

DATA REPORT

First Controlled Infiltration Test for the High Point Phase I Block-Scale Monitoring Project

Prepared for

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Background

Seattle Public Utilities (SPU) is implementing a large-scale natural drainage system (NDS) project in conjunction with the redevelopment project for the High Point neighborhood in West Seattle (Figure 1). NDS swales are part of what is termed a *low-impact development* approach to managing stormwater runoff. The goal of this approach is to minimize the potential effect of land use changes on the natural hydrograph that can result from urbanization. In contrast to conventional stormwater systems that route runoff directly to storm drains, the NDS swales route runoff first through a vegetated and compost-amended swale, reducing the rate of flow and allowing the runoff to infiltrate into the ground. The excess runoff is then routed to the conventional stormwater system. This approach increases infiltration, decreases the rate and volume of runoff, and improves water quality. The end result is decreased erosion, stabilized water temperatures, and improved downstream habitat.

As part of this NDS project, Seattle Public Utilities is implementing a block-scale monitoring project for NDS swales that have been installed on the High Point redevelopment site. The goal of the monitoring program is to quantify the treatment performance of the NDS swales in order to provide a basis for potential design refinements that might improve performance or reduce installation costs or both. The specific monitoring activities that will be performed to meet this goal are described in a quality assurance project plan (QAPP) that was prepared earlier for the project (Herrera 2006). In general, the QAPP describes hydrologic and water quality monitoring activities to be performed in association with an NDS test swale on the High Point redevelopment site over a 3-year period, beginning in winter 2006 and ending in September 2009.

As described in the QAPP, a specific component of this monitoring project is the implementation of three controlled tests to measure infiltration rates on the surface of the NDS test swale. The first and second tests are to be conducted during the first and second months, respectively, of the monitoring project, and the third test is to be performed during the third and final year of the monitoring project.

This report documents the results of the first controlled infiltration test which was conducted on March 7, 2007. It describes the study location and the procedures that were used during the test process. It also summarizes the results of the test using graphical representations of the data as necessary. The raw data from the test are provided in an appendix.

Study Location

The study location was the High Point redevelopment site in West Seattle (Figure 1). The site lies within the Longfellow Creek drainage basin and is generally bordered on the north by SW Juneau Street, on the west by 34th Avenue SW, on the south by SW Myrtle Street, and on the east by a designated steep-sloped greenbelt. The infiltration test was conducted in a representative NDS swale (NDS test swale) that parallels Highpoint Drive SW between SW Graham and SW Bataan Street (Figure 2).

Figure 1. Vicinity map for the High Point redevelopment project site in Seattle, Washington.

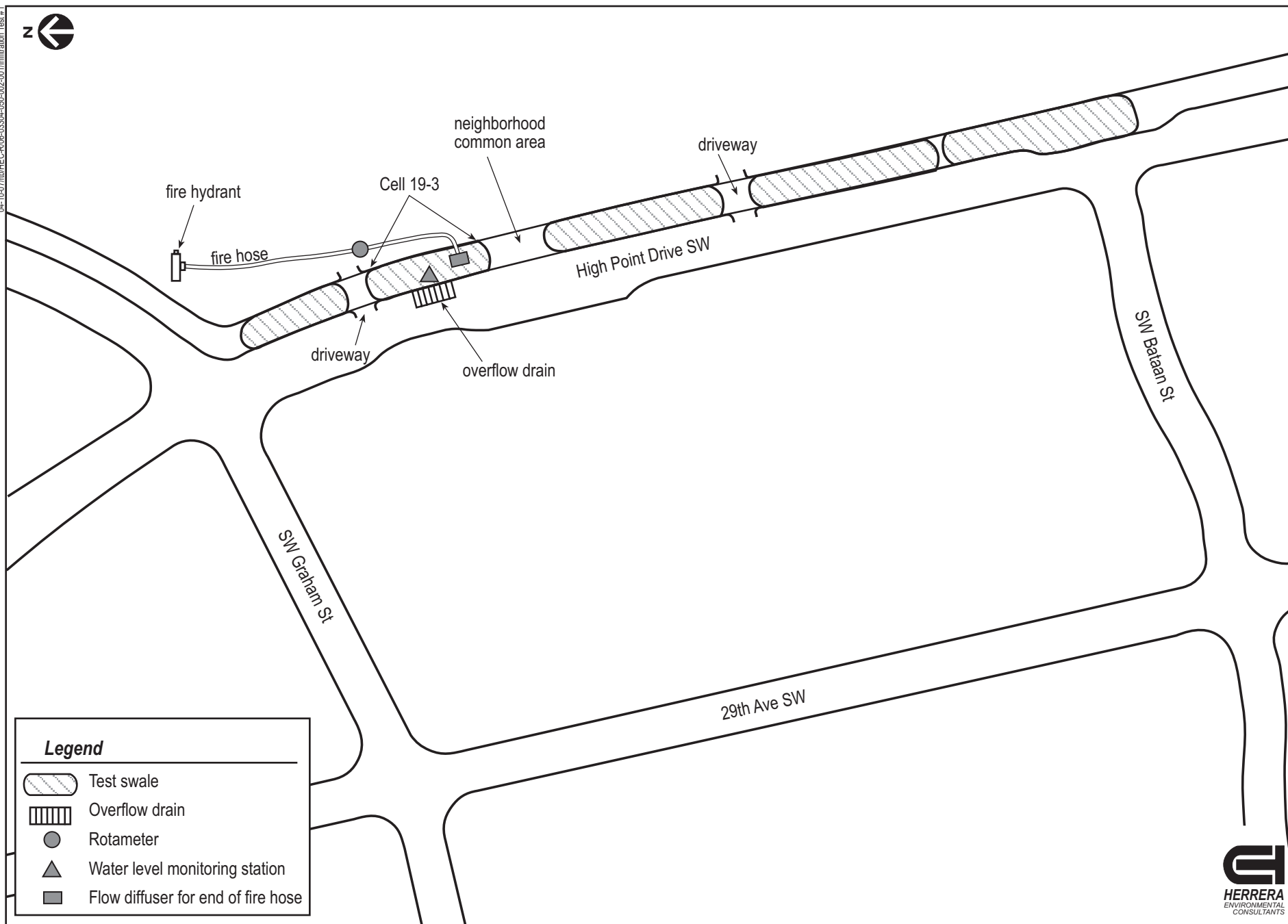


Figure 2. Plan view of natural drainage system test swale and controlled infiltration test monitoring station location for the High Point Phase I Block-scale Monitoring project.

