HFM14.

Pressure data	Nomenclature	Unit	Value
Hydraulic head in test section before start of flow period	h_i	m.a.s.l.	1.34
Hydraulic head in test section before stop of flow period	h_p	m.a.s.l.	0.78
Hydraulic head in test section at stop of recovery period	h_F	m.a.s.l.	0.75
Hydraulic head change during flow period (h_i–h_p)	dh_p	m	0.56

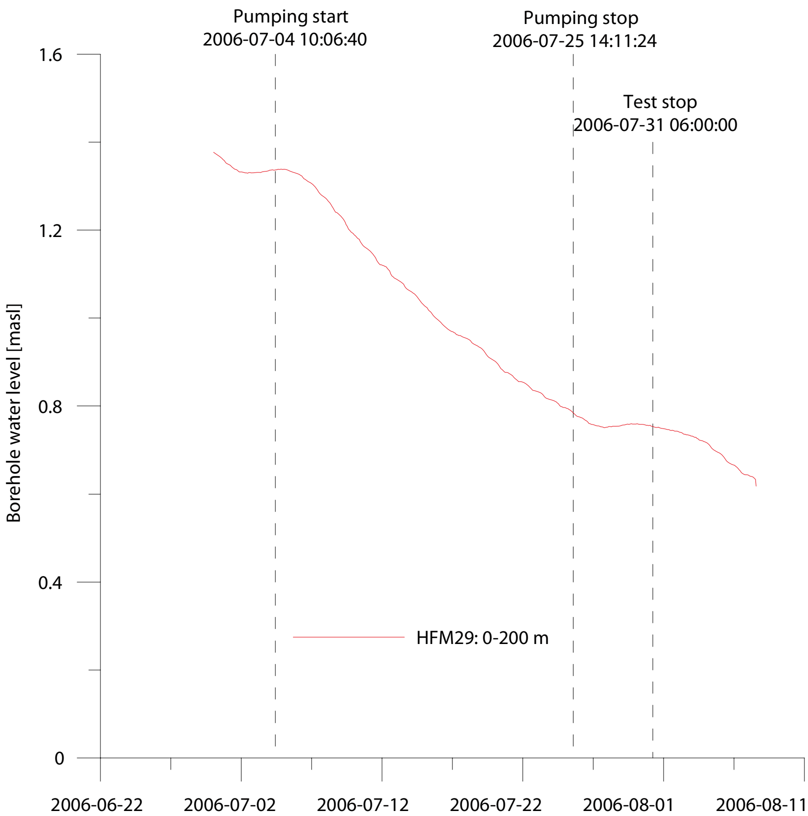


***Figure 6-30.** Linear plot of pressure versus time in the observation section in HFM29 during the interference test in HFM14.*

6.2.91 Observation section HFM17: 0–211 m

In Figure 6-31 an overview of the pressure responses in observation borehole HFM17 is shown. General test data from the observation section HFM17, 0–211 m, are presented in Table 6-91. According to Table 3-1, the borehole is cased to 8.00 m. The uncased interval of this section is thus c. 8–211 m.

Comments on the test

Weak indications of a response to pumping were detected in this section. The total drawdown during the flow period was c. 0.5 m. A drawdown of 0.01 m was reached approximately 9 hours after the pumping started in HFM14. The pressure was decreasing already prior to the pump start, but there is still a change in the slope of the pressure curve in connection with the start of pumping. There is also a slight recovery of c. 0.05 m measured during the recovery period that lasted for approximately 6 days. The recovery may be masked by the continued naturally decreasing pressure trend.

Table 6-91. General test data from the observation section HFM17: 0–211 m during the interference test in HFM14.

Pressure data	Nomenclature	Unit	Value
Hydraulic head in test section before start of flow period	h_i	m.a.s.l.	0.43
Hydraulic head in test section before stop of flow period	h_p	m.a.s.l.	–0.03
Hydraulic head in test section at stop of recovery period	h_F	m.a.s.l.	0.02
Hydraulic head change during flow period (h_i–h_p)	dh_p	m	0.46

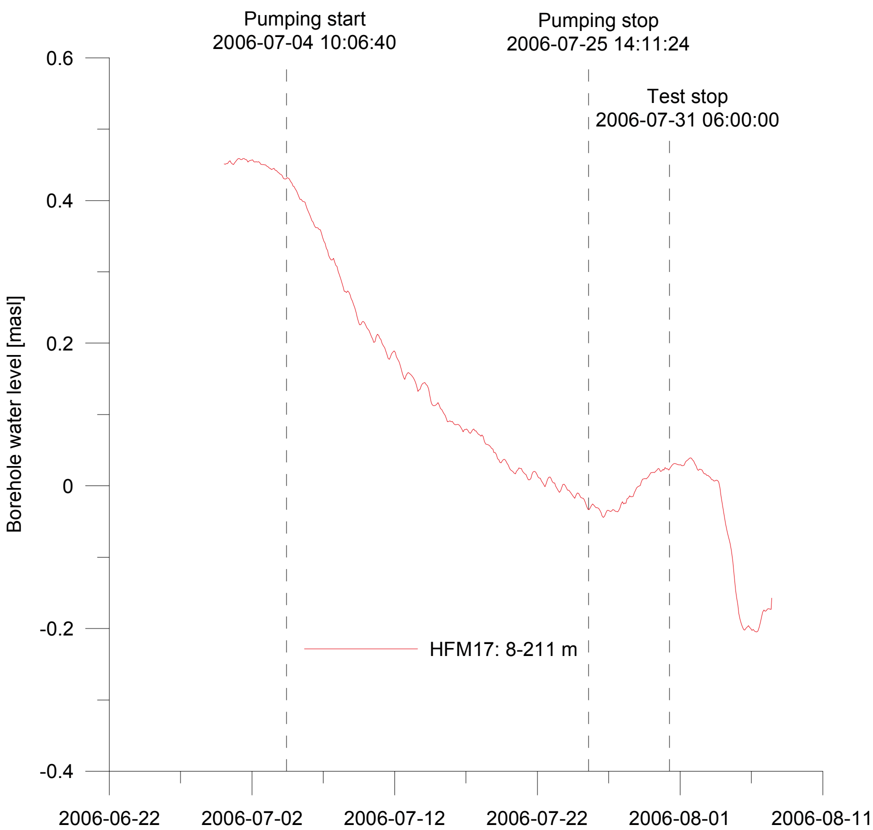


***Figure 6-31.** Linear plot of pressure versus time in the observation section in HFM17 during the interference test in HFM14.*

6.2.92 Observation section KFM02A: 0–132 m

In Figure 6-32 an overview of the pressure responses in observation borehole KFM02A is shown. General test data from the observation section KFM02A, 0–132 m, are presented in Table 6-92. According to Table 3-1, the borehole is cased to 11.80 m. The uncased interval of this section is thus c. 12–132 m.

Comments on the test

A relatively clear response to pumping was recorded in this section. The total drawdown during the flow period was c. 0.6 m. A drawdown of 0.01 m was reached approximately 17 hours after the pumping started in HFM14. There was a total recovery of c. 0.1 m during the recovery period that lasted for approximately 6 days.

Table 6-92. General test data from the observation section KFM02A: 0–132 m during the interference test in HFM14.

Pressure data	Nomenclature	Unit	Value
Hydraulic head in test section before start of flow period	h_i	m.a.s.l.	–0.01
Hydraulic head in test section before stop of flow period	h_p	m.a.s.l.	–0.57
Hydraulic head in test section at stop of recovery period	h_F	m.a.s.l.	–0.44
Hydraulic head change during flow period (h_i–h_p)	dh_p	m	0.56

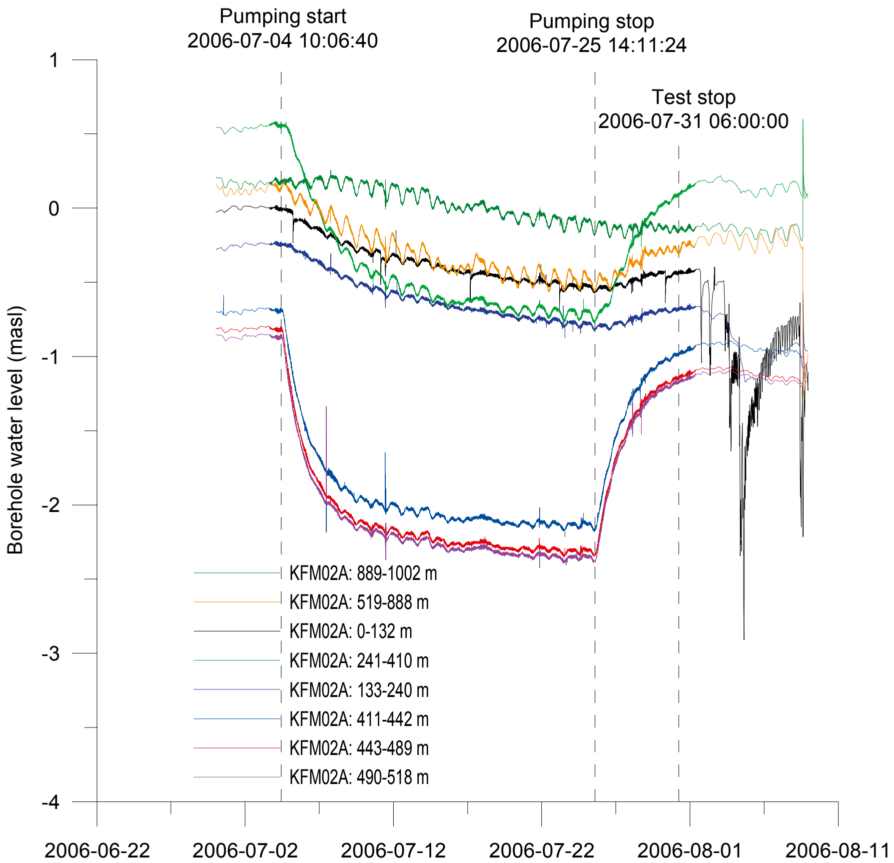


Figure 6-32. *Linear plot of pressure versus time in the observation sections in KFM02A during the interference test in HFM14.*

6.2.93 Observation section KFM02A: 133–240 m

In Figure 6-32 an overview of the pressure responses in observation borehole KFM02A is shown. General test data from the observation section KFM02A, 133–240 m, are presented in Table 6-93.

Comments on the test

A relatively clear response to pumping was recorded in this section. The total drawdown during the flow period was c. 0.6 m. A drawdown of 0.01 m was reached approximately 17 hours after the pumping started in HFM14. There was a total recovery of c. 0.1 m during the recovery period that lasted for approximately 6 days.

6.2.94 Observation section KFM02A: 241–410 m

In Figure 6-32 an overview of the pressure responses in observation borehole KFM02A is shown. General test data from the observation section KFM02A, 241–410 m, are presented in Table 6-94.

Comments on the test

A clear response to pumping was recorded in this section. The total drawdown during the flow period was c. 1.3 m. A drawdown of 0.01 m was reached approximately 9.5 hours after the pumping started in HFM14. There was a total recovery of c. 0.7 m during the recovery period that lasted for approximately 6 days.

Table 6-93. General test data from the observation section KFM02A: 133–240 m during the interference test in HFM14.

Pressure data	Nomenclature	Unit	Value
Hydraulic head in test section before start of flow period	h_i	m.a.s.l.	–0.25
Hydraulic head in test section before stop of flow period	h_p	m.a.s.l.	–0.81
Hydraulic head in test section at stop of recovery period	h_F	m.a.s.l.	–0.68
Hydraulic head change during flow period (h_i–h_p)	dh_p	m	0.56

Table 6-94. General test data from the observation section KFM02A: 241–410 m during the interference test in HFM14.

Pressure data	Nomenclature	Unit	Value
Hydraulic head in test section before start of flow period	h_i	m.a.s.l.	0.55
Hydraulic head in test section before stop of flow period	h_p	m.a.s.l.	–0.76
Hydraulic head in test section at stop of recovery period	h_F	m.a.s.l.	–0.09
Hydraulic head change during flow period (h_i–h_p)	dh_p	m	1.31

6.2.95 Observation section KFM02A: 411–442 m

In Figure 6-32 an overview of the pressure responses in observation borehole KFM02A is shown. General test data from the observation section KFM02A, 411–442 m, are presented in Table 6-95.

Comments on the test

A clear response to pumping was recorded in this section. The total drawdown during the flow period was c. 1.5 m. A drawdown of 0.01 m was reached approximately 173 minutes after the pumping started in HFM14. There was a total recovery of c. 1.2 m during the recovery period that lasted for approximately 6 days.

6.2.96 Observation section KFM02A: 443–489 m

In Figure 6-32 an overview of the pressure responses in observation borehole KFM02A is shown. General test data from the observation section KFM02A, 443–489 m, are presented in Table 6-96.

Comments on the test

A clear response to pumping was recorded in this section. The total drawdown during the flow period was c. 1.5 m. A drawdown of 0.01 m was reached approximately 123 minutes after the pumping started in HFM14. There was a total recovery of c. 1.2 m during the recovery period that lasted for approximately 6 days.

Table 6-95. General test data from the observation section KFM02A: 411–442 m during the interference test in HFM14.

Pressure data	Nomenclature	Unit	Value
Hydraulic head in test section before start of flow period	h_i	m.a.s.l.	–0.69
Hydraulic head in test section before stop of flow period	h_p	m.a.s.l.	–2.16
Hydraulic head in test section at stop of recovery period	h_F	m.a.s.l.	–0.99
Hydraulic head change during flow period (h_i–h_p)	dh_p	m	1.47

Table 6-96. General test data from the observation section KFM02A: 443–489 m during the interference test in HFM14.

Pressure data	Nomenclature	Unit	Value
Hydraulic head in test section before start of flow period	h_i	m.a.s.l.	–0.82
Hydraulic head in test section before stop of flow period	h_p	m.a.s.l.	–2.34
Hydraulic head in test section at stop of recovery period	h_F	m.a.s.l.	–1.14
Hydraulic head change during flow period (h_i–h_p)	dh_p	m	1.52

6.2.97 Observation section KFM02A: 490–518 m

In Figure 6-32 an overview of the pressure responses in observation borehole KFM02A is shown. General test data from the observation section KFM02A, 490–518 m, are presented in Table 6-97.

Comments on the test

A clear response to pumping was recorded in this section. The total drawdown during the flow period was c. 1.5 m. A drawdown of 0.01 m was reached approximately 78 minutes after the pumping started in HFM14. There was a total recovery of c. 1.2 m during the recovery period that lasted for approximately 6 days.

6.2.98 Observation section KFM02A: 519–888 m

In Figure 6-32 an overview of the pressure responses in observation borehole KFM02A is shown. General test data from the observation section KFM02A, 519–888 m, are presented in Table 6-98.

Comments on the test

A relatively clear response to pumping was recorded in this section. The total drawdown during the flow period was c. 0.7 m. A drawdown of 0.01 m was reached approximately 14 hours after the pumping started in HFM14. There was a total recovery of c. 0.3 m during the recovery period that lasted for approximately 6 days.

Table 6-97. General test data from the observation section KFM02A: 490–518 m during the interference test in HFM14.

Pressure data	Nomenclature	Unit	Value
Hydraulic head in test section before start of flow period	h_i	m.a.s.l.	–0.87
Hydraulic head in test section before stop of flow period	h_p	m.a.s.l.	–2.38
Hydraulic head in test section at stop of recovery period	h_F	m.a.s.l.	–1.17
Hydraulic head change during flow period (h_i–h_p)	dh_p	m	1.51

Table 6-98. General test data from the observation section KFM02A: 519–888 m during the interference test in HFM14.

Pressure data	Nomenclature	Unit	Value
Hydraulic head in test section before start of flow period	h_i	m.a.s.l.	0.13
Hydraulic head in test section before stop of flow period	h_p	m.a.s.l.	–0.56
Hydraulic head in test section at stop of recovery period	h_F	m.a.s.l.	–0.30
Hydraulic head change during flow period (h_i–h_p)	dh_p	m	0.69

6.2.99 Observation section KFM02A: 889–1,002 m

In Figure 6-32 an overview of the pressure responses in observation borehole KFM02A is shown. General test data from the observation section KFM02A, 889–1,002 m, are presented in Table 6-99.

Comments on the test

It is not likely that this section responded to the pumping in HFM14. Even though there is a drawdown recorded, it is probable that it is only an effect of a natural trend. Still, the total drawdown during the flow period was c. 0.4 m. There was a total recovery of c. 0.03 m during the recovery period that lasted for approximately 6 days. It should be noted that the tidal effects make it difficult to deduce representative values on the hydraulic head at the start and stop of the flow period, respectively.

6.2.100 Observation section HFM05: 0–200 m

In Figure 6-33 an overview of the pressure responses in observation borehole HFM05 is shown. General test data from the observation section HFM05, 0–200 m, are presented in Table 6-100. According to Table 3-1, the borehole is cased to 11.87 m. The uncased interval of this section is thus c. 12–200 m.

Comments on the test

The pressure data from this section displays a periodic behaviour and even though it is unlikely that the section is affected by the pumping in HFM14 there may be a response disguised behind the general appearance of the pressure curve. It is however probably more likely that the possible trend is natural and not caused by the pumping in HFM14. No real conclusion can be drawn about this observation section. The reason for the displayed behaviour is not known.

Table 6-99. General test data from the observation section KFM02A: 889–1,002 m during the interference test in HFM14.

Pressure data	Nomenclature	Unit	Value
Hydraulic head in test section before start of flow period	h_i	m.a.s.l.	0.17
Hydraulic head in test section before stop of flow period	h_p	m.a.s.l.	–0.18
Hydraulic head in test section at stop of recovery period	h_F	m.a.s.l.	–0.15
Hydraulic head change during flow period (h_i–h_p)	dh_p	m	0.35

Table 6-100. General test data from the observation section HFM05: 0–200 m during the interference test in HFM14.

Pressure data	Nomenclature	Unit	Value
Hydraulic head in test section before start of flow period	h_i	m.a.s.l.	0.25
Hydraulic head in test section before stop of flow period	h_p	m.a.s.l.	–0.10
Hydraulic head in test section at stop of recovery period	h_F	m.a.s.l.	–0.20
Hydraulic head change during flow period (h_i–h_p)	dh_p	m	0.35

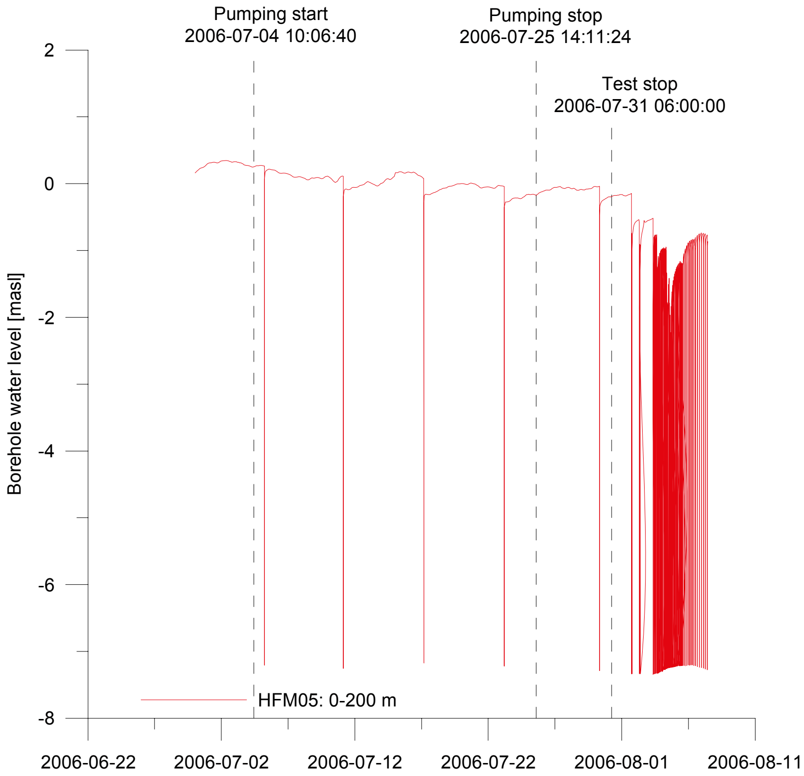


Figure 6-33. *Linear plot of pressure versus time in the observation section in HFM05 during the interference test in HFM14.*

6.2.101 Observation section HFM04: 0–57 m

In Figure 6-34 an overview of the pressure responses in observation borehole HFM04 is shown. General test data from the observation section HFM04, 0–57 m, are presented in Table 6-101. According to Table 3-1, the borehole is cased to 12.12 m. The uncased interval of this section is thus c. 12–57 m.

Comments on the test

The pressure data from this section are a little scattered and strongly influenced by tidal effects rendering interpretation more difficult. It seems clear however, that this section is affected by the pumping in HFM14. The total drawdown during the flow period was c. 0.6 m. A drawdown of 0.01 m was reached approximately 17 hours after the pumping started in HFM14. Only a change of slope in the pressure curve indicates that the recovery period has started. No actual pressure recovery is registered.

Table 6-101. General test data from the observation section HFM04: 0–57 m during the interference test in HFM14.

Pressure data	Nomenclature	Unit	Value
Hydraulic head in test section before start of flow period	h_i	m.a.s.l.	0.84
Hydraulic head in test section before stop of flow period	h_p	m.a.s.l.	0.26
Hydraulic head in test section at stop of recovery period	h_F	m.a.s.l.	0.24
Hydraulic head change during flow period (h_i–h_p)	dh_p	m	0.58

6.2.102 Observation section HFM04: 58–66 m

In Figure 6-34 an overview of the pressure responses in observation borehole HFM04 is shown. General test data from the observation section HFM04, 58–66 m, are presented in Table 6-102.

Comments on the test

A relatively clear response to pumping was recorded in this section. The total drawdown during the flow period was c. 0.5 m and a drawdown of 0.01 m was reached approximately 15 hours after the pumping started in HFM14. There was a total recovery of c. 0.1 m during the recovery period that lasted for approximately 6 days.

Table 6-102. General test data from the observation section HFM04: 58–66 m during the interference test in HFM14.

Pressure data	Nomenclature	Unit	Value
Hydraulic head in test section before start of flow period	h_i	m.a.s.l.	0.51
Hydraulic head in test section before stop of flow period	h_p	m.a.s.l.	0.014
Hydraulic head in test section at stop of recovery period	h_F	m.a.s.l.	0.15
Hydraulic head change during flow period (h_i–h_p)	dh_p	m	0.50

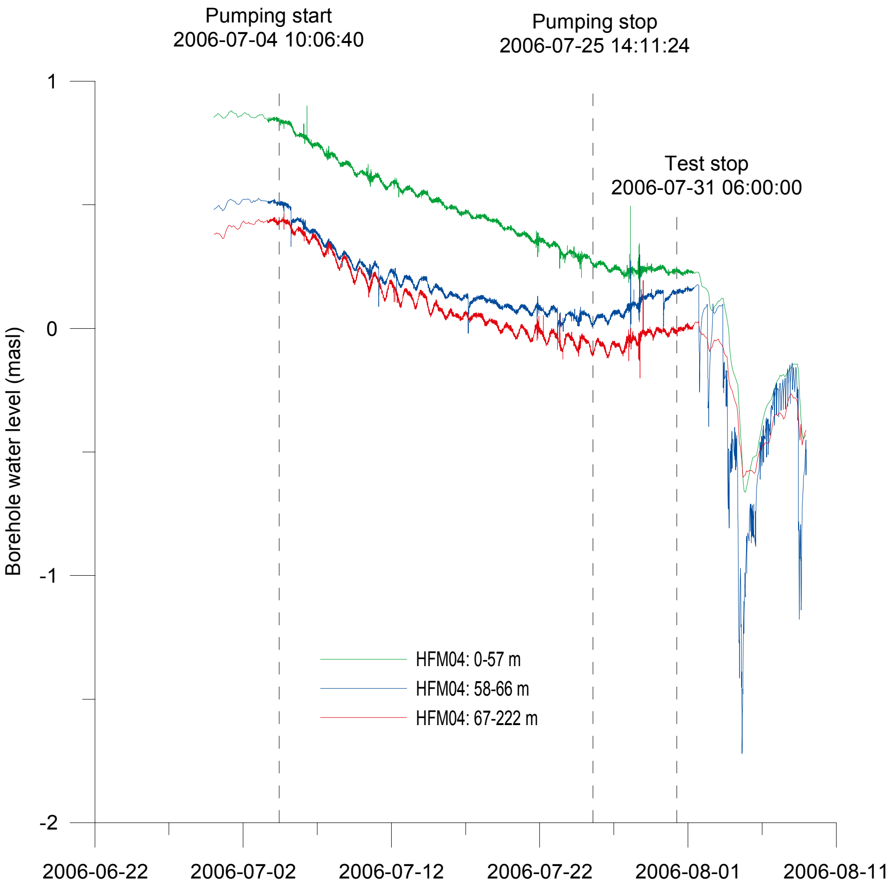


Figure 6-34. *Linear plot of pressure versus time in the observation sections in HFM04 during the interference test in HFM14.*

6.2.103 Observation section HFM04: 67–222 m

In Figure 6-34 an overview of the pressure responses in observation borehole HFM04 is shown. General test data from the observation section HFM04, 67–222 m, are presented in Table 6-103.

Comments on the test

A relatively clear response to pumping was recorded in this section. The total drawdown during the flow period was c. 0.5 m and a drawdown of 0.01 m was reached approximately 17.5 hours after the pumping started in HFM14. There was a total recovery of c. 0.09 m during the recovery period that lasted for approximately 6 days.

6.2.104 Observation section HFM12: 0–56.5 m

In Figure 6-35 an overview of the pressure responses in observation borehole HFM12 is shown. General test data from the observation section HFM12, 0–56.5 m, are presented in Table 6-104. According to Table 3-1, the borehole is cased to 14.90 m. The uncased interval of this section is thus c. 15–57 m.

Comments on the test

The pressure data from this observation section are very noisy. Furthermore, data are completely missing for long periods of time. It is not possible to make any reliable interpretation from these data. From inspection of the pressure curve however, Figure 6-35, it seems probable that the section is slightly influenced by pumping in HFM14. The reason for the missing data are due to poor transmission via the radio link that is used to transfer data from the site to the HMS-data base. Since a lot of data are missing the pressure values at pump stop and test stop presented in Table 6-104 are from 2006-07-18 09:32 and 2006-06-31 09:05.

Table 6-103. General test data from the observation section HFM04: 67–222 m during the interference test in HFM14.

