Appendix I
Hydraulic Conductivity Calculations
Using Packer Withdrawal Drawdown Data
Hoffmann-La Roche Inc.
Nutley, New Jersey

Problem Statement:

Estimate the horizontal hydraulic conductivity using drawdown data collected from packer intervals in rock boreholes completed at the HLR Site.

Approach:

The horizontal hydraulic conductivity of geologic materials can be estimated using flow rates and drawdowns measured during purging of packer intervals and the following radial flow equation developed by Hvorslev and cited by Robbins and others in "*Determining Hydraulic Conductivity using Pumping Data from Low-Flow Sampling*" (Groundwater, 2009).

$$K = [2.303 * Q * \text{Log}[L/D + (1+(L/D)^2)^{0.5}]/(2 * \pi * L * H)$$ (Equation)

Where:
K = horizontal hydraulic conductivity, L/T
Q = steady state flow rate, L^3/T
D = diameter of Packer Interval Borehole, L
L = Screen length exposed to aquifer, L
H = Steady-state drawdown, L

Well Location	Packer Interval (ft bgs)	Q (cm^3/sec)	D (cm)	L (cm)	H (cm)	K	
						(cm/sec)	(ft/day)
TW-158A	140 to 150	296.5	14.92	304.8	714.76	8.0E-04	2.28
	248 to 258	285.8	14.92	304.8	70.1	7.9E-03	22.40
TW-159	124 to 134	157.7	14.92	289.6	173.7	1.8E-03	5.18
	240 to 250	157.7	14.92	289.6	1581.6	2.0E-04	0.57
	285 to 300	108.5	14.92	442	393.2	4.1E-04	1.15
TW-160	40 to 50	32.8	14.92	304.8	45.72	1.4E-03	3.94
	250 to 260	151.4	14.92	304.8	321.9	9.1E-04	2.58
TW-161	166 to 176	287	14.92	304.8	658.4	8.4E-04	2.39
TW-162	28 to 38	119.9	14.92	304.8	170.7	1.4E-03	3.86

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Well Location	Packer Interval (ft bgs)	Q (cm^3/sec)	D (cm)	L (cm)	H (cm)	K	
						(cm/sec)	(ft/day)
TW-163	40 to 50	90.2	14.92	304.8	188.98	9.2E-04	2.62
	91 to 101	159.6	14.92	304.8	1174.1	2.6E-04	0.75
	193 to 203	188.6	14.92	304.8	396.24	9.2E-04	2.61
	220 to 230	203.1	14.92	304.8	15.24	2.6E-02	73.21
	250 to 260	246	14.92	304.8	451.1	1.1E-03	3.00
TW-164	72 to 82	229	14.92	304.8	599.54	7.4E-04	2.10
	130 to 140	360.2	14.92	304.8	377.34	1.8E-03	5.24
	190 to 200	363.4	14.92	304.8	35.052	2.0E-02	56.95
TW-165	39 to 49	155.8	14.92	304.8	117.04	2.6E-03	7.31
	130 to 140	151.4	14.92	304.8	66.75	4.4E-03	12.46
	184 to 194	170.3	14.92	304.8	44.2	7.5E-03	21.17
TW-166	207 to 217	222.68	14.92	304.8	230.43	1.9E-03	5.31
	240 to 250	119.86	14.92	304.8	3657.9	6.4E-05	0.18
TW-167	26.5 to 44	332.5	14.92	533.4	67.4	6.3E-03	17.82
	151 to 161	261.2	14.92	304.8	626.1	8.1E-04	2.29
TW-168	59 to 69	214.5	14.92	304.8	90.53	4.6E-03	13.02
	81 to 91	181	14.92	304.8	118.57	3.0E-03	8.39
	118 to 128	25.2	14.92	304.8	1048.5	4.7E-05	0.13
	141 to 151	131.2	14.92	304.8	75.28	3.4E-03	9.57
	153 to 163	145.1	14.92	304.8	99.97	2.8E-03	7.97
	277to 287	176.6	14.92	304.8	18.29	1.9E-02	53.04
	290 to 300	359.6	14.92	304.8	45.72	1.5E-02	43.21

References:

Robbins, G., T. Alejandra, J. Aragon, and R. Andres, 2009. *"Determining Hydraulic Conductivity using Pumping Data from Low-Flow Sampling"* , Groundwater, March-April, 2009.

Hvorslev, M.J., 1951. Time Lag and Soil Permeability in Groundwater Observations. Army Corps of Engineers Waterways Experiment Station, Vicksburg, Mississippi. Bulletin No. 36