Methods

Surface infiltration rates in the NDS test swale were measured using procedures adopted from the Washington State Department of Ecology's (2005) pilot infiltration test. The pilot infiltration test is a relatively large-scale infiltration test that is typically performed during the design phase of a project to estimate infiltration rates for a proposed stormwater infiltration facility. It specifically involves excavating a test pit to the same depth as that of the proposed infiltration facility. Water is then introduced to the pit at a variable rate to maintain a constant water level in the pit. During this process, a rotameter is used to measure the flow rate of this water. After the flow rate has remained stable (i.e., constant) for 60 minutes, the water is turned off and the rate of infiltration (in inches per hour) is recorded until the pit is empty. This method has been shown to provide the most accurate estimates of infiltration rates for large-scale infiltration facilities (Seattle University 2004).

The pilot infiltration test method was modified for use in the NDS test swale as follows:

1. Culverts immediately upgradient and downgradient of the overflow drain for the swale were blocked with inflatable plugs. These culverts convey water beneath a neighborhood common area and driveway, which cross the swale at two locations on High Point Drive SW. This isolated a 72.4-foot section of the swale with an approximate surface area of 391 square feet. This section of the swale (which is identified as Cell 19-3 in the drainage plans for the project) represents approximately 20 percent of the total surface area of the swale. All subsequent activities related to this test were performed on this section of the swale.
2. Water from a nearby fire hydrant (Figure 2) was discharged to the swale using approximately 300 feet of 4-inch-diameter fire hose. A rotameter was attached to the hose to measure the water discharge rate. To reduce potential soil erosion at the point of discharge, the end of the fire hose was placed in a makeshift flow diffuser consisting of a 40-gallon garbage can perforated with numerous 1.5-inch holes.
3. The discharge rate from the hose was varied to maintain a water depth of 0.79 feet in the swale. (Through the first several hours of the test, the water depth was maintained at 1.1 feet; however, at this water depth, water was observed discharging into the overflow drain for the swale through a joint in the associated concrete casing. Therefore, the discharge rate was subsequently adjusted to maintain a water depth of only 0.79 feet throughout the remainder of the test to prevent this overflow.) Every 15 to 30 minutes, the discharge rate of water entering the swale and the water depth in the swale were manually recorded. A pressure transducer and data logger were also installed in the swale near the overflow drain

(Figure 2) and programmed with a 1-minute logging interval to continuously record water depth during the test.

4. After the discharge rate required for maintaining the target water depth (0.79 feet) in the swale stabilized and remained constant for 60 minutes, water flow to the swale was turned off. The time required for water remaining in the swale to infiltrate the soil was then measured until there was no longer any standing water.
5. The infiltration rate for the swale was then computed using the following formula:

$$IR = \frac{\Delta L}{\Delta T}$$

where:

IR = infiltration rate (inches/hour)

ΔL = change in water depth (in inches) from point when water inputs are turned off to point when no standing water is present

ΔT = change in time (in hours) from point when water inputs are turned off to point when no standing water is present

Photographs documenting the implementation of these procedures during the actual test are provided in Appendix A.

Results

A graph of the water depth and discharge data collected during this test is provided in Figure 3. The field measurements recorded during the test are provided in Appendix B.

After setting up the required equipment, the infiltration test began at 9:14 a.m. with the first discharge of water into the NDS test swale. The prevailing weather at this time, overcast with sun breaks, generally persisted through the end of the test. However, approximately 0.22 inches of precipitation was measured at the site in the 24-hour period preceding the test. This rainfall resulted in nearly saturated conditions in the soils associated with the swale.

At the beginning of the test, the discharge rate for water entering the swale was initially ramped up to approximately 0.2 cubic feet per second (cfs) (Figure 3). After approximately 60 minutes of elapsed time, the ponding depth in the swale reached 1.1 feet, a level just below the invert for the swale's overflow drain. However, as noted above, at this water depth, water was observed discharging into the overflow drain for the swale through a joint in the associated concrete casing. Therefore, after 248 minutes of elapsed test time, the water discharge to the swale was