Pressure data	Nomenclature	Unit	Value
Hydraulic head in test section before start of flow period	h_i	m.a.s.l.	0.43
Hydraulic head in test section before stop of flow period	h_p	m.a.s.l.	–0.10
Hydraulic head in test section at stop of recovery period	h_F	m.a.s.l.	–0.01
Hydraulic head change during flow period (h_i–h_p)	dh_p	m	0.53

Table 6-104. General test data from the observation section HFM12: 0–56.5 m during the interference test in HFM14.

Pressure data	Nomenclature	Unit	Value
Hydraulic head in test section before start of flow period	h_i	m.a.s.l.	6.06
Hydraulic head in test section before stop of flow period	h_p	m.a.s.l.	5.81
Hydraulic head in test section at stop of recovery period	h_F	m.a.s.l.	5.62
Hydraulic head change during flow period (h_i–h_p)	dh_p	m	0.25

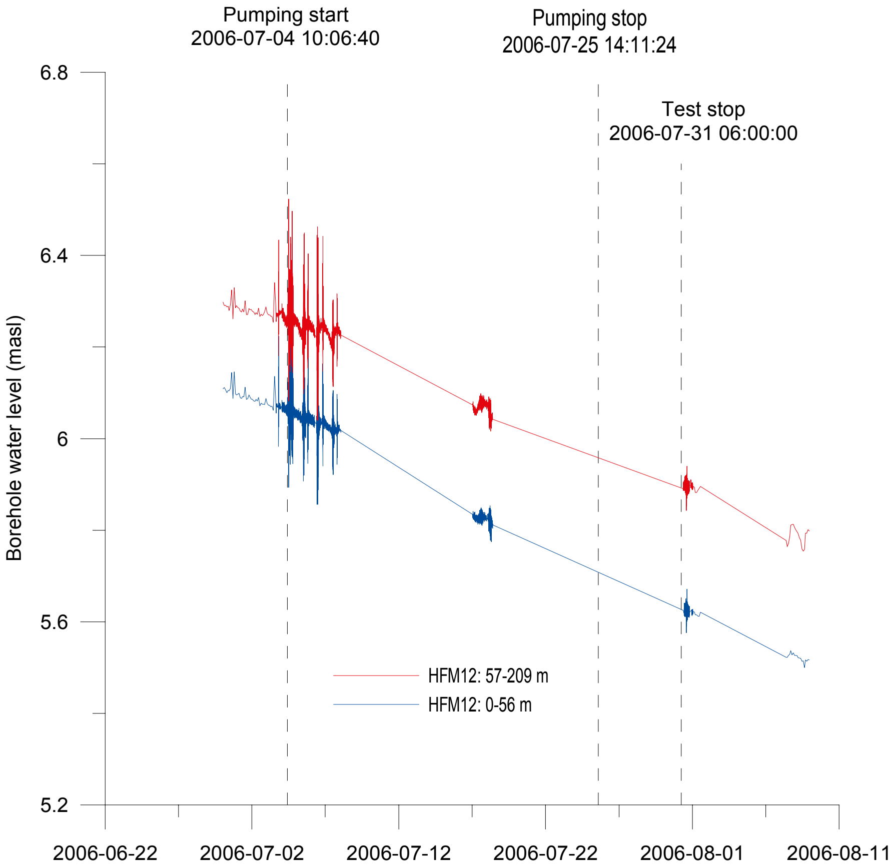


***Figure 6-35.** Linear plot of pressure versus time in the observation sections in HFM12 during the interference test in HFM14.*

6.2.105 Observation section HFM12: 57.5–210 m

In Figure 6-35 an overview of the pressure responses in observation borehole HFM12 is shown. General test data from the observation section HFM12, 57.5–210 m, are presented in Table 6-105.

Comments on the test

The pressure data from this observation section are very noisy. Furthermore, data are completely missing for long periods of time. It is not possible to make any reliable interpretation from these data. From inspection of the pressure curve however, Figure 6-35, it seems probable that the section is slightly influenced by pumping in HFM14. The reason for the missing data are due to poor transmission via the radio link that is used to transfer data from the site to the HMS-data base. Since a lot of data are missing the pressure values at pump stop and test stop presented in Table 6-105 are from 2006-07-18 09:32 and 2006-06-31 09:05.

Table 6-105. General test data from the observation section HFM12: 57.5–210 m during the interference test in HFM14.

Pressure data	Nomenclature	Unit	Value
Hydraulic head in test section before start of flow period	h_i	m.a.s.l.	6.26
Hydraulic head in test section before stop of flow period	h_p	m.a.s.l.	6.04
Hydraulic head in test section at stop of recovery period	h_F	m.a.s.l.	5.89
Hydraulic head change during flow period (h_i–h_p)	dh_p	m	0.22

6.2.106 Observation section HFM11: 0–53 m

In Figure 6-36 an overview of the pressure responses in observation borehole HFM11 is shown. General test data from the observation section HFM11, 0–53 m, are presented in Table 6-106. According to Table 3-1, the borehole is cased to 11.90 m. The uncased interval of this section is thus c. 12–53 m.

Comments on the test

The pressure data from this observation section are very noisy. Furthermore, data are completely missing for long periods of time. It is not possible to make any reliable interpretation from these data. From inspection of the pressure curve however, Figure 6-36, it seems possible that the section is slightly influenced by pumping in HFM14. The pressure prior to pumping start displays a decreasing trend making it even more difficult to say anything about the possible response in this section. The reason for the missing data are due to poor transmission via the radio link that is used to transfer data from the site to the HMS-data base. Since a lot of data are missing the pressure value at pump stop presented in Table 6-106 is from 2006-07-18.

Table 6-106. General test data from the observation section HFM11: 0–53 m during the interference test in HFM14.

Pressure data	Nomenclature	Unit	Value
Hydraulic head in test section before start of flow period	h_i	m	6.07
Hydraulic head in test section before stop of flow period	h_p	m	5.79
Hydraulic head in test section at stop of recovery period	h_F	m	5.56
Hydraulic head change during flow period (h_i–h_p)	dh_p	m	0.51

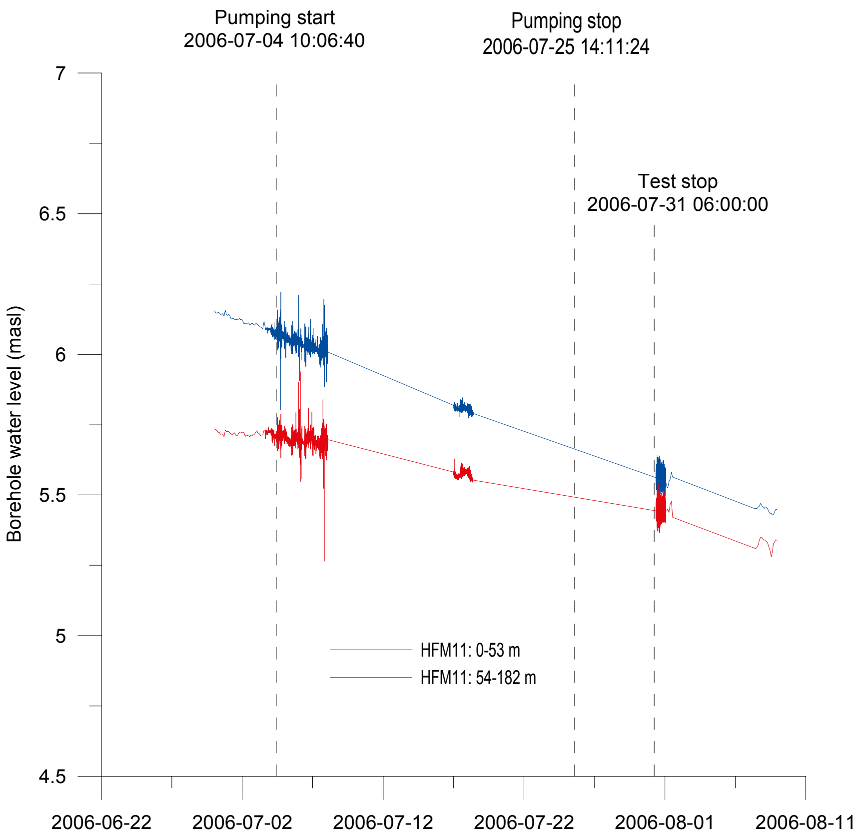


Figure 6-36. *Linear plot of pressure versus time in the observation sections in HFM11 during the interference test in HFM14.*

6.2.107 Observation section HFM11: 54–182 m

In Figure 6-36 an overview of the pressure responses in observation borehole HFM11 is shown. General test data from the observation section HFM11, 54–182 m, are presented in Table 6-107.

Comments on the test

The pressure data from this observation section are very noisy. Furthermore, data are completely missing for long periods of time. It is not possible to make any reliable interpretation from these data. From inspection of the pressure curve however, Figure 6-36, it seems probable that the section is slightly influenced by pumping in HFM14. The reason for the missing data is due to poor transmission via the radio link that is used to transfer data from the site to the HMS-data base. Since a lot of data are missing the pressure value at pump stop presented in Table 6-107 is from 2006-07-18.

6.2.108 Observation section HFM18: 0–27 m

In Figure 6-37 an overview of the pressure responses in observation borehole HFM18 is shown. General test data from the observation section HFM18, 0–27 m, are presented in Table 6-108. According to Table 3-1, the borehole is cased to 9.00 m. The uncased interval of this section is thus c. 9–27 m.

Comments on the test

It is very hard to tell if this section is responding to the pumping in HFM14. Prior to the start of pumping a strong trend of decreasing pressure is present. This trend continues during the entire flow period, but the slope is moving towards the horizontal a few days into the pumping period. The only sign that this section is possibly affected by the pumping is a slight pressure increase in conjunction with the start of recovery. The actual response, if there is any, is likely to be much weaker than indicated by the figures presented in Table 6-108.

Table 6-107. General test data from the observation section HFM11: 54–182 m during the interference test in HFM14.

Pressure data	Nomenclature	Unit	Value
Hydraulic head in test section before start of flow period	h_i	m	5.71
Hydraulic head in test section before stop of flow period	h_p	m	5.55
Hydraulic head in test section at stop of recovery period	h_F	m	5.44
Hydraulic head change during flow period (h_i–h_p)	dh_p	m	0.16

Table 6-108. General test data from the observation section HFM18: 0–27 m during the interference test in HFM14.

Pressure data	Nomenclature	Unit	Value
Hydraulic head in test section before start of flow period	h_i	m.a.s.l.	–0.02
Hydraulic head in test section before stop of flow period	h_p	m.a.s.l.	–0.46
Hydraulic head in test section at stop of recovery period	h_F	m.a.s.l.	–0.48
Hydraulic head change during flow period (h_i–h_p)	dh_p	m	0.44

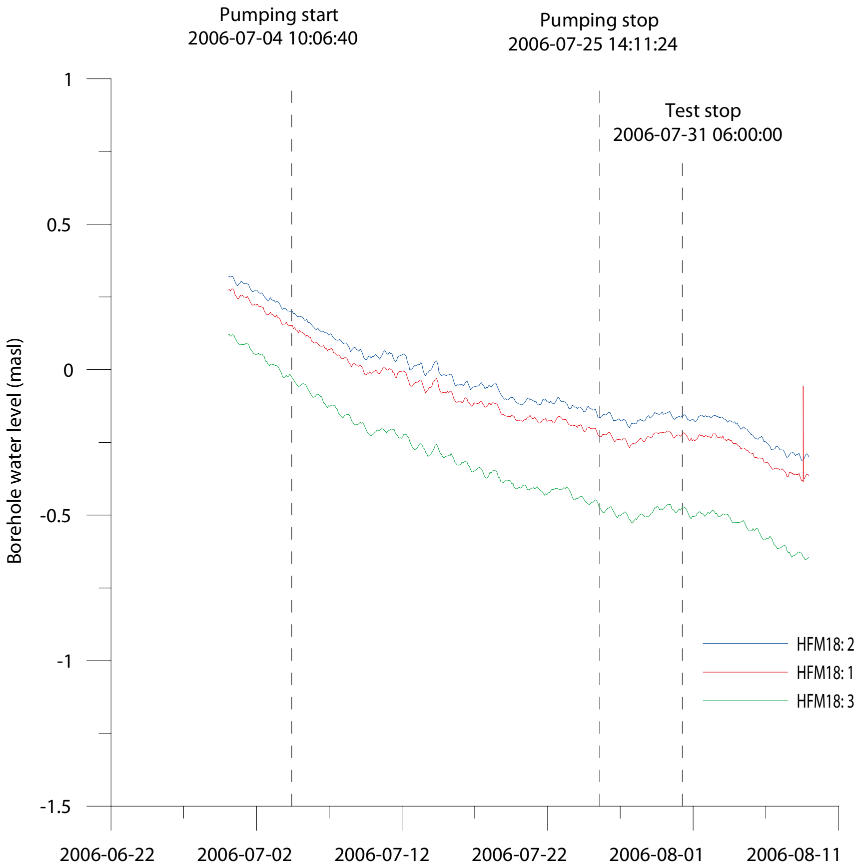


Figure 6-37. *Linear plot of pressure versus time in the observation sections in HFM18 during the interference test in HFM14.*

6.2.109 Observation section HFM18: 28–41 m

In Figure 6-37 an overview of the pressure responses in observation borehole HFM18 is shown. General test data from the observation section HFM18, 28–41 m, are presented in Table 6-109.

Comments on the test

It is very hard to tell if this section is responding to the pumping in HFM14. Prior to the start of pumping a strong trend of decreasing pressure is present. This trend continues during the entire flow period, but the slope is moving towards the horizontal a few days into the pumping period. The only sign that this section is possibly affected by the pumping is a slight pressure increase in conjunction with the start of recovery. The actual response, if there is any, is likely to be much weaker than indicated by the figures presented in Table 6-109.

Table 6-109. General test data from the observation section HFM18: 28–41 m during the interference test in HFM14.

Pressure data	Nomenclature	Unit	Value
Hydraulic head in test section before start of flow period	h_i	m.a.s.l.	0.20
Hydraulic head in test section before stop of flow period	h_p	m.a.s.l.	–0.14
Hydraulic head in test section at stop of recovery period	h_F	m.a.s.l.	–0.16
Hydraulic head change during flow period (h_i–h_p)	dh_p	m	0.34

6.2.110 Observation section HFM18: 42–180 m

In Figure 6-37 an overview of the pressure responses in observation borehole HFM18 is shown. General test data from the observation section HFM18, 42–180 m, are presented in Table 6-110.

Comments on the test

It is very hard to tell if this section is responding to the pumping in HFM14. Prior to the start of pumping a strong trend of decreasing pressure is present. This trend continues during the entire flow period, but the slope is moving towards the horizontal a few days into the pumping period. The only sign that this section is possibly affected by the pumping is a slight pressure increase in conjunction with the start of recovery. This may, however, be a sole effect of the precipitation that was observed at that time, cf. Figure A2-10 in Appendix 2. The actual response, if there is any, is likely to be much weaker than indicated by the figures presented in Table 6-110.

6.3 Interference test 2 in HFM14

A second, shorter interference test was performed to be able to include observation borehole KFM10A in the analysis.

The measured drawdowns (s_p) at the end of the flow period and the estimated response time lags (dt_L) from borehole KFM10A are included in Tables 6-114 and 6-115, respectively. The response time is defined as the time lag after start of pumping until a drawdown response of 0.01 m was observed in the actual observation section. Only KFM10A was analysed from the second pumping and therefore the results from the first and second pumping are not completely compatible. Since the flow rate was relatively similar it may still, however, be relevant to make some comparisons and therefore the results from the second pumping will be reported in some of the same tables and diagrams as the results from the first pumping.

All pressure data reported in this report have been corrected for atmospheric pressure changes by subtracting the latter pressure from the measured (absolute) pressure. This is also true for the data received from the HMS. All times presented are Swedish summer times, i.e. adjustment for daylight saving time has been made for any reported times.

During the 9th of September approximately 10 mm of total precipitation was reported from stations in the vicinity of the boreholes included in the test. No effect of this can be observed in the observation sections.

No transient evaluation of either the pumping borehole or the observation sections have been performed for this test.

Table 6-110. General test data from the observation section HFM18: 42–180 m during the interference test in HFM14.

Pressure data	Nomenclature	Unit	Value
Hydraulic head in test section before start of flow period	h_i	m.a.s.l.	0.15
Hydraulic head in test section before stop of flow period	h_p	m.a.s.l.	–0.20
Hydraulic head in test section at stop of recovery period	h_F	m.a.s.l.	0.22
Hydraulic head change during flow period (h_i–h_p)	dh_p	m	0.35

6.3.1 Pumping borehole HFM14: 0–150 m

General test data for the shorter, second pumping test in HFM14 are presented in Table 6-111. According to Table 3-1, the borehole is cased to 6.0 m. The uncased interval of this section is thus c. 6–150 m.

Table 6-111. General test data for the shorter, second pumping test in HFM14: 0–150 m.

General test data			
Pumping borehole	HFM14		
Test type[1)]	Constant Rate withdrawal and recovery test		
Test section (open borehole/packed-off section):	open borehole		
Test No	1		
Field crew	(GEOSIGMA AB)		
Test equipment system			
General comment	Interference test		
	Nomenclature	**Unit**	**Value**
Borehole length	L	m	150.50
Casing length	L_c	m	6.00
Test section – secup	Secup	m	6.00
Test section – seclow	Seclow	m	150.50
Test section length	L_w	m	144.50
Test section diameter[2)]	$2 \cdot r_w$	mm	136–138
Test start (start of pressure registration)		yymmdd hh:mm	060908 13:09
Packer expanded		yymmdd hh:mm:ss	
Start of flow period		yymmdd hh:mm:ss	060908 13:09:49
Stop of flow period		yymmdd hh:mm:ss	060911 12:40:33
Test stop (stop of pressure registration)		yymmdd hh:mm	060913 09:00
Total flow time	t_p	min	4291
Total recovery time	t_F	min	2659
Pressure data			
Relative pressure in test section before start of flow period	p_i	kPa	163.40
Relative pressure in test section before stop of flow period	p_p	kPa	49.55
Relative pressure in test section at stop of recovery period	p_F	kPa	158.40
Pressure change during flow period (p_i–p_p)	dp_p	kPa	113.85
Flow data			
Flow rate from test section just before stop of flow period [3)]	Q_p	m^3/s	0.00578
Mean (arithmetic) flow rate during flow period	Q_m	m^3/s	–
Total volume discharged during flow period	V_p	m^3	1490

Manual groundwater level measurements in HFM14 (6.0–150.5 m)			**GW level**	
Date YYYY-MM-DD	**Time tt:mm**	**Time (min)**	**(m b. ToC)**	**(m.a.s.l.)**
2006-06-30	16:44	–5362	4.16	0.32

1) Constant Head injection and recovery or Constant Rate withdrawal and recovery.

2) Nominal diameter.

3) The flow meter was out of order during the test and this is the best estimation of the actual final flow rate.

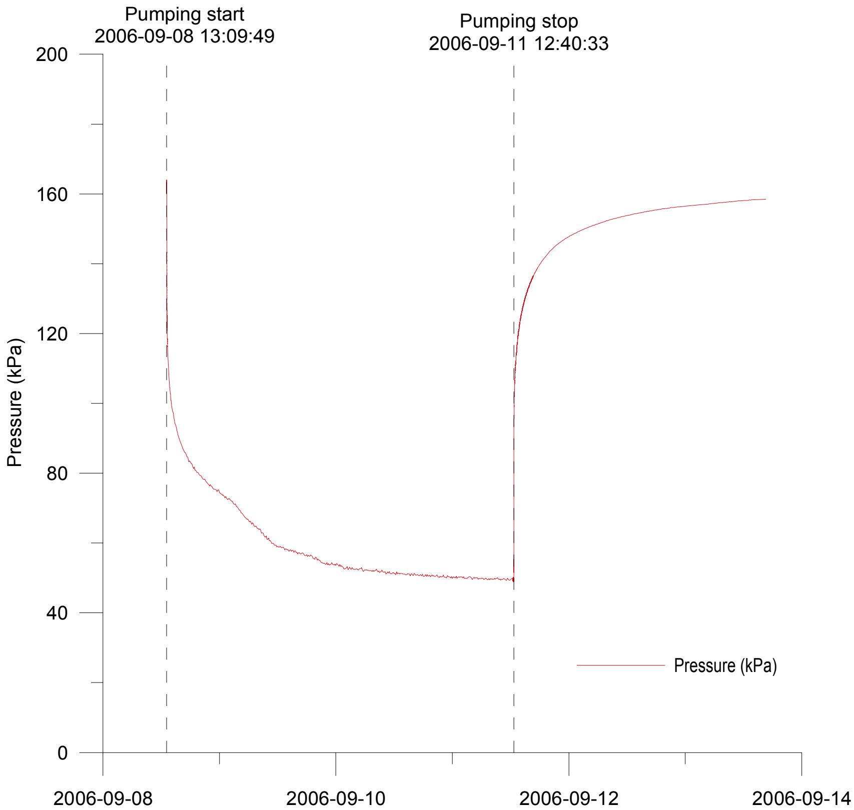


Figure 6-38. *Linear plot of pressure versus time in the pumping borehole HFM14 during the shorter, second interference test in HFM14.*

Comments on the test

The test was performed as a constant-flow rate pumping test. Since the flow meter was out of order the mean flow rate was estimated to be the same as the final flow rate at c. 347 L/min and the duration of the flow period was c. 3 days. After approximately half a day the pressure curve is changing appearance slightly and the pressure is decreasing at a slightly higher rate for a while. The pressure curve then flattens out after another half a day and past that point it is slowly going towards, but never reaching, a stationary level. The final drawdown in HFM14 was approximately 12 m. The pressure recovery was measured for almost 2 days. Overviews of the pressure response in HFM14 are presented in Figures 6-38.

6.3.2 Observation section KFM10A: 0–400 m

In Figure 6-39 an overview of the pressure responses in observation borehole KFM10A is shown. General test data from the observation section KFM10A, 0–400 m, are presented in Table 6-112. According to Table 3-1, the borehole is cased to 60.39 m. The uncased interval of this section is thus c. 60–400 m.

Table 6-112. General test data from the observation section KFM10A: 0–400 m during the shorter, second interference test in HFM14.

Pressure data	Nomenclature	Unit	Value
Hydraulic head in test section before start of flow period	h_i	m.a.s.l.	0.12
Hydraulic head in test section before stop of flow period	h_p	m.a.s.l.	0.38
Hydraulic head in test section at stop of recovery period	h_F	m.a.s.l.	0.48
Hydraulic head change during flow period (h_i–h_p)	dh_p	m	–0.26

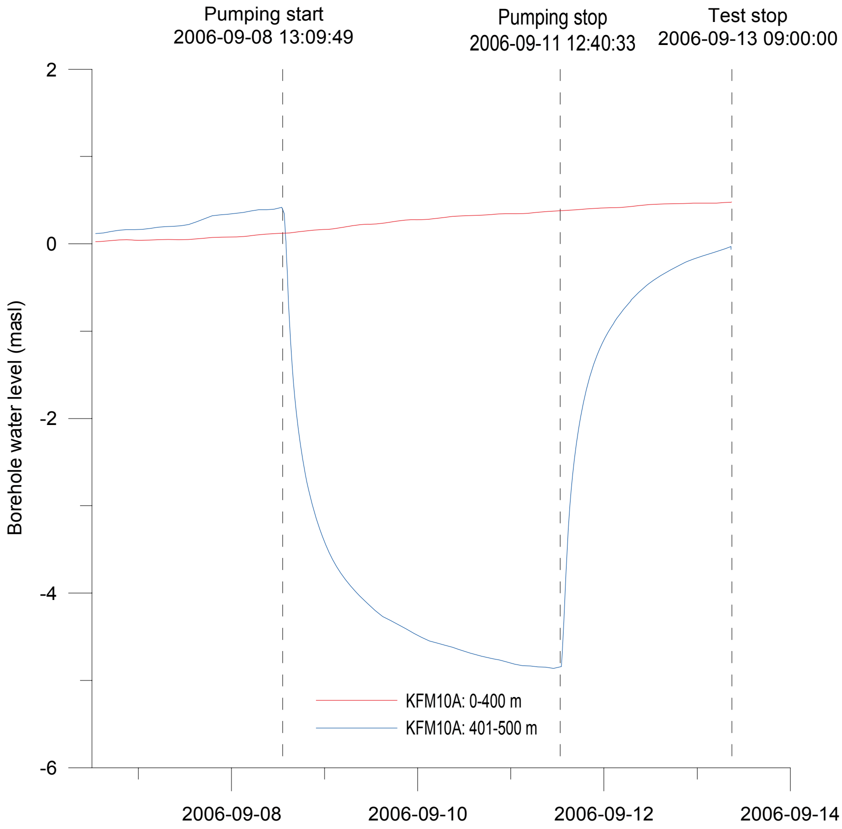


Figure 6-39. *Linear plot of pressure versus time in the observation sections in KFM10A during the shorter, second interference test in HFM14.*

Comments on the test

This observation section appears to be completely unaffected by the pumping in HFM14. The pressure is increasing during the entire test period.

6.3.3 Observation section KFM10A: 401–500 m

In Figure 6-39 an overview of the pressure responses in observation borehole KFM10A is shown. General test data from the observation section KFM10A, 401–500 m, are presented in Table 6-113.

Comments on the test

An obvious response to pumping was recorded in this section. The total drawdown during the flow period was c. 5.3 m and a drawdown of 0.01 m was reached approximately 3.5 minutes after the pumping started in HFM14. There was a total recovery of c. 4.8 m during the recovery period that lasted for approximately 44 hours.

Table 6-113. General test data from the observation section KFM10A: 401–500 m during the shorter, second interference test in HFM14.

Pressure data	Nomenclature	Unit	Value
Hydraulic head in test section before start of flow period	h_i	m.a.s.l.	0.42
Hydraulic head in test section before stop of flow period	h_p	m.a.s.l.	–4.86
Hydraulic head in test section at stop of recovery period	h_F	m.a.s.l.	–0.06
Hydraulic head change during flow period (h_i–h_p)	dh_p	m	5.28

6.4 Response analysis

A response analysis according to the methodology description for interference tests was made. However, because there was only one test performed, no response matrix was prepared. Nor are the wells monitoring the quaternary deposits, Figures A4-1 and A4-2, included in the response analysis. The response time lags (dt_L) in the observation sections during pumping in HFM14 are shown in Table 6-114. The lag times were derived from the uncorrected drawdown curves in the observation borehole sections at an actual drawdown of 0.01 m. No corrections of the drawdown for the decreasing natural trend during the interference tests or other corrections of drawdown have been made. Because of the oscillating behaviour of the measured pressure in some of the observation sections, see for instance Figure 6-17a, it was difficult to determine the exact time to reach a 0.01 m drawdown. It was possible, however, to make an approximate estimate from the drawdown curves.

Only observation sections in which an assumed, relatively clear, pressure response was recorded are included in the response analysis. In Tables 6-114 and 6-115 only sections comprised in the response analysis are presented, that is only sections showing a reasonably clear response to pumping in HFM14. An exception to this is borehole KFM06A where very weak responses were detected in two of the deep sections, cf Figure 6-17b. Even though these responses are weaker than some that are excluded from the response analysis, they are of such interest due to their deep location that they are still included in the response analysis.

It must be emphasized that section KFM10A: 401–500 that was only observed during the shorter second interference test is still included in the response analysis. This is possible since the same pumping borehole was used and the flow rate was very similar to that of the first interference test. Since the conditions, naturally, were not identical in the two tests the comparison must, however, be regarded as approximate.

The normalized response time with respect to the distance to the pumping borehole was calculated. This time is inversely related to the hydraulic diffusivity (T/S) of the formation. Also the inverse of above mentioned parameter was calculated since it is more closely related to the hydraulic diffusivity. In addition, the normalized drawdown with respect to the flow rate was calculated and is presented in Table 6-115.

In Figure 6-40 a response diagram, showing the presumptive responding observation sections, is presented. In this figure the observation sections are represented by different symbols. In the response diagram, observation sections represented by data points lying to the left generally indicate a better connectivity, a higher hydraulic diffusivity, in regard to the pumping borehole section than sections represented by data points further to the right in the diagram.

The following parameters are used in Tables 6-114 and 6-115 as well as in Figures 6-40 to 6-42:

$dt_L[s=0.01\ m] / r_s^2$ = normalized response time with respect to the distance r_s (s/m²),

$dt_L[s=0.01\ m]$ = time after start of pumping (s) at a drawdown s=0.01 m in the observation section,

r_s = 3D-distance between the hydraulic point of application (hydr. p.a.) in the pumping borehole and observation borehole (m),

s_p/Q_p = normalized drawdown with respect to the pumping flow rate (s/m²),

s_p = drawdown at stop of pumping in the actual observation borehole/section (m),

Q_p = pumping flow rate by the end of the flow period (m³/s).

The (normalized) response time lag for many of the observation sections included in the interference test, where a response was detected, must be considered as rough estimates. The main reason for this is, as mentioned above, the difficulty to make an estimate of this parameter due to the oscillating pressure.

Table 6-114. Calculated response lag times and normalized response time lags for the responding observation sections included in the interference tests.

Pumping borehole	Observation borehole	Section (m)	dt_L [s=0.01 m] (s)	r_s (m)	dt_L[s=0.01 m]/ r_s^2 (s/m²)	r_s^2/dt_L [s=0.01 m] (m²/s)
HFM14	HFM15	0–84	2	32.6	1.882E–03	5.31E+02
HFM14	HFM15	85–95	5	71.3	9.835E–04	1.02E+03
HFM14	KFM05A	0–114	60	88.2	7.713E–03	1.30E+02
HFM14	KFM05A	115–253	340	123.1	2.244E–02	4.46E+01
HFM14	HFM19	0–103	445	183	1.329E–02	7.53E+01
HFM14	HFM19	104–167	185	224.8	3.661E–03	2.73E+02
HFM14	HFM19	168–182	120	248.1	1.950E–03	5.13E+02
HFM14	HFM13	0–100	325	319	3.194E–03	3.13E+02
HFM14	HFM13	101–158	2,340	302.1	2.564E–02	3.90E+01
HFM14	HFM13	159–173	10,400	296.6	1.182E–01	8.46E+00
HFM14	KFM01C	0–58	775	367.5	5.738E–03	1.74E+02
HFM14	KFM01C	59–237	580	350	4.735E–03	2.11E+02
HFM14	HFM01	0–200	1,100	379	7.658E–03	1.31E+02
HFM14	KFM01A	109–130	2,085	416.1	1.204E–02	8.30E+01
HFM14	KFM01A	131–204	6,200	427.4	3.394E–02	2.95E+01
HFM14	KFM01B	0–100	200	415.9	1.156E–03	8.65E+02
HFM14	KFM01B	101–141	200	438.3	1.041E–03	9.61E+02
HFM14	KFM01B	142–500	5,000	555.6	1.620E–02	6.17E+01
HFM14	HFM32	0–25	8,165	511.1	3.126E–02	3.20E+01
HFM14	HFM32	26–31	20,105	512	7.669E–02	1.30E+01
HFM14	HFM32	32–97	14,265	517.8	5.320E–02	1.88E+01
HFM14	HFM32	98–203	3,575	546.2	1.198E–02	8.35E+01
HFM14	HFM03	0–18	3,200	532.1	1.130E–02	8.85E+01
HFM14	HFM03	19–26	1,400	532.4	4.939E–03	2.02E+02
HFM14	HFM02	0–37	800	535.7	2.788E–03	3.59E+02
HFM14	HFM02	38–48	775	536.3	2.695E–03	3.71E+02
HFM14	HFM02	49–100	990	539	3.408E–03	2.93E+02
HFM14	HFM27	0–24	1,400	561.8	4.436E–03	2.25E+02
HFM14	HFM27	25–45	710	564.2	2.230E–03	4.48E+02
HFM14	HFM27	46–58	1,015	573.4	3.087E–03	3.24E+02
HFM14	HFM27	59–128	2,000	602.1	5.517E–03	1.81E+02
HFM14	HFM24	0–151	1,034	647.4	2.467E–03	4.05E+02
HFM14	KFM04A	0–168	32,000	803	4.963E–02	1.16E+02
HFM14	KFM04A	169–1,001	39,200	773	6.560E–02	1.23E+02
HFM14	KFM06A	0–150	39,435	797.5	6.200E–02	1.61E+01
HFM14	KFM06A	151–246	29,367	793.1	4.669E–02	2.14E+01
HFM14	KFM06A	247–340	24,200	795.5	3.824E–02	2.61E+01
HFM14	KFM06A	341–362	64,870	810.3	9.880E–02	1.01E+01
HFM14	KFM06A	363–737	70,400	816.1	1.057E–01	9.46E+00
HFM14	KFM06A	738–748	64,510	979.9	6.718E–02	1.49E+01
HFM14	KFM06A	749–826	68,000	1,001.4	6.781E–02	1.47E+01
HFM14	KFM06C	0–186	24,500*	892.4	3.076E–02	3.25E+01
HFM14	KFM06C	187–280	31,700*	935.5	3.622E–02	2.76E+01
HFM14	KFM06C	281–350	94,700*	1,007.4	9.331E–02	1.07E+01

Pumping borehole	Observation borehole	Section (m)	dt_L [s=0.01 m] (s)	r_s (m)	dt_L[s=0.01 m]/ r_s^2 (s/m²)	r_s^2/dt_L [s=0.01 m] (m²/s)
HFM14	KFM06C	351–401	5,620*	1,069.1	4.917E–03	2.03E+02
HFM14	KFM06C	402–530	c. 50,000**	1,091.2	4.199E–02	2.38E+01
HFM14	KFM06C	531–540	c. 50,000**	1,188.3	3.541E–02	2.82E+01
HFM14	KFM06B	0–26	11,600	825.1	1.704E–02	5.87E+01
HFM14	KFM06B	27–50	5,940	823.5	8.759E–03	1.14E+02
HFM14	KFM06B	51–100	5,600	823.3	8.262E–03	1.21E+02
HFM14	HFM10	0–99	33,480	836.1	4.789E–02	2.09E+01
HFM14	HFM10	100–150	45,520	830.8	6.595E–02	1.52E+01
HFM14	HFM16	0–53	8,000	837.5	1.141E–02	8.77E+01
HFM14	HFM16	54–67	8,000	838	1.139E–02	8.78E+01
HFM14	HFM16	68–132	6,800	838.5	9.672E–03	1.03E+02
HFM14	HFM09	0–50	32,000	894.8	3.997E–02	2.50E+01
HFM14	KFM07B	0–299	8,000	931.4	9.222E–03	1.08E+02
HFM14	HFM21	0–202	1,600	1,012.6	1.560E–03	6.41E+02
HFM14	HFM22	0–222	11,600	1,227.4	7.700E–03	1.30E+02
HFM14	HFM20	0–48	60,740	1,289	3.656E–02	2.74E+01
HFM14	HFM20	49–100	19,585	1,292.4	1.173E–02	8.53E+01
HFM14	HFM20	101–130	13,615	1,295.9	8.107E–03	1.23E+02
HFM14	HFM20	131–301	12,200	1,308.5	7.125E–03	1.40E+02
HFM14	KFM08B	0–70	34,400	1,302.5	2.028E–02	4.93E+01
HFM14	HFM23	0–212	68,000	1,373.1	3.607E–02	2.77E+01
HFM14	HFM29	0–200	11,1200	1,499.5	4.946E–02	2.02E+01
HFM14	HFM17	0–211	32,000	1,536.5	1.355E–02	7.38E+01
HFM14	KFM02A	0–132	61,360	1,570.7	2.487E–02	4.02E+01
HFM14	KFM02A	133–240	61,015	1,571.1	2.472E–02	4.05E+01
HFM14	KFM02A	241–410	34,435	1,576.1	1.386E–02	7.21E+01
HFM14	KFM02A	411–442	10,400	1,593.7	4.095E–03	2.44E+02
HFM14	KFM02A	443–489	7,400	1,602.6	2.881E–03	3.47E+02
HFM14	KFM02A	490–518	4,655	1,609.5	1.797E–03	5.56E+02
HFM14	KFM02A	519–888	49,695	1,619.2	1.895E–02	5.28E+01
HFM14	HFM04	0–57	61,370	1,746.5	2.012E–02	4.97E+01
HFM14	HFM04	58–66	55,330	1,746.8	1.813E–02	5.51E+01
HFM14	HFM04	67–222	63,200	1,758.6	2.044E–02	4.89E+01
HFM14	KFM10A	401–500	221	492.1	9.13E–04	9.13E+02

* Estimated from the recovery period.

** Uncertain due to tidal fluctuations during the recovery period.

Table 6-115. Drawdown and normalized drawdown for the responding observation sections included in the interference test.

Pumping borehole	Flow rate Qp (m^3/s)	Observation borehole	Section (m)	s_p (m)	s_p/Q_p (s/m^2)
HFM14	0.00568	HFM15	0–84	8.41	1,479.8
HFM14	0.00568	HFM15	85–95	7.8	1,372.4
HFM14	0.00568	KFM05A	0–114	5.47	962.5
HFM14	0.00568	KFM05A	115–253	5.36	943.1
HFM14	0.00568	HFM19	0–103	6.23	1,096.2
HFM14	0.00568	HFM19	104–167	6.3	1,108.5
HFM14	0.00568	HFM19	168–182	6.3	1,108.5
HFM14	0.00568	HFM13	0–100	6.08	1,069.8
HFM14	0.00568	HFM13	101–158	4.83	849.9
HFM14	0.00568	HFM13	159–173	2.66	468.0
HFM14	0.00568	KFM01C	0–58	2.85	501.5
HFM14	0.00568	KFM01C	59–237	3.03	533.1
HFM14	0.00568	HFM01	0–200	2.58	454.0
HFM14	0.00568	KFM01A	109–130	1.39	244.6
HFM14	0.00568	KFM01A	131–204	1.81	318.5
HFM14	0.00568	KFM01B	0–100	2.81	494.4
HFM14	0.00568	KFM01B	101–141	1.64	288.6
HFM14	0.00568	KFM01B	142–500	1.88	330.8
HFM14	0.00568	HFM32	0–25	0.24*	42.2
HFM14	0.00568	HFM32	26–31	0.28*	49.3
HFM14	0.00568	HFM32	32–97	2.13*	374.8
HFM14	0.00568	HFM32	98–203	2.13*	374.8
HFM14	0.00568	HFM03	0–18	2.68	471.6
HFM14	0.00568	HFM03	19–26	2.79	490.9
HFM14	0.00568	HFM02	0–37	2.79	490.9
HFM14	0.00568	HFM02	38–48	2.8	492.7
HFM14	0.00568	HFM02	49–100	2.82	496.2
HFM14	0.00568	HFM27	0–24	2.73	480.4
HFM14	0.00568	HFM27	25–45	2.81	494.4
HFM14	0.00568	HFM27	46–58	2.73	480.4
HFM14	0.00568	HFM27	59–128	2.63	462.8
HFM14	0.00568	HFM24	0–151	1.53	269.2
HFM14	0.00568	KFM04A	0–168	0.66	116.1
HFM14	0.00568	KFM04A	169–1,001	0.70	123.2
HFM14	0.00568	KFM06A	0–150	0.71	124.9
HFM14	0.00568	KFM06A	151–246	0.82	144.3
HFM14	0.00568	KFM06A	247–340	0.95	167.2
HFM14	0.00568	KFM06A	341–362	0.63	110.9
HFM14	0.00568	KFM06A	363–737	0.62	109.1
HFM14	0.00568	KFM06A	738–748	0.17	29.9
HFM14	0.00568	KFM06A	749–826	0.15	26.4
HFM14	0.00568	KFM06C	0–186	0.51**	89.7
HFM14	0.00568	KFM06C	187–280	0.52**	91.5
HFM14	0.00568	KFM06C	281–350	0.42**	73.9
HFM14	0.00568	KFM06C	351–401	0.67**	117.9

Pumping borehole	Flow rate Qp (m^3/s)	Observation borehole	Section (m)	s_p (m)	s_p/Q_p (s/m^2)
HFM14	0.00568	KFM06C	402–530	0.51**	89.7
HFM14	0.00568	KFM06C	531–540	0.43**	75.7
HFM14	0.00568	KFM06B	0–26	1.45	255.1
HFM14	0.00568	KFM06B	27–50	1.6	281.5
HFM14	0.00568	KFM06B	51–100	1.52	267.4
HFM14	0.00568	HFM10	0–99	0.66	116.1
HFM14	0.00568	HFM10	100–150	0.65	114.4
HFM14	0.00568	HFM16	0–53	1.57	276.2
HFM14	0.00568	HFM16	54–67	1.47	258.7
HFM14	0.00568	HFM16	68–132	1.49	262.2
HFM14	0.00568	HFM09	0–50	0.66	116.1
HFM14	0.00568	KFM07B	0–299	1.56	274.5
HFM14	0.00568	HFM21	0–202	1.54	271.0
HFM14	0.00568	HFM22	0–222	1.37	241.1
HFM14	0.00568	HFM20	0–48	0.71***	124.9
HFM14	0.00568	HFM20	49–100	1.17***	205.9
HFM14	0.00568	HFM20	101–130	1.38***	242.8
HFM14	0.00568	HFM20	131–301	1.52***	267.4
HFM14	0.00568	KFM08B	0–70	0.43	75.7
HFM14	0.00568	HFM23	0–212	0.53	93.3
HFM14	0.00568	HFM29	0–200	0.56	98.5
HFM14	0.00568	HFM17	0–211	0.46	80.9
HFM14	0.00568	KFM02A	0–132	0.56	98.5
HFM14	0.00568	KFM02A	133–240	0.56	98.5
HFM14	0.00568	KFM02A	241–410	1.31	230.5
HFM14	0.00568	KFM02A	411–442	1.47	258.7
HFM14	0.00568	KFM02A	443–489	1.52	267.4
HFM14	0.00568	KFM02A	490–518	1.51	265.7
HFM14	0.00568	KFM02A	519–888	0.69	121.4
HFM14	0.00568	HFM04	0–57	0.58	102.1
HFM14	0.00568	HFM04	58–66	0.5	88.0
HFM14	0.00568	HFM04	67–222	0.53	93.3
HFM14	0.00578	KFM10A	401–500	5.28	913.5

* Recorded at 2006-07-18 (before stop of pumping).

** Head increase during the recovery period.

*** Recorded at 2006-07-16 (before stop of pumping).

The response diagram in Figure 6-40 together with diagrams 6-41 and 6-42 can be used to group observation sections by the strength of their responses and so the observation sections with the most distinct responses can be identified. Figure 6-40 indicates that the largest drawdown was found in section HFM15: 0–84 m and the weakest response in section KFM08B: 0–70 m. The most delayed response occurred in section KFM01A: 0–108 m. As mentioned above, sections KFM06A: 738–748 and KFM06A: 749–826 are included in the response diagrams even though their responses are very weak. They are still of interest due to the depth of the sections.

Some of the sections that are found in the upper left part of Figure 6-40 are likely to represent sections with more or less direct responses along fracture zones between borehole HFM14 and the actual observations sections.

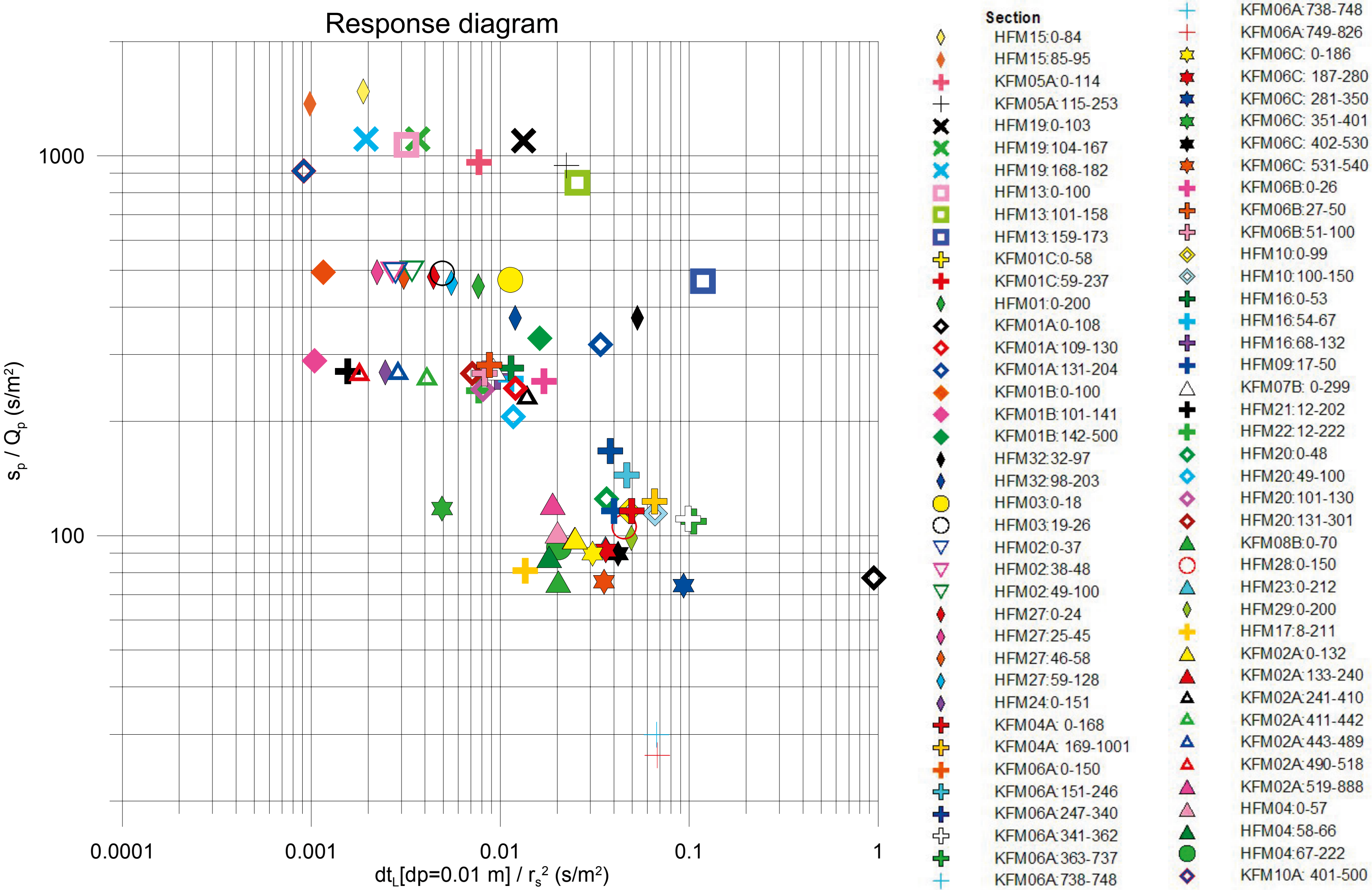


Figure 6-40. *Response diagram showing the responses in the presumed responding observation sections during the interference test in HFM14.*

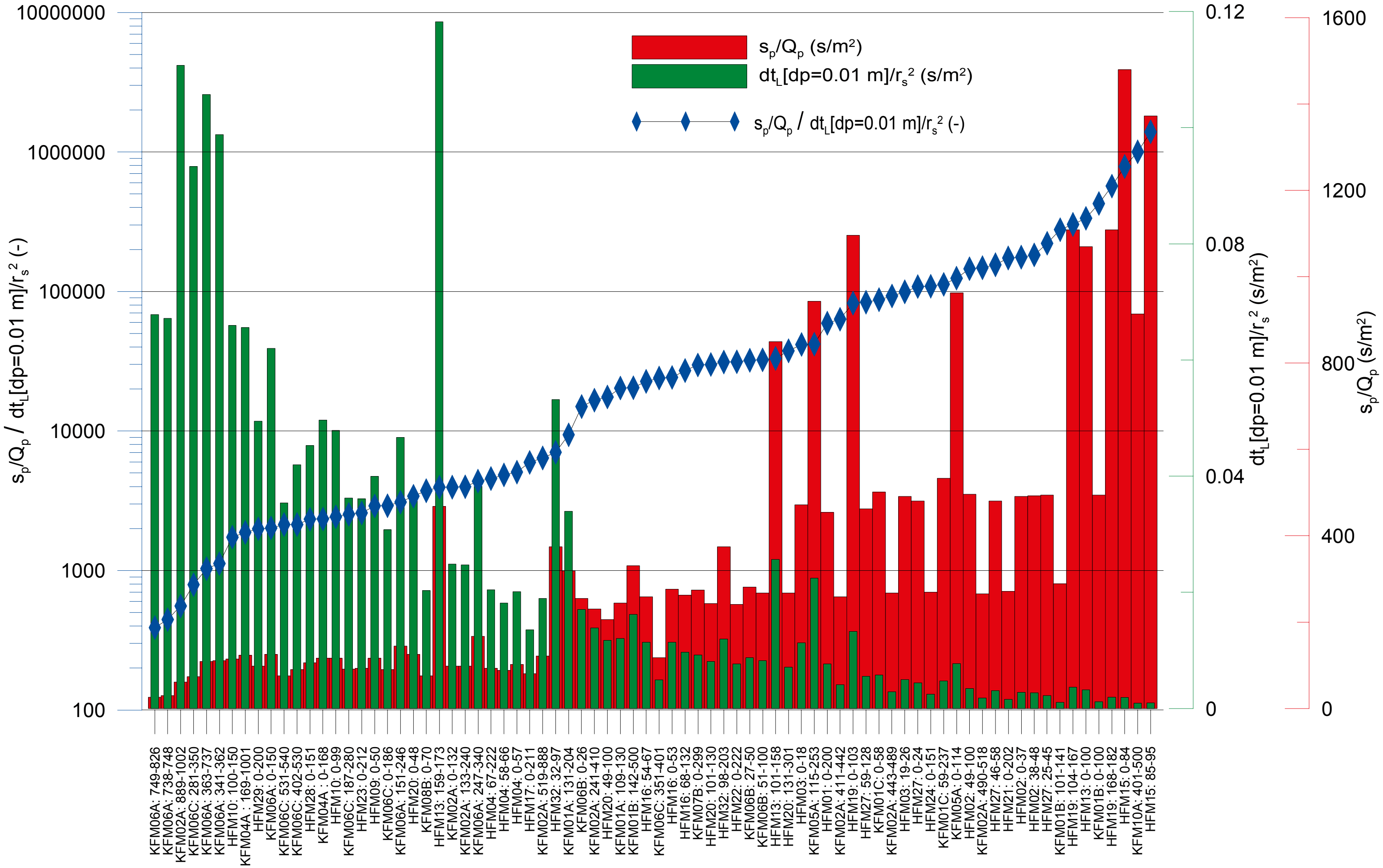


Figure 6-41. *Diagram showing normalized drawdown, normalized response time and the ratio between the two parameters for the responding sections in the interference tests. The observation sections are sorted by the magnitude of the ratio.*

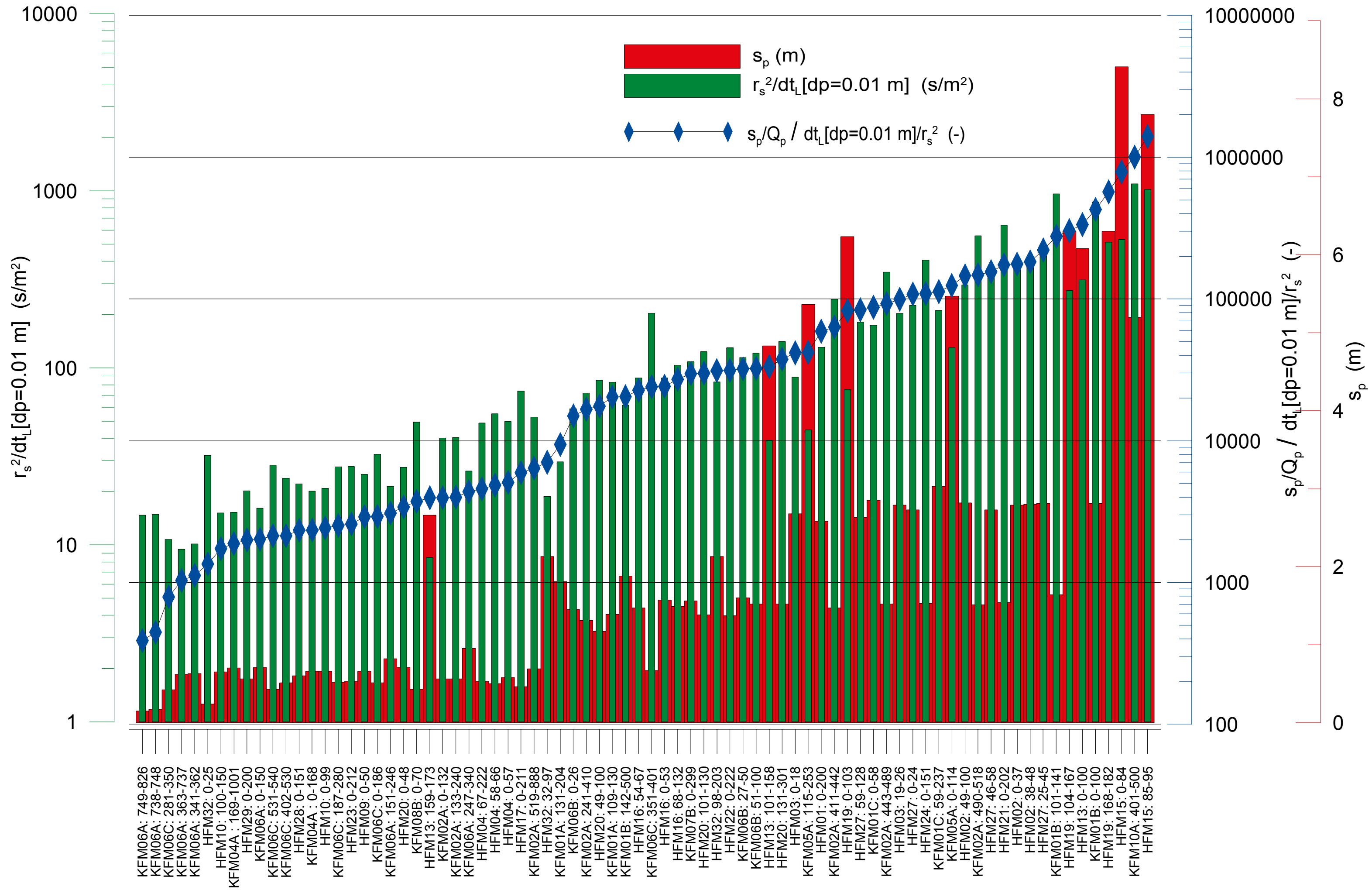


Figure 6-42. *Diagram showing drawdown, the inverse of the normalized response time and the same ratio that was previously presented in Figure 6-41, for the responding sections in the interference tests. The observation sections are sorted by the magnitude of the ratio.*

Figure 6-41 displays the same parameters as in the response diagram, but in a different type of diagram. In this diagram a third index is also displayed, i.e. the ratio between the two indices in the response diagram. Clearly, sections with higher ratios correspond to sections which are hydraulically well connected to the pumping borehole. In the diagram, all observation sections that responded clearly to pumping in HFM14 but one are included. In Figure 6-41 observation section KFM01A: 0–108 m is not included. This section demonstrates the weakest and most uncertain response, which can be observed in the response diagram (Figure 6-40) and is excluded to clarify the diagram. All other sections are ranked so that sections showing the weakest responses are located to the left in the diagram and observation sections with stronger responses are located to the right. The diagram is actually divided into two separate figures to make room for all sections.