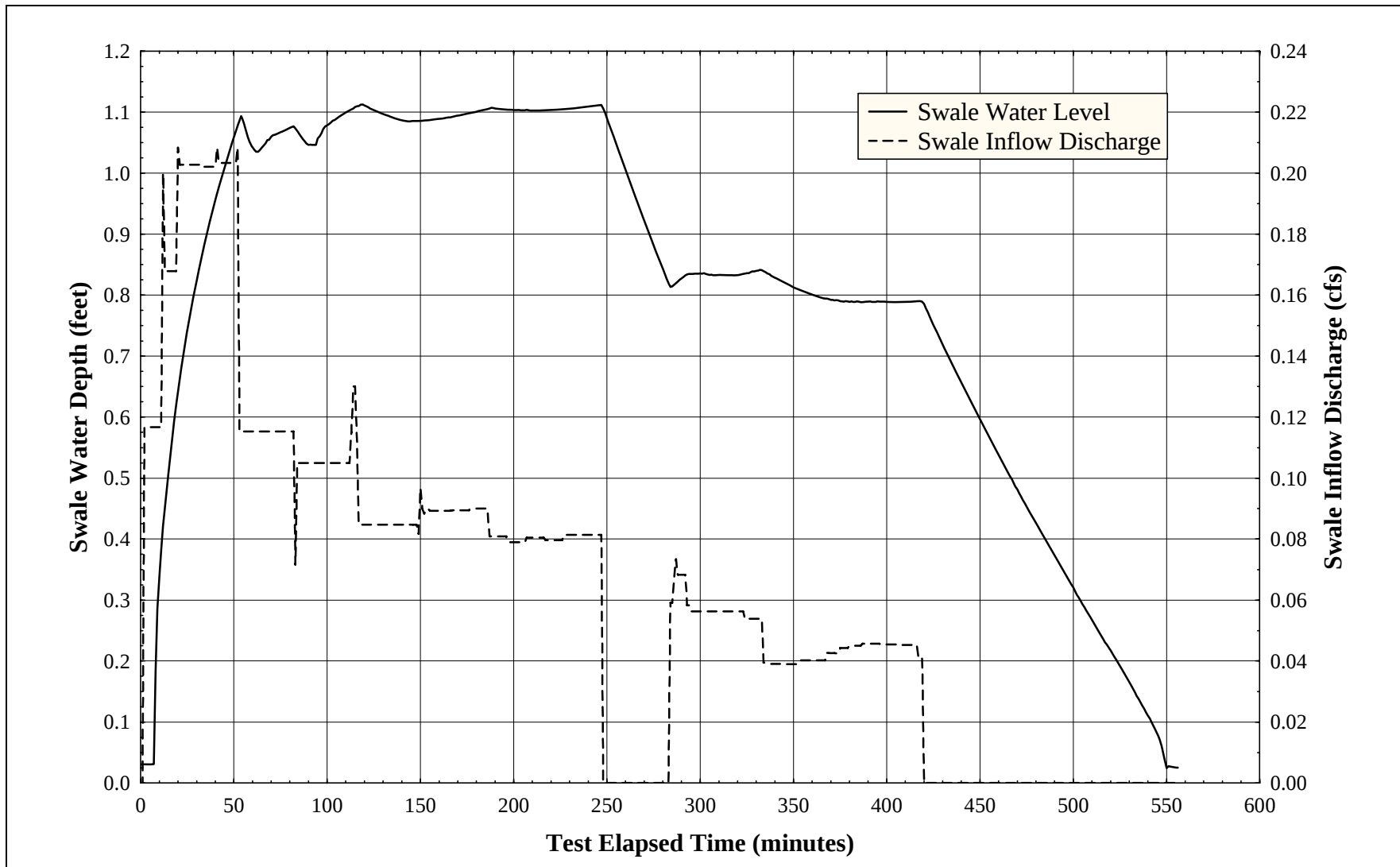


Figure 3. Inflow discharge rates and water depths measured during the controlled infiltration test on March 7, 2007, for the High Point Phase I Block-Scale Monitoring project.

turned off for approximately 30 minutes to allow the water depth to decrease to the new target of 0.79 feet. The inflow rate was then adjusted (primarily reduced) to maintain this water depth for the next 73 minutes (Figure 3).

After approximately 360 minutes of elapsed test time, the discharge rate required to maintain the target water depth in the swale stabilized at approximately 0.045 cfs. This discharge rate was then maintained for approximately 60 minutes, or until 420 minutes of elapsed test time, at which point the water input to the swale was turned off. The water depth then dropped steadily over the next 130 minutes (2.17 hours) from the target depth of 0.79 feet until there was no appreciable standing water left in the swale (Figure 3). The total elapsed time for the test at this point was 550 minutes. At the end of the test, the final water depth in the swale was 0.024 feet, which corresponds to a 0.762-foot (9.135-inch) change in water depth from the time when the flow to the swale was turned off. Based on these data, the calculated infiltration rate for the swale is 9.135 inches/2.17 hours or 4.216 inches/hour. To provide some perspective for interpreting these results, an infiltration rate of 2 inches/hour was assumed for the surface of the High Point NDS swales during the design phase of the project (Herrera and R.W. Beck 2004).

References

Ecology. 2005. Stormwater Management in Western Washington. Volume III, Hydrologic Analysis and Flow Control Design/BMPs. Publication 05-10-31 (a revision of Publication 99-13). Washington State Department of Ecology, Water Quality Program, Olympia, Washington. February 2005.

Herrera. 2006. Quality Assurance Project Plan: High Point Phase I Block Scale Monitoring. Draft. Prepared for Seattle Public Utilities by Herrera Environmental Consultants, Seattle, Washington. September 13, 2006.

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Seattle University. 2004. Soil Stormwater Detention Monitoring Method. Prepared for Seattle Public Utilities by Seattle University, School of Science and Engineering, Seattle, Washington. May 25, 2004.

APPENDIX A

Photographic Documentation of Field Measurement Procedures for March 7, 2007 Controlled Infiltration Test

**Controlled Infiltration Test on March 7, 2007
High Point Block-Scale Monitoring Program
Photographic Log**

Photo Number	Photo Description
1	Rotameter used to measure inflow discharge rates to the natural drainage system test swale
2	Pressure transducer used to measure water level in the natural drainage system test swale
3	Downgradient inflatable plug used to isolate Cell 19-3 of the natural drainage system test swale
4	Upgradient inflatable plug used to isolate Cell 19-3 of the natural drainage system test swale
5	Flow diffuser used for water entering the natural drainage system test swale
6	Flow diffuser used for water entering the natural drainage system test swale
7	Ponding in natural drainage system test swale during infiltration test
8	Ponding in natural drainage system test swale during infiltration test
9	Ponding near overflow drain for natural drainage system test swale during infiltration test









APPENDIX B

Field Measurements from Controlled Infiltration Test on March 7, 2007

Table B1. Field measurements from controlled infiltration test on March 7, 2007.

Date	Time	Elapsed Time (minutes)	Water Level (feet)	Inflow Discharge Rate (cubic feet per second)
3/7/2007	9:14:00	0	0.031	0.000
3/7/2007	9:15:00	1	0.031	0.000
3/7/2007	9:16:00	2	0.031	0.117
3/7/2007	9:17:00	3	0.031	0.117
3/7/2007	9:18:00	4	0.031	0.117
3/7/2007	9:19:00	5	0.031	0.117
3/7/2007	9:20:00	6	0.031	0.117
3/7/2007	9:21:00	7	0.031	0.117
3/7/2007	9:22:00	8	0.184	0.117
3/7/2007	9:23:00	9	0.286	0.117
3/7/2007	9:24:00	10	0.339	0.117
3/7/2007	9:25:00	11	0.382	0.117
3/7/2007	9:26:00	12	0.420	0.200
3/7/2007	9:27:00	13	0.452	0.168
3/7/2007	9:28:00	14	0.481	0.168
3/7/2007	9:29:00	15	0.511	0.168
3/7/2007	9:30:00	16	0.541	0.168
3/7/2007	9:31:00	17	0.568	0.168
3/7/2007	9:32:00	18	0.594	0.168
3/7/2007	9:33:00	19	0.618	0.168
3/7/2007	9:34:00	20	0.642	0.208
3/7/2007	9:35:00	21	0.664	0.203
3/7/2007	9:36:00	22	0.685	0.203
3/7/2007	9:37:00	23	0.705	0.203
3/7/2007	9:38:00	24	0.724	0.203
3/7/2007	9:39:00	25	0.742	0.203
3/7/2007	9:40:00	26	0.760	0.203
3/7/2007	9:41:00	27	0.777	0.203
3/7/2007	9:42:00	28	0.793	0.203
3/7/2007	9:43:00	29	0.809	0.203
3/7/2007	9:44:00	30	0.824	0.203
3/7/2007	9:45:00	31	0.839	0.203
3/7/2007	9:46:00	32	0.853	0.203
3/7/2007	9:47:00	33	0.867	0.202
3/7/2007	9:48:00	34	0.881	0.202
3/7/2007	9:49:00	35	0.894	0.202
3/7/2007	9:50:00	36	0.908	0.202
3/7/2007	9:51:00	37	0.920	0.202
3/7/2007	9:52:00	38	0.932	0.202
3/7/2007	9:53:00	39	0.944	0.202