Another version of Figure 6-41 is displayed in Figure 6-42. The units on the axes are somewhat different even though this figure is indicating the same phenomenon as is shown in Figure 6-41.

Two observation sections stand out as responding most strongly. These sections, KFM10A: 401–500 m and HFM15: 85–95 m, together with 6 other sections, HFM15: 0–84 m, HFM19: 168–182 m, KFM01B: 0–100 m, HFM13: 0–100 m, HFM19: 104–167 m and KFM01B: 101–141 m, demonstrate responses that are distinct enough to be characterized as potential zone responses between HFM14 and the actual sections.

6.5 Evaluation of responses in selected sections

Quantitative transient evaluation was made for five selected observation sections, decided upon in consultation with the activity leader. Due to the strong natural decreasing pressure trend during the interference tests the drawdown in these sections was corrected for the natural trend before the analysis. A linear correction was applied based on the linear drawdown diagrams presented above. Only the drawdown period was analysed.

In addition, estimation of the hydraulic diffusivity of these sections was made from the response time lag. The time lags were estimated from the corrected drawdown curves. Comparison was made of the estimated hydraulic diffusivity from the time lag and from the transient test evaluation, respectively.

Abbreviations of flow regimes and hydraulic boundaries that may appear in the text:

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

CHB = Constant – head boundary

6.5.1 Observation section HFM13: 159–173 m

Interpreted flow regimes

The drawdown period is dominated by a pseudo-spherical (leaky) flow regime or possibly a constant-head boundary (CHB) which is reached approximately $4 \cdot 10^5$ seconds into the drawdown period and then lingers until the end of the period.

Interpreted parameters

Transient evaluation of the drawdown period was chosen as the most representative and only results from this period are presented in this report. The transient evaluation was performed using the Hantush-Jacob model for confined leaky aquifers. Transient, quantitative interpretation of the drawdown period is shown in a log-log diagram in Figure A2-5, Appendix 2. The results from the transient evaluation are summarized in Table 6-120.

According to Table 6-114 the section has a relatively bad hydraulic connection to the pumping borehole HFM14. This makes the evaluation quite uncertain and possibly not representative of the formation close to the observation section.

6.5.2 Observation section KFM04A: 169–1,001 m

Interpreted flow regimes

The dominating flow regime during the flow period is interpreted to be pseudo-spherical (leaky).

Interpreted parameters

Transient evaluation of the flow period was chosen as the most representative and only results from this period are presented in this report. The transient evaluation was performed using the Hantush-Jacob model for confined leaky aquifers. Transient, quantitative interpretation of the flow period is shown in a log-log diagram in Figure A2-6, Appendix 2. The results from the transient evaluation are summarized in Table 6-120.

The section has a rather bad hydraulic connection to the pumping borehole HFM14, cf. Figure 6-40. This makes the evaluation quite uncertain and probably not representative of the formation close to the observation section. It is very likely that the estimated transmissivity and storativity actually reflect the conditions close to the pumping borehole HFM14 rather than in the vicinity of the observation section.

6.5.3 Observation section KFM06A: 341–362 m

Interpreted flow regimes

A transition period to a PSF is dominating the entire flow period.

Interpreted parameters

Transient evaluation of the flow period was chosen as the most representative and only results from this period are presented in this report. The transient evaluation was performed using the Hantush-Jacob model for confined leaky aquifers. Transient, quantitative interpretation of the flow period is shown in a log-log diagram in Figure A2-7, Appendix 2. The results from the transient evaluation are summarized in Table 6-120.

The section has a rather bad hydraulic connection to the pumping borehole HFM14, cf. Figure 6-40. This makes the evaluation quite uncertain and probably not representative of the formation close to the observation section. It is very likely that the estimated transmissivity and storativity actually reflect the conditions close to the pumping borehole HFM14 rather than around the observation section. This assumption is also supported by the fact that the evaluated transmissivity is very similar to that from previous single-hole investigations in the pumping borehole.

6.5.4 Observation section KFM02A: 411–442 m

Interpreted flow regimes

A transition period to a PSF is dominating the entire flow period.

Interpreted parameters

Transient evaluation of the flow period was chosen as the most representative and only results from this period are presented in this report. The transient evaluation was performed using the Hantush-Jacob model for confined leaky aquifers. Transient, quantitative interpretation of the flow period is shown in a log-log diagram in Figure A2-8, Appendix 2. The results from the transient evaluation are summarized in Table 6-120.

The section has a relatively bad hydraulic connection to the pumping borehole HFM14. This makes the evaluation quite uncertain and possibly not representative of the formation close to the observation section. It is very probable that the evaluated parameters for transmissivity and storativity actually reflect the conditions close to the pumping borehole HFM14 rather than the formation close to the observation section, leading to an overestimation of the transmissivity compared to the results of the previous single-hole tests. This assumption is also supported by the fact that the evaluated transmissivity is very similar to that from previous single-hole investigations in the pumping borehole.

6.5.5 Observation section KFM02A: 490–518 m

Interpreted flow regimes

The response of this section is very similar to that of KFM02A: 411–442. A transition period to a PSF is dominating the entire flow period.

Interpreted parameters

Transient evaluation of the flow period was chosen as the most representative and only results from this period are presented in this report. The transient evaluation was performed using the Hantush-Jacob model for confined leaky aquifers. Transient, quantitative interpretation of the flow period is shown in a log-log diagram in Figure A2-9 and Figure A2-10, Appendix 2. The results from the transient evaluation are summarized in Table 6-120.

The section has a relatively bad hydraulic connection to the pumping borehole HFM14. This makes the evaluation quite uncertain and possibly not representative of the formation close to the observation section. It is very probable that the evaluated parameters for transmissivity and storativity actually reflect the conditions close to the pumping borehole HFM14 rather than the rock volume around the observation section, leading to an overestimation of the transmissivity. This assumption is also supported by the fact that the evaluated transmissivity is similar to that obtained in previous single-hole tests of the pumping borehole.

6.5.6 Estimation of the hydraulic diffusivity of the sections

The hydraulic diffusivity of observation sections can be estimated from the response time lag in the section according to Streltsova (1988):

$$T/S = r_s^2 / [4 \cdot dt_L \cdot (1+dt_L/t_p) \cdot \ln(1+t_p/dt_L)] \qquad (6\text{-}1)$$

The time lag dt_L is based on a drawdown s=0.01 m in the observation section. The estimated time lags based on the corrected drawdown in the selected sections are shown in Table 6-116 together with the corresponding hydraulic diffusivity T/S of the sections. For comparison, the ratio of the estimated transmissivity and storativity T_o/S_o from the transient evaluation of the responses in these sections during the interference tests are also presented.

Table 6-116. Estimated response lag times and hydraulic diffusivity for the selected observation sections from the interference tests in HFM14 at Forsmark.

Pumping borehole	Observation borehole	Section (m)	Measured dt_L[s=0.01 m] (s)	Corrected dt_L[s=0.01 m] (s)	r_s (m)	T/S (m^2/s)	T_o/S_o (m^2/s)
HFM14	HFM13	159–173	$1.04 \cdot 10^{4}$	$1.5 \cdot 10^{4}$	297	$3.0 \cdot 10^{-1}$	$1.2 \cdot 10^{-1}$
HFM14	KFM02A	411–442	$1.04 \cdot 10^{4}$	$1.3 \cdot 10^{4}$	1,594	$9.8 \cdot 10^{0}$	$1.6 \cdot 10^{1}$
HFM14	KFM02A	490–518	$4.65 \cdot 10^{3}$	$1.0 \cdot 10^{4}$	1,609	$1.2 \cdot 10^{1}$	$2.1 \cdot 10^{1}$
HFM14	KFM04A	169–1,001	$3.92 \cdot 10^{4}$	$4.2 \cdot 10^{4}$	773	$9.2 \cdot 10^{-1}$	$1.5 \cdot 10^{0}$
HFM14	KFM06A	341–362	$6.49 \cdot 10^{4}$	$6.5 \cdot 10^{4}$	810	$7.2 \cdot 10^{-1}$	$6.5 \cdot 10^{-1}$

Table 6-116 shows that there is a rather good agreement between the estimated hydraulic diffusivity of the sections based on the response time lags and from the results of the transient evaluation, respectively, also at long distances from the pumping borehole. This is also illustrated in Figure 6-43. However, as discussed above, the estimated transmissivities from the interference tests differ significantly from the results of the previous single-hole tests in these sections.

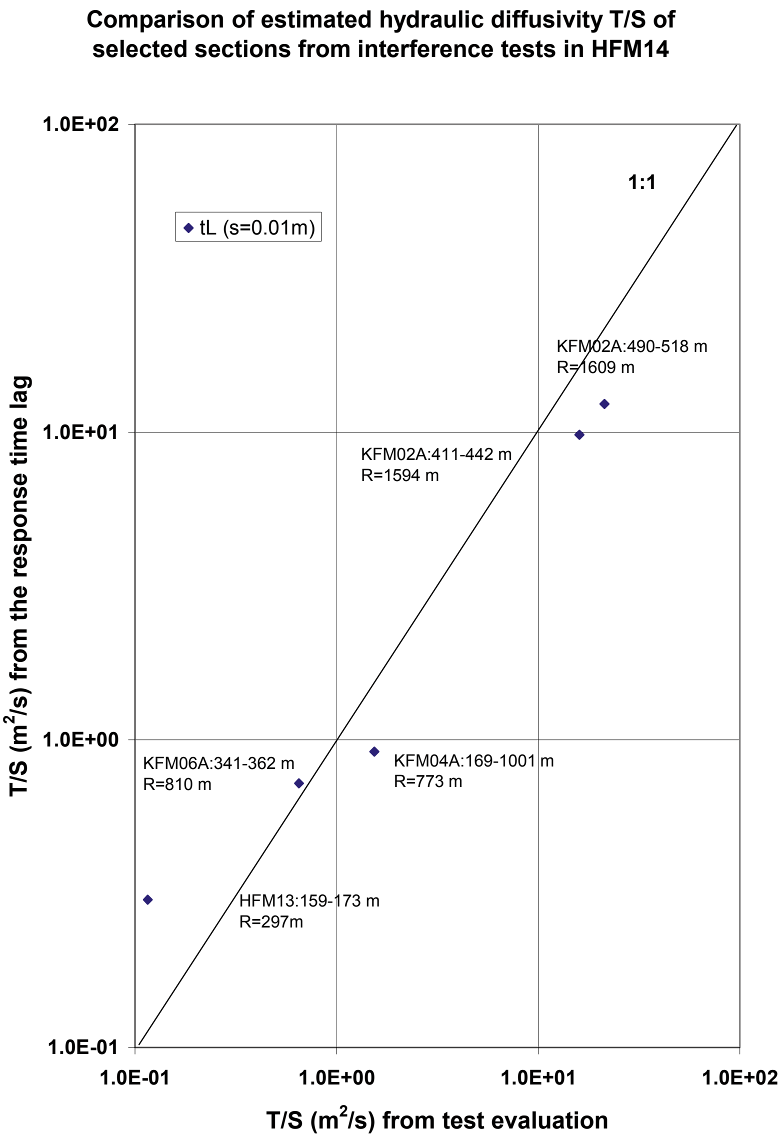


Figure 6-43. Comparison of estimated hydraulic diffusivity of selected observation sections from the interference tests in HFM14 at Forsmark.

6.6 Summary of the results of the interference test

A compilation of measured test data from the interference test in HFM14 is shown in Tables 6-117 and 6-118. In Tables 6-119 and 6-120 calculated hydraulic parameters for the pumping borehole and five observation sections selected for quantitative evaluation are presented.

Out of the 105 observation sections included in the interference test, 27 did not respond at all to pumping in HFM14 or responded very weakly. Of the remaining 78 sections, 69 showed distinct responses. Two observation sections stand out as responding most strongly. These sections, KFM10A: 401–500 m and HFM15: 85–95 m, together with 6 other sections, HFM15: 0–84 m, HFM19: 168–182 m, KFM01B: 0–100 m, HFM13: 0–100 m, HFM19: 104–167 m and KFM01B: 101–141m, display responses that are distinct enough to be characterized as potential zone responses between HFM14 and the actual sections. In KFM06A, section 363–737 m is clearly affected by the pumping in HFM14. Also the deeper sections 738–748 m and 749–826 m are slightly affected by the pumping.

The estimated T-value for HFM14 in Table 6-119 from transient evaluation is in good agreement with that ($T=4.7 \cdot 10^{-4}$ m^2/s) from the previous single-hole pumping test and flow logging in this borehole, /1/. The estimated transmissivities from observation sections KFM02A: 411–442 m, KFM02A: 490–518 m and KFM06A: 341–362 m are significantly higher than the T-values obtained from single-hole tests from previous investigations (/14/ and /12/), cf. Table 3-4. This fact may possibly be due to that the calculated T-values from the interference tests are more weighted towards the hydraulic properties close to the pumping borehole HFM14 because of the long distances between the boreholes. In addition, the estimated transmissivity in the observation sections may be overestimated from the interference test due to poor hydraulic connection to the pumping borehole, cf. Figures 6-40, 6-41 and 6-42. This is especially true for the observation sections in KFM06A.

The results of the interference tests show a rather good agreement between the estimated hydraulic diffusivity of the sections based on the response time lags and from the results of the transient evaluation, respectively, also at long distances from the pumping borehole. However, as discussed above, the estimated transmissivities from the interference tests differ significantly from the results of the previous single-hole tests in these sections. This fact may indicate that transmissivity and storativity cannot always be estimated individually but only the hydraulic diffusivity T/S from interference tests in heterogeneous formations, particularly at long distances from the pumping borehole. Transmissivity and storativity can probably only be estimated individually
for observation sections having a very good hydraulic connection to the pumping borehole.

Table 6-117. Summary of test data from the pumping borehole during the interference test performed in HFM14 in the Forsmark area.

Pumping borehole ID	Section (m)	Test type[1)]	h_i (m)	h_p (m)	h_F (m)	Q_p (m^3/s)	Q_m (m^3/s)	V_p (m^3)
HFM14	6–150	1B	16.58	4.56	15.95	0.00568	0.00580	10,600

[1)] 1B: Pumping test-submersible pump, 2: Interference test (observation borehole during pumping in another borehole).

Table 6-118. Summary of test data from the observation sections involved in the interference tests performed in HFM14 in the Forsmark area.

Pumping borehole ID	Borehole ID	Section (m)	Test type[1)]	h_i (m)	h_p (m)	h_F (m)
HFM14	HFM15	0–84	2	0.48	–7.93	–0.08
”	”	85–95	2	0.52	–7.28	–0.02
HFM14	KFM05A	0–114	2	0.11	–5.36	–0.28
”	”	115–253	2	0.00	–5.36	–0.46
”	”	254–272	2	–0.77	–0.30	–0.18
”	”	273–489	2	2.61	2.79	2.69
”	”	490–698	2	1.07	1.55	1.37
”	”	699–1,002	2	0.62	0.49	0.48
HFM14	HFM19	0–103	2	0.64	–5.59	0.22
”	”	104–167	2	0.46	–5.84	0.05
”	”	168–182	2	–0.06	–6.36	–0.51
HFM14	HFM13	0–100	2	0.09	–5.99	–0.34
”	”	101–158	2	0.81	–4.02	0.37
”	”	159–173	2	2.63	–0.03	1.5
HFM14	KFM01C	0–58	2	–979.05	–981.9	–979.43
”	”	59–237	2	–979.2	–982.23	–979.59
”	”	238–450	2	–983.4	–980.18	–980.3
HFM14	HFM01	0–200	2	0.16	–2.42	–0.26
HFM14	KFM01A	0–108	2	–1.44	–1.88	–1.77
”	”	109–130	2	–0.82	–2.21	–0.75
”	”	131–204	2	–0.24	–2.05	–0.72
”	”	205–373	2	–0.84	–0.86	–0.82
”	”	374–430	2	1.78	1.91	1.85
”	”	431–1,002	2	1.26	2.13	2.32
HFM14	KFM01D 2)	0–800	–	–	–	–
HFM14	KFM01B	0–100	2	0.16	–2.65	–0.24
	”	101–141	2	–0.57	–2.21	–0.8
	”	142–500	2	0.11	–1.77	–0.29
HFM14	HFM32	0–25	2	–0.03	–0.27	–0.21
”	”	26–31	2	–0.07	–0.35	–0.24
”	”	32–97	2	–0.35	–2.48	–0.69
”	”	98–203	2	–0.49	–2.62	–0.84
HFM14	HFM03	0–18	2	0.27	–2.41	–0.18
”	”	19–26	2	0.19	–2.60	–0.22
HFM14	HFM02	0–37	2	0.16	–2.63	–0.23
”	”	38–48	2	0.19	–2.61	–0.18
”	”	49–100	2	0.24	–2.58	–0.17
HFM14	HFM27	0–24	2	–9,980.80	–9,983.53	–9,981.25
”	”	25–45	2	–9,981.13	–9,983.94	–9,981.52
”	”	46–58	2	–9,980.85	–9,983.58	–9,981.24
”	”	59–128	2	–9,980.77	–9,983.40	–9,981.22
HFM14	HFM24	0–151	2	0.81	–0.72	0.14
HFM14	KFM04A	0–168	2	1,000.93	1,000.27	1,000.39
HFM14	KFM04A	169–1,001	2	1,004.21	1,003.51	1,003.68
HFM14	KFM06A	0–150	2	0.02	–0.69	–0.18
”	”	151–246	2	–0.16	–0.98	–0.37
”	”	247–340	2	–0.15	–1.1	–0.4

Pumping borehole ID	Borehole ID	Section (m)	Test type[1)]	h_i (m)	h_p (m)	h_F (m)
”	”	341–362	2	0.01	–0.62	–0.31
”	”	363–737	2	–0.27	–0.89	–0.61
”	”	738–748	2	–0.64	–0.81	–0.73
”	”	749–826	2	–0.46	–0.61	–0.53
”	”	827–1,001	2	–2.85	–1.87	–1.68
HFM14	KFM06C	0–186	2	–	–969.56	–969.05
”	”	187–280	2	–	–969.74	–969.22
”	”	281–350	2	–	–969.75	–969.33
”	”	351–401	2	–	–969.81	–969.14
”	”	402–530	2	–	–969.85	–969.34
”	”	531–540	2	–	–969.54	–969.11
”	”	541–646	2	–	–969.70	–969.63
”	”	647–666	2	–	–969.15	–968.98
”	”	667–872	2	–	–969.45	–969.40
”	”	873–1,001	2	–	–968.96	–968.95
HFM14	KFM06B	0–26	2	0.50	–0.95	0.05
”	”	27–50	2	0.48	–1.12	0.12
”	”	51–100	2	0.46	–1.06	0.11
HFM14	HFM10	0–99	2	2.14	1.48	1.46
”	”	100–150	2	2.08	1.43	1.56
HFM14	HFM16	0–53	2	0.46	–1.11	0.11
	”	54–67	2	0.47	–1	0.14
	”	68–132	2	0.47	–1.02	0.14
HFM14	HFM09	0–50	2	2.45	1.79	1.90
HFM14	KFM07B	0–299	2	0.06	–1.50	–0.26
HFM14	HFM21	0–202	2	0.07	–1.47	–0.30
HFM14	KFM07A 2)	0–1,002	–	–	–	–
HFM14	KFM09B 2)	0–616	–	–	–	–
HFM14	HFM22	0–222	2	–0.11	–1.48	–0.40
HFM14	HFM20	0–48	2	0.45	–0.26	–0.08
”	”	49–100	2	–4.19	–5.36	–4.56
”	”	101–130	2	0.4	–0.98	0.07
	”	131–301	2	0.58	–0.94	0.19
HFM14	KFM08A 2)	0–1,001	–	–	–	–
HFM14	KFM08B	0–70	2	–0.11	–0.10	0.97
”	”	71–112	2	–0.54	–0.12	0.65
”	”	113–200	2	–0.24	–0.18	0.60
HFM14	HFM25 2)	0–188	–	–	–	–
HFM14	KFM09A 2)	0–800	–	–	–	–
HFM14	HFM28	0–151	2	1.25	0.65	0.67
HFM14	HFM23	0–212	2	1.07	0.54	0.53
HFM14	HFM29	0–200	2	1.34	0.78	0.75
HFM14	HFM17	0–211	2	0.43	–0.03	0.02
HFM14	KFM02A	0–132	2	–0.01	–0.57	–0.44
”	”	133–240	2	–0.25	–0.81	–0.68
”	”	241–410	2	0.55	–0.76	–0.09
”	”	411–442	2	–0.69	–2.16	–0.99
”	”	443–489	2	–0.82	–2.34	–1.14
”	”	490–518	2	–0.87	–2.38	–1.17

Pumping borehole ID	Borehole ID	Section (m)	Test type[1)]	h_i (m)	h_p (m)	h_F (m)
”	”	519–888	2	0.13	–0.56	–0.30
”	”	889–1,002	2	0.17	–0.18	–0.15
HFM14	HFM05	0–200	2	0.25	–0.10	–0.20
HFM14	HFM04	0–57	2	0.84	0.26	0.24
”	”	58–66	2	0.51	0.01	0.15
”	”	67–222	2	0.43	–0.10	–0.01
HFM14	HFM12	0–56.5	2	6.06	5.81	5.62
”	”	57.5–210	2	6.26	6.04	5.89
HFM14	HFM11	0–53	2	6.07	5.79	5.56
”	”	54–182	2	5.71	5.55	5.44
HFM14	HFM18	0–27	2	–0.02	–0.46	–0.48
”	“	28–41	2	0.20	–0.14	–0.16
”	”	42–180	2	0.15	–0.20	0.22
HFM14	KFM10A 3)	0–400	2	0.12	0.38	0.48
		401–500	2	0.42	–4.86	–0.06

[1)] 1B: Pumping test-submersible pump, 2: Interference test (observation borehole during pumping in another borehole).

[2)] Section not used during the interference test in HFM01.

[3)] This section was only included in the shorter, second interference test.

Table 6-119. Summary of calculated hydraulic parameters from the single-hole test in HFM14 in the Forsmark area.

Pumping borehole ID	Section (m)	Test type	Q/s (m^2/s)	T_M (m^2/s)	T_T (m^2/s)	ζ (–)	C (m^3/Pa)	S* (–)
HFM14	6–150	1B	4.7·10–4	6.0·10–4	5.1·10–4	–3.98	2.9·10–6	1.59·10–5

Table 6-120. Summary of calculated hydraulic parameters from the interference test between HFM14 and the observation boreholes HFM13, KFM02A, KFM04A and KFM06A respectively in the Forsmark area.

Pumping borehole ID	Observation borehole ID	Section (m)	Test type	T_o (m^2/s)	S_o (–)	T_o/S_o (m^2/s)	K’/b’ (s^{-1})
HFM14	HFM13	159–173	2	$5.1·10^{-6}$	$4.4·10^{-5}$	$1.2·10^{-1}$	$9.2·10^{-10}$
”	KFM02A	411–442	2	$4.4·10^{-4}$	$2.8·10^{-5}$	$1.6·10^{1}$	$1.0·10^{-10}$
”	KFM02A	490–518	2	$5.4·10^{-4}$	$2.5·10^{-5}$	$2.1·10^{1}$	$7.2·10^{-11}$
”	KFM04A	169–1,001	2	$1.7·10^{-3}$	$1.1·10^{-3}$	$1.5·10^{0}$	$1.8·10^{-9}$
”	KFM06A	341–362	2	$4.7·10^{-4}$	$7.3·10^{-4}$	$6.5·10^{-1}$	$1.3·10^{-9}$

Q/s = specific flow for the pumping/injection borehole.

T_M = steady state transmissivity from Moye’s equation.

T_T = transmissivity from transient evaluation of single-hole test.

T_o = transmissivity from transient evaluation of interference test.

S_o = storativity from transient evaluation of interference test.

T_o/S_o = hydraulic diffusivity (m^2/s).

K’/b’ = leakage coefficient from transient evaluation of interference test.

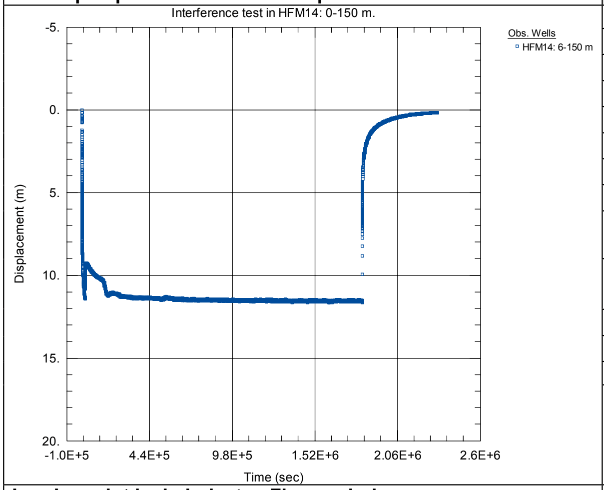
S* = assumed storativity by the estimation of the skin factor in single hole tests.

C = wellbore storage coefficient.

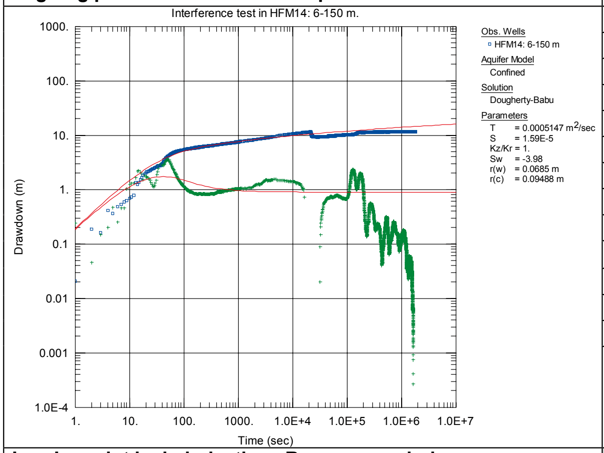
ζ = skin factor.

Test Summary Sheet - Pumping section HFM14: 6-150 m			
Project:	PLU	Test type:	1B
Area:	Forsmark	Test no:	1
Borehole ID:	HFM14	Test start:	2006-07-04 10:06
Test section (m):	6-150	Responsible for test performance:	GEOSIGMA AB K Gokall-Norman
Section diameter, 2·rw (m):	0.137	Responsible for test evaluation:	GEOSIGMA AB J-E Ludvigson

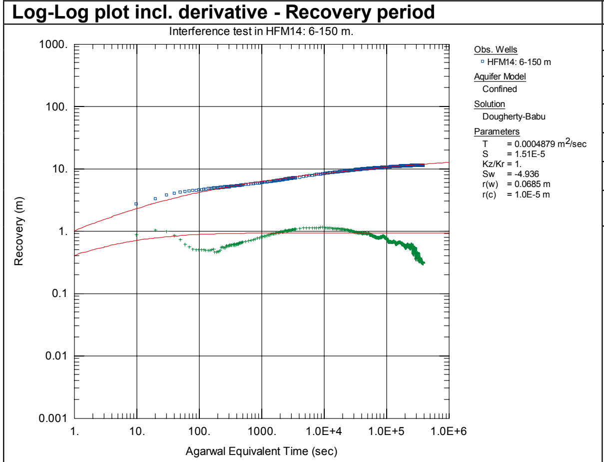
Linear plot pressure – Entire test period



Log-Log plot incl. derivate - Flow period



Log-Log plot incl. derivative - Recovery period



Flow period		Recovery period	
Indata		**Indata**	
p_0 (kPa)			
p_i (kPa)	162.74		
p_p(kPa)	44.77	p_F (kPa)	156.51
Q_p (m^3/s)	0.00568		
tp (s)	1829084	t_F (s)	488916
S*	$1.59 \cdot 10^{-5}$	S*	$1.5 \cdot 10^{-5}$
EC_w (mS/m)			
Te_w(gr C)			
Derivative fact.	0.3	Derivative fact.	0.1
Results		**Results**	
Q/s (m^2/s)	$4.7 \cdot 10^{-4}$		
T_{Moye}(m^2/s)	$6.0 \cdot 10^{-4}$		
Flow regime:		Flow regime:	
t_1 (s)	1000	dt_{e1} (s)	2000
t_2 (s)	100000	dt_{e2} (s)	30000
T_w (m^2/s)	$5.1 \cdot 10^{-4}$	T_w (m^2/s)	$4.9 \cdot 10^{-4}$
S_w (-)		S_w (-)	
K_{sw} (m/s)		K_{sw} (m/s)	
S_{sw} (1/m)		S_{sw} (1/m)	
C (m^3/Pa)	$2.9 \cdot 10^{-6}$	C (m^3/Pa)	-
C_D (-)		C_D (-)	
ξ (-)	-3.98	ξ (-)	-4.9
T_{GRF}(m^2/s)		T_{GRF}(m^2/s)	
S_{GRF}(-)		S_{GRF}(-)	
D_{GRF} (-)		D_{GRF} (-)	

Interpreted formation and well parameters.			
Flow regime:	PRF	C (m^3/Pa)	
t_1 (s)	10000	C_D (-)	
t_2 (s)	100000	ξ (-)	-3.98
T_T (m^2/s)	$5.1 \cdot 10^{-4}$		
S (-)			
K_s (m/s)			
S_s (1/m)			

Comments: All pressure data are relative pressures.

7 References

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List of data files

Files are named: Interferenstest_Pumphål_"BhID"_"YYYYMMDD"_"hhmm"_"File Type". Interferenstest_Pumphål is just an internal marker. "BhID" is the name of the borehole, after that the datafile start time is given. Pumpin and Ref_Da are parts of the original file names produced by the HTHB data logger. Ref_Da contains constants of calibration and background data. Pumpin contains data from pumping tests (no combined flow logging).

Bh ID	Test section (m)	Test type[1]	Test no	Test start Date, time YYYY-MM-DD tt:mm:ss	Test stop Date, time YYYY-MM-DD tt:mm:ss	Datafile, start Date, time YYYY-MM-DD tt:mm:ss	Datafile, stop Date, time YYYY-MM-DD tt:mm:ss	Data files of raw and primary data	Con-tent (parameters)[2]	Comments
HFM14	6–150	1B		20060704 10:06:02	20060731 06:00:00	20060704 10:06:02	20060913 16:34:20	Interferenstest_Pumphål_ HFM14_20060704_1006_ Pumpin00.DAT	P, Q	Pressure and flow registration in HFM14 for interference.
HFM14	6–150	1B		20060704 10:06:02	20060731 06:00:00	20030618 11:41:44	20060914 09:09:02	Interferenstest_Pumphål_ HFM14_20030618_1141_ Ref_Da00.DAT	C, R	

1) 1B: Pumping test-submersible pump, 2: Interference test (observation borehole during pumping in another borehole).

2) P =Pressure, Q =Flow, Te =Temperature, EC =El. conductivity. SPR =Single Point Resistance, C =Calibration file, R =Reference file, Sp= Spinner rotations.

Test diagrams and meteorological data

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)

r/B = leakage coefficient (s^{-1})

b = thickness of formation (m)

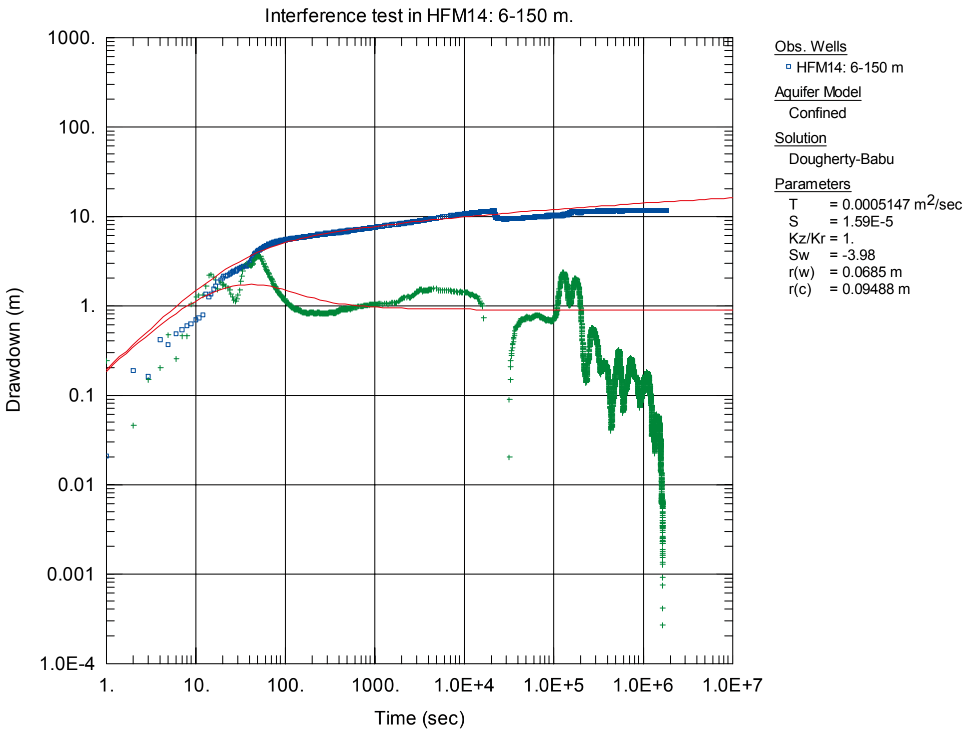

Figure A2-1. *Log-log plot of drawdown (▫) and drawdown derivative, ds/d(ln t) (+), versus time in HFM14 during the interference test in HFM14.*

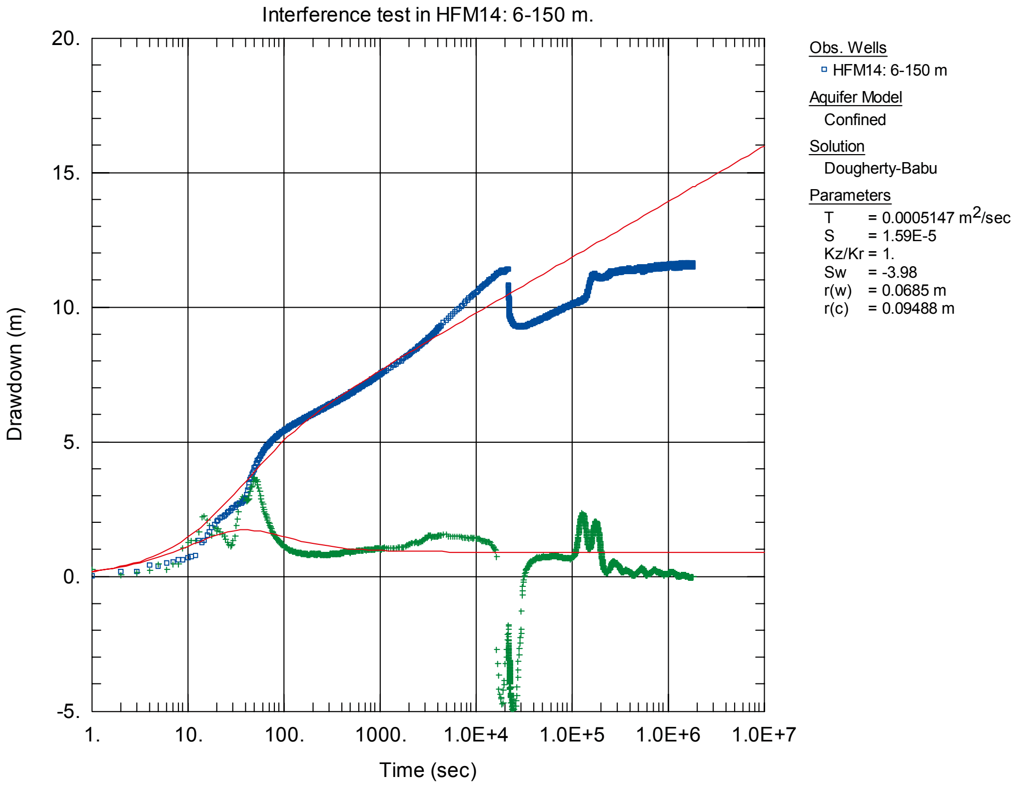

Figure A2-2. *Lin-log plot of drawdown (▫) and drawdown derivative, ds/d(ln t) (+), versus time in HFM14 during the interference test in HFM14.*

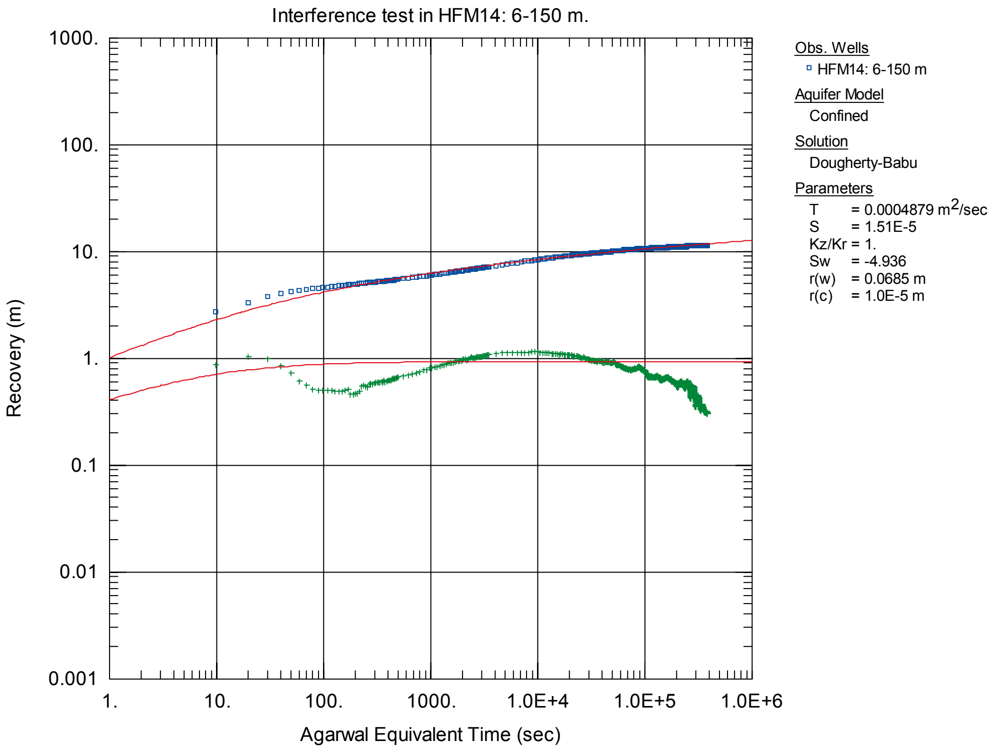

Figure A2-3. *Log-log plot of pressure recovery (▫) and derivative, dsp/d(ln dte) (+), versus equivalent time in HFM14 during the interference test in HFM14.*

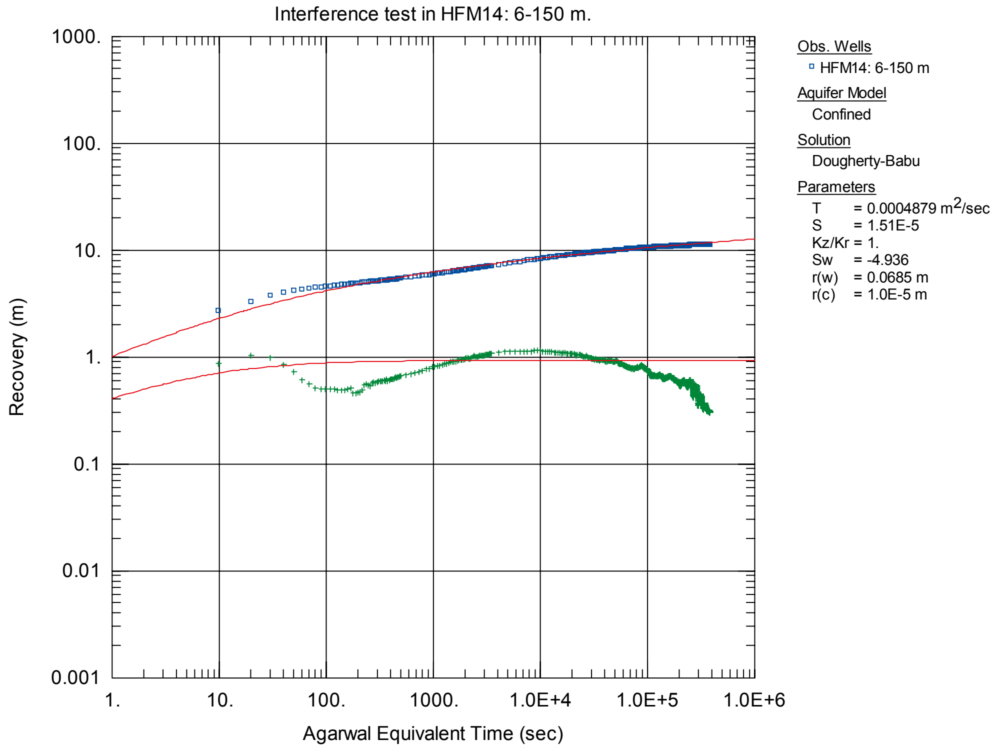

Figure A2-4. *Lin-log plot of pressure recovery (▫) and derivative, dsp/d(ln dte) (+), versus equivalent time in HFM14 during the interference test in HFM14.*

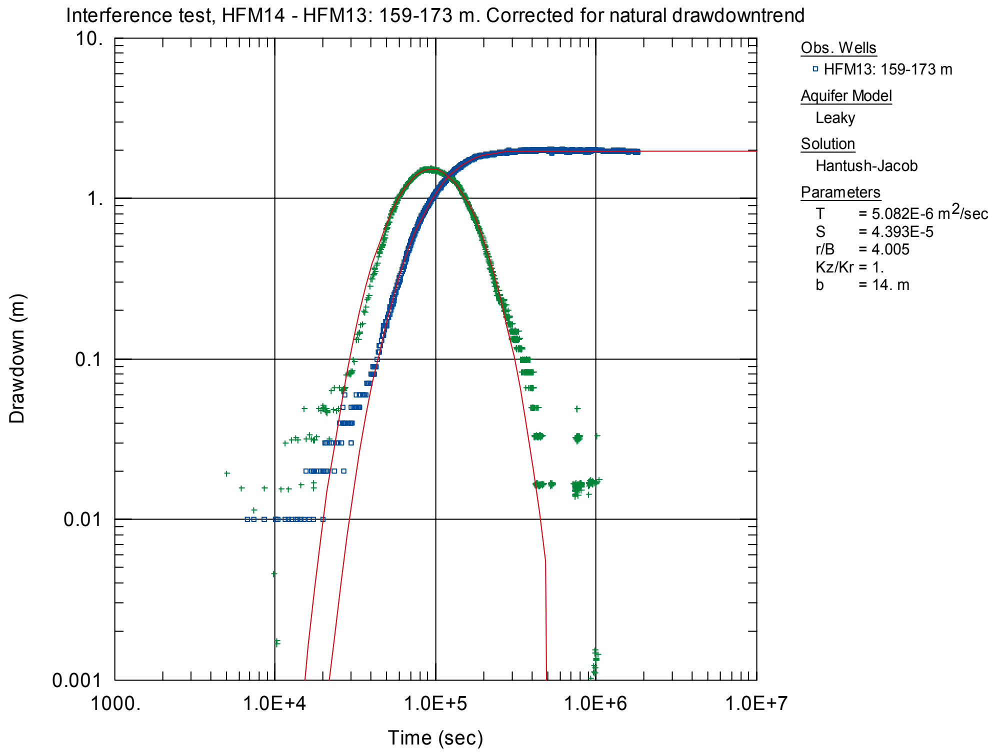

Figure A2-5. *Log-log plot of corrected drawdown (▫) and drawdown derivative, dsp/d(ln dte) (+), versus time in observation section HFM13: 159–173 m during the interference test in HFM14.*

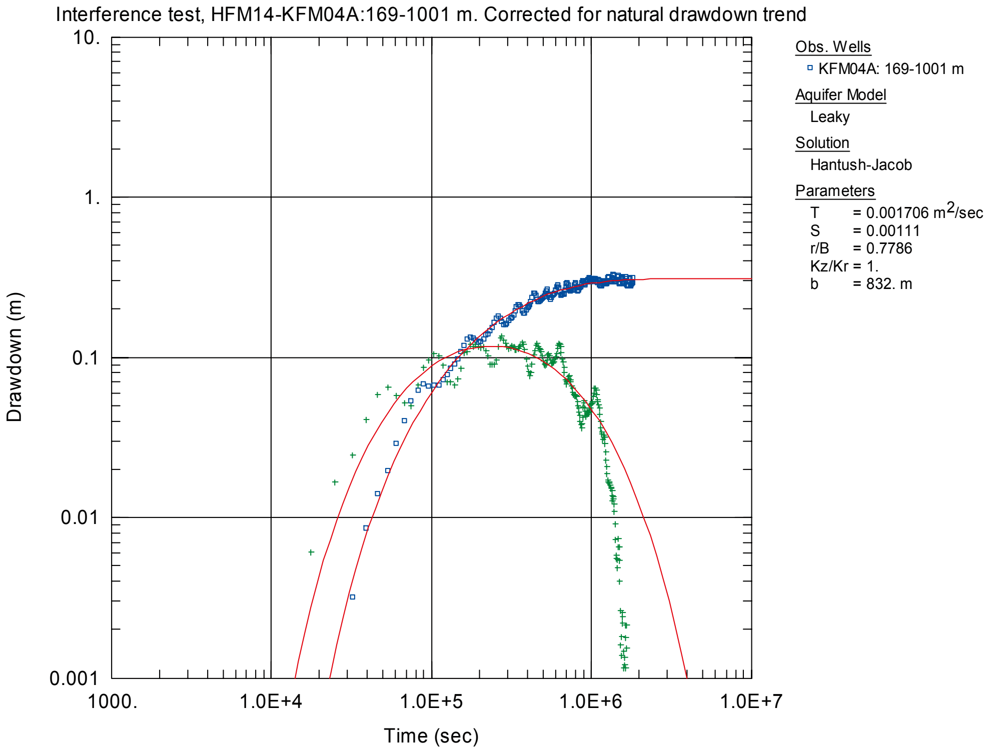

Figure A2-6. *Log-log plot of corrected drawdown (▫) and drawdown derivative, ds/d(ln t) (+), versus time in observation section KFM04A: 169–1,001 m during the interference test in HFM14.*

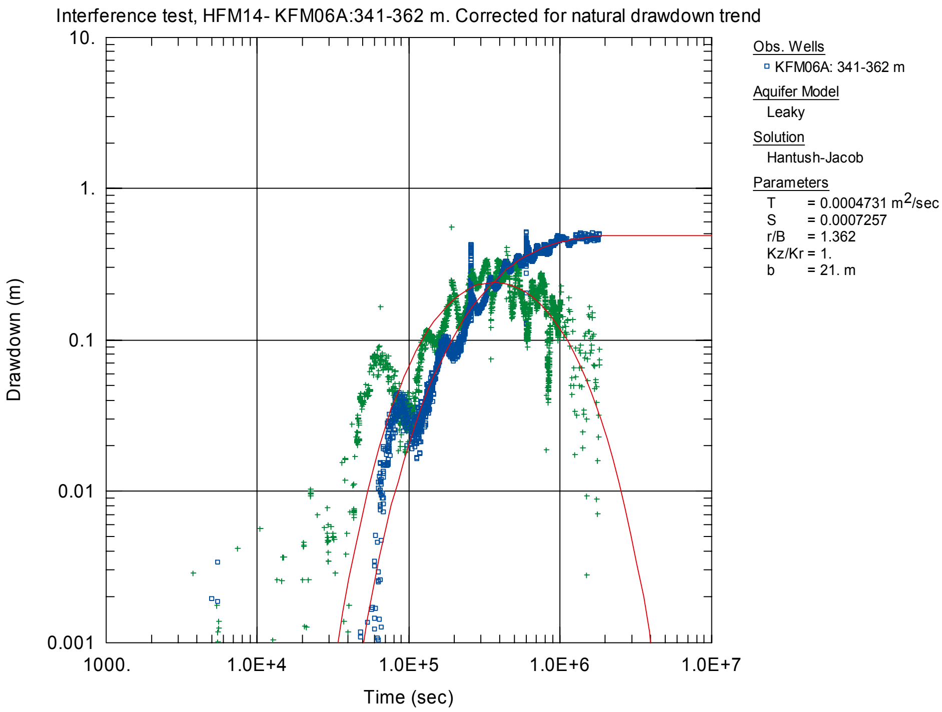

Figure A2-7. *Log-log plot of corrected drawdown (▫) and drawdown derivative, ds/d(ln t) (+), versus time in observation section KFM06A: 341–362 m during the interference test in HFM14.*

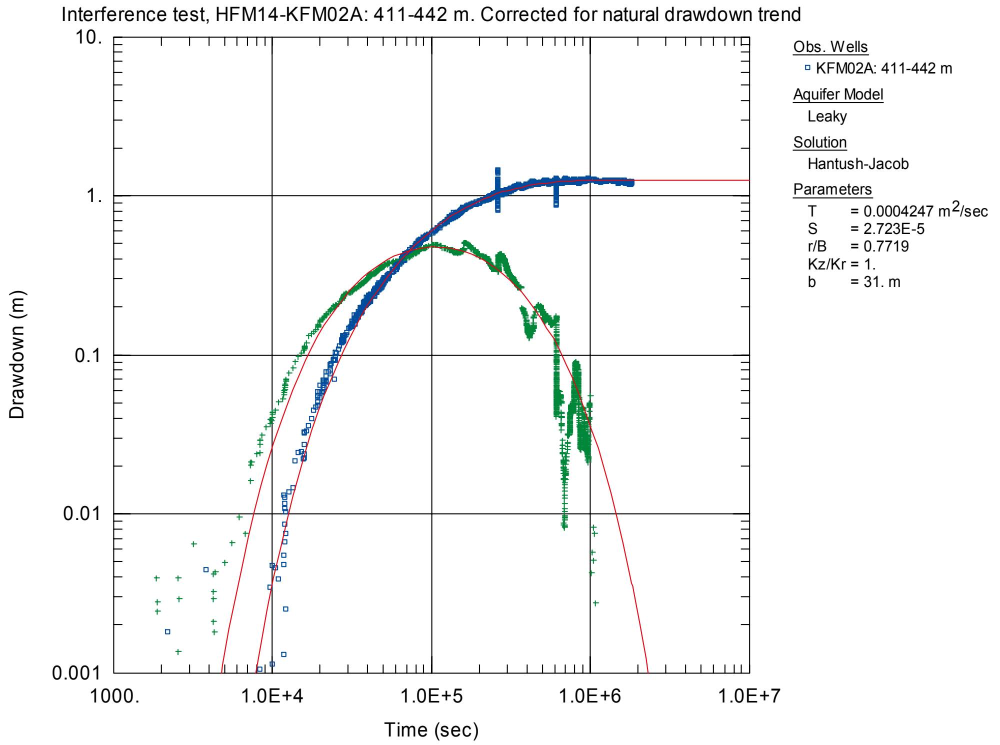

Figure A2-8. *Log-log plot of corrected drawdown (▫) and drawdown derivative, ds/d(ln t) (+), versus time in observation section KFM02A: 411–442 m during the interference test in HFM14.*