Table B1 (continued). Field measurements from controlled infiltration test on March 7, 2007

Date	Time	Elapsed Time (minutes)	Water Level (feet)	Inflow Discharge Rate (cubic feet per second)
3/7/2007	9:54:00	40	0.955	0.202
3/7/2007	9:55:00	41	0.967	0.208
3/7/2007	9:56:00	42	0.978	0.203
3/7/2007	9:57:00	43	0.988	0.203
3/7/2007	9:58:00	44	0.999	0.203
3/7/2007	9:59:00	45	1.009	0.203
3/7/2007	10:00:00	46	1.020	0.203
3/7/2007	10:01:00	47	1.030	0.203
3/7/2007	10:02:00	48	1.039	0.203
3/7/2007	10:03:00	49	1.049	0.203
3/7/2007	10:04:00	50	1.058	0.203
3/7/2007	10:05:00	51	1.068	0.203
3/7/2007	10:06:00	52	1.077	0.208
3/7/2007	10:07:00	53	1.086	0.115
3/7/2007	10:08:00	54	1.094	0.115
3/7/2007	10:09:00	55	1.086	0.115
3/7/2007	10:10:00	56	1.075	0.115
3/7/2007	10:11:00	57	1.064	0.115
3/7/2007	10:12:00	58	1.055	0.115
3/7/2007	10:13:00	59	1.047	0.115
3/7/2007	10:14:00	60	1.043	0.115
3/7/2007	10:15:00	61	1.038	0.115
3/7/2007	10:16:00	62	1.035	0.115
3/7/2007	10:17:00	63	1.035	0.115
3/7/2007	10:18:00	64	1.038	0.115
3/7/2007	10:19:00	65	1.042	0.115
3/7/2007	10:20:00	66	1.045	0.115
3/7/2007	10:21:00	67	1.049	0.115
3/7/2007	10:22:00	68	1.054	0.115
3/7/2007	10:23:00	69	1.055	0.115
3/7/2007	10:24:00	70	1.060	0.115
3/7/2007	10:25:00	71	1.062	0.115
3/7/2007	10:26:00	72	1.063	0.115
3/7/2007	10:27:00	73	1.064	0.115
3/7/2007	10:28:00	74	1.066	0.115
3/7/2007	10:29:00	75	1.067	0.115
3/7/2007	10:30:00	76	1.069	0.115
3/7/2007	10:31:00	77	1.069	0.115
3/7/2007	10:32:00	78	1.071	0.115
3/7/2007	10:33:00	79	1.072	0.115

Table B1 (continued). Field measurements from controlled infiltration test on March 7, 2007

Date	Time	Elapsed Time (minutes)	Water Level (feet)	Inflow Discharge Rate (cubic feet per second)
3/7/2007	10:34:00	80	1.074	0.115
3/7/2007	10:35:00	81	1.076	0.115
3/7/2007	10:36:00	82	1.077	0.115
3/7/2007	10:37:00	83	1.073	0.072
3/7/2007	10:38:00	84	1.069	0.105
3/7/2007	10:39:00	85	1.064	0.105
3/7/2007	10:40:00	86	1.060	0.105
3/7/2007	10:41:00	87	1.056	0.105
3/7/2007	10:42:00	88	1.052	0.105
3/7/2007	10:43:00	89	1.048	0.105
3/7/2007	10:44:00	90	1.046	0.105
3/7/2007	10:45:00	91	1.047	0.105
3/7/2007	10:46:00	92	1.046	0.105
3/7/2007	10:47:00	93	1.046	0.105
3/7/2007	10:48:00	94	1.046	0.105
3/7/2007	10:49:00	95	1.057	0.105
3/7/2007	10:50:00	96	1.060	0.105
3/7/2007	10:51:00	97	1.066	0.105
3/7/2007	10:52:00	98	1.072	0.105
3/7/2007	10:53:00	99	1.077	0.105
3/7/2007	10:54:00	100	1.078	0.105
3/7/2007	10:55:00	101	1.080	0.105
3/7/2007	10:56:00	102	1.083	0.105
3/7/2007	10:57:00	103	1.086	0.105
3/7/2007	10:58:00	104	1.087	0.105
3/7/2007	10:59:00	105	1.090	0.105
3/7/2007	11:00:00	106	1.092	0.105
3/7/2007	11:01:00	107	1.094	0.105
3/7/2007	11:02:00	108	1.096	0.105
3/7/2007	11:03:00	109	1.097	0.105
3/7/2007	11:04:00	110	1.100	0.105
3/7/2007	11:05:00	111	1.101	0.105
3/7/2007	11:06:00	112	1.103	0.105
3/7/2007	11:07:00	113	1.104	0.115
3/7/2007	11:08:00	114	1.106	0.130
3/7/2007	11:09:00	115	1.108	0.130
3/7/2007	11:10:00	116	1.110	0.112
3/7/2007	11:11:00	117	1.110	0.085
3/7/2007	11:12:00	118	1.112	0.085
3/7/2007	11:13:00	119	1.113	0.085

Table B1 (continued). Field measurements from controlled infiltration test on March 7, 2007