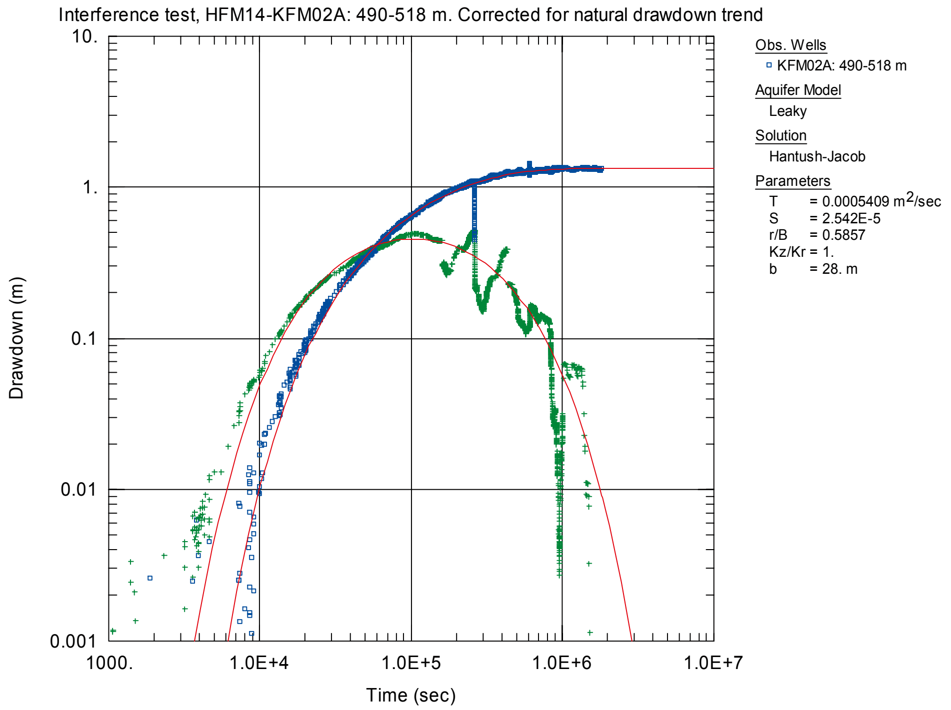

Figure A2-9. *Log-log plot of corrected drawdown (▫) and drawdown derivative, ds/d(ln t) (+), versus time in observation section KFM02A: 490–518 m during the interference test in HFM14.*

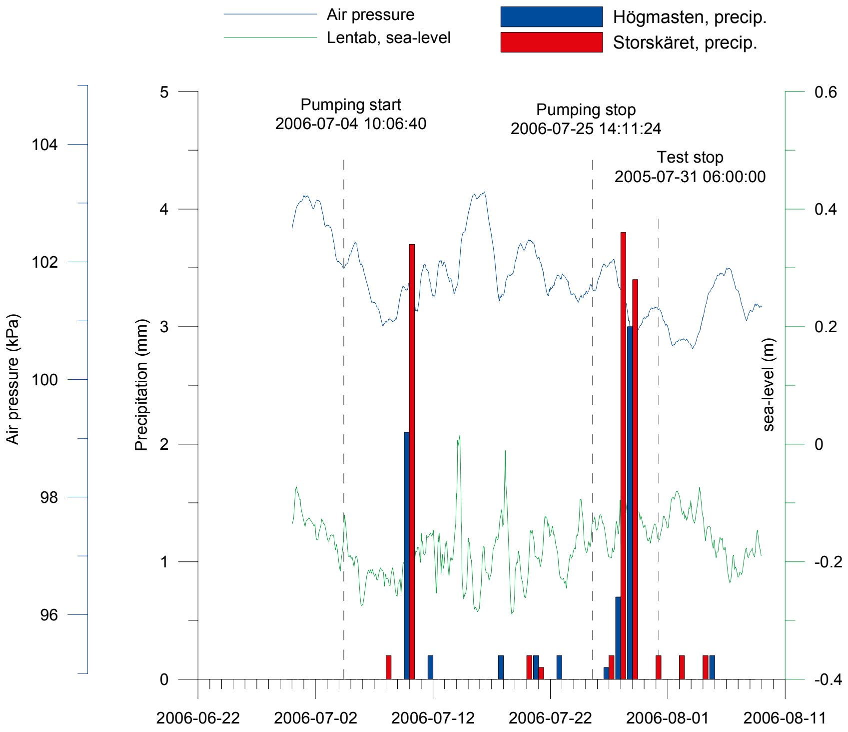

Figure A2-10. *24 hours summed precipitation in the Forsmark area during the first interference test in HFM14. Also air-pressure and sea-level is included in the diagram.*

Result tables to SICADA

Result tables to SICADA from the single hole test in HFM14

plu_s_hole_test_d.

idcode	start_date	stop_date	secup	seclow	sec-tion_no	test_type	forma-tion_type	start_flow_period	stop_flow_period	flow_rate_end_qp	value_type_qp	mean_flow_rate_qm	q_measl__l
HFM14	2006-07-04 10:06	2006-07-31 06:00	0.00	150.00		1B	1	2006-07-04 10:06:40	2005-07-25 14:11:24	5.6800E–03	0	5.8000E–03	

cont.

q_measl__u	tot_volume_vp	dur_flow_phase_tp	dur_rec_phase_tf	initial_head_hi	head_at_flow_end_hp	final_head_hf	initial_press_pi	press_at_flow_end_pp	final_press_pf	fluid_temp_tew
	1.0600E+04	1,829,084.00	488,916.00				162.74	44.77	156.51	

cont.

fluid_elcond_ecw	fluid_salinity_tdsw	fluid_salinity_tdswm	reference	comments	lp
				Pressure values are relative air pressure	

SICADA – description of plu_s_hole_test_d

PLU Injection and Pumping tests. *General information.*

SICADA header	Header	Unit	Explanation
Idcode	Borehole		ID for borehole
Secup	Borehole secup	(m)	Length coordinate along the borehole for the upper limit of the test section
Seclow	Borehole seclow	(m)	Length coordinate along the borehole for the lower limit of the test section
Test_type	Test type (1–7)	(–)	1A: Pumping test – wireline eq., 1B:Pumping test-submersible pump, 1C: Pumpingtest-airlift pumping, 2: Interference test, 3: Injection test, 4: Slug test, 4B: Pulse test 5A: Difference flow logging-PFL-DIFF-sequential, 5B: Difference flow logging-PFL-DIFF-overlapping, 6:Flow logging_Impeller,7:Grain size analysis
start_date	Date for test start	YYYY- MM-DD hh::mm	Date for the start of the pumping or injection test (YYYY-MM-DD hh:mm)
start_flow_period	Start flow/ injection	YYYY- MM-DD hh::mm:ss	Date and time for the start of the pumping or injection period (YYYY-MM-DD hh:mm:ss)
stop_flow_period	Start flow/ injection	YYYY- MM-DD hh::mm:ss	Date and time for the end of the pumping or injection period (YYYY-M-M DD hh:mm:ss)
mean_flow_rate_qm	Q_m	(m^3/s)	Arithmetic mean flow rate during flow (pumping/injection) period.
flow_rate_end_qp	Q_p	(m^3/s)	Flow rate at the end of the flow (pumping/injection) period.
value_type_qp			Code for Q_p-value; –1 means Q_p<lower measurement limit, 0 means measured value, 1 means Q_p> upper measurement value of flowrate
q_measl_l	Qmeasl_L	(m^3/s)	Estimated lower measurement limit for flow rate
q_measl_u	Qmeasl_U	(m^3/s)	Estimated upper measurement limit for flow rate
total_volume_vp	V_p	(m^3)	Total volume pumped or injected water during the flow period.
dur_flow_phase_tp	t_p	(s)	Duration of the flow period.
dur_rec_phase_tf	t_F	(s)	Duration of the recovery period.
initial_head_hi	h_i	(m)	Hydraulic head in test section at start of the flow period.
head_at_flow_end_hp	h_p	(m)	Hydraulic head in test section at stop of the flow period.
final_head_hf	h_F	(m)	Hydraulic head in test section at stop of the recovery period..
initial_press_pi	p_i	(kPa)	Ground water pressure in test section at start of the flow period.
press_at_flow_end_pp	p_p	(kPa)	Ground water pressure in test section at stop of the flow period.

SICADA header	Header	Unit	Explanation
final_press_pf	p_F	(kPa)	Ground water pressure in test section at stop of the recovery period.
fluid_temp_tew	Te_w	(C°)	Measured borehole fluid temperature in the test section (representative for evaluated parameters, in general the last temperature value)
fluid_elcond_ecw	EC_w	(mS/m)	Measured electric conductivity of the borehole fluid in the test section (representative for evaluated parameters, in general the last EC value)
fluid_salinity_tdsw	TDS_w	(mg/L)	Calculated total dissolved solids of the borehole fluid in the test section, based on EC-measurement
fluid_salinity_tdswn	TDS_{wn}	(mg/L)	Measured total dissolved solids of the borehole fluid in the test section, based on water sampling and chemical analysis
Reference	References		SKB report No for reports describing data and evaluation
Comments	Comments		Short comment to data

plu_s_hole_test_ed1.

idcode	start_date	stop_date	secup	seclow	section_no	test_type	formation_type	lp	seclen_class	spec_capacity_q_s	value_type_q_s
HFM14	2006-07-04 10:06	2006-07-31 06:00	0	150		1B	1	20		4.70E–04	0

cont.

transmissivity_tq	value_type_tq	bc_tq	transmissivity_moye	bc_tm	value_type_tm	hydr_cond_moye	formation_width_b	width_of_channel_b	tb	l_measl_tb	u_measl_tb	sb
			6.00E–04	0	0	4.17E–06	144					

cont.

assumed_sb	leakage_factor_lf	transmissivity_tt	value_type_tt	bc_tt	l_measl_q_s	u_measl_q_s	storativity_s	assumed_s	s_bc	ri	ri_index
		5.10E–04	0	1	2.00E–06	2.00E–02		1.59E–05			

cont.

leakage_coeff	hydr_cond_ksf	value_type_ksf	l_measl_ksf	u_measl_ksf	spec_storage_ssf	assumed_ssf	c	cd	skin	dt1	dt2	t1	t2	dte1	dte2
							2.90E–06		–3.98			1,000	100,000	2,000	30,000

cont.

p_horner	transmissivity_t_nlr	storativity_s_nlr	value_type_t_nlr	bc_t_nlr	c_nlr	cd_nlr	skin_nlr	transmissivity_t_grf	value_type_t_grf	bc_t_grf	storativity_s_grf	flow_dim_grf	comment

SICADA – description of plu_s_hole_test_ed1

PLU Single hole tests, pumping and injection. ***Basic evaluation.***

SICADA header	Header	Unit	Explanation
idcode	Borehole		ID for borehole
secup	Borehole secup	m	Length coordinate along the borehole for the upper limit of the test section
seclow	Borehole seclow	(m)	Length coordinate along the borehole for the lower limit of the test section
test_type	Test type (1–7)	(–)	1A: Pumpingtest-wireline eq., 1B: Pumpingtest-submersible pump, 1C: Pumpingtest-airlift pumping, 2: Interference test, 3: Injection test, 4: Slug test, 4B: Pulse Test, 5A: Flowlogging-PFL-DIFF_sequential, 5B: Flowlogging-PFL-DIFF_overlapping, 6: Flowlogging-Impeller, 7: Grain size analysis
formation_type	Formation type	(–)	1: Rock, 2: Soil (Superficial deposits)
seclen_class		(m)	Planned ordinary test interval during a test campaign when a great part of a borehole is tested. The test interval length might differ due to border conditions (e.g borehole end) but is still considered to be included in the same section length class.
start_date		YYYY-MM-DD hh:mm	Date for the start of the test (YYYY-MM-DD hh:mm)
lp	L_p	(m)	Hydraulic point of application for a test section, based on the geometric midpoint of test section or the main point of transmissivity distribution in test section
spec_capacity_q_s	Q/s	m^2/s	Specific capacity, generally estimated from Q_p, s_p or dh_p
value_type_q_s			Code for Q/s; –1 means Q/s< lower measurement limit, 0 means measured value,–1 means Q/s>upper measurement limit.
transmissivity_tq	T_Q	m^2/s	Transmissivity, based on Q/s and a function T = f(Q/s), see e.g. /Rhén et al. 1997/ s. 190. The function used should be refered to in ”Comments”.
transmissivity_moye	T_M	m^2/s	Transmissivity (T_M)based on /Moye 1967/
value_type_tm			Code for T_M ; –1 means T_M < lower measurement limit, 0 means measured value,–1 means T_M >upper measurement limit.
formation_width_b	b	m	Representative aquifer thickness for inferred transmissivity, generally estimated as test section length L_w
width_of_channel_b	B	m	Inferred width of formation for evaluated TB
tb	TB	m^3/s	Flow capacity in 1D formation of width B and transmissivity T based on transient evaluation. Considered best estimate from transient evaluation of flow period or recovery period.
l_measl_tb	TB-measl-L	m^3/s	Estimated lower measurement limit for evaluated TB.
u_measl_tb	TB-measl-L	m^3/s	Estimated upper measurement limit for evaluated TB.

SICADA header	Header	Unit	Explanation
sb	SB	m	Storage capacity of 1D formation of width B and storativity S based on transient evaluation. Considered best estimate from transient evaluation of flow period or recovery period.
assumed_sb	SB*	m	Assumed storage capacity of 1D formation of width B and storativity S based on transient evaluation.
ri_index	ri-index		**ri-index= 0**: Pressure response indicates that the size of the hydraulic feature is greater than radius of influence based on time for last pressure response measured (tp=t2). Size of hydraulic feature greater than radius of influence based on t2. **ri-index= 1**: Pressure response indicates that the hydraulic feature assigned the representative transmissivity is connected to hydraulic feature with less transmissivity or barrier boundary. Size of hydraulic feature estimated as radius of influence based on t2. (Size of feature somewhat under estimated using t2- but error considered as small.) **ri-index= –1**: Pressure response indicates that the hydraulic feature assigned the representative transmissivity is connected to hydraulic feature with greater transmissivity or a constant head boundary. Size of hydraulic feature estimated as radius of influence based on t2. (Size of feature somewhat under estimated using t2- but error considered as small.)
bc_s	S-BC		Calculated by using S if S=value or S=f(T) if S*=value
leakage_factor_lf	L_f	m	Leakage factor. $L_f = (K \cdot b \cdot c_f)^{0.5}$ where K represents the aquifer conditions. $c_f = b'/K'$ based on 1D linear flow model. Considered best estimate from transient evaluation of flow period or recovery period.
transmissivity_tt	T_T	m^2/s	Transmissivity (T) of formation, based on 2D radial flow model. Considered best estimate from transient evaluation of flow period or recovery period.
value_type_tt			Code for T_T; –1 means T_T < lower measurement limit, 0 means measured value,–1 means T_T >upper measurement limit.
l_measl_q_s	Q/s-measl-L	m^2/s	Estimated measurement limit for evaluated T (T_T, T_Q, T_M). If estimated T equals Q/s-measl in the table actual T is considered to be equal or less than Q/s-measl
u_measl_q_s	Q/s-measl-U	m^2/s	Estimated measurement limit for evaluated T (T_T, T_Q, T_M). If estimated T equals Q/s-measl in the table actual T is considered to be equal or grater than Q/s-measl
storativity_s	S	(–)	Storativity (Storage coefficient) of formation based on 2D radial flow model. Considered best estimate from transient evaluation of flow period or recovery period.
assumed_s	S*		Assumed storativity of formation based on 2D radial flow model.
leakage_koeff	K′/b′	(1/s)	Leakage coefficient evaluated from 2D radial flow model. K′= hydraulic conductivity across the aquitard, b′ = water saturated thickness of aquitard (leaky formation). Considered best estimate from transient evaluation of flow period or recovery period.
hydr_kond_ksf	K_{sf}	m/s	Hydraulic conductivity of formation, based on 3D spherical flow model. Considered best estimate from transient evaluation of flow period or recovery period.
value_type_ksf			Code for K_{Sf}; –1 means K_{Sf} < lower measurement limit, 0 means measured value,–1 means K_{Sf} >upper measurement limit.
l_measl_ksf	K_S-measl-L	m/s	Estimated lower measurement limit for evaluated K_{sf}.
u_measl_ksf	K_S-measl-U	m/s	Estimated upper measurement limit for evaluated K_{sf}.

SICADA header	Header	Unit	Explanation
spec_storage_ss	S_{sf}	1/m	Specific storage of formation based on 3D spherical flow model. Considered best estimate from transient evaluation of flow period or recovery period.
assumed_ss	S_{sf}*	1/m	Assumed specific storage of formation based on 3D spherical flow model.
c	C	(m^3/Pa)	Wellbore storage coefficient. Considered best estimate from transient evaluation of flow period or recovery period.
cd	C_D	(–)	Dimensionless wellbore storage coefficient, $C_D = C \cdot \rho_w g /(2\pi \cdot S \cdot r_w^2)$.
skin	ξ		Skin factor. Considered best estimate from transient evaluation of flow period or recovery period.
dt1	dt_1	s	Estimated start time after pump/injection start or recovery start, for the period used for the evaluated parameter
dt1	dt_2	s	Estimated stop time after pump/injection start or recovery start, for the period used for the evaluated parameter
dte1	dt_{e1}		Start time for evaluated parameter from start of recovery period.
dte2	dt_{e2}		Stop time for evaluated parameter from start of recovery period.
t1	t_1		Start time for evaluated parameter from start of flow period.
t2	t_2		Stop time for evaluated parameter from start of flow period.
p_horner	p*		Horner extrapolated pressure (used as an estimation of natural pressure of the test section)
transmissivity_t_nlr	T_{ILR}	m^2/s	Transmissivity, based on Non Linear Regression of the entire test sequence.
storativity_s_nlr	S_{ILR}	(–)	Storativity, based on Non Linear Regression of the entire test sequence.
c_nlr	C_{ILR}	(m^3/Pa)	Wellbore storage coefficient, based on Non Linear Regression of entire test sequence.
cd_nlr	$C_{D,ILR}$		Dimensionless wellbore storage coefficient, based on Non Linear Regression of entire test sequence.
skin_nlr	ξ_{NLR}		Skin factor, based on Non Linear Regression of entire test sequence.
transmissivity_t_grf	T_{GRF}	m^2/s	Transmissivity, based on the Generalized Radial Flow model /Baker 1988/. Considered best estimate from transient evaluation of flow period or recovery period.
storativity_s_grf	S_{GRF}	(–)	Storativity, based on Generalised Radial Flow model. Considered best estimate from transient evaluation of flow period or recovery period.
flow_dim_grf	D_{GRF}	(–)	Inferred flow dimension, based on the Generalized Radial Flow model /Barker 1988/. Considered best estimate from transient evaluation of flow period or recovery period.
comment	comment		comments on the test

Result table to SICADA from the interference test in HFM14

plu_inf_test_obs_d.

idcode	start_date	stop_date	secup	seclow	section_ no	test_ type	formation_ type	start_flow_period	stop_flow_period	test_ borehole	test_ secup	test_ seclow	lp
HFM15	2006-07-04 10:06	2006-07-31 06:00	0.00	84.00		2	1	2006-07-04 10:06:40	2005-07-25 14:11:24	HFM14	0.00	150.00	50.00
HFM15	2006-07-04 10:06	2006-07-31 06:00	85.00	95.00		2	1	2006-07-04 10:06:40	2005-07-25 14:11:24	HFM14	0.00	150.00	89.00
KFM05A	2006-07-04 10:06	2006-07-31 06:00	0.00	114.00		2	1	2006-07-04 10:06:40	2005-07-25 14:11:24	HFM14	0.00	150.00	109.00
KFM05A	2006-07-04 10:06	2006-07-31 06:00	115.00	253.00		2	1	2006-07-04 10:06:40	2005-07-25 14:11:24	HFM14	0.00	150.00	145.00
KFM05A	2006-07-04 10:06	2006-07-31 06:00	254.00	272.00		2	1	2006-07-04 10:06:40	2005-07-25 14:11:24	HFM14	0.00	150.00	256.00
KFM05A	2006-07-04 10:06	2006-07-31 06:00	273.00	489.00		2	1	2006-07-04 10:06:40	2005-07-25 14:11:24	HFM14	0.00	150.00	292.00
KFM05A	2006-07-04 10:06	2006-07-31 06:00	490.00	698.00		2	1	2006-07-04 10:06:40	2005-07-25 14:11:24	HFM14	0.00	150.00	594.00
KFM05A	2006-07-04 10:06	2006-07-31 06:00	699.00	1,002.00		2	1	2006-07-04 10:06:40	2005-07-25 14:11:24	HFM14	0.00	150.00	850.00
HFM19	2006-07-04 10:06	2006-07-31 06:00	0.00	103.00		2	1	2006-07-04 10:06:40	2005-07-25 14:11:24	HFM14	0.00	150.00	101.00
HFM19	2006-07-04 10:06	2006-07-31 06:00	104.00	167.00		2	1	2006-07-04 10:06:40	2005-07-25 14:11:24	HFM14	0.00	150.00	150.00
HFM19	2006-07-04 10:06	2006-07-31 06:00	168.00	182.00		2	1	2006-07-04 10:06:40	2005-07-25 14:11:24	HFM14	0.00	150.00	176.00
HFM13	2006-07-04 10:06	2006-07-31 06:00	0.00	100.00		2	1	2006-07-04 10:06:40	2005-07-25 14:11:24	HFM14	0.00	150.00	50.00
HFM13	2006-07-04 10:06	2006-07-31 06:00	101.00	158.00		2	1	2006-07-04 10:06:40	2005-07-25 14:11:24	HFM14	0.00	150.00	106.00
HFM13	2006-07-04 10:06	2006-07-31 06:00	159.00	173.00		2	1	2006-07-04 10:06:40	2005-07-25 14:11:24	HFM14	0.00	150.00	162.00
KFM01C	2006-07-04 10:06	2006-07-31 06:00	0.00	58.00		2	1	2006-07-04 10:06:40	2005-07-25 14:11:24	HFM14	0.00	150.00	38.00
KFM01C	2006-07-04 10:06	2006-07-31 06:00	59.00	237.00		2	1	2006-07-04 10:06:40	2005-07-25 14:11:24	HFM14	0.00	150.00	85.00
KFM01C	2006-07-04 10:06	2006-07-31 06:00	238.00	450.00		2	1	2006-07-04 10:06:40	2005-07-25 14:11:24	HFM14	0.00	150.00	436.00
HFM01	2006-07-04 10:06	2006-07-31 06:00	0.00	200.00		2	1	2006-07-04 10:06:40	2005-07-25 14:11:24	HFM14	0.00	150.00	51.00
KFM01A	2006-07-04 10:06	2006-07-31 06:00	0.00	108.00		2	1	2006-07-04 10:06:40	2005-07-25 14:11:24	HFM14	0.00	150.00	105.00
KFM01A	2006-07-04 10:06	2006-07-31 06:00	109.00	130.00		2	1	2006-07-04 10:06:40	2005-07-25 14:11:24	HFM14	0.00	150.00	118.00
KFM01A	2006-07-04 10:06	2006-07-31 06:00	131.00	204.00		2	1	2006-07-04 10:06:40	2005-07-25 14:11:24	HFM14	0.00	150.00	148.00
KFM01A	2006-07-04 10:06	2006-07-31 06:00	205.00	373.00		2	1	2006-07-04 10:06:40	2005-07-25 14:11:24	HFM14	0.00	150.00	285.00
KFM01A	2006-07-04 10:06	2006-07-31 06:00	374.00	430.00		2	1	2006-07-04 10:06:40	2005-07-25 14:11:24	HFM14	0.00	150.00	402.00
KFM01A	2006-07-04 10:06	2006-07-31 06:00	431.00	1,002.00		2	1	2006-07-04 10:06:40	2005-07-25 14:11:24	HFM14	0.00	150.00	715.00
KFM01B	2006-07-04 10:06	2006-07-31 06:00	0.00	100.00		2	1	2006-07-04 10:06:40	2005-07-25 14:11:24	HFM14	0.00	150.00	54.00
KFM01B	2006-07-04 10:06	2006-07-31 06:00	101.00	141.00		2	1	2006-07-04 10:06:40	2005-07-25 14:11:24	HFM14	0.00	150.00	121.00
KFM01B	2006-07-04 10:06	2006-07-31 06:00	142.00	500.00		2	1	2006-07-04 10:06:40	2005-07-25 14:11:24	HFM14	0.00	150.00	321.00
HFM32	2006-07-04 10:06	2006-07-31 06:00	0.00	25.00		2	1	2006-07-04 10:06:40	2005-07-25 14:11:24	HFM14	0.00	150.00	19.00
HFM32	2006-07-04 10:06	2006-07-31 06:00	26.00	31.00		2	1	2006-07-04 10:06:40	2005-07-25 14:11:24	HFM14	0.00	150.00	29.00

idcode	start_date	stop_date	secup	seclow	section_no	test_type	formation_type	start_flow_period	stop_flow_period	test_borehole	test_secup	test_seclow	lp
HFM32	2006-07-04 10:06	2006-07-31 06:00	32.00	97.00		2	1	2006-07-04 10:06:40	2005-07-25 14:11:24	HFM14	0.00	150.00	64.00
HFM32	2006-07-04 10:06	2006-07-31 06:00	98.00	203.00		2	1	2006-07-04 10:06:40	2005-07-25 14:11:24	HFM14	0.00	150.00	150.00
HFM03	2006-07-04 10:06	2006-07-31 06:00	0.00	18.00		2	1	2006-07-04 10:06:40	2005-07-25 14:11:24	HFM14	0.00	150.00	15.00
HFM03	2006-07-04 10:06	2006-07-31 06:00	19.00	26.00		2	1	2006-07-04 10:06:40	2005-07-25 14:11:24	HFM14	0.00	150.00	21.00
HFM02	2006-07-04 10:06	2006-07-31 06:00	0.00	37.00		2	1	2006-07-04 10:06:40	2005-07-25 14:11:24	HFM14	0.00	150.00	31.00
HFM02	2006-07-04 10:06	2006-07-31 06:00	38.00	48.00		2	1	2006-07-04 10:06:40	2005-07-25 14:11:24	HFM14	0.00	150.00	43.00
HFM02	2006-07-04 10:06	2006-07-31 06:00	49.00	100.00		2	1	2006-07-04 10:06:40	2005-07-25 14:11:24	HFM14	0.00	150.00	74.00
HFM27	2006-07-04 10:06	2006-07-31 06:00	0.00	24.00		2	1	2006-07-04 10:06:40	2005-07-25 14:11:24	HFM14	0.00	150.00	20.00
HFM27	2006-07-04 10:06	2006-07-31 06:00	25.00	45.00		2	1	2006-07-04 10:06:40	2005-07-25 14:11:24	HFM14	0.00	150.00	28.00
HFM27	2006-07-04 10:06	2006-07-31 06:00	46.00	58.00		2	1	2006-07-04 10:06:40	2005-07-25 14:11:24	HFM14	0.00	150.00	54.00
HFM27	2006-07-04 10:06	2006-07-31 06:00	59.00	128.00		2	1	2006-07-04 10:06:40	2005-07-25 14:11:24	HFM14	0.00	150.00	119.00
HFM24	2006-07-04 10:06	2006-07-31 06:00	0.00	151.00		2	1	2006-07-04 10:06:40	2005-07-25 14:11:24	HFM14	0.00	150.00	35.00
KFM04A	2006-07-04 10:06	2006-07-31 06:00	0.00	168.00		2	1	2006-07-04 10:06:40	2005-07-25 14:11:24	HFM14	0.00	150.00	114.00
KFM04A	2006-07-04 10:06	2006-07-31 06:00	169.00	1,001.00		2	1	2006-07-04 10:06:40	2005-07-25 14:11:24	HFM14	0.00	150.00	220.00
KFM06A	2006-07-04 10:06	2006-07-31 06:00	0.00	150.00		2	1	2006-07-04 10:06:40	2005-07-25 14:11:24	HFM14	0.00	150.00	130.00
KFM06A	2006-07-04 10:06	2006-07-31 06:00	151.00	246.00		2	1	2006-07-04 10:06:40	2005-07-25 14:11:24	HFM14	0.00	150.00	215.00
KFM06A	2006-07-04 10:06	2006-07-31 06:00	247.00	340.00		2	1	2006-07-04 10:06:40	2005-07-25 14:11:24	HFM14	0.00	150.00	267.00
KFM06A	2006-07-04 10:06	2006-07-31 06:00	341.00	362.00		2	1	2006-07-04 10:06:40	2005-07-25 14:11:24	HFM14	0.00	150.00	357.00
KFM06A	2006-07-04 10:06	2006-07-31 06:00	363.00	737.00		2	1	2006-07-04 10:06:40	2005-07-25 14:11:24	HFM14	0.00	150.00	392.00
KFM06A	2006-07-04 10:06	2006-07-31 06:00	738.00	748.00		2	1	2006-07-04 10:06:40	2005-07-25 14:11:24	HFM14	0.00	150.00	743.00
KFM06A	2006-07-04 10:06	2006-07-31 06:00	749.00	826.00		2	1	2006-07-04 10:06:40	2005-07-25 14:11:24	HFM14	0.00	150.00	775.00
KFM06A	2006-07-04 10:06	2006-07-31 06:00	827.00	1,001.00		2	1	2006-07-04 10:06:40	2005-07-25 14:11:24	HFM14	0.00	150.00	913.00
KFM06C	2006-07-04 10:06	2006-07-31 06:00	0.00	186.00		2	1	2006-07-04 10:06:40	2005-07-25 14:11:24	HFM14	0.00	150.00	144.00
KFM06C	2006-07-04 10:06	2006-07-31 06:00	187.00	280.00		2	1	2006-07-04 10:06:40	2005-07-25 14:11:24	HFM14	0.00	150.00	214.00
KFM06C	2006-07-04 10:06	2006-07-31 06:00	281.00	350.00		2	1	2006-07-04 10:06:40	2005-07-25 14:11:24	HFM14	0.00	150.00	316.00
KFM06C	2006-07-04 10:06	2006-07-31 06:00	351.00	401.00		2	1	2006-07-04 10:06:40	2005-07-25 14:11:24	HFM14	0.00	150.00	395.00
KFM06C	2006-07-04 10:06	2006-07-31 06:00	402.00	530.00		2	1	2006-07-04 10:06:40	2005-07-25 14:11:24	HFM14	0.00	150.00	422.00
KFM06C	2006-07-04 10:06	2006-07-31 06:00	531.00	540.00		2	1	2006-07-04 10:06:40	2005-07-25 14:11:24	HFM14	0.00	150.00	536.00
KFM06C	2006-07-04 10:06	2006-07-31 06:00	541.00	646.00		2	1	2006-07-04 10:06:40	2005-07-25 14:11:24	HFM14	0.00	150.00	593.00
KFM06C	2006-07-04 10:06	2006-07-31 06:00	647.00	666.00		2	1	2006-07-04 10:06:40	2005-07-25 14:11:24	HFM14	0.00	150.00	658.00
KFM06C	2006-07-04 10:06	2006-07-31 06:00	667.00	872.00		2	1	2006-07-04 10:06:40	2005-07-25 14:11:24	HFM14	0.00	150.00	770.00
KFM06C	2006-07-04 10:06	2006-07-31 06:00	873.00	1,001.00		2	1	2006-07-04 10:06:40	2005-07-25 14:11:24	HFM14	0.00	150.00	927.00

idcode	start_date	stop_date	secup	seclow	section_ no	test_ type	formation_ type	start_flow_period	stop_flow_period	test_ borehole	test_ secup	test_ seclow	lp
KFM06B	2006-07-04 10:06	2006-07-31 06:00	0.00	26.00		2	1	2006-07-04 10:06:40	2005-07-25 14:11:24	HFM14	0.00	150.00	11.00
KFM06B	2006-07-04 10:06	2006-07-31 06:00	27.00	50.00		2	1	2006-07-04 10:06:40	2005-07-25 14:11:24	HFM14	0.00	150.00	45.00
KFM06B	2006-07-04 10:06	2006-07-31 06:00	51.00	100.00		2	1	2006-07-04 10:06:40	2005-07-25 14:11:24	HFM14	0.00	150.00	56.00
HFM10	2006-07-04 10:06	2006-07-31 06:00	0.00	99.00		2	1	2006-07-04 10:06:40	2005-07-25 14:11:24	HFM14	0.00	150.00	50.00
HFM10	2006-07-04 10:06	2006-07-31 06:00	100.00	150.00		2	1	2006-07-04 10:06:40	2005-07-25 14:11:24	HFM14	0.00	150.00	118.00
HFM16	2006-07-04 10:06	2006-07-31 06:00	0.00	53.00		2	1	2006-07-04 10:06:40	2005-07-25 14:11:24	HFM14	0.00	150.00	41.00
HFM16	2006-07-04 10:06	2006-07-31 06:00	54.00	67.00		2	1	2006-07-04 10:06:40	2005-07-25 14:11:24	HFM14	0.00	150.00	58.00
HFM16	2006-07-04 10:06	2006-07-31 06:00	68.00	132.00		2	1	2006-07-04 10:06:40	2005-07-25 14:11:24	HFM14	0.00	150.00	69.00
HFM09	2006-07-04 10:06	2006-07-31 06:00	0.00	50.00		2	1	2006-07-04 10:06:40	2005-07-25 14:11:24	HFM14	0.00	150.00	26.00
KFM07B	2006-07-04 10:06	2006-07-31 06:00	0.00	299.00		2	1	2006-07-04 10:06:40	2005-07-25 14:11:24	HFM14	0.00	150.00	236.00
HFM21	2006-07-04 10:06	2006-07-31 06:00	0.00	202.00		2	1	2006-07-04 10:06:40	2005-07-25 14:11:24	HFM14	0.00	150.00	68.00
HFM22	2006-07-04 10:06	2006-07-31 06:00	0.00	222.00		2	1	2006-07-04 10:06:40	2005-07-25 14:11:24	HFM14	0.00	150.00	62.00
HFM20	2006-07-04 10:06	2006-07-31 06:00	0.00	48.00		2	1	2006-07-04 10:06:40	2005-07-25 14:11:24	HFM14	0.00	150.00	25.00
HFM20	2006-07-04 10:06	2006-07-31 06:00	49.00	100.00		2	1	2006-07-04 10:06:40	2005-07-25 14:11:24	HFM14	0.00	150.00	77.00
HFM20	2006-07-04 10:06	2006-07-31 06:00	101.00	130.00		2	1	2006-07-04 10:06:40	2005-07-25 14:11:24	HFM14	0.00	150.00	118.00
HFM20	2006-07-04 10:06	2006-07-31 06:00	131.00	301.00		2	1	2006-07-04 10:06:40	2005-07-25 14:11:24	HFM14	0.00	150.00	215.00
KFM08B	2006-07-04 10:06	2006-07-31 06:00	0.00	70.00		2	1	2006-07-04 10:06:40	2005-07-25 14:11:24	HFM14	0.00	150.00	26.00
KFM08B	2006-07-04 10:06	2006-07-31 06:00	71.00	112.00		2	1	2006-07-04 10:06:40	2005-07-25 14:11:24	HFM14	0.00	150.00	92.00
KFM08B	2006-07-04 10:06	2006-07-31 06:00	113.00	200.00		2	1	2006-07-04 10:06:40	2005-07-25 14:11:24	HFM14	0.00	150.00	174.00
HFM28	2006-07-04 10:06	2006-07-31 06:00	0.00	151.00		2	1	2006-07-04 10:06:40	2005-07-25 14:11:24	HFM14	0.00	150.00	82.00
HFM23	2006-07-04 10:06	2006-07-31 06:00	0.00	212.00		2	1	2006-07-04 10:06:40	2005-07-25 14:11:24	HFM14	0.00	150.00	30.00
HFM29	2006-07-04 10:06	2006-07-31 06:00	0.00	200.00		2	1	2006-07-04 10:06:40	2005-07-25 14:11:24	HFM14	0.00	150.00	105.00
HFM17	2006-07-04 10:06	2006-07-31 06:00	0.00	211.00		2	1	2006-07-04 10:06:40	2005-07-25 14:11:24	HFM14	0.00	150.00	31.00
KFM02A	2006-07-04 10:06	2006-07-31 06:00	0.00	132.00		2	1	2006-07-04 10:06:40	2005-07-25 14:11:24	HFM14	0.00	150.00	118.00
KFM02A	2006-07-04 10:06	2006-07-31 06:00	133.00	240.00		2	1	2006-07-04 10:06:40	2005-07-25 14:11:24	HFM14	0.00	150.00	173.00
KFM02A	2006-07-04 10:06	2006-07-31 06:00	241.00	410.00		2	1	2006-07-04 10:06:40	2005-07-25 14:11:24	HFM14	0.00	150.00	282.00
KFM02A	2006-07-04 10:06	2006-07-31 06:00	411.00	442.00		2	1	2006-07-04 10:06:40	2005-07-25 14:11:24	HFM14	0.00	150.00	428.00
KFM02A	2006-07-04 10:06	2006-07-31 06:00	443.00	489.00		2	1	2006-07-04 10:06:40	2005-07-25 14:11:24	HFM14	0.00	150.00	478.00
KFM02A	2006-07-04 10:06	2006-07-31 06:00	490.00	518.00		2	1	2006-07-04 10:06:40	2005-07-25 14:11:24	HFM14	0.00	150.00	513.00
KFM02A	2006-07-04 10:06	2006-07-31 06:00	519.00	888.00		2	1	2006-07-04 10:06:40	2005-07-25 14:11:24	HFM14	0.00	150.00	558.00
KFM02A	2006-07-04 10:06	2006-07-31 06:00	889.00	1,002.00		2	1	2006-07-04 10:06:40	2005-07-25 14:11:24	HFM14	0.00	150.00	945.00
HFM05	2006-07-04 10:06	2006-07-31 06:00	0.00	200.00		2	1	2006-07-04 10:06:40	2005-07-25 14:11:24	HFM14	0.00	150.00	153.00

idcode	start_date	stop_date	secup	seclow	section_ no	test_ type	formation_ type	start_flow_period	stop_flow_period	test_ borehole	test_ secup	test_ seclow	lp
HFM04	2006-07-04 10:06	2006-07-31 06:00	0.00	57.00		2	1	2006-07-04 10:06:40	2005-07-25 14:11:24	HFM14	0.00	150.00	35.00
HFM04	2006-07-04 10:06	2006-07-31 06:00	58.00	66.00		2	1	2006-07-04 10:06:40	2005-07-25 14:11:24	HFM14	0.00	150.00	62.00
HFM04	2006-07-04 10:06	2006-07-31 06:00	67.00	222.00		2	1	2006-07-04 10:06:40	2005-07-25 14:11:24	HFM14	0.00	150.00	145.00
HFM12	2006-07-04 10:06	2006-07-31 06:00	0.00	56.50		2	1	2006-07-04 10:06:40	2005-07-25 14:11:24	HFM14	0.00	150.00	22.00
HFM12	2006-07-04 10:06	2006-07-31 06:00	57.50	210.00		2	1	2006-07-04 10:06:40	2005-07-25 14:11:24	HFM14	0.00	150.00	117.00
HFM11	2006-07-04 10:06	2006-07-31 06:00	0.00	53.00		2	1	2006-07-04 10:06:40	2005-07-25 14:11:24	HFM14	0.00	150.00	43.00
HFM11	2006-07-04 10:06	2006-07-31 06:00	54.00	182.00		2	1	2006-07-04 10:06:40	2005-07-25 14:11:24	HFM14	0.00	150.00	125.00
HFM18	2006-07-04 10:06	2006-07-31 06:00	0.00	27.00		2	1	2006-07-04 10:06:40	2005-07-25 14:11:24	HFM14	0.00	150.00	19.00
HFM18	2006-07-04 10:06	2006-07-31 06:00	28.00	41.00		2	1	2006-07-04 10:06:40	2005-07-25 14:11:24	HFM14	0.00	150.00	35.00
HFM18	2006-07-04 10:06	2006-07-31 06:00	42.00	180.00		2	1	2006-07-04 10:06:40	2005-07-25 14:11:24	HFM14	0.00	150.00	111.00

cont.

lp	radial_ distance_rs	shortest_ distance_rt	time_lag_ press_dtl	initial_ head_hi	head_at_ flow_end_hp	final_ head_hf	initial_ press_pi	press_at_ flow_end_pp	reference	comment
50.00	32.60		2.00	0.48	–7.93	–0.08				dtl is for 0.01 m change
89.00	71.30		5.00	0.52	–7.28	–0.02				dtl is for 0.01 m change
109.00	88.20		60.00	0.11	–5.36	–0.28				dtl is for 0.01 m change
145.00	123.10		340.00	0.00	–5.36	–0.46				dtl is for 0.01 m change
256.00	232.70		–	–0.77	–0.30	–0.18				dtl is for 0.01 m change
292.00	268.50		–	2.61	2.79	2.69				dtl is for 0.01 m change
594.00	568.20		–	1.07	1.55	1.37				dtl is for 0.01 m change
850.00	821.40		–	0.62	0.49	0.48				dtl is for 0.01 m change
101.00	183.00		445.00	0.64	–5.59	0.22				dtl is for 0.01 m change
150.00	224.80		185.00	0.46	–5.84	0.05				dtl is for 0.01 m change
176.00	248.10		120.00	–0.06	–6.36	–0.51				dtl is for 0.01 m change
50.00	319.00		325.00	0.09	–5.99	–0.34				dtl is for 0.01 m change
106.00	302.10		2,340.00	0.81	–4.02	0.37				dtl is for 0.01 m change
162.00	296.60		10,400.00	2.63	–0.03	1.50				dtl is for 0.01 m change
38.00	367.50		775.00	–979.05	–981.90	–979.43				dtl is for 0.01 m change
85.00	350.00		580.00	–979.20	–982.23	–979.59				dtl is for 0.01 m change
436.00	403.90		–	–983.40	–980.18	–980.30				dtl is for 0.01 m change
51.00	379.00		1,100.00	0.16	–2.42	–0.26				dtl is for 0.01 m change
105.00	411.90		160,760.00	–1.44	–1.88	–1.77				dtl is for 0.01 m change
118.00	416.10		2,085.00	–0.82	–2.21	–0.75				dtl is for 0.01 m change
148.00	427.40		6,200.00	–0.24	–2.05	–0.72				dtl is for 0.01 m change
285.00	500.30		426,800.00	–0.84	–0.86	–0.82				dtl is for 0.01 m change
402.00	582.30		–	1.78	1.91	1.85				dtl is for 0.01 m change
715.00	849.60		–	1.26	2.13	2.32				dtl is for 0.01 m change
54.00	415.90		200.00	0.16	–2.65	–0.24				dtl is for 0.01 m change
121.00	438.30		200.00	–0.57	–2.21	–0.80				dtl is for 0.01 m change
321.00	555.60		5,000.00	0.11	–1.77	–0.29				dtl is for 0.01 m change
19.00	511.10		8,165.00	–0.03	–0.27	–0.21				dtl is for 0.01 m change
29.00	512.00		20,105.00	–0.07	–0.35	–0.24				dtl is for 0.01 m change
64.00	517.80		14,265.00	–0.35	–2.48	–0.69				dtl is for 0.01 m change

lp	radial_ distance_rs	shortest_ distance_rt	time_lag_ press_dtl	initial_ head_hi	head_at_ flow_end_hp	final_ head_hf	initial_ press_pi	press_at_ flow_end_pp	reference	comment
150.00	546.20		3,575.00	–0.49	–2.62	–0.84				dtl is for 0.01 m change
15.00	532.10		3,200.00	0.27	–2.41	–0.18				dtl is for 0.01 m change
21.00	532.40		1,400.00	0.19	–2.60	–0.22				dtl is for 0.01 m change
31.00	535.70		800.00	0.16	–2.63	–0.23				dtl is for 0.01 m change
43.00	536.30		775.00	0.19	–2.61	–0.18				dtl is for 0.01 m change
74.00	539.00		990.00	0.24	–2.58	–0.17				dtl is for 0.01 m change
20.00	561.80		1,400.00	–9,980.80	–9,983.53	–9,981.25				dtl is for 0.01 m change
28.00	564.20		710.00	–9,981.13	–9,983.94	–9,981.52				dtl is for 0.01 m change
54.00	573.40		1,015.00	–9,980.85	–9,983.58	–9,981.24				dtl is for 0.01 m change
119.00	602.10		2,000.00	–9,980.77	–9,983.40	–9,981.22				dtl is for 0.01 m change
35.00	647.40		1,034.00	0.81	–0.72	0.14				dtl is for 0.01 m change
114.00	803.80		32,000.00	1,000.93	1,000.27	1,000.39				dtl is for 0.01 m change
220.00	772.90		39,200.00	1,004.21	1,003.51	1,003.68				dtl is for 0.01 m change
130.00	797.50		39,435.00	0.02	–0.69	–0.18				dtl is for 0.01 m change
215.00	793.10		29,367.00	–0.16	–0.98	–0.37				dtl is for 0.01 m change
267.00	795.50		24,200.00	–0.15	–1.10	–0.40				dtl is for 0.01 m change
357.00	810.30		64,870.00	0.01	–0.62	–0.31				dtl is for 0.01 m change
392.00	816.10		70,400.00	–0.27	–0.89	–0.61				dtl is for 0.01 m change
743.00	979.90		64,510.00	–0.64	–0.81	–0.73				dtl is for 0.01 m change
775.00	1,001.40		68,000.00	–0.46	–0.61	–0.53				dtl is for 0.01 m change
913.00	1,103.20		–	–2.85	–1.87	–1.68				dtl is for 0.01 m change
144.00	892.40		–	–	–969.56	–969.05				dtl is for 0.01 m change
214.00	935.50		–	–	–969.74	–969.22				dtl is for 0.01 m change
316.00	1,007.40		–	–	–969.75	–969.33				dtl is for 0.01 m change
395.00	1,069.10		–	–	–969.81	–969.14				dtl is for 0.01 m change
422.00	1,091.20		–	–	–969.85	–969.34				dtl is for 0.01 m change
536.00	1,188.30		–	–	–969.54	–969.11				dtl is for 0.01 m change
593.00	1,238.40		–	–	–969.70	–969.63				dtl is for 0.01 m change
658.00	1,296.70		–	–	–969.15	–968.98				dtl is for 0.01 m change
770.00	1,398.50		–	–	–969.45	–969.40				dtl is for 0.01 m change
927.00	1,543.50		–	–	–968.96	–968.95				dtl is for 0.01 m change
11.00	825.10		11,600.00	0.50	–0.95	0.05				dtl is for 0.01 m change

lp	radial_ distance_rs	shortest_ distance_rt	time_lag_ press_dtl	initial_ head_hi	head_at_ flow_end_hp	final_ head_hf	initial_ press_pi	press_at_ flow_end_pp	reference	comment
45.00	823.50		5,940.00	0.48	–1.12	0.12				dtl is for 0.01 m change
56.00	823.30		5,600.00	0.46	–1.06	0.11				dtl is for 0.01 m change
50.00	836.10		33,480.00	2.14	1.48	1.46				dtl is for 0.01 m change
118.00	830.80		45,520.00	2.08	1.43	1.56				dtl is for 0.01 m change
41.00	837.50		8,000.00	0.46	–1.11	0.11				dtl is for 0.01 m change
58.00	838.00		8,000.00	0.47	–1.00	0.14				dtl is for 0.01 m change
69.00	838.50		6,800.00	0.47	–1.02	0.14				dtl is for 0.01 m change
26.00	894.80		32,000.00	2.45	1.79	1.90				dtl is for 0.01 m change
236.00	931.40		8,000.00	0.06	–1.50	–0.26				dtl is for 0.01 m change
68.00	1,012.60		1,600.00	0.07	–1.47	–0.30				dtl is for 0.01 m change
62.00	1,227.40		11,600.00	–0.11	–1.48	–0.40				dtl is for 0.01 m change
25.00	1,289.00		60,740.00	0.45	–0.26	–0.08				dtl is for 0.01 m change
77.00	1,292.40		19,585.00	–4.19	–5.36	–4.56				dtl is for 0.01 m change
118.00	1,295.90		13,615.00	0.40	–0.98	0.07				dtl is for 0.01 m change
215.00	1,308.50		12,200.00	0.58	–0.94	0.19				dtl is for 0.01 m change
26.00	1,302.50		34,400.00	–0.11	–0.10	0.97				dtl is for 0.01 m change
92.00	1,320.50		–	–0.54	–0.12	0.65				dtl is for 0.01 m change
174.00	1,348.80		59,600.00	–0.24	–0.18	0.60				dtl is for 0.01 m change
82.00	1,349.00		–	14.23	16.11	16.77				dtl is for 0.01 m change
30.00	1,373.10		68,000.00	1.07	0.54	0.53				dtl is for 0.01 m change
105.00	1,499.50		111,200.00	1.34	0.78	0.75				dtl is for 0.01 m change
31.00	1,536.50		32,000.00	0.43	–0.03	0.02				dtl is for 0.01 m change
118.00	1,570.70		61,360.00	–0.01	–0.57	–0.44				dtl is for 0.01 m change
173.00	1,571.10		61,015.00	–0.25	–0.81	–0.68				dtl is for 0.01 m change
282.00	1,576.10		34,435.00	0.55	–0.76	–0.09				dtl is for 0.01 m change
428.00	1,593.70		10,400.00	–0.69	–2.16	–0.99				dtl is for 0.01 m change
478.00	1,602.60		7,400.00	–0.82	–2.34	–1.14				dtl is for 0.01 m change
513.00	1,609.50		4,655.00	–0.87	–2.38	–1.17				dtl is for 0.01 m change
558.00	1,619.20		49,695.00	0.13	–0.56	–0.30				dtl is for 0.01 m change
945.00	1,739.80		335,150.00	0.17	–0.18	–0.15				dtl is for 0.01 m change
153.00	1,712.00		73,100.00	0.25	–0.10	–0.20				dtl is for 0.01 m change
35.00	1,746.50		61,370.00	0.84	0.26	0.24				dtl is for 0.01 m change

lp	radial_ distance_rs	shortest_ distance_rt	time_lag_ press_dtl	initial_ head_hi	head_at_ flow_end_hp	final_ head_hf	initial_ press_pi	press_at_ flow_end_pp	reference	comment
62.00	1,746.80		55,330.00	0.51	0.01	0.15				dtl is for 0.01 m change
145.00	1,758.60		63,200.00	0.43	–0.10	–0.01				dtl is for 0.01 m change
22.00	1,881.90		–	6.06	5.81	5.62				dtl is for 0.01 m change
117.00	1,911.80		–	6.26	6.04	5.89				dtl is for 0.01 m change
43.00	2,027.60		–	6.07	5.79	5.56				dtl is for 0.01 m change
125.00	2,007.80		–	5.71	5.55	5.44				dtl is for 0.01 m change
19.00	2,506.20		–	–0.02	–0.46	–0.48				dtl is for 0.01 m change
35.00	2,495.50		–	0.20	–0.14	–0.16				dtl is for 0.01 m change
111.00	2,455.60		–	0.15	–0.20	0.22				dtl is for 0.01 m change

SICADA – description of plu_inf_test_obs_d

PLU interference tests, Observation section data.