Date	Time	Elapsed Time (minutes)	Water Level (feet)	Inflow Discharge Rate (cubic feet per second)
3/7/2007	11:14:00	120	1.111	0.085
3/7/2007	11:15:00	121	1.110	0.085
3/7/2007	11:16:00	122	1.108	0.085
3/7/2007	11:17:00	123	1.106	0.085
3/7/2007	11:18:00	124	1.105	0.085
3/7/2007	11:19:00	125	1.103	0.085
3/7/2007	11:20:00	126	1.102	0.085
3/7/2007	11:21:00	127	1.100	0.085
3/7/2007	11:22:00	128	1.099	0.085
3/7/2007	11:23:00	129	1.098	0.085
3/7/2007	11:24:00	130	1.097	0.085
3/7/2007	11:25:00	131	1.096	0.085
3/7/2007	11:26:00	132	1.095	0.085
3/7/2007	11:27:00	133	1.094	0.085
3/7/2007	11:28:00	134	1.092	0.085
3/7/2007	11:29:00	135	1.091	0.085
3/7/2007	11:30:00	136	1.090	0.085
3/7/2007	11:31:00	137	1.089	0.085
3/7/2007	11:32:00	138	1.088	0.085
3/7/2007	11:33:00	139	1.087	0.085
3/7/2007	11:34:00	140	1.086	0.085
3/7/2007	11:35:00	141	1.086	0.085
3/7/2007	11:36:00	142	1.085	0.085
3/7/2007	11:37:00	143	1.085	0.085
3/7/2007	11:38:00	144	1.085	0.085
3/7/2007	11:39:00	145	1.085	0.085
3/7/2007	11:40:00	146	1.085	0.085
3/7/2007	11:41:00	147	1.085	0.085
3/7/2007	11:42:00	148	1.085	0.085
3/7/2007	11:43:00	149	1.085	0.082
3/7/2007	11:44:00	150	1.085	0.097
3/7/2007	11:45:00	151	1.086	0.090
3/7/2007	11:46:00	152	1.086	0.088
3/7/2007	11:47:00	153	1.086	0.090
3/7/2007	11:48:00	154	1.087	0.090
3/7/2007	11:49:00	155	1.087	0.089
3/7/2007	11:50:00	156	1.087	0.089
3/7/2007	11:51:00	157	1.088	0.089
3/7/2007	11:52:00	158	1.088	0.089
3/7/2007	11:53:00	159	1.088	0.089

Table B1 (continued). Field measurements from controlled infiltration test on March 7, 2007

Date	Time	Elapsed Time (minutes)	Water Level (feet)	Inflow Discharge Rate (cubic feet per second)
3/7/2007	11:54:00	160	1.089	0.089
3/7/2007	11:55:00	161	1.089	0.089
3/7/2007	11:56:00	162	1.090	0.089
3/7/2007	11:57:00	163	1.090	0.089
3/7/2007	11:58:00	164	1.091	0.089
3/7/2007	11:59:00	165	1.091	0.089
3/7/2007	12:00:00	166	1.091	0.089
3/7/2007	12:01:00	167	1.092	0.090
3/7/2007	12:02:00	168	1.093	0.089
3/7/2007	12:03:00	169	1.094	0.090
3/7/2007	12:04:00	170	1.094	0.089
3/7/2007	12:05:00	171	1.095	0.090
3/7/2007	12:06:00	172	1.095	0.089
3/7/2007	12:07:00	173	1.096	0.090
3/7/2007	12:08:00	174	1.097	0.089
3/7/2007	12:09:00	175	1.097	0.090
3/7/2007	12:10:00	176	1.098	0.089
3/7/2007	12:11:00	177	1.099	0.090
3/7/2007	12:12:00	178	1.099	0.090
3/7/2007	12:13:00	179	1.100	0.090
3/7/2007	12:14:00	180	1.101	0.090
3/7/2007	12:15:00	181	1.102	0.090
3/7/2007	12:16:00	182	1.102	0.090
3/7/2007	12:17:00	183	1.103	0.090
3/7/2007	12:18:00	184	1.104	0.090
3/7/2007	12:19:00	185	1.104	0.090
3/7/2007	12:20:00	186	1.105	0.090
3/7/2007	12:21:00	187	1.106	0.081
3/7/2007	12:22:00	188	1.107	0.081
3/7/2007	12:23:00	189	1.107	0.081
3/7/2007	12:24:00	190	1.106	0.081
3/7/2007	12:25:00	191	1.105	0.081
3/7/2007	12:26:00	192	1.105	0.081
3/7/2007	12:27:00	193	1.105	0.081
3/7/2007	12:28:00	194	1.105	0.081
3/7/2007	12:29:00	195	1.104	0.081
3/7/2007	12:30:00	196	1.104	0.081
3/7/2007	12:31:00	197	1.104	0.079
3/7/2007	12:32:00	198	1.104	0.079
3/7/2007	12:33:00	199	1.104	0.079

Table B1 (continued). Field measurements from controlled infiltration test on March 7, 2007

Date	Time	Elapsed Time (minutes)	Water Level (feet)	Inflow Discharge Rate (cubic feet per second)
3/7/2007	12:34:00	200	1.103	0.079
3/7/2007	12:35:00	201	1.103	0.079
3/7/2007	12:36:00	202	1.103	0.079
3/7/2007	12:37:00	203	1.103	0.079
3/7/2007	12:38:00	204	1.103	0.079
3/7/2007	12:39:00	205	1.103	0.079
3/7/2007	12:40:00	206	1.103	0.079
3/7/2007	12:41:00	207	1.104	0.080
3/7/2007	12:42:00	208	1.103	0.080
3/7/2007	12:43:00	209	1.103	0.081
3/7/2007	12:44:00	210	1.103	0.080
3/7/2007	12:45:00	211	1.103	0.080
3/7/2007	12:46:00	212	1.102	0.081
3/7/2007	12:47:00	213	1.103	0.080
3/7/2007	12:48:00	214	1.102	0.080
3/7/2007	12:49:00	215	1.102	0.080
3/7/2007	12:50:00	216	1.103	0.081
3/7/2007	12:51:00	217	1.103	0.080
3/7/2007	12:52:00	218	1.103	0.080
3/7/2007	12:53:00	219	1.103	0.080
3/7/2007	12:54:00	220	1.103	0.080
3/7/2007	12:55:00	221	1.104	0.080
3/7/2007	12:56:00	222	1.104	0.080
3/7/2007	12:57:00	223	1.104	0.080
3/7/2007	12:58:00	224	1.104	0.080
3/7/2007	12:59:00	225	1.105	0.080
3/7/2007	13:00:00	226	1.105	0.080
3/7/2007	13:01:00	227	1.105	0.081
3/7/2007	13:02:00	228	1.105	0.081
3/7/2007	13:03:00	229	1.105	0.081
3/7/2007	13:04:00	230	1.106	0.081
3/7/2007	13:05:00	231	1.106	0.081
3/7/2007	13:06:00	232	1.106	0.081
3/7/2007	13:07:00	233	1.106	0.081
3/7/2007	13:08:00	234	1.107	0.081
3/7/2007	13:09:00	235	1.107	0.081
3/7/2007	13:10:00	236	1.108	0.081
3/7/2007	13:11:00	237	1.108	0.081
3/7/2007	13:12:00	238	1.108	0.081
3/7/2007	13:13:00	239	1.109	0.081

Table B1 (continued). Field measurements from controlled infiltration test on March 7, 2007