SICADA Header	Header	Unit	Explanation
idcode	ID Obs Borehole		ID for observation borehole
secup	Borehole secup	(m)	Length coordinate along the borehole for the upper limit of observation section
seclow	Borehole seclow	(m)	Length coordinate along the borehole for the lower limit of observation section
start_date	Date for test start	YYYY-M M-DD hh:mm	Date for the start of the pumping/injection test (YYYY-MM-DD hh:mm)
stop_date	Date for test stop	YYYY-M M-DD hh:mm	Date for the stop of the pumping/injection test (YYYY-MM-DD hh:mm)
test_type	Test type (1–7)	(–)	1A:Pumping test-wireline eq.,1B: Pumping test-submersible pump, 1C: Pumping test-airlift pumping. 2: Interference test.3: Injection test. 4: Slug test., 4B: Pulse test. 5A: Flowlogging-PFL-DIFF_sequential. 5B Flowlogging-PFL-DIFF_ overlapping. 6: Flowlogging Impeller. 7: Grain size analysis
test_borehole	ID. pumped Borehole	(–)	ID for pumped or injected borehole
test_secup	Test secup	(m)	Length coordinate along the borehole for the upper limit of pumped or injected section
test_seclow	Test seclow	(m)	Length coordinate along the borehole for the lower limit of pumped or injected section
start_flow_period	Start flow	YYYY-MM-DD hh:mm:ss	Time for the start of the pumping/injection period (YYYY-MM-DD hh:mm:ss)
stop_flow_period	Stop flow	YYYY-MM-DD hh:mm:ss	Time for the stop of the pumping/injection period (YYYY-MM-DD hh:mm:ss)
lp	Lp	(m)	Hydraulic point of application for a test section, based on the geometric midpoint of test section or the main point of transmissivity distribution in test section
radial_distance_rs	rs	(m)	Geometrical distance from point of application in test section to point of application in observation section.
shortest_distance_rt	rt	(m)	Representative hydraulic distance from point of application in test section to point of application in observation section via inferred major conductive features. The actual structural model version shall be reported.
time_lag_press_dtl	dtL	(s)	Time lag for pressure response to reach observation section after start/stop of pumping or injection, based on the first significant response in the observation section.
initial_head_hi	hi	(m)	Hydraulic head in observation section at start of flow period
head_at_flow_end_hp	hp	(m)	Hydraulic head in observation section at stop of flow period

SICADA Header	Header	Unit	Explanation
final_head_hf	hF	(m)	Hydraulic head in observation section at stop of recovery period
initial_press_pi	pi	(kPa)	Groundwater pressure in observation section at start of flow period
press_at_flow_end_pp	pp	(kPa)	Groundwater pressure in observation section at stop of flow period
final_press_pf	pF	(kPa)	Groundwater pressure in observation section at stop of recovery period
fluid_temp_teo	Teo	(Co)	Measured borehole fluid temperature in the observation section (representative for evaluated parameters)
fluid_elcond_eco	ECo	(mS/m)	Measured electric conductivity of the borehole fluid in the observation section (representative for evaluated parameters)
fluid_salinity_tdso	TDSo	(mg/L)	Calculated total dissolved solids of the borehole fluid in the observation section, based on EC-measurement
fluid_salinity_tdso	TDSom	(mg/L)	Measured total dissolved solids of the borehole fluid in the observation section, based on water sampling and chemical analysis
reference	References		SKB report No for reports describing data and evaluation
comment	Comments		Short comment to the evaluated parameters (Optional)
Index o			Observation borehole or observation section (o short for observation)

plu_inf_test_obs_ed.

idcode	start_date	stop_date	secup	seclow	sec-tion_no	test_borehole	test_secup	test_seclow	formation_width_b	lp	width_of_channel_b	tbo	l_measl_tbo	u_measl_tbo
HFM13			159.00	173.00		HFM14	0.00	150.00	14.00	162.00				
KFM02A			411.00	442.00		HFM14	0.00	150.00	31.00	428.00				
KFM02A			490.00	518.00		HFM14	0.00	150.00	28.00	513.00				
KFM04A			169.00	1,001.00		HFM14	0.00	150.00	832.00	220.00				
KFM06A			341.00	362.00		HFM14	0.00	150.00	21.00	357.00				

cont.

sbo	leakage_factor_lof	transmissivity_to	value_type_to	l_measl_to	u_measl_to	storativ-ity_so	leakage_coeff_o	hydr_cond_kosf	l_measl_kosf	u_measl_kosf	spec_storage_sosf	dt1	dt2
		5.10E–06	0			4.40E–05	9.20E–10						
		4.40E–04	0			2.80E–05	1.00E–10						
		5.40E–04	0			2.50E–05	7.20E–11						
		1.70E–03	0			1.10E–03	1.80E–09						
		4.70E–04	0			7.30E–04	1.30E–09						

cont.

t1	dte1	dte2	transmissivity_to_nlr	value_type_to_nlr	storativity_so_nlr	transmissivity_to_grf	value_type_to_grf	storativ-ity_so_grf	flow_dim_grf_o	comments

SICADA – description of plu_inf_test_obs_ed

PLU interference test, evaluated data of observation sections.

SICADA header	Header	Unit	Explanation
idcode	ID Obs. Borehole		ID for obsevation borehole
secup	Borehole secup	m	Length coordinate along the borehole for the upper limit of the observation section
seclow	Borehole seclow	(m)	Length coordinate along the borehole for the lower limit of the observation section
start_date	Date for test start	YYYY-MM-DD hh:mm	Date for the start of the interference test (YYYY-MM-DD hh:mm)
stop_date	Date for test stop	YYYY-MM-DD hh:mm	Date for the stop of the interference test (YYYY-MM-DD hh:mm)
test_borehole	ID- Pumped borehole	(–)	ID for pumped or injected borehole
test_secup		(m)	Length coordinate along the borehole for the upper limit of pumped or injected section
test_seclow		(m)	Length coordinate along the borehole for the lower limit of pumped or injected section
formation_width_b	b	m	b:Representative aquifer thickness for inferred transmissivity, generally estimated as observation section length L_o
width_of_channel_b	B	m	B:Inferred width of formation for evaluated TB
lp	L_p		Hydraulic point of application for a test section, based on the geometric midpoint of test section or the main point of transmissivity distribution in test section
tbo	TB_o	m^3/s	Flow capacity in 1D formation of width B and transmissivity T based on transient evaluation in observation section. Considered best estimate from transient evaluation of flow period or recovery period.
l_meas_limit_tbo	TB-measl-L	m^3/s	Estimated lower measurement limit for evaluated TB in observation section.
u_meas_limit_tbo	TB-measl-U	m^3/s	Estimated upper measurement limit for evaluated TB in observation section.
sbo	SB_o	m	SB_o: Storage capacity of 1D formation of width B and storativity S based on transient evaluation in observation section. Considered best estimate from transient evaluation of flow period or recovery period.
leakage_factor_lof	L_{of}	m	Leakage coefficient in observation section evaluated from 2D radial flow model. K´ = hydraulic conductivity across the aquitard, b´ = water saturated thickness of aquitard (leaky formation). Considered best estimate from transient evaluation of flow period or recovery period.
transmissivity_to	T_o	m^2/s	Transmissivity of formation in observation section, based on 2D radial flow model. Considered best estimate from transient evaluation of flow period or recovery period.

SICADA header	Header	Unit	Explanation
l_measl_to	$T_{o\text{-}measl\text{-}L}$	m^2/s	Estimated lower measurement limit for evaluated T_o in observation section
u_measl_to	$T_{o\text{-}measl\text{-}U}$	m^2/s	Estimated upper measurement limit for evaluated T_o in observation section
storativity_so	S_o	(–)	Storativity (Storage coefficient) of formation in observation section based on 2D radial flow model. Considered best estimate from transient evaluation of flow period or recovery period.
leakage_coeff_o	$(K'/b')_o$	(l/s)	Leakage coefficient in observation section evaluated from 2D radial flow model. K´ = hydraulic conductivity across the aquitard, b´ = water saturated thickness of aquitard (leaky formation). Considered best estimate from transient evaluation of flow period or recovery period.
hydr_kond_kosf	K_{osf}	m/s	Hydraulic conductivity of formation in observation section, based on 3D spherical flow model. Considered best estimate from transient evaluation of flow period or recovery period.
l_measl_kosf	$K_{osf\text{-}measl\text{-}L}$	m/s	Estimated lower measurement limit for evaluated K_{osf} in observation section.
u_measl_kosf	$K_{osf\text{-}measl\text{-}U}$	m/s	Estimated upper measurement limit for evaluated K_{osf} in observation section.
spec_storage_sosf	S_{osf}	1/m	Specific Storage of formation in observation section, based on 3D spherical flow. Considered best estimate from transient evaluation of flow period or recovery period.
dt1	dt_1	s	Estimated start time after pump/injection start or recovery start, for the period used for the evaluated parameter
dt2	dt_2	s	Estimated stop time after pump/injection start or recovery start, for the period used for the evaluated parameter
t1	t_1	s	Start time for evaluated parameter from start of flow period.
t2	t_2	s	Stop time for evaluated parameter from start of flow period.
dte1	dt_{e1}	s	Start time for evaluated parameter from start of recovery period.
dte2	dt_{e2}	s	Stop time for evaluated parameter from start of recovery period.
transmissivity_to_nlr	T_{oNLR}	m^2/s	Transmissivity in observation section, based on Non Linear Regression of the entire test sequence.
storativity_so_nlr	S_{oNLR}	(–)	Storativity in observation section, based on Non Linear Regression of the entire test sequence.
transmissivity_to_grf	T_{oGRF}	m^2/s	Transmissivity in observation section, based on the Generalised Radial Flow model /Baker 1988/. Considered best estimate from transient evaluation of flow period or recovery period.
storativity_so_grf	S_{oGRF}	(–)	Storativity in observation section, based on Generalised Radial Flow model. Considered best estimate from transient evaluation of flow period or recovery period.
flow_dim_grf_o	D_{oGRF}	(–)	Inferred flow dimension in observation section, based on the Generalised Radial Flow model /Barker 1988/. Considered best estimate from transient evaluation of flow period or recovery period.
Comments	Comments		Short comment to the evaluated parameters (Optional)

Monitoring wells in Quaternary deposits

Some monitoring wells in Quaternary deposits were included in the first interference test. The observations in these wells were included at a late stage and are therefore reported separately in this appendix.

In Figure A4-1 an overview of the groundwater levels in the included wells in Quaternary deposits is shown.

In SFM058 data are not available for the entire period of the interference test. It seems, however, evident that the well is responding to the pumping in HFM14. Also SFM001, SFM013 and SFM030 are visibly affected by the pumping in HFM14. The last two wells; SFM023 and SFM062 appear to be reacting to the pumping as well, although not as strongly. In all cases, a trend of declining groundwater levels before the start of pumping complicates the estimation of the real extent of the drawdown.

Pumping for water sampling disturbed the groundwater level in SFM023 during the flow period of the interference test, resulting in the dip of the level curve in Figure A4-1.

In Figure A4-2, a map showing the geographic locations of the monitoring wells in Quaternary deposits is displayed.

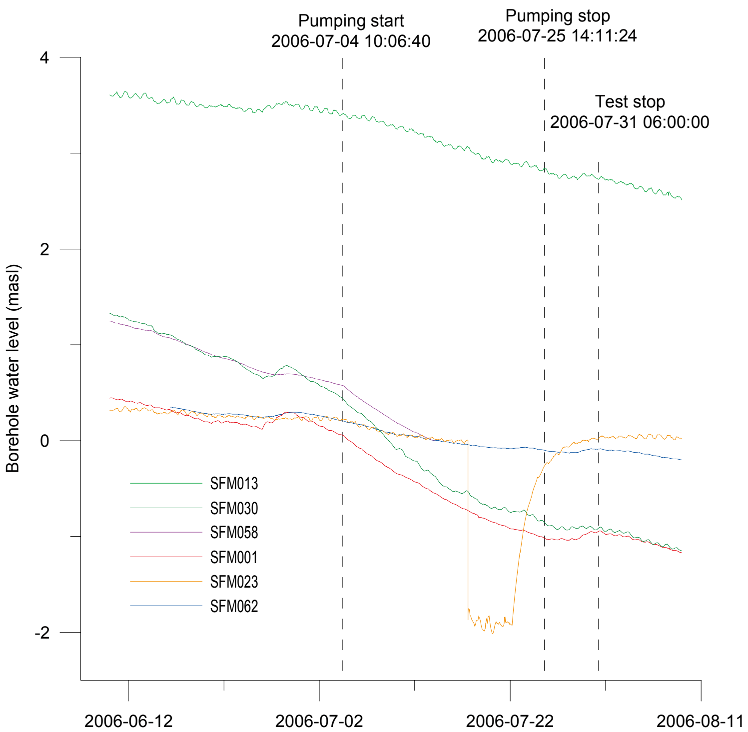

Figure A4-1. *Linear plot of pressure versus time in 6 monitoring wells during the first interference test in HFM14.*

Figure A4-2. *Map showing the positions of the selected monitoring wells relative the pumping borehole HFM14 cf. Figure 1-1.*

Correction of head and drawdown for natural trend

During the entire period of the interference test in HFM14 a strong, decreasing natural head trend was ongoing. The data from drawdown period were corrected for the natural trend using the graphical technique described in Figure A5-1. The onset of the correction was assumed at start of pumping. After test stop the data acquisition continued and the actual head trend during this period was assumed to represent the existing natural head trend during the entire test period. Extrapolation of this trend backward coincides approximately to the head at start of pumping. A linear trend correction with time was determined individually for all responding observation sections according to Equation (A5-1) and applied to the drawdown period. The total correction at stop of pumping is denoted corr(t_p). The corrected drawdown $s(t)_{corr}$ at time t is calculated according to Equation (A5-2).

$$corr(t)=[corr(t_p) / t_p]\cdot t \qquad (A5\text{-}1)$$

$$s(t)_{corr} = s(t) - corr(t) \qquad (A5\text{-}2)$$

$s(t)_{corr}$ = corrected drawdown at time t after start of pumping (m)

$s(t)$ = measured drawdown at time t after start of pumping (m)

corr(t) =applied correction at time t after start of pumping (m)

corr(t_p) =applied correction at time t_p at stop of pumping (m)

t_p = duration of drawdown period (s)

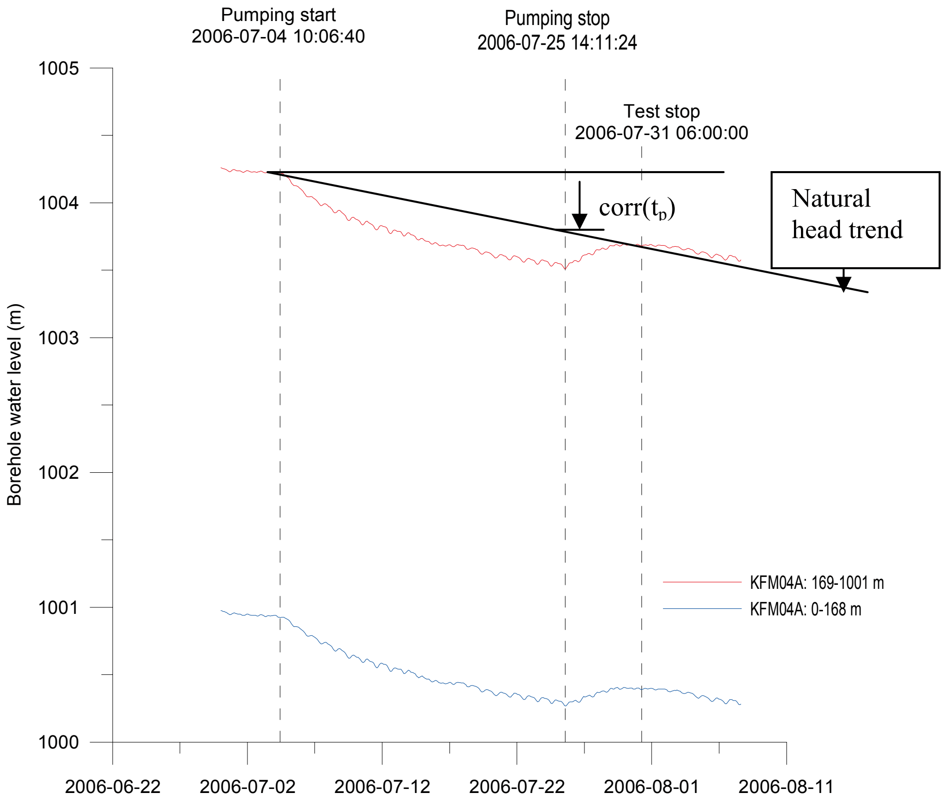

Figure A5-1. *Linear plot of pressure versus time in the observation sections in KFM04A during the interference test in HFM14. An example of the technique of correction for the natural decreasing head trend during the test is shown. The final drawdown correction at stop of pumping is denoted corr(t_p).*

Data files with time and corrected head and drawdown for all responding observation sections were prepared and stored in Sicada. In addition, a data file with time, flow rate and drawdown in the pumping borehole HFM14 was prepared and stored in Sicada. The data files can be identified from the Activity Plan (AP PF 400-06-038).

In Table A5-1 the measured and corrected final drawdown together with the corrected normalized drawdown for the responding observation sections during the interference test in HFM14 are shown. In KFM06C the head recovery was used since no representative drawdown could be calculated in this borehole, see Section 6.2.54. No corrections are applied of the recovery of the head in these borehole sections. The corrected drawdown data are used together with the original data in Table 6-114 for preparation of a corrected response diagram, Figure A5-2, similar to Figure 6-40 for uncorrected data. The estimated response times for the responding sections were not updated after the correction of the drawdown since the response times were not significantly altered by the correction.

Table A5-1. Measured (s_p) and corrected (s_p-corr) total drawdown together with corrected normalized drawdown for the responding observation sections included in the interference test in HFM14.

Pumping borehole	Flow rate Qp (m^3/s)	Observation borehole	Section (m)	s_p (m)	s_p-corr (m)	s_p-corr/Qp (s/m^2)
HFM14	0.00568	HFM15	0–84	8.41	7.91	1,391.8
HFM14	0.00568	HFM15	85–95	7.80	7.30	1,284.5
HFM14	0.00568	KFM05A	0–114	5.47	5.18	910.7
HFM14	0.00568	KFM05A	115–253	5.36	5.03	885.0
HFM14	0.00568	HFM19	0–103	6.23	5.89	1,035.7
HFM14	0.00568	HFM19	104–167	6.30	5.96	1,048.0
HFM14	0.00568	HFM19	168–182	6.30	5.96	1,048.0
HFM14	0.00568	HFM13	0–100	6.08	5.64	992.4
HFM14	0.00568	HFM13	101–158	4.83	4.39	772.4
HFM14	0.00568	HFM13	159–173	2.66	1.95	343.1
HFM14	0.00568	KFM01C	0–58	2.85	2.53	445.2
HFM14	0.00568	KFM01C	59–237	3.03	2.71	476.8
HFM14	0.00568	HFM01	0–200	2.58	2.27	399.4
HFM14	0.00568	KFM01A	109–130	1.39	1.39	244.6
HFM14	0.00568	KFM01A	131–204	1.81	1.44	253.4
HFM14	0.00568	KFM01B	0–100	2.81	2.50	439.2
HFM14	0.00568	KFM01B	101–141	1.64	1.48	260.4
HFM14	0.00568	KFM01B	142–500	1.88	1.53	268.9
HFM14	0.00568	HFM32	0–25	0.24*	0.07*	12.3
HFM14	0.00568	HFM32	26–31	0.28*	0.11*	19.4
HFM14	0.00568	HFM32	32–97	2.13*	1.90*	334.3
HFM14	0.00568	HFM32	98–203	2.13*	1.90*	334.3
HFM14	0.00568	HFM03	0–18	2.68	2.33	410.0
HFM14	0.00568	HFM03	19–26	2.79	2.48	436.4
HFM14	0.00568	HFM02	0–37	2.79	2.47	434.6
HFM14	0.00568	HFM02	38–48	2.80	2.48	436.4
HFM14	0.00568	HFM02	49–100	2.82	2.50	439.9
HFM14	0.00568	HFM27	0–24	2.73	2.40	422.3
HFM14	0.00568	HFM27	25–45	2.81	2.49	438.1
HFM14	0.00568	HFM27	46–58	2.73	2.43	427.6
HFM14	0.00568	HFM27	59–128	2.63	2.30	404.7
HFM14	0.00568	HFM24	0–151	1.53	1.03	181.2
HFM14	0.00568	KFM04A	0–168	0.66	0.27	47.5

Pumping borehole	Flow rate Qp (m^3/s)	Observation borehole	Section (m)	s_p (m)	s_p-corr (m)	s_p-corr/Qp (s/m^2)
HFM14	0.00568	KFM04A	169–1,001	0.70	0.31	54.5
HFM14	0.00568	KFM06A	0–150	0.71	0.58	102.1
HFM14	0.00568	KFM06A	151–246	0.82	0.64	112.6
HFM14	0.00568	KFM06A	247–340	0.95	0.82	144.3
HFM14	0.00568	KFM06A	341–362	0.63	0.50	88.0
HFM14	0.00568	KFM06A	363–737	0.62	0.45	79.2
HFM14	0.00568	KFM06A	738–748	0.17	0.10	17.6
HFM14	0.00568	KFM06A	749–826	0.15	0.08	14.1
HFM14	0.00568	KFM06C	0–186	0.51**	0.51**	89.7
HFM14	0.00568	KFM06C	187–280	0.52**	0.52**	91.5
HFM14	0.00568	KFM06C	281–350	0.42**	0.42**	73.9
HFM14	0.00568	KFM06C	351–401	0.67**	0.67**	117.9
HFM14	0.00568	KFM06C	402–530	0.51**	0.51**	89.7
HFM14	0.00568	KFM06C	531–540	0.43**	0.43**	75.7
HFM14	0.00568	KFM06B	0–26	1.45	1.17	205.9
HFM14	0.00568	KFM06B	27–50	1.60	1.40	245.5
HFM14	0.00568	KFM06B	51–100	1.52	1.32	232.3
HFM14	0.00568	HFM10	0–99	0.66	0.17	29.9
HFM14	0.00568	HFM10	100–150	0.65	0.27	47.5
HFM14	0.00568	HFM16	0–53	1.57	1.37	241.1
HFM14	0.00568	HFM16	54–67	1.47	1.29	227.0
HFM14	0.00568	HFM16	68–132	1.49	1.31	230.5
HFM14	0.00568	HFM09	0–50	0.66	0.26	44.9
HFM14	0.00568	KFM07B	0–299	1.56	1.33	234.0
HFM14	0.00568	HFM21	0–202	1.54	1.33	234.0
HFM14	0.00568	HFM22	0–222	1.37	1.16	204.1
HFM14	0.00568	HFM20	0–48	0.71***	0.29***	51.0
HFM14	0.00568	HFM20	49–100	1.17***	0.91***	160.1
HFM14	0.00568	HFM20	101–130	1.38***	1.16***	204.1
HFM14	0.00568	HFM20	131–301	1.52***	1.20***	211.1
HFM14	0.00568	KFM08B	0–70	0.43	0.31	54.5
HFM14	0.00568	HFM23	0–212	0.53	0.13	22.0
HFM14	0.00568	HFM29	0–200	0.56	0.11	19.4
HFM14	0.00568	HFM17	0–211	0.46	0.17	29.2
HFM14	0.00568	KFM02A	0–132	0.56	0.23	40.5
HFM14	0.00568	KFM02A	133–240	0.56	0.23	40.5
HFM14	0.00568	KFM02A	241–410	1.31	1.05	184.8
HFM14	0.00568	KFM02A	411–442	1.47	1.32	232.3
HFM14	0.00568	KFM02A	443–489	1.52	1.36	239.3
HFM14	0.00568	KFM02A	490–518	1.51	1.35	237.5
HFM14	0.00568	KFM02A	519–888	0.69	0.43	75.7
HFM14	0.00568	HFM04	0–57	0.58	0.12	21.1
HFM14	0.00568	HFM04	58–66	0.50	0.27	46.6
HFM14	0.00568	HFM04	67–222	0.53	0.24	41.5
HFM14	0.00578	KFM10A	401–500	5.28	5.28****	929.0

* Recorded at 2006-07-18 (before stop of pumping).

** Head increase during the recovery period.

*** Recorded at 2006-07-16 (before stop of pumping).

**** Not corrected for natural trend (different flow period).

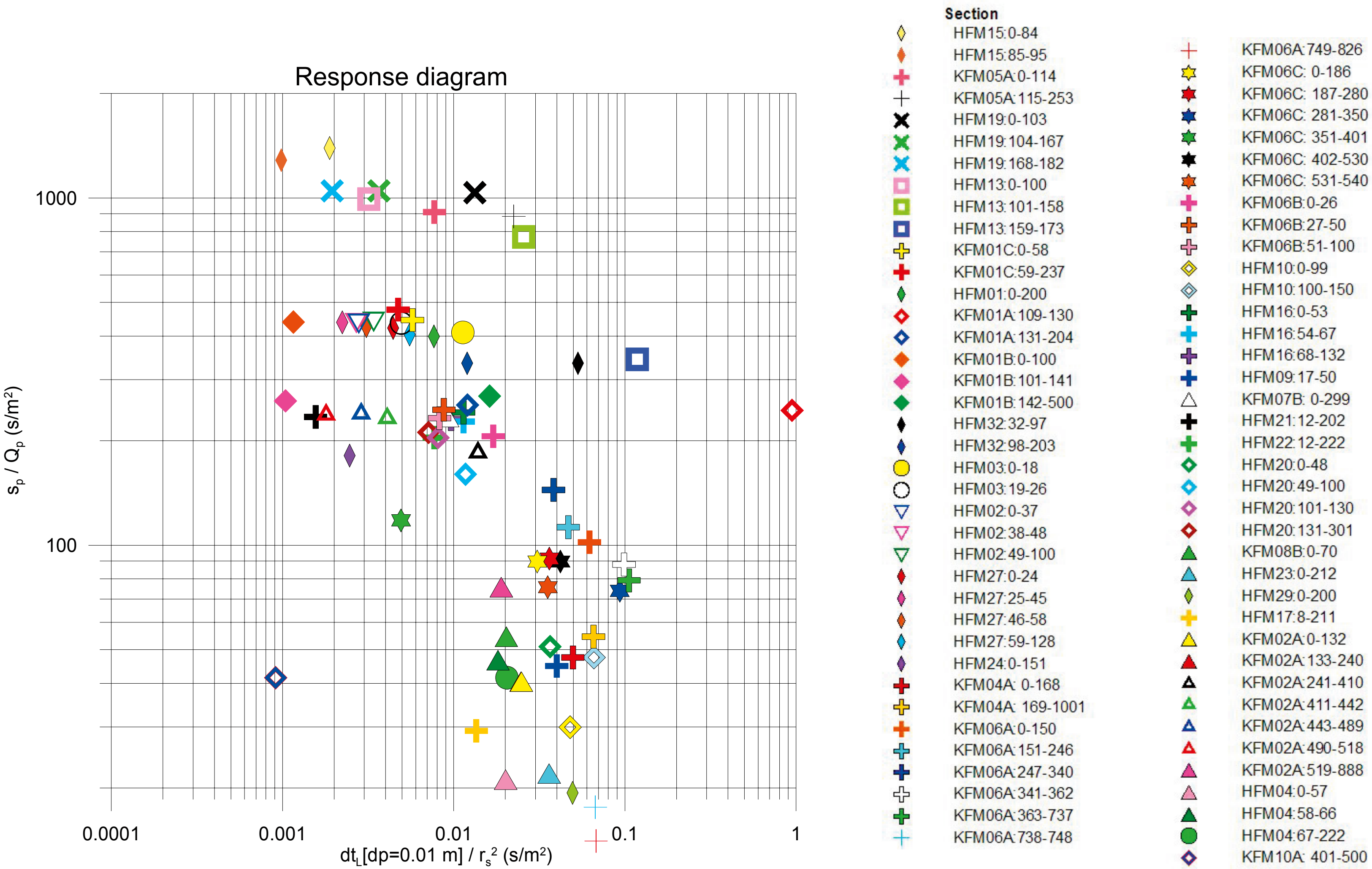

Figure A5-2. *Response diagram showing the responses in the presumed responding observation sections during the interference test in HFM14, using corrected drawdown data.*