Date	Time	Elapsed Time (minutes)	Water Level (feet)	Inflow Discharge Rate (cubic feet per second)
3/7/2007	13:14:00	240	1.109	0.081
3/7/2007	13:15:00	241	1.109	0.081
3/7/2007	13:16:00	242	1.110	0.081
3/7/2007	13:17:00	243	1.110	0.081
3/7/2007	13:18:00	244	1.111	0.081
3/7/2007	13:19:00	245	1.111	0.081
3/7/2007	13:20:00	246	1.111	0.081
3/7/2007	13:21:00	247	1.112	0.081
3/7/2007	13:22:00	248	1.106	0.000
3/7/2007	13:23:00	249	1.099	0.000
3/7/2007	13:24:00	250	1.090	0.000
3/7/2007	13:25:00	251	1.082	0.000
3/7/2007	13:26:00	252	1.073	0.000
3/7/2007	13:27:00	253	1.065	0.000
3/7/2007	13:28:00	254	1.056	0.000
3/7/2007	13:29:00	255	1.048	0.000
3/7/2007	13:30:00	256	1.039	0.000
3/7/2007	13:31:00	257	1.031	0.000
3/7/2007	13:32:00	258	1.023	0.000
3/7/2007	13:33:00	259	1.014	0.000
3/7/2007	13:34:00	260	1.006	0.000
3/7/2007	13:35:00	261	0.997	0.000
3/7/2007	13:36:00	262	0.989	0.000
3/7/2007	13:37:00	263	0.981	0.000
3/7/2007	13:38:00	264	0.972	0.000
3/7/2007	13:39:00	265	0.964	0.000
3/7/2007	13:40:00	266	0.955	0.000
3/7/2007	13:41:00	267	0.947	0.000
3/7/2007	13:42:00	268	0.938	0.000
3/7/2007	13:43:00	269	0.930	0.000
3/7/2007	13:44:00	270	0.922	0.000
3/7/2007	13:45:00	271	0.914	0.000
3/7/2007	13:46:00	272	0.906	0.000
3/7/2007	13:47:00	273	0.898	0.000
3/7/2007	13:48:00	274	0.890	0.000
3/7/2007	13:49:00	275	0.882	0.000
3/7/2007	13:50:00	276	0.874	0.000
3/7/2007	13:51:00	277	0.866	0.000
3/7/2007	13:52:00	278	0.858	0.000
3/7/2007	13:53:00	279	0.850	0.000

Table B1 (continued). Field measurements from controlled infiltration test on March 7, 2007

Date	Time	Elapsed Time (minutes)	Water Level (feet)	Inflow Discharge Rate (cubic feet per second)
3/7/2007	13:54:00	280	0.843	0.000
3/7/2007	13:55:00	281	0.835	0.000
3/7/2007	13:56:00	282	0.827	0.000
3/7/2007	13:57:00	283	0.820	0.000
3/7/2007	13:58:00	284	0.814	0.059
3/7/2007	13:59:00	285	0.814	0.059
3/7/2007	14:00:00	286	0.817	0.067
3/7/2007	14:01:00	287	0.820	0.073
3/7/2007	14:02:00	288	0.822	0.068
3/7/2007	14:03:00	289	0.825	0.068
3/7/2007	14:04:00	290	0.827	0.068
3/7/2007	14:05:00	291	0.830	0.068
3/7/2007	14:06:00	292	0.832	0.068
3/7/2007	14:07:00	293	0.834	0.058
3/7/2007	14:08:00	294	0.835	0.058
3/7/2007	14:09:00	295	0.835	0.056
3/7/2007	14:10:00	296	0.835	0.056
3/7/2007	14:11:00	297	0.835	0.056
3/7/2007	14:12:00	298	0.835	0.056
3/7/2007	14:13:00	299	0.835	0.056
3/7/2007	14:14:00	300	0.835	0.056
3/7/2007	14:15:00	301	0.835	0.056
3/7/2007	14:16:00	302	0.836	0.056
3/7/2007	14:17:00	303	0.835	0.056
3/7/2007	14:18:00	304	0.834	0.056
3/7/2007	14:19:00	305	0.833	0.056
3/7/2007	14:20:00	306	0.833	0.056
3/7/2007	14:21:00	307	0.833	0.056
3/7/2007	14:22:00	308	0.833	0.056
3/7/2007	14:23:00	309	0.833	0.056
3/7/2007	14:24:00	310	0.833	0.056
3/7/2007	14:25:00	311	0.833	0.056
3/7/2007	14:26:00	312	0.833	0.056
3/7/2007	14:27:00	313	0.833	0.056
3/7/2007	14:28:00	314	0.833	0.056
3/7/2007	14:29:00	315	0.833	0.056
3/7/2007	14:30:00	316	0.833	0.056
3/7/2007	14:31:00	317	0.833	0.056
3/7/2007	14:32:00	318	0.833	0.056
3/7/2007	14:33:00	319	0.832	0.056

Table B1 (continued). Field measurements from controlled infiltration test on March 7, 2007

Date	Time	Elapsed Time (minutes)	Water Level (feet)	Inflow Discharge Rate (cubic feet per second)
3/7/2007	14:34:00	320	0.832	0.056
3/7/2007	14:35:00	321	0.833	0.056
3/7/2007	14:36:00	322	0.834	0.056
3/7/2007	14:37:00	323	0.835	0.056
3/7/2007	14:38:00	324	0.836	0.054
3/7/2007	14:39:00	325	0.836	0.054
3/7/2007	14:40:00	326	0.836	0.054
3/7/2007	14:41:00	327	0.838	0.054
3/7/2007	14:42:00	328	0.839	0.054
3/7/2007	14:43:00	329	0.839	0.054
3/7/2007	14:44:00	330	0.840	0.054
3/7/2007	14:45:00	331	0.840	0.054
3/7/2007	14:46:00	332	0.841	0.054
3/7/2007	14:47:00	333	0.841	0.054
3/7/2007	14:48:00	334	0.839	0.039
3/7/2007	14:49:00	335	0.837	0.039
3/7/2007	14:50:00	336	0.835	0.039
3/7/2007	14:51:00	337	0.834	0.039
3/7/2007	14:52:00	338	0.832	0.039
3/7/2007	14:53:00	339	0.830	0.039
3/7/2007	14:54:00	340	0.829	0.039
3/7/2007	14:55:00	341	0.827	0.039
3/7/2007	14:56:00	342	0.825	0.039
3/7/2007	14:57:00	343	0.824	0.039
3/7/2007	14:58:00	344	0.822	0.039
3/7/2007	14:59:00	345	0.821	0.039
3/7/2007	15:00:00	346	0.819	0.039
3/7/2007	15:01:00	347	0.818	0.039
3/7/2007	15:02:00	348	0.816	0.039
3/7/2007	15:03:00	349	0.815	0.039
3/7/2007	15:04:00	350	0.813	0.039
3/7/2007	15:05:00	351	0.812	0.039
3/7/2007	15:06:00	352	0.810	0.039
3/7/2007	15:07:00	353	0.809	0.039
3/7/2007	15:08:00	354	0.808	0.040
3/7/2007	15:09:00	355	0.806	0.040
3/7/2007	15:10:00	356	0.805	0.040
3/7/2007	15:11:00	357	0.804	0.040
3/7/2007	15:12:00	358	0.803	0.040
3/7/2007	15:13:00	359	0.802	0.040

Table B1 (continued). Field measurements from controlled infiltration test on March 7, 2007

Date	Time	Elapsed Time (minutes)	Water Level (feet)	Inflow Discharge Rate (cubic feet per second)
3/7/2007	15:14:00	360	0.801	0.040
3/7/2007	15:15:00	361	0.800	0.040
3/7/2007	15:16:00	362	0.799	0.040
3/7/2007	15:17:00	363	0.798	0.040
3/7/2007	15:18:00	364	0.797	0.040
3/7/2007	15:19:00	365	0.796	0.040
3/7/2007	15:20:00	366	0.795	0.040
3/7/2007	15:21:00	367	0.794	0.040
3/7/2007	15:22:00	368	0.794	0.043
3/7/2007	15:23:00	369	0.793	0.043
3/7/2007	15:24:00	370	0.792	0.043
3/7/2007	15:25:00	371	0.792	0.043
3/7/2007	15:26:00	372	0.791	0.043
3/7/2007	15:27:00	373	0.792	0.042
3/7/2007	15:28:00	374	0.791	0.043
3/7/2007	15:29:00	375	0.790	0.044
3/7/2007	15:30:00	376	0.790	0.044
3/7/2007	15:31:00	377	0.789	0.044
3/7/2007	15:32:00	378	0.790	0.044
3/7/2007	15:33:00	379	0.790	0.044
3/7/2007	15:34:00	380	0.789	0.045
3/7/2007	15:35:00	381	0.790	0.045
3/7/2007	15:36:00	382	0.789	0.045
3/7/2007	15:37:00	383	0.789	0.045
3/7/2007	15:38:00	384	0.790	0.045
3/7/2007	15:39:00	385	0.789	0.045
3/7/2007	15:40:00	386	0.788	0.045
3/7/2007	15:41:00	387	0.789	0.046
3/7/2007	15:42:00	388	0.789	0.046
3/7/2007	15:43:00	389	0.789	0.046
3/7/2007	15:44:00	390	0.789	0.046
3/7/2007	15:45:00	391	0.790	0.046
3/7/2007	15:46:00	392	0.789	0.046
3/7/2007	15:47:00	393	0.789	0.046
3/7/2007	15:48:00	394	0.789	0.046
3/7/2007	15:49:00	395	0.790	0.046
3/7/2007	15:50:00	396	0.789	0.046
3/7/2007	15:51:00	397	0.789	0.046
3/7/2007	15:52:00	398	0.790	0.046
3/7/2007	15:53:00	399	0.789	0.046

Table B1 (continued). Field measurements from controlled infiltration test on March 7, 2007

Date	Time	Elapsed Time (minutes)	Water Level (feet)	Inflow Discharge Rate (cubic feet per second)
3/7/2007	15:54:00	400	0.789	0.046
3/7/2007	15:55:00	401	0.789	0.046
3/7/2007	15:56:00	402	0.789	0.046
3/7/2007	15:57:00	403	0.789	0.045
3/7/2007	15:58:00	404	0.788	0.046
3/7/2007	15:59:00	405	0.788	0.046
3/7/2007	16:00:00	406	0.788	0.046
3/7/2007	16:01:00	407	0.789	0.045
3/7/2007	16:02:00	408	0.789	0.045
3/7/2007	16:03:00	409	0.789	0.045
3/7/2007	16:04:00	410	0.789	0.045
3/7/2007	16:05:00	411	0.789	0.045
3/7/2007	16:06:00	412	0.789	0.045
3/7/2007	16:07:00	413	0.789	0.045
3/7/2007	16:08:00	414	0.789	0.045
3/7/2007	16:09:00	415	0.790	0.045
3/7/2007	16:10:00	416	0.790	0.045
3/7/2007	16:11:00	417	0.790	0.042
3/7/2007	16:12:00	418	0.790	0.042
3/7/2007	16:13:00	419	0.789	0.042
3/7/2007	16:14:00	420	0.786	0.000
3/7/2007	16:15:00	421	0.778	0.000
3/7/2007	16:16:00	422	0.772	0.000
3/7/2007	16:17:00	423	0.765	0.000
3/7/2007	16:18:00	424	0.758	0.000
3/7/2007	16:19:00	425	0.752	0.000
3/7/2007	16:20:00	426	0.746	0.000
3/7/2007	16:21:00	427	0.738	0.000
3/7/2007	16:22:00	428	0.732	0.000
3/7/2007	16:23:00	429	0.726	0.000
3/7/2007	16:24:00	430	0.719	0.000
3/7/2007	16:25:00	431	0.713	0.000
3/7/2007	16:26:00	432	0.706	0.000
3/7/2007	16:27:00	433	0.700	0.000
3/7/2007	16:28:00	434	0.693	0.000
3/7/2007	16:29:00	435	0.688	0.000
3/7/2007	16:30:00	436	0.681	0.000
3/7/2007	16:31:00	437	0.675	0.000
3/7/2007	16:32:00	438	0.669	0.000
3/7/2007	16:33:00	439	0.663	0.000

Table B1 (continued). Field measurements from controlled infiltration test on March 7, 2007

Date	Time	Elapsed Time (minutes)	Water Level (feet)	Inflow Discharge Rate (cubic feet per second)
3/7/2007	16:34:00	440	0.656	0.000
3/7/2007	16:35:00	441	0.651	0.000
3/7/2007	16:36:00	442	0.645	0.000
3/7/2007	16:37:00	443	0.639	0.000
3/7/2007	16:38:00	444	0.633	0.000
3/7/2007	16:39:00	445	0.626	0.000
3/7/2007	16:40:00	446	0.621	0.000
3/7/2007	16:41:00	447	0.614	0.000
3/7/2007	16:42:00	448	0.608	0.000
3/7/2007	16:43:00	449	0.603	0.000
3/7/2007	16:44:00	450	0.596	0.000
3/7/2007	16:45:00	451	0.591	0.000
3/7/2007	16:46:00	452	0.585	0.000
3/7/2007	16:47:00	453	0.579	0.000
3/7/2007	16:48:00	454	0.573	0.000
3/7/2007	16:49:00	455	0.567	0.000
3/7/2007	16:50:00	456	0.561	0.000
3/7/2007	16:51:00	457	0.555	0.000
3/7/2007	16:52:00	458	0.550	0.000
3/7/2007	16:53:00	459	0.544	0.000
3/7/2007	16:54:00	460	0.538	0.000
3/7/2007	16:55:00	461	0.532	0.000
3/7/2007	16:56:00	462	0.526	0.000
3/7/2007	16:57:00	463	0.521	0.000
3/7/2007	16:58:00	464	0.515	0.000
3/7/2007	16:59:00	465	0.510	0.000
3/7/2007	17:00:00	466	0.503	0.000
3/7/2007	17:01:00	467	0.498	0.000
3/7/2007	17:02:00	468	0.492	0.000
3/7/2007	17:03:00	469	0.486	0.000
3/7/2007	17:04:00	470	0.481	0.000
3/7/2007	17:05:00	471	0.475	0.000
3/7/2007	17:06:00	472	0.470	0.000
3/7/2007	17:07:00	473	0.464	0.000
3/7/2007	17:08:00	474	0.459	0.000
3/7/2007	17:09:00	475	0.453	0.000
3/7/2007	17:10:00	476	0.448	0.000
3/7/2007	17:11:00	477	0.442	0.000
3/7/2007	17:12:00	478	0.437	0.000
3/7/2007	17:13:00	479	0.432	0.000

Table B1 (continued). Field measurements from controlled infiltration test on March 7, 2007

Date	Time	Elapsed Time (minutes)	Water Level (feet)	Inflow Discharge Rate (cubic feet per second)
3/7/2007	17:14:00	480	0.426	0.000
3/7/2007	17:15:00	481	0.421	0.000
3/7/2007	17:16:00	482	0.416	0.000
3/7/2007	17:17:00	483	0.410	0.000
3/7/2007	17:18:00	484	0.405	0.000
3/7/2007	17:19:00	485	0.400	0.000
3/7/2007	17:20:00	486	0.394	0.000
3/7/2007	17:21:00	487	0.389	0.000
3/7/2007	17:22:00	488	0.384	0.000
3/7/2007	17:23:00	489	0.378	0.000
3/7/2007	17:24:00	490	0.373	0.000
3/7/2007	17:25:00	491	0.368	0.000
3/7/2007	17:26:00	492	0.362	0.000
3/7/2007	17:27:00	493	0.357	0.000
3/7/2007	17:28:00	494	0.352	0.000
3/7/2007	17:29:00	495	0.347	0.000
3/7/2007	17:30:00	496	0.342	0.000
3/7/2007	17:31:00	497	0.336	0.000
3/7/2007	17:32:00	498	0.331	0.000
3/7/2007	17:33:00	499	0.326	0.000
3/7/2007	17:34:00	500	0.321	0.000
3/7/2007	17:35:00	501	0.315	0.000
3/7/2007	17:36:00	502	0.309	0.000
3/7/2007	17:37:00	503	0.304	0.000
3/7/2007	17:38:00	504	0.298	0.000
3/7/2007	17:39:00	505	0.293	0.000
3/7/2007	17:40:00	506	0.288	0.000
3/7/2007	17:41:00	507	0.283	0.000
3/7/2007	17:42:00	508	0.278	0.000
3/7/2007	17:43:00	509	0.273	0.000
3/7/2007	17:44:00	510	0.267	0.000
3/7/2007	17:45:00	511	0.262	0.000
3/7/2007	17:46:00	512	0.257	0.000
3/7/2007	17:47:00	513	0.252	0.000
3/7/2007	17:48:00	514	0.247	0.000
3/7/2007	17:49:00	515	0.241	0.000
3/7/2007	17:50:00	516	0.237	0.000
3/7/2007	17:51:00	517	0.231	0.000
3/7/2007	17:52:00	518	0.227	0.000
3/7/2007	17:53:00	519	0.222	0.000

Table B1 (continued). Field measurements from controlled infiltration test on March 7, 2007

Date	Time	Elapsed Time (minutes)	Water Level (feet)	Inflow Discharge Rate (cubic feet per second)
3/7/2007	17:54:00	520	0.217	0.000
3/7/2007	17:55:00	521	0.212	0.000
3/7/2007	17:56:00	522	0.207	0.000
3/7/2007	17:57:00	523	0.202	0.000
3/7/2007	17:58:00	524	0.197	0.000
3/7/2007	17:59:00	525	0.192	0.000
3/7/2007	18:00:00	526	0.187	0.000
3/7/2007	18:01:00	527	0.181	0.000
3/7/2007	18:02:00	528	0.176	0.000
3/7/2007	18:03:00	529	0.171	0.000
3/7/2007	18:04:00	530	0.166	0.000
3/7/2007	18:05:00	531	0.160	0.000
3/7/2007	18:06:00	532	0.155	0.000
3/7/2007	18:07:00	533	0.149	0.000
3/7/2007	18:08:00	534	0.143	0.000
3/7/2007	18:09:00	535	0.138	0.000
3/7/2007	18:10:00	536	0.132	0.000
3/7/2007	18:11:00	537	0.127	0.000
3/7/2007	18:12:00	538	0.121	0.000
3/7/2007	18:13:00	539	0.116	0.000
3/7/2007	18:14:00	540	0.111	0.000
3/7/2007	18:15:00	541	0.105	0.000
3/7/2007	18:16:00	542	0.099	0.000
3/7/2007	18:17:00	543	0.094	0.000
3/7/2007	18:18:00	544	0.087	0.000
3/7/2007	18:19:00	545	0.081	0.000
3/7/2007	18:20:00	546	0.074	0.000
3/7/2007	18:21:00	547	0.064	0.000
3/7/2007	18:22:00	548	0.051	0.000
3/7/2007	18:23:00	549	0.037	0.000
3/7/2007	18:24:00	550	0.024	0.000
3/7/2007	18:25:00	551	0.028	0.000
3/7/2007	18:26:00	552	0.027	0.000
3/7/2007	18:27:00	553	0.026	0.000
3/7/2007	18:28:00	554	0.026	0.000
3/7/2007	18:29:00	555	0.025	0.000
3/7/2007	18:30:00	556	0.025	0.000
3/7/2007	18:31:00	557	0.025	0.000
3/7/2007	18:32:00	558	0.025	0.000